SUPPLEMENT TO "THE ENGINEER," JANUARY 18, 1895

# The Engineer.

VOL. LXXVIII.—FROM JULY TO DECEMBER, 1894.

London:
OFFICE FOR PUBLICATION AND ADVERTISEMENTS, 33, NORFOLK STREET, STRAND, W.C.

THE ENGINEER.

## THE ANTWERP EXHIBITION.

### THE MARITIME SECTION.—I.

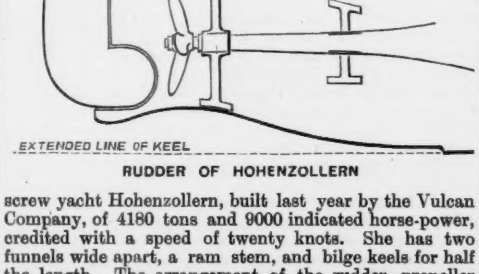
While shipping, shipbuilding, and cognate matters in the Antwerp Exhibition are, roughly speaking, contained within the "Maritime Section,"—as already stated in a recent issue—to which a very extensive portion of the main buildings are devoted, the bounds thus given to the domain of things maritime are very far from thoroughly embracing all the varied and important objects coming under the general category. Not a few highly-important exhibits connected with ships and with seafaring matters—such as the complete marine engines and propeller shown at work by the Société Cockerill, of Seraing, and the shafting, propellers, and other heavy items shown by other firms—are naturally relegated to the Halles des Machines, or Machinery in Motion Department. Similarly in the general section of the Exhibition occupied by Britain, Belgium, France, and Germany, whole stands—and numerous individual items—are to be found directly connected with shipping, while even in the outside grounds or in separate pavilions or annexes are objects intimately associated with the general subject, from the representation or fac-simile of the ancient Viking ship found in Norway, down to the diving operations on the most advanced modern principle exhibited in the pavilion of Messrs. Siebe, Gorman, and Co., of London.

Generally speaking, however, interest is pretty well centralised about the courts in the Hall of Industries section, where, under the conspicuous sky-sign spelling "Navigation," ship models and photographs, model marine engines, and small-scale models of docks and shipping-ports are congregated. While there is a good deal that must be already familiar to our readers, there is also much of novelty and interest attaching to by far the greater number of exhibits. The Clyde, the Tyne, the Wear, and other British centres of shipbuilding, are all well represented by beautiful models, photographs, &c., of ships, many of them of recent build or now being built. Where shipbuilding firms are not themselves exhibitors, their work is often to be found represented by the shipowners; very many of whom send splendid models—now usually supplied to them by builders as part of the contract. In not a few cases both shipbuilders and shipowners are found sending models of the same vessels; but as these are all of such exceptional interest as attaches to famous modern mail and passenger steamships, and as the models themselves are beautiful works of art, the redundancy is highly acceptable rather than otherwise. The principal ocean mail lines are fully represented, while, of course, an exhaustive and thoroughly representative show is made by the various companies engaging in Channel passenger service. The German, French, and Belgian mail steamship lines are especially well represented, and the same may be said of some of the continental shipbuilding and marine engineering firms. The efforts to secure attention, and subsequent patronage, put forth by such companies as the North German Lloyd, the Hamburg-American, the Red Star, and the International (American) Line, are of the most imposing and effective kind.

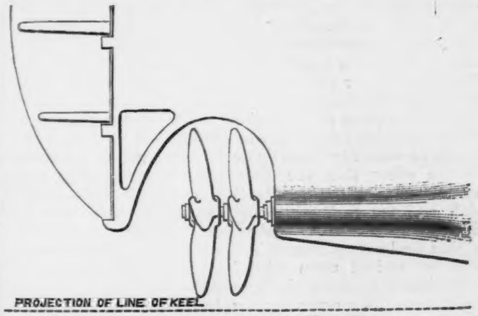
Advantage has been taken of the Exhibition by the Chambers of Commerce or Harbour Commissioners of almost all the well known continental shipping ports, to make known the importance of the shipping accommodation and the facilities for loading and unloading they can offer. Both by bird's-eye models of great minuteness of detail, and by pictorial representation, such ports as Hamburg, Antwerp, Dunkirk, Ghent, Copenhagen, &c., are very strikingly illustrated, and information given of interest and utility to all engaged in maritime industry; while Southampton, as well as the London and St. Katherine Docks, also the Royal Victoria and Royal Albert Docks, are similarly in evidence. In a subsequent article further attention will be directed to the matter of docks and shipping ports as here exemplified. Marine engineering and allied branches of industry, including, of course, steel manufactures, forgings, castings, &c., form no inconsiderable part of the machinery-in-motion section, and to some extent in the general sections of individual countries like Britain, France, Germany, Belgium, Holland, &c.; but the first-named country, considering its pre-eminence in these branches of industry, has but indifferently responded to the invitation of the Antwerp Exhibition promoters.

That the maritime section has been made the highly important section it undoubtedly is, is largely owing to the efforts of Mr. John P. Best, an Englishman resident in Antwerp, and the head of a most extensive shipping agency business in the city. His enterprise and energy, and his intimate knowledge of shipping and widespread connection, have served him well as director of the committee charged with collecting and organising the section, and the result amply testifies to these facts. The large space allotted to the section enables the stand or pavilion of each firm, and even of each individual exhibit—as in the case of large full models, in which the section is particularly rich—to be minutely and comfortably inspected. The want of a catalogue for this as for other sections, however, has made it difficult to take adequate or orderly note of all that is to be seen, or at least to make any very satisfactory attempt at dealing with exhibits according to their class or character. In the circumstances what is proposed to be done in this, and the articles immediately succeeding, is to describe the larger and more strikingly interesting stands as they occur in a walk through the section, and afterwards treat separate and more notable exhibits fully, and in a comparative way, as regards the several firms or countries producing the real ships, &c., they represent.

Occupying a large space, and a most commanding position in the centre of the main avenue, is a pavilion, approached on all sides by flights of steps, containing the exhibits made by the North German Lloyd Company, of Bremen, and by the Vulcan Shipbuilding and Marine Engineering Company, of Stettin, who have built several of the recent vessels of the North German Lloyd fleet. The two companies thus associated as exhibitors share the pavilion between them, and together they make one of the most superb displays of ship models and photographs, marine paintings, and articles of nautical equipment, we ever remember to have seen. The pavilion itself is a notable erection in white and gold, about 120ft. by 70ft., open-arched on all four sides, with Corinthian pillaring and massive balustrading partially screening the interior, and with coats of arms and emblematic figures worked into the ornamentation of the structure. Inside, the various models—all full ones in large glass cases—are most suitably disposed for all-round inspection, and the pleasure of this is enhanced by much soft carpets, luxurious lounges, cool green palms, and civil and obliging attention on the part of the ships' officers in charge. On the deep freize running round the upper part of the interior are well-executed paintings, representing ports, harbours, and scenes of note with which the company's fleet is associated; while at the Vulcan end of the pavilion the corresponding scenes represent views of the Vulcan Company's shipyard, quays, engine-works, &c.—all in themselves quite educational. In the centre of the German Lloyd end of the pavilion is a flat glass table exhibiting a chart of the world, with the various routes taken by the company's fleet pictorially delineated. Several of the models represent vessels which are already well known, while others are of steamers not yet launched. Of the former, we need only mention the s.s. Havel and Spree, Atlantic liners built in 1890 by the Vulcan Company; the s.s. Karlsruhe, engaged in the Australian service, built by the Fairfield Company; the H. H. Muir, in the South American service, built by Armstrong, Mitchell, and Co.; and the Kaiser Wilhelm II., in the Mediterranean and New York service, built in 1889 by the Vulcan Company. A striking exhibit is that of a model of the Kaiser's twin-screw yacht Hohenzollern, built last year by the Vulcan Company, of 4180 tons and 9000 indicated horse-power, credited with a speed of twenty knots. She has two funnels wide apart, a ram stem, and bilge keels for half the length. The arrangement of the rudder, propeller swelling and brackets, and the line of keel in their vicinity, are peculiar. A rough, hastily-taken hand sketch herewith may convey some idea of these features. A similarly rough hand sketch taken from the model is also given of the screw aperture and rudder of the twin s.s. Patria, now being built by the Vulcan Company for the Hamburg American Company. This vessel is 460ft. by 52ft. by 35ft.; is about 7600 tons gross, 4100 indicated horse-power, and is intended to travel at thirteen knots. The line of keel, it will be observed from the sketch, rises from the general level as it proceeds aft, and is arched over the propeller aperture, thence down to meet the bottom pintle of the rudder, thus having no "heel" or under connection whatever. The shafting of the propellers is housed in a swelling of the hull proper, and the propellers themselves are arranged one further ahead than the other, and the blades of the two overlap each other in revolving. What the idea of the designers may be for these several departures from what is most usual is not very apparent, the more so as what might stand as an explanation or *raison d'être* for one thing appears likely to be neutralised by another. Possible want of rigidity and liability to foul with sea wreckage would almost suggest themselves as contingencies attaching to the overhang of propellers and the open aperture adopted. This vital matter of screw propeller disposition and aperture seems to be made a study of by German builders, because in another of the models shown—that of the vessels Prinz Luitpold and Prinz Henreich, at present under construction in the yard of Herr Schicau, of Elbing, Prussia, for the German Lloyd's Australian and China service—the propeller blades also overlap each other; but they do so in an aperture of the ordinary kind. Remaining models in the pavilion, all shown by the Vulcan Company, are those of the German twin-screw cruising corvette Irene, of 8000-horse power and 18 knots, built in 1887; the Chinese cruisers, King Yuen and Lai Yuen, of 2900 tons displacement, 3400 indicated horse-power, and 15 knots, speed, and the German torpedo cruiser Comet—built last year—78m. in length, 9m. breadth, and 5·875 depth; 975 tons displacement, 5000 indicated horse-power. She is of razor-like fineness, and the 21 knots speed with which she is credited does not appear to be too high a rating of her capabilities in moderately calm states of the sea.



RUDDER OF HOHENZOLLERN



STERN FRAME OF PATRIA

The Hamburg-American Company's pavilion—not far off—occupies even a larger space than the German Lloyd's, but incorporated with the larger company's display are a great number of exhibits shown by various shipping concerns trading out of Hamburg, or forming extensions of the larger company's service. Roominess and luxuriance are also characteristics of the pavilion here, and the ottoman lounges provided constitute a rallying and seductive feature for the foot-weary wanderers through courts and avenues. A large and specially screened part of the pavilion contains an extensive series of moving dioramic views of the company's steamers, exteriors and interiors, and scenes associated with their arrival and departure from the several ports. These peep-show views are most excellent of their kind, and the twenty-five or more chairs in front of the moving pictures are constantly occupied by delighted spectators. The interior views—especially of the Fürst Bismark, the Normannia, and Augusta Victoria—give a very realistic impression of the superb accommodation provided on board. Notable among the full models occupying the floor are those of the twin s.s. Fürst Bismark, built by the Vulcan Company in 1891, of 8875 tons, 14,000 indicated horse-power, and 19½ knots speed, a striking feature of which is, besides her three funnels, the perfect forest of large ventilators to her machinery rooms; the twin s.s. Columbia, built by Messrs. Laird and Co., Birkenhead, in 1889, of 7363 tons, 13,500 indicated horse-power, trial speed 20 knots, average speed on best voyage 19·14 knots, and average speed on four voyages during 1889, 18·57 knots; the single s. s. Dania and Scandia, built by the Vulcan Company in 1889, 4050 tons, 3000 indicated horse-power, 13 knots speed; and the single s.s. Kanzler, built by Messrs. Blohm and Voss, of Hamburg, in 1892, of 3053 tons and 1600 indicated horse-power. A half model of one of the company's steamers, the Frisia—an elaborately finished sectional model showing all interior detail—and a model to a ¼in. scale of the company's graving dock, pump-house, &c., with the Frisia on the blocks, are two other objects worthy of mention. Messrs. Blohm and Voss are represented by a collection of half models of their largest productions, including the s.s. Stassfont of 340ft. in length, and the twin s.s. Witteking of 364ft. in length. A series of excellent photographs illustrates their shipbuilding yard, pontoon docks, and engine works, and a second series is shown of the pontoon dock, containing the s.s. Bayern, under process of being lengthened amidships. At various other parts of the walls of the pavilion are half models representing steamers and sailing vessels, the Hamburg companies owning which are less easily identified than the names of the builders attached to each model. Messrs. Stephens and Sons, of Linthouse, and Charles Connell and Company, of Whiteinch, Glasgow, predominate; but the Germania Shipyard, of Kiel, and Blohm and Voss, of Hamburg, are also in evidence, The Kingsen Line of screw steamers, trading between Hamburg and China and Japan, is represented by several models and photographs; one model being that of the Kriemhild, 324ft. long, and of 3910 tons, built by Messrs. Swan and Hunter, of Wallsend-on-Tyne. A large collection of the older style of sailing vessels frequenting the port of Hamburg, as well as of old two and three-decker men-of-war, and innumerable views and diagrams of things pertaining to the port, and of the various foreign ports to which it is linked by "Giant Steam," are remaining items in a very prolific and interesting display—amounting to a small exhibition in itself. A circular basin containing a map of the world, ocean, and continents, as in the case of the chart shown by the North German Lloyd Company, occupies the centre of the Hamburg pavilion. The map bears upon it lines radiating apparently to all parts of the universe, representing the routes followed by steamers from Hamburg; and actual miniature models identifying the ships of the various lines heighten the public interest in this exhibit. Above the basin and map is a canopy-tower with panel sides, on which are inscribed the names of the individual steamers.

The Red Star Line, conjointly with the International —American—Line, owning the twin s.s. Paris and New York, have a smaller stand almost adjacent to the Hamburg-American Company's. A considerable degree of interest attaches to this stand, as it embraces, amongst other items—models of the s.s. Paris and New York, and of the s.s. Southwark and Kensington for example—a splendidly executed painting of the twin s.s. St. Louis and St. Paul, now building by Messrs. Cramp and Sons, of Philadelphia, for the International Company, and a full size suite of state rooms as fitted up in these new vessels. The first of these ships is to be launched from the yard at Philadelphia sometime this month, and in view of the boast, persistently made by the builders and their friends, to the effect that the new ships are "of American model and design, and built with American materials, skill and muscle"—although many readers will be disposed to take all this, about the "design" especially, a good deal *cum grano salis*—their advent on the Atlantic will be waited upon with interest. The picture at least does not convey the impression that the American built boats differ extensively or in any radical way from the Paris and New York, which have been available as patterns for a considerable time. What the future, or more intimate knowledge of the boats may declare, cannot, of course, be foretold; but that they embody any main features which have not first of all attained their full development on this side the herring-pond, may safely be doubted. The state-room accommodation on board, as exemplified at the Exhibition, is on a scale of even greater lavishness, as regards space and furnishing, than is to be found on the Paris, and this consideration, combined with the slightly higher speed intended—20 knots—may be taken as additional incentives to the patriotism which is likely to find vent in patronage of the rival American "home-built" greyhounds.

The Peninsular and Oriental Company has also an extensive and well-arranged stand adjacent to the Red Star Line exhibits. Prominent amongst the full models shown are those representing four of the company's modern steamers, the Oceana, the Victoria, the Himalaya, and the Caledonia; the last-named being the vessel recently launched, and now being fitted out by Messrs. Caird and Co., of Greenock. As a contrast to this, the latest vessel of its numerous fleet, measuring some 6500 tons and 486ft. long, it shows, alongside, a model on the same scale of the pioneer paddle-steamer of the fleet, the William Fawcett, built in 1829, 206 tons and 60-horse power. A noteworthy and most interesting exhibit is a long glass case containing a seascape, on which have been placed small rigged models, representing in the order of time the whole fleet of the company, past and present, from the small William Fawcett down to the Caledonia recently launched at Greenock. The past and the present order of things are also brought into striking juxtaposition at the P. and O. Company's stand in the matter of marine engines. A large view is given of the engines fitted into the p.s. Iberia in 1837, and, alongside, a similarly executed illustration of the engines fitted into the s.s. Victoria, built in 1887. This gap of half a century's engineering practice is sufficiently suggested to the initiated reader by simply mentioning that the early paddle engines were of the side-lever type, by Messrs. Forrester and Co., of Liverpool, were of 400 indicated horse-power, the boilers being worked at 8 lb. pressure per square inch, giving the vessel a speed of 7 knots per hour, but at the cost of 5 lb. of coal per indicated horse-power per hour. The modern triple engines by Caird and Co. are of 7000 indicated horse-power, the boiler pressure being 150 lb., speed of vessel 17 knots, and the coal consumption 1·6 lb. per indicated horse-power per hour.

The Cunard Steamship Company is represented by a galaxy of highly finished models of its modern steamships, and several of its earlier vessels. The models include the Campania and Lucania, Umbria and Etruria, Gallia, Hibernia, Asia, and the last and first of its paddle-wheel mail steamers, the Scotia, Persia, and the Britannia. It also shows, in the form of a diagram, the gradual increase in the size and power of its vessels from 1840 to 1893, beginning with the Britannia, of 207ft. long and 740-horse power, and ending, meantime, with the Lucania, of 600ft. long and 26,000-indicated horse power.

Here it naturally occurs to us to mention that neither the White Star Company nor its builders, Messrs. Harland and Wolff, are represented in the Exhibition, although the latest and best examples of its fleet, the Teutonic and Majestic, would have conferred completeness on the show as representative of modern transatlantic steamships. While their absence is matter of regret, it is not, on the other hand, matter for surprise that the hopes of some of the exhibition promoters have not been realised regarding a possible "show of hand" as concerns the record-breaker Gigantic persistently rumoured as being under way or contemplated at Belfast.

While Messrs. Harland and Wolff, as builders of the Atlantic liners owned by the White Star Line, are not directly exhibitors, their work in other directions finds representation. The Union Steamship Company, of Southampton, in addition to a magnificent model of its twin s.s. Scot, 6750 tons and 12,000-indicated horse power, built by Messrs. Denny, Dumbarton, shows views and particulars of other vessels of its fleet, including the twin screw steamers Gaul, Goth, and Greek, built last year by Messrs. Harland and Wolff, also a sister ship, the Guelph, 4830 tons, launched from the Belfast yard on the 26th ult. The present month will also see the launch of the company's new mail steamer Norman, of 7500 tons.

The South African Cape mail service is also represented in the section by Sir Donald Currie's Castle Packet Company. At its attractive stand are three full models, representing the Norham Castle, the Dunnottar Castle, and the latest vessel the Tantallon Castle, built by the Fairfield Company, and for some months now in active service on the South African route. This splendid vessel is 440ft. long, by 50ft. 8in. beam, and 35ft. depth, 5636 tons, 7500 indicated horse-power, and steams 17½ knots.

Other important steamship lines represented, and which may here be mentioned, are the Royal Mail Steam Packet Company, which shows a splendid model of the West Indian mail steamer Orinoco, of 4627 tons and 5000 indicated horse-power, built in 1886 by Messrs. Caird and Company, Greenock; the Anchor Line, which shows models of four of its well-known transatlantic steamers; the Allan and State Line, which is represented by photographs of its vessels and a full-size specimen of the second-class berths to be found on board; and the Orient Steam Navigation Company, which exhibits its large mail steamer Ophir, of 6910 tons, and 10,000 indicated horse-power, built by Messrs. Napier and Sons, and the Austral, of 5527 tons and 7000 indicated horse-power, which, as everyone knows, emanated from the stocks at Fairfield.

The display of models made by the Fairfield Company is contiguous to the models of its patrons the Cunard Company, and embraces the Campania and Lucania; the Umbria and Etruria; the Arizona, Alaska, Normannia, and other large Atlantic liners, and well known to voyagers at sea, as their models must now be to exhibition visitors. Alongside that of the Campania, and as if to court contrast, is a model of the sailing vessel Pass of Melfort, a class of production for which the famous Fairfield establishment does not, except in unusually dull times, lay itself out. Other Fairfield models are those of the s.s. Lahn, of the North German Lloyd fleet; and the Dunnottar Castle, of the Castle Packet Company's Cape mail fleet. Of paddle steamers and twin-screws there are the p.s. England, built for the Zeeland Steamship Company, Flushing; the p.s. Queen Victoria and Prince of Wales; the Thames p.s. Kohinoor; the twin s.s. Tynwald, on the service between Liverpool and Isle of Man; the p.s. Rouen and Paris, of the London, Brighton, and South Coast Railway Company's fleet between Newhaven and Dieppe. Two remaining and very diverse exhibits, although the term "yacht" has been applied to both, are the steam yacht Lady Torfrida, of 539 tons and 700 indicated horse-power, built for Sir William Pearce, and the yacht Livadia for the Czar of Russia — the nine days' wonder of her time, but now relegated to the limbo of things all-but forgotten. The only model of Government ships shown is that of H.M. twin screw Magicienne and Marathon, of 3000 tons displacement and 9000 indicated horse-power. On the arched divisions, which define the bounds of the Fairfield Stand, are displayed a varied collection of photographs of engines and machinery, as well as of the Fairfield Company's gigantic works.

Messrs. J. and G. Thomson, of Clydebank, send eight highly-finished full models in glass cases, representing the different class of vessels for which their yard is famous. The collection includes models of the world-renowned p.s. Columbia, of Mr. MacBrayne's fleet; the p.s. Glen Sannox, built two years ago for the Glasgow and South-Western Railway Company; the twin s.s. Fredrica, Lydia, and Stella, built in 1890 for the London and South-Western Railway Company; and the s.s. America, designed and built originally for the transatlantic service between Liverpool and New York, but now owned by foreigners. Besides these, Messrs. Thomson show a selection of their naval ships, including H.M. battleship Ramillies, of 14,300 tons and 13,000 indicated horse-power; H.M. cruisers Terpsichore, Thetis, and Tribune, of 3400 tons and 9000 indicated horse-power; each of the latter having a speed of 20 knots. All these warships are twin-screw steamers, as is the Spanish cruiser Reina Regente, of 5600 tons and 12,000 indicated horse-power, which completes the list of Messrs. Thomson's exhibits.

Messrs. Denny and Bros. of Dumbarton, are represented by a select, though not very numerous, group of models of their productions in the way of merchant steamships and fast mail and passenger paddle steamers, and by a small scale working model of the engines and paddle shaft and wheels of the Dover and Ostend Channel steamers Princess Henriette and Princess Josephine, built a few years ago. A still later vessel, the Leopold II., built by Messrs. Denny for the same service, is shown, while her Belgian-built rival, the Marie Henriette, is to be found represented by a model in the stand of the Société Cockerill adjacent to Messrs. Denny's stand. Naturally, the models and engines of these several fast Channel steamers attract a good deal of attention. Besides the Belgian boats, Messrs. Denny also show models of the successful Clyde river steamer Duchess of Hamilton, belonging to the Caledonian Steam Packet Company, the p.s. London Belle, and p.s. Woolwich Belle, built a year or two ago, and now doing service on the Thames. The collection also includes models of the s.s. Jumna, of 5200 tons, built for the British India Company; the s.s. Antonio Lopez, 3460 tons, built for the Campania Transatlantic of Spain; and the p.s. Shooreah, a many-decked light-draught vessel characteristic of the vessels employed in Indian river service, so many of which have emanated from the yard of Messrs. Denny. Elsewhere in the maritime section, and under the wing of the companies owning the vessels, are splendid full models of others of Messrs Denny's recent productions, including the Union Company's twin s.s. Scot, and the s.s. Southwark, both already referred to.

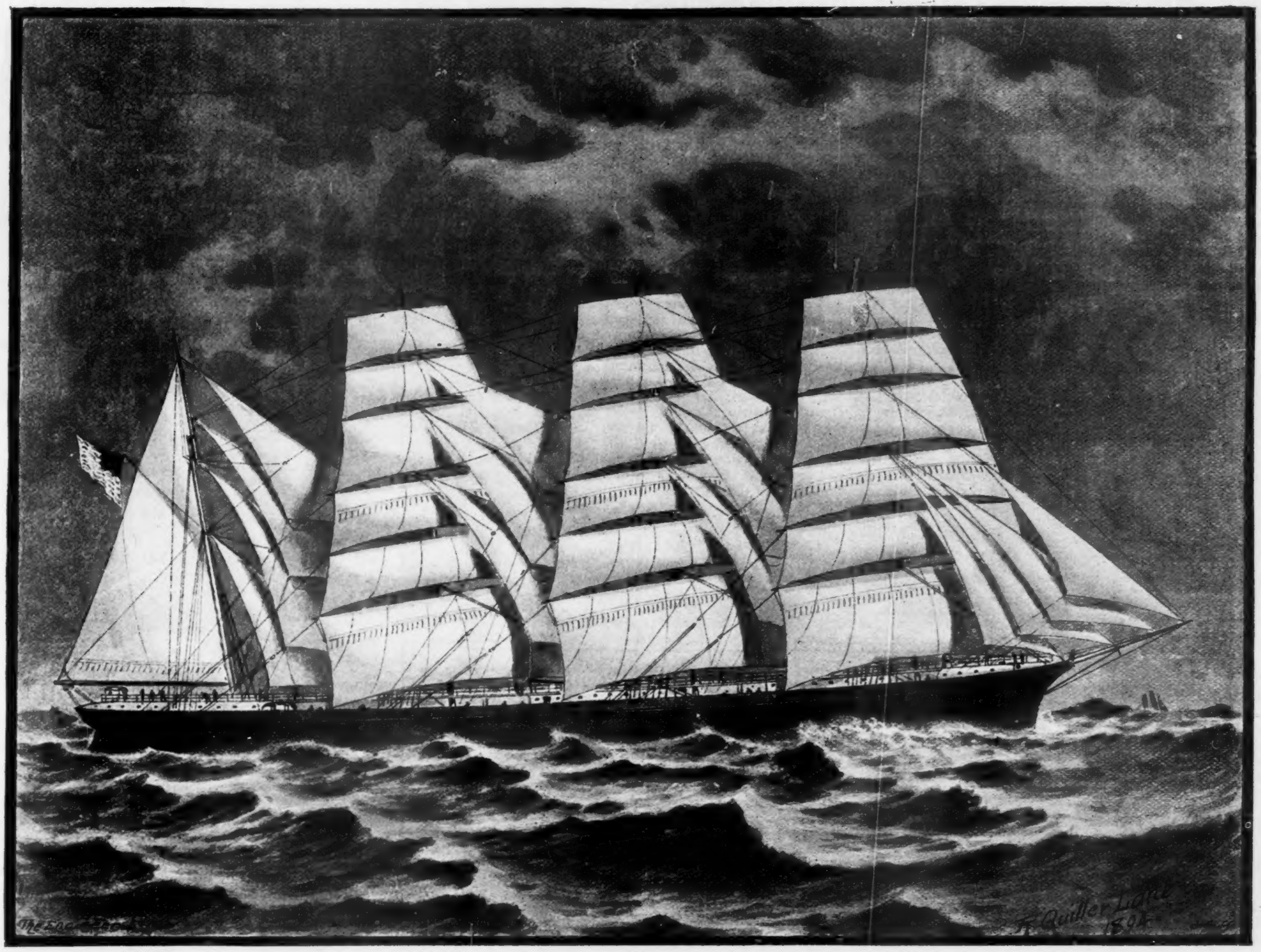
Alongside of Messrs. Denny and Brothers' stand, as already mentioned, is the stand of the Société Cockerill of Seraing and of Hoboken, near Antwerp. The model shown here of the Channel steamer Marie Henriette bears a brass plate announcing in three different languages, amongst other particulars, that she is "the fastest paddle-steamer in existence." Impressed with a due sense of the significance of this statement, it will be easily understood that the public turn with heightened interest to another, and by far the most imposing, exhibit at the Société's stand. This is nothing less than a spare crank-shaft belonging to the vessel herself—a beautiful piece of work seventy tons in weight, and of the hollow-built type. In addition, there are about a dozen other models of the vessels built at the Société's shipyard at Hoboken, where at the present time an additional fast paddle-steamer for the Belgian Government's Ostend and Dover Channel service is being laid down. These other exhibits, however, and that of the splendid full-size working marine engines shown at the Société's stand in the machinery section—which we hope to illustrate—will be referred to in further articles, when dealing more particularly with continental shipbuilding and shipping firms. Notice of the numerous exhibits made by north-east coast of England firms—such as Sir William Armstrong, Mitchell, and Co.; the Palmer Company of Jarrow; Messrs. Hawthorn, Leslie, and Co.; Swan and Hunter; Wigham, Richardson, and Co.; Raylton, Dixon, and Co.; the Darlington Forge Company, &c.—is also deferred.

## NEW WAREHOUSE SHEDS FOR THE MANCHESTER AND SALFORD DOCKS.

With a view of more completely equipping the Manchester and Salford Docks, for dealing with the large cargoes brought by cotton steamers, the directors of the Manchester Ship Canal Company have just given out contracts for the erection of a range of three-storey warehouses. The contract for one portion of these warehouses has been placed in the hands of Mr. Edward Wood of the Ocean Ironworks, Manchester, who has already built for the company a number of one-storey sheds at the docks, and the buildings are being pushed forward with all possible speed, in order to be in a complete state before the arrival of the first cargoes of cotton with the opening of the cotton season, which begins early in October. The warehouses which are now being erected are to be of the latest type throughout, built of fireproof materials, and designed to carry extremely heavy loads on all the floors. They are being built in pairs three storeys high, with a covered roadway between to enable loading and unloading to be carried on in inclement weather. Owing to the unstable nature of the ground the superstructure will rest on a foundation of wood piles, with a bed of concrete on top. Blue brick footings will be built on these, and cast iron base-plates laid on the same to receive the feet of the steel lattice pillars. The main floor girders and floor joists will be constructed of steel. The second and third floors throughout will be composed of concrete 7in. thick with a layer of rock asphalte on top. The first floor will be paved with 4in. stone flags. The roofs over the warehouses will be slated and glazed; and those over the roadway will be glazed throughout to admit ample light for the discharge of the wagons and lurries. The roof principals will in all cases be constructed of steel, and will carry angle-steel laths and purlins for supporting the slates and glass. Iron fireproof staircases will be placed at the ends of the warehouses, to enable access to be gained to all floors. The sides of these buildings will be covered with sliding doors which will run throughout the entire length on all floors. This will enable a steamer to load or discharge at any point along the side, and thus greatly facilitate the transhipment of the goods. On the quayside hydraulic cranes for the handling of the goods will be provided, and on the covered wayside continuous rails for carrying a number of travelling hoists will be supported under the roof. The second portion of the contract has been placed with Messrs. De Bergue and Co., of the Strangeways Ironworks, Manchester, who have in hand the building of two pairs of warehouses, mostly of steel, each pair warehouse being about 300ft. long and 72ft. wide, and there will be a clear space between each of 50ft., covered in with a glass roof. In each of these warehouses the ground floor is raised about 3½ft. above the quay level, and is flagged throughout. There are two upper floors, carried by steel girders and joists, filled in with concrete to make all fireproof, and the warehouses have slated roofs and skylights. A system of iron sliding doors covers in both sides of all the warehouses, giving free access at any point from end to end at every floor. The necessity for increased warehouse accommodation at the Manchester and Salford Docks has long been felt, and the new buildings now being put up will not only form a very important addition to their equipment, but when fully completed will be a distinct advance upon buildings of their class at other seaports.

City Commission of Sewers.—A meeting of the City Commission of Sewers was held at Guildhall on July 3rd, Mr. Alderman Bell presiding. It was decided to repave the carriage-ways of London-wall, Princes-street, and Moorgate-street with Val de Travers asphalte, at a cost of £4450, and the carriage-ways of Bartholomew-close, Beech-street, and Aldersgate-buildings with French asphalte, at an expense of £1375. Other footways were ordered to be repaved with asphalte by the Limmer Company. Reference was made to complaints which had been made in the newspapers of nuisance from sewer ventilators, and the matter was referred to the Streets Committee, the clerk being requested to direct the attention of the London County Council to the matter, as it appeared that one of the deep main sewers under their control was responsible for the nuisance complained of.

# THE UNITED STATES SAILING SHIP DIRIGO.



## THE "DIRIGO."

THIS fine vessel is the first steel vessel built in the United States of America. She was launched last February from the yard of Arthur Sewell and Company, Bath, Maine, and is 330ft. long over all, 310ft. between perpendiculars, 45ft. beam, and 27ft. 3in. depth of hold, designed to carry 4500 tons dead weight on a 22ft. 6in. draught of water, and to stand without ballast when light in port. Her lower deck is composed of stringers and tie plates, planked with 2in. hard pine; main deck of steel. She has raised poop and forecastle with flying bridge extending from one to the other for use in rough weather, and can spread 13,000 yards of canvas.

She is owned by her builders, and started last April on her first voyage to Japan laden with a cargo of 1,210,300 gallons of refined petroleum.

## HARBOURS AND WATERWAYS.

*Belfast.*—The tender of Messrs. Workman and Co. has been accepted for the new branch dock, the amount being £28,945. The works include the extension of the existing branch tidal dock at its southern end for 315ft., so as to form a junction with the northern side of the Prince's Dock; the closing of the river entrance into the Prince's Dock near its eastern side, and filling in the space between this wall and the new river wall to quay level, so as to make a continuous river quay. This scheme, prepared by Mr. G. F. L. Giles, the engineer to the Commissioners, having met with some local objection, principally on the doing away with the entrance to the Prince's Dock, Messrs. Hawkshaw and Hayter, the consulting engineers, were asked to advise on the matter, and having done so, expressed their entire approval of the proposed works, suggesting, however, if the funds would allow of such course, a further extension at a cost of £20,000.

*Hull.*—The trade of Hull is beginning to overset the harm that it received during the strike, and the amount of shipping entering and leaving the port is rapidly increasing. The increase in the foreign arrivals during the present as compared with the corresponding period of the previous year is 200,000 tons, and in the coasting arrivals 64,000; while in the outward trade the increase since the beginning of the year amounts to 305,000 tons. The North-Eastern Railway Company is about to construct, at a cost estimated at £72,000, an addition of 10 acres to the St. Andrew's Dock, with three slipways, and a timber jetty and river wall.

*Barry.*—The directors have invited tenders for the construction of the proposed new 20-acre dock, which is expected to cost between £300,000 and £400,000.

*Ballina.*—The Inspectors of Irish Fisheries have lately been making an investigation into the condition of this harbour. The present accommodation in the river is admitted to be utterly insufficient for the vessels trading to the port. In 1860 Parliament authorised the construction of walls, for the purpose of deepening the channel, and enabling vessels to get up the river. A portion of the works was constructed, but owing to want of funds they were not completed. The Commissioners have recently obtained the promise of a loan of £6000 from the Board of Works for the completion of the work, but as their powers have expired, it became necessary to obtain a provisional order, and hence the inquiry that has recently been held. The fisheries of the Moy are very valuable, and objections to the proposed continuation of the works were raised by the Moy Fishery Company.

*Ouse navigation.*—There have been several attempts within the last few years to get this navigation restored. At the instigation of the County Council the Board of Trade were moved to send an inspector to report on the condition of the locks and other works. A company was also started to purchase the rights of the proprietor; to put the works in order, and extend the navigation by a new cut from Bedford to a junction with the Grand Junction Canal. The proposed Bill for accomplishing this was not proceeded with. Last year the rights of the owner of the navigation passed into the possession of Mr. L. T. Simpson. Soon after the completion of the purchase he commenced restoring the locks and putting the navigation in order. At the end of last year, the St. Ives lock and staunch of fourteen gates, the locks at Hemingford, Houghton, Godmanchester, Brampton, Offord, and St. Neots, with the bridges and tow paths on twelve miles of the river, had been restored. Since then the work has been continued, and includes the entire rebuilding of Tempsford Staunch, Wellington lock, and Castle Staunch. Between St. Neots and Bedford thirty-two new lock gates with sills and hollow quoins will be required, and about twenty-five new flood gates and staunches. It is intended that the traffic shall be worked by the Ouse Transport Company, which has already placed a number of new barges on the navigation, and a steam tug. A fair amount of trade is already being done between St. Neots and Lynn. Although there is no present intention of extending the navigation to the Grand Junction Canal, this work will no doubt be ultimately proceeded with, as it would open up communications between all the Midland district and the port of King's Lynn, and give more direct access for trade to and from the Continent.

*The Provisional Orders* relating to piers and harbours brought forward by the Board of Trade for confirmation in this session of Parliament include the incorporation of the Collieston Harbour Trustees, with power to construct harbour works and to borrow £5000; also of the Polperro Harbour Trustees, with power to borrow £3000 for the construction of new works; also of the Whitelinks Harbour Trustees, with power to borrow £38,000 for new works; an order authorising Mr. Fletcher to construct a pier, quay, and breakwater at Avoch, and to borrow for the purpose £8500; the vesting of the harbour of Burnmouth in trustees, with power to construct a wharf and to borrow £5000; an order empowering Sir T. Campbell Orde to construct a pier at Loch Efort, and to borrow £4000. This order was opposed but confirmed by the committee to which it was referred. An order empowers the Poole Harbour Trustees to construct groynes on the south-east side of the entrance to Poole Harbour, to acquire the sandbanks, and to borrow £5000.

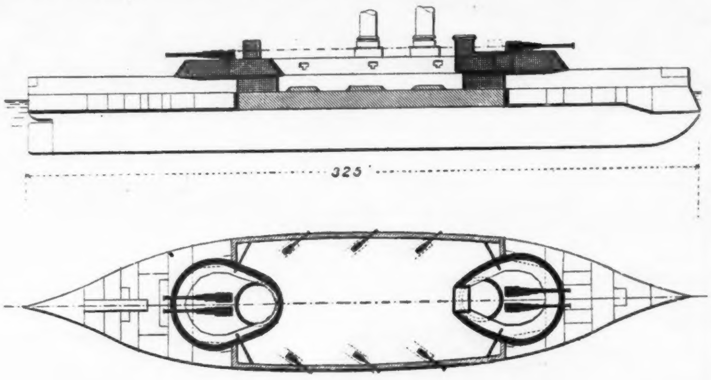
*Rouen.*—The statistics of the navigation returns at this port are interesting, as its position and circumstances are frequently referred to as corresponding to those of Manchester since the canal has been made; in fact, it has been termed the Manchester of France. From the consul's report for last year there appears to be a marked decline in the amount of shipping, following on an unbroken increase for the previous twenty years. The number of vessels increased from 3750 in 1872 to 5986 in 1891. This increase was due to the improvement of the channel of the Seine by training and dredging between Rouen and the estuary. In 1892 the number of the vessels declined to 5229, and the tonnage from 2,435,850 to 1,932,029. The import of coal, wine, and wheat has considerably decreased. The import of wood, lead, bar iron, and petroleum had increased, but not in sufficient quantity to make up for the decrease in imports. Although Rouen has better facilities for railway distribution than Havre, the imports of raw cotton to the former port do not show any marked tendency for the transfer of the cotton market to Rouen. The total import of cotton last year was 628 tons, being an increase on 1892, but a falling-off from 1431 tons imported in 1891. The largest ships which navigated the 70 miles of the Seine to Rouen varied from 1100 to 3750 tons, and included grain ships from New Orleans, Melbourne, Odessa, petroleum ships from New York and Batoum. The greatest draught of any vessel on entry was 22ft. Nine-tenths of the imports consist of coal, timber, petroleum, and grain. The trade in timber to Rouen is falling more to British vessels, contracts which have been refused by Swedish ships, on account of the low freights offered being taken by British vessels. This is the more remarkable as it is well known that a British ship cannot be run at so low a cost as that of a Norwegian or Swedish. It is partly explained by the fact that vessels which would not be allowed to trade in this country, owing to the ever-increasing requirements of the Board of Trade, are being parted with at low prices for purely continental traffic. As regards the trade in coal, timber, and raw materials, Consul O'Neil says: "A very great part is played in the transport of these essentials to a manufacturing country by such a canal system as that of France. It is impossible for an Englishman to see, without regret, the abandonment of a systematic canal construction in his own country. With foreign manufacturers on every side competing, and too often successfully, with British, it seems to one who observes this from abroad that we must be seriously handicapped by so great a want. Every element in production is being pared down to the lowest possible limits, and wages, if we may judge from recent events, are to be no longer squeezable. Prices, we are now told, must start from the bed rock of a living wage. Is the constant perfection of water transport in foreign manufacturing countries a matter of so little concern to us? More especially in the production of coal, timber, and raw materials, in whose cost manual labour or wages form so large an element." Canals in France transported, in 1892, 25,957,686 tons of merchandise, and railways, in 1891, 96,553,763 tons, the proportion being 26 8 per cent. Although the trade to Rouen shows signs of depression, improvements in the port and navigable waterways are being carried on in a very extensive way. The quays and appliances for rapidly loading and unloading vessels are being greatly extended; gas is being replaced by the electric light, so that work may go on during the night; additional railway connections and facilities are being provided; the petroleum basin is being doubled in length and area, and the shoal places in the river are being dredged away. An increased depth of from 3ft. to 4ft. has been secured through the

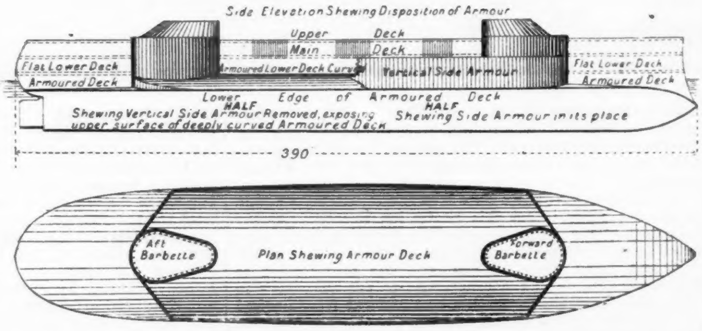
Bourdonville Pass at a cost of £54,308, and it is intended to spend a further sum of £25,000. It has also been determined to dredge the Banc de Flaques for a width of about 500ft. to an increased depth of 3¼ft., at a cost of £40,000. This shoal consists of hard conglomerate, and forms a bar across the river which materially hinders the free flow of the tidal water. The greatest improvement, however, which has been carried out is the lighting of the estuary channel with gas-boat buoys. Within the last five years the system of marking the estuary channel has been twice changed. First, iron buoys were substituted for poles crowned with faggots, which had served for many years before. After three years' use these were changed to boats carrying a lantern lighted with compressed gas. The result has been so satisfactory that the testimony of pilots and mariners is that it is now as easy to navigate the twelve miles of the estuary by night as by day, and that the system is as good as any that could be desired, and renders the navigation perfectly safe, except in foggy weather.

*Suez Canal.*—The annual report of the directors shows that there has been a marked decrease both in the number of ships and in the tonnage which passed through the canal during the past year. The total number of steamers, 3341, is the smallest since 1887, and is 218 less than in the previous year. The gross tonnage is 1½ millions less than in 1891. The average gross tonnage has increased during the last ten years from 2437 tons to 3219 tons, being an increase of 32½ per cent. The maximum draught allowed for vessels passing through the canal four years ago was 24ft. 7in.; now it is a foot more; 164 vessels drawing more than 24ft. 7in. used the canal. The percentage of vessels drawing under 23ft. has declined from 73 to 69 per cent.; the vessels drawing more have increased from 26·69 per cent. to 31·07 per cent. England still maintains her position, although the proportion to other nations shows a decrease from 77·63 in 1891 of the whole of the tonnage passing through the canal to 74·18 in 1893. Germany stands second with 7·43 per cent.; France 6·53 per cent., an increase in the past three years of 1·48 per cent. Holland has increased from 3 to 4·12 per cent. Of the total number of vessels passing through 92¼ per cent. used the electric light, which is an increase of about 1¼ per cent. on the previous year. The average time taken by vessels which only navigated in daylight was 31 hours 24 minutes, and of those which continue their passage during the night by the aid of the electric light 19 hours 52 minutes. The improvement works have been regularly proceeded with.

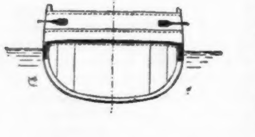
## THE MAGNIFICENT AND MAJESTIC.

The two fine battleships which are building respectively at Chatham and Portsmouth, the Magnificent and Majestic, are progressing with rapid strides. The disposition of their armour is of so different a character to that employed, even in the most recent battleships, that we have engraved a sketch elevation and plan, indicating the immense development which has been effected. Although we have, however, adverted in the drawing to the side armour as "vertical," it is not in reality vertical, but slopes backwards to a considerable degree, as the French plan of making the ship's sides "tumble home" has been adopted to a modified extent by the constructive department of our Admiralty.




Side Elevation Shewing Disposition of Armour
Upper Deck
Main Deck
Flat Lower Deck
Armoured Deck
Armoured Lower Deck Curve
Vertical Side Armour
Flat Lower Deck
Armoured Deck
Lower Edge of Armoured Deck
HALF Shewing Vertical Side Armour Removed, exposing upper surface of deeply curved Armoured Deck
HALF Shewing Side Armour in its place
390
Aft Barbette
Plan Shewing Armour Deck
Forward Barbette

In order to show how the armoured surface has increased since the days when the "Admirals" were designed, we also append a drawing of the Collingwood, whose comparatively meagre and insufficient defence is apparent at a glance. It will be observed that the old plan of starting the armoured side streak a few feet below the surface of the water has been adhered to, the thickest portion of the steel plates reaching to the level of the flat lower deck, which rests upon the crown of the arch of the armoured lower deck. Thinner steel armour is carried up to the level of the main deck. But the most important modifications are in the armoured deck and barbettes. The armoured deck, instead of being a mere flat roof to the citadel, curves downwards on each broadside to the armour shelf, or lower edge of the side armour; so that, in addition to having the side armour to penetrate, a projectile would meet with 4in. of steel set at an angle which would give a further reinforcement of about 6in. to pass through. The height of the curve of the armoured deck is about 9ft., and it extends unbroken from apex to apex of the citadel. It will thus be seen that the outer edge of the armoured deck stretches from stem to stern in a horizontal line. This is a most invaluable feature of the new designs, and was never attempted before, the horizontal line of the armoured deck being raised above the citadel in all earlier battleships. The barbettes rise at either end of the citadel, and are pear-shaped, passing upwards through main and upper decks, beyond the latter of which they project a little, and upon their summits will be revolving armoured hoods or turrets, as in the cases of the Barfleur and Renown. The bulkheads of armour which enclose the ends of the citadel are in reality merely a prolongation of the side armour, which is carried round thus to meet the barbettes at the central line, and they enclose the curved slope of the armoured deck, being built against it.



Another important feature of improvement which is observable in these ships is the greatly extended inner skin. It reaches unbroken to two bulkheads some 8ft. or 9ft. forward and aft of the apices of the citadel, and is thus very much more effective than in any ships previously designed. The unprotected ends of these two new battleships really sink into insignificance. The extent of armoured surface from apex to apex of the citadel is nearly 300ft., and it is almost inconceivable that any injury to the unprotected portion would be of so serious a character as to affect the trim or stability of these vessels to a dangerous degree.

## GAINSBOROUGH WATER SUPPLY.

At the latter end of last year the Gainsborough Local Board of Health obtained the sanction of the Local Government Board to a loan of £12,500 for the purpose of carrying out a scheme of water supply in accordance with the designs and estimates of their engineer, Mr. Jabez Church, M. Inst. C.E. The Board have, however, since considered the risks attached to this scheme—see The Engineer, vol. lxxvi., page 337—which involved the construction of a heading 25ft. long from the bottom of a well 250ft. deep to their existing boring—which is only 10in. diameter in the sandstone—and finding also, on a careful test of this boring, that its capacity was hardly equal to their requirements without tapping it at a greater depth than 250ft; they have now decided to abandon the original scheme and to substitute a new and independent boring for the well and heading originally contemplated. This alteration of plans, while involving a slight additional cost, will secure a perfectly new and independent supply of water; it will also avoid the risks and difficulties connected with making the heading to the boring at a considerable depth from the surface, and it is anticipated that the extra size and depth of the new boring will not only increase the amount of water available, but will enable it to rise to a higher level when being drawn upon by the pumps, thus reducing the lift.

The scheme now proposed, which has been designed by Mr. Church and approved by the Waterworks Committee of the Local Board, consists of a single boring 1450ft. deep—or 700ft. into the water-bearing sandstone—18in. minimum diameter at the bottom, 30in. diameter for a depth of 300ft. from the surface, having a 20in. lift pump suspended in it, worked from a direct-acting compound condensing engine, also a force pump worked from the tail rod of the low-pressure cylinder. Unfortunately it will be impossible, owing to the great depth of the water-bearing strata below the surface, to have two borings side by side with a pump in each, as would be the most satisfactory and economical plan; consequently the pump rods will be balanced by means of adjustable counterweights carried on the rocking lever. The total capacity of the new plant will be—as in the original scheme—from 50,000 to 60,000 gallons per hour under a maximum total lift of 400ft. Application is now being made to the Local Government Board for their sanction to the alteration to the scheme.

## OLD ROMAN PUMPS.

The illustrations here given will be interesting to some of our readers who are not in the habit of visiting the British Museum, or for whom, at all events, those rooms which contain the Roman antiquities possess no attraction. At the same time it may serve to take some of the conceit out of engineers of the present day to see how much the Romans knew 2000 years ago. The origin of the pump is attributed by Vitruvius to Ctesibius, of Alexandria, about 224 B.C., although we know that Danaus, brother of the Pharoah Rameses, as far back as 1485 B.C., used pumps when digging the wells at Argos. In either case, however, the origin is Egyptian. In his work entitled "Spiritalia seu Pneumatica," 130 B.C., Hero described pumps precisely similar to these, and seeing how complicated they were, it is reareasonable to infer that the invention must have been in his time quite old. We are therefore inclined to think that the theory attributing the design to Ctesibius is the preferable.

We illustrate two pumps, of which that shown in Fig. 1 is probably the older, having flap valves, that shown in Fig. 2 having lift valves of an astonishingly modern design. The flap valve shown by Fig. 1 *a* was usually a coin—Lat. *assarius*, an older form of "*as*." From this the word "*assarium*" was derived, which Vitruvius always employs, and the Greek word ἀσσάριον which actually means a "valve." The castings appear to be of a rich gun-metal, and have as neat a surface as is produced in modern foundry practice.

Fig. 1—A

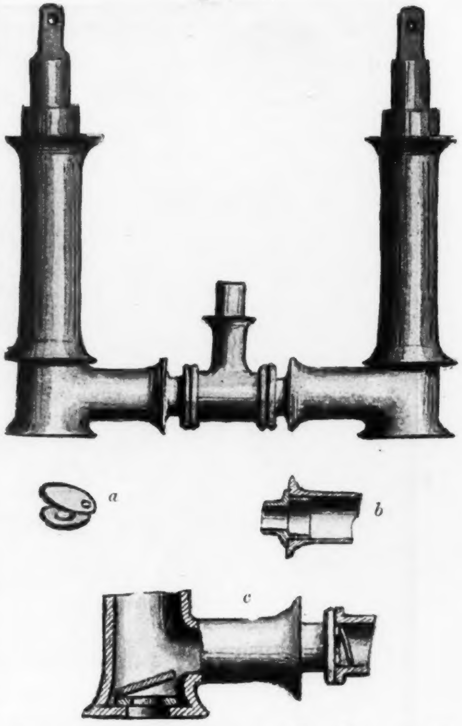
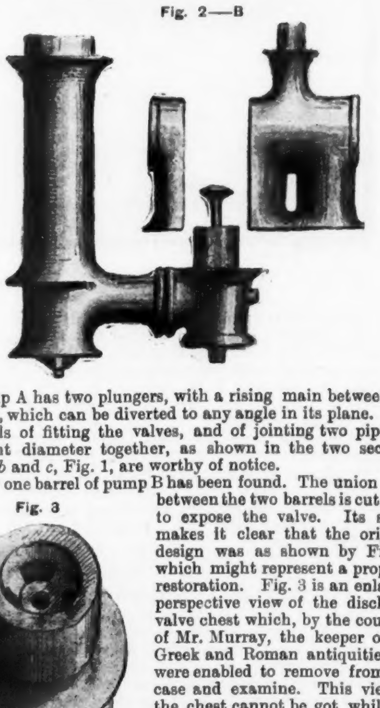


Fig. 2—B



Pump A has two plungers, with a rising main between the barrels, which can be diverted to any angle in its plane. The methods of fitting the valves, and of jointing two pipes of different diameter together, as shown in the two sections given, *b* and *c*, Fig. 1, are worthy of notice.

Only one barrel of pump B has been found. The union piece between the two barrels is cut open to expose the valve. Its shape makes it clear that the original design was as shown by Fig. 4, which might represent a proposed restoration. Fig. 3 is an enlarged perspective view of the discharge valve chest which, by the courtesy of Mr. Murray, the keeper of the Greek and Roman antiquities, we were enabled to remove from the case and examine. This view of the chest cannot be got while the latter lies in the case. The valve spindle is guided by the ferrule, which can be seen supported by our webs, with which it does not appear to be of one casting, but driven in, while the water is enabled to rise through the annular orifice surrounding the ferrule. In the barrel of this are the remains of a connecting-rod, still hanging on to the piston, which is immovable. It is consoling to know, however, that the Romans knew nothing of the *lift* pump. Atmospheric pressure was not estimated then. That was left to the Spaniards to conceive, and the Italian Torricelli to determine.

Fig. 3

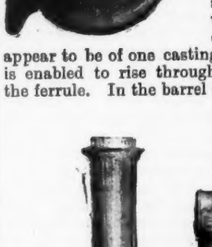
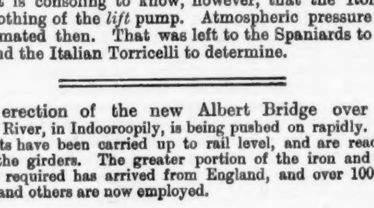


Fig. 4

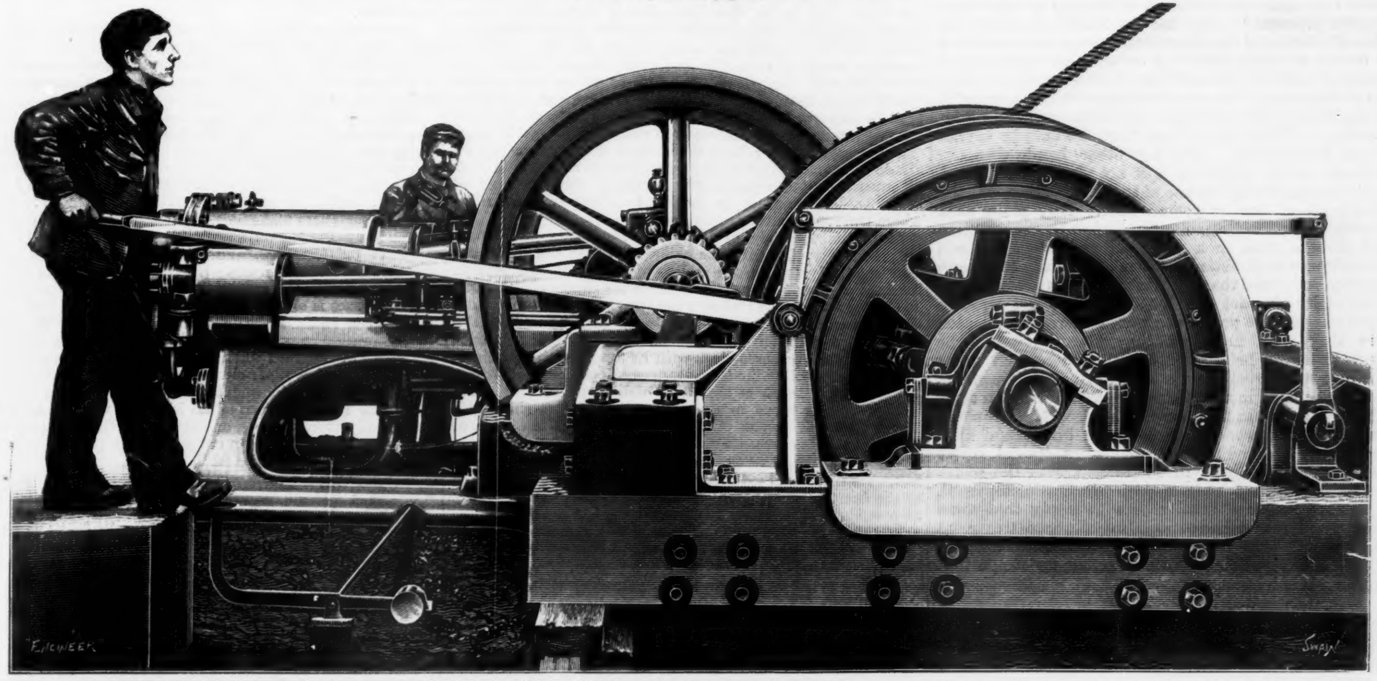


The erection of the new Albert Bridge over the Brisbane River, in Indooroopily, is being pushed on rapidly. The abutments have been carried up to rail level, and are ready to receive the girders. The greater portion of the iron and steel material required has arrived from England, and over 100 iron workers and others are now employed.

## TWENTY-HORSE POWER OIL ENGINE AND WINDING GEAR

MESSRS. PRIESTMAN BROS., HULL, ENGINEERS

(*For description see page* 9)



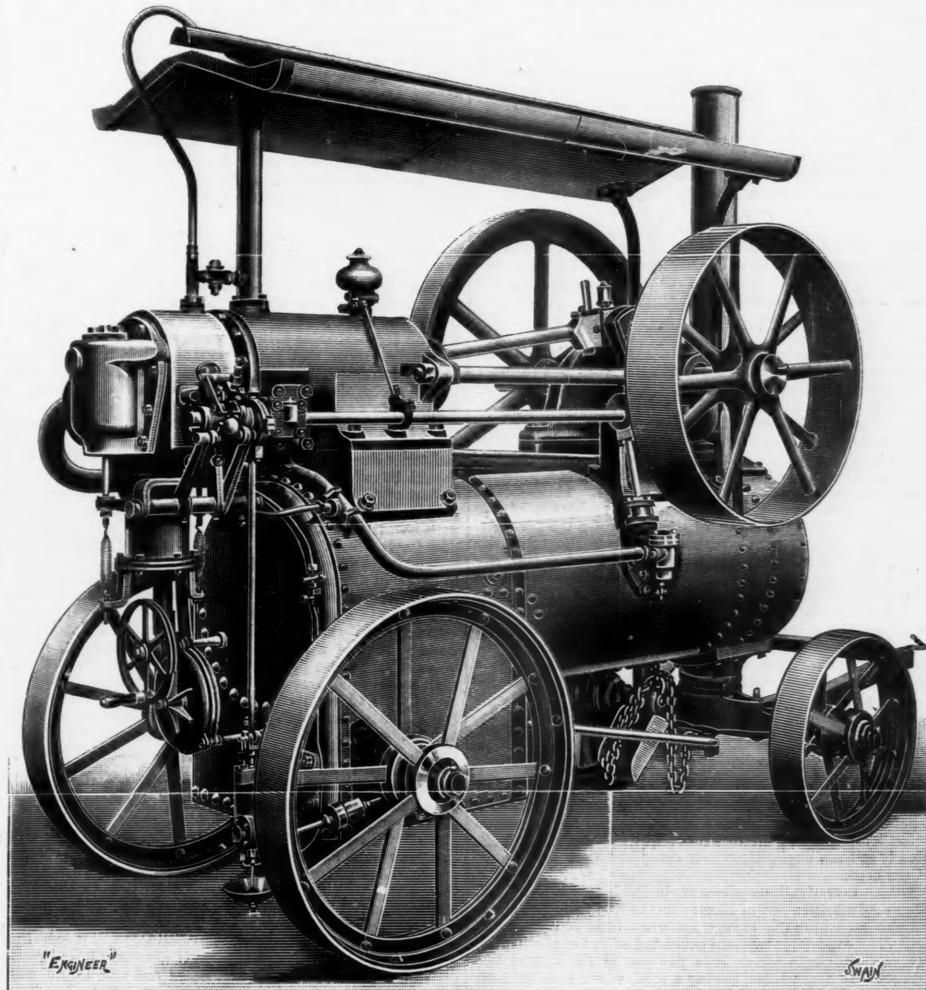
## NEW RUSSIAN STEEL SHOT.

A PLATE trial is reported in the *Times* to have taken place at Ochta, near St. Petersburg, on June 28th, which is specially to be noticed on account of results obtained by the mysterious shot of whose powers we have heard occasionally, though nothing definite has been declared. The trial on June 28th was decisive as far as a single experiment can be pronounced to be so. Three armour-plates were tested, two measuring 8ft. by 8ft. by 6in., made by Messrs. Cammell and Brown, and one by the latter, 8ft. by 8ft. by 10in. All of them had been treated on the Harvey and Tresidder system. They were attacked by a 6in. Oboukhoff gun, 45 calibres long, firing two kinds of projectiles—namely, first, the best projectiles which could be made on Holtzer's system at the Putilof Works, which projectiles past experience has shown to be practically identical with Holtzer shot purchased direct; and secondly, similar projectiles to which the secret Russian improvement had been applied. The rounds were fired at the 6in. plates with about 1850 foot seconds striking velocity, while at the 10in. plate the striking velocity was 2400 foot-seconds. It is stated that one projectile of each kind was fired at each plate, that the plates were curved, and that the angle of incidence was from 8 to 10 degrees with the normal. The Holtzer projectiles proper broke up, but obtained greater penetration than has yet been reached under comparable conditions in England, while the "secret process" shells passed right through the targets and cut holes in a wooden screen in rear which, as we understand the account, were so clean as to argue that the projectiles were uninjured. No one, however, was allowed to see them after recovery—the secret being jealously guarded. Of the excellent performance of these projectiles then there can be no doubt. That these had energy enough to pass clean through the plates goes without saying. No projectile can be expected to perforate with less than the theoretical energy; the excellence of the treated plates has shown itself in defeating projectiles whose energy would be sufficient to perforate by breaking them up, as, indeed, on this occasion took place with the Holtzer shells proper. By Krupp's formulæ the calculated direct perforation due to the striking velocity against the 6in. plate was 13·8in. of iron, or 10·3in. of steel, and against the 10in. plate, 17·1in. of iron, or 13·7in. of steel. The obliquity would reduce this slightly, and moreover would render the projectiles much more likely to break. Consequently, seeing that the plates were supplied by Brown and Cammell, and that striking superiority is shown by direct comparison with projectiles of very high quality, and is maintained without exception in each case, we must admit, as we have said above, that the extraordinary power of the Russian projectiles has been as completely proved as it can be in a single trial.

We now pass on to the question as to what these "secret process" shot are. Interesting as such a question is, we fear we are not in a position to throw very much light on the subject. We can, however, inform our readers what we have heard from time to time on the matter. From one to two years ago, the Russians considered that they had projectiles which were not liable to be broken up by treated plates. The device they adopted was the use of a wrought iron cap, as mentioned in THE ENGINEER of June 16th, 1893, in an article headed, "Armour Question Puzzles." It must be understood that the function of the hard skin of a treated plate is to break the extreme point or tip of the projectile before it enters and obtains support from the surrounding metal. The importance of this has been curiously illustrated more than once. For example, in the Texel trials last autumn it was found that at low velocities projectiles absolutely entered more deeply into all the treated plates than into the one untreated plate, the probable explanation being that this St. Chamond untreated plate was as a mass harder, and so when the shot point held, it carried itself with the thin hard plate skin round it more deeply into the softer treated plates than with the stiffer mass of the untreated one. When the velocity rose, however, the projectiles were broken by certain treated plates while they perforated the untreated plate without failure. This is a single experiment, but taking it for what it may be worth, the above is the best explanation that can be suggested so far as we know. The action of the wrought iron cap is then quite conceivable; it saves the point from an abrupt shock and supports it, and thus, under favourable conditions, may save the projectile from fracture at the critical moment, and enable it to do its work. This device was tried at Shoeburyness in 1878 and rejected as untrustworthy and worse than useless at oblique impact. Its functions might be more complete when applied to overcome a thin film or skin such as is given to plates by the water hardening than when the earlier and inferior shot were opposed by steel whose hardness, though less, extended some inches in depth. Nevertheless the Russians burst one gun by the cap coming off in the bore and acting as a wedge; and considering the difficulty of angular impact, it was expected that the idea would be dropped. Shortly after this it became known that the Russians had obtained remarkable results

## 10-H.P. PORTABLE OIL ENGINE

MESSRS. ROBEY AND CO., LINCOLN, ENGINEERS



against treated plates with certain very small projectiles, but all attempts to obtain information were unsuccessful. The matter was declared to be "a Russian secret." No doubt the projectiles fired last week were of the same nature as the small ones previously tried; the question is, were they some modification of the cap or something altogether different? That the cap could be made to hold we do not doubt, and the chances may seem to be against a new device suddenly following on the first without any connection with it. Nevertheless there is strong evidence of some departure. It cannot be supposed that a wrought iron cap of the form used by us would be carried through the armour. We know, in fact, that it would be spread out and left behind. On the other hand, that the excellence of the projectile was not due to treatment alone, is suggested by the use of the wood screen and the concealment of the recovered shot. Any plain steel projectile that passed clean and unbroken through a plate would show no trace on a wood screen, except perhaps some obliquity in direction, and might hardly tell more tales when recovered than it did before it was fired, beyond the fact of its abstract excellence. We do not know at present whether the projectiles were allowed to be seen before they were fired. If they were allowed to be actually handled before firing, the presumption is no doubt that their excellence is due to special treatment, invisible of course in the unfired shot, but of which signs might be detected in the recovered projectile. If, on the other hand, they were concealed both before and after firing, we are inclined to think that some special device may have been employed in connection with the point. The fact that finished Holtzer projectiles were employed, and all the language used, seems to imply that some distinct device rather than a special metallurgical treatment way employed. The test at an angle further suggests that the device was such as specially called for such a test. More than this we cannot say.

## THE RESISTANCE OFFERED BY CURVES ON RAILROADS.

AN elaborate series of experiments have recently been made in France to determine the resistance due to curves on railroads. The results are discussed at great length in a paper in one of the bulletins of the International Commission of the Railroad Congress. In the following lines we give some of the principal results obtained, and must refer those of our readers who may wish to follow the matter up more closely to the original paper. The point which it was sought to determine by these experiments may be summed up in the words, "What means would experience appear to dictate as the most efficacious for reducing the resistance to the passage of rolling stock over curves?" In some experiments made on the Eastern Railroad of France, it was found that with passenger trains of from eight to twenty carriages running at a speed of from 22 to 30 miles per hour over curves of from 2625ft. radius and upwards, the influence of the curve is not appreciable. At 35 miles per hour there is a sensible increase in the resistance amounting to about 5 per cent. With freight trains running over curves of 3281ft. radius, 2·2 lb. per ton must be added to the unit of resistance, and on curves of 2625ft. 3·3 lb. per ton. The length of the curve appears to be the greatest factor in influencing the increase of resistance. The above-cited coefficient applies to trains whose average running speed is considerably below that for which the elevation of the outer rail has been calculated.

The results of experiments made at various times on the Paris-Orleans line suggests the following formula :—

$$C = 1000 \frac{V}{R^2} n,$$

where C = additional resistance in kilogrammes per ton, R the radius curvature in metres, V the speed in kilometres per hour, on the number of ordinary four-wheel carriages in the train. This formula becomes :—

$$C^1 = 4200 \frac{V^1}{R_1^2 n},$$

where $C^1$ = English pounds per ton, assuming French and English tons to be the same for the purposes of a formula in which the constant must of necessity be only approximate: $V^1$ = miles per hour; $R_1$ = yards; $n$ = as before.

The values yielded by this formula should be added to the normal resistance of the train under consideration. Thus for a train of thirty trucks, running over a curve of 1148ft. radius at a speed of about 12½ miles per hour, the increase of resistance would be about 10·5 lb. per ton. This amount is just a trifle over the actual rolling resistance of the train, and is practically equal to the effect of a 0·5 per cent. up gradient. More recent experiments seem to show that the values yielded by this formula for curves of short radius, say less than 650ft., are too high. Mr. Fetter, engineer-in-charge of the rolling stock of the departmental roads of France, has deduced the following results by assuming that the diminution of speed of a train when running from the straight on to a curve—all conditions being maintained the same on the curve as when on the straight—could be relied on as a measure of the increase of resistance offered by the curve:—

| | |
|---|---|
| Load hauled .. .. .. .. | 19 to 81 tons. |
| Gauge of rails .. .. .. | 3·28ft. |
| Gradient .. .. .. .. .. | 0·24 per cent. |
| Radius of curve .. .. .. | 984ft. |
| Nature of rolling stock .. | Locomotive, combined duplex, Mallet type. |
| Remarks .. .. .. .. .. | Resistance not appreciable. |

Mr. Fetter, therefore, was led to the conclusion that on a road of one metre gauge, with carriages having two axles and a wheel base of 8·2ft., the resistance due to a curve of 1000ft. radius is at least negligible when compared to a gradient of 0·24 per cent.

Further investigations were made in 1891 by the State Railway Administration of Saxony on the line from Chemnitz to Annaberg, where the curves are sometimes of a radius of 560ft. The experimental train consisted of five cars with two axles each, having a wheel base per car of 19¾ft., and two carriages with three axles, having a total wheel base of 23ft. The whole seven cars were fitted with apparatus whereby the axles could be made to act radially or as rigid axles. The influence of a sharp curve—560ft. radius—was found to be exceedingly marked. The initial resistance was doubled when the axles were allowed to work radially, and was increased by 270 per cent. with the axles rigid. For curves of 980ft. radius the increase was about half as great.

The paper also deals with the question of the super-elevation of the outer rail. This, as is well known, is generally regarded as facilitating the passage of a train over a curve, and doubtless, if a train were running perfectly smoothly, and the plane of the rails happened to coincide with the normal to the resultant of the centrifugal force at each point, and the weight of the train taken to act vertically through the centre of gravity of the portion considered, this might be the case. But in practice, the authors observe, the super-elevation has for a long time been regulated by the maximum speeds at which trains are to run; hence for low speeds the carriages must of necessity be forcibly drawn against the inner rail, and the resistance increased, either because the inside flange touches the rail or the conical part of the tire acts in the wrong direction, so that the largest circle of contact between the wheel and the rail is on the inside rail.

There seems to be little doubt that the experiments we allude to have established one point clearly, and that is that all super-elevation could be with advantage banished from all goods yards, sidings, or, in general, from all parts of the line where the speed is necessarily low.

As to the widening of the gauge at curves, this would only appear to increase the obliquity which the axles can take relatively to the centre line of the road, and thus to increase the angle of contact between the flange and the rail. It has been found that when a car travels over a curve under the influence of an original impulse, it takes up in general a well-defined position relatively to the line. The outside wheel of the front axle bears with its flange against the rail, the axle tends to incline from its normal position relatively to the carriage as much as the play which is given it will allow. This incline is taken in such a way as to give the inside wheel as much lead as possible, the axle tends to deviate as much as possible from its radial position.

The inside wheel of the back axle just touches the inside rail. Its flange and axle tend to incline in the same direction as the front axle, still giving the inside wheel as great a lead as possible, and inversely to what takes place to the forward axle, this inclination tends to bring it to a radial position.

The bulletin then goes on to discuss the theory of how resistance is set up at some length. The measuring instrument used is novel, and will be of interest to those studying the subject. It is composed of a pendulum, the inclination of which to a vertical scale measures the positive or negative acceleration of the carriage; the pendulum in its motion traces a line upon a length of paper, which is unrolled by a clock train. The variation of the ordinates of this line from the vertical is proportional to the resistance opposed to the car. Their variation, when the car enters on a curve, indicates the increase of resistance due to the curve, and this applies equally well whether the car is hauled by a locomotive or is moving under some initial impulse, or to an engine alone moving under a motive effort, which is kept as constant as possible. The mechanism has the further advantage of being portable.

As to the action of the wheel base upon the resistance offered by a curve, it is found that the pressure of the front wheel can be lessened by introducing a third axle. Now, as regards the distance these should be apart, it is evident that as the distance between two rigid axles is increased, the arm of the lever is increased, also in most cases the obliquity of the front wheel is increased, and there is additional tendency to cause resistance. The variation of the wheel base, however, does not appear to cause any very marked influence on the resistance until a very long wheel base is reached. On the other hand, if the wheel base is decreased too much, the obliquity of the leading wheels, after passing a minimum, begins again to increase, and this in proportion as the play on the rails increases. The very short wheel bases, therefore, are not so efficient in minimising resistance as might at first sight be anticipated. Cars with bogie trucks behave exactly like two separate cars with short wheel bases, and they do not show such a marked increase in resistance on a curve as might be expected, compared with other cars with longer and rigid wheel bases.

The following are the conclusions arrived at by the Commission:—(1) It is possible, under favourable conditions, to construct lines with a gauge of 4ft. 8½in., and with curves varying from 500ft., and even lower under exceptional circumstances, and that it is possible to work these roads with the rolling stock used in France. This applies specially to six and eight-wheeled coupled goods engines. Also that most of the passenger and goods wagons would pass over such a line in safety. This opinion is supported not only by the tests just dealt with, but by information regarding the practices in France and abroad. (2) In projecting new roads the following data may be accepted:—Increase of resistance due to curves of 650ft. radius = 8·8 lb. per ton; increase of resistance due to curves of 492ft. radius = 13·25 lb. Gradients should be reduced in proportion. (3) A geometrical examination of the problem as applied to passenger and goods wagons shows that, with the usual arrangement of axles and with new tires, a two-axle wagon, with rigid wheel bases, will pass freely over a curve of 330ft. radius as long as its wheel base does not exceed 46ft. (4) The widening of the gauge tends to admit of a greater obliquity of the leading axle, and is therefore of little or no use. (5) The stability against overturning is calculated as a function of the gauge, radius of curve, height of centre of gravity and speed. Under the worst possible conditions, namely, that of a passenger car with seats on the roof, a speed of 46·6 miles per hour would have to be reached before such a car would overturn. During the experiments separate carriages, and even entire trains, were impelled on to the experimental line at 37½ miles per hour without exhibiting any tendency to overturn, or even showing any marked oscillation. (6) From the point of view of shock and the tendency to derailment, all observations made at speeds varying in some cases from thirty-seven to forty-one miles per hour, have shown that the passage over curves of 330ft. radius, or even from one curve to the reverse curve, can be accomplished with considerable smoothness. (7) As long as the line was kept in good condition and improved by repairs, wherever indications of such improvement were noticeable the average resistance of the curved portion of the experimental line fell to as low as 17·64 lb. per ton. (8) Greater or less side play did not appear to have any appreciable influence upon the resistance measured. This influence, if it exist at all, would seem to be unfavourable, as it allowed of side motion. (9) The super-elevation of the outer rail was found not to exert any influence on the resistance. (10) Freedom of adjustment of axles seems to slightly decrease the resistance, but in several consecutive experiments dissimilar results were obtained, so that this must not be taken as a conclusive result. (11) The long bogie carriages do not differ in specific resistance from two axle-cars. Different experiments gave a coefficient of from 17·64 lb. to 18·74 lb. per ton. A slight defect in parallelism of axles decreases the resistance in one direction and increases it in the other. (12) Newly turned tires, with a decidedly pronounced conicity, give less resistance than those whose flanges have been worn to almost a vertical face. (13) A goods engine with four axles should, without allowing any lateral play whatever, pass over a curve of 262½ft. radius. Hence a curve of 330ft. radius would leave a certain amount of play, even in the case of rigid wheel base.

The average resistances obtained were:—Passenger engines, four wheel coupled, 19·8 lb. per ton; goods engines, six wheel coupled, 17·6 lb. per ton; goods engines, eight wheel coupled, 17·6 lb. per ton. It is stated that lightening the load on the leading axle materially decreased the resistance.

*Results of experiments with trains of variable length.*—Experiments were made with trains of ten, sixteen, and thirty cars. The latter was about 820ft. long, and extended almost the entire length of the curve with three bends along its length. The following observations were made on a curve of 246ft. radius, at a speed of 25 miles per hour:—(1) All engines, passenger and goods wagons, used in every-day work on the large French railways will run perfectly freely over a curve of 328ft. radius, and even at 246ft. radius on the standard gauge of 4ft. 9in. (2) Increase of gauge offers no advantages. (3) The interposition of a straight line between reverse curves is of use only from the point of view of play at the buffers, and may be limited from 33ft. to 65ft. (4) All super-elevation may be dispensed with without compromising the safety of the train when passing over curves even at high speed. Excessive super-elevation may act very prejudicially in causing the displacement of the axles towards the inner rails. (5) The resistance of all kinds of wagons, as well as engines of different types, on curves of 330ft. radius averages about 17·6 lb. per ton. On curves of 246ft. radius the average resistance does not exceed 22 lb. per ton.

The experiments as a whole show that a variation of the wheel-base and of the speed—within the moderate limits obtainable—do not influence the resistance to any very marked extent, and that lightening the load in the leading axle decreased the resistance offered by the curve. The results obtained by oiling the flanges are interesting. It was found that a diminution of increase of resistance was observed varying from 17 per cent.—of the increase observed with unoiled flanges—on a curve of 660ft. radius, to 25 per cent. on a curve of 492ft. radius, and to 27 per cent. on a curve of 330ft. radius. On the Brighton Railway a jet of exhaust steam is turned on the leading flanges for the same purpose.

## EMIGRATION PROSPECTS.

THE July circulars of the Emigrants' Information Office, 31, Broadway, Westminster, S.W., show the present prospects of emigration. The best season for going to Canada is far advanced, and emigrants who intend to go there this year should not delay; the principal demand is for experienced farm labourers, there being no real demand for mechanics, except in a few cases.

In New South Wales the number of unemployed about Sydney is said to be decreasing, many men being employed in road-making and in prospecting on the gold-fields. A large number were assisted to the fields by the Government Labour Bureau, and nearly all of them have done well. Several thousand persons have gone to the new gold-fields at Wyalong—some 300 miles south of Sydney—but a warning has been issued against more miners going there, as "the field is overdone." The coal-mining industry has been in a very unsettled condition, and several hundred men in the southern collieries struck against a reduction of wages, but it is hoped that a settlement has now been arrived at. At the large Newcastle Collieries to the north of Sydney, the output of coal is increasing, and the selling price of coal and the wages paid to miners have been proportionately reduced. Under the new shearing agreement, which applies to other colonies also, the employers propose that the shearing rates in Southern Riverina should be reduced to 18s. per 100 sheep shorn, but that elsewhere the rates should be the same as those of 1893, *i.e.*, 20s. per 100. The shearers are refusing to accept these terms. Taking New South Wales as a whole, there does not seem to be any opening for more emigrants at the present time, other than domestic servants.

The monthly official reports from Victoria, dated 20th March and 30th April last, state:—"The pressure upon the labour market has been much relieved in consequence of the efforts of the Government to place men upon the land, and to give employment to others upon works of a reproductive character. The railway lines, which have been in course of construction in the Mallee district, in the north-west, being nearly completed, the Government have determined to extend them still further without waiting for the sanction of Parliament. The men to be employed will be selected from among those whose names are registered at the Railway Department for employment, and care will be taken that only those who have been some time in the Colony, and are deserving of employment, will be given work." Several of the principal brickyards, which have been closed during the last eighteen months owing to the great depression in the building trades, have been re-opened and are employing a number of men, while a large order has been given for pipes for the new drainage works of Melbourne. During the first quarter of this year the output of gold in Victoria was 2475 oz. more than in the first quarter of 1893, and fresh discoveries both in the gold mining and coal mining industry are being reported.

In South Australia there is no demand for more hands.

In Queensland there is no material improvement in the building trade at Brisbane; but the erection of the new bridge over the Brisbane River is giving employment to ironworkers, navvies, pile drivers, masons, and labourers, of whom, however, there are plenty on the spot. In the north there is no demand for emigrants without capital; but as land is now very cheap, a man with a capital of £600 would find a good opening.

In Western Australia there has been a large influx of miners from other parts of Australia to the new Coolgardie gold fields, but water has been scarce, and no one is advised to go there from this country without some money and experience.

In Tasmania there are considerable numbers of men, both in the chief cities and in the country districts, who have been for some time past, and who will be for some time in the future, largely dependent upon relief works provided by Government.

New Zealand continues to be prosperous, but there seems to be for the most part a sufficiency of labour, this being now the winter season.

In Cape Colony the Labour Commission, which has been sitting for more than a year, has just issued its report. It recommends the formation of a Labour Bureau, and states that there appears to be no strong desire or demand for the introduction of European labour, except for that of female servants. The new education report of Cape Colony calls attention to the dearth of experienced teachers in the Government schools.

Considerable changes are about to be introduced in connection with granting passages to Natal; at present free passages are being given to female domestic servants, and artisans can obtain assisted passages on the application of colonists resident in the colony; there are new Crown Land Regulations which are intended to facilitate the settlement of the lands in the colony.

With respect to Mashonaland and Matabeleland no one should go there at present, unless he has a capital of £200 to £300, and is competent to take up mining, prospecting, trading, building, or some other work; the railway from Beira is now finished for seventy-five miles.

## OIL ENGINES AT THE R.A.S.E. SHOW.

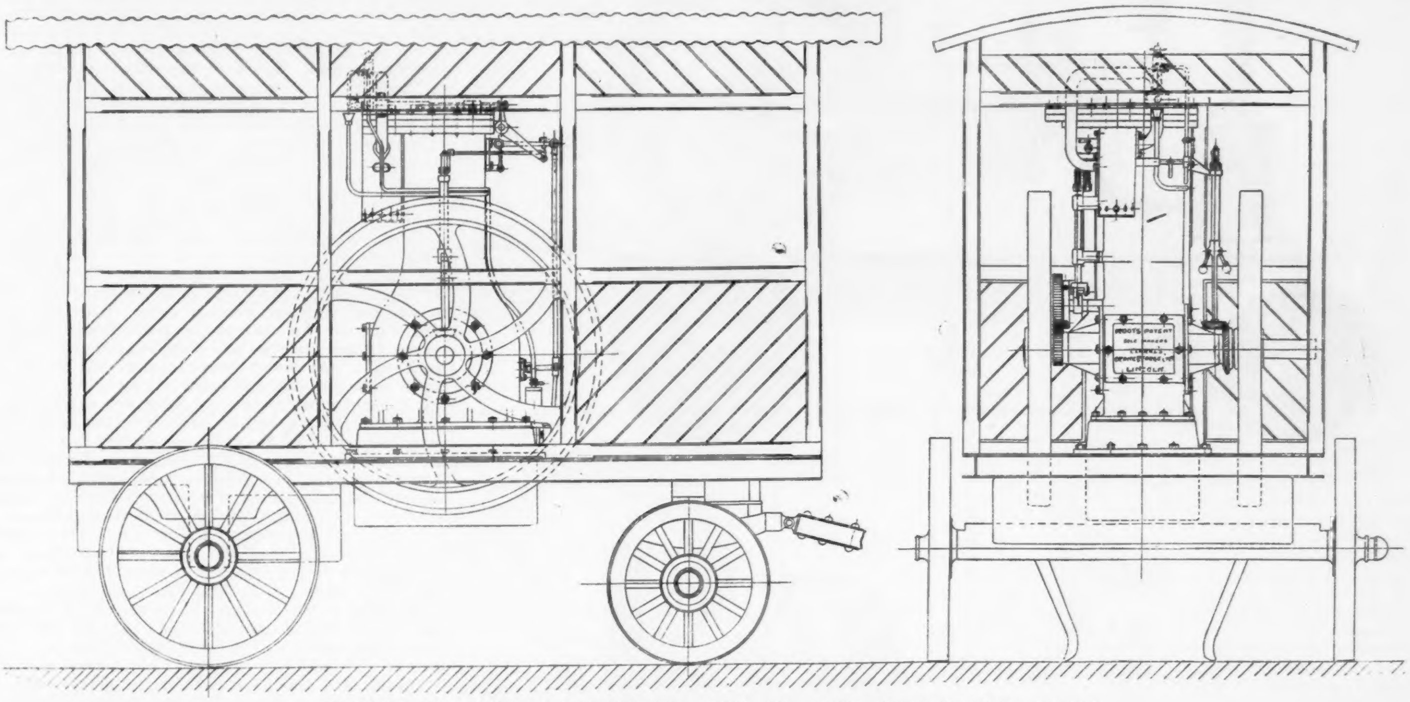
Returning to the engines which were the subjects of the trials to which we have referred in previous impressions, we may, with the object of dealing with them more fully, again take them in the order in which they stood in the trial shed.

In The Engineer, vol. lxxiii., page 539, we divided the various forms of oil engines exhibited at the Warwick Show into a series of types or classes. The classification has been very generally followed since, and the number of types has not been since increased. In 1892 six makers exhibited seven engines, while only two years before there were only two engines entered for the prizes offered for small engines at Plymouth, namely, the Priestman and the Knight engines; the latter having been unsatisfactorily made, and working improperly. Since that time, however, the system has been properly carried out by another firm of makers, and with excellent results. The classification referred to is as follows.

1. Engines in which the charge of oil is prepared for admission to the cylinder by a spray maker which forms an oil shower readily converted into a vapour on its entrance into the heater and cylinder.
2. Engines which receive and convert the oil into a gaseous vapour in an extension of the working cylinder open to the cylinder.
3. Engines which receive and convert the oil into a gaseous vapour in an oil-receiving jacket extension of the working cylinder, but not open to the cylinder except by a valve controlling admission of the vapour thereto.
4. Engines which receive and convert the oil into a gaseous vapour in a vaporiser separately heated by an oil lamp with forced air combustion.
5. Engines in which ignition of the charge is effected by an electric spark.
6. Engines in which ignition is effected by an ignition tube heated by an oil lamp with forced air combustion.
7. Engines in which ignition is effected by the heat received by the charge from the hot walls of the combustion chamber aided by that due to compression, and its effects.

The first engine is that of the Britannia Company, which comes under classes 4 and 6. Its general appearance is shown by the engraving herewith, and the system of working and construction of the vaporiser may be described with reference to the annexed sectional sketch, which also serves to show the arrangements adopted for directing heated currents of air past and through the drop-by-drop supply of oil. This is admitted by a plunger valve controlled by the governor, an arrangement which causes the air to evaporate and take up the oil as vapour on its way into the cylinder. Another feature, which was formerly used in this engine and is claimed to be an important one in gas engines, is a small chamber or pocket connected with the cylinder in which some of the air required for the working charge is imprisoned and compressed to, say, 40 lb. on the square inch, the piston then covering the port to this chamber and compressing the remainder of the charge to the advantageous pressure of about 80 lb. per square inch. In the oil engine, however, this pocket is now discontinued because unused oil vapour would sometimes explode early in it and push the piston hard against the opposite side of the cylinder. This sketch, Fig. 2, shows the general form of the apparatus, and is similar to that used in the engine illustrated in The Engineer, vol. lxxv., page 257. The air enters at A into the casing B containing the annular channels C. The casing B also forms the cover for the ignition tube, and is heated by the same flames. The air traverses all the channels C, passing from one to the next, and becomes highly heated by contact with the metal wall. It then passes to the tube D, which conveys it to the air space E in the oil feeder F; J is the oil cock. The small plunger G is reciprocated by a lever 2, shown on the end elevation of the engine, and the groove H is pushed forward into the oil space I, and, being filled with oil, is returned just at the commencement of the suction stroke of the engine to the position as shown in the air space E, when the heated air, moving at a high velocity, sweeps off, mixes with, and evaporates the oil. The mixture then proceeds by the pipe K to the annular space or chamber L at the top of the ignition tube casing, and thence by the pipe M to the admission valve of the engine N. Additional heated, or slightly heated air is admitted by the cock O through the pipe P, which is connected to a channel cast in the cylinder cover. The oil, by these means, is thus vaporised by the heated air, and at the same time intimately mixed by the high velocity air current, the two being finally heated, and perhaps gasified, together, on their way to the cylinder, where complete gasification is effected under the influence of the high temperature of the cylinder and of compression of the charge. The further air supply which is admitted by the main air valve when the engine has got well under weigh is slightly heated, when working under ordinary conditions, by its passage through a coiled air pipe in the exhaust box.

The governing of the engine is effected by graduated oil charge, the hit-and-miss finger missing or catching one or other of three steps on the piece which actuates the small oil feeder rod G. On this rod there are several grooves instead of the one shown. The reduction of the speed of the engine is thus accompanied by the introduction of a larger supply than when speed is normal. This system does not, however, always operate satisfactorily; for instance, when a miss is made and the engine is on a dead load, two revolutions with a moderate weight of fly-wheel gives sufficient time for a large reduction of speed, so that after a miss, comes a large quantity of oil, some of which is not completely used on the first working stroke, and is liable to be fired on the next compression stroke. This upsets the working for two or three strokes and causes irregularity. At the trials, for instance, this engine would make from twenty to thirty strokes with regularity in speed and with perfectly satisfactory combustion. Then would come the one miss, followed by a quarrel between vaporiser, governor, heat in cylinder, imperfect combustion of the large introduction of oil, and exhaust of useful oil vapour. When the introduction of the extra quantity of oil is followed by complete evaporation and a sufficient quantity of air is present for combustion, a heavy explosion occurs, speed is accelerated, miss again occurs, oil is cut out, and the speed may or may not fall just sufficiently to let in the small quantity of oil. When it does the engine gets off again and runs regularly for a considerable period. If, however, the speed falls quickly after a heavy explosion, as it may if the fly-wheel is light, then the large oil



PORTABLE OIL ENGINE BY THE CLARKE'S CRANK AND FORGE COMPANY—ROOT'S SYSTEM

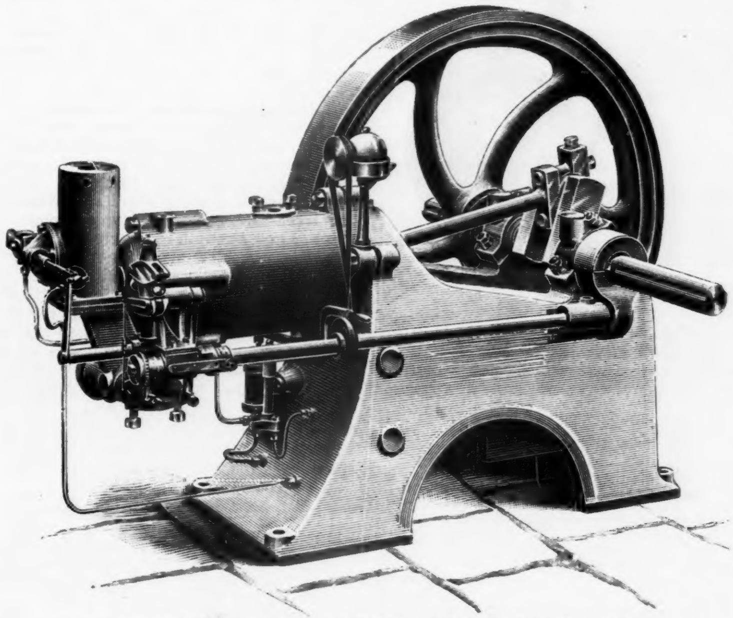


Fig. 1—OIL ENGINE BY THE BRITANNIA COMPANY—ROOT'S SYSTEM

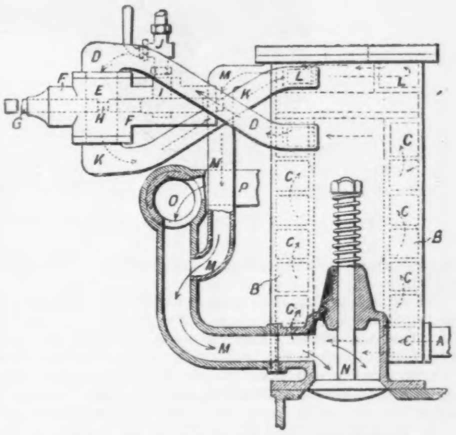
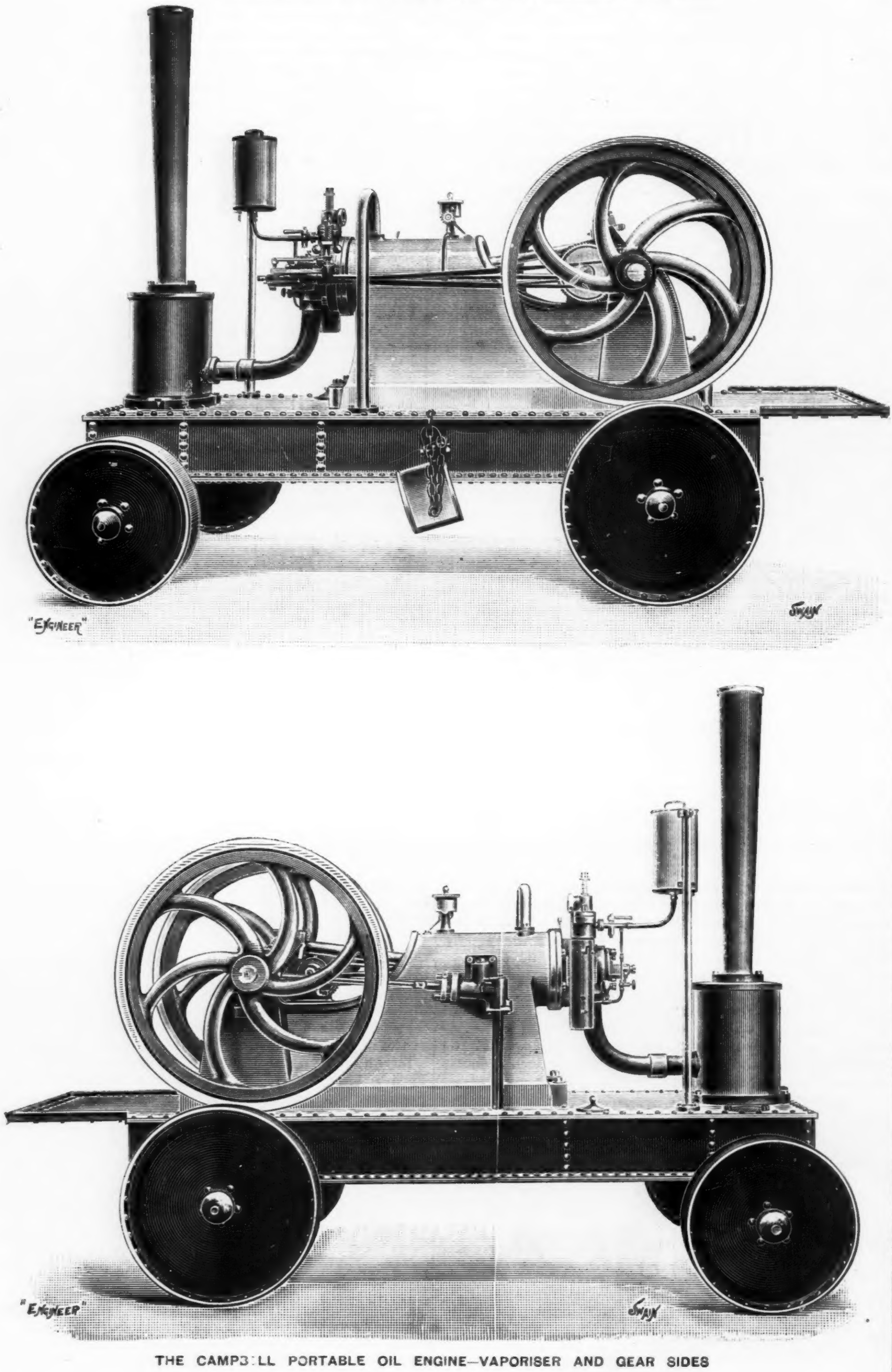


Fig. 2—ROOTS OIL FEED AND VAPORISER

# PORTABLE OIL ENGINES AT THE R.A.S.E. SHOW

THE CAMPBELL GAS ENGINE COMPANY, HALIFAX, ENGINEERS



THE CAMPBELL PORTABLE OIL ENGINE—VAPORISER AND GEAR SIDES

supply occurs with repetition of the results already mentioned.

When this engine is to be started the exhaust valve is held open by a finger-piece which is placed upon a collar upon the cam shaft. This prevents the exhaust valve lever from falling to the position for a closed valve. Thus no compression can take place. But to put the lever again into action automatically, a screw thread is cut in the collar referred to, and the finger follows this as the shaft is revolved. The finger arrives at the end of the thread after two revolutions, and reaches a simple groove normal to the axis, which, of course, gives no motion to the finger. In its passage from one end of the screw to the other the finger has moved the exhaust lever from the position on the cam, where it is concentric, and by which the valve is held open continuously, to the part of gradually increasing excentricity. In starting the engine the quantity of air drawn into the cylinder and the amount of compression is thus gradually increased automatically. The engine, as will be seen, is fitted with an air pump, which serves to supply the vaporiser lamp, and to force air into the oil vessel to supply it to the valve; the latter was not used in the trials.

During the long duration trials of this engine the combustion was perfect, except for the occasional big explosion and accompanying effects as described, but it is obvious that this may be remedied. We would prefer to run the engine with probably a single groove in the little feed rod G, Fig. 2, and to govern by complete cut-out and by the exhaust valve. The engine is of small dimensions for its power, as shown by the long runs and the full power trial, and it contains features of great importance.

The next engine is the 4-horse power nominal of the Campbell Gas Engine Company. This again is of the classes 4 and 6, and although it differs in detail, the essential features are the vaporisation of a certain quantity of oil by introducing it into a vaporiser with a current of inrushing air. The vaporiser has been modified since we published a perspective view of it on the 8th December last. Its construction is roughly shown by the accompanying sketch, Fig. 3, and the action of it and of the engine is as follows:—When the speed of the engine is such that it causes the governor to operate for the admission of oil, and of vapour, and air, the exhaust valve is allowed to close. On its first outstroke the piston then acts as a pump and takes in air and anything else that can go in with it. The cylinder is in communication with the vaporiser by a pipe at E. The inrushing air which enters at A, pulls the valve V down against the resistance of the spring S, which may be varied by means of the nut N. In passing the valve V the air carries oil from two small oil holes C communicating with an annular oil supply passage B. The fine jets of oil under, $\frac{1}{16}$in. in diameter, are dashed into spray as they leave the valve, and hit the surfaces D. The rush of air and the eddies thus thoroughly prepare the oil for complete vaporisation in the hot vaporiser. It will be noticed that an essential point is observed, namely, the inlet of a quantity of air with the oil into the vaporiser, the best and probably the only means of preventing harmful deposits. Below the vaporiser is a heating lamp, the flame from which impinges upon the igniting tube, T, and at the same time heats the vaporiser, the lost products of combustion passing out at the holes in the surrounding jacket shown. The quantity of oil admitted is not determined by the size of the holes C, but by a feed-cock on the oil supply pipe. The oil jet holes C might, in fact, be larger than they are, and by the use of a closely-adjustable cock the quantity of oil might be adjusted apart from the self-adjustment which automatically follows from the adjustment of the air valve. Thus, although the oil no doubt does get sprayed as it is admitted at high speed against the surfaces D, the apparatus cannot be included in the spray maker class. With the exception of the use of a small oil pump and this vaporiser, the engine is the same as the Campbell gas engine, and it works well. On two or three occasions bad starts were made with the engine, because attempts were made to run the engine before the vaporiser was ready. Otherwise the engine ran well, and when working on either full or on half load, with the exception of very few intervals, the combustion was perfectly satisfactory. When running light the combustion was not so good, but this was more notably the case with the previously-described engine. This is not, perhaps, of the greatest importance, as people do not buy engines to run idle. The Campbell Company's engine has the merit of simplicity, and although like several others it is susceptible of improvements, it is already a practical commercial engine.

The next engine is that of Messrs. Clark, Chapman, and Co. It is made under Butler's patents, and comes partly under classes 1 and 3, and under Class 5. It has moreover another peculiarity, namely, that it is started by means of a small quantity of a highly-volatile oil, such as benzoline, and it is afterwards worked by the heavier oils like Russoline. The fixed engine is illustrated by the accompanying engraving, from a photograph, of the valve-side of the engine. The valve rotates once every two revolutions of the engine, and acts both as mixed vapour and air inlet, and exhaust outlet. It is slightly taper, and is kept in its place by a spring at the smaller end, the spring being adjusted as to compression by the set screw seen in the engraving. Fig. 4 is a diagram transverse section of the valve and of the vapour and air mixer. The exhaust leaves the back-end of the valve, and passes beneath a conical surface on its way to the space F by means of an inlet, broken away to show the outlet B. Air for the main supply enters at the end of a jacket J surrounding this space F, and ultimately finds its way as indicated by the arrows past the ejector or inspirator apparatus, containing the central double-coned plug P. The exhaust in the space F thus heats the air as it enters, and again after it is in the mixing ejector and in the space E on its way to the valve V. The oil used for working is first passed over the exhaust heated cone just mentioned, and then as a vapour finds its way through a pipe O V and enters the injector just behind the plug P, and is thoroughly mixed with the air, partly on entrance and partly in the eddy space E. The governing is effected by the throttle valve T, moved by the governor and lever $T^1$. The throttling automatically varies the quantity and strength of the charge, as the plug P moves with the inrushing air against the resistance of the spring S more or less, according to the quantity of air passing T. From this description it will be seen that the mode of working of the Butler engine is the same as was described with reference to the small engine illustrated in THE ENGINEER, vol. lxx., pages 65-66, the chief difference being that in the engines of 1894 the oil is first admitted through a separate very finely-adjusted annular nozzle, so that it sprays over the exhaust heated cone referred to, and without any admixture of air, as far as we know, passes to the apparatus shown in Fig. 4, where it mixes with the main air supply.

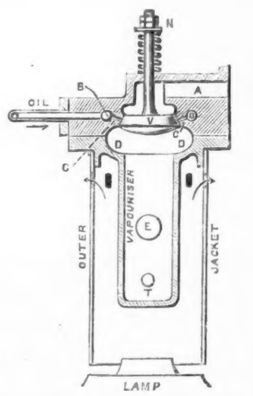


Fig. 3—CAMPBELL'S VAPORISER

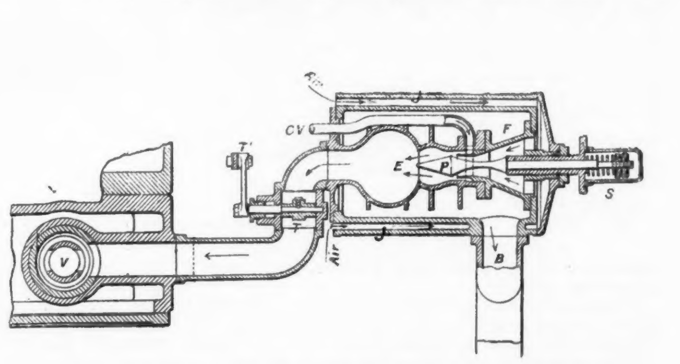
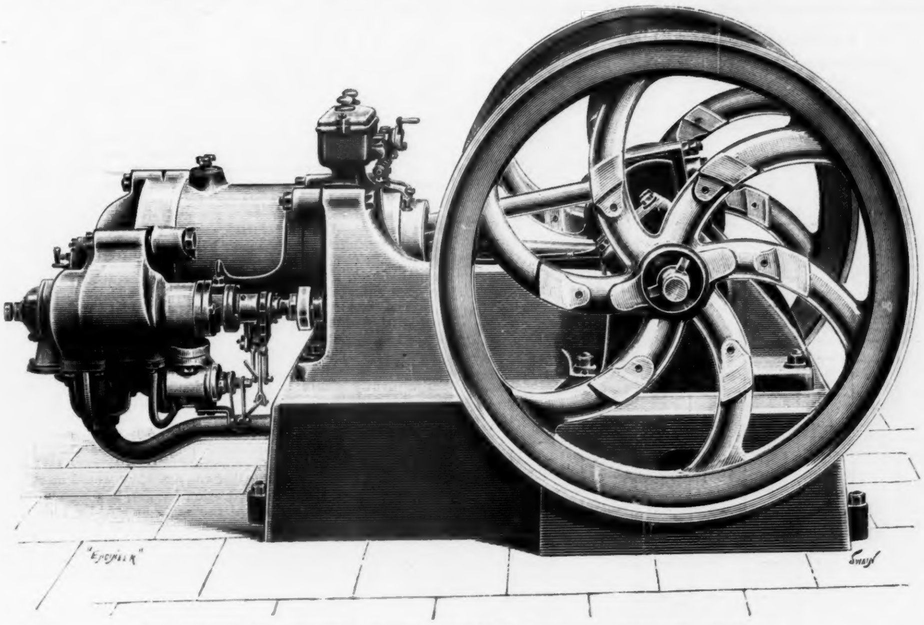


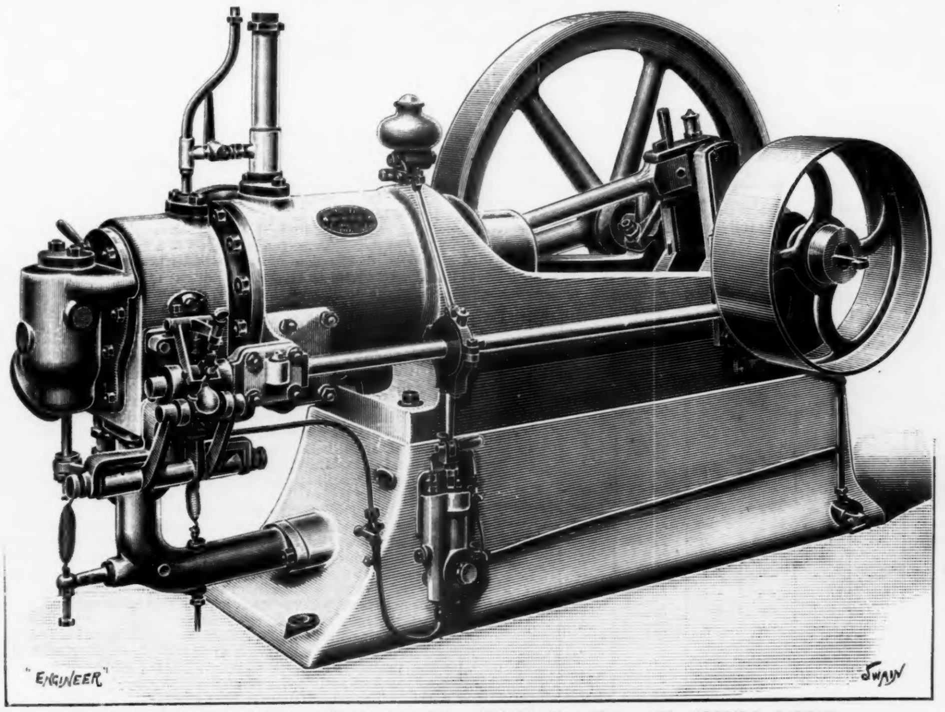
Fig. 4—BUTLER'S AIR AND VAPOUR MIXER AND HEATER

The ignition is effected by means of a paste bichromate

# OIL ENGINES AT THE R.A.S.E. SHOW



OIL ENGINE BY MESSRS. CLARK, CHAPMAN AND CO.—BUTLER'S SYSTEM



OIL ENGINE BY MESSRS. ROBEY AND CO.—RICHARDSON, BELL, AND NORRIS'S SYSTEM

battery, but in the portable engine, and presumably in the fixed, when the engine is at work on full load, the ignition takes place automatically by the internal and compression heat, and the battery is then cut out. The governor, by means of which the air throttle valve is actuated, is of the fly-wheel type. The engine runs smoothly at a high speed, and although its use of a battery and of a pint or two of benzoline for starting is against it for farm use, it need not be so much so for town use. The consumption by this engine was only obtained during the long duration trials, which we did not witness, and are not given in the table on page 10, but judging from its subsequent running, the alleged consumption, and the imperfect combustion, it is probable that it and some others of the engines would, under ordinary working conditions, work better than they were worked at Cambridge.

The next engine is that of Messrs. Crossley Brothers. This engine was illustrated in THE ENGINEER on the 30th June, 1893, page 575, and has since then been but slightly modified. It belongs to classes 4 and 6, the ignition tube being heated by a forced combination oil lamp fed by an air pump, and the flame from the same lamp is enclosed in a chimney which contains a coil or coil-like passage, into which oil is supplied by a hit-and-miss valve. Air is also admitted to this annular or coil passage, entering by passages in the top part of the annular chimney over the ignition tube flame. The important features of heated air admission to the oil to be evaporated and of vaporisation, independent of the fluctuations of the exhaust temperature, are thus secured. It seems to be thoroughly understood now that for clean and effective vaporisation and gasification, air, and preferably hot air, must be admitted with the oil to the hot retort or other vaporising surfaces. Messrs. Crossley use an ignition timing valve, and the engine is similar, but smaller, to that of the portable engine of which we gave an exterior view on page 540 of our issue of the 22nd ult. During one of their runs, the full power trial of two hours, the hit-and-miss actuated valve-rod was fouled by a temporary device for working a miss counter, and this made a stop necessary, but in other respects this engine worked well and the combustion was perfect. The consumption by this engine is given in the table, page 10.

The next engine in the shed is that of Messrs. Fielding and Platt. It belongs to classes 4 and 6, the vaporiser being of the form roughly indicated by the diagram,

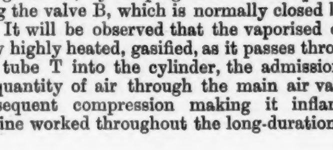
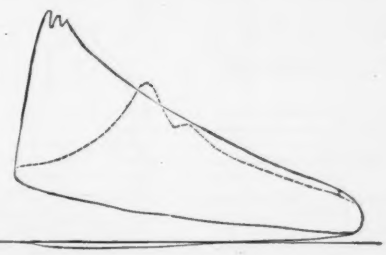


Fig. 3—FIELDING'S VAPORISER

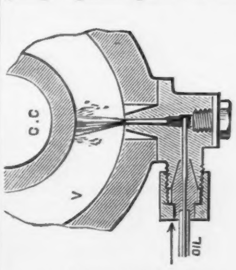
Fig. 3, in which T is an ignition tube heated by a lamp below, the same lamp flames heating the tube V above it, which acts as a vaporiser and is separated from the ignition tube during working strokes by the outwardly closing valve B. The apparatus is surrounded by a hood, as shown by the engravings on page 567 of our last issue. Governing is effected with a hit-and-miss and a rotating governor, by keeping the exhaust open and by actuating the valve B, which is normally closed by a coil spring. It will be observed that the vaporised oil from V is very highly heated, gasified, as it passes through the ignition tube T into the cylinder, the admission of the further quantity of air through the main air valve, and the subsequent compression making it inflammable. This engine worked throughout the long-duration trials; but the combustion was seldom satisfactory, and Mr. Fielding found that he could not get sufficient air to his lamp to maintain the required high temperature of the vaporiser and ignition tube. The effect of this may be seen in the diagrams of which the annexed sketch affords an illustration. The normal diagram of the engine and vaporiser is shown from memory in the full line



diagram, Fig. 5. The dotted line shows the sort of diagram that was being obtained, but generally the expansion line was higher than that of the proper diagram. The very late and slow ignition and burring being due to the cause mentioned. The engine ran the full-load two-hours' trial, but not the half-load and light runs. The alterations necessary to secure the required high temperature will probably be easily made.

Our notice of the remainder of the fixed engines entered for trial must remain until next week.

Messrs. Robey and Co.'s fixed horizontal engine, illustrated by the annexed engraving, is made under Bell and Richardson and Richardson and Norris's patents. It comes under classes 2 and 7, but it differs in principle from many of the others in the Show. The oil is injected under considerable pressure by a pump against part of the surface of the vaporiser, which is an extension of the back of the cylinder. It is of annular form, *i.e.*, one chamber, namely, the combustion chamber C C, inside another, with an intervening space V, but with a few holes in the wall of the inner chamber, so that it is connected for passage of the vapour with the annular space. The vapour is formed partly by the injection of the oil across the space V against the inner wall of the vaporiser, and partly by subsequent heating, at first by an exterior heating lamp, and afterwards by the internal heat due to combustion. At the rear end of the cylinder is a casting containing the main air admission valve. This and the arrangements for heating the vaporiser for starting are also seen in the illustration of the portable engine by the same firm—page 5. The pump which forces the oil into the jet piece, as indicated by the above sketch, is kept constantly at work, and the governor acts by causing all or none of the oil to be returned to the overflow tank. The hole through which the oil is sent in as a jet is a very fine one, and the constructors rely upon a combination of jet spray and surface vaporisation, the air passages being so made that a portion of the air passes over part of the heated surfaces and carrying the vapour with it. The vaporiser has been made in several forms, but the system of working remains the same as formerly, and is sufficiently indicated by the above sectional sketch. Messrs. Robey and Co.'s engines were not entered for the trials.



ROBEY VAPORISER

Messrs. J. and F. Howard entered an engine for trial, but were unable to get it ready in time for the Show We have not seen their engine yet, and the patents concerning it being in the early stages we are not much informed concerning it, but gather that it is of the vaporiser type without either jet, atomiser, or spray-maker.

The portable engine entered by the Clarke's Crank and Forge Company is of the vertical type, as shown by the engraving, page 7. The vertical form is said to be used to secure uniform wear of the piston, and a continuous lubrication of all internal parts. This is not, however, unattended by disadvantages. The engine is said to develope 9 brake horse-power, and has been made with alterations under Root's patents. Ignition is by tube, enclosed in and heated by the lamp which heats the vaporiser. Circulation is obtained in the water jacket by means of a pump worked from a rocking shaft at the back of engine, to which is also attached the oil feed gear and air pumps. The undercarriage is surmounted by a closed cab, the woodwork of which has been constructed in panels, so as to be easily removable at the will of the attendant. The centre panels are removed in the first of our illustrations. The engine was started, but the vertical form was soon seen to be very much against it for portable purposes, especially when worked on a piece of soft watery ground. We do not illustrate the engine in detail because we think that the makers will probably discard the vertical form of engine for the purpose as not suitable, especially with a single-cylinder four cycle engine. The trolley upon which it was placed is, moreover, obviously a first essay in this direction, and the arrangement which necessitates running fly-wheels in slots is dangerous as well as inconvenient for driving.

Messrs. Priestman exhibited a number of their well-known engines, but they made no entry for the trials. The engraving on page 5 is from a photograph of a 20-horse power engine, similar to one of four different engines they exhibited. The engraving shows the engine as it has been supplied for colliery purposes, with winding gear. Messrs. Priestman have, we understand, for some time past been turning their attention to oil engines of larger power. The engine illustrated has two cylinders, and therefore gets one impulse at every revolution of the crank. It is fitted with the self-starter, and with an electric igniter, which can be run, we are informed, from 500 to 800 hours without recharging, or any attention being given to the cells. We are not acquainted with the nature of the improvement by which this is effected, but it must be accepted as an important one for oil or gas engines using electric ignition, which will no doubt be more extensively used than hitherto for engines in towns. The arrangement of the engine and gear it drives is clearly shown by the engraving, and needs no description.

*To be continued.*

## THE R.A.S.E. OIL ENGINE TRIALS AT CAMBRIDGE—RESULTS.

*Trials of Oil Engines at Cambridge.*

| Fixed engines. | Duration of trial. | Diameter of cylinder. | Stroke. | Revolutions per minute. | Circumference of brake circle. | Net load. | Brake horse-power. | Oil used—lbs. Engine. | Oil used—lbs. Lamp. | Oil used—lbs. Total. | Oil used—lbs. Per B.H.P. hour. | Oil used—lbs. Per B.H.P. with lamp. | Brake H.P. represented by oil used running light. | Price. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hrs. | In. | In. | | Feet. | lbs. | | | | | | | | £ |
| 1. Britannia Company ... ... ... | — | 7·5 | 13·0 | — | 13·46 | — | — | — | — | — | — | — | — | 120 |
| Full load ... ... ... ... | 2 | — | — | 251·6 | — | 64·75 | 6·64 | — | — | 20·0 | — | 1·508 | — | — |
| Half load ... ... ... ... | 2 | — | — | 251·0 | — | 43·75 | 4·47 | 12·0 | 1·5 | 13·5 | 1·34 | 1·510 | — | — |
| Light ... ... ... ... ... | 4 | — | — | — | — | — | — | — | — | ‡5·75 | — | — | 0·95‡ | — |
| 2. Campbell Company ... ... ... | — | — | — | — | 14·27 | — | — | — | — | — | — | — | — | 110 |
| Full load ... ... ... ... | 2 | — | — | 202 | — | 51·4 | 4·48 | — | — | 10·75 | — | 1·20 | — | — |
| Half load ... ... ... ... | 2 | — | — | 203 | — | 31·0 | 2·74 | — | — | 7·0 | — | 1·36 | — | — |
| Light .. ... ... ... .. | 4 | — | — | — | — | — | — | — | — | 9·5 | — | — | 1·98 | — |
| 3. Crossley Brothers ... ... ... | — | 7 | 15 | — | 15·95 | — | — | — | — | — | — | — | — | 110 |
| Full load ... ... ... ... | 2 | — | — | 201 | — | 73·0 | 7·3 | 9·75 | 1·75 | 11·5 | 0·69 | 0·82 | — | — |
| Half load ... ... ... ... | 2 | — | — | 200 | — | 39·3 | 3·75 | 7·50 | 2·42 | 9·92 | 1·00 | 1·32 | — | — |
| Light ... ... ... ... ... | 4 | — | — | — | — | — | — | 6·25 | 4·50 | 10·75 | — | — | 3·29 | — |
| 4. Fielding and Platt ... ... ... | — | 7·75 | 14·0 | — | 15·8 | — | — | — | — | — | — | — | — | 150 |
| Full load ... ... ... ... | 2† | — | — | 156 | — | 78·5 | 5·88 | — | — | 28·0 | — | 2·38 | — | — |
| Half load ... ... ... ... | 2 | — | — | 172 | — | 45·75 | 3·76 | — | — | — | — | — | — | — |
| Light ... ... ... ... ... | 4 | — | — | — | — | — | — | — | — | — | — | — | — | — |
| 5. Richard Hornsby and Sons ... | — | 10·0 | 15·0 | — | 14·95 | — | — | — | — | — | — | — | — | 160 |
| Full load ... ... ... ... | 2 | — | — | 238 | — | 78·5 | 8·47 | — | — | 16·75 | — | 0·98 | — | — |
| Half load ... ... ... ... | 2 | — | — | 236 | — | 42·0 | 4·48 | — | — | 13·56 | — | 1·51 | — | — |
| Light ... ... ... ... ... | 4 | — | — | 207 | — | — | — | — | — | 13·7 | — | — | 3·50 | — |
| 6. Wells Brothers... ... ... ... | — | 8·25 | 15·0 | — | 16·25 | — | — | — | — | — | — | — | — | 112 |
| Full load ... ... ... ... | 2 | — | — | 163 | — | 82·25 | 6·62 | 13·75 | 1·50 | 15·25 | 1·036 | 1·15 | — | — |
| Half load ... ... ... ... | 2 | — | — | 161 | — | 44·0 | 3·50 | 10·0 | 1·60 | 11·60 | 1·43 | 1·66 | — | — |
| Light ... ... ... ... ... | 4 | — | — | 164 | — | — | — | — | — | — | — | — | 2·5 | — |
| 7. Weyman and Hitchcock... ... | — | 6·75 | 13·0 | — | 14·39 | — | — | — | — | — | — | — | — | 125 |
| Full load ... ... ... ... | 2 | — | — | 262 | — | 44·0 | 4·95 | 10·25 | 1·0 | 11·25 | 1·02 | 1·12 | — | — |
| Half load ... ... ... ... | 2* | — | — | 267 | — | 22·0 | 2·56 | 6·75 | 0·875 | 7·625 | 1·32 | 1·490 | — | — |
| Light ... ... ... ... ... | 4·16 | — | — | 264 | — | — | — | — | — | 9·75 | — | — | 2·16 | — |

* This engine ran the half load trial twice; the figures given are those of the second run.
† This engine was out of adjustment, and the consumption cannot be taken as a guide.
‡ This quantity needs confirmation.

*Trials of Portable Oil Engines.*

| Name of maker, &c. | Duration of trial. | Diam. cylind'r | Stroke. | Revolutions per minute. | Circumference of brake circle. | Net load. | Brake H.P. | Oil used. Engine. | Oil used. Lamp. | Oil used. Total. | Oil per B.H.P. | Brake H P. represented by oil used run'ing light |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hours. | | | | | lbs. | | lbs. | lbs. | lbs. | lbs. | |
| 1. Campbell Gas Co.... ... ... | — | 8·5 | 16·0 | — | 14·0 | — | — | — | — | — | — | — |
| Full load... ... .. ... | 2 | — | — | 182 | — | 125·5 | 9·7 | — | — | 19·0 | 0·98 | — |
| Half load ... ... ... | 2 | — | — | 185·8 | — | 63·0 | 4·97 | — | — | 11·25 | 1·13 | — |
| Light ... ... ... ... | 4 | — | — | 190·7 | — | — | — | — | — | 12·0 | — | 3·07 |
| 2. Crossley Brothers... ... ... | — | 8·5 | 18·0 | — | 15·75 | — | — | — | — | — | — | — |
| Full load... ... ... ... | 2 | — | — | 207·0 | — | 101·4 | 9·95 | 16·0 | 2·0 | 18·0 | 0·90 | — |
| Half load ... ... ... | 2 | — | — | 214·0 | — | 49·4 | 5·03 | 17·50 | 2·25 | 19·75 | 1·97† | — |
| Light ... ... ... ... | 4 | — | — | — | — | — | — | 12·5 | 5·5 | 17·58 | — | 4·75 |
| 3. Clark, Chapman, and Co. ... | — | 10·125 | 16·0 | — | 15·83 | — | — | — | — | — | — | — |
| Full load... ... ... ... | 2 | — | — | 193 | — | 150·2 | 13·95 | — | — | 34·18 | 1·22 | — |
| Half load ... ... ... | 2 | — | — | 186 | — | 76·6 | 6·82 | — | — | 18·75 | 1·37 | — |
| Light ... ... ... ... | 4 | — | — | 187 | — | — | — | — | — | 28·42 | — | 5·82 |
| 4. Richard Hornsby and Sons... | — | 12·0 | 16·0 | — | 13·48 | — | — | — | — | — | — | — |
| Full load... ... ... ... | 2 | — | — | 196·5 | — | 131·6 | 10·52 | — | — | 24·25 | 1·15 | — |
| Half load ... ... ... | 2 | — | — | 199·0 | — | 63·7 | 5·98 | — | — | 14·50 | 1·21 | — |
| Light ... ... ... ... | 4 | — | — | — | — | — | — | — | — | 19·75 | — | 4·30 |

† Exceptional; engine out of adjustment.

---

## A NEW MECHANICAL FLUID.*

By Charles Wallace Hunt, New York City.

A hydraulic piston for adjusting journal boxes to take up the wear from use would have the desirable features of delicacy of adjustment and ample rigidity for any strain which it would be called upon to sustain. The cost of the accurate construction needed and the probable leakage of the fluid would usually prevent serious consideration of this method.

In canvassing the various methods of adjustment which could be used in the bearings of the connecting-rods of our steam engines, the advantages and faults of this method were carefully investigated. The inevitable leakage of the liquid presented an almost insurmountable barrier to its use. The thorough examination of its availability for this purpose, however, brought to mind the method of packing the plungers of mine pumps used by Mr. Eckley B. Coxe, which has since been presented to this society in a discussion of topical questions at the New York meeting, December, 1893.† This method was to fill the spaces for the packing material around the plunger with untried tallow, cut in pieces about an inch across, and kept under sufficient pressure to make it flow into the packing spaces. The tallow packing also lubricated the piston, and as it was gradually worn away, the membranes in the tallow were too large to pass between the plunger and its casing, and remained, forming under the pressure a mass of semi-fluid packing. If we consider this material as a fluid, we can conceive of it as a liquid with masses of animal membranes for atoms, instead of the usual conception of atoms of infinitesimal size.

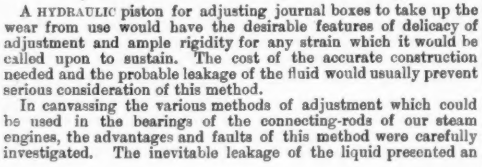


FIG. 1

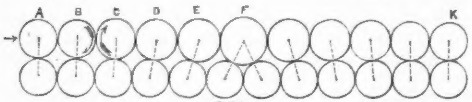


FIG. 2

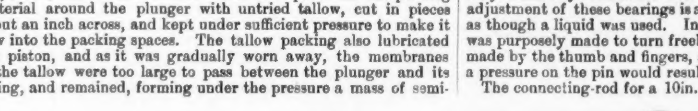


FIG 3.

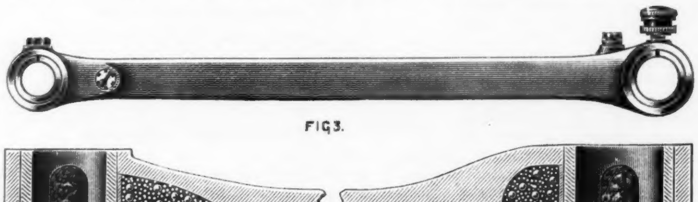


FIG 4.

After making this wide departure from our ordinary conceptions in molecular physics, we can take a further step by imagining a liquid which was composed of atoms as large as bicycle bearing-balls. The anticipated trouble from the leakage of the fluid would then disappear as a factor in the ordinary mechanical fitting in steam-engine work.

If the balls of this hypothetical fluid vary in size, their mutual pressures may be supposed to balance each other somewhat as shown in Fig. 1. The lower balls are of equal size, and the upper ones of varying diameter. The ball A is placed directly over the centre of the lower ball, and has no tendency to move in either direction, but the balls B, C, D, E, and F are each larger than the preceding ball, and each one rests upon the inclined surface of a supporting ball, all together throwing a horizontal pressure on the ball F. A similar series of balls is shown on the opposite of the ball F, and the whole system of balls from A to K is in equilibrium, with no tendency to move. The whole system, however, is in a position of unstable equilibrium, and will move if the lightest pressure is applied to the ball A in the direction of the arrow. If the balls were infinite in number, and the size limited, but with an infinite number of variations of diameter within the limits, the various local pressures would be balanced, and the mass would have the mobile property of a liquid.

The actual movement of the upper system of balls would result in a movement of revolution in each of the balls. Assuming that the friction of the lower ball would cause each one of the upper balls to revolve, the surfaces in contact in the upper system would move in opposite directions, as shown by the arrows in the balls B and C. This friction would depend upon the material, the smoothness of the surfaces, and the lubrication of the balls, and can be likened to that property of a liquid which is known as viscosity.

Under compression each ball of a mass of various sizes would have the resultant of all the pressures on it at its centre, and consequently would be in a position of equilibrium; but should the enclosing envelope change in form of capacity, a change in the direction of the pressures would take place; first, in the balls nearest to the movement, then in the adjoining ones, the balls severally moving in the direction of least resistance, until the resultant of the pressures again came in the centre of each ball.

If the mass of balls were all of one size, they would interlock in a manner analogous to the illustration in Fig. 2, where a series of balls is shown, with a set of the same size resting upon them, interlocked in the spaces of the lower set. If a pressure in the direction of the arrow is applied, it must raise each ball, and the pressure required would be in proportion to the distance or to the number of balls moved. This rigidity resembles the property of a solid.

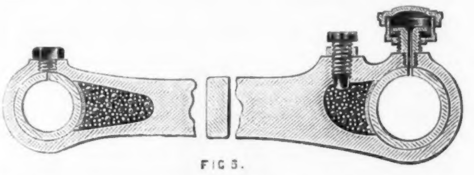


FIG 5.

If these balls of equal size had different coefficient of expansion by heat, it could be imagined that at some higher temperature these balls would become of different sizes, when they would cease to interlock, the mass becoming a fluid above that temperature, a property analogous to the melting point of a solid.

If the balls had different coefficients of compressibility, a great pressure on the mass might change the relative diameter of the balls enough to change the solid mass to a fluid.

A mass of balls of various sizes, under pressure, does act like a liquid, as we have ascertained by testing in various ways. On the table, at the reading of the paper, is to be found a connecting-rod of full size fitted up to be adjusted in this manner, just as it is used in practice, and also a model with a glass front and a spring piston, which permits the individual motion of the steel balls to be seen when the adjusting screw is turned. The mass is kept mobile by putting sufficient pressure on the movable piston.

Fig. 3 is an elevation, and Fig. 4 is a cross section of a solid-end connecting-rod, having an annular brass bushing with an opening, in order that adjustment for wear can be made. One side of the bushing is held in place and adjusted by the pressure of a mass of hardened steel balls, varying in diameter from ⅛in. to ¼in. Between the bushing and the balls is a thin plate of hardened steel, to prevent the balls from indenting the softer metal. The adjustment for wear is made by forcing the mass of balls forward with a hardened steel adjusting screw—Fig. 5.

When the wear has become so great that the range of the adjusting screw has been exhausted, a few more balls are inserted under the point of the screw, and an adjustment of the bearing made as before. On the crank end of the rod, the adjusting screw is on top, but on the crosshead end it is on the front side, clear of the crosshead, where the adjustment is as conveniently made as it is on the crank end.

We have been running last year forty bearings of this type in various places, in the East and in the West, working with steam boiler pressures of from 80 lb. to 160 lb., giving pressures per square inch of projected area of the pins ranging from 600 lb. to 1000 lb. The pressure on the balls per square inch is about 50 per cent. greater. If we assume that the balls are about ⅛in. in diameter, and that sixty balls are in contact with the bushing on each square inch, the pressure sustained by each ball would be from 15 lb. to 25 lb. Assuming that the elastic limit of the steel in the connecting-rod shown is 30,500 lb. per square inch, and that the hardened steel balls have a pressure of 25 lb. on each one, we would expect that each ball would embed itself in the steel envelope until the area sustaining the pressure was strained to the elastic limit. This area would be $\frac{1}{1275}$ of a square inch for each ball, which is almost exactly equal to the area of a circle $\frac{1}{100}$in. in diameter. At first the bearings require frequent adjustment, but the balls soon get in a fixed position, and then they need adjustment for the wear of the bushing only. The adjustment of these bearings is apparently as delicate and positive as though a liquid was used. In cases where the adjusting screw was purposely made to turn freely, the adjustment could easily be made by the thumb and fingers, and if care was not used too great a pressure on the pin would result.

The connecting-rod for a 10in. diameter cylinder steam engine here shown is a steel casting made by I. G. Johnson and Company, fitted with an adjusting screw having fourteen threads to an inch, and a pressure area of balls on the bushing eighteen times the area of the screw. If the screw is turned with a force of 25 lb. on an 8in. wrench, the friction of the screw absorbing 25 per cent. of the force, the pressure on the bushing would be over 50 tons. While this pressure might be used in other applications of this novel fluid that have been proposed, it was clearly out of place in connecting-rod bearings, and we now make the head of the adjusting screw of such a form that an ordinary wrench cannot be used, and the adjustment made only by a spanner which will, by its peculiarity, remind the engineer that care is necessary in the adjustment.

---

While surveying for the Chittagong-Akyab-Minhla Railway, in Burmah, large quantities of coal have been discovered in the vicinity of the operations.

---

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

† "Transactions American Society of Mechanical Engineers," vol. xv., page 599.

## RAILWAY MATTERS.

The work of the new Electric Railway between the City and Waterloo Station has already been commenced by the contractors, Messrs. John Mowlem and Co., who seem to be losing no time.

The United States Government has issued an order that all the rolling stock of the railway companies in Uruguay is to be fitted with the vacuum brake in such a way as will allow of the interchange of the stock over the whole system of railways in that State.

A serious accident on the B. and N.-W. Railway, India, was attributed to the rails having expanded from the intense heat of the weather. The engine of a goods train was thrown off the line, the fuel caught fire, and the guard's van was burnt. The line was blocked for several hours.

The Kolar Goldfields Railway was handed over to the Madras Railway Company on the 1st instant. It starts at Bowringpett and runs through the mining camps of Balaghat, Oorgaum, the Champion Reefs and the Mysore Company, being ten miles long. It is expected that the line will greatly facilitate the working of the Mysore goldfields. Four trains run to and fro daily.

The survey of the Nong Khai Railway is progressing favourably, and it will probably be completed this month. Throughout the length of the line easy gradients prevail, and, on the whole, the undertaking promises to prove very cheap. One drawback to be contended with is the scarcity, during the dry season, of water for the locomotives. This difficulty, however, is to be overcome either by sinking wells or by leading water by conduits from the adjacent mountains.

The directors of the Midland Railway purpose erecting, in Sheffield, works for the manufacture of oil gas. The oil is distilled from shale found in Scotland, and the gas made from it is capable of compression—which ordinary coal gas is not. The advantage is, that a large quantity of oil gas can be stored for use in the train. The company have found electricity too costly. They have started an oil gas factory at Derby, and intend constructing others in large centres such as Sheffield and Nottingham.

The proposed extension of the Salonica-Monastir Railway to the Adriatic has been abandoned, the Italian engineers who surveyed the country to be traversed by the proposed line having reported unfavourably. The expense of construction would be more than double that of the Salonica-Monastir section, viz., £16,083, against £7269 10s. per mile for the latter, and would necessitate the increase of the guarantee sought from the Government from £933 to £1930 per mile. The Acting British Consul-General at Constantinople regards the revival of the scheme in some shape as inevitable.

The railway from Manila to Dagupan continues to work well, and is very beneficial to cultivators in the neighbourhood of the line. The iron bridge over the Rio Grande, 492ft. long in three spans, has been recently opened, and will be of great benefit both to the country and line; the transport across the river hitherto having been made by ferries and temporary bridges, the latter of which have been twice swept away. The obstacles to erecting the new bridge were chiefly caused by the difficulty of finding a bottom to the river for sinking the caissons. A new line has been resolved upon from Manila to Batangas, and the Dagupan line will probably be extended to the province of Ilocos in the north, with which communication is very difficult.

The directors of the Midland Railway Company have accepted the tender of Mr. Scott, railway contractor, Newcastle, for the construction of a new railway from Chapletown to Ardsley. The line, starting from a point north of Chapeltown, forms a junction with the new Midland Railway from Wincobank to Chapeltown, and will pass between the Thorncliffe Ironworks and Chapeltown Works, continuing through a tunnel under the village of Warren and the Dolphin Wood, and emerging near Hood Hill. The route is then by Lidgett Colliery on to Wombwell, and from thence to Ardsley, joining the company's present system at that point. The length of line is about ten miles, and the cost estimated at £420,000. Double lines will be laid throughout.

A Board of Trade inquiry respecting the condition of the tramway in Uxbridge-road, in the parishes of Hammersmith and Acton, was resumed by Major-General Hutchinson at the Vestry Hall, Hammersmith, yesterday. The inquiry was held on the application of the Hammersmith Vestry and the Acton Local Board, and the evidence on their behalf was completed yesterday. Several witnesses expressed the opinion that the immediate reconstruction of the line was essential. In the course of the inquiry, the *Times* says, it was stated that a contract with respect to the undertaking, which is the property of the West Metropolitan Tramways Company, had been entered into, subject to the approval of the Court of Chancery. By this contract a purchaser agreed to reconstruct the line and alter it from a single to a double line, an outlay of from £25,000 to £30,000 being involved. The inquiry was further adjourned.

In Switzerland there were in operation at the close of 1893 2221 miles of railroads, of which 1860 miles were standard gauge and 277 miles narrow gauge there were forty-eight miles of rack railroads, twenty-six miles of street railroads, and ten miles of cable roads. There were under construction 156 miles of railroads. On the five principal lines 41 per cent. of the ties are of iron, 14 per cent. of oak, and 45 per cent. of other woods. Of the rails 75 per cent. are of steel, and 25 per cent. of iron. The rolling stock consists of 932 locomotives, 6417 passenger cars, 1263 baggage and mail cars, and 1887 freight car axles; the cars, which have partly two, partly three axles, being counted thus: Eighty-five per cent. of the locomotives, 67 per cent. of the passenger cars, and 78 per cent. of the baggage and mail cars are equipped with continuous brakes, and 59 per cent. of the cars are heated by steam. The *Railway News* says that in the latter part of last year a conference took place between the Jura Simplon Railroad and the contractors of the projected Simplon Tunnel, at which it was resolved to submit the new plans to an expert examination.

The Hawkesbury Railway Bridge which spans the "Australian Rhine," near Sydney, is said to be the largest of its kind in the Southern Hemisphere, and, as regards its foundations, one of the most remarkable in the world. The actual length of the bridge between the abutments is 2900ft., and it is supported by six piers, each resting on a caisson filled with concrete, and forming the most solid foundation possible. One caisson is 162ft. deep. The method of construction employed displayed considerable ingenuity. Each span was constructed on a large pontoon, 335ft. long, 61ft. wide, 10ft. deep, and provided with staging sufficiently strong to bear the whole weight of the immense mass of iron work, and high enough to enable the span on the pontoon being floated at high water into position, to clear the tops of the opposite piers, on which the girders rested when finally in place. *Indian Engineering* says that when the pontoon, which was provided with forty-four water-tight compartments, was complete with its staging, it was towed over a gridiron of piles and sills, in shallow sheltered water, and sunk, the exterior and interior valves being all left open, so that the water ran freely in and out at all tides. After the span was ready, the valves were closed, the water pumped out, and as the tide rose the pontoon floated and was towed into position between the two piers on which the span was intended to rest. As the tide fell, each end of the span descended into its proper place, and the pontoon and staging, released from its ponderous load, floated back to the gridiron.

## NOTES AND MEMORANDA.

Prometheum or titan metal, a new alloy containing 60 per cent. of copper, 38 per cent. of zinc, and 2 per cent. of aluminium, is said to possess a remarkable degree of resistance. A small quantity of sodium is added to the molten mass when being cast.

Gold occurring in a soft matrix is often distinctly crystallised, as also when it has been formed in a cavity whatever the nature of the veinstone. But, says the *Journal* of the Society of Chemical Industry, the gold contained in massive quartz as a rule is not crystallised, as may be seen by dissolving the silica away by hydrofluoric acid.

The transformers at the power transmission plant of the Oerlikon Electrical Works are interesting from the fact of their having an oil circulation. Taking the average load on each transformer as 170 kilowatts, and allowing a loss in conversion of 2 per cent., some 3·4 kilowatts is being lost, appearing as heat. In order to dissipate this heat, the oil is circulated through serpentine tubes immersed in a tank through which there is a constant flow of cold water. The circulation is effected with a pump.

Recently an experiment was made in America of casting concrete casings round piles for the purpose of resisting the attacks of the teredo insect. Iron tubes were clamped round the piles and driven to a depth of 12in. or so below the water bottom. The water inside the tube was then pumped out, and the space filled in with a mixture of one part Portland cement, two parts sand, and three parts gravel, well diluted. After three years some of these casings have been examined, and they are as hard as stone.

The sewerage system of Berlin, Germany, had a total length of 452·112 miles, of which 89·333 miles were brick sewers. It will doubtless be recalled that Berlin is sewered on the radial system, there being twelve sectors, from each of which a main sewer is to lead to one of the sewage disposal farms about the city. The *Engineering Record* says the first sector was finished in 1876, and eleven were completed by the close of 1893. On April 1st, 1894, there were 23,302 separate properties connected with the system, and the total area drained was about 13,815 acres, with about 1,600,000 inhabitants.

The mean daily motion of the air in 1893, as measured at Greenwich, was 270 miles, being eleven miles below the average of the previous twenty-six years. The greatest daily motion in the twelve months ending April 30th, 1894, was 942 miles on February 11th, and the least was forty miles on July 15th. The greatest pressure registered was 37 lb. on the square foot on December 12th, being the greatest which has been registered since the substitution of the flexible chain for the stiff copper connecting wire in 1882. The greatest pressure previously recorded was 31 lb. in March, 1888. A pressure of 35 lb. was recorded on February 11th.

During the twelve months ending April 30th, 1894, the highest air temperature in the shade at the Greenwich Observatory exceeded 80 deg. on twenty-eight days. It was 91 deg. on June 19th, 93 deg. on August 16th, 94·2 deg. on August 17th, and 95·1 deg. on August 18th. In the fifty-three years since 1841, higher temperatures have been recorded only twice previously—on both occasions in July. The lowest was 12·8 deg. on January 5th, the maximum on that day being only 19 deg., and the mean daily temperature 15·9 deg. The mean temperature on August 18th was 79·6 deg., being the highest mean value recorded in August since 1841. The mean temperature of January 5th was lower than any previously recorded since 1841, with two exceptions. The mean monthly temperature was above the average in all months excepting September, November, and January, 1894. In May it was 4·6 deg., in August 3·9 deg., in March 2·7 deg., and in April 3·8 deg. above the average. In November it was 1·5 deg. below the average.

The working of amber in Burma, the only locality in the Indian Empire where it is known with certainty to exist, is described in the *Times* as follows. By some superstitious rite a lucky place to dig is selected and a shaft made about 70ft. or 80ft. deep. If a vein is struck a side passage is made tracing it; at certain points lumps are found which are alleged to reach 1000 lb. in weight. A shaft is usually dug over these lumps, and the amber is extracted and sawn into the required sizes. A variety of amber used to be sold by the miners to the Chinese, and taken to China for use in making medicine. It is said that the mines were nearly exhausted many years ago. They are at present worked in a fitful and haphazard manner by the Kachins. A stone known in commerce as jade is extensively worked in certain districts of Upper Burma. Its colour varies from nearly gray to dark green. It is in universal demand throughout China. A variety highly prized by the Chinese is pale gray with bright apple-green spots, clouds, and veins. A block of less than a cubic yard in size was some years ago valued at £10,000 in Rangoon, and the Chinese are said to have offered £8000 for it. The Bhamo jade-producing country is far more important. It may be described as the district lying between the 25th and 26th parallels of latitude and shut in by the Chindwin and Mu rivers on the west and east respectively.

A paper on "The Isothermals of Ether" was recently read before the Physical Society by Mr. Rose Innes. Taking the important linear law $p = b\,T - a$ connecting the pressure and temperature of substances—liquid and gaseous—at constant volume, given by Ramsay and Young—*Phil. Mag.*, vol. xxiii., page 436—and subsequently confirmed by Amagat and Tait, the author has endeavoured to express the constants $b$ and $a$ in terms of the volume $v$. Using the results of Ramsay and Young's experiments on ether, because they extended over a large range of volume—1·9 to 300—the following formulæ were found to give the best approximation, viz.:—$b = \dfrac{751\cdot9}{v - 0\cdot9173\, v^{\frac{2}{3}}}$ and $a = \dfrac{23,300,000}{v^2 + 11\cdot05\, v^{\frac{5}{3}}}$. Tables of curves accompanying the paper showing that for volumes between 6 and 300 the agreement of calculated and observed values of $p$ do not differ more than can be accounted for by errors of experiments. For volumes less than 5 the formula for $p$ gives numbers quite wrong. In searching for a physical basis for the expressions for $b$ and $a$, the author puts $l^3$ for $v$ in the above formulæ, $l$ being the side of a cube whose volume is $v$. The expression for $p$ then becomes

$$p = \frac{R\,T}{l^3 - c\,l^2} - \frac{A}{l^6 + h\,l^5} \quad . \quad . \quad (3).$$

Writing the coefficient of T in the form $\dfrac{R}{l^3} \cdot \dfrac{l}{l - c}$, the author showed that this form might be expected if the molecules had finite dimensions, for the number of impacts on the faces of a cube would be increased in the ratio $\dfrac{l}{l - c}$, where $c$ is a quantity depending on the size of the molecules. Ingenious arguments suggested by Van der Waal's remark that his formula must not be pushed beyond the point where the actual volume is less than eight times the volume of the molecules, led the author to infer that for ether this limiting volume is somewhat above 6. Hence he would not expect his—Mr. Rose Innes'—formula to hold below this volume. The formula for $a$, the "internal pressure," is explained as a supposition that a "skin" effect exists between the matter of the vessel and the boundary layers. By clearing expression (3) in fractions, the author showed that the shapes of the isothermals are represented by an equation of the seventh degree in $l$, which cannot have more than three positive roots, and thence infers that isothermals are not necessarily represented by cubic equations as is sometimes assumed.

## MISCELLANEA.

A Board of Engineers has been appointed by President Cleveland to report on "What length of span, not less than 2000ft., would be practicable and safe for a bridge over the Hudson River at New York."

We read of a curious explosion on a locomotive. An engine driver was blown off his engine on the Great Western Railway, near Leamington, by the bursting of a hot water pipe. He died on the way to Leamington.

The new U.S. cruiser Minneapolis, sister ship of the Columbia, on her preliminary trial, burning anthracite coal, made 21·75 knots, as against the Columbia's 20·98 knots on her trial. This would indicate that she will surpass the 22·87 knot record of the Columbia.

The works in connection with the utilisation of the power of the Granier Falls, near Chambéry, are being pushed forward. A head of 2000ft. is available, which will yield 13,000 to 14,000-horse power. It will provide current for the electric lighting of Chambéry and intermediate localities.

Messrs. Siemens Brothers telegraph that the steamer Faraday completed the laying of the Commercial Cable Company's third Atlantic cable on Monday last. The insulation is perfect. During the laying of the cable no hitch of any kind has occurred, but operations have been much impeded by dense fogs.

We are informed that Messrs. J. P. Hall and Co., Blackriding Ironworks, Werneth, Oldham, have just satisfactorily completed electric light installations for the Manchester Ship Canal Company at the locks at Barton, Irlam, and Latchford. The installations each comprise arc lamps, dynamos, steam engines, boilers, &c.

Trials have recently taken place in Munich of a new bullet-proof cuirass, invented by a Hamburg armourer, Wilhelm Weber. The cuirass was fired at with a service rifle at a distance of ten paces, the bullets being shattered into small fragments. The cuirass weighs 11 lb., but the inventor states that it can be safely reduced to 8 lb.

The growth this year of gold production in Colorado is shown by the statements of the Denver Mint. In spite of the troubles at Cripple Creek the gold receipts for the month of May amounted to 431,934 dols., as compared with 99,786 for May, 1893—that is, they were considerably over four times the amount reported last year.

We are sorry to hear that the Woolwich Polytechnic is to be closed, in consequence of "financial difficulties." The handsome building was only erected two or three years ago, at an enormous expense. The trustees state that as they have themselves undertaken to be responsible for the liabilities of the institute, the debts will be paid in full.

We have received the second supplement to Sell's Telegraphic Directory of 1894. It contains some thousands of new registrations, cancellations, and other alterations effected during the quarter, and is sent free to all subscribers. Firms who have purchased the directory, and who desire to have sent to them these supplements, have only to notify their addresses to Mr. Sell.

We have received a geological sketch map of Western Australia, which should be useful to intending emigrants. The colouring shows at a glance the superficial composition of the earth, small patches indicating the presence of gold, copper, lead, tin and coal wherever they occur, according to the observations of H. P. Woodward, F.G.S., F.R.G.S. The map is compiled and published by Geo. Philip and Son, Fleet-street, London.

We have received a small two-page set of trigonometrical tables and formulæ, with explanations by sin. and cos. only. It is entitled "Trigonometry in a Nutshell," is handy in form, and can be easily carried in the pocket. The table gives the natural sines and cosines for every degree in the quadrant, and should be useful to many. It is arranged by Mr. W. H. Bidder, and is published by Messrs. Gale and Polden, Paternoster-row.

The Patent Equilibrium Piston Company, Cardiff, are making a piston on the principle of admission of steam to both sides of the packing rings. This is done by means of perforations in the top and bottom flanges of a carrier ring, through which the steam passes to both sides of the ring. Two rings are necessarily employed—which exert themselves alternately—that is, the ring next the side of the piston taking steam is always expanded by the pressure on that side, being released as soon as the return stroke is commenced.

In a resolution passed on the 4th inst. by the Hornsey Local Board accepting the resignation of Mr. Thomas de Courcy Meade, M.I.C.E., on his appointment as chief surveyor of Manchester, it was mentioned that during the thirteen years he has been engineer for the Hornsey Local Board the death-rate in the last ten years had been reduced from 13·6 per thousand inhabitants to 11·33, notwithstanding its immense growth and development. Mr. Meade's work had included many engineering and architectural works of considerable importance, and these, with the making of many miles of roads and works of sewerage, are represented by an expenditure of about half a million of money.

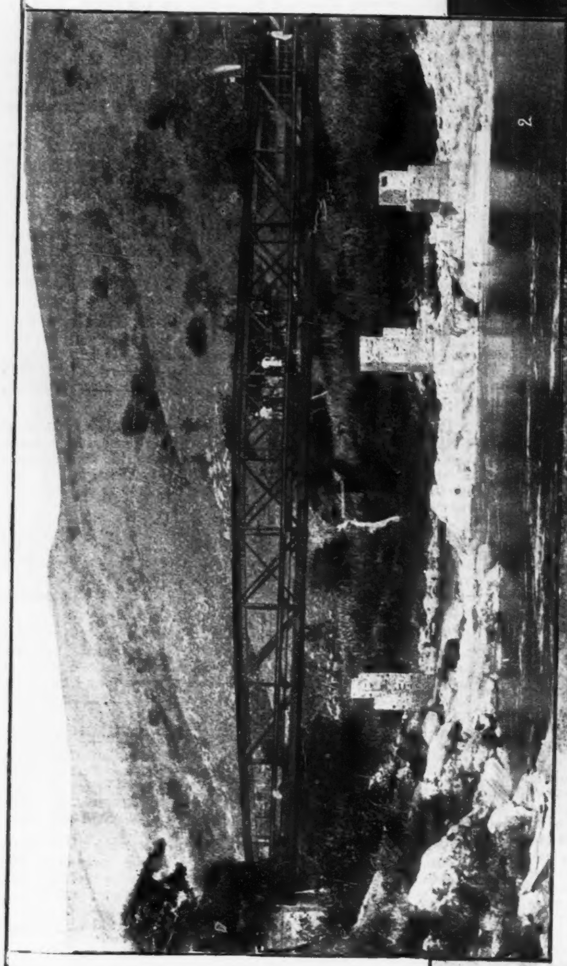
A thermometer for measuring very high temperatures is described in *La Nature*, the peculiarity of which is that quicksilver is replaced by a liquid alloy of sodium and potassium. The boiling point of this alloy is about 700 deg. C., and its freezing point is −8 deg. The graduation is made only from 200 deg. up to avoid the great length of tube which would otherwise be necessary. In taking temperatures it is necessary to heat only the reservoir and a small part of the tube, because there is a slight increase in the coefficient of expansion of the alloy as the heat increases, which will compensate for any error due to the lower temperature of the protected part of the tube. The thermometer has been designed by MM. Baly and Charley.

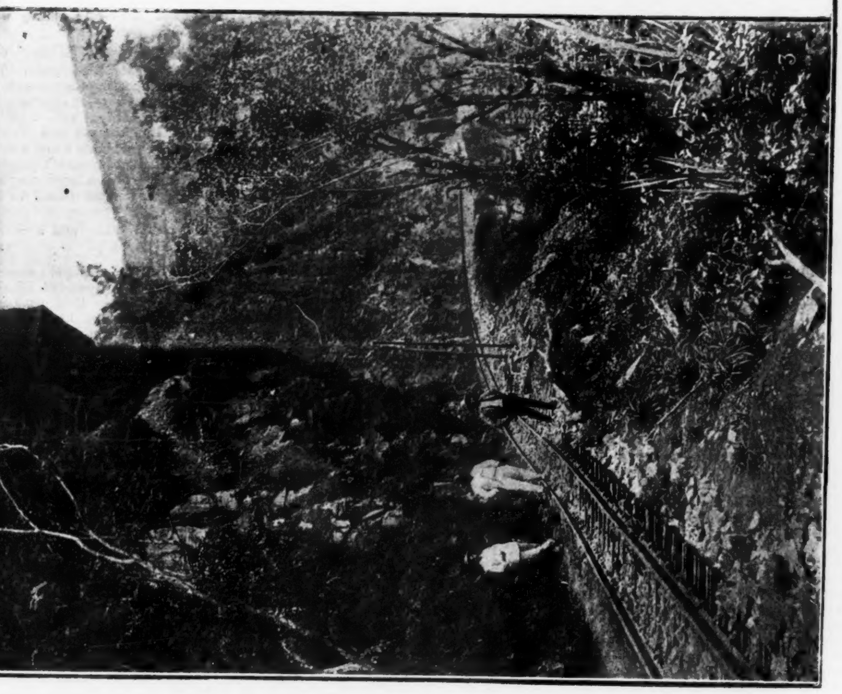
Large irrigation works are to be built in the Rio Verde Valley of Arizona by the Rio Verde Canal Company. The *Engineering Record* says that the contracts for the construction, which amount to about 2,000,000 dols., have been let to Langdon, Linton and Co., of Minneapolis, Minn., who say that about 110 miles of canal work will be done about Storage, a 150ft. dam will be built at the Horseshoe Bend of the Rio Verde, forming a reservoir of 205,000 acre-feet capacity, and a diversion weir will be built across the same stream about twelve miles from Mt. Dowell. Work will begin in a short time, and is to be completed in about eighteen months. About 400,000 acres of land will be irrigated by the system when complete.

Mr. Hall, the Inspector of Mines for the Liverpool district, states, in his report for 1893, that of the whole of the dusts tested, that from the Albion Colliery—Aberdare or Merthyr 4ft. seam or upper 4ft.—excels all others in violence and sensitiveness to explosion. He adds that this seam had the worst history of any in the kingdom, upwards of 1600 persons having been killed in it by explosions since the year 1845; indeed, "throughout the experiments one could not fail to be struck by the great violence and sensitiveness to explosion exhibited by the samples received from collieries with an unfortunate history as regards explosions." Mr. Hall's conclusions are dated August 20th, 1893, so that there was a delay of over three months in bringing the matter to the notice of the Home Office. The report was made "by desire of the Secretary of State to the Royal Commission on Explosions from Coal Dust in Mines."

## VIEWS ON THE CONGO RAILWAY

*(For description see page 13)*





## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

## CONTENTS.

THE ENGINEER, July 6th, 1894.

THE ANTWERP EXHIBITION—THE MARITIME SECTION. No. I. (Illus.) 1
NEW WAREHOUSE SHEDS FOR THE MANCHESTER AND SALFORD DOCKS 2
THE DIRIGO. (Illustrated.) .. .. .. 3
HARBOURS AND WATERWAYS .. .. .. 3
THE MAGNIFICENT AND MAJESTIC. (Illustrated.) .. .. 4
GAINSBOROUGH WATER SUPPLY .. .. .. 4
OLD ROMAN PUMPS. (Illustrated.) .. .. 4
NEW RUSSIAN STEEL SHOT .. .. .. 5
THE RESISTANCE OFFERED BY CURVES ON RAILROADS .. .. 6
EMIGRATION PROSPECTS .. .. .. 6
OIL ENGINES AT THE R.A.S.E. SHOW. (Illustrated.) .. .. 7
A NEW MECHANICAL FLUID. (Illustrated.) .. .. 10
RAILWAY MATTERS—NOTES AND MEMORANDA—MISCELLANEA .. .. 11
LEADING ARTICLES—The Railway Strike in the United States—Metropolitan Water Schemes .. .. .. 13
Absolute Zero—Tyne Dues and Steamers—The Water Supply of Paris .. .. .. 14
The Scotch Oil Trade—Mr. Ludwig Mond and the Royal Institution—Mining in Yorkshire and Lincolnshire .. .. .. 15
LITERATURE .. .. .. 15
THE TOWER BRIDGE .. .. .. 15
PARLIAMENTARY NOTES .. .. .. 15
THE ROYAL AGRICULTURAL SOCIETY'S SHOW. (Illustrated.) .. .. 16
HYDRAULIC POWER SUPPLY FOR GLASGOW .. .. .. 16
THE EYEMOUTH RAILWAY. (Illustrated.) .. .. .. 17
THE CONGO RAILWAY. (Illustrated.) .. .. .. 18
LETTERS TO THE EDITOR—Entropy Diagrams—Carnot and Modern Heat—The Kinetic Theory of Gases—The Latent Heat of Steam Steamship Propulsion—Stress in Crane Hooks—Engineering as a Profession .. .. .. 19
The Projected Tower Bridge of the Year 1824 .. .. .. 20
AMERICAN ENGINEERING NEWS .. .. .. 21
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. .. 20
The Sheffield District—The North of England .. .. .. 20
Notes from Scotland—Wales and Adjoining Counties—Germany .. 22
LAUNCHES AND TRIAL TRIPS .. .. .. 23
THE PATENT JOURNAL .. .. .. 28
SELECTED AMERICAN PATENTS .. .. .. 24

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. S. (Stockport).—*Letters addressed in accordance with your postcard have been sent you and returned through the Post-office. Send proper address.*

J. R. (Birmingham).—*The application must be made within seven months of the application for protection in the country in which the protection has been first secured. It does not, however, make it necessary that you should file a complete specification as early as you mention, and the publication of your invention here within the seven months does not invalidate your claim abroad in the countries within the International Convention.*

### SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

THIN PAPER COPIES—
*Half-yearly* .. .. £0 18s. 0d.
*Yearly* .. .. £1 16s. 0d.
THICK PAPER COPIES—
*Half-yearly* .. .. £1 0s. 8d.
*Yearly* .. .. £2 0s. 6d.

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

### MEETINGS NEXT WEEK.

LIVERPOOL ENGINEERING SOCIETY.—Friday, July 13th. Excursion to the Hydraulic Power and Electric Lighting Stations of the Manchester Corporation, by kind permission of the respective Committees, Mr. F. M. Evanson, Assoc. M. Inst. C.E., and Mr. C. H. Wordingham, Assoc. M. Inst. C.E., engineers.

# THE ENGINEER.

*JULY* 6, 1894.

## THE RAILWAY STRIKE IN THE UNITED STATES.

A MOST remarkable strike is in progress in the United States, and we learn without surprise that its headquarters are in Chicago; a marvellous mushroom city, in which are knotted together most of the principal railway lines of North America, and mainly inhabited by a mixed semi-savage population collected from every nation on earth. It is by no means easy to ascertain what the strike is about; the affair is hardly understood in New York, for example. All that is certainly known is that it originated in some dispute between the Pullman Car Company and its hands. In our impression for September 29th, 1893, will be found a very full description of the town of Pullman and the car works. These last employ about 6300 hands, whose average earnings are £120 per annum. The Pullman Company has contracts whereby none but its sleeping cars are allowed to run over 130,000 miles of railroad, and it owns and operates 2300 cars. All the long-distance travelling in the United States involves the use of sleeping cars; and consequently the railway companies are largely in the hands of the Pullman Company. It appears that the dispute between the company and its hands was not about wages. More than that we cannot say. The Pullman hands turned out and succeeded in getting the railway porters, drivers, signalmen, and shunters to assist them by refusing to handle Pullman cars. The immediate result was a stoppage of all traffic on several of the more important railways. Pullman is only a few miles from Chicago—a fact very much in favour of the strikers. The railway companies found no difficulty in getting fresh hands to take the place of the strikers. Then the strikers resorted to open warfare. The singularly inefficient magistrates called out a yet more inefficient posse of marshals, who were incontinently captured by the strikers. Chicago is dependent for its food supplies on the railways, and we are told that famine is at the gates. Chicago is also the centre of the meat trade—we had almost said of the world. As the packers can get no cattle or hogs, they are closing their works and discharging their hands by the thousand. A telegraphic despatch by the *Times* correspondent states that "The various railroads that bring cattle are pasturing thousands of animals along their lines, being unable to enter the city. The North-Western has 8000, the Burlington 6000, and the Rock Island 20,000 pasturing." It is clear that a small further development will paralyse the whole railway system of the United States. A body of several thousand men having obtained possession of the railways will prevent them from being used until such time as their demands have been satisfied. Cities will be reduced to starvation, trade ruined, and the country reduced very much to the condition in which it would have been placed by an invading army.

The strikers are apparently determined that they will win at all costs to the community at large, and the question very naturally arises, what are the limits to the operations of the "labour party" of the United States? If they are successful in this instance, there is nothing to prevent them from proceeding further, and so far as can be seen, they may take possession of not only the railways but the factories. Under the modern systems of civilisation, any interference with transport can inflict fearful evils on a country. If pushed far enough, famine and its natural concomitant pestilence can be forced upon a nation. Under these conditions it is evident that the law of self-preservation will assert itself, and history tells us that the people of the United States when they are once really roused do not spare. The supreme power of the nation can only be made to act with difficulty. Each State is a law to itself, and to secure action at once harmonious and prompt is by no means easy. The President of the United States has, however, adopted the one course open to him. He has insisted that the national mails must be carried without interruption—strike or no strike; he has declared the strikers to be "rebels," and he has ordered the despatch of troops to protect those who are willing to take the place of the strikers. The United States Court at Chicago has granted a general injunction against the railway strikers, prohibiting all interference with mail trains, and also with all trains crossing the State boundaries. The injunction covers Illinois, Indiana, and Wisconsin. But this injunction will be a dead letter unless it be enforced, and it seems to be more than probable that it cannot be enforced without much fighting. The situation is, it will be seen, very different from that brought about by a strike affecting private interests only. If in a certain community of one hundred individuals any transaction affects, say five, the remaining ninety-five will care very little about the matter. Should it inconvenience ten, the remaining ninety will begin to talk and say that something should be done. If it concerns twenty, then the remaining eighty will probably exert themselves a little to settle the affair. If it affects eighty persons out of the hundred, they will very quickly and suddenly take the trouble necessary to bring about a more comfortable state of life. Now a strike in an ironworks, such as that at Messrs. Carnegies' last year, affects a very small percentage of the community; but a great railway strike affects a very large proportion. The people say that as for the dispute between Messrs. Pullman and their hands they may fight that out as they please, but they must not interfere with the national railway traffic. The result has been that troops have been called out, and the strikers will be beaten. We read of Gatling guns commanding the streets in Chicago, and already Mr. Debs, the leader of the strike, has announced that a settlement is possible. This is all quite as it should be, but the mistake so constantly made by Governments of all kinds is that they assert their power too late. Violence of all kinds is illegal. If men are found burning or destroying the property of other people, or threatening, beating, and terrifying those who wish to work, then punishment should follow swiftly and surely. And it is all the more necessary that the arm of the law should be felt promptly, because the working population of the United States is so largely composed of men of all nationalities except American. No one who watches the signs of the times can fail to perceive that of late years strikes have been accompanied to an unprecedented extent by crimes of violence. This is an evil fact—a thing of bad omen. In this country, at all events, the law is satisfactory enough, its enforcement is not. In the United States the law is defective. Its enforcement is generally tolerably complete and sweeping. An improvement would be effected by amalgamating the two systems. The United States might learn something from us—we might learn something from them, and the progress of the present strike will be watched just now with special interest in this country for reasons which should be so obvious that it is not necessary to specify them.

## METROPOLITAN WATER SCHEMES.

THERE is every indication that the supply of water to London will be made a very urgent question in the Parliamentary session of next year. The County Council are devising plans for a supply to be drawn from some distant source, apparently in Wales, and are at the same time entering on the preparation of eight separate Bills, providing for the transfer to the Council of the undertakings of the eight metropolitan water companies. On the other hand, those of the companies who take their supply from the Thames, are consulting as to the preparation of a scheme which shall fulfil the requirements laid down by the recent Royal Commission, and for which the sanction of Parliament will necessarily have to be sought. In the session now being held, the Bill of the Southwark and Vauxhall Company for enlarged storage works above Hampton, having passed through the Commons with some amendments, has been read a second time in the House of Lords, together with the Bill of the East London Company, authorising an extension of their works in the Lea Valley. The Thames Conservancy Bill, which is connected on some important points with the question of the water supply, is vigorously opposed in the House of Commons by the London County Council, who are moving for its re-committal, accompanied by sundry instructions.

The plan devised by Messrs. Hunter and Fraser for a series of storage reservoirs in the neighbourhood of Staines is understood to be still entertained by one or more of the water companies, though on a reduced scale; and there is at least a probability that a Bill on this basis will take its place among the rest in the coming session. Some remarks made last week in the House of Lords by Lord Balfour seem to point in the direction of this project as a "comprehensive scheme" to be brought forward next year, and for which the way should be left open. As if anticipating the further investigation which the subject thus appears destined to undergo, Dr. Frankland's annual report to the Registrar-General, which has just been issued, relative to the water-supply of the metropolis, contains a much larger amount of information than usual, although it is a document always prepared with much care and elaboration. Before discussing Dr. Frankland's report, we may observe that, according to a statement which immediately precedes it, the average daily supply of water to London last year exceeded 196 million gallons. This is a very large amount, greater than the average of the previous year by nearly 10 million gallons per day. The hot dry weather which characterised so large a portion of last year, doubtless had its effect in an increased demand on the services of the water companies. The growth of the population constantly tells in the same direction. Registration London is estimated to have added quite 42,000 to the number of its inhabitants last year, and this fails to include the large addition which must have taken place in the outer area supplied by the London water companies. That measures must needs be adopted to meet the ever-growing demand cannot be denied, and it is to be hoped that the Bills now promoted by the water companies will receive the approval of Parliament, though impaired by the strange embargo that the statutory rights of the companies to abstract water from the river shall not be enlarged. It is tolerably certain that the companies will not pump and filter more water than they can help; while, on the other hand, if London wants more water than the law allows, the supply must be given. London will not endure drought by Act of Parliament.

Discussing the quality of the water supplied to the metropolis, Dr. Frankland admits that organic matter of animal origin enters both the Thames and the Lea above the points whence the supply is taken. But he goes on to say it is gratifying to find, as the result of recent researches, that the zymotic poisons are rapidly destroyed in running water exposed to sunlight, "so that the most minute microscopic inspection of the water at the intakes of the various companies has hitherto failed to discover a single pathogenic germ." Even supposing such germs should arrive in a living condition at the intakes of the companies, efficient sand filtration would ultimately arrest their progress. This is asserted as an established fact—provided, of course, that the filtration is conducted in a proper manner. "Efficiency" in this case is the grand condition of safety. How far this state is arrived at may be inferred from the extent to which germs of all kinds are excluded. A great destruction of bacteria is also effected by storage preliminary to filtration. As an instance, it is stated that while the water at the intake of the East London Company contained, on the average of the year, nearly 10,000 microbes per cubic centimetre, the same water, after storage for fourteen days, averaged only 1200 microbes per cubic centimetre, to be afterwards virtually extinguished by the filter beds. The Chelsea Company, with reservoirs affording 14·7 days' storage, and filter beds surmounted by 4ft. of sand, removed on an average more than 98 per cent. of the microbes, and as a maximum result excluded them all. The West Middlesex Company, with less than 3ft. of sand, attained an average removal of nearly 99 per cent. of the microbes, and a maximum of 99·94. The lowest number of microbes found in the West Middlesex water was five per cubic centimetre in December, while the raw water of the Thames at the intake contained at the same time 6316 microbes in the cubic centimetre. The maximum removal effected by the Southwark and Vauxhall Company was 99·92 per cent., with an average of 98. Dr. Frankland makes the remark that efficient filtration does not seem to depend essentially on the thickness of sand which covers the filter beds—an instance of this kind being afforded by a comparison between the West Middlesex and the Chelsea water. The New River Company, with less than two feet of sand, contrived to deliver throughout the year water possessing a high degree of bacterial purity. It is suggested as probable that a regular rate of filtration throughout the twenty-four hours is of much more importance than the thickness of the filtering medium. Even this conclusion somewhat fails, for the New River Company works its filters at a higher rate than that employed by any of the other companies, except the Lambeth, and yet stands at the head of the filtering companies as regards bacterial purity, never having more than thirty-seven microbes per cubic centimetre during the year, the prescribed limit being 100. One consideration must not be lost sight of—that the bacterial efficiency of sand filtration depends, to a very large extent, upon the formation of a thin film upon the surface, derived from subsidence of suspended particles in the raw water. The entire subject is undergoing further investigation, and until the experiments are complete Dr. Frankland refrains from drawing any definite conclusions, though offering certain remarks based on the existing data.

The general rule that cholera travels up the stream instead of down, has sometimes been used as an argument to show that water is not the vehicle of contagion. Dr. Frankland offers a fair explanation of the circumstance, and one which carries a distinct warning with it. Cholera, he observes, almost always arrives at the mouths of rivers by sea. The estuary becomes polluted, and the infecting matter is carried up by the tide. The barges create the subsequent danger, it being the habit of the bargemen to dip their drinking water out of the river at any point where it ceases to be brackish, and then to consume the liquid without any filtration. They thus become infected, and convey the zymotic poison up the stream as far as the river is navigable. Canals may in some respects open up a still further inlet for the transmission of the disease. The dietetic use of raw or imperfectly filtered water derived from open streams is at such times fraught with extreme danger. But experience gained on the Continent has shown that filtration can be made effectual as a barrier against cholera. If this disease should menace England, it becomes imperative that all public supplies of water should be protected against the inroads of the zymotic poison. In London this is being accomplished, but the difficulty will be to make local authorities and small water companies perform their duty as guardians of the public health. The great majority may do well, but there will be a stupid minority capable of working widespread mischief. Yet the knowledge which is now gained will be of inestimable value, as showing where the danger lies. Dr. Frankland has given himself earnestly to the subject, and feels that the bacterioscopic examination of the water supplied to vast communities like London, has become an investigation of the highest importance from a hygienic point of view. He is therefore each year devoting an increased amount of attention to the bacteriological character of the various waters supplied to the Metropolis. The inhabitants of London and its environs may be congratulated on the fact. Much needless alarm is thus prevented, and at the same time wise and precautionary measures are initiated, such as were unknown to a previous generation.

## ABSOLUTE ZERO.

THE discussion on thermodynamics which has proceeded for some weeks in our correspondence columns becomes more interesting. How can it be otherwise when we find such redoubtable physicists and mathematicians as Dr. Lodge, Professor Alexander, Mr. Mansel, Major Basevi, and Mr. Donaldson joining issue? Nor is the discussion carried on without humour. Dr. Lodge frankly confesses that a chapter in Professor Alexander's book has "fairly stumped" him. Professor Alexander retaliates and explains that he has set a mathematical trap for Dr. Lodge "to draw him," and chuckles with delight at the fact that he has accomplished that feat. Dr. Lodge has written not one but two articles on entropy, a thing concerning which it is not too much to say that engineers are densely ignorant, which is not after all so astonishing as at first sight it might appear to be when we remember that Clerk-Maxwell hailed the advent of entropy with delight, and wrote an explanation of it which he had to withdraw in a succeeding edition of his book when it was explained to him that the word meant something entirely different from what he supposed. Then we have various other correspondents asking for explanations or disputing the soundness of views expressed by more or less shining lights in more or less valuable text-books; and so at last an outsider may not unnaturally ask what the discussion is about, and how it comes to pass that there is any discussion at all. It may serve a good purpose if just at this stage we endeavour to clear the ground a little, and enlighten our readers in general on the nature of the *casus belli*.

It is very erroneously asserted that the science of thermodynamics is exceedingly simple. Nothing can be further from the truth. It very closely resembles Lindley Murray's grammar. There are a lot of rules, which are easily remembered. All would be well if Lindley Murray on the one hand, and thermodynamics on the other, stopped there. They do not stop there; to every rule there is an exception, sometimes two or three. This complicates matters frightfully. To cite an instance, let us take Marriotte's law. It is beautifully simple. The volume and the pressure of a gas multiplied by each other always give the same result. Double the pressure, half the volume, and so on. In other words, the pressure of a gas varies inversely as its volume. This is simplicity itself. But unfortunately it is true only of what does not exist on earth—a perfect gas, and it is not true of that save under special conditions. The law is all right, and the exceptions are all right, but to combine the two is not a task always performed satisfactorily for all gases. If our readers will bear the fact steadily in mind, that the so-called laws of thermodynamics are based partly on experiments, partly on theories which are really more or less clever guesses at truth, partly on mathematical deductions from assumptions and deductions, they will be in a position to understand how wide is the door that stands open for controversy. It is, of course, useless to assert that there is no door open. The facts are all the other way.

Recently much of this discussion has turned on the question of absolute zero; that is to say that state of matter when there is absolutely no heat present in it. Here we fall at the outset on a stumbling-block. No one has the smallest idea what heat is, and no one knows what temperature is. When it is said that heat is something that burns your fingers, and temperature something that makes the thermometer work, we seem to have summed up human knowledge on the subject. Now when the physicist speaks of absolute zero, he means absolute absence of temperature. No one can tell, however, whether the total absence of temperature would be attended with the total absence of heat. Until quite recently anyone who attempted to question the accuracy of Lord Kelvin's dictum that absolute zero was − 273 deg. C., would have been, metaphorically, burned as a heretic. It appears, however, that Mr. Donaldson and others are quite prepared to risk the stake. We shall first state the fundamental basis of the absolute zero theory. It is Gay-Lussac's law:—"The coefficient of dilatation of a perfect gas under constant pressure is constant and independent of this pressure." If this law is not true, then it is certain that − 273 deg. C is not absolute zero.

Let us proceed next to explain what it all means, and in the first place we cannot do better than quote a passage from Clerk-Maxwell. Having described—page 49 of the fifth Edition of the "Theory of Heat"—an air thermometer and its graduation, he goes on, "To determine the reading at the bottom of the tube is a very simple matter. We know that the distance of the freezing point from the bottom of the tube is to the distance of the boiling point from the bottom in the proportion of 1 to 1·3665, since this is the dilatation of the air between the freezing and the boiling temperatures. Hence it follows by an easy arithmetical calculation, that if, as in Fahrenheit's scale, the freezing point is marked 32 deg. and the boiling point 212 deg., the bottom of the tube must be marked −459·13 deg. If, as in the Centigrade scale, the freezing point is marked 0 deg. and the boiling 100 deg., the bottom of the tube will be marked −272·85. This, then, is the reading at the bottom of the scale." Again, the range of a thermometer may be expressed in terms of work done on a substance by each addition of heat, in a way fully explained by Maxwell at page 156 of the "Theory of Heat," and it is this consideration that brings J into our correspondent's letters. We may now try to simplify all this. Let us suppose that we have in a bag a large number of marbles—how many marbles we cannot tell; but we can put the bag in a pair of scales, and we find that its contents weigh 1 lb. We assume that all the marbles are of the same size and weight. We have plenty more besides those in the bag. We now add, say, ten marbles to those in the bag, and we weigh the whole again. We find that the bag now weighs 1 lb. and $\frac{10}{273}$ of a pound. We add ten more marbles, and we find that the bag weighs 1 lb. and $\frac{20}{273}$ of a pound. We then have no hesitation in saying that there are 273 marbles in the bag to begin with. Now let us take another case. We have a thermometer, the stem of which is equally graduated into, say, 300 spaces. We apply heat, say, for 15 seconds, and the mercury rises one degree; then for 15 seconds more and it rises another degree, and so on. It is assumed that the quantity of heat poured into the thermometer is directly proportional to the time of action. The mercury stood at the 273rd mark to begin. A certain increment of heat raised it one degree, and so on. But it is quite natural to assume that if we took out heat in the same way, after we had removed 273 deg., there would be none left. These two methods are not identical in their method of teaching. Taken together they explain the kind of reasoning by which the notion of absolute zero was arrived at. Now, to apply Gay-Lussac's law to all this we have only to conceive that we have a perfect gas occupying a given volume, under a piston. If we apply heat the gas will expand and the piston will rise. Let the rise be $n$; then by doubling the quantity of heat supplied the rise will be doubled, and we shall have the total rise as $2\,n$, and so on, equal increments of heat giving us $1\,n$, $2\,n$, $3\,n$, and so on. But, on the other hand, if we abstract heat we shall have successive descents of the piston $1\,n_1$ $2\,n_1$ &c.; and it is obvious that if we continue the process of abstracting heat, we shall at last come to a point when the gas will have no volume at all and no heat. As to whether this point is reached at 273 deg. or not, depends on the length of the $n$ divisions to begin with. On Fahrenheit's scale the divisions are 460. All this is plain sailing; and provided it is conceded, as we have said, that Gay-Lussac's law is true, then absolute zero is 273 deg. below the arbitrary zero of the Centigrade scale. If, however, the amount by which the gas expands or contracts for a given addition or subtraction of heat varies, then the whole calculation is upset. If, for example, our marbles were all of different weights, it would be quite impossible to ascertain by any conceivable process of weighing how many marbles there were in the bag to begin with. It is here that Professor Alexander, Mr. Donaldson and Major Basevi enter their protest, directly or indirectly. They maintain that Gay-Lussac's law is not true without important qualifications; that any air or gas thermometer which it is possible to construct does not contain a perfect gas, and that the coefficient of dilatation is not constant, but variable in a way and to an extent which has not been determined with accuracy. And here it is proper to remark that the question becomes complicated yet further by the importation of the term specific heat. That in its simplest form means the *quantity* of heat required to raise the temperature of a given weight of any substance one degree. In other words, specific heat is the heat needed to bring about a definite change in a body, such as a rise in temperature. We have then to consider two points in dealing with Gay-Lussac's law. In the first place, assuming that the specific heat of a gas remains constant at all temperatures, will its coefficient of dilatation vary? In the second place, assuming that its coefficient of dilatation remains constant, will its specific heat vary? That is to say, will the same quantity of heat invariably produce the same rise in temperature? Nothing is easier than to ring the changes on these points. Thus it may be said that for nitrogen, for example, equal additions of heat neither effect equal changes in temperature nor in dilatation; or it may be said that while equal additions of heat produce equal changes in temperature in all regions of the scale, they do not effect equal changes in volume. But above and beyond this question comes another to make confusion worse confounded. Is it certain that when a body has lost all its temperature it must have lost all its heat? We know that heat may be poured into water, for example, or into ice, without producing any effect, however minute, on the thermometer. Major Basevi argues with sufficient plausibility that water at absolute zero could have no specific heat whatever.

It will be seen, then, that while the deduction of the absolute zero from a thermometer so constructed that equal additions or subtractions of heat invariably produce equal effects, is the easiest thing imaginable, the carrying of the deduction into practice is full of difficulties; so full of them, in fact, that it would be quite wrong to assume it certain that if Professor Dewar could succeed in getting a temperature of − 273 deg. C. on any thermometer, it would be beyond all doubt that the substance so cooled down would be entirely devoid of heat. It may be said that, after all, this question of absolute zero is one of very little practical importance. That is not quite true, however. It is only necessary, for example, to read such papers as those which Dr. Lodge has contributed to our columns, to understand how important a part is played by this same absolute zero. What will be the ultimate result of the discussion of the subject in our columns we cannot pretend to say. We venture to think, however, that it can hardly fail to place the matter on a firmer basis than it has hitherto possessed, and that will be a distinct gain to science.

## TYNE DUES AND STEAMERS.

AN agitation of some moment seems commencing on the Tyne for the reduction of dues on steamers frequenting the port. It is probably increased by the fact that the dues on the neighbouring river Tees have been reduced with good results both to the conservancy of the river and to the steamers trading thereto; but it unquestionably arises from the depressed state of shipping, and the fact that some of the heavy works needed on the Tyne are about completed, and the steamship owners believe that there is now not only the need for lower dues but the possibility of obtaining them. The heavy nature of the imposts on steamers may be conjectured when it is stated that the dues on a steamer a little over 1500 tons net register, which entered the river for dry docking purposes only, amounted to £30 15s.—more for river dues, pilotage, and towage than the cost of the dry docking. It is clear that charges such as these on steamers that actually use none of the public docks or wharves must militate against the interests of the port, and must tend to drive some of the work to places where the dues are less. Vast engineering works have been in progress on the Tyne, and during their continuance heavy dues were paid with some cheerfulness; but the great walls at the mouth of the Tyne are now practically completed, and with a reduced capital expenditure there is now the strong desire for some reduction of the imposts, so as to make the great coal river a cheaper port, and thus to give relief to steam shipping at a time when it needs every aid it can get to enable it to work without loss. One of the most marked features in the trade of the Tyne of recent years is the decay of the general trades, and that decay is in some degree due to the change from the small steamers that could take full cargoes to the very large boats that can only get part cargoes. As the dues are charged on the tonnage of the vessel, it is evident that there is a difference between the two methods, for in the small steamer the tonnage of goods was greater than that on which dues were paid; whilst the large vessel pays dues sometimes on threefold the tonnage of the goods taken on board. Hence goods are sent by rail at times to other and larger ports, where there is the greater likelihood of a full cargo, and ports such as the Tyne suffer in consequence. Under the circumstances, then, there is a strong claim for abatement which is being pressed, but the concession of which is doubtful. None the less, however, is the claim of the steamship owner important, and one that can scarcely be overlooked in the growing competition of the ports.

## THE WATER SUPPLY OF PARIS.

THE Anderson Revolving Purifier Process, by means of metallic iron, is meeting with great favour for the treatment of the river water supplied to Paris and its suburbs. A plant purifying over a million gallons a day has been steadily at work for nearly two years at the Boulogne-sur-Seine waterworks of the Compagnie Générale des Eaux — which are situated below the city—and gives most satisfactory results. The General Council of the Department of the Seine, after a long and careful investigation, has abandoned the proposal to obtain a supply of spring water for the suburbs of Paris in favour of the scheme put forward by the Compagnie Générale des Eaux to deliver purified Seine and Marne water to the fifty-seven Communes in their district. The new supply, amounting to 15 million gallons a day, will be drawn from the Seine and the Marne above Paris and purified by the Anderson process; the Compagnie Générale des Eaux undertaking to remove 99 6 per cent. of the microbes in the original water. The work under this contract is now in hand, and is to be completed by the end of 1895. In addition to this a further portion of the suburbs included in the territory of the Compagnie des Eaux de la Banlieue is to be supplied with some 7 million gallons a day of purified Seine water taken from the river at Suresnes. A third scheme has also now been completed for a supplementary supply of some 9 million gallons daily for the city of Paris itself. The source of this supply will be the river Marne, and the necessary purifying and filtering plant will soon be put in hand. Within a short time, therefore, some 31,000,000 gallons of river water, purified by the Anderson process, will be supplied daily to Paris and its suburbs. A series of twenty-two analyses of samples taken at Boulogne-sur-Seine—at dates unknown to the Cie. Général des Eaux — by Dr. P. Miquel, of the Paris Municipal Laboratory, shows an average reduction of bacteria amounting to 99·57 per cent. Of these twenty-two analyses, which extended over a period of six months, seven showed a reduction of over 99·8 per cent., and twelve of over 99·6 per cent.; the rate of infiltration averaging 6in. per hour. The bacterial purity of the purified Seine water taken below Paris was greater than that of the spring water of the Vanne in the case of nine samples, and equal to it in the case of two. The average of the twenty-two samples gave a lower figure than was obtained from the average of the bacterial analyses of any of the spring waters supplied to Paris, with the exception of the Vanne, to which it nearly approached.

### MINING IN YORKSHIRE AND LINCOLNSHIRE.

MR. F. N. WARDELL, F.G.S., H.M. Inspector of Mines for Yorkshire and Lincolnshire has issued his report for 1893. It is of exceptional interest, as the loss of life in his important district during the year reached a total of 218. This was caused chiefly by a great calamity at Combs Colliery, an explosion of fire-damp there involving the deaths of 139 persons. At Sharlston Colliery three lives were lost from a similar cause. The most fertile source of fatalities is that recorded under the heads of "Fall of roof and sides." Mr. Wardell states that this is nearly always the most serious cause of mortality. The loss of life from falls amounted in 1893 to 37, the result of 35 separate accidents, the numbers in the previous year being 45 and 43 respectively. Owing to the long cessation of work at the collieries experienced during the year through the strike, the output of coal was very much reduced, the weight brought to bank in 1893 having been 15,951,843 tons, or a decrease of 7,233,665 tons on the output of 1892. The amount of fireclay raised in 1893 was 190,271 tons, or a decrease of 52,830 tons. In 1893 164,108 tons of ironstone were produced, representing a decrease of 22,005 tons as compared with 1892. Shale and other minerals exhibited a reduction of 17,263 tons. The total amount of mineral raised in 1893 was 16,383,309 tons, or a decrease of 7,325,763 tons on the previous year. The total amount of mineral raised in the United Kingdom in 1893 was 175,236,857 tons, which is a reduction from the total of the previous year of 16,718,051 tons. The number of lives lost in and about mines in the United Kingdom during 1893 was 1060, or an increase of 44 over the number in 1892. 683,008 persons were employed in the production of minerals in the United Kingdom, a number which represents a decrease of 634 on those employed in the year preceding. The proportion is thus given as one death to every 644 persons employed, and 165,318 tons produced. In the Yorkshire and Lincolnshire districts, owing to the Combs Colliery calamity, the proportions are less favourable, viz., one death to every 407 persons employed, and 75,103 tons produced.

### MR. LUDWIG MOND AND THE ROYAL INSTITUTION.

MR. LUDWIG MOND, well-known in the world of chemistry for his research, has purchased the freehold of No. 20, Albemarle-street, close to the Royal Institution building, and this he proposes to give to the Royal Institution, after he has fitted it up as a research laboratory. It is to be known not as the Mond, but as the Davy-Faraday Laboratory. We need scarcely add that no pains will be spared or expense avoided in the endeavour to make this establishment the most perfect of its kind. When we bear in mind the great cost of such apparatus as that used by Professor Dewar in his interesting investigations into the properties of gases, we may form an idea of Mr. Mond's munificence. The laboratory is to be placed under the control of a committee, nominated by the managers of the Royal Institution from among themselves, and reporting to them. While the laboratory will have a competent chief of its own, devoting all his time to its work, Mr. Mond desires that the resident professor at the Royal Institution should accept the position of director. The laboratory is to be free to all persons, without distinction of sex or nationality, who, in the opinion of the manager of the Institution, are fully qualified to undertake scientific investigation, preference being naturally given to those who have actually done original work. It is a noble gift not a little enhanced by the self-effacing manner of the giving.

## LITERATURE.

*Sewage Disposal.* By Mr. W. SANTO CRIMP. London: Charles Griffin and Co. Second Edition. 1894.

THIS is the second edition of a work on sewage disposal which the author published in 1890, and contains much useful information that will be appreciated by engineers who are engaged in advising about sewage disposal. We think the book could have been condensed by the omission of the verbatim references to the reports of ancient date, which are now only of interest historically. The introductory portion of the book is devoted to a summary of what has been attempted in regard to the prevention of pollution of rivers by sewage or manufacturing refuse, the data being mainly derived from the reports of the River Pollution Commissioners of 1865 and of 1868. The time that has elapsed since the recommendations contained in these reports were pressed on the notice of the public, and the knowledge that legislation in the direction of enforcing the recommendations has been far too permissive, leaves one to hope that Parliament may soon find time to pass drastic measures to take the place of the existing permissive statutes.

The author devotes a chapter to the consideration of the rate of the flow of sewage from houses and factories, and refers to the conclusions which were arrived at by the referees who reported upon the scheme for the main drainage of the metropolis. He states that those conclusions are confirmed by his own observations as the engineer in charge of the Metropolis Northern Outfall Works of the London County Council. He agrees with the opinion of the late Mr. Gordon—whose untimely death when chief engineer of the London County Council was greatly deplored—who, when at Leicester, found that 70 per cent. of the daily flow may be discharged in twelve hours. The calculation generally adopted is that 50 per cent. of the maximum flow may pass to an outfall in six hours. The proportion to be adopted must necessarily be governed by the area which the sewers drain. Provision for a smaller volume could be made in an outfall sewer receiving sewage from various contributing sewers over an extensive drainage area, from which the heavy flow due to sudden storms could not arrive at the outfall simultaneously, contributions from distant parts of the district arriving later at the outfall than those from districts that were nearer, or where the steeper gradients of the sewers brought the sewage more rapidly to the outfall. In the case of sewers which have to serve a small area the conditions would be different, and the risk of flooding would be greater than would be the case with large areas, if the lower calculations above referred to were adopted. There is a great need of careful calculation for, and skilful arrangement of, a system of sewers. This is too often not recognised by local authorities who entrust the sewerage of their districts to those who have had no previous experience in this important branch of practice.

The author points out the wide variations that occur in regard to population and area, seven to eight people to the acre being taken in suburban parts of the metropolis, whilst from 200 to 300 to the acre represent the population in thickly-populated parts. Some data are given as to the basis which was adopted for sewering the metropolis, and the author gives some information as to the discharging capacity of the metropolitan northern outfall sewer. In 1857 Messrs. Bidder, Hawksley, and Bazalgette calculated the size of this sewer by the formula $V = \sqrt{1·6. H.F.}$, where $V$ = velocity in feet per second, $H$ = hydraulic mean depth in feet, $F$ = flow in feet per mile. The author found by gaugings that the actual discharge was 30 per cent. more than the calculated one. He does not, however, give the data on which this conclusion is based, as the sewer might have been under pressure by the sewage rising in manholes, &c., so that the sewer was gorged. We wish the author had devoted some part of his book to the important question of the flow of sewage, and the discharge from sewers, which at the present time require to be better dealt with than by resorting to the published tables that are based on old and erroneous formulæ. The author had good opportunities of observation during the time he had charge of the northern metropolitan sewers.

Information on the flow of water in culverts and channels is given in the work by Professor H. Robinson, on "Hydraulic Power and Hydraulic Machinery," which was recently reviewed in THE ENGINEER, vol. lxxvi., page 616.

Much useful information is given in regard to the sizes of settling tanks for chemical precipitation processes, and detailed descriptions of the various systems are afforded which furnish a complete historical record. This, however, might have been condensed, as several of the systems are now obsolete. Presses for converting sewage sludge—which used to be the bug-bear of precipitation works — into portable material are fully described and their construction illustrated. The tables showing the composition of sewage sludge that were prepared by Dr. Wallace in 1879, and by Dr. Munro in 1887, are given, as well as the more recent analyses by Mr. Dibdin of pressed sludge from the Crossness Outfall Works.

Numerous sewage farms are described in detail, and the practical operations are entered upon very fully. The Berlin Sewage Farm is referred to as an example of a skilfully-designed and successful undertaking, the data being based on a paper by Mr. Roechling, which was read before the Institution of Civil Engineers. The book is evidently the outcome of much careful compilation, and the author deserves thanks for the trouble he has taken.

## PARLIAMENTARY NOTES.

*Government shipbuilding contracts.*—A return was made to this subject on Friday, when Mr. Macdonald and Mr. Keir-Hardie applied further questions to the Secretary of the Admiralty. Sir U. Kay-Shuttleworth said:—"The statement that the tender sent in last December by the Thames Ironworks Company for the Powerful was only £5000 in excess of those of the successful competitors is not correct. The difference was much larger. The Thames Company also offered an alternative and lower price, but not as much as £50,000 lower than their tender for the ship as designed, upon a proposed design of their own with different boilers. But the introduction of tubulous boilers was an integral part of the design for which tenders were invited. The tubulous boilers as adopted in the Powerful and Terrible are not experimental. But it is useless to quote or discuss a tender upon a design not proposed or wanted by the Admiralty. Any tender that could be entertained must be in accordance with the design. I now turn to the case of the tenders for two battleships. When these had been examined in March, an offer was made to a Clyde firm, because that firm was amongst those who had tendered lowest. The same offer was made at the same time to another of those who had tendered lowest, the latter firm accepted; the former declined. A similar offer was then made to a third firm, also one of the lowest tenderers, and accepted. The Thames Ironworks Company were not among the lowest tenderers; therefore no such offer could be made to them. Nor was any offer made to any firm not in the tendering list. After both the battleship contracts had been placed, the Thames Ironworks Company made proposals to build a battleship for the amount of the lowest tender or somewhat less, and asked for the transfer to them of the order for one of the battleships provided for in the dockyard programme. This proposal could not be entertained, because it would have deranged that programme and left one of the dockyards with insufficient work for the employment of its workpeople, thus necessitating their discharge in large numbers. The amounts of tenders which are not accepted cannot be published without a breach of confidence. But as I have before stated, a return will be presented as soon as all the contracts are complete, which will give the amounts of the actual contracts made, as well as the name of each contractor." Sir Ughtred declined to state how much the tender was in excess of the tender of the Clyde firm, and in reply to Mr. Allan he said that the royalty for the French boilers was part of the price the Admiralty had to pay for the work. Then came a struggle by Mr. Keir Hardie in the interests of the unemployed on the Thames. Had not nearly the whole of the Thames Ironworks men been thrown out of employment for nearly two years through the withdrawal of Government work? The Secretary to the Admiralty said everything had been done that could be done. The company was always invited to tender, but it must take its chance like everybody else. He was sorry that men on the Thames were out of work, but that was also the case in other parts of the kingdom, a statement which was cheered. A discussion then followed as to the practice of the Government in dealing with tenders. Mr. Noble asked whether it was the custom to allow tenderers to revise their tenders and so to bring them down below a tender which had been accepted. Sir U. Kay-Shuttleworth said such a course would be most objectionable. Sometimes, of course, there were circumstances which made the lowest tenderers unacceptable. Mr. T. G. Bowles asked if the company in question were among the lowest tenderers? Sir U. Kay-Shuttleworth: They were not only not among the lowest, but they were very much higher than those whose tenders were accepted. Lastly, in reply to Mr. Benn, Sir U. Kay-Shuttleworth said:—"The practice of the Admiralty, when ships are to be built by contract, is to invite tenders from selected firms and to give the preference to those who tender lowest, provided that they fulfil all other necessary requirements, including conditions as to workmanship, date of delivery, and the other points usually specified when tenders are invited. Therefore we cannot promise to give a preference on the next occasion, either to the Thames Ironworks Company or to any other firm. Any such preference, or any departure from the present practice of competitive tenders, would open the door to suspicions of favouritism and jobbery, and would be highly undesirable in the public interests. The fact that lack of work and consequent distress has existed in certain shipbuilding districts is much to be deplored. But this condition is not peculiar to London. It is not admitted that the work for the Navy in the London district has been superior to that done elsewhere—for example, in Scotland and the North of England, where the recent orders have been placed with thoroughly competent firms. Nor do we admit that the Thames Company can build a battleship 20 per cent. cheaper than it can be built in a Government yard. It is not true that in order to build the dockyard battleships the men will have to work night and day. Overtime is being kept within very reasonable bounds, and is only resorted to temporarily in cases of necessity."

*The fair wages clause.*—The Secretary to the Admiralty informed the House that the Steel Company of Newton are executing some work for the Admiralty, some of this being under a sub-contract with Messrs. J. and G. Thomson, of Glasgow. A complaint as to the wages which they pay under that sub-contract has been lately received through the Secretary for Scotland from the Associated Iron Dressers of Scotland, and was under consideration at the Admiralty.

*The atmosphere of the Underground Railway.*—A good deal has been said of late about the condition of the atmosphere in the Underground Railway tunnels. "Shall London choke?" is a question that a good many have been asking since the hot weather began. It seems that Sir Benjamin Baker has reported to the Metropolitan Company, but the latter has informed the Board of Trade that the report is of a private character. Nothing is said about any prospective attempt to improve matters.

*Rolling ships and bilge keels.*—Mr. T. G. Bowles asked whether, on a recent passage from Stornoway to Greenock, with a calm sea and heavy swell, her Majesty's ship Empress of India rolled 28 deg. and her Majesty's ship Royal Sovereign 33 deg., while her Majesty's ship Repulse only rolled 11 deg.; and whether the Repulse was the only vessel fitted with bilge keels. Sir U. Kay-Shuttleworth replied that after the experience gained some months ago of the rolling of the Royal Sovereign and other ships of her type, the Admiralty decided to fit the Repulse with bilge keels. The recent rolling of the Empress of India and Royal Sovereign has been nearly what the hon. member states, while the Repulse rolled only 11 deg. or so. Arrangements were made a few days ago to fit bilge keels as in the Repulse to other ships of the Royal Sovereign class. The existing docks can be used by the vessels thus fitted with bilge keels. We are glad to hear this, for if we remember rightly not many months ago Sir Ughtred was of opinion that there were only two docks of sufficient size.

*An alleged unsafe railway.*—In reply to Dr. Kenny, Mr. Bryce said that the Board of Trade were not aware that a feeling of uneasiness existed among those who use the Dublin, Wicklow, and Wexford Railway between Shanganagh and Bray. The Board had no power to compel the company to divert their line, but if representations disclosing a dangerous state of things are made to the Board, he would at once direct an inspecting officer to visit the locality and report.

## THE TOWER BRIDGE.

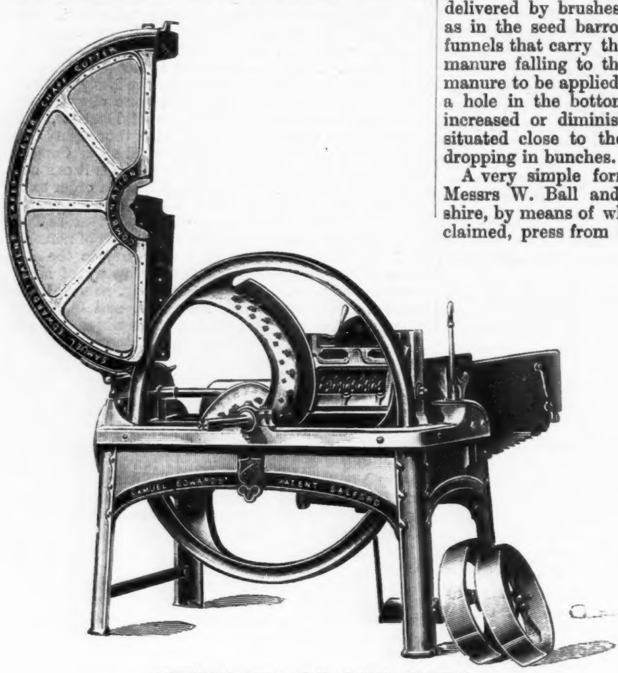
THE Tower Bridge was opened by the Prince of Wales on Saturday, the 30th of June, with much success and a great deal of well-managed pageantry. Some little time must elapse, however, before the bridge is brought into general use, as the pavilions used at the opening ceremony have to be cleared away. Numerous honours have been conferred. The Lord Mayor, Sir George Robert Tyler, becomes a Baronet; Mr. John Wolfe Barry a C.B. We believe that he was offered and refused knighthood. We have so recently and so fully described the bridge that nothing remains to be said, save to express our congratulations on the successful termination of this great work.

NAVAL ENGINEER APPOINTMENTS.—The following appointment have been made at the Admiralty:—Chief Engineer Frederick J. Flood, to the Onyx. Staff Engineer Thomas Rule, to the Bonaventure. Engineers—Henry Toop, to the Bonaventure; George H. Morris, to the Raven; Henry E. Tregenna, to the Barrosa; Charles G. Taylor, to the St. George; and John A. Murray, to the Sheldrake. Assistant Engineers—Arthur P. S. Spencer, to the Gibraltar; George S. Holgate, to the Hood; Mark Rundle and Hugh H. Ricketts (probationary), to the Bonaventure; and Henry F. Danes, to the Sheldrake. Assistant Engineers to H.M.S. Pembroke—James Maxwell, F. Magrath, W. J. Steil, Charles G. Ware, John Thomson, J. Murphy, G. H. Jeffery, E. E. Pethick, G. W. Wooldridge, and Thomas W. Richards. The following to the Victory—C. H. Harding, W. Stokes, H. F. Smith, E. P. Soper, H. T. Canning, I. E. S. Roberts, W. M. M'Donald, B. C. Minhinnick, J. J. Shirvell, and A. E. J. Murray. The following to the Vivid—J. T. C. Butland, E. Stocker, J. Kelly, G. Robertson, G. H. Page, W. B. Hall, F. G. Charlton, P. Stocker, and John H. Hare.

## THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

MESSRS. J. L. LARKWORTHY AND CO., Lowesmoor Ironworks, Worcester, had on view at their stand a new implement called the "Eckley" wagon and cart hoist, which is adapted for many purposes, but particularly for farmers' use during hay making and harvest operations. It consists of a strong oak frame having a vertically movable platform, on which the cart or wagon may be drawn. The movable platform is supported by screwed brackets on four vertical screwed rods, which revolve upon ball bearings. By means of a horizontal rod and bevel gearing placed along one side of the machine rotary movement may be communicated to two of the vertical rods, and hence by chain wheels and chains to the two opposite rods, so that the platform can be raised or lowered. The horizontal first motion shaft may be provided with one or more cranks for hand driving, according to the size of the machine.

Mr. Robert Maynard, of Whittlesford Works, Cambridge, had on view a portable combined chaff cutter, fitted with a new exhaust cavings elevator, which is designed to obviate a defect prevalent in some other elevators, in which stones or other hard substances which have once passed through the feed-box are continually carried back there again, thereby damaging the knives considerably. The new elevator is operated by an exhaust, and the cavings are drawn up and deposited in the feed-box, while all the hard substances are left behind and allowed to fall to the ground. By means of this elevator, the cavings, as they are sifted from the chaff, are delivered upon and mixed with the feed as it passes into the feed-box, and so are re-cut, nothing being left behind when the chaff cutting is finished.


CROWLEY AND CO.'S CHAFF CUTTER

Messrs. Nalder and Nalder, Wantage, showed two finishing thrashing machines, and a barley dressing and grading machine.

Messrs. Woods and Co., of Suffolk Ironworks, Stowmarket, exhibited a new type of stone picking machine which is worthy of more than a passing notice. It is claimed by the patentees that not only does this machine gather all the large stones from the land, but when used upon young layers, summerlands, &c., it is a certain destroyer of the poppy and other seedling weeds, and where not too thick it is a most valuable implement as a spear grass or couch collector. The machine is mounted upon two wheels, and can be drawn by one horse. The collecting rakes are formed by rows of steel teeth and attached to three endless chains, each working on three centres, the latter being arranged so that each rake runs parallel to the earth for a certain distance, at the same time raking it, and as it rises from the earth the stones are held in the bend of the teeth. As each rake comes in contact with the earth before the previous one rises, the whole surface of the land is acted upon. The stones are carried over the top and delivered at the rear of the machine into a cradle receiver or bags. The arrangement for lifting the bags is very simple, being worked by levers, and a lad can easily take the sacks off and replace them as they become filled. The machine is very strong, simple in construction, and not liable to get out of order.

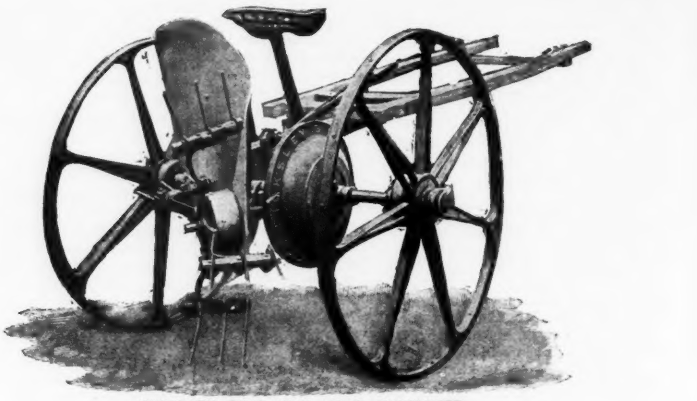
The engraving above represents a new chaff cutter, the invention of Mr. Samuel Edwards, which was exhibited on the stand of Messrs. John Crowley and Co., Sheffield, and in which there are one or two novel features. In the first place, the teeth of the feed rollers by which the material is fed to the cutting knives are arranged obliquely round the peripheries, an arrangement which is said to prevent vibration, and ensure a firmer grip upon the material. The pressure plate is made to swivel upon the shaft, and its angle of resistance is regulated by a set screw passing through the top cross bar of the mouth. By this means the said angle can be adjusted while the machine is in motion. A new feature in the swivel mouth is the absence of any fixed or projecting dead-plate inside the mouthpiece. The point of the bearing surface is inside the slots between the mouthplate and the side cheeks, thus allowing the feed to pass freely to the knives without any obstruction, and at the same time giving all the advantages of an adjustable mouthpiece. A safety lever is provided on each side in such a position as to enable the machine to be stopped or reversed, while one lever also regulates the length of cut. These levers cannot be moved in the wrong direction, when it is desired to stop or reverse the machine; while in case of accident, their disposition is such that the attendant can scarcely fail to move one of them over. A travelling feed web is fitted in the bottom of the straw box, and carries the material upon it towards the rollers, so that there is little probability of the feeder's hands becoming drawn in between the rollers. Behind the top pressure plate is placed a wooden friction roller, which only turns by the material passing over it. This is provided to prevent the attendant's hands getting too near the toothed rollers. The front of the pressure plate is open, to allow anything which might pass through the tooth plate to pass away without doing any injury to the machine. Protecting covers are used throughout the machines, so that only the driving pulleys are exposed. The cover for the fly-wheel is hinged on to the frame in a very simple manner, which allows full scope for sharpening the knives, and it can be very easily removed.

Mr. T. H. Chandler, of Rowde, Devizes, exhibited a new combined drill for seed and manure which differs from other appliances of this description in the construction of the shares which make the furrows for the reception of the seed. They are secured to the coulter by a clip and set screw, and are arranged so that any depth of furrow can be cut. The seed in the corn drill is delivered by brushes through copper plates with holes, as in the seed barrow, with dry or liquid manure into funnels that carry them into the furrows, both seed and manure falling to the earth together. The quantity of manure to be applied is regulated by a slide passing over a hole in the bottom of the box, whereby the hole is increased or diminished as required. The seed-box is situated close to the ground, and so ensures the seed dropping in bunches.

A very simple form of hay press was exhibited by Messrs W. Ball and Son, of Rothwell, Northamptonshire, by means of which two men and a boy can, it is claimed, press from 4½ to 5 tons of hay per diem. The machine is adjustable for making different sizes of trusses, and is so constructed that no needle is required for threading the string or wire round them, while the total weight of the appliance is only about one and three-quarter tons. Another new appliance shown was the "Pioneer" potato picker, which can be attached to a digger for collecting the potatoes in bags or baskets carried upon the machine. It is questionable, however, whether much saving in labour would result from the addition of this appliance to diggers, as it would of necessity also collect large stones which come in the way of the machine, and which would afterwards have to be abstracted from the bags or baskets by hand. The Halladay windmill was shown by Messrs. A. Williams and Co., Great Eastern-street, London, together with a complete set of artesian well-boring plant. These wind motors are becoming extensively adopted for raising sewage and for driving farm machinery in addition to ordinary pumping.

In flour milling machinery an exhibit of considerable interest is that of Mr. Alfred R. Tattersall, of Willesden, N.W., who shows an entirely new roller mill which will greatly economise floor space. This apparatus is designed to treat English wheats, and although not of itself a complete mill, manipulates the material by a graduated system of fluted rolls and sieves, so as to separate the bran and render it ready for sale, and make the kernel of the wheat ready for being reduced to flour by the millstones which already exist. The flour thus obtained is of high quality. Messrs. E. R. and F. Turner, of St. Peter's and Grey Friars Works, Ipswich, in point of variety have a stand which is worthy of more than a passing notice. Besides a lavish display of roller mills, various types of dressing machines for the new roller flour milling process, fixed and portable steam engines, this firm have in operation a new scalper.

Messrs. Picksley, Sims, and Co., Leigh, Lancashire, amongst their interesting group of exhibits, had one machine which was catalogued as new—their new "Palatine" haymaker, which is a simple machine designed with the object of more efficiently turning the swath or swathes and lightening the crop, while injuring as little as possible the seeds. It is a narrow machine, as will be observed from the accompanying engraving, and will take one swath only of a mowing-machine, having a cut of 4ft. 8in. The rotating set of forks are placed on an axis arranged at a suitable angle to the main axle, and driven therefrom by bevel gearing, and strike the butt end of the crop, thereby effectually turning it to the one side clear of the track, and exposing the latter to the atmosphere until the succeeding round, when the next swath is distributed over it. The machine is automatically thrown into gear when in the position for work, while when the driver, by means of a side lever, tilts the machine so that it can pass over the turned crop, or when travelling upon the road, the machine is simultaneously thrown out of gear. The tines, as will be observed, are coiled around the arms to prevent injury by coming in contact with hard materials; and the rotating forks being so near the axis, the narrow machine is rendered especially suitable for ridge and furrow, or upon rough and hilly ground. In view of the Darlington trials, and owing to the novelty in the construction of this machine, the stewards of the Royal Agricultural Society have intimated to Messrs. Picksley, Sims, and Co. that this machine may be again exhibited next year as a "new implement."


PICKSLEY SIMS AND CO.'S HAYMAKER

Messrs. Thomas Robinson and Son, Rochdale, Mr. Thomas Corbett, of Shrewsbury, Mr. A. C. Bamlett, of Thirsk, and Messrs. Howard, of Bedford, all had extensive exhibits of "standard" types of machines. Messrs. Greenwood and Batley, Albion Works, Leeds, exhibited an "Excel" pneumatic hammer; Messrs. Hawksley, Wild, and Co., Sheffield, besides a large high-pressure Lancashire boiler, showed some interesting hydraulic flanging work. The Weardale Iron Company also exhibited some beautiful examples of the same class of work.

## HYDRAULIC POWER SUPPLY FOR GLASGOW.

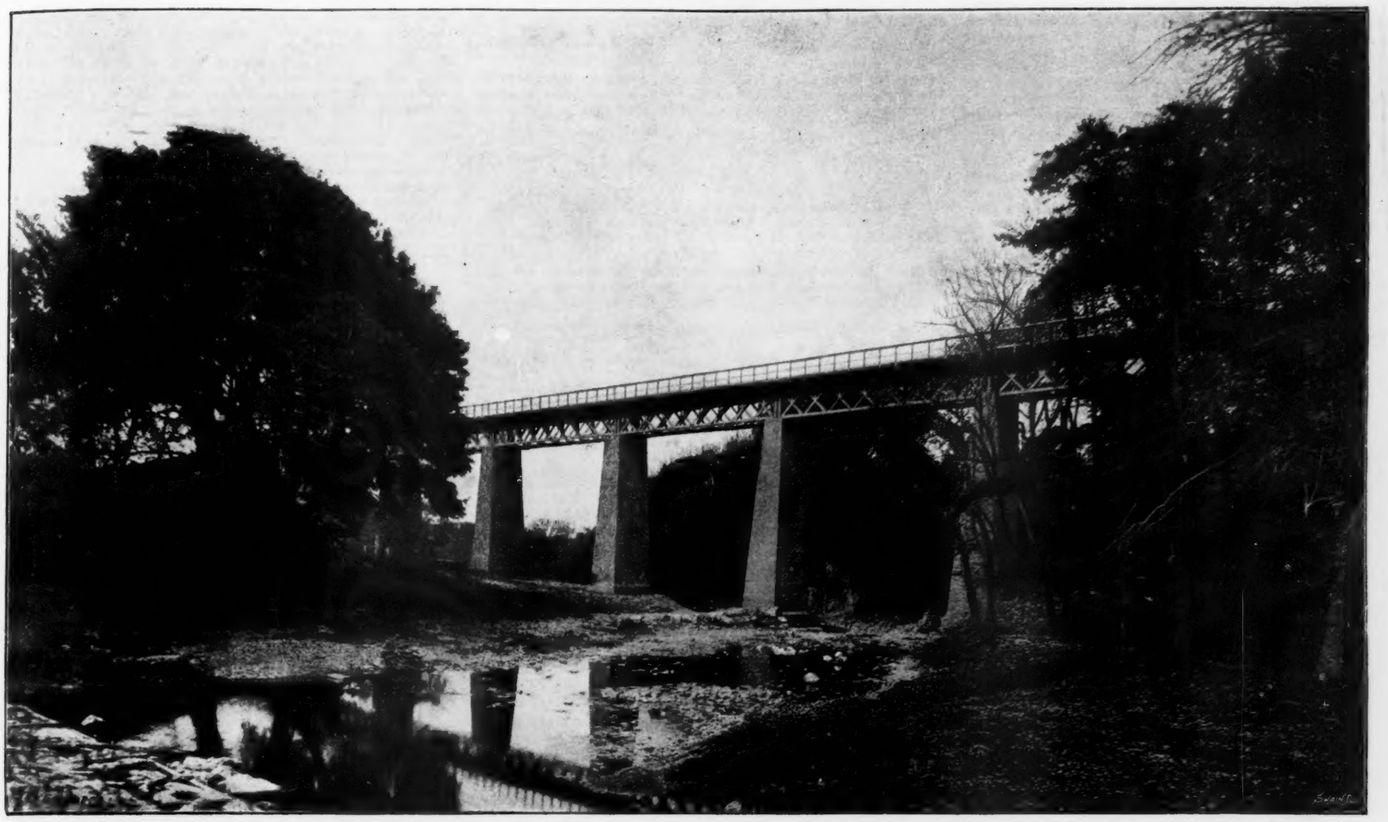
THE advantages of a high-pressure water supply for motive purposes in large towns have been for a long period so well understood, that it is a matter for some surprise that Glasgow is only now preparing to give the business community the option of using this safe and cleanly method of power transmission. About a couple of years ago Sir William Arrol and a number of other gentlemen formed a company for the public supply of hydraulic power. This involved the right to open the streets for the purpose of laying pipes and making connections, the Corporation regarding it as inadvisable that any second body should have such power, and moreover looking upon the scheme as to some extent interfering with their monopoly of the city's water supply, applied for and obtained Parliamentary powers for the supply of high-pressure water for general power purposes. The undertaking was arranged to be worked under the direct control of the Water Trust, of which Mr. James M. Gale is the well-known engineer. The general arrangement was entrusted to Messrs. Ellington and Woodall, of Westminster, and rather more than a year ago a piece of land belonging to the Corporation, at the corner of High-street and Rotten-row, was selected as a site for the power-station, where operations have since been pushed vigorously forward. The engine and boiler houses are now in an advanced stage of construction. They are of undressed ashlar, and designed externally to harmonise with the surroundings, which have been vastly improved within recent years under the operations of the City Improvement Trust. The chimney—always, unfortunately, the most prominent feature of such stations—will be 155ft. high, with a square masonry base carried up for 34ft. above the ground-line, the upper part being octagonal, and of brick with stone coigns, surmounted by an ornamental stone coping.

The mechanical arrangements of the station follow pretty closely the lines laid down at London, Manchester, and other places; but a higher working pressure, viz., 1120 lb. per square inch, has been decided upon. The steam required for the pumping engines will be derived from four steel boilers of the Lancashire type, made by Messrs. Inglis and Hossack, of Airdrie, and they are all in position. They are each 30ft. long and 7ft. in diameter, with flues 2ft. 9in. in diameter. They have been tested at the makers' works to a hydraulic pressure of 250 lb., and will be subjected to a further hydraulic test in position of 200 lb., and, finally, with a steam pressure of 160 lb. per square inch, the ordinary working pressure being 150 lb. Firing will be performed by the aid of Vickers' mechanical stokers, and the feed-water will be heated by a Green's economiser.

The pumping engines, three in number, will be inverted direct-acting triple-expansion engines, with one high-pressure cylinder, one intermediate, and one low-pressure cylinder of 15in., 19in., and 36in. diameter respectively, the stroke being 2ft. The pumps are single-acting, with plungers 4¼in. diameter attached directly to the steam piston-rods. The engines have fly-wheels 7ft. in diameter, weighing about two tons each. Each set of pumps is to be capable of delivering 230 gallons of water per minute against an accumulator pressure of 1120 lb. per square inch with a steam pressure of 120 lb., and a piston speed of 240ft. per minute. The accumulator ram will be 4ft. in diameter, the weight case, of wrought iron, being about 11ft. in diameter, and loaded to give the required pressure of 1120 lb. per square inch. All the pumping machinery is being supplied to the drawings

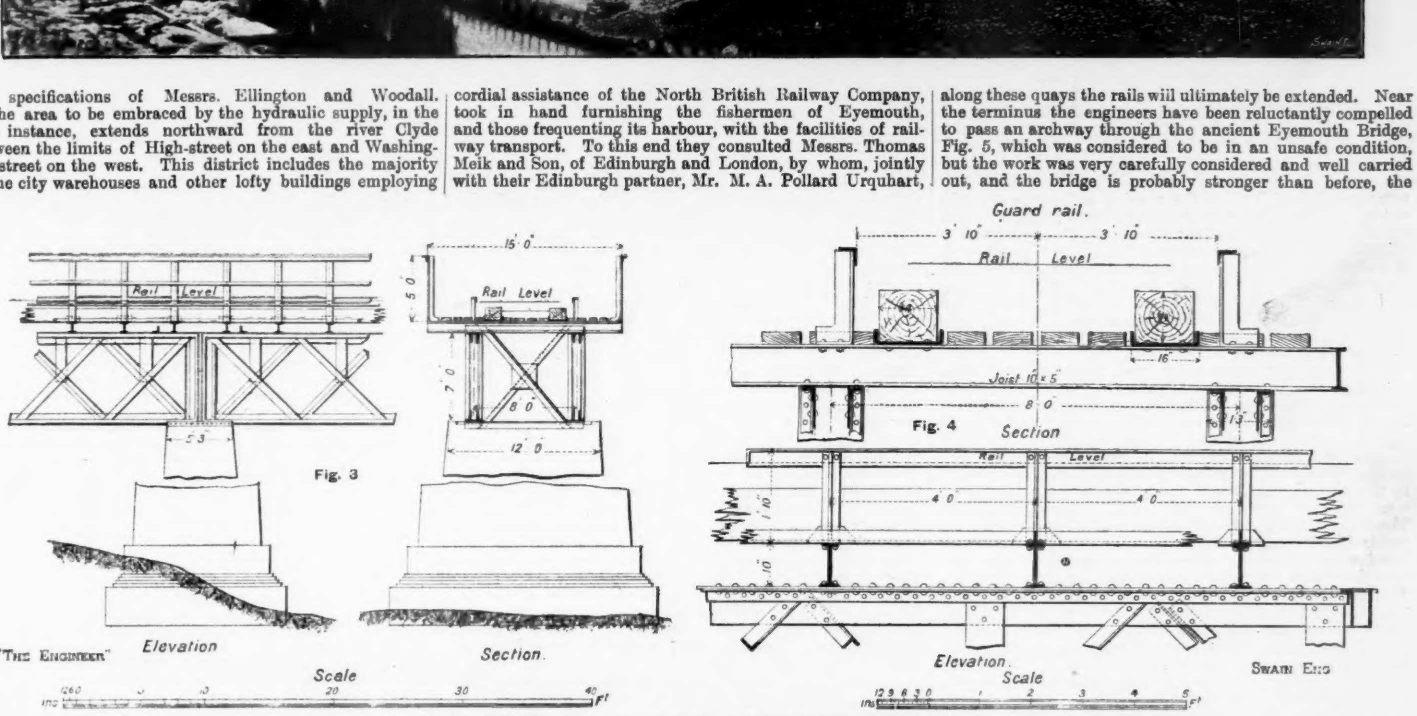
# THE EYEMOUTH RAILWAY—VIADUCT NEAR EYEMOUTH

MESSRS. THOMAS MEIK AND SONS, MM. INST. C.E., ENGINEERS



and specifications of Messrs. Ellington and Woodall.

The area to be embraced by the hydraulic supply, in the first instance, extends northward from the river Clyde between the limits of High-street on the east and Washington-street on the west. This district includes the majority of the city warehouses and other lofty buildings employing elevators or lifts of various kinds in great numbers. These are at present operated by low-pressure water obtained from the street mains, or from tanks to which it is pumped by gas engines, enabling the water to be used over and over again; but the Corporation expect that the high-pressure water will be generally adopted in preference to such expedients, and, moreover, that it will be largely used as a motive power for light machinery. All the streets in the district indicated will be intersected by the high-pressure supply pipes varying in diameter from 7in. down to 2in., the valve fittings, &c., being supplied by the Glenfield Company, Kilmarnock. The estimated cost of the whole installation is between £45,000 and £50,000, and everything is expected to be in full working order in about nine months.

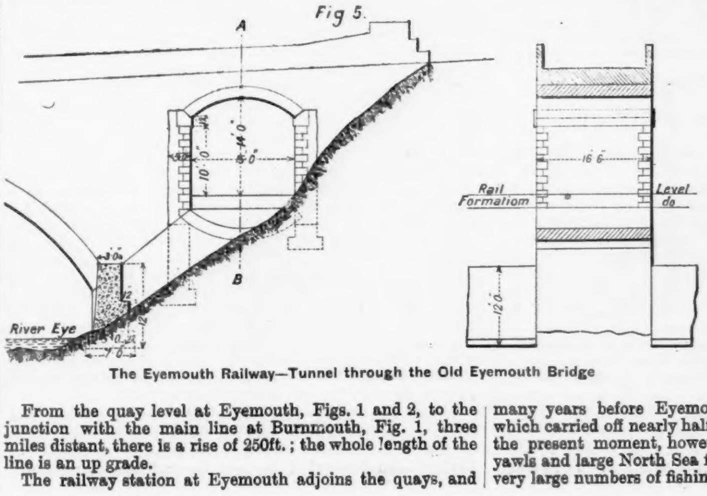


THE EYEMOUTH RAILWAY—VIADUCT NEAR EYEMOUTH—DETAILS

## THE EYEMOUTH RAILWAY.

AROUND the coast of Great Britain, and especially on the Scotch and Irish coasts, are numbers of fishery harbours giving fair accommodation so far as shelter, &c., is concerned to the fishermen who frequent them. Many of these harbours are, however, entirely without railway communication with the centres of population, and the fish having been landed have to be carted long distances inland, which wastes both time and money and produces great waste of fish, and in the event of extra large catches, as the means of transport are entirely inadequate to meet more than the carriage of a very few tons, the ultimate fate of any fish beyond this amount is to be tipped in heaps as manure!

This was very much the state of things at Eyemouth in Berwickshire, until some five years since a little company was formed, consisting of landowners and others interested in the district and harbour, and this company, with the cordial assistance of the North British Railway Company, took in hand furnishing the fishermen of Eyemouth, and those frequenting its harbour, with the facilities of railway transport. To this end they consulted Messrs. Thomas Meik and Son, of Edinburgh and London, by whom, jointly with their Edinburgh partner, Mr. M. A. Pollard Urquhart, various important works were carried out, having for their object the enlargement and improvement of the harbour and the construction of some miles of difficult railway, the contractors for the railway being Messrs. Beattie and Son, of Edinburgh.



The Eyemouth Railway—Tunnel through the Old Eyemouth Bridge

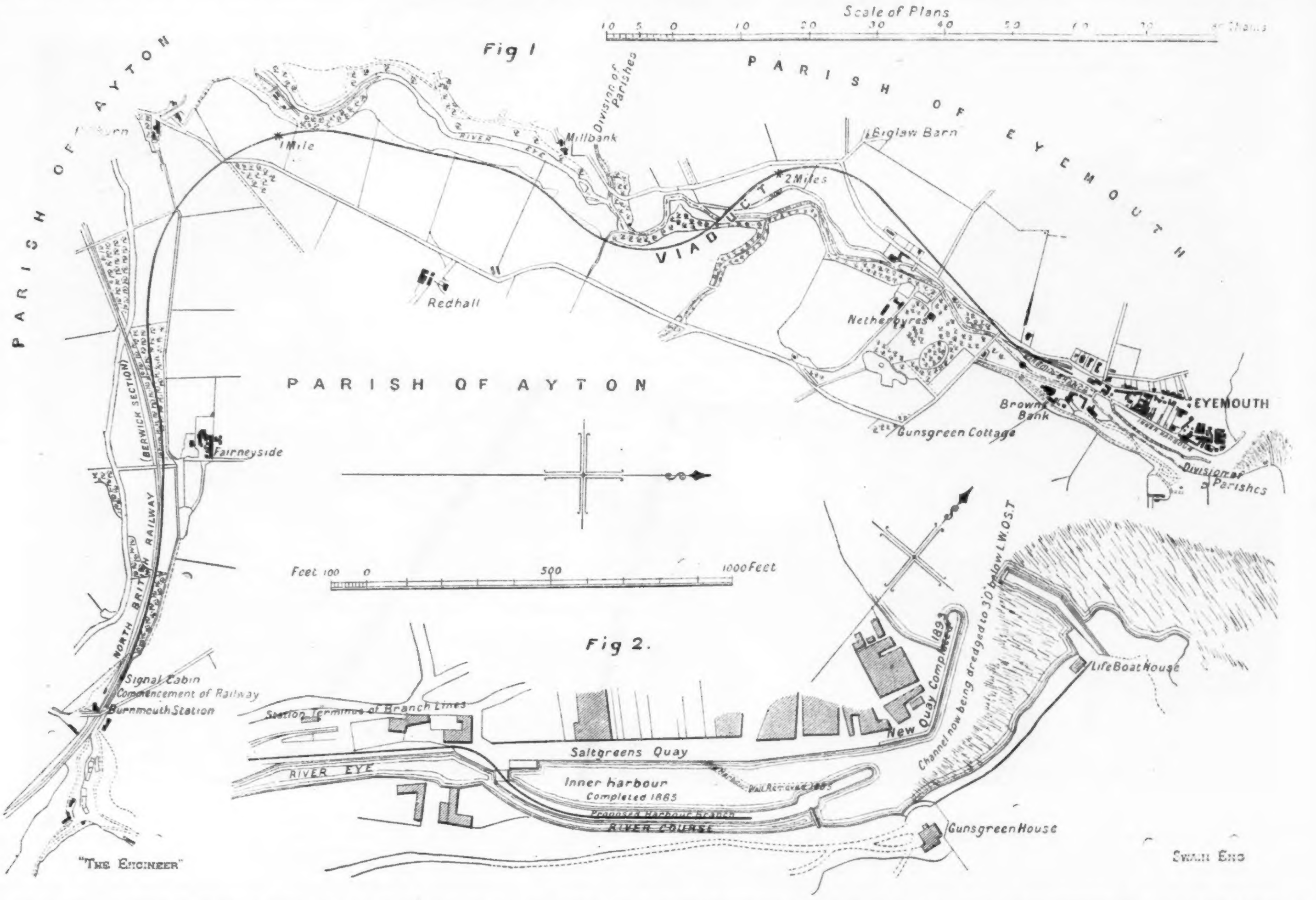
From the quay level at Eyemouth, Figs. 1 and 2, to the junction with the main line at Burnmouth, Fig. 1, three miles distant, there is a rise of 250ft.; the whole length of the line is an up grade.

The railway station at Eyemouth adjoins the quays, and along these quays the rails will ultimately be extended. Near the terminus the engineers have been reluctantly compelled to pass an archway through the ancient Eyemouth Bridge, Fig. 5, which was considered to be in an unsafe condition, but the work was very carefully considered and well carried out, and the bridge is probably stronger than before, the archway for the railway having an inverted arch sprung under the line to give additional stability.

The gradient on leaving Eyemouth Station is severe, 1 in 50, the railway keeping to the north bank of the river, which it eventually crosses at a distance of one mile from the terminus by means of a six-span viaduct, which we illustrate, Figs. 3 and 4. The viaduct is of the lattice girder type, the piers being concrete and brick. Shortly after leaving the viaduct the train enters a 50ft. cutting in hard rock. Away to the north the line passes under Hill Burn Bridge and enters the open country near Ayton Castle. Close at hand is Burnmouth Station, whence fish is despatched to all parts of the kingdom direct, even as far south as Brighton.

It will be remembered that Eyemouth is the port whence in October, 1881, sailed some fifty large fishing boats, each carrying eight hands, all of whom were lost during a great gale which occurred towards the end of the month. It was many years before Eyemouth recovered from this blow, which carried off nearly half her fishing tonnage and men. At the present moment, however, there are some one hundred yawls and large North Sea fishing boats registered there, and very large numbers of fishing vessels belonging to other ports

# THE EYEMOUTH RAILWAY—MAP OF LINE AND EYEMOUTH HARBOUR



now land their fish since the opening of the railway. The railway, although only three miles in length, contains many difficult works, and has been completed at a total cost of £21,000. The harbour improvements are now in progress; it is being deepened, and new quays are being erected, the necessary capital being obtained through the Public Works Loan Board. The railway is already a paying concern, and when the present works on the harbour are completed, there is no doubt that the capital expended on them will also bring good returns.

The Eyemouth harbour works were begun in 1883, when the Public Works Loan Board granted a sum of £25,000 for the enlargement of the old harbour—shown on dotted lines Fig. 2—these works were completed at the end of 1885. In 1891 a further sum of £10,000 was obtained in the same manner for building new quays and deepening the entrance channel; these works are now nearly completed, and already, by the increased facilities to the fishing industry, are having a marked effect on the prosperity of the town of Eyemouth. The harbour works, like the railway, are being carried out under Mr. Urquhart, of Messrs. Thos. Meik and Sons, of London and Edinburgh, whilst the contract for the harbour is in the hands of Messrs. George Lawson, of Rutherglen. It is greatly to be wished that the investing public would more readily turn their attention to works of this character, which not only give a direct return for the money invested, but which tend to increase the welfare and prosperity of the community at large by developing sources of industry hitherto suffering for want of means of communication with the large centres of population.

If people were half as ready to develope industries of this kind through responsible engineers as they now are, aided by non-technical company promoters and inside and outside brokers, to float rash speculations headed by those retired from all sorts of official positions, we should hear less of total loss of fortune on the part of investors, and nothing of the distress and poverty of the outlying fishing districts in remote parts of our coasts. The bountiful harvest of the sea would be made available to a fuller extent than at present as food for our population, a food, moreover, which unlike so large a proportion of the meat and cereals consumed in this country, we can procure for ourselves without sending money out of the country.

## THE CONGO RAILWAY.

THE views which we publish on page 12 of the Congo Railway, now in course of construction, should be of special interest at the present moment, when that State has so suddenly become the absorbing topic of European politicians. On the other hand, the commercial importance of the line in the future cannot be over-estimated. However, up to the present, in spite of some five years of work, only the first section of the line—Matadi to Kengé—has been finished, owing to climate obstacles and the great engineering difficulties which have had to be overcome. Money, too, has not been over plentiful.

On leaving Matadi, in the Congo Basin, and destined to become the greatest emporium on the West African coast, the train, running past the Belgian and Portuguese factories, issues by the Pass of the Pintades on the Leopold ravine spanned by a bridge 20 metres in length, and presently the bank of the Congo is reached, where a fine panorama comes into view. For some 6 kilometres the line is flanked by thick forests, a height of 60 metres being attained. The scenery up to the conflux of the Congo and the M'pozo is described as very grand, the great river forming several splendid falls. The engineering difficulties as far as the bridge over the Mpozo have been very great, the track having been cut through rock of the hardest nature, and laid through ravines entangled with primeval creepers and forest vegetation. The bridge across the M'pozo is of iron, 60 metres in length, and was constructed by the late M. Glaseneer. The line then runs on the right bank of the river. Presently, at a distance from Matadi of 10 kilometres, the magnificent Palaballa mountain comes into view, the elevation being now 95 metres. Here the locomotive is replenished with water. The track next runs through massive forests up to the village and mission station of Palaballa, situated at a height of 280 metres, crossing the forbidding-looking Ravine du Diable. The line runs on the left of the ravine, crossing by turns five bridges of 40, 25, 20, and 10 metres in length, thrown over ravines variously named. The track still rises some 100 to 150 metres above the Ravine du Diable until Palaballa Station is entered. This is the grandest and most interesting portion of the journey. Hence to Kengé four rivers are crossed, spanned by handsome iron bridges respectively 20, 30, 70, and 60 metres in length, but there are no engineering difficulties at all resembling those encountered between the Congo and the M'pozo. The country is more level and open, palm and banana groves being also passed. The track now descends a little, crosses the river Kimueza, thereupon the train presently runs into the Kengé Station, at an elevation of 260 metres, and 40 kilometres distant from Matadi. The run has occupied one hour and a-half, the average speed having been 17 kilometres, or 10 5 miles an hour. At Matadi a long station of corrugated iron has been constructed, and workshops, depôts, &c., with a huge hotel, also of iron. On the section of 40 kilometres described there are in all some 200 aqueducts, cuttings, &c., and 26 bridges, varying in length from 5 metres to 70 metres. The longest, 60 metres and 70 metres respectively, are found at the beginning and the end of the line. The progress of the railway is now being actively continued inland, and with more dispatch, the engineering difficulties being lessened. The railway company has just taken up a loan of 6,000,000f., wherewith to continue the work. From the last report issued by the company it appears that the total expenditure has been 18,360,272f., divided as follows:—Cost of constitution, 2,049,290f.; registration, 390,919f.; fixtures, &c., 1,255,242f.; steamers and armaments, 208,289f.; rolling stock, 792,263f.; interest on capital, &c., 2,228,135f.; service of construction, 11,436,132f. The amount at disposal is about 5,000,000f. The track has now been completed for a distance of about 60 kilometres, and the terracing effected for about another 10 kilometres. The total estimated length of the entire line should be about 150 kilometres. Naturally the chief support of the railway will be furnished by the ivory trade; and it may therefore be of interest to mention that the exports of this valuable commodity from the Congo have increased enormously since 1885—viz., 1885, 98 tons; 1886, 106 tons; 1887, 88 tons; 1888, 120 tons; 1889, 134 tons; 1890, 184 tons; 1891, 172 tons; 1892, 204 tons. Thus in seven years the exports have been more than doubled in this young State, a fact which augurs well for the future of the railway. In 1892 in Europe the sale of ivory amounted to 575 tons, as against 546 tons in 1891, and 508 tons in 1890.

We are indebted for the photographs from which our illustrations have been reproduced to M. A. J. Wauters, director of the *Congo illustré* and the *Mouvement Géographique*, having been forwarded by him through one of our correspondents. No. 1 shows a portion of the line in Palabala district. No. 2 is the bridge over the river M'pozo. No. 3 is a view on the left bank of the river M'pozo. No. 4 is a view which illustrates the difficulties encountered in driving the line along the precipitous banks of the Congo.

WEST HIGHLAND RAILWAY.—Princess Louise, the Marchioness of Lorne, will, it is understood, perform the ceremony of opening the West Highland Railway on the 12th of July. There is still a deal of work to do in connection with the undertaking, but strenuous efforts are being put forth by the contractors to have the new line ready for traffic by the above date. The brickwork of the station at Fort William is in an advanced state, and the platforms have been formed. It is proposed, however, to erect a temporary wooden structure in the event of the permanent station not being completed by the date fixed for the opening. The permanent points and crossings are being put in, and good progress is being made with the erection of signals, signal cabins, &c. Sidings and a turning-table are at present being constructed on the site of the old military fort, the houses in which are being taken down. The railway company's ground along the foreshore at Fort William is also being fenced off from the town, and the permanent way ballasted and finished off. A great deal of dissatisfaction has been caused by the company closing with fencing several lanes leading from Fort William to the foreshore. A special meeting of the Police Commissioners of that burgh was held to consider the matter, and after discussing the various points at issue, they came to the conclusion that the present operations, including the construction of railway station platforms, signal box, and fencing between the town and embankment, were not in conformity with the plans submitted by the railway company. They agreed, therefore, to ask the Board of Trade to exercise the power conferred upon them by Clause 33 of the West Highland Railway Act, 1889, and insist upon the embankment being formed in terms of the adjusted clause and approved plan. Major Marindin went over the line from Tyndrum to Craigendoran lately, and expects to have the final inspection early in July.

THE LONDON ASSOCIATION OF FOREMEN ENGINEERS.—VISIT TO MESSRS. WILLANS AND ROBINSON'S WORKS.—On Saturday last, the 23rd inst., the members of the London Association of Foremen Engineers and Draughtsmen paid a visit to the works of Messrs. Willans and Robinson, at Thames Ditton, and were cordially received by Mr. Mark Robinson and Captain Sankey. After the members had assembled in order to be photographed by the firm's photographer, they were split up into groups, each under the charge of a member of the firm's staff, and conducted round the various departments of the works. Special features of interest, which greatly impressed the visitors, were the methods of testing the accuracy of finish of each detail of the Willans engine, and the elaborate organisation by which this accuracy is constantly maintained and checked. Each engine detail, however small, is interchangeable into any engine of its series, and its history can be traced in case of any after defect or peculiarity. The extreme accuracy obtained, and shown by various tests, was an excellent object lesson to the young and even old mechanical engineers present. As an example of this accuracy, two piles of central piston valves were placed upon a surface plate. The separate rings were 0·5in. thick, and each pile contained about thirty rings. A straight edge was placed across the top of the two piles, and, by means of strips of gauge paper one-thousandth of an inch in thickness, it was shown that the accumulated thickness error did not amount to one-thousandth of an inch. After the party had visited the whole of the departments, the ywere invited to a tea, prepared in the firm's mess-room, after which a vote of thanks was given to the firm and their staff for their kindness, and reference was made to the late Mr. Willans, and the great loss which the firm and mechanical engineering generally had suffered by his premature and much-regretted death. The party returned together down the river by steam launch as far as Putney, where they separated, all being agreed that they had spent a most agreeable and instructive afternoon.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### ENTROPY DIAGRAMS.

SIR,—The recent articles by Dr. Lodge on this subject will, I hope, be interesting to your readers. These entropy-temperature diagrams represent well the quantity of heat in a working cylinder, although the name has often a depressing effect on engineers. To try to popularise this interesting subject, perhaps Dr. Lodge would kindly give, with your permission, an entropy-temperature diagram, worked out from an actual indicator diagram—volumes and pressures—with a description of the operation in detail, to enable practical engineers to apply them. I could send, if wished, the requisite data, as also two indicator diagrams from the same single-cylinder steam engine and at the same cut-off, all conditions being the same, except that in one case there was steam in the jacket and in the other none. Such a pair of entropy-temperature diagrams differ considerably, and are very instructive. They show well the exchanges of heat between the metal and the steam, or, in other words, the wall action in the case of a hotter and a colder cylinder. The percentages of steam and water in the cylinder at different parts of the stroke can be read off from the diagram.

These entropy-temperature diagrams represent thermal units, quantities of heat, or pound-degrees during the stroke.

Neither here nor on the Continent do reference books give clear and practical directions how to construct such diagrams with saturated or superheated steam, gas or oil motors. In a steam cylinder, while open to the boiler, a closed cycle is not carried out. Could not an entropy-temperature diagram be given for a steam, gas, and oil motor by those who understand this question better than **BRYAN DONKIN.**

Bermondsey, July 3rd.

### CARNOT AND MODERN HEAT.

SIR,—At last Dr. Lodge has taken notice of my acceptance of his challenge, but virtually avoids the contest. He has not been able to find any flaw in my argument, and has not the generosity to say so, but resorts to what I call "Mathematical Billingsgate" to cover his lack of logic. I shall, therefore, demolish my own argument, and then challenge Dr. Lodge to show—if it be so evident as he says it is—that, given that the specific heat of air, volume constant, is the same at all temperatures, the scale of the constant volume air thermometer is the same as Thomson's absolute scale. The flaw in the argument of my letter of May 11th—which I discovered immediately after its publication—is that although N—the specific heat of air of constant volume—is constant when the scale used is that of the constant volume air thermometer, it is not necessarily constant when the absolute scale is used. Hence my letter merely proves that the scale of the constant volume air thermometer does not differ from itself.

A similar flaw vitiates my proof, in Chapter XI. of my treatise, that "the scale of the constant pressure air thermometer is the same as the absolute scale." Having thus demolished my own arguments, I now formally challenge Dr. Lodge to do what I appeared to do in my letter, and which he says can be done quite easily, without "mathematical fireworks," from the given data. But I limit him to the use of ordinary logic and mathematics—*i.e.*, he must not use "oracular demonstration."

Dr. Lodge says he possesses my treatise on thermodynamics, but he has up till now neglected the common civility of acknowledging the receipt of a conplimentary copy from the author. He is very severe on some very long terms I have tried to introduce, and which, in spite of their length, are good. He neglects to say that I use, as an alternative in the same chapter, the nomenclature he ascribes approvingly to Mr. Macfarlane Gray. Dr. Lodge must have been very much put out by my letter when he introduced such weak remarks about this chapter, which is not immediately relevant to the subject under discussion. With regard to his objection to equation (24)*, it is equivalent to a clodhopper's objection to an algebraic solution of an arithmetical problem. Certainly the objection is weighty if the solution of a special example of the problem is all that is aimed at.

I admit, however, that I have in my treatise made the same mistake as Rankine made in his treatises. That is, I have first obtained the most general expressions of the laws, and from these have deduced all the particular forms. But I thought I was writing for advanced students, to whom this mode of treatment is usually more acceptable than the other, which is more suitable for beginners.

I take this opportunity of apologising to Mr. Donaldson for not answering his letters, but he will see now that I could not well do so without giving myself away, as the saying is. The chief remark I would make in reply to him is, that two things, very different in kind, may be *numerically* equal. For example:—

Force = mass × acceleration.
= rate of change of momentum.

This is a very valuable equation which follows immediately from Newton's Second Law of Motion. Perhaps I should, in quoting the formula I started with, have explained the meanings of the letters used. I do so now.

N = specific heat of air whose volume remains constant.
M = heat absorbed, per unit increase of volume, by a unit mass of air, whose temperature remains constant while it is expanding.

I need not explain further, as I can easily see that Mr. Donaldson is not so ignorant of mathematics as he professes to be.

**PETER ALEXANDER, M.A.**

Anderson's College Medical School, Professor of Physics.
Glasgow, June 30th.

### THE KINETIC THEORY OF GASES: VALUE OF $\beta$ FOR VAPOURS.

SIR,—In the calculation given in my last letter—page 542—for the value of $\beta$ for steam, the quantity of heat energy in water at the temperature of melting ice was not taken into account. This quantity could be found if the absolute zero of temperature and the mean specific heat of ice between that and the zero of the Centigrade thermometer were known. Now, Regnault found the mean specific heat of ice between − 20 deg. C. and 0 deg. C. to be 0·504; and between − 78 deg. and 0 deg. to be 0·474—Everett's "C. G. S. System of Units," page 107. If the absolute zero of temperature is − 273 deg., and if the mean specific heat of ice continues to decrease at the same rate as above indicated, then its mean value between − 273 deg. and 0 deg. will be 0·37. But the specific heat may decrease more rapidly as the temperature falls, or the absolute zero of temperature may be lower than − 273 deg., either of which circumstances would reduce its value.

If $\bar{s}$ represent the mean specific heat of ice, and $\bar{S}$ that of water between the absolute zero − N deg. and 0 deg C., then $N\bar{s}$ will be the quantity of heat in ice, and $N\bar{S}$ the quantity in water at the temperature of melting ice. The difference between these quantities will be the latent heat of water at 0 deg. C. Hence, if L equal the latent heat at this temperature,

$$L = N(\bar{S}-\bar{s}) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

In the above equation the meaning of $\bar{S}$ may be interpreted thus. Supposing water could fall to − N deg. without change of physical state, its specific heat would fall also, becoming zero at the absolute zero of temperature. For we may define the specific heat of a substance at a given temperature as the heat necessary to be withdrawn from it to cause it to fall 1 deg. in temperature. Thus the specific heat of all substances will vanish at the absolute zero of temperature. $\bar{S}$ is then the mean specific heat of water between − N deg. and 0 deg. C. under the supposed conditions. Now Person found experimentally—see Miller's "Elements of Chemistry," vol. 1, page 367—that the latent heat of liquids is given by the equation

$$L = (160 + t)(S - s); \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where $t$ is the temperature of fusion, S the specific heat of the liquid, and $s$ that of the solid at that temperature. In the case of water $t = 0$, and the equation becomes

$$L = 160(S - s) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3).$$

Combining (1) and (3) we get

$$N(\bar{S} - \bar{s}) = 160(S - s) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4).$$

If we assume, as is only reasonable, that the ratio of the specific heats of water and ice remain the same at all temperatures, and that $n$ is this ratio, then in the last equation we may substitute $n\,s$ for S, and $n\,s$ for S, and it becomes

$$N\bar{s}(n-1) = 160\,s(n-1),$$
$$\text{or, } N\bar{s} = 160\,s.$$
$$\text{Similarly } N\bar{S} = 160\,S.$$

But $N\bar{S}$ is the quantity of heat in 1 lb. of water at 0 deg. C., hence 160. S is also this quantity, and since S for water at the above temperature is unity, the quantity of heat in 1 lb. of water is 160 units.

It was shown in my last letter that $\beta$ was the ratio of the total energy in steam to the energy of its latent heat. Hence steam at 100 deg. C., since its latent heat is 537, has a total energy of 637 + 160 units, or 797. Therefore, $\beta = \frac{797}{537} = 1{\cdot}484$. At 200 deg. C. the latent heat of steam being 476 5, $\beta = \frac{676{\cdot}5 + 160}{476{\cdot}5} = 1{\cdot}77$; showing an increase of about 19·6 per cent.

London, June 28th. **C. E. BASEVI.**

### THE LATENT HEAT OF STEAM.

SIR,—In your last few issues there have appeared criticisms by Mr. Donaldson of an equation given by Mr. Alexander. It appears from them that Mr. Donaldson's grievance is rather with the fact that he does not understand the notation. One can hardly believe that Mr. Donaldson is such an ardent student of thermodynamics as he professes to be if he is not familiar with the writings and notation of Lord Kelvin on the subject. Perhaps it will relieve Mr. Donaldson's mind if you will kindly insert the following method of deducing the equation—

$$J\left\{\left(\frac{dM}{dt}\right)_v - \left(\frac{dN}{dv}\right)_t\right\} = \left(\frac{dp}{dt}\right)_v.$$

The first law of thermodynamics gives us—

$$J\,dQ = dE + dW \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $dQ$ = quantity of heat received by the body; $dE$ = internal work done; $dW$ = external work done.

Now, in the mechanical theory of heat we have as characteristic equation of a body—

$$F(p\,v\,t) = 0,$$

where $p$ = pressure, $v$ = volume, $t$ = absolute temperature. F is a function determined experimentally. We may choose any two of these variables as our independent variables. Let them be $v$ and $t$. Then—

$$\left.\begin{aligned} dQ &= \frac{dQ}{dv}dv + \frac{dQ}{dt}dt \\ dE &= \frac{dE}{dv}dv + \frac{dE}{dt}dt \\ dW &= \frac{dW}{dv}dv + \frac{dW}{dt}dt \end{aligned}\right\} \quad \begin{array}{c}\text{Substitute}\\ \text{in}\\ \text{Equation (1).}\end{array}$$

We have

$$J\left\{\frac{dQ}{dv}dv + \frac{dQ}{dt}dt\right\} = \left\{\left(\frac{dE}{dv} + \frac{dW}{dv}\right)dv + \left(\frac{dE}{dt} + \frac{dW}{dt}\right)dt\right\}$$

An identity from which we conclude

$$\left.\begin{aligned} J\frac{dQ}{dv} &= \frac{dE}{dv} + \frac{dW}{dv} \\ J\frac{dQ}{dt} &= \frac{dE}{dt} + \frac{dW}{dt} \end{aligned}\right\} \quad \begin{array}{c}\text{Eliminate}\\ \frac{dE}{dv} \text{ and } \frac{dE}{dt}.\end{array}$$

$$J\left\{\left(\frac{d}{dt}\right)_v\left(\frac{dQ}{dv}\right)_t - \left(\frac{d}{dv}\right)_t\left(\frac{dQ}{dt}\right)_v\right\} =$$
$$\left(\frac{d}{dt}\right)_v\left(\frac{dW}{dv}\right)_t - \left(\frac{d}{dv}\right)_t\left(\frac{dW}{dt}\right)_v.$$

Now put $W = p\,dv$.

$$J\left\{\left(\frac{d}{dt}\right)_v\left(\frac{dQ}{dv}\right)_t - \left(\frac{d}{dv}\right)_t\left(\frac{dQ}{dt}\right)_v\right\} = \left(\frac{dp}{dt}\right)_v\left(\frac{dv}{dv}\right)_t -$$
$$\left(\frac{dp}{dv}\right)_t\left(\frac{dv}{dt}\right)_v = \left(\frac{dp}{dt}\right)_v.$$

Now $\left(\frac{dQ}{dv}\right)_t$ denotes the latent heat of dilatation. Lord Kelvin uses M for this.

$\left(\frac{dQ}{dt}\right)_v$ is the specific heat at constant volume, replace it by N.

Then our last equation becomes—

$$J\left[\left(\frac{dM}{dt}\right)_v - \left(\frac{dN}{dv}\right)_t\right] = \left(\frac{dp}{dt}\right)_v \quad . \quad . \quad . \quad . \quad . \quad (2)$$

the required equation.

Mr. Donaldson has not attacked Mr. Alexander's final result, and I think he will now see that his analysis of equation (2) is a failure. **STUDENT.**

Cardiff, June 25th.

### STEAMSHIP PROPULSION.

SIR,—Colonel Beaufoy, in his "Nautical and Hydraulic Experiments," makes use of the following definitions:—

By *head pressure* is meant the total pressure which exists against the head end, or foremost part of a body, immersed either wholly or in part in any given fluid when such body is at rest.

By *stern pressure* is meant the total pressure which exists against the stern end, or hindermost part of a body under the same conditions.

By *plus pressure* is meant the additional pressure which is sustained by the head end, or foremost part of a body moved through a fluid; which additional pressure is over and above what we have termed the head pressure, and arises from the fluid being obliged to be displaced in order to permit the moving body to pass through it.

By *minus pressure* is meant a subtraction of pressure from the stern pressure, and which subtraction is occasioned by the fluid not pressing so strongly against the stern end, or hindermost parts of a body, when such body is in motion through the fluid as when the body is at rest.

By *friction*—as relating to this subject—is meant that sort of resistance to a body moved through a fluid, which arises either from the adhesion of the particles of the fluid to the surface of the moving body, or from the roughness of the body, or from both those causes combined.

By *total resistance* is meant the sum total of the plus pressure, the minus pressure, and the friction united.

These definitions are as suitable to a steamship to-day as they were one hundred years ago, except that perhaps in the definition of friction the viscosity of the fluid would have to be taken into account.

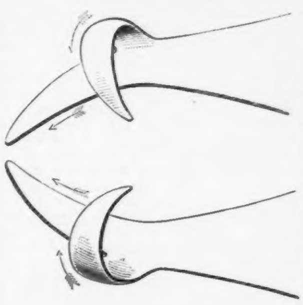
It is of course a truism to assert that if any of these resistances can be reduced in any ship, she can be made to travel faster with the same expenditure of power.

Putting aside the plus pressure and the friction, I propose to confine my remarks to the minus pressure, which, I think I may say without fear of contradiction, is *chiefly* caused in a steamship by the inertia of the water.

A little reflection will show that this minus pressure must have a limit, and that that limit will be reached when the steamship is travelling at the velocity at which water at rest will flow into a vacuum—or about 18 knots. At speeds above this the minus pressure will remain constant, and consequently the total resistance will increase in a lower ratio—compared to the velocity—than at lower speeds. This is exactly what is found to be the case in torpedo boats which have what Mr. Mansel calls a "critical speed" at about 18 knots, above which speed the resistance *actually* increases in a much lower ratio than it does at speeds below this.

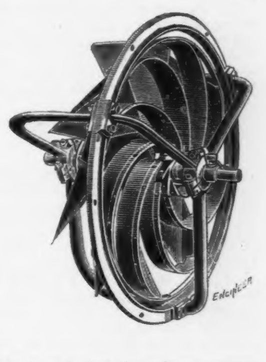
This minus pressure acts in a similar manner to the brake on the guard's van of an ordinary train, and if this "brake" can be taken off the stern of the vessel an increase of speed will be the result. Is it *possible*, however, to take this brake off? Or if not possible to take it off entirely, is it possible to reduce its resistance to the ship's advance? I think that undoubtedly it *can* be reduced very materially, and by a very simple device.

Some time ago—I forget the exact date, but that is immaterial—a whale was stranded on the shores of Great Britain, and, having been killed, its measurements were carefully taken, and calculations made of the number of horse-power which it must have exerted in travelling at a certain speed. Now, had the whale been moved by a tow line, or had it been propelled by a screw propeller, these calculations would probably have brought out a result not far removed from the truth; but the whale's tail is *not* a screw propeller, and its action does not resemble that of a screw propeller; there is an essential difference. I am afraid I am a little sceptical of some of these calculations, for I *have* seen that a savant calculated that seventeen swallows could, and did under certain circumstances, exert one horse-power whilst flying; also the power exerted by a goose whilst on the wing has been calculated variously at 10-horse power, 1-horse power, and $\frac{1}{10}$-horse power, the lowest of which even appears somewhat excessive. As M. Bertrand said, it would be "as easy to prove by calculation that birds could *not* fly—a conclusion which would rather compromise mathematics." If the action of a fish's tail be examined carefully, it will be seen that whilst what I may call one "blade" of the tail is propelling the fish, the other "blade" is forcing water centripetally towards the base of the tail, and so reducing the minus pressure — the two blades acting alternately in the manner indicated by the rough sketch.



Now, a ship travelling through the water has a considerable minus pressure at its stern, and the screw propeller causing *some* centrifugal motion of the water increases this minus pressure, instead of reducing it. If, however, supplementary or "feeding blades" be placed on the leading side of the propeller, so as to cause a *centripetal* movement of the water in front of the propeller, the minus pressure will be reduced or eliminated, according to the size of the feeding blades—in the same manner as is done by the fish—and the resistance of the ship to motion will be reduced. This, of course, will result in increased speed.

To explain my meaning better, I attach a sketch of the "Tattersall" ventilating fan, where the same principle has been adopted. It is perhaps not so apparent at first sight why this should be advantageous in a fan—which is stationary—but I see it stated that these supplementary blades increase the efficiency of the fan by 25 per cent. without necessitating any increase in the driving power.

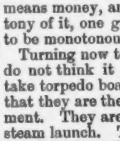


On a steamship the advantage in reducing the minus pressure will be self-evident, and whilst the feeding blades will do this when the propeller is revolving in one direction to make the ship advance, when the propeller is reversed, these supplementary blades acting centrifugally, will enormously increase the minus pressure, and so bring the ship to rest in a reduced time; in the same manner on a vessel with twin screws the power of turning the ship with the propellers alone will be increased.

St. Helena, June 12th. **R. DE VILLAMIL.**

### STRESS IN CRANE HOOKS.

SIR,—At a large quarry a crane hook recently broke while carrying about three tons. The hook is of the ordinary construction. The peculiarity, as it seems to me, of the fracture is that the hook broke right under the ring. The dotted line shows the fracture. Now I shall be much obliged if some reader will explain to me what were the stresses in this hook, and how to plot them graphically. I cannot understand why the hook broke just where it did. There is no evidence of a flaw. **QUARRYMAN.**



Inverary, July 2nd.

### ENGINEERING AS A PROFESSION.

SIR,—Your correspondent Mr. Dodd is a man with whom I should like to shake hands. I have spent about as many years at it as he has, and I can endorse all he says. Repetition work means money, and so does division of labour; but as to the monotony of it, one gets used to that. All work that I know of gets to be monotonous—it comes the easier.

Turning now to "E. C. A." He cites Messrs. Yarrow. Now, I do not think it is right to mention individual firms. But I will take torpedo boats in the mass, so to speak, and I assert plainly that they are the result of nothing but extended and costly experiment. They are neither more nor less than an outcome of the steam launch. Their history is the same as that of the Atlantic greyhound, or the modern express engine. They are the result of trial and error. Mr. Froude taught torpedo boat builders nothing, but he learned a great deal from them. I have said, and I repeat, that the great bulk of the mechanical engineering trade of this country—a trade representing a turnover of millions of pounds sterling per annum—is no more scientific than the trade in blankets and tea. Of course there are exceptions, but they have next to nothing to do with the matter being discussed.

Mr. Lightfoot's letter can be answered in a few words. He suggested superheated steam as an outcome of thermodynamic theory. I replied that superheating had been tried before thermodynamics had been heard of as such by engineers. I pointed out that the refrigerating machine was not suggested by anyone versed in thermodynamics. I said that it was a growth. I do not for an instant dispute that at the eleventh hour the chemist has come in and suggested improvements.

But I shall simplify matters with Mr. Lightfoot by offering him a challenge. If he will tell me what Hirn has done to improve the steam engine, and to what extent he has improved it, as a mathematician and a physicist, I will acknowledge that I have been all wrong. I shall admit that I have entirely failed to appreciate the value of scientific work in bettering the steam engine.

On the other hand, if Mr. Lightfoot fails, I shall expect him to admit that he has overrated the value of pure science as compared with the effect of evolution, the survival of the fittest, which has, I maintain, produced the modern steam engine, aye, and the modern refrigerator too. Why, even as regards the dynamo, one of the most recent and startling improvements has been brought out, as I am informed, by a man with little or no scientific training. May I, in conclusion, ask Mr. Lightfoot what he thinks of Edison?

DENARIUS.

July 2nd.

SIR,—Referring to my letter in your last issue, I beg to state that there is an error in the fourth line. "Experiments conducted by him" should be "Experiments conducted by Hirn." This is, of course, totally different, so I trust you will find room for this correction in your next number.

CECIL LIGHTFOOT.

7, Eastcombe Villas, Blackheath, S.E., July 1st.

July 3rd.

THE PROJECTED TOWER BRIDGE OF THE YEAR 1824.

SIR,—Now that this noble structure is completed, it is interesting to recall the particulars of the construction as it was intended to be seventy years ago, which I take from the *Mechanics' Register*. In its impression of March, 1824, it is stated that an application was to be made to Parliament for leave to erect a wrought iron bridge over the Thames from St. Catherine's to the opposite shore, the bridge to be of an elevation sufficient to admit ships to pass under it at all times.

A Captain Brown seems to have made a report thereon, for in the May number the following extract is given from his report:—"The bridge is to consist of three spans of 600ft. each and two side spans of 300ft. each. The extent of the suspended bridge, including the towers, is 2400ft., or a little more than half a mile. The road on the north side is to take its rise from Little Tower-hill, opposite to the Minories; that on the south side near Dockhead, in Bermondsey, which forms a central point to the streets leading to the great Kent and Surrey roads. The rise from its commencement on each side is formed by an easy acclivity of one foot perpendicular in 20 horizontal. The carriage way is to be 21ft. wide, and the footpaths on each side, 8ft.; the height of the bridge above high water mark, 70ft. in front of the towers, rising to 75ft. in the centre. This height will allow ships of 200 tons to pass without striking their topgallant masts, and ships of 300 and 400 tons to pass with their main topgallant masts down. The towers will be constructed of granite. Each of the bridges will be supported by sixty-four principal bars or belts of suspension, 2½in., as shown in the designs. The bolts will be 20ft. long, joined by side plates and pins of proportional strength. They will be extended from their respective points over the towers, in four rows, each over other, one foot apart, each row to consist of four lines of bolts parallel with each other. These principal lines of suspension may now be denominated chains, although differing from the common form and acceptation of the word. The joints being exactly opposite to each other, the saddles which support the perpendicular bolts rest on them and bear equally on all. The principal suspenders are so arranged that the beams are ultimately supported by a different row of chains, so that an equal strain is produced."

The foregoing plan renders the united strength of the principal suspenders certain, and Captain Brown estimates the least breaking weight of any one span 3204 tons. The total weight that could be put on the bridge he estimates at 550 tons. It will be necessary to state most unequivocally, he says, that there will be no hindrance on land or water during the erection. When the towers are finished temporary chains, fixed in half an hour, will be stretched across, and the whole by means of a temporary gangway will be put together aloft.

J. H. RAWLINS.

15, Kelvin-grove, Liverpool.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Torpedo boat Ericsson, United States Navy.*—The latest addition to the "new navy" of the United States is the torpedo boat Ericsson, which was launched at Dubuque, Iowa, on the Mississippi River, in May. This is really the first torpedo boat built for the Navy, as the Cushing—or No. 1—was altered from her original design to suit her for torpedo work. The Ericsson, while larger than the Cushing, does not draw so much water. The Cushing has a length on load water-line of 138¾ft., a beam of 14ft. 10in., and a mean draught of 5¼ft., giving her a displacement of 110 tons. The new boat has a length of 150ft., a beam of 15½ft., and, with a depth of 10ft. 6in., has a normal draught amidships of 4¾ft., with a displacement of 120 tons. She has 1800 maximum horse-power, against the Cushing's 1720-horse power. The motive power, though greater than that of the Cushing, is similar. It consists of two sets of four-cylinder quadruple-expansion engines of the vertical inverted direct-acting type, operating twin screws. The cylinder diameters are 11½in., 16in., 21½in., and 30in. The stroke of all pistons is 16in. The estimate of 1800 indicated horse-power of the propelling and circulating pump engines is based on the propeller speed of 412 revolutions per minute. One water-tight compartment is sufficient for the two engines. Each of the two Thornycroft boilers is also in a water-tight compartment, the engines standing between them. The Cushing, with a required speed of 22 knots an hour, made 22·52 on her trial trip, and has done better since. The required speed of the Ericsson is 24 knots, and the builders are to receive premiums ranging from 2500 dols. to 3500 dols. for each quarter knot above the guarantee, and corresponding reductions are to be made for deficiencies. This speed requires the best possible model, engines, and boilers. It also demands strength and accurate bearings. To secure strength the transverse system of construction has been adopted. Longitudinal strength has been secured by the use of an intercostal vertical keel and broad, heavy stringer plates. The intercostal keel connects the outer keel plate firmly to the inner flat keelson. This prevents tripping of the floors and reduces the vibration caused by the engines. The frames are of steel and the plating of galvanised steel $\frac{3}{16}$in. to ¼in. thick. The conning tower is of conical form, about 6ft. diameter and 7ft. high. The interior of the boat is divided into twelve water-tight compartments by bulkheads. In the bow are the steam windlass, locker seats, torpedo store-room and crew space for the twelve men. Amidships are two fresh water tanks for distilled water, 360 gallons, boiler room, engine-room 10ft. by 20ft., and boiler room with coal bunkers on either side, lockers for signals, compass-room, and state-room for commander and engineers, next to which is the powder magazine. Aft, are the ward-room, officers' dining-room, lavatory, &c. The interior is covered with cork paint to prevent the sweating of the metal. The armament of the Ericsson consists first of a fixed torpedo tube, whose mouth, 18in. in diameter, is in the prow 2ft. above the water-line. This is fired by compressed air, controlled from the conning tower. On the deck are four one-pounder rapid-fire guns for repelling boarders. There are two turntable tubes on a training circle aft on the upper deck, just abaft the after funnel. The diameter of these is 14in. The Whitehead torpedo will be used. The turntable tubes will be discharged with powder. The torpedoes are intended to be discharged at a range of about half a mile, and the torpedo boat, travelling at twenty-seven knots, would be difficult for the enemy to hit. The complement of officers and crew will be twenty in all. The boat will be sent down the Mississippi to the gulf, and delivered to the Government at the Pensacola navy yard in Florida. It may be mentioned that torpedo boat No. 1, the Cushing, is named after Lieutenant Cushing, U.S. Navy, who during the civil war succeeded in blowing up the frigate Albemarle with a spar torpedo from an open torpedo launch, the boat being almost simultaneously smashed and sunk by a shot from the Albemarle. At the same yards at Dubuque is being built the revenue cutter William Windom, which will not be completed until next spring. Her dimensions are:—Length, 171ft.; beam, 27ft.; depth, 13½ft.; contract price, 98,000 dols. She will have a single Scotch double-ended boiler of 800-horse power, a pair of triple-expansion engines of 800-horse power, and a hull plating of ⅜in. steel. She will be placed in the service of the Treasury Department at the Baltimore station.

*Railways of Massachusetts.*—The report of the Railway Commissioners of Massachusetts for the year 1893 contains some interesting details of receipts, operating expenses, &c., as shown in the table below. The State has 2120 miles of main and branch lines, with 4151 miles of track.

| | |
|---|---|
| Number of passengers | 119,779,947 |
| Average journey per passenger | 14·56 miles |
| Number of passengers carried one mile | 1,744,388,553 |
| Average passenger fare per mile | 1·83 cents |
| Number of tons of freight | 32,995,033 |
| Average haul per ton | 73·68 miles |
| Number of tons carried one mile | 2,431,081,708 |
| Average freight rate per ton per mile | 1 39 cents |
| Passenger revenue | 50·16 per cent. |
| Freight revenue | 48·44 „ |
| Other earnings | 1·40 „ |
| Gross assets | 334,744,845 dols. |
| Gross liabilities | 320,551,031 dols. |
| Percentage of surplus to capital | 7 60 per cent. |
| Capital stock | 186,440,423 dols. |
| Net debt | 115,003,021 dols. |
| Total income | 76,391,933 dols. |
| Total expenditures | 75,163,831 dols. |
| Gross income from operation | 54,480,968 dols. |
| Operating expenses | 37,188,292 dols. |
| Percentage of expenses to income | 69·79 per cent. |
| Gross earnings per mile | 16,390 dols. |
| Cost of operation per mile | 11,438 dols. |
| Passenger train mileage | 26,041,383 |
| Freight „ „ | 19,172,518 |
| Other „ „ | 12,213,041 |
| Total „ „ | 57.426,942 |
| Earnings for total revenue train mile | 1·558 dols. |
| Cost of running trains per train mile | 0·862 „ |
| Cost of repairs per total train mile:— | |
| Roadbed | 0·100 „ |
| Bridges | 0 018 „ |
| Rails | 0·016 „ |
| Locomotives | 0 039 „ |
| Passenger cars | 0 034 „ |
| Freight cars | 0·046 „ |
| Wages per total train mile | 0 298 „ |
| Fuel per total train mile | 0·101 „ |
| Total | 0 652 „ |
| Number of employés | 48,381 |

*Railway operating statistics.*—In this column of THE ENGINEER I have already given the actual operating statistics of several American railways, which are in many ways of greater value than the assumed averages for the whole United States, which are so often used in discussions on railway rates, &c. Below I give similar statistics of the Norfolk and Western Railroad for the year ending December 31st, 1893, which railroad is an important coal and freight route, comprising 1567 miles:—

| | |
|---|---|
| Miles of railway | 1567 |
| Locomotives per mile | 0·26 |
| Passenger cars per mile | 0·17 |
| Freight, &c., cars per mile | 11·10 |
| Passenger engine mileage per day | 117·33 |
| Freight engine mileage per day | 80·16 |
| Freight car mileage per day | 33·24 |
| Average load per freight car—tons | 18·11 |
| Average loaded cars per freight train | 16·90 |
| Gross earnings—dollars | 10,032,617 |
| Operating expenses—dollars | 7,199,460 |
| Net earnings—dollars | 2,833,157 |
| Gross earnings per mile—dollars | 6,448 |
| Net earnings per mile—dollars | 1,821 |
| Number of passengers | 2,052,387 |
| Passenger mileage | 70,593,740 |
| Earnings per passenger per mile—cents | 2·897 |
| Expenses per passenger per mile—cents | 2·235 |
| Profit per passenger per mile—cents | 0·662 |
| Number of tons of freight | 6,325,735 |
| Tonnage mileage | 1,554,938,009 |
| Earnings per ton per mile—cents | 0·514 |
| Expenses per ton per mile—cents | 0·362 |
| Profit per ton per mile—cents | 0·152 |
| Mineral traffic—tons | 4,599,914 |
| Passenger earnings per train mile—cents | 79·11 |
| Passenger expenses per train mile—cents | 61·04 |
| Net earnings per passenger train mile—cents | 18·07 |
| Ratio of passenger expenses to earnings, per cent. | 77·16 |
| Earnings per freight train mile—cents | 102·46 |
| Expenses per freight train mile—cents | 72·11 |
| Net earnings per freight train mile—cents | 30·35 |
| Ratio of freight expenses to earnings, per cent. | 70·50 |
| Ratio of total expenses to earnings, per cent. | 71·77 |
| Average journey per passenger—miles | 34·40 |
| Average haul per ton of freight—miles | 245·81 |
| Cost of maintenance of way per mile—dollars | 826 |
| Cost of maintenance of way per car mile—cents | 0·68 |
| Cost of engine repairs per 100 miles run—dollars | 5·90 |
| Cost of engine fuel per 100 miles run—dollars | 4·29 |
| Average cost per engine per 100 miles run—dollars | 10·58 |

TRAWDEN SEWERAGE SCHEME.—A Local Government Board inquiry has recently been held at Trawden by Colonel Ducat, R.E., into an application by the Local Board of Trawden for a loan for works of sewerage and sewage disposal. The sewage scheme is being carried out with a view to prevent pollution of the tributaries of the Calder. Mr. William Dent, the Board's engineer, described the sewage purification system to be adopted, which is that known as the "International," consisting of precipitation by ferozone, and filtration through polarite, with tanks on the continuous flow principle. Evidence was given in support of the application, and the inquiry then terminated without any opposition.

THE NATIONAL TRACTION ENGINE OWNERS' AND USERS' ASSOCIATION.—A general meeting of the Association was held, according to the rules, at the Royal Agricultural Society's Show at Cambridge on Wednesday last. The meeting was held, by the permission of the Council of the Royal Society, in their tent. Mr. H. D. Marshall, of Gainsborough, took the chair, among those present being Mr, J. E. Ransome (President of the Agricultural Engineers' Society), Mr. T. Aveling of Rochester, Mr. Burrell of Thetford, Mr. Murrison of Aberdeen, Mr. Jesse Ellis of Maidstone, Mr. Allen of Oxford, Mr. Chittenden of West Malling, Mr. de Mattos of Dorchester, Mr. R. W. Eddison of Leeds, Mr. Willcox of London, Mr. R. Neville of Somerset, Mr. Hancock of Bristol, and Mr. H. R. Summers (the secretary). The report of the General Council on the work of the Association since its inauguration in December last was read. Mr. Murrison, of Aberdeen, spoke of the strength of the feeling being aroused in Scotland on the subject. Mr. R. Neville told how the Somerset County Council had, in response to a local deputation of engine owners, lengthened the hours during which engines could work through the country. Mr. J. E. Ransome referred to the strong opposition against railways which had now been overcome, and said that the opposition against the traction engine would be similarly overcome; and stated that he knew from practical experience that horses could be educated so as not to have the least fear of traction engines. Mr. Knight, of Farnham, spoke of the facilities given in France to steam road locomotion. Mr. Hancock, of Bristol, spoke of the difficulties under which showmen who want to take a large number of light wagons behind one engine have to put up with. Mr. Jesse Ellis, of Maidstone, spoke of the trouble and annoyance caused by having to take out a fresh licence for each county, and of the necessity of all engine owners joining the Association. Mr. Burrell proposed and Mr. Eddison seconded a hearty vote of thanks to the chairman, and the meeting concluded.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE fact that the quarterly meetings are to be held next Thursday in Birmingham, and in Wolverhampton on the previous day, tends to restrict current business within narrow limits. No one seems inclined to order in advance of those gatherings. Prices on the whole may be expected to be rather weaker than was the case in April, though doubtless the strained position of affairs in the coal trade will have a tendency to prevent as much decadence as might otherwise be observable. Staffordshire furnace coal is quoted 10s. to 11s.; best forge, 9s.; second sorts, 8s. 6d.; and ordinary 7s. Manufacturing slack ranges from 5s. down to 3s., according to quality and fineness. Inquiries made as to the course coke is likely to take show that vendors are endeavouring to keep up prices. North Staffordshire descriptions are 13s.; Yorkshire, 16s. to 18s.; Derbyshire, 16s.; and Welsh, 16s. 6d. to 18s. These are furnace sorts. Foundry coke from South Wales is quoted 18s. to 21s., and from the North-East coast, 22s. to 25s. In the manufactured iron and steel trade a fairly regular business has of late been carried on.

Cinder pigs are 37s. 6d. to 38s.; part mines 41s. to 42s., and hot blast from 55s. to 62s. 6d., according to quality. Galvanised corrugated sheets are quoted £9 15s.; and black doubles £6 10s., whilst trebles are £7 5s. An important step has this week been taken in the local iron trade. Owing to the unsuccessful attempt at a sale of the iron and steel works of the New British Iron Co., Corngreaves, to which I referred last week, notice has this week been posted to the workpeople terminating all contracts at the end of the month. The effect of this decision will be that one of the oldest of the Staffordshire iron works will cease manufacturing. It has for some time past been evident that only the sale of the works as a going concern could prevent this step, and the attempt in this direction having failed, no alternative is left but to close down the concern. The position of the firm as a marked bar house and as Government contractors for iron and steel was considerable, and its history dates back into some of the best periods of the Staffordshire iron trade. The effect of the closing of the works must be to throw out of employment a large number of both iron workers, colliers, and other classes of labour. The company employ from 1500 to 1800 workpeople, and at one time the pay roll was £2000 a week in wages.

The local steel works are profiting to some extent by the quietude in the iron trade. The basic steel works at Bilston of the Staffordshire Steel and Ingot Iron Co. are understood to have already booked large orders on next quarter's account. The new steel works of the Round Oak Iron Co., Brierley Hill, with which the Earl of Dudley is connected, are progressing satisfactorily, and are expected to be in operation in a month or two. Staffordshire steel boiler plates of basic quality are quoted at date £6 5s., tees and channels £5 10s.; machine shafting bars—round—from 1¼in. up to 6in., £6; bridge plates, £5 10s., and angles £5 5s. In comparison with these prices may be placed the figures at which some of the North of England steelmakers are offering what they declare to be Siemens-Martin steel delivered into this district. The figures are:—Billets, £4 5s.; bridge plates, £5 12s. 6d. to £5 15s.; plates to stand Indian States Railway tests, £6; and boiler plates £6 5s. The Lilleshall Steel Co., Shropshire, quote steel wire rods, delivered into the Birmingham district, £5 15s., and plating bars, £5 2s. 6d. to £5 5s. Leeds steel joists are quoted, delivered Birmingham, £5 10s.; channels, £5 15s., and bars, flat, £5 5s. per ton.

Much satisfaction was expressed on 'Change in Birmingham on Thursday at the information of the passing of the American Tariff Bill. Reports from the other side of the Atlantic have for so long a time been of a contradictory nature regarding the chances of the measure, that the intelligence of its success in the Senate comes as a relief, and improved anticipations are indulged of the future of trade. Private advices received by certain leading houses in this district announce that when trade revival commences in America, and costs of material and manufacture begin to go up there, British iron and steel makers will, under the new duties, now be able to send in material and command American orders. The new tariff entirely removes the duty on baling hoops, of which 40,000 tons are annually consumed for the American cotton crop. The probability is that British ironmasters will now secure more of this business than ever before.

A very fair account is given by the bridge builders of the current demand, steel structures being well called for for the colonies and some of the foreign markets. A moderate extent of business is reported in the chain and anchor trades, but there is continued quiet in some other departments of the heavy hardware industries. The vice and anvil makers report rather more business for the home trade, but the continental and colonial demand is very dull. Steam tube makers are more favourably situated, and here and there good contracts are in hand among the engineers.

A week or two ago I announced that the result of the appeals which have recently been made by manufacturers in Wolverhampton to the Union Assessment Committee against the increased rating of their machinery and other properties, would very probably be that certain of the cases would be carried to quarter sessions. It is now definitely made known that several of the leading firms and other property owners have resolved upon taking this course, and unless the Union authorities consent to further reductions, the appeals are certain to go into court.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—The position throughout the engineering, iron, and coal trades of this district remains without improvement, and the uncertainty as to the course of events with regard to the wages question in the coal trade induces an unsettled feeling as to the future. Some of the large users of fuel are taking advantage of the present excessively low prices to get in stocks, as a precaution against possible eventualities; whilst for pig iron makers are not anxious about committing themselves to engagements over any extended period, and generally there is a disposition to restrict operations to as narrow limits as possible, which necessarily checks the development of anything like speculative enterprise. The probable outcome of the miners' strike against a reduction in wages is being keenly anticipated here, as it will largely govern the action of the English coalowners with regard to wages; and the fact that the Miners' Federation have increased the special levy in support of the Scotch miners to 1s. per member per week, shows that they regard the struggle as a vital one, and that they are determined to use every effort to prevent any reduction whatever in wages.

A generally depressed tone continues to be reported throughout the iron market here, and at Tuesday's meeting there was again only a very limited weight of business stirring, whilst pig iron makers in most cases complain that, even where they are fairly well sold, their customers are only taking deliveries on account of contracts very indifferently. As regards pig iron, there is no change so far as local and district brands are concerned. Lancashire makers still quote nominally on the basis of about 39s. 6d. to 40s. for forge to 42s. for foundry, less 2½, at the works, but they remain practically out of the Manchester market, the delivered prices for which are about 42s. for forge to 44s. 6d. for foundry, and they are booking very little business of any moment, even where they have much more favourable rates of carriage. For district brands prices continue extremely low, Lincolnshire not averaging more than 38s. 6d. for forge to 39s. 6d. for foundry, with Derbyshire foundry readily obtainable at 44s. 6d. to 45s. 6d. net cash, delivered Manchester. The miners' strike in Scotland, and the damping down of some of the furnaces, necessarily has some effect upon outside brands offering here, and prices have shown a hardening tendency, but any appreciable advance is little more than nominal, as there is scarcely any business to really test prices. Good foundry Middlesborough is, however, not quoted under 44s. 4d. net cash, delivered Manchester, whilst as regards Scotch iron, some of the makers have withdrawn quotations altogether, and where there are sellers in the market, they are asking about 46s. for Eglinton to 49s. and 49s. 6d. for Glengarnock and Gartsherrie, net prompt cash, delivered at the Lancashire ports.

In the finished iron trade only the slowest possible business continues to be reported, forges not starting before Tuesday or Wednesday, and only just kept going hand-to-mouth with this restricted production. For Lancashire and North Staffordshire bars the quoted prices remain nominally at £5 10s. to £5 12s. 6d., delivered in the Manchester district, but it is exceptional where local makers are getting more than £5 7s. 6d.; Lancashire sheets can be bought at £6 17s. 6d. to £7 2s. 6d., and Staffordshire about £7 5s. per ton. The official list rates for Lancashire hoops remain at £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Nut and bolt makers report a continued decreasing inquiry, with excessively keen competition to get hold of any orders that happen to come upon the market.

In the steel trade only a very quiet business comes forward, with prices about as last quoted, ordinary foundry hematites averaging about 52s. 6d., less 2½; ordinary basic billets £4 net cash, with steel boiler plates obtainable at £6 7s. 6d. to £6 10s., local makers who quote £6 15s. being altogether out of the market.

In the metal market there is perhaps more inquiry stirring at the reduced list rates for manufactured goods, but there is still no great weight of actual business doing.

The position, generally, throughout the engineering industries remains very much what I have reported for some time past. Only in exceptional cases are establishments more than very moderately off for orders, whilst new work still comes forward very indifferently, and the outlook for the immediate future shows no indication of any probable revival of activity.

The official programme in connection with the approaching visit of the Institution of Mechanical Engineers to Manchester has been issued this week, and the following papers have been offered for reading and discussion at the summer meeting, which will be held in the Owens College during the visit:—"Description of the New Electric Lighting Works, Manchester," by Dr. John Hopkinson, F.R.S., Member of Council; "Electric Welding," by Mr. Benjamin Alfred Dobson, Member of Council; "Description of Twin-screw Propellers with Adjustable Immersion, fitted on Canal Boats," by Mr. Henry Barcroft, of Newry; "Description of the Manchester Main Drainage Works," by Mr. William Thomas Olive, resident engineer; "The Manufacture of Standard Screws for Machine-made Watches," by Mr. Charles J. Hewitt, of Prescott; "Drilling Machine for Cylindrical Boiler Shells," by Mr. Samuel Dixon, of Manchester. The proceedings open with a reception of the Council and Members of the Institution by the Right Hon. the Lord Mayor of Manchester—Sir Anthony Marshall—and the Mayor of Salford—Sir Wm. H. Bailey—at the Owens College, on Tuesday morning, July 31st, to be followed by the reading and discussion of papers on that and the subsequent Wednesday morning, the visit extending over until Friday. On the Tuesday and Wednesday afternoons, excursions are to be made to various works of interest in the district; on Tuesday there is to be a conversazione in the Town Hall, by invitation of the Lord Mayor of Manchester; on Wednesday evening the Institution dinner is to be held at the Grand Hotel; on Thursday, excursions are to be made to various points of interest in the district, and in the evening the local members of the Institution have specially engaged the Theatre Royal, where a private operatic performance will be given, to which the members of the Institution are invited. On Friday there are to be excursions to Bolton, where several of the important cotton mills and machine and engineering works; to Horwich, where the Lancashire and Yorkshire Railway Locomotive Works; and to Crewe, where the extensive London and North-Western Steel and Locomotive Works are thrown open for inspection by the members.

In the coal trade only a very slow inland demand for all descriptions of fuel continues to be reported, and stocks go on rapidly accumulating, although very few pits are working more than three to four days per week. The increased demand for shipment, however, reported last week, is fully maintained, owing to the miners' strike in Scotland, and this is helping to clear away some of the surplus supplies, which would otherwise be coming upon the market, whilst it is also tending to steady prices somewhat, which might otherwise have shown a downward move. At the pit mouth best Wigan Arley coals remain at 11s. to 11s. 6d.; Pemberton, four feet and seconds Arley, 10s. to 10s. 6d.; with common house-coals ranging, according to quality, from 7s. for steam and forge descriptions up to 8s. to 8s. 6d. per ton. With regard to gas coals prices would seem to get weaker, if anything, as the season advances, and contracts which have been placed during the past week or so have in most cases been taken at very low figures; in some instances quite as low as those ruling last year, ranging from about 7s. for ordinary screened, up to 8s. and 8s. 6d. for the best screened gas coals at the pit mouth. The supplies of engine classes of fuel are generally plentiful, and for these, prices, if anything, are rather easier, common slack being readily obtainable at 4s. 3d. to 4s. 6d.; medium sorts, 5s. to 5s. 6d., with very best qualities quoted at from 6s. up to 6s. 6d. per ton.

In the shipping trade, as already stated, there is a fair amount of activity just now, and better prices have been got, ordinary Lancashire steam coal, delivered at the Garston Docks, or the High Level, Liverpool, fetching about 9s. to 9s. 3d. per ton.

*Barrow.*—There is no increase in the activity of the local hematite pig iron trade. Makers are indifferently employed, and have only thirty-six furnaces in blast. Some slight improvement may be realised by the Scotch strike, and by an increased demand for hematite on Scotch account, but while the pig iron trade may be benefitted by this cause, there will be a corresponding falling off in the consumption of native iron ore, which to the extent of several hundred tons is shipped weekly to Scotch smelters of hematite. Warrant iron is quoted at 44s., net cash sellers, and 43s. 11d. buyers. Makers' prices are unchanged at 44s. 6d. to 45s. 6d. net, f.o.b., for mixed Bessemer numbers. Stocks of warrant iron have increased during the week to the extent of 1320 tons, leaving stocks in hand 147,496 tons, or an increase of 52,873 tons since the beginning of the year.

Iron ore is in quiet local consumption. Ordinary qualities are quoted at 8s. 6d. per ton, better sorts at 9s. 6d., and picked samples at 13s. 6d. per ton net at mines.

In the steel trade there is not much life. Inquiries for steel rails are comparatively few, and foreign orders are especially scarce. Very few new consignments are in the market, and makers are not well sold forward. Steel for shipbuilding purposes is in fair but not brisk request, but makers are still fairly well sold forward on local account, while at the same time holding orders for Liverpool, Belfast, Scotch and other shipbuilding centres. There is not much doing in billets, tin bars, or hoops. Trade is nil in blooms, wire rods and slabs.

Shipbuilders and engineers are fully employed in most departments; but additional orders will soon be required, and if they are not soon forthcoming the initial departments of trade will be slack. There is a prospect of orders for some important high-class lines; but the general demand for new shipping tonnage is very small indeed, although probably ships could now be built at less money per ton than at any previous time in the history of the trade. There is not, however, much employment for shipping, and freights are low. A consignment of 12,000 tons of steel rails was fixed by steamers, from Barrow to Calcutta, at 8s. per ton.

The coal and coke trades are very quiet, and the volume of business doing is small. Prices are, however, steady at old rates.

The shipping trade shows again a falling off in tonnage. The exports of pig iron from West Coast ports last week reached 5505 tons, compared with 7390 tons in the corresponding week of last year, a decrease of 1885 tons. The aggregate shipments of pig iron for the year so far have reached 195,121 tons, compared with 132,868 tons in the corresponding period of last year, an increase of 62,253 tons. The exports of steel last week amounted only to 4266 tons, compared with 10,267 tons in the corresponding week of last year, a decrease of 6001 tons. The shipments of steel to date this year have reached 194,719 tons, compared with 239,404 tons, a decrease of 44,685 tons.

There is still a large number of unemployed skilled and unskilled artisans in the district.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE effect of the Scotch miners' strike is beginning to make itself apparent in the Yorkshire district, although not to the extent that was anticipated. Owing to the sudden advent of exceptionally warm weather, household coal is again somewhat depressed, many of the largest collieries producing steam coal, enjoying at present an abnormal demand, have consequently an unusual quantity of softs—that is household fuel—to get rid of. This has been severely felt for some time, particularly in West Yorkshire, where many of the manufacturers obtain supplies at very low prices. Should the Scotch strike continue, efforts will no doubt be made to dispose of the surplus of it in that direction. Prices in the neighbourhood of the coal-pits are well maintained, and the demand from the metropolis being fully up to the average, quotations remain unchanged. Coal by sea is going to London in less quantities, and this has the effect of benefiting Midland coal proprietors. Silkstones are making from 9s. 6d. to 11s. per ton; Barnsley house, from 8s. 6d. to 10s. per ton; Flockton, 8s. 9d. to 10s. per ton; inferior grades, from 8s. to 8s. 6d. per ton. The district pits are sending large supplies of steam coal to the Humber ports, the thick-seam collieries obtaining a better position with regard to this trade. Values remain steady, Barnsley hards keeping at 7s. 9d. to 8s. 6d. per ton; other qualities from 7s. per ton. Gas coal is in fair demand, at 7s. 6d. to 8s. per ton. Manufacturing fuel is plentiful, but there is little demand, and prices are low, good slacks making only from 4s. 6d. to 5s. 6d. per ton. Smudge and small coal in dull request from 2s. per ton. Coke quiet at from 9s. to 11s. per ton.

In consequence of an improved call for house coal from London and the South, prices have been advanced 6d. to 8d. per ton. One of the largest of the gas contracts, that of the Birmingham Corporation, was placed in the end of last week, at prices rather higher than for the previous year. A considerable portion of the order has again been secured by Messrs. J. and G. Wells, of the Eckington Collieries. Railway companies have generally arranged for contracts for the supply of fuel for the ensuing year at prices varying from 8s. 3d. to 8s. 6d. per ton.

There is a slight, but very slight, improvement in the iron and steel industries. More is doing in the rolling mills, caused by increased demand in the lighter staple trades. Hematite irons remain at from 51s. to 52s. 6d.; common forge iron is at 38s., both delivered at Sheffield. Bar iron is quoted at from £5 10s. to £5 15s.; Bessemer billets, £5 7s. 6d. to £5 10s.; ordinary iron sheets, £8 10s.; English dead softs wire rods £5 5s., and high carbon and rope rods £8 per ton. There is a considerable business doing in finished iron. The outlook in the shipbuilding trade is discouraging.

Sheffield manufacturers are in daily expectation of the tariff arrangements being settled in the United States. The agreement come to is expected to be about equivalent to a duty of 62½ per cent. all round, as compared with the 50 per cent. *ad valorem* in force prior to the McKinley measure. If this comes about the new tariff will be a considerable advantage compared with the McKinley Act, which imposed a duty upon pen and pocket knives of between 70 and 100 per cent. There is an expectation in local quarters that, as the result of a conference to be held, the tax will be reduced to 50 per cent. all round. Trade continues very quiet in the United States, although a good many orders are coming to hand now, in consequence of stocks being entirely exhausted. Sheffield trade with Spain is also in an unsettled state. Our treaty with that country terminated on June 30th, and as no fresh arrangement has been come to, the probability is that England will come under the maximum tariff, as Germany has done. Between Germany and Spain a war of tariffs is at present being carried on, the one country retaliating against the other.

The annual meeting of Messrs. John Brown and Co., Atlas Steel and Iron Works, Sheffield, was held on the 3rd instant, Mr. J. D. Ellis, J.P., the chairman of the company, presiding. The proceedings were of more than usual interest owing to this company having been somewhat exceptionally situated in regard to the great coal strike. The chairman stated that the outlook, with regard to their ordinary trades, such as axles, tires, and steel, was not any better than at the corresponding period of last year. With regard to the miners' strike, the shareholders could hardly imagine the difficulties the strike entailed upon the company. Their collieries were very large, raising 20,000 tons of coal per week. They had coal to last them six weeks, but the strike extended over sixteen weeks, and when their supplies were exhausted they had terrible difficulties to contend with. They had the ordinary expenses of the collieries, the maintenance of the staffs and horses, and in addition to that they had to consider the question of their workmen. Some of their neighbours, perhaps wisely, decided to shut up their works altogether, informing their customers that they could deliver nothing until the strike was over. The directors of John Brown and Co. did not think it wise to do that. They determined to consider their workmen, particularly as a very large number of them had only been working three days a week for a whole year before the strike occurred, and therefore had not been able to lay by anything for the calamity. The directors had therefore decided to keep the works going, and to give them employment one or two days a week as they could. Then, with regard to armour-plates, the Government had decided that they must adopt steel according to the Harveyised method. In 1886 the company had put down a large press, but under the Harveyised method the Bessemer process, for which John Brown and Co. had taken out the first patent, was not required. They had, therefore, to extend their Siemens-Martin plant. In the expectation of the very large orders to come, the directors had felt that it was not safe to depend upon a single press only. They therefore had decided to order another press from Messrs. Whitworth and Co., of Manchester. That would be a 10,000-tons press, which, when they got at work, would put them in the very best position for supplying the British and other Governments with Harveyised plates. Some idea of the magnitude of this press will be obtained from the fact that two of its pieces would weigh 80 tons each, and would have to be lifted above the uprights to a height of 100ft. Referring to the armour-plate tests which had taken place at Russia, Mr. Ellis mentioned that as the Russian projectiles were fired at a 6in. plate when the plate ought to have been 10in., it was not extraordinary that the plate should have been pierced. As far as the trials have gone, Messrs. John Brown and Co. had no reason to be dissatisfied with the result.

Mr. H. D. Pochin, J.P., vice-chairman, in seconding the adoption of the report, said that one-third of the whole money-getting power of the company was in armour plates, and the other third was in coal, so that two-thirds of the entire money-getting power was affected by the condition of trade last year. He mentioned that the 10,000-ton press now ordered would be the largest in this country, the only one equal to it being in America. The nearest to it in England was that of Messrs. Vickers, Sons and Co., which was an 8000-ton press. The cost of the 10,000-ton press would be, with its surroundings, £100,000. Two large departments recently added to the establishment were now in full operation. One of these was the Purves flue, which had now been fitted into 1800 ships. The other was the Serve tube, with which seventy-eight vessels were now at work. The outlook for the ensuing year was believed to be most encouraging. The dividend declared for the past year was 5 per cent., against 7½ for the previous year, the diminished return being entirely owing to the two causes mentioned—the absence of orders in the armour-plate department and the coal strike.

Captain Tressider, who is at present in Russia attending the tests of armour-plates, has been appointed a director of John Brown and Company, Limited, Sheffield. The chairman of the company, Mr. Ellis, stated that Captain Tressider's experience in the army was very great and valuable, and his technical knowledge—particularly in regard to the resisting power of armour-plates—stood as high as that of anyone else, if not higher at the present moment.

Mr. A. M. Chambers, J.P., President of the Coalowners' Federation of Great Britain, has been presented with a cheque for a handsome sum in acknowledgment of his services in connection with the sixteen weeks' coal war. The cheque was accompanied by a piece of plate for presentation to Mrs. Chambers. The plate was in the form of a silver loving cup, with two handles, a figure emblematic of "Peace" being placed upon the lid. The cup is handsomely chased, and bears a suitable inscription. Mr. Hewlitt, on behalf of the members, made the presentation, and Mr. Chambers, in acknowledging it, mentioned that he was once engaged in a coal war which lasted thirty-three weeks, and cost the life of his father and uncle. He felt deeply grateful to the coalowners for the way in which they had stood by him in the recent trying circumstances, and hoped, as his health had been much improved by his stay abroad, that he would still have strength to be devoted to their service.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUSINESS continues to be greatly interfered with by the disputes between labour and capital, which in some cases have led to strikes, and in other cases strikes are threatened. The chief labour difficulty in this district is the strike of the moulders and patternmakers at the shipyards and engineering establishments, a strike which has already lasted for fourteen weeks, and which does not give promise of an early termination. The men have refused to allow the dispute to be settled by a Conciliation Board, which the masters suggest shall be formed, and yet they blame their employers for the continuance of the stoppage. Operations are further hampered by the shipyard joiners striking work, and what is worse, these difficulties do not involve the stoppage of the men on strike only, but many more have to be paid-off, because the employers cannot get castings, &c., to go on with, and they cannot make further progress with the orders in course of execution. Both at the engineering works and shipyards is this the case, and some establishments are to be closed altogether within the next few days. Thus Messrs. William Gray and Co.'s central shipyard at West Hartlepool is to be closed on Saturday, according to notice given last Saturday. From the Central Marine Engine Works, at Hartlepool, a large number of hands were discharged on Saturday, because the firm can find no employment for them through their inability to obtain castings, and there is now not more than a fourth of the normal staff working. From Messrs. Richardson's Marine Engine Works at Hartlepool about 1000 men have had to be discharged, and the rest have gone on three-quarter time this week. At various shipyards vessels are on the stocks ready for their engines, but these cannot be obtained. On this account Messrs. Ropner and Sons have had to give notice that from Tuesday next their extensive shipyard at Stockton will be closed. Sir Raylton Dixon and Co., Cleveland Shipyard, Middlesbrough, have posted a notice that owing to the continuance of the joiners' strike the yard will be closed on and after Wednesday next, and no men will be further employed, except such as may be specially arranged with by the foremen of the different departments. Vessels are being sent abroad to have their woodwork completed, owing to the joiners' strike, and already five have been so sent from the Tees to Germany. It is to be regretted that no move is made to bring about a speedy settlement of a dispute so disastrous, not only to the shipbuilding and engineering industries, but also to the trades which are to a large extent dependent upon them. The spirit of the men is shown by a resolution passed last Saturday at a conference of moulders at Middlesborough. It is to the effect "That this conference recommend to all trades unionists on the North-East coast that it is their duty to abstain from working on any job in which a casting may be used which has not been cast, or the pattern for which has not been made by the men now on strike." Even were the strike ended at once it would be two or three months before work could be fully resumed at the shipyards, as builders would have to wait for the engines. But the men do not show a conciliatory spirit at all, as they think their position is better than it has been at any time during the strike.

Another difference between employers and employed which threatens to become serious is that about the adoption of the eight hours' shifts at the blast furnaces. The ironmasters have refused to grant this, and accordingly the men have decided to stop work for twenty-four hours on August 6th, so that they may hold a demonstration in favour of the shorter day. The employers do not see their way to give leave for such a stoppage; but nevertheless the men are determined at whatever cost to have the holiday, and on Monday—after a conference with the men—the ironmasters passed the following resolution:—"The ironmasters are of opinion that a stoppage of twenty-four hours will entail a most serious and far-reaching loss on the industries of the district. While they recognise that the men are entirely within their legal rights in giving notice to terminate the existing engagements, they hold that in so doing they are acting against the spirit of the sliding scale, and of all arrangements which have hitherto existed between the employers and the blast furnacemen. They regret to find that an attitude which appears to the employers to be so hostile in character should be adopted by the men, and they desire to record their protest against the course which it is intended to pursue. They take note of the intention of the men, as intimated by their representatives, to give notice on the 21st July to terminate their engagement on Saturday, the 4th of August, and they will consider what action they on their side will adopt under the circumstances." With regard to the eight hours' shifts, they have been adopted at two works in this district, and are promised at a third next month, these works being connected with the Ironmasters' Association, but admittedly the adoption is only an experimental one, and it is expected that it will need a twelvemonth's experience to determine the cost. It would seem the better plan for the blast furnacemen, instead of pressing for the immediate general adoption of the system, to wait the result of the experiment at the works that have adopted it, and then if successful they would have a very strong case.

Some improvement is noticeable in the demand for Cleveland foundry pig iron, which is due to the strike in Scotland, and prices are firmer, and are likely to be higher if the stoppage in Scotland is not speedily ended, as Cleveland foundry pigs will have to be taken by the Scotch founders, who, it is expected, will be able to keep their establishments going by importing the comparatively small quantities of coke which they need. This district will also profit by the strike in Scotland, in that there will be less competition for the continental trade, as the Scotch makers are having to stop their furnaces. A greater share of the continental trade will thus come to the North of England. But if the strike is favourable to Cleveland foundry iron, it will be just the opposite for forge pigs, and also hematite iron, of which less will be required for Scotland, seeing that nearly all the finished iron and steel works there will be closed; indeed, many are so already.

There will, however, be a little to counterbalance this, because our local finished iron and steel works will be consuming more, as they are receiving more orders from the Clyde shipbuilders.

The June statistics of the Cleveland Ironmasters' Association are somewhat disappointing, seeing that they show a considerably greater increase of stock than had been estimated—no less than 9178 tons, making 20,363 tons for the last two months, when there should have been a decrease. The increase was nearly all in Middlesbrough makers' unsold stocks, for other makers reduced theirs, and there were only very small increases in makers' and the public warrant stores. The production of pig iron was as follows:—Cleveland pig, 123,733 tons—decrease, 3931 tons on May; hematite, basic, and spiegel iron, 127,493 tons—decrease, 1518 tons; total, 251,226 tons—decrease, 5449 tons. The decrease is more than accounted for by June being a day shorter than May. The number of furnaces in operation showed no change, and of the 93 in operation 52 were making ordinary Cleveland iron, and 41 hematite, &c. The stock of Cleveland pig iron amounted to 163,666 tons—increase, 9178 tons. Of this, Middlesbrough makers held unsold 57,444 tons—increase, 9099 tons; and other North of England makers 6841 tons—decrease, 606 tons. In makers' stores there were 1335 tons—increase, 10 tons; in the North-Eastern Railway Company's stores 15 tons—unchanged; and in Connal's stores 98,031 tons—increase, 675 tons.

The pig iron shipments from Middlesbrough during June reached 82,052 tons—4418 tons less than in May, and 706 tons less than in June last year. About one-sixth of the pig iron now exported from Middlesbrough is hematite, the quantity being 14,568 tons in June, and 14,228 tons in May. To Germany, over 20,000 tons of pig iron were sent last month from the Tees, and to Scotland 25,818 tons.

The quotation for No. 1 Cleveland pig iron, which is sent mainly to the Continent, is 38s., while for prompt f.o.b. deliveries of No. 3 nothing below 35s. 6d. has this week been taken, and this is readily paid; indeed, consumers would give it for deliveries up to the close of the quarter, but producers will not sell so far ahead. This week's fluctuations in Cleveland warrants have been small, having ranged over no more than 2d. No. 4 Cleveland foundry pig is quoted 35s., and grey forge 34s. 6d., but both are obtainable at less. Mixed numbers of East Coast hematite pig are quoted 44s., but have been sold at 43s. 9d. Connal's, at June 30, had in stock 43,589 tons of hematite pig, 2875 tons increase for the month. Foreign ore is cheaper, 12s. 3d. per ton delivered Tees being the figure for average Rubio. Good blast furnace coke can be bought at 12s. 3d. per ton delivered at Middlesbrough furnaces.

Messrs. Bolckow, Vaughan and Company, the Clay Lane Iron Company, and the Cargo Fleet Iron Company have agreed with the Tees Conservancy Commissioners to reclaim nearly 300 acres of foreshore at Eston and Cargo Fleet. They will effect the reclamation by tipping their slag upon it, and for this they will pay 2d. per ton, to be divided among the Tees Conservancy Commissioners, the frontagers, and the Crown authorities. This will afford facilities for the erection of further works on the south bank of the river Tees. Land on which to deposit the refuse of blast furnaces is getting very scarce in the neighbourhood of Middlesbrough, and several firms have to send their slag out to sea.

The finished iron and steel trades are a little more active than they have been, owing to additional orders from Scotland, and prices are stiffer. Bridgebuilders are also better off. A Darlington firm has secured the order for steel bridgework for the Great North of Scotland line from Ellen to Cruden. The Blythe Dry Dock Company has commenced with the third graving dock, which will be capable of accommodating the largest vessels.

In commemoration of the fiftieth anniversary of the establishment of the firm of Bell Brothers, the officials connected with the commercial department, the Clarence Iron and Alkali Works, the collieries, ironstone mines, and limestone quarries, &c., and also the representatives of the workmen, on Saturday presented a congratulatory address and a valuable service of silver plate to Sir Lowthian Bell, Bart., F.R.S., the senior member and founder of the firm. It is fifty years since Messrs. Bell Brothers started as iron manufacturers, and over forty since they commenced as producers of Cleveland pig iron, erecting their Clarence furnaces in 1852, within two years after the discovery by Mr. Vaughan of the main seam of Cleveland ironstone. Towards the presentation over 4000 workmen employed by the firm contributed. The address referred to Sir Lowthian's work in developing the minerals, coal, ironstone, and limestone of Durham and Cleveland, and also in founding the salt trade of Tees-side. It was stated that since the Clarence furnaces had been built, they had converted into Clarence pig iron over 20 million tons of Cleveland ironstone, and Sir Lowthian himself remarked that his firm had during the half century at their various works used no less than 74 million tons of minerals. The Council of the Middlesbrough Chamber of Commerce at its meeting on Wednesday, passed a resolution congratulating Sir Lowthian on his having attained the 50th year of his business life. It was stated that the Cleveland district was under great obligations to him for the investigations he had undertaken with a view of cheapening and improving the manufacture of the staple product of the district.

The coal trade is improving, and the higher prices generally asked are being maintained. Fully 11s. per ton, f.o.b., is paid for best Northumberland steam coal, or 1s. more than was recently paid, and some firms are quoting 12s. Best Durham house coals have been put up to 8s. per ton, f.o.b.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market has been in an irregular state this week, owing to the miners' strike. Business in warrants is limited, and while the varying opinions held with reference to the strike affect the market from day to day, the fluctuations in prices are within a comparatively narrow range. Scotch warrants have sold from 41s. 11½d. to 42s. 1d. cash; Cleveland, 35s. 3½d. and 35s. 4d., the quotations of Cumberland warrants being 43s. 11d. and 44s., and of Middlesbrough hematite warrants 43s. 3d. and 43s. 0½d. There is still a marked absence of speculation in warrants.

The attitude of the ironmasters with regard to the strike is very decided: they are resolved to close down their furnaces rather than make any concession to the colliers in their employment, and in the course of the past week a large proportion of the furnaces has been damped out. The production of basic iron is again stopped altogether. Monkland has been coming into request, and Gartsherrie is so scarce that the makers are keeping in as many furnaces as possible. Some of the lower priced special brands are in improved demand, and all of them have been rising somewhat in price. G.M.B. f.o.b. at Glasgow No. 1 is quoted 43s. 6d. per ton; No. 3, 42s. 6d.; Carnbroe, No. 1, 44s. 6d.; No. 3, 43s. 6d. Calder and Summerlee No. 1, 52s.; No. 3, 47s.; Gartsherrie No. 1, 52s. 6d.; No. 3, 47s.; Clyde No. 1, 49s.; No. 3, 46s.; Coltness No. 1, 54s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan No. 1, 50s.; No. 3, 47s. 6d.; Eglinton No. 1, 48s. 6d.; No. 3, 44s. 6d.; Dalmellington at Ayr No. 1, 45s. 6d.; No. 3, 44s.; Shotts at Leith No. 1, 53s. 6d.; No. 3, 49s. 6d.

The shipments of pig iron from Scottish ports in the past week have been much larger than usual, amounting to 10,248 tons, compared with 5603 in the corresponding week of last year. Of the total, Holland took 1225 tons, United States 25, Canada 200, South America 40, India 110, Australia 270, France 60, Italy 400, Germany 703, Belgium 10, Spain and Portugal 100, China and Japan 40, other countries 1018; the coastwise shipments being 6037, against 2972 in the same week of 1893.

The malleable iron and steel trades are depressed, a large number of the works is already closed, and will not re-open until after the strike is over. There is at the moment practically no market for finished iron and steel, both foreign and home requirements being small, and maker, merchant, and shipper acting with caution. Prices are nominally unaltered.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced locomotives worth £7000, sewing machines £7664, other machinery £7815, steel goods £14,918, and miscellaneous iron goods £22,736.

There has been a great falling-off in the coal shipments, the total quantity despatched from the various ports being only 79,643 tons, compared with 154,361 in the preceding week, and 156,986 in the corresponding week of last year. An advance has occurred in the prices of coals, but it is very irregular, and only in cases where supplies are urgently wanted are buyers consenting to pay the advanced rates. The miners' strike is very complete, there being very few men working.

During the past month 36 vessels of 37,226 tons were launched from the Clyde shipyards, against 29 vessels and 22,727 tons in June, 1893. The output of the six months has been 135 vessels and 168,818 tons, compared with 132 vessels and 121,700 tons in the first half of last year.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE number of bodies brought up from the Albion Colliery now totals 279, and it is currently reported that eighteen are still unaccounted for. If true, this will bring the death roll close up to 300, as suggested in this column last week. The inquiry is now about to begin, before a selected jury, and strenuous efforts will be made to trace the cause. It is not at all unlikely that, as many of the morning shifts continued to work on in the afternoon shift, some act of rashness, such as opening a lamp to light a pipe, was the first fatal cause. An invention by Mr. D. Evans, of Merthyr, which has just been patented, is now being discussed by mining engineers and colliery managers, as promising to effectually prevent the tampering of the locks of miners' lamps. Once locked, it is intact until handed back again by the collier. Such an invention is urgently needed, especially, as it must be considered the coal working of Wales is entering upon a critical epoch. Pits are deeper, acreage of working larger, output greater, and the speed of output is immense.

Coalowners and colliery managers are too well aware of the cost of these great explosions—apart from questions of humanity—to run any risk for mere questions of outlay. The mechanical appliances are of the best; timbering is ample, wire ropes rigidly tested. Their foremen are vigilant, and their action is supplemented by careful inspection, periodically, of the colliers selected for the purpose.

Local discussion is active, and the inquest is being awaited with great interest, especially as is pointed out, that other large collieries in the district are being worked under similar conditions to the Albion, and the output great and incessant.

The explosion has had the effect of sending coal prices up, the supply being insufficient to meet the demand, and this failure of the Albion output and the Scotch strike threaten still further to advance prices. At present, prices are distinctly 1s. per ton better than they were a month ago. Best steam is now quoted at 12s. to 12s. 3d., and even seconds 11s. to 11s. 3d., while best Monmouthshire is firm at 10s. 6d. to 10s. 9d. Little if any "dry coal" can be obtained under 10s. 6d., the price at which best ruled a short time ago. Best small is at 6s. 9d. to 7s., and ordinary 5s. 9d. to 6s.

House coal continues to keep up remarkably well. The time has now arrived when, usually, demands are sensibly less, and prices low. This week best house is selling in Cardiff at 11s. to 11s. 3d.; No. 3 Rhondda, 10s. 6d. to 10s. 9d.; brush, 9s.; small, 7s. to 7s. 3d.; No. 2, Rhondda, 9s.; through, 7s. to 7s. 6d.; small, 5s. 3d. to 5s. 6d. At all ports the shipments of coal last week were large, but not so great as they would have been if more coal had come to hand. Swansea total was a long way above the average: 48,473 tons; patent fuel, 6773 tons. In all the Swansea exports showed an increase of 20,000 tons above that of the corresponding week last year.

At Newport, too, the coal shipments were very large. The June total at the Alexandra Dock was 297,975 tons, the heaviest on record. The June total 1893 was 243,751, so that the last month showed an increase of no less than 54,223 tons.

No change of importance has occurred in coke, though the improving character of the iron and steel trades gives reasonable hope for better prices. Cardiff prices this week are:—Furnace, 15s. 6d. to 16s. 6d.; foundry, 17s. 6d. to 18s. 6d.; and special foundry, 20s. to 20s. 6d. Patent fuel is in better demand at Cardiff—prices, 10s. 9d. to 11s. 6d. Prices have an upward tendency. Pitwood tolerably firm, 15s. to 15s. 3d. per ton.

Iron ore is arriving in large quantities at Cardiff, and Newport, Mon. Some of the notable cargoes have been 2071 tons to Tapson and Son, 1800 tons Blaenavon Company. Dowlais and Cyfarthfa have also been receiving large consignments. Present prices Cardiff are:—Best Rubio, 11s. 6d. to 11s. 9d.; Garucha, 11s.; Tafna, 11s. to 11s. 3d.; Porman, 10s. 6d. to 10s. 9d.

A moderate degree of activity has begun to characterise the principal ironworks, and last week a fair quantity of merchant bar, sheet bar for tin-plate works, rails, and small goods was worked off. The principal features were an increased make of bar to the Swansea and neighbouring works, rails to Barry and to Christiania. The last-named was a cargo of 800 tons.

On 'Change, Swansea, it was commented upon that the steel trade of the district remained unaltered. Glasgow pig iron was quoted at 42s. 1d.; Welsh bars, £5; sheet steel and iron, £5 5s. to £6 10s.; steel rails, £3 15s. to £4 for heavy; light, £4 10s. to £5 10s. Bessemer steel: tin-plate bars, £4 to £4 2s. 6d.; Siemens best, £4 2s. 6d. to £4 5s.; seconds, £4 to £4 2s. 6d.; all delivered in the district, cash less 2½.

There is no change to report in tin-plate, only that shipments are larger; but booking for forward delivery has not improved to the extent desirable, and prices only show a slight advance. Bessemer now realises 10s. 4½d. to 10s. 6d.; Siemens, coke finish, 10s. 6d. to 10s. 9d.; best charcoal, 11s. 9d. to 12s. 9d.; ternes, per double box, 28 by 20 C.: 20s., 21s., 23s. There is fair ground for expecting better trade in tin-plates, as with the settlement of the tariff question—fixing the date when the reduced duty will come into force—forward business is sure to increase. One of the worst symptoms, however, is the attitude of some of the men; and employers openly complain that there is little hope of good business being done, so long as men do their best to intimidate others from working. This perversity has prevented several re-starts of late.

Last week Swansea shipped 79,643 boxes of tin-plates, and received from works 70,695 boxes. Stocks now have fallen to 273,602 boxes.

A test action was brought at the Glamorgan Assizes this week by Mrs. Brown, widow of one of the sufferers by the Taff Vale railway accident, August, 1893, against the directors of that company. Her claim was damages for the loss of her husband, which counsel, on her behalf, contended was due to the negligence of the company. Mr. Abel Thomas, Q.C., M.P., and Mr. Walter Tyrell appeared for the plaintiff, and Sir R. Webster, Q.C., M.P., Mr. J. E. Banks, and Mr. Bailhade represented the defendants. The result of a two days' action, and the evidence of leading experts, that of Mr. Riches the locomotive superintendent of the Taff Vale, and other prominent authorities, was a verdict for the company.

The progress of electrical appliances in collieries and of electric lighting in towns is becoming marked. For a number of years the Ocean Collieries have used the electric light, and this is steadily on the increase, and of late has been conveyed to villages belonging to the company. In the Park pit twenty-one lamps are placed, at the Dare pit sixty-five are underground. The engine there—15 nominal horse-power—is working a Crompton patent dynamo by means of countershafting. The Plymouth Collieries, which may be said to have been singularly fortunate by their early adoption of the electric power, are winding from a considerable distance by the same agency, and in the lessened number of horses used have realised substantial benefits alone.

The directors of the Rhymney Iron Co. have issued their report upon the year's transactions to March 31st, 1894, and from this I note that after payment of August dividend and debentures, a balance is shown of £78,950. From this sum an interim dividend was paid in January of ½ per cent., amounting to £4452, and the directors now recommend a further dividend of 3 per cent., making 3½ per cent. for the year, a very satisfactory notification, which I am only too happy in scattering broadcast, as the Rhymney shareholders are numerous and widely spread. The report shows cogently that by stoppage of the steel works, and the better development of the large coalfield owned by the company, this satisfactory state of things has been brought about, and now that the mineral development is in such good hands, still better may be looked for in the near future.

I learn, with regret, that the hauliers at Plymouth meditate a strike.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE accounts that come in from the different iron markets show a slight decrease in the demand for most articles. A giving way in quotations has even been noticeable in some instances, producers being extremely anxious to secure the few orders that are offering. Home as well as foreign inquiry having considerably lessened during the past week, there is but little business of importance transacted on the Silesian iron market. The falling off in demand is chiefly felt in the malleable iron branch, which had, hitherto, maintained a very satisfactory condition. Prices are weak, but no actual going down has as yet been reported.

The total output of the collieries in Upper Silesia has been in 1893 17,095,531 t., worth M. 91,811,797, against 16,431,540 t., worth M. 89,328,998 in the year before, which is equal to an increase of about 4·04 per cent. Consumption is stated to have been 17,087,081 tons, showing an increase of 666,746 tons against last year. In the mining district of Lower Silesia, total production of the collieries amounted to 3,569,125 tons in 1893, against 3,411,753 tons in 1892, of which 3,120,716 tons were sold at the average price of M. 7·37 per ton.

At the present moment the Austro-Hungarian iron market appears to be the only one that can boast of a lively activity in most departments. Although fresh orders are coming in rather less frequently than during former weeks, the greater part of the works are, nevertheless, vigorously engaged on orders previously booked. In prices no change has taken place, but there is much firmness exhibited in the quotations for both raw and finished iron.

A pretty satisfactory business is still being done on the French iron market generally, some branches not having been so well employed for months as they are now. This has a direct effect on prices, which show considerable firmness, and it is very likely that there will be a general improvement in quotations before long. The works of the Nord are reported to have formed a plate convention recently.

On the Belgian iron market there is not the slightest improvement in business noticeable, prices remaining weak and pointing in a downward direction. The general tone is naturally depressed, the more so as there appears to be little prospect for an improvement in the immediate future. The situation of the Rhenish-Westphalian iron market has, on the whole, not changed since last week, buyers still showing some reserve, which is, however, not very keenly felt at the present moment, because there has been a sufficient number of orders secured previously, which will keep their works in regular though not remunerative employment. With the exception of some favoured sorts, pig iron shows a falling off in demand lately. The works of Luxemburg-Lorraine get their coke at much lower rates than the Rhenish-Westphalian firms, and are thereby enabled to offer pig iron at prices considerably below those quoted by the Westphalian makers, who find it almost impossible to compete with their more favoured rivals. On the malleable iron market there is likewise not much animation noticeable, most articles meeting with but limited demand; there is also considerable weakness reported in prices. Both consumers and dealers hold back with their orders as much as possible, finding that makers, being rather hard up for new work, generally give way in their prices when an order of some weight is concerned. Under such circumstances an advance in quotations is simply out of the question for the present. Bars and girders are in comparatively fair request, while hoops show a decided decrease upon the week. The plate mills are, on the whole, quite well employed, and sheets are likewise rather brisk of sale, but it is impossible to carry the slightest advance in prices. The wire trade is quiet so far as home demand is concerned, but large lots have recently been ordered from abroad. Since last week the situation of the foundries and machine factories has in no wise altered; the rail department will be fairly well employed for some time, the long expected orders for 80,000 t. rails and 25,000 t. sleepers having finally been given out by the Government.

The Association des Ingénieurs sortis de l'Ecole de Liège, who paid a visit to the iron and coal producing district of Rheinland-Westphalia last year, have now sent their German hosts an invitation to come over and inspect the different departments of iron industry in Belgium, and at the same time visit the Antwerp Exhibition.

EIGHT HOURS DAY AT THE DOCKYARDS.—A new departure was made at the Royal Dockyards on Monday, when the average eight hours day or forty-eight hours week came into operation. For purposes of account in paying the wages, the week is to be reckoned as five and a-half days, instead of six as heretofore. The working year will consist of 313 days, and for women employed in the ropery and colour loft 307 days. The only immediate advantage gained by the dockyard men is that they will leave off work at twelve noon on Saturday. The shorter days generally do not commence till the autumn.

THE TRAMWAYS INSTITUTE.—The annual meeting of this Institute commenced on Thursday. One of the first papers read was on the "Soulerin Automatic Vacuum Brake for Steam Tramways," by Mr. George Cawley, M.I. Mech. E. The paper described the general action and construction of this pneumatic brake, and gave some particulars of its working on the Paris-St. Germain tramway. Briefly, the automatic Soulerin brake comprises:—A main brake-pipe, an auxiliary reservoir, a brake diaphragm vessel or brake cylinder, a distributor, and an ejector for producing the vacuum. Combined with the ejector is a driver's brake-valve, The apparatus works as follows:—As long as the brakes are to be "off" a vacuum is created and maintained by means of the ejector in the main brake pipe and auxiliary reservoirs. Then the main brake pipe and auxiliary reservoirs communicate through the distributor, and the external air can enter freely into the diaphragm vessels. To apply the brakes, the driver causes external air to enter the brake pipe by means of his brake valve and thus puts in motion the movable parts of the distributors by means of which the brake diaphragm vessels or cylinders are then put in communication with their corresponding reservoirs, and the brakes are applied by the atmospheric pressure acting on the outer surface of the diaphragms. To release the brake the driver admits steam into the ejector, and then creates afresh a vacuum in the brake pipe. The movable parts of the distributor—which is synonymous with the triple valve of the air pressure brake—then resume their former positions, and atmospheric pressure entering the brake diaphragm vessel, the brakes are released. The Soulerin brake has been largely adopted for railway purposes in France, and the author states, is particularly efficacious in that the pressure of the blocks on the wheels can be graduated with any necessary degree of precision.

## LAUNCHES AND TRIAL TRIPS.

On Monday there was launched from the Cleveland Dockyard of Sir Raylton Dixon, and Co., Middlesbrough, a very fine steel screw steamer which has been built to the order of Messrs. David McIver, Sons and Co., of Liverpool and London for their River Plate Line. This is the first of three sister vessels which these builders are at present constructing for the same firm, and all the steamers have been specially designed and fitted for the River Plate trade. The accommodation for the passengers will be fitted up in the poop, and will be of the most comfortable description, special attention being given to the efficient ventilation of all the rooms. A plentiful supply of water for the baths, lavatories, &c. is provided, and, in fact, everything possible will be done to minimise the discomfort of steaming through the tropics. The vessel is of the partial awning decked type, with long raised quarter deck and poop, and has been built under special survey for Lloyd's 100 A1 class, the principal dimensions being:—305ft. by 41ft. 3in. by 20ft. 3in., with a deadweight carrying capacity of over 3500 tons on a very light draught of water, and the deck houses, boats, beams and other erections are so arranged that the steamer can be promptly adapted for the purpose of carrying cattle. The engines will be fitted by Messrs. Blair and Co., of Stockton on Tees, the sizes of cylinders being 23in., 37in., 61in. by 42in., with two large steel boilers working at 160 lb. pressure per square inch, and as the vessel is of fine lines a good sea speed will be maintained. She will be rigged as a fore-and-aft schooner with Sidgwick's patent hinged topmasts, by means of which the upper portion of the masts can be immediately lowered when the steamer is required to pass under any obstructions to navigation, such as the bridges of the Manchester Ship Canal, &c. The vessel has been built under the superintendence of Mr. Roscoe, of Liverpool, consulting engineer to the owners. A large and influential company witnessed the launch, amongst those present being Mr. David McIver, Mr. and Mrs. Robert McIver, Lady Dixon, Mr. C. Livingston, &c., and as the steamer was leaving the ways she was named the Saxony by Mrs. R. McIver, of Rothay Bank, Ambleside, who was presented by Sir Raylton Dixon with a beautiful bouquet of choice orchids.

The s.s. Turret Bell was launched from the the Yard of Messrs. William Doxford and Sons, of Sunderland, on the 3rd inst, having been built to the order of Messrs. The Turret Steam Shipping Co., of Newcastle—Messrs. Petersen Tate and Co., managers—and will receive the highest class in the British Corporation and Bureau Veritas registries.

## THE WEARING AWAY OF METAL PLATES BY THE ACTION OF STEAM JETS.

In an article on this subject by Mr. J. Walter—*Chem. Ind.*—the author states that he was led to the consideration of this subject by the behaviour of a steam-jacketed copper boiling pan. The copper pan was originally 8 mm. thick, and the steam entered the jacket at its lowest point. Being rather too small, the copper pan, after it had been at work for some years, was replaced by a rather deeper one, but one which in all other respects was exactly similar to the original pan. After the second pan had been in use for about a year, a hole was blown through the bottom, opposite the steam inlet to the jacket.

Believing that the mishap was due to the metal having been worked down too thin at this point, a third pan was made, slightly thicker—12 mm.—which was carefully measured all over, before putting into use.

To avoid a second accident the pan was tested from time to time, and after about fourteen months' work it was found that the bottom had been reduced to the thickness of paper.

This time the author attributed the wear to the hydrochloric acid used for cleaning out the pan. He had previously noticed the "pitting" produced on iron plates by the action of steam jets, and, although he could not in this case trace the wear to the steam jet, he placed the steam inlet at the side as a precaution. Some eleven months later he was convinced that the wear was due to the steam jet, as he found the pan again worn away; not at the bottom, but opposite the jet. The reason the original pan lasted so much longer is due, the author thinks, to it being shallower than the others, and therefore not so near to the steam inlet, and not subjected to such intense action. The author mentions a similar case that occurred with a lead-lined vessel which was heated by blowing in steam from pipes, perforated with rows of holes on each side, fastened to the bottom of the vessel by lead straps. From the stirring of the contents of the vessel one pipe got twisted, whereby the row of holes on one side pointed downwards. Very shortly the steam jets issuing from them pierced a row of holes through the lead bottom.

It is pointed out that the action of a steam jet is similar to that of a sand blast. In the former the abrading particles, instead of being sharp grains, are minute particles of water and rust, &c., from the pipes. Besides the purely mechanical abrasion there is also chemical action. The steam carries with it air, which oxidises the freshly-exposed surface, and the oxide film thus formed is more readily removed than the metal itself. The appearance of holes produced by the impinging of steam jets on to copper and cast iron plates is described, and the author concludes by pointing out that once the cause of such wearing away is recognised, its prevention becomes easy.

This prevention can be effected by placing over the point of impact thick metal discs about 200 mm. diameter; by making the direction in which the steam enters parallel to, instead of across, the jacket space; or by placing a thimble, closed at the top and perforated at the sides, over the steam inlet.

---

According to Professor Bauschinger, the adherence between iron and Portland cement is as much as 625 lb. per square inch.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*21st June*, 1894.

11,971. Handles for Skipping Ropes, J. and L. Baron, Douglas.
11,972. Detachable Corset Busks, T. H. Parker, Stourbridge.
11,973. Preparing Concrete, J. Stow, Hessle.
11,974. Cycle Saddles, H. Williams, Manchester.
11,975. Mechanism of Small-arms, W. H. Brighton, London.
11,976. Burner, E. E. Donald, Ipswich.
11,977. Furniture, J. C. Willis, Leeds.
11,978. Tap, H. E. Blakeborough and J. H. Rhodes, Stockton-on-Tees.
11,979. Brushes for Dynamos, W. vom Braucke, Stockton-on-Tees.
11,980. Window Sashes, J. Lakin and C. Johnson, Redcar.
11,981. Plug for Tobacco Pipes, J. Stephens, Tunbridge Wells.
11,982. Spinning Machinery, J. and R. S. Dawson, Bradford.
11,983. Gas Engines, J. Mackintosh, Dundee.
11,984. Pneumatic Tires for Cycles, J. T. Grey, South Shields.
11,985. Flyers for Balling Machines, J. P. Dalby, Leeds.
11,986. Miners' Safety Lamps, T. Woods, Liverpool.
11,987. Printing Machines, A. Jubb and J. Chalmers, Huddersfield.
11,988. Sulphur, G. S. Albright and J. J. Hood, London.
11,989. Bicycle Tires, E. Brown and S. Brown, Birmingham.
11,990. Stone-breaking Hammers, T. Evans, Birmingham.
11,991. Apparatus for Filtering Sewage, W. Evans, Manchester.
11,992. Binders for Books and Papers, J. M. Arnot, Edinburgh.
11,993. The Invisible Hook and Eye, E. and C. Mackenzie, Inverness.
11,994. Parallel Vices, J. Adamson and V. Lister, Woolwich.
11,995. Working Electric Telegraphs, W. Thomson, Glasgow.
11,996. Oil Lamps, C. Hide, Worthing.
11,997. Explosive Engines, J Fielding, Gloucester.
11,998. Printing Machine Cylinders, W. H. and A. P. Dawson, and J. Stott, Yorkshire.
11,999. Operating Organ Swells, H. J. Weintz and J. Willimont, Suffolk.
12,000. Manufacture of Railway Chairs, A. E. Muirhead, Glasgow.
12,001. Transmitting Signals between Railway Carriages, J. Murrie, Glasgow.
12,002. Pedals for Velocipedes, H. E. Wollmer, Manchester.
12,003. Hygroscopic Regulators for Humidifiers, J. Wallace, Manchester.
12,004. Buffering Apparatus, W. S. Laycock, Sheffield.
12,005. Washing Machine, T. B. Grant, London.
12,006. Fixing Electric Light Casing, C. Bishop, Liverpool.
12,007. Brooms and Brushes, A. M. F. Thatcher, London.
12,008. Chain Wheels of Cycles, J. Barratt, London.
12,009. An Automatic Electrical Switch, W. R. V. Marshall, London.
12,010. Curtain Stretcher, P. M. Hartpence, London.
12,011. Automatic Alarm Box, J. H. Smith, London.
12,012. Releasing Iron Tubes from Mandrels, R. Wootton and B. Hewitt, Birmingham.
12,013. A New or Improved Cloth, M. Lobley, London.
12,014. Printing Roller, L. Edwards, London.
12,015. Lamp Bracket for Cycles, A. E. Attack, Bedford.
12,016. Self-closing Collarettes, H. W. Bamford, London.
12,017. Suspending Trousers, &c., E. Beaumont, London.
12,018. Jets for Lime Light, J. E. Anderson and A. Wrench, London.
12,019. Golf Clubs, C. J. Jacobs, London.
12,020. Fastenings for Brooches, H. J. Cook, London.
12,021. Closing and Opening Gas Pipes, C. Weuste, London.
12,022. Soap Frames, A. E. Benjamin, Liverpool.
12,023. Envelopes for Transmission of Money, D. H. Fisher, Liverpool.
12,024. Refrigerating Apparatus, &c., M. Frank, London.
12,025. Fire Extinguishers, J. Tombeur, London.
12,026. Cigar or Cigarette Holders, D. H. Fisher, Liverpool.
12,027. Musical Instruments, F. Pietschmann, Liverpool.
12,028. Pneumatic Tires, T. Sloper, London.
12,029. Sewing Machines, D. M. Gerbaulet, London.
12,030. Valve Gear for Engines, F. Lamplough and T. P. Borden, London.
12,031. Material for Umbrellas, &c., W. H. Rooke, London.
12,032. Weighing Apparatus, H. H. Lake.—(*L. Berthon, France.*)
12,033. Automatic Smoke Consumer, &c., J. Butler, London.
12,034. Walls and Partitions of Buildings, E. Reiss, London.
12,035. Spindles for Spinning Machines, E. J. Fenderson and A. A. Coburn, London.
12,036. Tubular Boiler Steam Engines, J. Angus, London.
12,037. Manufacture of Figured Fabrics, F. Boyer, London.
12,038. Pneumatic Tires for Cycles, R. S. Anderson, London.
12,039. Trusses, A. Strauss, London.
12,040. Clip or Holder, E. Murrle, London.
12,041. Separating Oil, &c., from Steam, E. Austin, London.
12,042. Coin-freed Apparatus, C. A. Kaichen, London.
12,043. Convertible Billiard Tables, W. Kitteridge, London.
12,044. Toy Puzzle, A. A. Newbigin, London.
12,045. Secondary Batteries, A. Schanschieff, London.
12,046. Shaping Glass Objects, K. E. Grützner and B. A. Gruhl, London.
12,047. Carbonisation of Rags, A. J. Boult.—(*G. Schüll, Germany.*)

*22nd June*, 1894.

12,048. Artificial Fuel, W. H. Biggs and R. R. Greenhow, Cardiff.
12,049. Apparatus for Teaching Music, J. McGuinness, London.
12,050. Advertising Apparatus, W. Timns and R. Smith, London.
12,051. Billiard-cue Tips and Door Stops, C. T. Kempton, London.
12,052. Regulating Steam Supply, G. M Williams, London.
12,053. Producing the Tone of a Banjo, A. J. Jones, Birmingham.
12,054. Invalid Beds and Couches, A. C. Roper, London.
12,055. Hair-curler, W. W. Tambs, Birmingham.
12,056. Manufacture of Sheet Glass, R. M. Wight, Bradford.
12,057. Lids of Axle-boxes of Vehicles, J. Donnelly, Longport.
12,058. Appliance for Holding Reins, H. Machell, Dewsbury.
12,059. Steel Castings for Ships, J. and J. E. Muir, Liverpool.
12,060. Wind Motors, W. J. S. Barber-Starkey, Manchester.
12,061. Woven Quilts, W. A. Moore, Manchester.
12,062. Railway Fog Signals, T. Jenkins and S. Illidge, Birmingham.
12,063. Wheels for Vehicles, A. Smallwood, Birmingham
12,064. Wheels for Road Vehicles, &c, J. Main, Glasgow.
12,065. Welding the Joints of Pipes, J. G. Stewart, Glasgow.
12,066. Oil Stoves, W. Reynolds and C. H. Sherer, Coventry.
12,067. Constructing Steamships, T. Mercer, Liverpool.
12,068. Appliance for Peeling Potatoes, E. B. Pallett, Bristol.
12,069. Cleaning Cotton Seed, J. Bibby, Liverpool.
12,070. Covers of Pipes, W. Pearce, Birmingham.
12,071. Hay-making Machines, J. F. Phillips, Lancashire.
12,072. Manufacture of Soap, J. P. F. Field, London.
12,073. Drawing up Fires, A. and W. H. Heaton, Bradford.
12,074. Apparatus for Boiling Sugar, W. H. Percy, Bristol.
12,075. Making Ships' Fenders, R. Cole and F. Cole, Bristol.
12,076. Mouse-trap, Truttmann and Francis, Newcastle-on-Tyne.
12,077. Cigarette-making Machines, A. L. Munson, London.
12,078. Fire-escapes, W. Rose and O. F. Vollhard, Manchester.
12,079. Automatic Tipper for Closets, T. Hargreaves, Manchester.
12,080. Mattresses, V. Czerink and P. Mattlach, Glasgow.
12,081. Egg Safety Carrier, A. Neil and J. Coats, Govan.
12,082. Shields for Ordnance, W. Skerry, Newcastle-on-Tyne.
12,083. Vermin Trap, A. Hill, Hayward's Heath.
12,084. Explosives, D. Hickie and G. F. Beutner, London.
12,085. Cartridges, H. Güttler, London.
12,086. Making Bicarbonate of Soda, H. R. Angel, London.
12,087. Railway Fog-signalling, R. Brown, Brentford.
12,088. Guards for Carving Forks, F. Buckland, Thornton Heath.
12,089. Book Support or Book Holder, C. L. Work, London.
12,090. Decorating, W. W. Colley and Colley's Patents, Ld., London.
12,091. Knitting Machines, H. Verges, London.
12,092. Spanner, R. Wootton and B. Hewitt, Birmingham.
12,093. Carpets, &c., G. Barker.—(*M. J. Whittall, United States.*)
12,094. Stop Cocks and other Taps, W. B. Press, London.
12,095. Manufacture of Boots and Shoes, T. Field, London.
12,096. Thrashing Machines, &c, W. McKenzie, London.
12,097. Cartridges for Aerating Liquids, G. Bamberg, London.
12,098. Automatic Sash Fastener, E. F. Rawlins, Richmond.
12,099. Dynamo-electric Machines, H. F. Joel, London.
12,100. Electrical Signalling, J. W. Sunderland and G. Bilbrough, London.
12,101. Bending Tubes, W. B. Leachman and H. H. Grenfell, London.
12,102. Lamp, B. Lietar, Brussels.
12,103. Storing Explosive Liquids, C. A. Mesenhol, Germany.
12,104. Motors for Cycles, A. J. Boult.—(*La Société Française Des Cycles "Gladiator" and P. Barbé, France.*)
12,105. Watch, W. P. Thompson.—(*F. Masi and A. Cano, France.*)
12,106. Pumps, P. Stahl, London.
12,107. Preventing Corrosion in Boilers, A. F. Law.—(*C. Law, United States.*)
12,108. Regulators for Gas or Water, J. L. Dupont, London.
12,109. Heads of Tripods for Cameras, J. E. Touch, London.
12,110. Armlet, E. Murrle, London.
12,111. Constructing Hinge Joints, Z. Leglay, London.
12,112. Traps for Vermin and other Animals, A. Diss, London.
12,113. Cycles, A. T. Lyne, Old Southgate.
12,114. Camera Shutters, E. T. Hughes.—(*L. F. Eiden, United States.*)
12,115. Ladies' Evening Dresses, H. S. Malet, London.
12,116. Horseshoes, J. Terry, London.
12,117. Fastening for Envelopes or Bags, A. Eade, London.
12,118. Limelight Jets, W. A. Dawkins, Birmingham.
12,119. Photographic Cameras, W. A. Dawkins, Birmingham.
12,120. Cigar Cases, A. Stoecker, Germany.
12,121. Cigar Boxes, A. Stoecker, Germany.
12,122. Knife Sharpener, F. Tschofen, London.
12,123. Training Hops and other Plants, J. Watkins, London.
12,124. Divers' Boots, W. R. Foster and R. Fox, London.
12,125. Divers' Air-pumps, W. R. Foster and R. Fox, London.
12,126. Inflating Pneumatic Tires, S. Spencer, London.
12,127. Elevators, J. W. Naylor, London.
12,128. Spittoons, W. Jucker, London.
12,129. Boot Tag or Lift, R. Haddan.—(*P. Förck, jun., Germany.*)
12,130. Holding Photographic Films, A. C. Kitz, London.
12,131. Electric Brake Mechanism, L. E. Freedley, London.
12,132. Riveting Machines, B. L. D'Aubigné, London.
12,133. Picture Suspender, W. Beeston, London.
12,134. Deodorising or Disinfecting Apparatus, W. Gedge, London.
12,135. Guard for Points of Bonnet Pins, R. Wilkins, London.
12,136. Stencil and other Sheets, E. de Zuccato, London.
12,137. Walking-stick and Lamp, H. Newbold, London.
12,138. Cigarette Makers, W. D. and H. O. Wills.—(*D. B. Strouse, United States.*)

*23rd June*, 1894.

12,139. Playing Board, F. Allen and F. Waldock, Hampton.
12,140. Electric Igniters, A. A. C. Swinton, London.
12,141. Cellar and other Guards, J. J. Adkins, London.
12,142. Curling and Rounding Hats, F. Elliott, Atherstone.
12,143. Book Protector, J. Elliott and A. E. Waite, London.
12,144. Laundry Blue, E. J. Surl and H. Chancellor, Bristol.
12,145. Colouring Matters, I. and I. Levinstein and Co., Ld., Manchester.
12,146. Street and other Lamps, J. C. Bell, London.
12,147. Electrical Gripper Bar, W. B. Silverlock, London.
12,148. Money or other Case, E. Harrison, London.
12,149. Case for Money and Cards, &c., E. Harrison, London.
12,150. Valves for Pneumatic Tires, W. Phillips, Leicester.
12,151. Lever Switch, C. Langstone and B. Young, Birmingham.
12,152. Indicating and Checking Apparatus, E. Parr, London.
12,153. Securing Window Sashes, G. Wheeldon, son, Derby.
12,154. Accordeons or Melodeons, J. P. Browne, Glasgow.
12,155. Seats of Cycle Saddles, T. Webb, Birmingham.
12,156. Cycle Driving Gear, F. Smart, Manchester
12,157. Apparatus for Advertising on Wheels, J. Leadbeater, Leeds.
12,158. Perforated Music Sheets, &c., W. G. Griffith, Manchester.
12,159. Woven Fabric, J. Bright and Brothers and W. Briggs, Manchester.
12,160. Driving Gear of Cycles, J. H. Baynes and J. O. M. Parker, Manchester.
12,161. Hair Waving Appliances, W. L. B. Binde, London.
12,162. Fixing Photographic Cameras, F. W. Turner, Bury St. Edmunds.
12,163. Camera Stands, W. J. Pickersgill and M. Hunter, Sunderland.
12,164. Trasparent Tympan, E. Lee, Leeds.
12,165. Automatically Holding Candles, J. Legge, Willenhall.
12,166. Vehicle Tires, J. Duncan and W. Whyte, Glasgow.
12,167. Preventing Ships Sinking, T. H. Watson, Newcastle-on-Tyne.
12,168. Oil Lamps and Fittings, W. Reynolds and C. H. Sherer, Coventry.
12,169. Fasteners for Ladies' Hats, C. Merington, Essex.
12,170. Two-speed Gearing for Bicycles, J. I. and W. F. Richards, Swansea.
12,171. Method for the Removal of Arsenic, &c., W. A. Jenkin, Spain.
12,172. Bicycles, G. B. Main, Glasgow,
12,173. Sliding Windows, J. Money, Glasgow.
12,174. Peptonised Extract of Malted Cereals, P. Maltine, Leicester.
12,175. Cranes for Ships, A. B. Brown, Glasgow.
12,176. Preparing Arsenic for Destroying Weeds, J. R. Carruthers, Glasgow.
12,177. Automatic Sluices, F. G. M. Stoney, Glasgow.
12,178. Binding Sheets of Music, D. Mitchell, Birmingham.
12,179. Refuse Furnaces, B. D. Healey, London
12,180. Wheels for Vehicles, W. H. Atwood and N. Smythe, Birmingham.
12,181. Apparatus for Soldering, R. E. B. Crompton, London.
12,182. Grinding or Polishing Tubes, J. McGhie, Glasgow.
12,183. Electrical Propulsion, J. E. Parker, United States.
12,184. Improving the Female Figure, H. J. Bildyard, London.
12,185. An Improved Stopper and Bottle, J. W. Alexander, London.
12,186. Seed Drills, A. J. Boult.—(*W. Hull, Canada.*)
12,187. Preserving Changeable Liquids, F. de Backer, Liverpool.
12,188. Teaching Models, Drawing, &c., C. Clark, Manchester.
12,189. Tandem Bicycles, P. Gill, Liverpool.
12,190. Circular Looms, R. Weiss, London.
12,191. Filling Bottles with Liquids, T. Roberts, Manchester.
12,192. Hypodermic Injection Syringes, F. de Backer, Liverpool.
12,193. Medals, Medallions, &c, H. Grueber, London.
12,194. Vermin Traps, J. Johnstone, London.
12,195. Bottling and Stoppering Liquids, T. Sutcliffe, London.
12,196. Brewing Beer, A. F. Spencer, London.
12,197. Moving Targets, G. T. Teasdale-Buckell and E. W. D. Cuming, London.
12,198. Treatment of Gonorrhea, W. H. Greer, London.
12,199. Stands for Bouquets and the like, J. Feaver, London.
12,200. Materials for Rims of Cycles, J. H. Barry, London.
12,201. Mills, R. Harris, United States.
12,202. Compensator for Railway Signal Wires, G. H. Phillips, London.
12,203. Railway Signalling Apparatus, W. Saunders, London.
12,204. Driving Mechanism for Machinery, F. H. Crafts, London.
12,205. Perpetual Calendar, H. L. Weed and E. Pittwood, London.
12,206. Liquid Cooling Apparatus, J. E. Bennett, London.
12,207. Releasing Tubes, R. Wootton and B Hewitt, Birmingham.
12,208. Manufacture of Machine Screws, R. J. Alpe, Birmingham.
12,209. Punching and Eyeletting Machine, A. Senior, London.
12,210. Gaiters, &c., J. Faulkner and W. J. Vann, Manchester.
12,211. Clocks, W. H. Alderson, Manchester.
12,212. Omnibus Starting Apparatus, A. D. Bowie, London.
12,213. Supporting Optical Instruments, J. Aitchison, London.
12,214. Colouring Matters, O. Imray.—(*The Society of Chemical Industry in Basle, Switzerland.*)
12,215. Drainage Traps for Steam Pipes, E. E. Gold, London.
12,216. Velocipedes, T. Ledward and E. H. Beckett, London.
12,217. Mirrors, The Hon. C. A. Parsons, J. B. Willis, and G. G. Stoney, London.
12,218. Manufacture of Cyanides, H. Y. Castner, London.
12,219. Manufacture of Cyanides, H. Y. Castner, London.
12,220. Bath for Infants, G. L. Lavington and E. A. Wright, London
12,221. Electrical Furnaces, P. M. Justice.—(*E. G. Acheson, United States.*)
12,222. Bells, C. H. Gerrard, London.
12,223. Boiler Furnaces, J. Y. Johnson.—(*J. P. Serve, France.*)
12,224. Steam Boilers, J. Y. Johnson.—(*J. P. Serve, France.*)
12,225. Storing and Delivering Coins, H. M. Field, London.
12,226. Cigar-cutters, E. Miller, London.
12,227. Dress Fastenings, I. K. Young, London.
12,228. Chaff Cutters, E. Scales, London.
12,229. Checking the Withdrawal of Liquids, J. Boden, London.
12,230. Collapsible Magic Lanterns, A. Wrench, London.
12,231. Machine for Cutting Boards, J. C. Roberts, London.
12,232. Door-closing Devices, G. F. Redfern.—(*J. Stenbäck, Russia.*)
12,233. Non-slippery Pavements, A. J. B. Ward, London.
12,234. Bathing the Legs of Animals, H. M. Christopher, London.
12,235. Coverings for Bottles, H. Luyken and the Thompson and Norris Manufacturing Company, Ld., London.

12,236. Inkstands, H. H. Lake.—(*Hillgren and Company, Switzerland.*)
12,237. Ordnance, B. H. Thwaite, London.
12,238. Automatic Fire Alarms, H. H. Lake.—(*A. T. Wall and G. A. Wall, United States.*)
12,239. Leather and Canvas Bags, &c., H. H. Phillpot and J. Bathurst, London.

*25th June*, 1894.

12,240. Securing Buttons to Boots, C. Nicholls, Birmingham.
12,241. Electro-magnetic Traction, J. Perry and T. Tomlinson, London.
12,242. Clutches and the like, R. Harrington, Wolverhampton.
12,243. Wheel Hubs for Cycles, &c., I. Whitehouse, Birmingham.
12,244. Cycle Treadles, D. Spink, Dover.
12,245. Apparatus for Preventing the Abstraction of Letters from Boxes, C. T. and T. E. Gambrell and H. Headland, London.
12,246. Weaving Double-pile Fabrics, J. Clough and J. Park, London.
12,247. Cycle Gearing, B. Carreg, Liverpool.
12,248. Machine for Cleaning Fur, H. Beech, Manchester.
12,249. Key Sticks for Tip Carts, J. Trimmer, Southampton.
12,250. Bar Bells and Indian Clubs, A. Sturrock, Dundee.
12,251. Kites, B. F. S. Baden-Powell, London.
12,252. Oil Lamp, E. T. Daniels and S. W. Burton, London.
12,253. Tablet Detector, H. Powis and G. Evans, Shrewsbury.
12,254. Moustache Guards, D. H. Croll and C. Grant, Watford.
12,255. Railway Buffers, &c., T. and W. Latham, Sheffield.
12,256. Kitchen Safe or Cabinet, &c , J. H. Keys, London.
12,257. Pneumatic Tires of Bicycles, W. H. Sewell, Glasgow.
12,258. Stud for Wearing Apparel, G. T. Jones, Glamorgan.
12,259. Tandem Safety Bicycles, R. Kendrick, Birmingham.
12,260. Bicycle for Road or Water, W. Wagstaff, Farnworth.
12,261. Bicycles, W. H. Hockley, Birmingham.
12,262. Coal Vase Lid or Door, W. F. Bradbury, Birmingham.
12,263. Socketted Drain Pipes, J. Coulthurst, Manchester.
12,264. Cultivating, &c., the Land, J. E. Steevenson, Nottingham.
12,265. Single-speed Motion for Mules, W. Hurst, Bolton.
12,266. Taps, F. G. Fender, London.
12,267. Compound for Waterproofing Boots, W. J. Birnie, Bournemouth.
12,268. Syphon Flush Cistern, W. G. Jenkinson and T. Cartwright, Sheffield.
12,269. Photography, A. B. Chatwood, London.
12,270. Metal Tubes, R. Wooton and L. W. Goold, Birmingham.
12,271. Gas Engines with Slide Valves, W. J. Whitely, Birmingham.
12,272. Boxes for Millinery, J. H. Duffell, Birmingham.
12,273. Sinking Shafts, &c., G. C. Downing.—(*F. H. Poetsch, Germany.*)
12,274. Portable Air - propeller, L. G. and P. Chinnery, London.
12,275. Hydrocarbon Lamps, M. Dietmar, London.
12,276. Sheet-metal Mantels, J. Groves, London.
12,277. Consuming Smoke, A. J. Boult.—(*L. Hallbauer, United States.*)
12,278. Fastening Device for Clothing, E. Vollmer, Liverpool.
12,279. Tins for Printers' Inks, M. J. Smyth, Liverpool.
12,280. Friction Clutches, W. H. Cranstone and W. R. Hay, London.
12,281. Trimming of Wall Papers, W. Canning, Birmingham.
12,282. Cycle Stand, H. W. Holt and the Nimrod Cycle Company, London.
12,283. Block System for Electric Railways, E. Langen, London.
12,284. Securing Blind Cords, E. A. Jeffreys, A. H. Johnston, and A. K. Rotherham, London.
12,285. Dental Mirrors, F. H. Nalder, C. W. S. Crawley, and A. Soames, London.
12,286. Dies for Moulding, &c , Clay, D. Lewis, London.
12,287. Tube Expanders, W. Cross.—(*I. Allworthy, France.*)
12,288. Bending Metal Plates, F. Friedenthal, London.
12,289. Removing Fibre from Cotton Seed, R. Silcock, London.
12,290. Gripping Devices, T. Jenner, London.
12,291. Fire-places for Kilns, W. Hassall and H. W. Sansom, London.
12,292. Flying Machines, W. C. Sly, London.
12,293. Table Knives, J. Delaire, London.
12,294. Magazine, &c., Cameras, E. H. M. Seymour, London.
12,295. Condensing Alcoholic Vapours, P. C. Vivien, London.
12,296. Umbrella and Cane Stand, J. Funt, London.
12,297. Hair Brushes, L. W. Todd, London.
12,298. Plough Shares, J. H. Howard, London.
12,299. New Manufacture of Paint, A. J. Protheroe, London.
12,300. Coat Retainer, R. H. Wall, London.
12,301. Hair Frames, F. W. Kuschmann, London.
12,302. Moistening Labels, A. Rosenberg and J. Olfen, London.
12,303. Printing Fabrics, H. H. Lake.—(*La Société Bonnet, Ramel, Savigny, Giraud, and Marnas, France.*)
12,304. Telephone Systems, H. N. Frenay-Olyff, London.
12,305. Furniture Polish, A. P. Horn, London.
12,306. Foot - warmer Device, R. H. Thielemann, London.
12,307. Drawing Beer from Casks, T. W. Thorpe and W. H. Thomas, London.

*26th June*, 1894.

12,308. Governor for Motors, J. E. Greenhill and W. Fitch, London.
12,309. Distance - measuring Instruments, J. H. Steward, London.
12,310. Last, J. W. Curtis, Leicester.
12,311. Water - waste Preventer, &c., A. Monk, London.
12,312. Child's Bicycle Seat, J. Yates and A. Yates, Leicester.
12,313. Arc Lamps, F. M. Lewis, Leeds.
12,314. Curling Irons, T. Warsop, Nottingham.
12,315. Construction of Steam Vessels, R. Clegg, Halifax.
12,316. Sewing Machine Reel Carriers, D. Flanagan, Halifax.
12,317. Traction Engines, W. Sandeman, jun.—(*J. R. Greenwood, Argentine Republic.*)
12,318. Screw-down Taps or Cocks, W. H. Foster, Halifax.
12,319. Ventilating Apparatus, J. Evans, C. Harris, and T. F. Evans, Manchester.
12,320. Cover for Cooking Utensils, A. O. Morley, Birmingham.
12 321. Sewer Gas Taps, F. Parkin, London.
12,322. Spyhon Flushing Cisterns, W. Rodgers, Sheffield.
12,323. Bearing for Revolving Shafts, W. H. Baines, Sheffield.
12,324. Multiple Drilling Machines, G. W. Hawksley, Sheffield.
12,325. Sole for Boots and Shoes, D. G. Thomas, Glasgow.
12,326. Rubber Cushion or Buffer, J. MacDonald, Glasgow.
12.327. Air Pump and Bicycle Rest, G. F. Benson, Belfast.
12,328. Heating Furnaces for Ironworks, J. Brookes, Staffordshire.
12,329. Recording Quantities of Liquids, H. H. S. Pearse, London.
12,330. Clips, W. C. Butler, Edinburgh.
12,331. Mud Guard, W. T. Fuller, Bedford.
12,332. Musical Instruments, G. Ingram, London.
12,333. Hangers for Waist Bands, T. Davies, Pembroke Dock.
12,334. Valves, T. Thorp and T. G. Marsh, Manchester.
12,335 Shuttle-boxes of Looms, W. H. Hacking, Manchester.
12,336. Suspending Trousers, C. H. Spencer, Manchester.
12,337. Brushing Carpets, C. S. Chaffee, A. S. Hoffman, and F. A. Green, London.
12 338. Street-watering Vehicle, W. H. Miller, London.
12,339. Flap for Carriage Axles, G. Wilkes, Southampton.
12,340. Gear Cases for Bicycles, W. Brookes, Manchester.
12,341. Distillation of Zinc, H. T. Barnett, Westminster
12,342. Tap Holes of Casks, &c., C. J. Hill, Birmingham.
12,343. Clasp for Garments, S. Drew and R. Drew, Lancashire.
12,344. Delivering Boxes of Pins, A. G. Herbert, Birmingham.
12,345. System of Electrical Distribution, P. Wright, London.
12,346. Heating Liquids, W. P. Thompson.—(*J. Hutchinson, United States.*)
12,347. Flax Pulling Machines, W. P. Thompson.—(*L. P. Ordway, United States.*)
12,348. Portable Stands or Seats, J. R. Selbach, London.
12,349. Heating Metals, W. P. Thompson.—(*C. L. Coffin, United States.*)
12,350. Hydraulic Cement, W. Bruch, Liverpool.
12,351. Cotton Beaters, W. E. Heys.—(*A. Kirschner, France.*)
12,352. Appliance for Cleaning the Teeth, J. Weile, Glasgow.
12,353. Gas Stove, F. Littlewood, London.
12,354. Fanlight Fastenings, R. Hodges and S. Hill, London.
12,355. Calculating Clock or Dial, F. A. Göttsch, London.
12,356. Water Heaters or Boilers, C. T. Toulmin, London.
12,357. Strap Fasteners, F. L. Moore, London.
12,358. Skirt and Trousers, B. J. B. Mills.—(*B. Zeller and H. Crager, United States.*)
12,359. Pumps for Cycle Tires, W. F. Taylor and G. J. Philpott, Croydon.
12,360 Pumps for Cycle Tires, W. F. Taylor and G. J. Philpott, Croydon.
12,361. Pneumatic Pumps, W. F. Taylor and G. J. Philpott, Croydon.
12,362. Junction Ferrules for Piping, R. H. Attwater, London.
12,363 Ear Trumpets, J. Barr, London.
12,364. Boots, H. H. Lake.—(*E. F. Grandy, United States.*)
12,365 Post-marking Machines, H. H. Lake.—(*A. Leavitt, United States.*)
12,366. Boots, H. H. Lake.—(*J. H. Hannan, United States*)
12,367. Obtaining Glycerine, J. Van Ruymbeke and W. F. Jobbins, London.
12,368. Steam Boiler Furnaces, O. D. Orvis, London.
12,369. Elevator Controlling Devices, C. A. Harkness, London.
12,370. Vehicle Wheels, R. F. Hall, London.
12,371. Pneumatic Tire Detaching Tool, R. F. Hall, London.
12,372. Textile Machinery Aprons, J. H. Lorimer, London.
12,373. Wrought Metal Plough Share, J. Robinson, London.
12,374. Mudguard for Cycle Wheels, G. C. Topp, London.
12,375. Preventing Explosions in Boilers, G. L. Stocker, London.
12,376. Sash Fasteners, G. T. Lester, London.
12,377. Safe Petroleum Lighting, R. H. Courtenay, London.
12,378. Well Fishing Vessels, J. F. Green, London.
12,379. Water-tube Boilers, W. T. Whiteman.—(*J. W. Van Dyke, United States.*)
12,380. Water-tube Steam Boilers, L. D. Davis, London.
12,381. Metallic Powders, O. Imray.—(*J. Sachs, United States.*)
12,382. Metallic Powders, O. Imray.—(*J. Sachs, United Statee.*)
12,383. Glazing and Enamelling Bricks, M. Ahern, London.
12,384. Stannic Acid, I. A. F. Bang and M. F. A. Ruffin, London.
12,385. Keeping Tobacco, &c., Moist, F. Tschoffen, London.
12,386. Safety Envelopes, I. S. McGiehan, London.
12,387. Road Vehicles, H. Maasen, London.
12,388. Device for Locking Cycle Wheels, H. Badger, London.
12,389. Scales on Thermometers, E. M. V. Gibb and F. Cossor, London.
12,390. Feeding Device for Petroleum Engines, F. B. Poerschmann, London.
12,391. Connection of Bowls with Shafts, O. J. Ström, London.
12,392. Aerated Beverages, D. and J. B. Jackson, London.
12,393. Apparatus for Cleaning Boots, F. R. Smale, London.
12,394. Double-action for Velocipedes, E. Pasetti, London.
12,395. Legible Thermometer Scale, E. Jones, London.
12,396. Water and other Cocks, J. L. Dubois, London.
12,397. Gauging and Testing Rails, &c., P. Soulé, London.
12,398. Sprocket and other Wheels, W. A. Leggo, jun., London.
12,399. Safety Stirrup, A. Mihaloczy, London.
12,400. Lamp Regulator, F. Suisse and P. E. Hennequin, London.
12,401. Riding Carriages or Vehicles, H. L. Casse, London.
12,402. Fastening Handles on Brooms, C. Slater, London.
12,403. Chaff - cutting Machines, H. G. Waldock, London.
12,404. Commercial Travellers' Order-books, A. J. Tozer, London.
12,405. Advertising Device, W. G. Hawkins and A. R. Callcut, London.
12,406. Electric and other Motors, T. E. Waltham, London.
12,407. Cable Transmitters, H. Taylor, London.
12,408. Purification of Caramel, A. M. Clark.—(*La Société Gallet, Gibou, et Cie., France*)
12,409. Instantaneous Steam Generators, L. E. Solignac, London.
12,410. Filtering Materials, J. Wetter.—(*M. Weinrich, United States.*)
12,411. Lighting Tobacco Pipes, F. W. Schindler, London.
12,412. Knife Cleaner, A. N. Warburton, London.
12,413. Device for Cleaning Buttons, E. A. Meredith, London.
12,414. Machines for Washing Clothes, W. Berriman, London.
12,415. Oil and other Lamps, C. F. R. A. H. Bagot, London.
12,416. Covers for Tennis Balls, &c., H. Meenan, London.

*27th June*, 1894.

12,417. Pencil Sharpeners, &c., P. M. Gallagher, London.
12,418. Door and Window Frame, A. P. Sharp, Dublin.
12,419. Metal Clip for Roofs, Plant, Jackson, & Co., Birmingham.
12.420. Folding Telescope and Stand, T. Marshall, Surbiton.
12,421. Tachometer or Indicator, T. W. Harding, Leeds.
12,422. Levelling Instrument, F. J. Ryan and F. J. Ryan, jun , London.
12,423. Bottle Filling Machines, A. P. Blaxter, sen., London.
12,424. Knitting Machines, J. Schmitt and J. B. Coblenzer, London.
12,425. Refrigerator, H. Clarke, Burslem.
12,426 Teaching Children Arithmetic, R. G. Bennett, London.

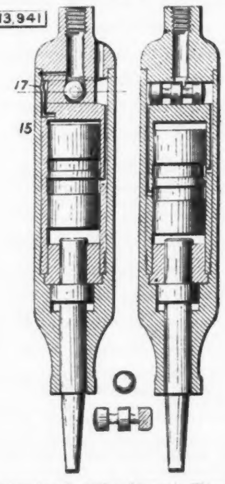
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**513,941.** Pneumatic Tool, *C. B. King, Detroit, Mich. —Filed May 19th*, 1892.

*Claim.*—(1) The combination in a tool, of a cylindrical body portion having a shoulder at the top, a rotatorily adjustable sleeve upon the cylindrical body bearing at its upper end against the shoulder, said sleeve forming a controlling valve and a detachable clamping ring bearing against the lower end of the sleeve, substantially as described. (2) The combination in a tool, of a cylindrical body portion, having a cylinder and a valve chamber therein, the striker and valve, a nose-piece carrying the tool, and the sleeve rotatorily adjustable upon the cylindrical body, and forming the valve for controlling the blows of the tool, substantially as described. (3) In a tool of the kind described, the combination with the body, the reciprocating piston therein, the tool stock adapted to be struck by said piston, a piston on the tool stock, a cylinder in which said piston engages, having a passage connectiing the lower end thereof with the induction passage for the motive agent during the downward movement of the piston and having an opening at the upper end thereof above the piston, substantially as described. (4) In a tool of the kind described, the combination with the body portion, a detatchable nose-piece, of a spring latch, having a secured portion engaging into the nose-piece, and a pin passing through an aperture in the nose-piece and entering into the body, substantially as described. (5) In a tool of the kind described, the combination with a body and a sleeve movable thereon, of a spring catch for holding the sleeve in its adjusted position, consisting of a spring arm having the bent portion 15 forming the securing portion and a locking portion 17 adapted to engage in notches in the sleeve, substantially as described.

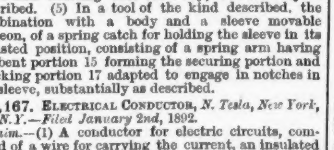
513,941



**514,167.** Electrical Conductor, *N. Tesla, New York, N.Y.—Filed January 2nd*, 1892.

*Claim.*—(1) A conductor for electric circuits, composed of a wire for carrying the current, an insulated coating or covering and a surrounding conducting sheath or screen divided into insulated sections, as set forth. (2) A conductor for electric circuits, composed of a wire for carrying the current, a coating or covering of insulating material and a surrounding conducting sheath or screen divided into insulated sections, the ends of which overlap, as set forth. (3) The combination of a wire or conductor for conveying electric currents, an insulated coating or covering therefor, a conducting sheath or screen surrounding the insulating coating and a connection between said sheathing and the ground containing a condenser of very small capacity or its equivalent.

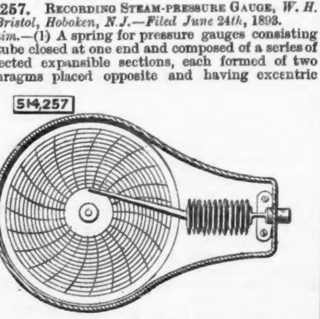
514,167



**514,257.** Recording Steam-pressure Gauge, *W. H. Bristol, Hoboken, N.J.—Filed June 24th*, 1893.

*Claim.*—(1) A spring for pressure gauges consisting of a tube closed at one end and composed of a series of connected expansible sections, each formed of two diaphragms placed opposite and having excentric openings, substantially as described. (2) A spring for pressure gauges, consisting of a tube closed at one end and composed of a series of connected corrugated diaphragms, each rendered more sensitive on one side of the axial line than on the other, substantially as described.

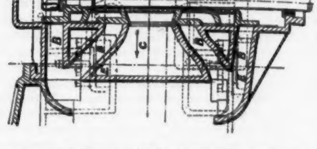
514,257



**514,333.** Steam Engine Attachment, *A. Normand, Havre, France.—Filed September 5th*, 1893.

*Claim.*—The combination with an engine cylinder having a valve chest, supply passages B for the cylinder, and an exhaust C, of independent blow-off valves arranged respectively at opposite end portions of the cylinder and communicating by passages E, which are independent of the passages B, with the cylinder, said valves being unseated by pressure in the cylinder and blowing off into the valve-chest, substantially as and for the purposes described.

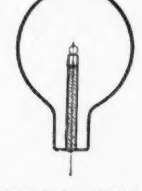
514,333



**540,170.** Incandescent Electric Light, *N. Tesla, New York, N.Y.—Filed January 2nd*, 1892.

*Claim.*—(1) In an incandescent electric lamp, the combination of an exhausted globe, a refractory light-giving body therein, a conductor leading into the globe and connected to or supporting the said body, and a conducting screen surrounding the said conductor, as set forth (2) In an incandescent electric lamp, the combination of an exhausted globe, a refractory light-giving body or button therein, a conducting support for said button within the globe, and a metallic tube surrounding or inclosing the said conductor up to the point of union with the button, as set forth. (3) In an incandescent electric lamp, the combination of an exhausted globe, a wire sealed therein, and coated with or embedded in a glass stem, a carbon stem united with the wire, a refractory conductor mounted on said stem, and a conducting tube or cylinder surrounding the wire and carbon stem, as and for the purpose set forth.

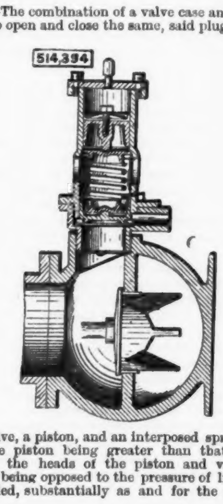
514,170



**514,394.** Device for Regulating and Relieving Pressure in Water Pipes, *H. G. van Everen and J. Henderson, Three Rivers, Mich.—Filed April 16th*, 1892.

*Claim.*—The combination of a valve case and a plug adapted to open and close the same, said plug consisting of a valve, a piston, and an interposed spring, the area of the piston being greater than that of the valve and the heads of the piston and valve respectively, being opposed to the pressure of liquid to be controlled, substantially as and for the purpose specified.

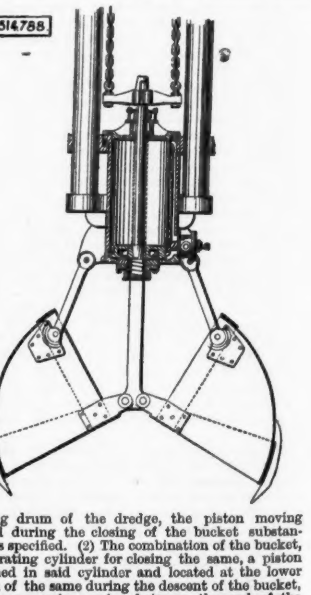
514,394



**514,788.** Dredging Bucket, *T. Symonds, Leominster, Mass.—Filed February 15th*, 1893.

*Claim.*—(1) The combination with the dredging bucket, of a cylinder, a piston contained therein, a piston-rod, a crosshead connected to the bucket, and hoisting chains extending from the crosshead to the winding drum of the dredge, the piston moving upward during the closing of the bucket substantially as specified. (2) The combination of the bucket, an operating cylinder for closing the same, a piston contained in said cylinder and located at the lower portion of the same during the descent of the bucket, and a compression spring between the end of the cylinder and said piston, substantially as and for the purpose set forth.

514788



## OIL ENGINES AT THE R.A.S.E. SHOW.

IN continuing our notice of the fixed engines which entered the consumption trials, we now reach the Hornsby-Akroyd engine which was next in order to that of Messrs. Fielding and Platt, which we described in our last issue. This engine, as most of our readers are aware, differs essentially from all the others which were tested, in that it employs no ignition tube or lamp for heating and ignition. It is the only engine which comes under Class 2 of the classification given on page 7 *ante*. The main features of the vaporiser, the lamp for heating it, the hand fan for supplying air to the lamp, and the cover to the vaporiser, may be gathered from the annexed sketches. The vaporiser is a small-necked bottle-shape extension of the cylinder. It contains a number of inwardly projecting longitudinal radial ribs. These serve as heat-receiving and heat-emitting masses and surfaces, upon which the oil used is vaporised and converted into a gas. For starting the engine the vaporiser marked V is heated by means of two lamps—as shown in the engraving in our impression of the 29th ult.—each one similar to that shown at L in the annexed section. These are rough, strong lamps, which with the supply of air from a fan at F, give a very powerful flame of high intensity. By this means the vaporiser is raised to a sufficiently high temperature to evaporate oil sent into the vaporiser by the hand working of the oil pump, and also to ignite the mixture of oil, gas, and air which is formed when the fly-wheel of the engine is turned two or three times by hand. When care was taken to make sure of this high temperature ignition of the air and gas mixture always took place with a few turns of the engine. Once started, the temperature necessary for vaporisation is maintained by the heat due to combustion, and that necessary for ignition has the same origin plus the rise in temperature due to the compression of the working mixture. The admission of the oil to the vaporiser from the pump is controlled firstly by the valve at N, and secondly by the valve above it, which is an overflow valve controlled by the governor, the latter acting by permitting the escape of the oil by an easier path than that into the vaporiser which it enters at H.

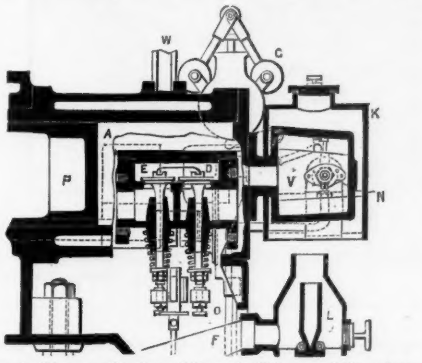


Fig. 1—Diagram Section of Hornsby Valves and Vaporiser

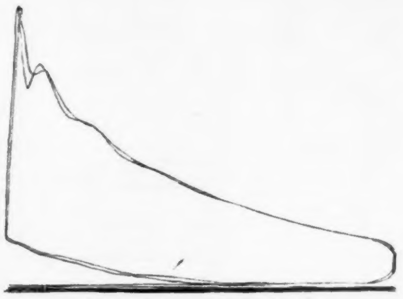


Fig. 4—Diagram Griffin Engine

The leading dimensions of this engine and the oil consumption were given at page 10 of our last issue, from which it will have been seen that the consumption on full load was such as to give satisfaction to the makers of the engine. On full load the working of the engine did credit to the system, and the conditions were, of course, the best possible for the operation of an engine in which it is necessary for the best working to run without any misses—in other words, to run with a regular load, so as to maintain with the greatest possible uniformity the proper internal temperature for vaporisation and for automatic or spontaneous ignition at the proper moment. A good idea of the arrangement of the oil pump, oil pipes, and connections, and of the fan and lamps, may be obtained by reference to the engraving on page 566 above mentioned. It will be seen from the sketch above, giving a transverse section of the vaporiser and oil valves, that the latter are contained in a small casting attached to the vaporiser by a flange at H. It is just outside the cover K, but in order to keep it at a uniform and moderate temperature a small supply of water is circulated through a jacket round the valve by means of a pipe J, and a delivery pipe J, connected to the delivery from the main cylinder jacket. The section shown above is taken partly along the axis of the cylinder and vaporiser, and partly through the valve-box; the air admission valve being shown at E and the exhaust valve at D. On the top of the cover which protects the vaporiser from cooling draughts are two lids, either or both of which may be removed if the vaporiser reaches too high a temperature. When running on half load the combustion in this engine was almost as perfect as when running on full load; but when running light this was not the case, and observation on this point is confirmed by the consumption of oil when running light. During the last-mentioned run of four hours, the engine took and fired a charge at every fourth stroke, there being practically no misses, yet the engine did not apparently increase in speed, and as far as is known no change was made either in the amount of compression or in the coating of the vaporiser. This light run was, in fact, a remarkable performance, and the temperature of the vaporiser was maintained automatically throughout, with the exception of one lighting up of the lamps and use of the fan. For this purpose, and in this respect, the use of an independent pump or fan has some advantages, as a flagging vaporiser and ignition surface, can be recuperated at any time during a run. It proved to be of great value in this case, and also during the half-power run. It is perhaps necessary to the Hornsby-Akroyd system, and we do not know that any objection can be urged to the use of the hand fan during the no-load run. Where an independent vaporiser is employed it is not necessary, and instead of using a combustible charge at every possible working stroke, only one now and then need be taken, and the consumption in this way may be very light. The same remark holds with regard to the half load, though of course to a lesser degree, but the independent lamp has to be fed. Messrs. Hornsby are to be congratulated upon the running of their engine; and although it was not the lowest in oil consumption, even when compared with an engine approaching its own power, it was shown to be a thoroughly practical engine, and one which could be depended upon to give excellent results in ordinarily careful hands.

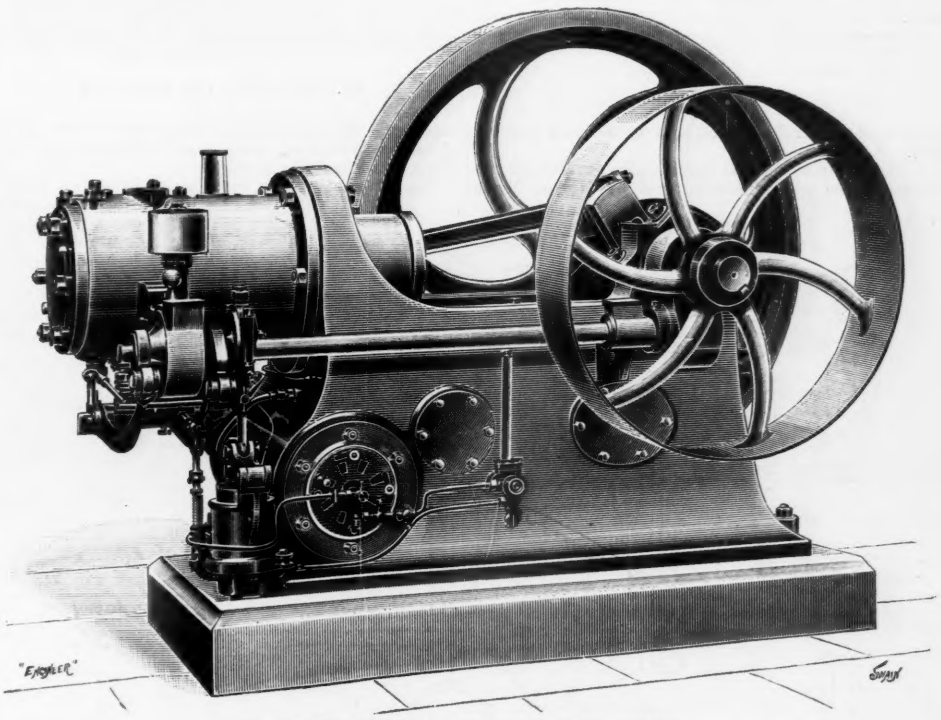


Fig. 3—SAMUELSON'S OIL ENGINE—GRIFFIN'S SYSTEM

The next engine in the order in the trial shed is that of Messrs. Samuelson and Co., which we illustrate on this page. This engine is made under the Griffin patents, and is one which recently gained the Vermiel Medal at a recent trial at Paris, carried out under the auspices of the French Government. Other English engines were present at this trial, but this one received the highest number of marks. At Cambridge it was the only engine which comes under Class 1 and Class 6. A perspective view taken from a photograph is given on this page, and details are given on this and on page 26. The spray-maker, by which the oil in a fine state of division is sent into the retort or heater—page 27—is attached at the end, and in the centre of the cover, carrying the air-admission plate, held in place by the butterfly nuts shown. At the opposite end of the same heater, which is surrounded by exhaust and air passages, is an adjustable air inlet valve adjusted by a handle and screw, as shown. The heater is of itself, in section, a corrugated tube, and its temperature after the engine has been started by means of a hand pump and ignited spray inside the heater is maintained at the necessary temperature for complete vaporisation by the exhaust gases on their passage to the atmosphere. The end of the heater which receives the spray is shown in the elevation of the engine, page 26, and this also shows the connection between the air pump—which can either be worked by a hand lever or by the excentric shown—and the oil supply within the tank formed in the frame of the engine. From the same view may be seen the attachment of the inlet and exhaust pipes which connect the far end of the heater with the valve case shown in detail on page 26. The end elevation of the engine also shows the connection by these pipes between heater and inlet and exhaust valve chest. The spray maker employed at the pump end of the heater or retort is of a simple form, and is somewhat like the diffuser form of spray maker adopted for the lamp for heating the ignition tube, as shown on page 27. This ignition tube heater may be at once described. It is almost the same, and the action is precisely that described in THE ENGINEER of the 2nd December, 1892. Oil is supplied by the pipe marked oil tube, air being admitted under pressure of about 12 lb. per square inch through the air tube shown. This air-jet blows the oil, which by capillarity finds its way between the two bent pins seen in elevation and by dotted lines in plan on page 27. A constant supply of oil is provided, and any excess over that necessary to maintain it at the proper level in the little tank supplying the capillary pins passes away down the oil overflow tube. This is one of the prettiest details in the engine, and it is rather curious that such a means of avoiding the use of oil jets with very fine holes and very fine adjustment is not employed for the main spray maker in this and other spray maker engines.

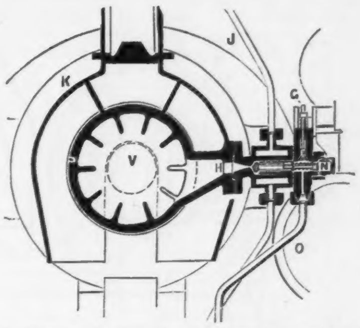


Fig. 2—Diagram Section, Hornsby Vaporiser and Oil Valves

The spray maker used for this purpose in the Griffin engine is shown in section at the left-hand corner of the spray maker engravings just referred to. The oil inlet is at the lower part of a casing containing a valve on the end of a piston of some length immediately below the words air inlet. This valve is ordinarily pushed upwards by a spring beneath it. Above it is an inlet for air under pressure, the inlet being controlled by the governor gear, and hit-and-miss arrangements which control the inlet valve. This air under pressure pushes the piston down, and at the same time some of it rushes through the horizontal jet piece, which by induction draws oil from the space in which the valve at the bottom of the valve stem dips. Oil and air are thus together blown from the double jet piece only when a working stroke has to be made. The inlet and exhaust valves are both operated by hit-and-miss knife edge pieces, controlled by the governor, and by the rocking levers shown in the end elevation, page 26. Thus the spray making, the exhaust, and the inlet, all are under the control of the governor, and the all or none system of governing is adopted.

At Cambridge this engine ran through the preliminary trials, but a hitch occurred when the engine was to be started for the consumption trials. Some time was expended in starting the engine, but it did not run as it had previously, and eventually it was found necessary to withdraw from the further trials and to ascertain the cause of the difficulty. Whatever this difficulty may have been, it was removed on the Friday morning, and as far as we know, the only change made was the insertion of a new ignition tube of greater length, after which the engine was kept running for some time, but not in competition. The diagram, Fig. 4, was taken at this time. The engine, as we have stated, had run through the long duration trials, but its combustion was not quite satisfactory, and on the third day was less so than it had been. It is probable that unsatisfactory ignition was the cause, as this would be reflected and magnified in an engine depending upon exhaust temperature for the classification of the oil vapour. The next engine was the Capitaine, but as it did not run in the consumption

# THE GRIFFIN OIL ENGINE AT THE R.A.S.E. SHOW

MESSRS. SAMUELSON AND CO., BANBURY ENGINEERS

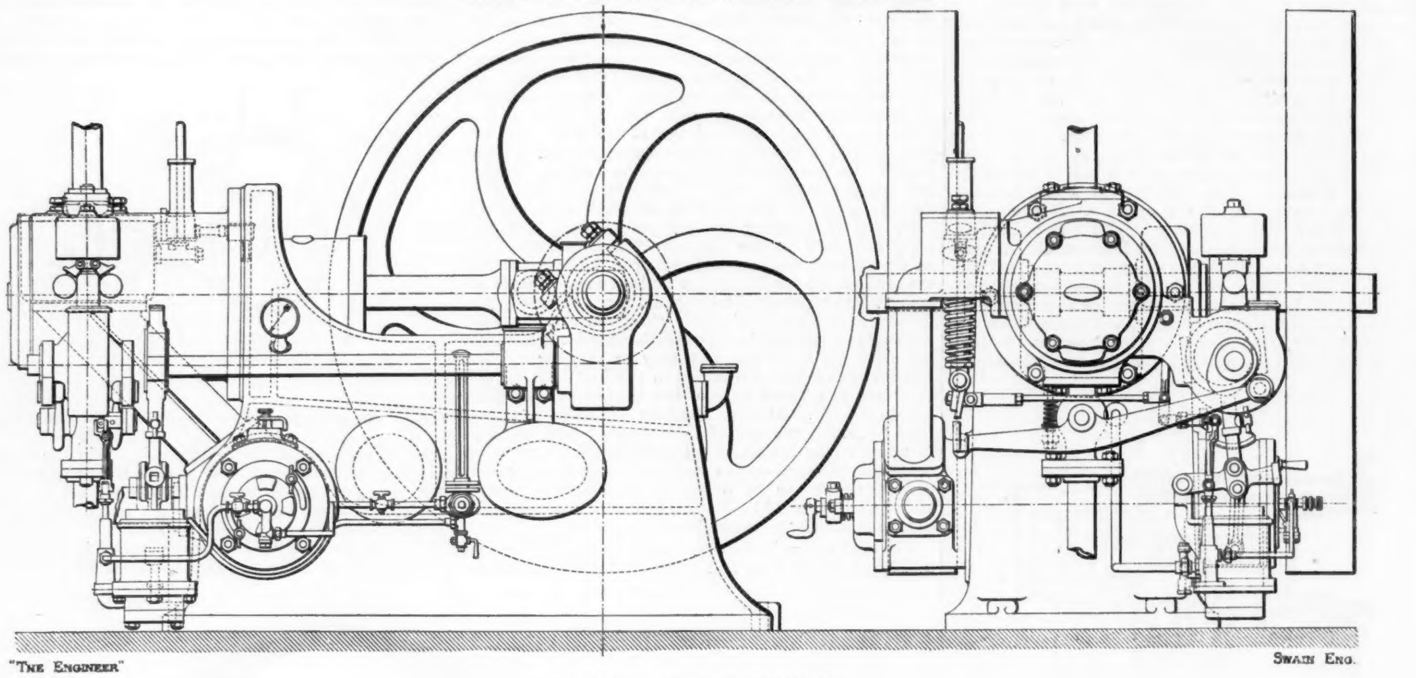


Fig. 5—SIDE AND END ELEVATION

trials we defer our description of it to our next impression.

We now come to the next engine which ran through the whole of the trials, namely, that by Messrs. Wells Brothers, made under Hamilton's patents. We are not yet in possession of a perspective view of this engine, but the accompanying engraving from an end view shows the arrangement of the vaporiser and valve gear, and the small engraving, Fig. 10, shows the arrangement of the vaporiser. The engine comes under classes four and six of our classification, the vaporiser being of the high temperature gasifying type.

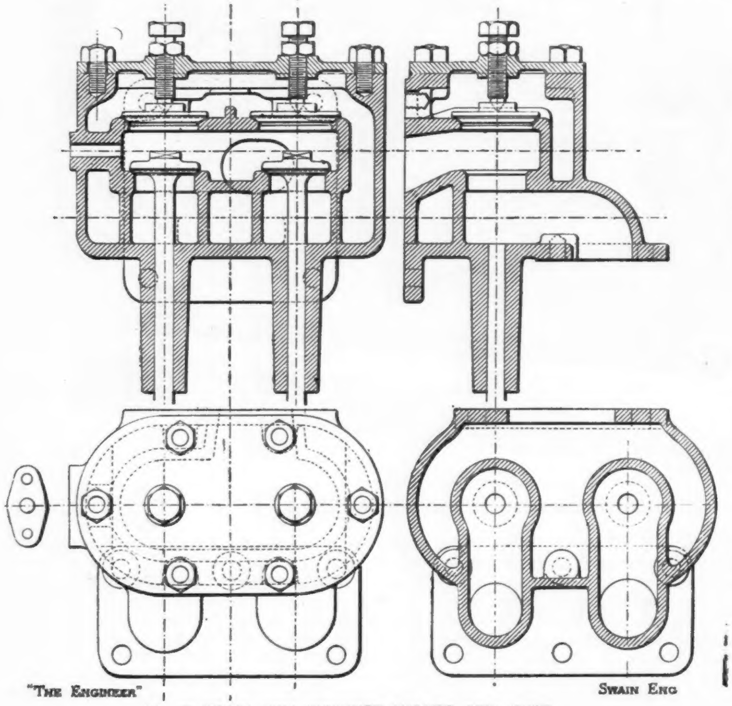


Fig. 6—INLET AND EXHAUST VALVES AND CASE

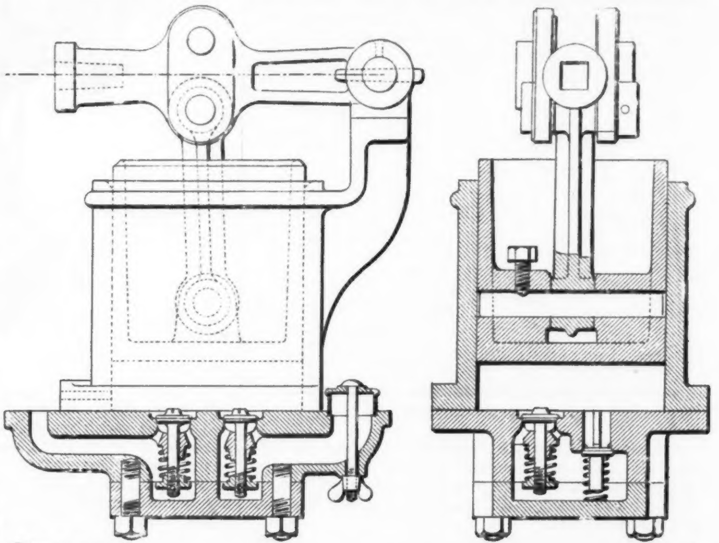


Fig. 7—AIR PUMP

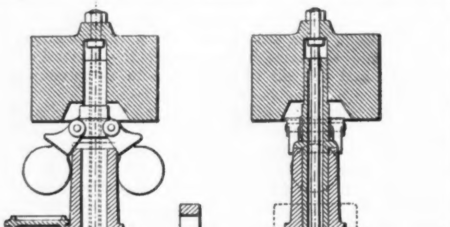


Fig. 8—GOVERNOR OF GRIFFIN OIL ENGINE

The air used is heated by being led through a passage round the combustion chamber. The valves are three in number, viz., an oil measuring and admission valve—Figs. 12 and 13—of the oscillating type, to which the oil flows by gravity; an admission valve for oil, vapour, and air; and an exhaust valve, the latter two being of the usual mushroom type. All these valves are operated by one lever and cam, a spring being used to keep the roller in contact with the cam as described hereafter.

The governing is effected by cutting out ignitions and holding the exhaust valve open. For this purpose a catch attached to a horizontal lever comes into engagement with a tooth on the valve operating lever when the latter has opened the exhaust valve, and thus the lever and all the valves remain at rest during one or more cycles, according to the work the engine is doing.

The horizontal lever above mentioned has at the opposite end to that at which the catch is fixed a hardened steel cam surface, which is struck by a similar surface on the crank arm which operates the oil-measuring valve. The action of this mechanism is to bring the catch opposite the tooth on the lever, and if the spring which acts on the horizontal lever is not strong enough to overcome the inertia of this lever, thus allowing the cam surfaces to separate, an engagement will take place, and there will be no following ignition.

The ignition is effected by a hot tube of durable metal, the tube being kept red hot by the burner that heats the vaporiser. This burner is of the regenerative kind, the waste products of combustion forming a jacket round the pipe which conveys the mixed oil and air to the burner. The air is supplied under pressure by an air pump, which can either be worked by hand or by the engine, and an air reservoir is used in connection with the delivery pipe to equalise the blast.

A very ingenious arrangement is adopted for working the air pump either by hand or by the engine, as required. An excentric on the side shaft has its strap pivoted to the lever which works the pump, the fulcrum of the lever being a pin in the side shaft bracket. When the pump is to be worked by hand this pin is removed, and the pin jointing the excentric strap to the lever now forms the fulcrum of the latter.

In general design the engine much resembles the Premier gas engine made by the same firm. In the trial shed it was known as the dark horse, for no one knew of it, and no wonder, when we are told that experiments in connection with it were only commenced about nine months ago.

Referring now to the engravings, the oil-supply pipe O leads from a tank at a higher level than the engine, and supplies oil to the burner by means of a connection P, having a cock for turning off the oil, and also an adjusting screw to regulate the feed of oil to the burner. The main cock M shuts off oil from the admission and measuring valve N, which consists of an oscillating plug having a recess in it, and also a port for the passage of some of the air supply. The oscillating plug is operated from the lever L, which also operates the admission valve A and exhaust valve E. The pipe Q allows the air to escape from the recess in the plug when a charge of oil enters,

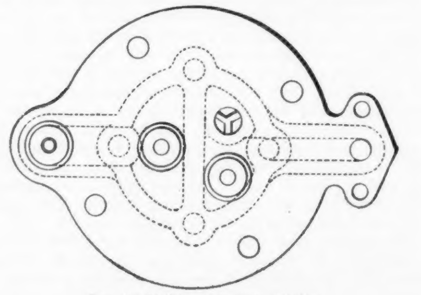
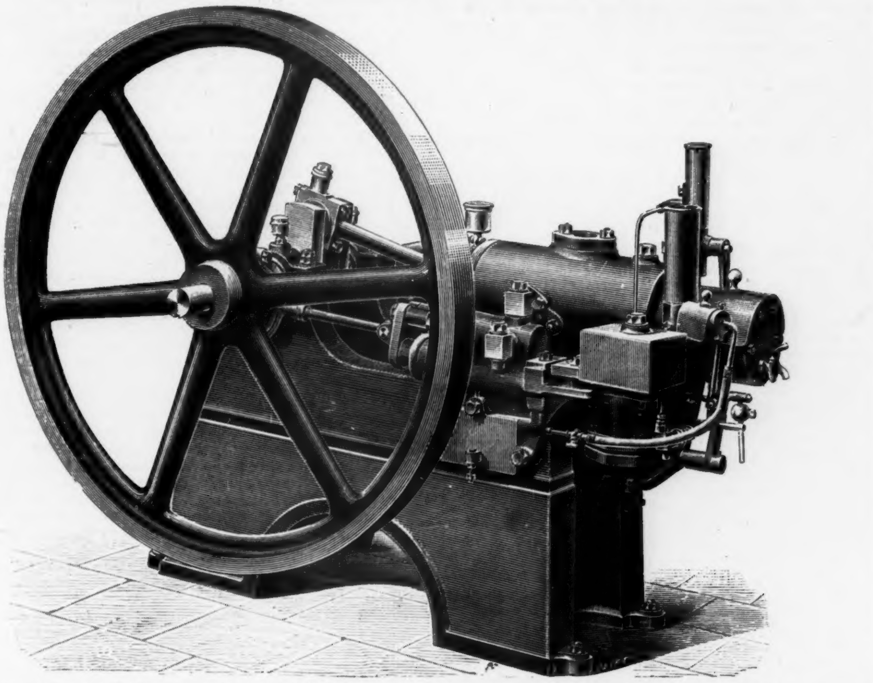


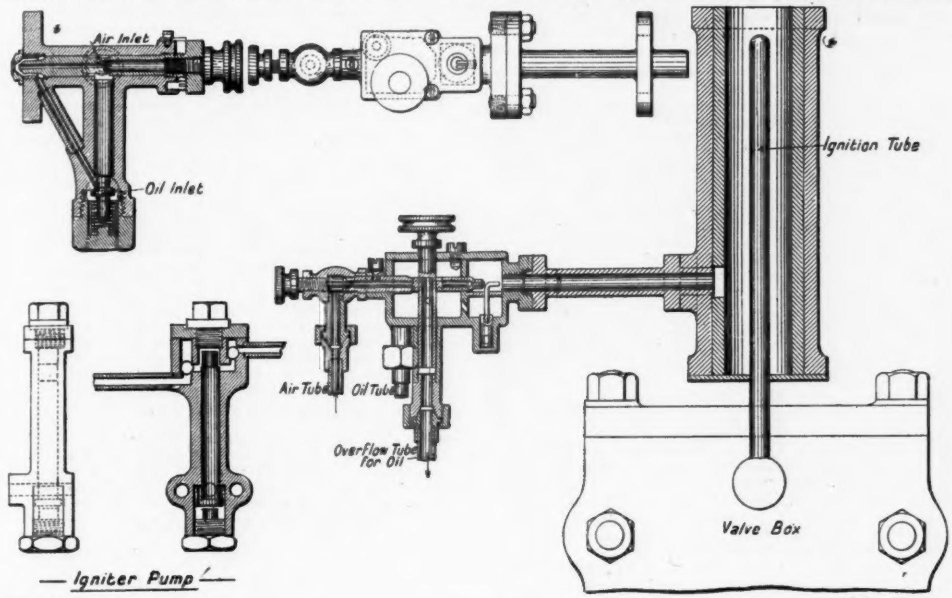
Fig. 9—PLAN OF AIR PUMP

# THE TRUSTY OIL ENGINE, R.A.S.E., CAMBRIDGE

MESSRS. WEYMAN AND HITCHCOCK, GUILDFORD, ENGINEERS



and when this is of glass, the ascent of each bubble shows when a charge of oil is taken.



"The Engineer" Swain Eng.

Fig. 10—GRIFFIN SPRAY MAKER, AND SPRAY BURNER FOR IGNITION TUBE

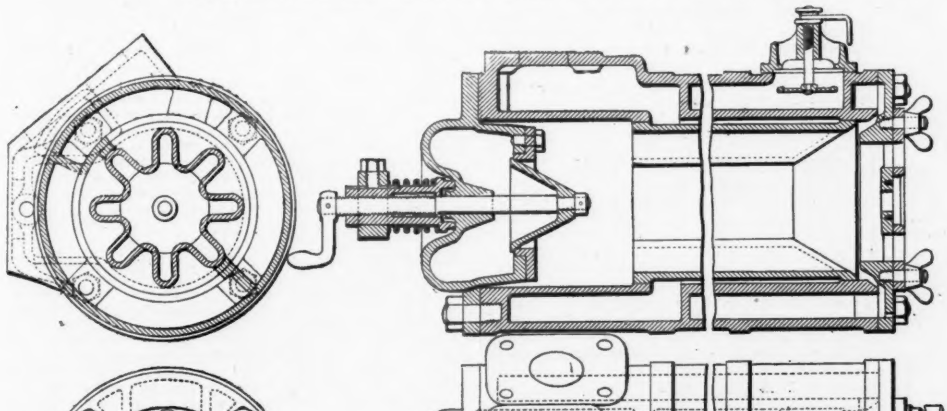


Fig. 10—GRIFFIN OIL ENGINE—VAPOUR HEATER AND EXHAUST AND CHARGING PASSAGES

When the plug is in the position shown on the engraving the recess is in the bottom side, and the oil flows out of it on to a plate inside the vaporiser V, which is simply the admission valve chamber. This chamber is in communication with an air passage around the combustion chamber, the water jacket being outside this passage. The oil falls on the plate T, and the air that enters through the left-hand part of the port F passes upward and through a port in the oscillating plug, and then down over the wetted surface of the plate T, shown in Fig. 13. The burner which heats the ignition tube I also heats the bottom of the vaporiser, and the waste products from its combustion are led back around the pipe conveying the oil and air to the mouth of the burner. The oil is thus vaporised by the lamp flame as above mentioned, and the air is also heated by the heat of the combustion chamber before it enters the vaporiser. In entering the latter, part of the air is diverted so as to sweep through the port in the plug above mentioned and over the surfaces wetted by the oil.

The governing is effected by bringing the whole valve motion to rest, the exhaust valve being full open, as shown in the engraving, the admission valve closed, and the recess in the plug towards the bottom. The governor mechanism is clearly shown. When starting, the products of the combustion of the lamp are passed into the air passage to heat it up, and this is done by turning the plug X, Fig. 12.

In the table we published last week we do not give the oil consumption of this engine running light, as we did not obtain it at the time of the trial. We are, however, informed that during the four hours the lamp used 2 lb. and the engine 6 lb., or a total for four hours of 8 lb. This gives for a consumption of 1·15 lb. per brake horse-power an equivalent of 1·74 brake horse-power for running the engine light. This is very low, and although we did not see the oil weighed, we must say that it is consistent with the running of the engine, which was remarkably regular, and the combustion good, the admissions of oil being practically a constant of one in eleven. The consumption of oil on the long duration tests was less than in the short runs, as might be expected, for in both cases the oil used while putting on the brake, &c., is booked against the engine, as it was with the others, and sometimes the brake was not quickly got on, so that the loss on this head was not inconsiderable in a trial of two hours.

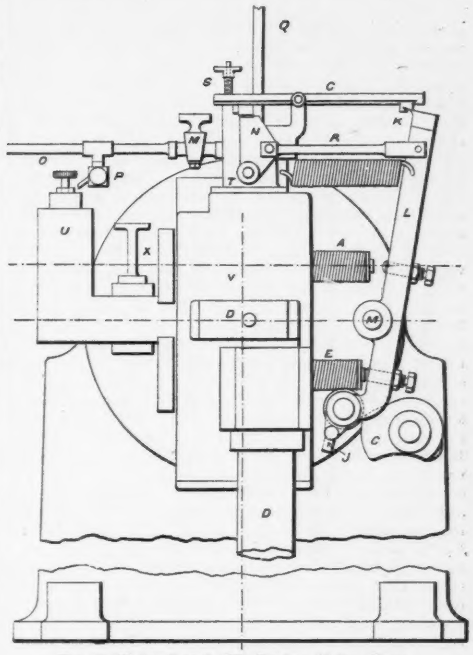


Fig. 12—Wells Bros.' Oil Engine Valve Gear

We have not mentioned that the engine ran five minutes over the two hours with the full load before the readings were taken. If duration of the trial be taken as 2 hours 5 minutes, the consumption per brake horse-power hour would be 1·10 not 1·15. The engine ran well, but at a slower speed than is desirable for most work. The combustion was generally complete, and the speed is said to have been reduced in consequence of the vibration, or we might almost say oscillation, of the ground during the first few days.

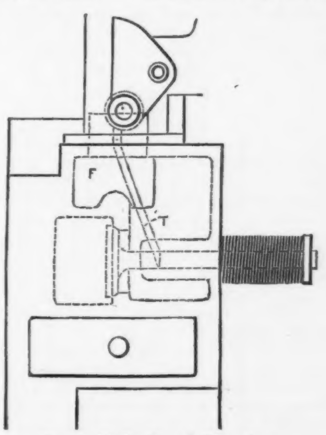
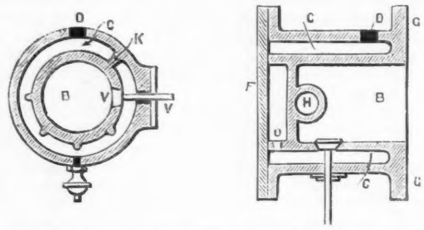


Fig. 13—Wells Bros.' Vaporiser

We now arrive at the last of the fixed engines which ran through the consumption trials, namely, the Trusty engine made under the Weyman-Knight patents by Messrs. Weyman and Hitchcock. This engine was of small size, a larger engine, which the makers intended to send, not being ready. It comes under classes 3 and 6 of the classification. Its construction is almost the same as that illustrated in The Engineer of the 4th December, 1891, which contains the results of a trial of the engine of that date. The engine tested at Cambridge gave higher brake horse-power with smaller diameter of cylinder and stroke, showing a considerable advance in this respect, although the Cambridge trials gave a less satisfactory result than was obtained in the trials reported in the above-mentioned impression. The vaporiser of this engine is fed by a small pump, which only acts when oil is required, and this varies in proportion to the load. The pump is worked by the hit-and-miss, controlled by the governor. The same hit-and-miss finger actuates the lever which opens the valve through which gas or vapour passes from the vaporiser to the combustion chamber. The vaporiser is roughly shown by the annexed diagram, in which B is the combustion chamber fixed to the end of the cylinder by the flanges G. Around the chamber B is an annular space formed by the chamber and a surrounding cylinder. This space C is not quite continuous, the diaphragm K filling the space between the inner and outer parts, and between the cover F and the flange G. Oil is admitted at D through a short glass tube drop by drop from the pump as required, air being at the same time admitted through the tube seen at the top of the cylinder. The section Fig. 14 is a vertical section at the vapour or gas valve, and Fig. 15 a horizontal mid-section showing the tube H, which is cast in and forms a chimney for the vaporiser heating lamp. The oil dropping on the upper surface of the inner cylinder below D is heated and evaporated as it passes round towards the bottom of the annular space and ultimately through the valve V into the combustion space, the passage of the gas and air being, however, by the form of the ribs and diaphragm shown, forced to pass the space O to reach the part containing the valve. It will thus be seen that the essentials of a really good vaporiser, namely, evaporating surface swept over by a current of heated air, are obtained in a simple way, while any excess of oil admitted for starting or during running may be, when necessary, drawn off by the cock shown in Fig. 14 above. This vaporiser is under complete control by means of the oil-drop system and vapour valve, with the result that, as was particularly noticed at Cambridge, the combustion was perfect during the whole of the long duration runs and during the consumption trials. The engine runs at a moderately high speed, which is necessary in a four-cycle engine if anything like regularity of turning with moderate rate of fly-wheel is to be attained. It is also important in engines of this cycle, for the work done by portable engines on farms, including the very irregular work of thrashing and sowing. For this reason it is to be regretted that a double-cylinder portable engine by the same makers was not ready for the trials. The governing of the engine is effected entirely with the oil pump and vapour valve, a jerk governor being used for the hit-and-miss finger. The gear is of the very simple kind, and there is no doubt that the time taken in starting, getting the brake on, and the oil used for these very short durations, tell heavily in such trials on so small an engine.



Figs. 14 and 5—Vaporiser of Trusty Oil Engine

The regularity of running of this engine was especially marked by the observers. The half-power run was made twice, in consequence of some uncertainty in the oil weighed out and back, and on the second run of two hours it was noted that during two consecutive quarter-hours the revolution counter gave exactly the same register; not one revolution difference in twice running through the two quarter-hours, or twice 4005 revolutions. On the two next quarter-hours there was a difference of only two revolutions. The oil consumption according to the second run on half-load 1·485 lb., including lamp, and 1·32 lb. without the lamp; but on the first run, the consumption was 1·129 lb. with the lamp, and 1 00 lb. without the lamp; and these figures, for the first half-load run, are so very nearly the same as those obtained on previous trials, that there seems to be very little doubt that the first oil weighings gave the correct total consumption, and not the second.

Before concluding this notice of the trials of the fixed engines on the consumption trials, reference should be made to the engine constructed by Messrs. Clayton, Shuttleworth, and Co., on the "Trusty" system. The engine was entered on behalf of the makers by Messrs. Weyman and Hitchcock, and it ran perfectly through the long-duration trials. As, however, it was fitted with a temporary lamp to show it at work without an air pump, it was decided to withdraw it from the consumption trials, as it was thought that the temporary character of the lamp would prejudice the engine in the eyes of the judges. Messrs. Clayton and Shuttleworth find that their special lamp without an air pump is sufficient when Royal Daylight and similar oils are used, but it was necessary to modify it to use Russoline. The engine itself, however, ran remarkably well, and combustion was perfect throughout the three long days. It ran at 252 revolutions per minute, and gave 6·83 brake horse-power.

With reference to the Britannia Company's engine particularly described last week, it should perhaps have been more explicitly stated that the diagram sketch of the vaporiser and connections was intended to show the principle of construction, and not the precise conformation given to the vaporiser and its connected passages. With regard to the running of the engine, it may be well to remark, though it is clear to those conversant with the subject, that the defects which we said on page 8 could obviously be remedied with ease, were due to the governing. But as we find that this was not understood, although the context showed it, we repeat that the engine would undoubtedly have run better with only one groove in feeding rod, and then govern by complete cut out; probably also by the exhaust valve. We may also repeat that the system on which the engine is constructed contains features of great importance, and it is, in fact, one of the best of all brought forward.

We shall return to the subject in another issue.

## MINERALS, RAILWAYS, AND ROADS OF HONDURAS.

The British Minister at Guatemala in a recent report on the economic condition of Honduras, the middle, and in size, the third State of Central America, observes: Honduras is essentially a mining country, and in the opinion of American experts and prospectors, the mineral wealth hidden beneath its serrated soil is enormous; yet on this so vital point, hardly any statistics are published. The country, considering its area, may be almost described as depopulated, and is seriously affected by the scarcity of labour, towards which the apathy and inherent aversion of the native is so great that unless recourse is had to foreign immigration on a large scale, the Republic is likely to remain, for years to come, in its present backward and undeveloped condition. Antimony, copper, gold, iron, lead, and silver are found in almost every department, and brown coal is said to be plentiful on the North coast. Recently, coal of a superior quality has been discovered by an Englishman residing in Sanpedro Sula. The coal, of a semi-anthracite character, is in a vein 5ft. thick, cropping to surface in close proximity to the Atlantic port of La Ceiba. This discovery will be of the greatest importance to the Republic, as the establishment of a coaling station in one of the central American Atlantic ports is one of the most urgent wants of steamers plying in that region. According to the mining code of Honduras—included in report—coal deposits are the exclusive property of the State, and cannot be denounced like other mineral-bearing deposits; but it is to be hoped that the Government will assist in securing some of the coal lands, and opening up the hidden treasure.

The hitherto non-success of many mining enterprises must be attributed chiefly to gross incompetence and often to dishonesty on the part of their managers. In addition, former administrations, in their anxiety to foster and extend the mining industry, made the mistake of conceding extensive tracts of land to applicants not in a position to turn their concessions to account, and often actuated by dishonest motives. The consequence was that so-called companies and syndicates acquired vast tracts of land, to the detriment of legitimate enterprise and honest prospectors. An idea of the worthlessness of these companies may be formed from the fact that while in the years 1887—9 no less than 800 mines were discovered, up till to-day hardly two or three of these claims have made a pretence of honest development.

The want of good internal communication is a serious drawback, which can only be removed by earnest and immediate endeavours of the Government to open up the remote districts of the country. No extension of the railway system has been made in the past year. The only line running is that from Puerto Cartér, one of the Atlantic ports, to San Pedro Sula, a distance of about 37 miles. A contract has been signed by Messrs. Valentine and Van Auken, American contractors, to extend this line to Amapala on the Pacific Coast, and thus connect the two oceans. If this contract be carried out, the Republic will benefit to a very great extent, as vast tracts of rich land and virgin forests will be opened out. If the great scheme of an inter-continental railway to connect New York and Patagonia is ever carried out, Honduras, with the whole of Central America, will reap considerable benefits, and be reckoned among the richest of the Latin-American States. Cart roads do not exist; traffic with the interior is chiefly carried on by pack mules; and in the winter time, *i.e.*, the rainy season, the condition of the bridle paths is such as to render them dangerous and often impassable for even these sure-footed animals.

The climate is good, and on the whole healthy, except on the coast, where the heat is intense, and malarial fevers, &c., prevalent. The mean reading of the thermometer at Tegucigalpa, the capital, situate about 3000ft. above the sea level, ranges from 64·4 deg.-68 deg. Fah. in December, to 73·4 deg. in April, May, June, July, and August. The great evil with which Honduras has to cope equally with the other Central American Republics is the frequency and evil of internecine strife, and their inevitable consequences, commercial and financial instability, which necessarily act as a powerful deterrent to any rapid advancement.

## INTERNAL NAVIGATION OF FRANCE.

French canal and river traffic experienced to a slight extent the general depression of French trade in 1893, tonnage on the former having decreased by 379,752 tons, or 2·29 per cent., and on the latter by 155,662 tons, or 1·77 per cent.; but these decreases were partly owing to increased railway competition. Goods rates were reduced in 1892 by 27 to 33 per cent. on slow, and by 50 per cent. on fast trains. According to a report of a committee of the Chamber of Deputies appointed to inquire into and report upon the subject of inland navigation, in 1881 the quantity of goods carried on canals and rivers was 19,740,000 tons, and on railways—exclusive of express goods—850,640,000 tons, the proportions being 17·88 and 82·12 per cent. respectively. In 1891 canal and river traffic had risen to 2,520,000 tons, and railway traffic to 99,600,000 tons, increases of 5,460,000 tons, or 27·66 per cent., and of 14,540,000 tons, or 17·02 per cent. respectively. The proportion of goods carried on canals and rivers rose to 20·19 per cent., while that on railways fell to 79·81 per cent. This increase of water-borne goods was due to legislation. In 1879 the length of French inland navigable waters was 7437 miles, but boats 120ft. long could not be taken through more than 906 miles of canal. A law was then enacted to the effect that all locks should be reduced to a uniform size, so as to allow the passage of 300 tons burden, 125ft. long, 16ft. 6in. wide, and 5ft. 10in. deep. Improvements were also made in the courses of the rivers Rhone, Saone, and Seine. The result was that in 1891 the length of navigable rivers had increased to 7670 miles, and the length open for boats 120ft. long to 2494¼ miles. A boat of 300 tons can now be hauled direct from Havre to the frontiers of Alsace, and from Dunkirk to Lyons, but there still remains much to be done to complete the network, large gaps existing between the Marne and Saone, Saone and Besançon, Rhone and Marseilles. In 1891 the number of boats was 15,925, the burden 2,996,583 tons, and the crews 40,468, of which half were men and the remainder women and children. The increases over 1881 were boats 1, tonnage 10, and crews 6 per cent. In addition to these boats, there are 691 steamers of 43,583 tons plying on the rivers. Many do a good business between Havre, Paris, and Lyons, and some constructed for sea voyages between Paris and French Atlantic ports, or Paris and London.

In 1880 all inland navigation dues in France were abolished, which gave an impetus to the carriage of heavy goods by water, but the necessity for some sort of tolls by water, leviable locally, for the use and repair of canals has lately been experienced, and an agitation for their establishment commenced. The cost of freight has varied since 1880 from ·2318d. to ·5408d., and is at present a little over ·1445d. per ton per mile. Most of the haulage on canals is done by horses, which in East France belong to the boat owners, and that on rivers by steam tugs. Where horses are not used, hauling is done by cattle hired from the farmers along the canals, the charge rising and falling as the demands of agricultural labour at harvest or sowing time are more or less pressing. The cost varies from ·04636d. to ·049272d. per ton per mile.

The drawbacks to the expansion of canal navigation are defective arrangements as to traction, and want and habit of organisation as regards freight. Vessels in some instances are owned by companies, and do a fair amount of continuous business, but half the boats are navigated by their owners, who live on board with their families, and whose usual career is—they start as boatman at monthly wages, and being thrifty generally save enough after years to buy a boat of 300 tons worth from £480 to £600, which they navigate themselves.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### CARNOT AND MODERN HEAT.

Sir,—Professor Alexander seems to have rather curious ideas concerning the value of time. I have not the least notion what he means about "a challenge" in my article of April 6th, nor why he thinks I must have been "put out" by his letter of May 11th, which in no way concerned me. He seems to be annoyed that I omitted to acknowledge receipt of his book, an omission which is doubtless a regrettable though a very frequent one, but I fear I scarcely realised that it was from him and not from his publishers that the copy came. He now adopts a curious method of admitting the futility of some of his mathematical processes, and challenges me to substantiate what I said in my article of June 29th, viz.: "That if we extrapolate quite illegitimately from Regnault's experiments, and assume that air has a perfectly constant specific heat, then it is a perfect gas, and its thermometric scale will agree with the absolute scale. But there needs no fireworks to tell us that."

Well, there was not intended to be the slightest difficulty about the meaning of this. A thing with constant specific heat has its intrinsic energy a linear function of its temperature, *i.e.*, proportional to the temperature reckoned from an appropriate zero; the absolute scale is a scale on which heat and temperature are proportional; hence allowing that a gas has no intrinsic energy at absolute zero, the statement is justified.

If there are any intermolecular forces the energy need not vanish at absolute zero, but it is just those intermolecular forces to which we must attribute observed variations in specific heat. Not indeed specific heat at constant volume, Regnault made no observations on that, nor could such observations throw any light on the subject of internal forces or absolute zero, but the ordinarily-measured specific heat after deducting the external work of expansion.

Putting the matter into symbols, the equations—

$$d\,Q = c\,d\,T + R\,\theta\frac{d\,v}{v} = T\,d\,\phi.$$

where $\theta$ is air-thermometer temperature, T is absolute temperature, and $c$ is specific heat at constant volume, do not, indeed, carry us much further, even though we are told that $c$ is constant, unless we know a relation between $\theta$ and T. But subdividing the expansion term into internal and external work, so as to write,

$$d\,Q = c'\,d\,T + R\,T\frac{d\,v}{v} = T\,d\,\phi,$$

and then being told that $c'$ is constant, we can proceed without difficulty.

Professor Alexander chooses to say now that his N was the specific heat at constant volume, the same as my $c$; but in that case his appeal to the experiments of Regnault was meaningless. Taking N as equal to $c'$, that is to say, giving to N the suitable interpretation—the only interpretation consistent with his assumed value for M—his proof, such as it is, holds. Whatever confusion there may be arises from his sentence, "But by Regnault's experiments it appears that for air N is constant." Everything depends on what you choose to assume constant; and since Regnault's experiments give one no right to assume *anything* strictly constant, the whole discussion is barren and a waste of time.

Given a perfect gas, its temperature scale is the same as the absolute scale, and there is no difficulty. Given an imperfect gas, there is an internal virial, and it is a matter of circumstance and convenience whether this be treated as a separate term in the general first law equation, or whether it be included in one or other of the coefficients. Experimentally it most naturally occurs along with the temperature coefficient, especially when small.

Liverpool, July 9th. Oliver J. Lodge.

Sir,—I have read and read again Dr. Lodge's two articles on "Entropy," and I confess that I am still quite in the dark as to what it is. I should not trouble the Professor, however, if Mr. Donkin had not written to ask Dr. Lodge for a practical example of it. That is to say, he wants Dr. Lodge to do something with an indicator card. From this I take it for granted that entropy is a thing which has something to do with the steam engine.

I have looked at Clausius; but I cannot make out from him what entropy is. Maxwell says, "We have next to consider the series of adiabatic lines as indicating a series of degrees of another property of the body expressed as a measurable quantity, such that when there is no communication of heat this quantity remains constant; but when heat enters or leaves the body, the quantity increases or diminishes. This is entropy."

I have not the least idea what "the degrees of a property" may mean. A body has either a property or it has not; but that property cannot be expressed in degrees. We may say that a body possesses the property of hardness; and we can legitimately qualify the hardness or express it in degrees, but not the property. Besides, the word "property" taken alone has in this case no definite meaning. Thus it is nonsense to write, "The body has a property." We ask at once, What property?

Turning to Dr. Lodge, I find on page 557 of The Engineer: "Entropy, a property characteristic of the state of a given quantity of matter, such that without a change in its value no heat can be imparted, and such that its change multiplied by temperature represents the amount of heat energy transferred." I do not know what these words mean, or rather, what Dr. Lodge intends them to mean. They seem to be nonsense. Suppose, for example, that

I have a pound of iron at 32 deg., am I to understand that some change must take place in some property of the iron before any heat can be imparted to it? Iron is heated every day. What brings about the change which alone enables it to receive the heat? Again, how are we to multiply a "change" by a temperature? In the "Arabian Nights" we hear of a man being changed into an ape, but it puzzles me to know how the change could be multiplied by the heat of the sun. Perhaps Dr. Lodge will give us a numerical example of this extraordinary arithmetical process. Thus, for instance, a pound of iron is raised in temperature 10 deg. Fah. In order, I suppose, to get the entropy, something has to be multiplied by 10 deg. Will Dr. Lodge say what?

In another place Dr. Lodge says that energy divided by temperature is entropy. Am I to conclude that the greater the temperature the less the entropy? Again, Dr. Lodge says on the same page, 557, that if a source of heat is applied to a gas at the same temperature as the gas, the gas may expand and do work without having either its temperature or its pressure raised. In this case the gas is certainly receiving heat. What is the change in the value of the entropy of the gas under the stated conditions? Lastly, is not Dr. Lodge mixing up temperature and heat?

To me it seems that entropy is neither more nor less than an algebraic expression—that it has no real existence. Dr. Lodge tries one definition after another. It is, he tells us, "a thing which falls in temperature down an adiabatic." I can understand a pound of iron or of air falling in temperature in such a way that a curve drawn through the plotted temperatures shall be an adiabatic, but I cannot understand an entropy as "a thing" which can be either hotter or cooler, any more than it can be heavier or lighter, stronger or weaker, at one time more than another.

I am not writing in any captious spirit. I do not want, like Professor Alexander, to "draw him.' I do want to know what the word entropy means. All that I can gather is what it is not. Thus I am told that it is "one factor in energy but not the whole." It would, I think, immensely simplify matters if Dr. Lodge and other writers like him would begin by stating precisely the sense in which they use words. It is with the greatest difficulty I can make out in some cases whether temperature or heat is meant. I know that to the non-scientific they are synonymous, but any approach to want of discrimination in their scientific use is most perplexing. Again, there are the words "work" and "energy." I am constantly puzzled to know in what sense Dr. Lodge uses them. Take, for instance, the sentence near the bottom of the middle column, page 557: "Suppose, for instance, that *no* energy is utilised, but that the whole of the heat supplied is allowed to fall in temperature by mere conduction out of a body at temperature $T_1$ into a body at $T_2$, the heat transferred being Q, and no work being done." I fail to see how it is possible for the body which receives heat not to have work done on it which will precisely equal the energy lost by the other body. There is no doubt a loss of availability; but that is not a real loss, but only a loss as compared with some third body at a different temperature; and if heat is a mode of motion, as Dr. Lodge says it is, "Energy in the form of the irregular motion called heat," then it is certain that the sum of the energy existing in the parts of any system cannot be altered by the interaction of the parts. What is needed here is a definite explanation of the meaning which Dr. Lodge attaches to "energy." Engineers usually define it as capacity for performing work. I do not think this is the sense in which Dr. Lodge uses it.

May I venture, in conclusion, to sum up my questions and ask Dr. Lodge to define in as few words as possible:—(1) What is the meaning of the word "entropy?" Is it, for example, "Loss of power to do work?" (2) Will he define the sense in which he uses energy? Is it, for example, power of doing work, and consequently the antithesis of energy? (3) What does he mean by heat; is it, for example, a mode of motion? I do not think it matters very much what the precise definition is, so long as we know exactly what it is each man has in his mind. If, for example, entropy means loss of power to overcome resistance, why not say so in these words? I can understand at once that low-pressure steam has more entropy than high-pressure steam. Of course the value of the knowledge of the meaning of entropy—when I have acquired it—I do not know; but I shall no doubt know when I read Dr. Lodge's reply to Mr. Donkin.

W. OLDKNOW.

Wolverhampton, July 8th.

### THE MAJESTIC AND MAGNIFICENT.

SIR,—Much interest will be felt in your description of these two ships, which I believe applies in its main features also to the Renown. Your information is probably derived from an inspection of the vessel, and is not official, so that even now we have not to thank the naval authorities for our tardy and partial enlightenment. There is probably no parallel, even in the history of public spending departments, for the course which the Admiralty have pursued in this matter. Ten new ships, costing nearly as many millions, are calmly declared to have been a mistake in their most important features, and another ten millions-worth are begun without any information being given as to the alterations proposed.

I observe with satisfaction that the course you have permitted me to urge in your columns for several years past has at length been adopted, and that the low belt with armour-deck above it has disappeared, it may be hoped, for ever. It is a remarkable fact that no one has ever been able to explain wherein the virtue of such a belt resided. Sir E. Reed, Sir N. Barnaby, and Mr. White are at one as to its uselessness to preserve stability, but yet the Admiralty have till now adhered with desperate tenacity, as usual, however, to suddenly abandon it, without giving any reason.

Your naval readers will be amused to learn that the arrangement by which the outer edge of the armour-deck stretches from stem to stern in a horizontal line "is a most invaluable feature of the new designs, and was never attempted before." They were probably under the impression, as I was, that it had been not only attempted, but achieved, in every protected cruiser that has ever been built. The new system is, in fact, the admission of the principle I have long contended for, viz., that as the armour-deck fitted in cruisers affords, weight for weight, a very much better protection to engines, magazines, and steering gear than the belt and deck hitherto fitted in battleships, and that as the armoured stability supposed to be furnished by a belt is a pure illusion, the armour-deck should be taken as the basis of protection in battleships as well as cruisers, and that what more is needed should be supplied independently. It need not be said that there is nothing new or original in this. It has been adopted in the three last completed of the six large Italian battleships, and in all the new French and American armoured cruisers. The only novelty is that, as in the Eclipse, the deck rises somewhat higher than heretofore, and that, judging from the increased displacement and much reduced armament, engine power, and coal supply as compared with the Italian ships, the side armour is thicker, ranging probably from 12in. to 15in.

It is satisfactory to note that one of the most vicious features of the Sovereign design to which I drew attention in your issue of January 30th, 1891, has been much modified in the new ships. The barbettes are within the citadel, and we thus no longer have the curious spectacle of an arrangement for bursting shells outside the ship in close proximity to one for ensuring their bursting inside. Above the citadel, however, the design is the same, and the barbette guns are still apparently to be carried so low that they are liable to be put out of action by the blowing up of the deck, while they cannot be fired ahead or astern. As evidence of the latter, I believe in none of the Sovereign class has it ever been attempted to fire the heavy guns without elevation within 70 deg. of the keel line. It is true we were told that the forward guns of the Majestic were to be 4ft. higher than in the Sovereign, but it was also stated to be the freeboard, not the barbette alone, which was to be thus raised. The immense superiority of the Admirals in this respect is clearly shown in the drawings illustrating your description.

The new arrangement of side-armour saves the designers from committal to the singular principle, which all evidence contradicts, that while 18in. armour is necessary from the water-line to 3ft. above it, from that point up to 9ft. all risks are sufficiently met by 4in. plating; but we are still apparently to believe that the crowded main deck, with its funnels, communications, and air-shafts, needs no armour at all, except round the guns, and that shells can burst with impunity beneath the upper-deck battery. In the French Brennus, launched three years ago, the upper-deck guns are in armoured turrets, mounted above an armoured side. Ten years hence we may hope to see British ships similarly protected. On the whole, however, the Majestic may be pronounced a decided improvement upon the Sovereign, except in the fact that while the displacement is increased, the coal supply remains the same.

One other question arises. The Majestic, you inform your readers, is to have a 4in. armour-deck reinforced by an armoured side. The Powerful, produced at the same time by the same designers, is, we are told, to have an 8in. deck, and no side-armour. The natural inference is that the Powerful is a battleship which has to meet ships with such enormously heavy guns that side-armour is useless. If the Powerful were a cruiser, intended to engage cruisers with numerous and comparatively light armaments, she would surely have been given a thinner deck and some side plating.

G. W. COBB.

Brecon, July 10th.

### TO ADVERTISERS.

SIR,—Will you kindly grant me space to vent a little grumble at the indifference shown by advertisers to applicants for such appointments as managers, foremen, and draughtsmen, especially the last. Advertisements continually appear inviting applications for this or that post. Men apply and patiently wait week after week without hearing aught further of the matter. To those out of employ, and with little or no means, and those having families dependent on them, this waiting becomes a serious consideration. Would it not be as well if advertisers included in their invitation to applicants for minor posts something after the style of "No reply by . . . Negative;" or, in the case of managers and higher positions, to notify immediately the selection is made that the "Vacancy advertised . . is now filled." Such a system as that suggested would be a relief to many who are waiting and watching hopefully for some response to their communications. If one's application be not entertained, it is some consolation to learn definitely and early that it is so. The trouble and cost involved in a general notification would be trifling indeed. We all know that to reply to each individual would be tedious and costly, and scarcely to be expected, especially at this time when advertisers are likely to be inundated with applications, but a general notice in your columns would be the means of setting many a mind at rest.

I have long been puzzled to understand why so many advertisers hide their identities under a *nom de plume* or Box No. Firms of repute rarely follow this rule. What is to be gained from its adoption is not very clear, unless it be to prevent undesirable personal application. That, however, could be easily avoided by distinctly specifying that applications be by letter only. Under the present system applicants have not the remotest idea of the destination of their communications. It is scarcely reasonable to expect a man to give such full particulars as advertisers ask for, and to furnish testimonials and references without knowing with whom he is communicating.

Again, as to the vagueness of some advertisements. Frequently one will be found to read something after this style:—"Wanted, a works manager for general engineering works. State age, experience, references, and salary required, to Box No. ——." How is it possible from such data to state a salary if the applicants be unacquainted with the name of the firm or establishment? The works may employ fifty men or 500 men. Perhaps the applicants, if any there be, will state a sum out of all proportion for a works of fifty men and sadly incommensurate for one of 500 men. If they be in doubt, and write asking for further information, the chances are that their letters are consigned to the waste basket or the boiler furnaces.

Now those referred to above are supposed to be men of intelligence and education, and if not gentlemen born, to be of gentlemanly demeanour, and as such they are entitled to some semblance of courtesy.

Surely the age of chivalry is not so far past that it will be deemed treasonable to ask *bonâ fide* advertisers to adopt in some degree the form I have suggested, presuming always that many will continue to hide under the objectionable *nom de plume*, or Box No. ——.

ONE OF THE APPLICANTS.

Newcastle-on-Tyne, July 19th.

### ENGINEERING AS A PROFESSION.

SIR,—I regret that I have been unable to follow up all the correspondence upon this subject. Among the letters I have seen I have only noticed two remarks upon the value of civil engineering as a profession. "Pater's" allusion to an individual's "one day's experience upon an iron bridge erected over a rapid stream" shows that one man entered this profession with no more aptitude for it than that possessed by the medical student who had to resign because he could not stand the dissecting-room. "Stud. Inst. C.E." shows that there is a man who can gather some of the harvest which is still to the hand of those engineers who can gather it. Of course it cannot be gathered by those who are "more fitted to be tailors," or by him who "only possesses the simian propensity to imitate what he sees."

When a large public work is commenced, one sees a variety of men come on the ground. I will say nothing of the chief engineer and his immediate subordinates; their positions speak for themselves. But I wish to call attention to the numerous young gentlemen who may generally be distinguished by their Norfolk jackets, pretty caps, and stockings of wonderfully variegated pattern. A few of these prove their ability and energy, and that, wherever engineers are required, they will get on. The majority remaining appeared to have obtained their position through "canvassing and influence," and, when once they have mastered the slight intricacies of the level and theodolite, seem as though they intend to devote the remainder of their days to swaggering around with these instruments, putting in pegs for the navvy ganger, who is generally a born engineer saving the education, to work to. I contend that, as long as such young men as these are permitted to dub themselves engineers, this profession can never take the exclusive standing accorded to, say, the medical or legal profession. I contend that it is these engineers' hacks who are chiefly responsible for raising the bitter cry for employment, and swelling the ranks of the hundreds who clamour for every appointment vacant, and bring the profession into disrepute.

A.M.I.C.E.

### INDIAN RAILWAY CONTRACTS.

SIR,—The answer of the India-office to Sir A. Hickman, M.P., has been read out here with the most profound astonishment. Sir A. Hickman charged the India-office with wishing or intending to order certain material abroad, because it could be obtained 25 per cent. cheaper than in England, and the India-office actually defended themselves from this imputation as from a crime, instead of replying that Sir A. Hickman had overlooked the fact that they were not British funds in question, that in the adjustment of accounts England does nothing for India, but rather drives a hard bargain, and that simple honesty demanded the purchase of the material in the best market. They might also have pointed out that Parliament takes the greatest interest in the welfare of the poor Indian when it is a case of making factory laws for his protection, and that certainly such a benevolent interest would not approve of the purchase in the dearest market, especially in the present critical state of Indian finances. I forget just how it was shown that the exclusion of cotton goods from the tariff was to the advantage of the poor Indian.

Have the English people any conscience, and are they content to be accused of the vilest hypocrisy in pretending to govern India for the good of the people, and in not having anything to do with their financial arrangements, while a representative of any British trade interest can have these arrangements upset—to suit his book—as a matter of course? Be at least honest and say, "Yes, we just govern India for what we can get out of it, and the interests of any tinker in England must stand before those of the people of India."

AN INDIAN ENGINEER.

Calcutta, June 18th.

### VACUUM BRAKES.

SIR,—In a recent trial at Swansea, arising out of the accident on the Taff Vale Railway near Llantrissant on the 12th August, 1893, the question was raised as to whether the driver of the train was guilty of negligence in not applying the continuous brake, but allowing his train to run on unchecked with the front van off the rails for more than a quarter of a mile, without even communicating with the guards, who were absolutely ignorant of anything amiss till the moment before their van at the centre of the train toppled over the bank. Into the merits of the case I will not enter, but I wish to refer to the evidence of the driver, who stated that he was afraid to put on the brake, as it would have checked his engine as well as the train, and caused telescoping, so he contented himself with putting on and shutting off steam alternately, with a view, as he said, to straighten the coach until the couplings snapped, and the brakes went on automatically, pulling up the engine which had been going at thirty miles an hour in a distance of 60 or 70 yards.

Now, if the driver was justified in his fears, it seems quite evident that the continuous brake as fitted on the Taff Vale Railway is of very little use, as it cannot be used on occasions when if it could be trusted it would be of the utmost value, and the simplest method of rendering it useful seems to be that the brake should be wholly disconnected from the engine wheels, and only operate on those of the coaches and brake vans, while the engine should have a perfectly independent brake. I do not know whether the system on the Taff Vale Railway is the same as that on other lines, or if it is in accordance with the regulations of the Board of Trade; but if it is, then it is manifest that a modification should be made in those regulations, and the brakes so fitted as to allow of their being used if necessary without checking the engine.

London, July 7th. W. P. THOMAS.

### OIL ENGINE TRIALS AT CAMBRIDGE.

SIR,—We strongly disapprove of the exclusion of the engineer Press representatives from the engine shed. Being informed that only the expert and one attendant could be present, no other representative of our firm attended, although we very much wished to see the test. We cheerfully submitted to our exclusion, as the space was limited, and we inferred the Press representatives would be present. We were much surprised to hear that eight or ten persons from one competing firm were allowed to be present in the shed during trials. At any future trials we should stipulate that all are treated alike, and that the Press representatives are present, or we certainly would not compete. It is important that we know the results promptly, and not wait months to get the information through the "Society's Journal." Had your representative been present we should have immediately received details which might be of considerable value to us and to the general public.

BRITANNIA COMPANY.

Colchester, July 5th.

### SEWAGE DISPOSAL.

SIR,—May I be allowed to point out, in connection with your kind notice of my work on "Sewage Disposal," that the northern outfall sewer is carried on an embankment for upwards of five miles, and cannot become surcharged, because of a storm overflow at the beginning of the sewer, and because of numerous openings in the crown of the sewer? The true discharging capacity can therefore be ascertained in wet weather. I am dealing with the subject in another way, and hope to raise a discussion on the matter next session at the Institution of Civil Engineers.

London, July 7th. N. SANTO CRIMP.

## SOCIETY OF ENGINEERS.

ON the 10th July, 1894, a visit was paid by the Society of Engineers to the Royal Small Arms Factory at Enfield Lock.

The following are the special operations carried out in the various sections of the factory:—

Smithery.—Barrel rolling, sword and sword bayonet rolling, stamping bodies, guards, bolts, &c., and forging various components.

Machine Gun Department.—Manufacture and repair of machine guns—Maxim, Nordenfelt, Gardner, and Gatling.

Barrel Room.—Barrel drilling, boring, turning, setting, rifling and chambering.

Tool Room.—Die sinking, manufacture of mills, drills, tools, and gauges generally.

Sword Department.—Machining and mounting swords, sword bayonets, and scabbards.

Large Room.—Noticeable for its size, containing 50,000 square feet and 1503 machines, requiring ten miles of belting. In this room the majority of the components in the rifle are machined, such as bolt, guard, sights, &c.

Stocking Department, woodwork.—Rough and finished turning stock, butts, and fore-ends, grooving fore-ends, and figure machining.

Screw Department.—Screw making by automatic machinery.

Grinding and Polishing Department.—Swords, sword bayonets, lance heads and shoes, and components of rifle generally.

Hardening and Tempering Department.—Swords, sword bayonets, springs, and general components.

Browning.—Sand blasting components before browning, browning barrels, bodies, &c.

Assembling Department.—Assembling actions and rifles.

The different buildings contain a floor space of about 300,000 square feet, the plant being capable of producing 2000 magazine rifles, with their accessories—bayonet, scabbard, &c.—also 1000 spare barrels and bayonets, in addition to cavalry swords, cutlasses, boarding pikes, lances, &c., in a working week of forty-eight hours. The factory is worked by means of a total engine power of 1050-horse power.

The number of different operations in the manufacture of components, Lee-Metford Rifle II proper, is about 1500, and with accessories, such as sight protector, handguard, bayonet and scabbard, oil bottle, and pull-through, the number is increased to about 1750.

Among those present on Tuesday were Mr. George A. Goodwin—president—Mr. J. C. Fell and Mr. G. M. Lawford—members of council—Messrs. W. H. Ball, W. Benbow, D. B. Butler, W. G. Cooke, W. H. Dallimore, J. H. Davies, W. H. Hardy, F. Hovenden, F. A. Robinson, S. Simmelkjor, W. T. Sugg, and G. A. Pryce Cuxson, secretary.

A SPARE length of nickel steel shafting constructed for the American liner Paris has tensile strength of about 90,000 lb., probably 25,000 lb. more than any British or German steel shaft, so the *Engineering and Mining Journal* says.

# CHANDLER'S COMPOUND THREE-CRANK YACHT ENGINE

MESSRS. BUMSTED AND CHANDLER, HEDNESFORD, ENGINEERS

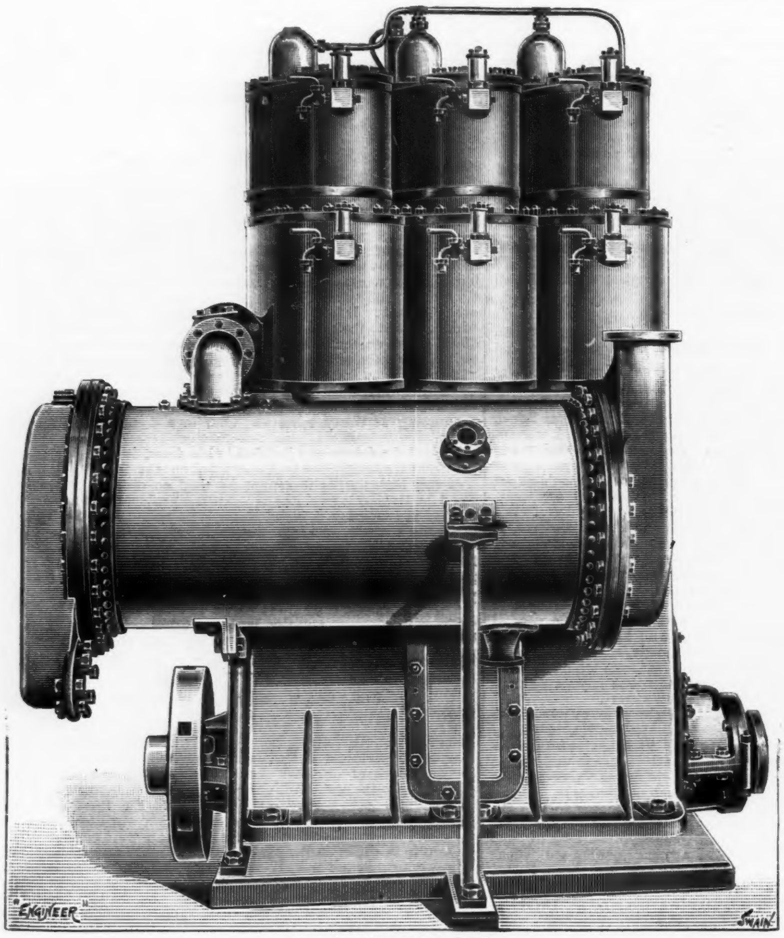


Fig. 1-CONDENSER SIDE

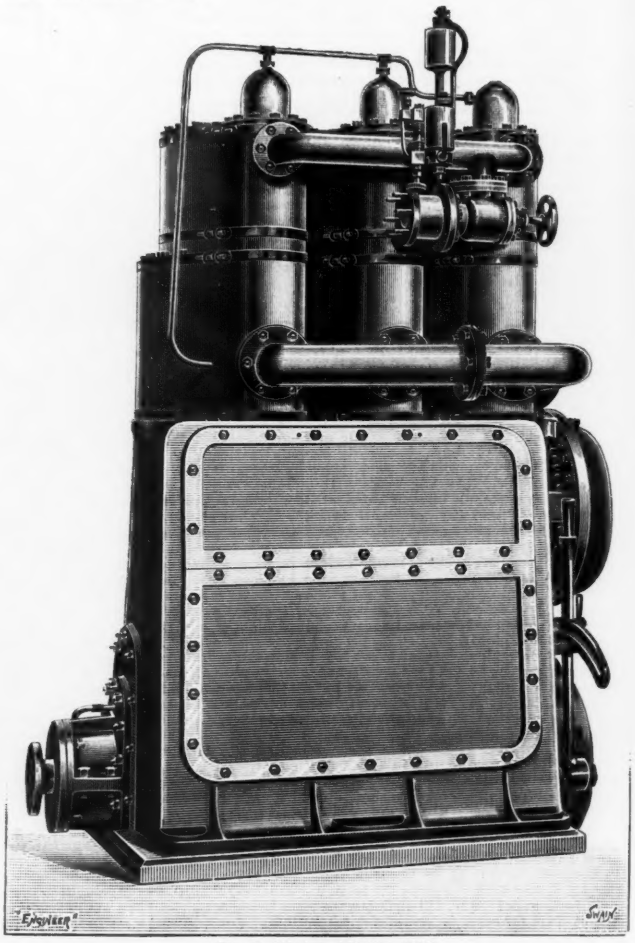


Fig. 2—VALVE CHEST SIDE

## BUMSTED AND CHANDLER'S YACHT ENGINE.

THE above engravings illustrate a set of engines made by Messrs. Bumsted and Chandler, for steam yachts and launches. The engines illustrated have recently been constructed and fitted into the steam yacht Etheldreda—owned by Mr. F. B. Bumstead, the senior partner of the firm. The results have exceeded the expectations of the makers. The engines are of 150 indicated horse-power, and are of the three-crank compound type. The yacht was built and engined two years ago by a first-class firm on the Clyde, but it was found impossible to obtain the silent working desirable on a pleasure yacht, and necessity became the mother of this new departure; the original double-acting compound engines and condensing arrangements were removed, and the new single-acting engine and condensing plant substituted, with the result that a great saving in space in the engine-room is effected. This, coupled with cleanliness, and an entire absence of splashes of oil, steam leaking from piston and valve rod glands, silence, and absence of vibration, renders the alteration a distinct gain from every point of view.

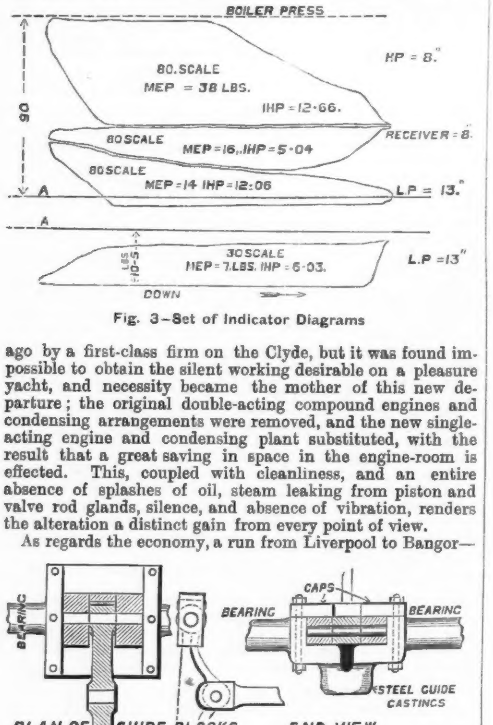


Fig. 3—Set of Indicator Diagrams

As regards the economy, a run from Liverpool to Bangor—when the diagrams were taken—proves the new engines to be more economical in steam than the former engines, and since then a trip from Bangor to Torquay has shown that is is far easier to maintain steam than it was with the old engines running at the same speed. From the first start the new engines have, we are informed, worked entirely successfully and without a hitch of any kind. The thrust block is formed in the after bearing of the engine; a stream of oil constantly flows through it and keeps it cool and clean. There are three high-pressure and three low-pressure cylinders of 8in. and 13in. diameter respectively; the stroke 13in. The cylinders are all close as possible together, but are cast separately. The valves being at the side of the cylinder, are in a suitable position for being worked by a reversing valve gear of the Hackworth type, improved by Mr. Chandler.

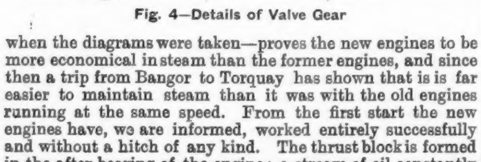


Fig. 4—Details of Valve Gear

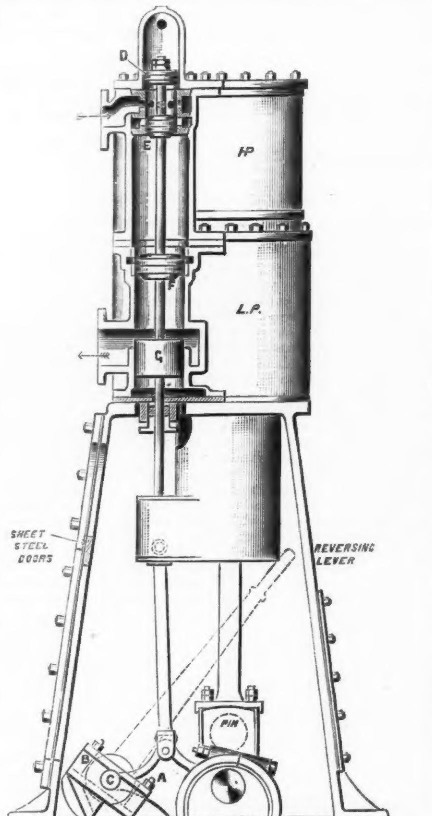


Fig. 5—VALVES AND VALVE GEAR

Great care has been bestowed on this gear, and all the working surfaces are large, see detail views, and immersed in oil, as are all the parts of the engine inside the crank chamber.

A small fly-wheel is shown at the forward end of engine; this is simply for barring round when steam is not up. Fig. 3 shows the four indicator diagrams taken at sea when the engines were running at 202 revolutions per minute with 90 lb. boiler pressure; it will be seen that this pressure is also maintained in the high-pressure cylinders, showing that the valves and ports are of ample size. At this comparatively low pressure, the engines indicated 107-horse power, but they are constructed for 140 lb. pressure, and it is ultimately intended to put in a water-tube boiler for this pressure, when the engines will indicate about 150-horse power. The new engines, condenser, and pumps are only 5 cwt. heavier than the old engines, and the makers state that the next they make of this size and power will be 10 cwt. lighter. The crank shaft is of Siemens-Martin steel, the excentrics being forged solid with the cranks. The arrangement of the valve gear and valves is shown by Fig. 5, and by the detail Fig. 4. The condenser shown in Fig. 1 is sufficient for 150-indicated horse power. It contains 291 brass tubes, 0·75 outside diameter, the cooling surface being 257 square feet.

## THE MUSHKAF BOLAN STATE RAILWAY.

QUETTA is the old capital of Baluchistan, and is now our largest military cantonment on the North-West Frontier of India. The Pishin Plateau, on which this interesting town has been built, rises over 5000ft. above the level of the sea, and many of the high peaks round it are from 4000ft. to 6000ft. higher.

Within the last ten years Quetta has been developed into a first-class *place d'armes*, and many of our foremost soldiers seem to think that the Quetta defences will preserve our Indian Empire against the attack of the Northern invader. The art of modern war, however, demands for success unbroken communication with the base, and it is that necessity which has caused the Mushkaf Bolan Railway to be undertaken after having been shelved for about five years. Quetta is now connected with India by the Sind Pishin Railway, which, though a bold undertaking, has never been a success; and its usefulness as an aid in a campaign is utterly destroyed by the persistent slips at Mud Gorge, which, though instructive to the engineers, are certainly destructive to continuity of carriage between India and the Pishin Plateau.

Such being the case, a project for an absolutely safe line of railway was demanded by the military authorities, and the Mushkaf Bolan Railway, which is now approaching completion, is expected to fulfil that requirement. It might now have been on the eve of opening for traffic but for the scattering of scanty funds over a number of public works, instead of concentrating them on the most important, since the financial position of the Government of India has become so involved, owing to the depressed state of its silver currency. A broad policy in dealing with the funds for public works in India will, however, never be initiated so long as the portfolio of the Public Works Minister continues to be entrusted to either an ex-magistrate, or an ex-soldier, waiting for higher appointments.

The new line leaves the North-Western Railway at the old frontier station of Sibi, and runs due north-west for about 65 miles, where it strikes the southern end of the Pishin Plateau, along which a line of rails has already been laid into Quetta itself.

The Sibi station is 430ft. above sea level, and the summit is 5900ft. above the sea, the total rise being nearly 5500ft. in about 60 miles. The gauge of this line is 5ft. 6in., and the system of "bunching" the steepest gradients has been developed with special consideration for convenience of working with auxiliary engines, an arrangement which will enable the traffic to be carried forward as on a ruling gradient of 1 in 55. Another feature of construction is the refusal to repeat the errors of the Sind Pishin alignment which skirts the spurs of the shale and disintegrated sandstone hills, while on this new railway such spurs have been tunnelled, thus avoiding any disturbance of their slopes. Although there is not so bold a piece of engineering as the "Chuppar Rift," there is, on the other hand, no "Mud Gorge" on this new line, care having been taken to avoid running unnecessarily into engineering difficulties merely for the sake of display in trying to overcome them.

The country traversed by the Mushkaf Bolan Railway may be divided into three well-defined sections having distinctly different features. The first thirty miles are very rough and cut through numerous high rocky spurs, requiring thirteen tunnels and a number of large bridges, the ruling gradient being 1 in 55. The next twenty miles are over an open, stony, waterless country along the base of steep sloping limestone hills, and requiring an abnormal number of bridges to pass the storm waters that occasionally pour down the numerous gorges which deeply score the hill sides, and if checked would simply overwhelm the line with masses of rocks and boulders.

The upper sixteen miles are in a wild country of high, bare limestone hills, through which the Bolan River has cut a deep tortuous channel. Some idea of the difficulty of this section as an engineering achievement may be obtained from the fact that the railway has to cross the Bolan torrent nine times in four miles, which necessitated the most careful individual designing to adapt the bridges to the many varied conditions of construction. On the old Bolan line the bridges were very carelessly placed, so that the flood-water often impinged broadside on to the piers, which were actually battered to pieces by the boulders dashed against them. In the Mushkaf Bolan bridges this danger has been obviated by constructing all piers parallel to the axis of the river, however much skew that may be, and some of the piers have their cut-waters built something like the piers on Canadian railway bridges for parting ice floes. All the masonry is laid in Portland cement mortar.

There are five tunnels on this upper length, and the ruling gradient is 1 in 25. The tunnelling through the treacherous shales, with soft sandstones and disintegrated limestones, has been very arduous, and the most of the 10,000 lineal feet has been done with native miners. The Panir tunnel, 3000ft. long, is the longest tunnel, and is the only one at which compressed air machinery was used; and, in order to work both faces simultaneously, the compressed air has been carried in iron pipes over the summit of the hill, which is 1000ft. above the tunnel. The average progress of the headings worked out to 13 lineal feet per day. The tunnels and the masonry of all the bridges are built for the double track. All tunnels on the straight are 29ft. wide, and some had to be extensively timbered, the general principle for conducting these works being that nothing is so expensive in tunnelling as a cave in. The girders are heavy, and they have been designed to carry the track through on ballast laid on corrugated iron flooring, as was first introduced in India on the Delhi Kalka Railway.

On the "bunched" steep gradients the permanent way is of flat-footed rails, weighing 100 lb. to the yard, laid on steel trough sleepers, this being the heaviest section of rail as yet introduced into India. A temporary track is laid along the upper thirty miles of the line, over which trains work regularly for carriage of materials to the sites of works; and at one place there is a "zigzag" on the ruling grade of 1 in 25, rising 70ft. in a horizontal distance of less than half a mile. At the Panir tunnel there is a temporary rope incline on the three-rail system—that is, with the centre rail common to both tracks—with passing places in the middle, the slope throughout being 2½ to 1, or 40 per cent.

The country through which this new line passes is practically waterless, and is totally uninhabited. Water has had to be brought in wrought iron pipes from springs long distances apart, and is distributed for many miles along the line in smaller pipes for masonry and drinking purposes. The heat in the lower lengths during the summer is terrible, while in the upper lengths the cold is very severe during the winter, when work is often stopped by severe blizzards. The whole of the labour has had to be imported.

To construct a railway on the 5ft. 6in. gauge through such a country, under these conditions, is indeed an engineering achievement; and the Government of India were fortunate to be able to entrust this heavy work to so experienced an engineer as Mr. James Ramsay, M. Inst. C.E., the engineer-in-chief who, under the rigid rules of the Indian Public Works Department, must retire just before his work is completed. Mr. Ramsay brought a ripe experience to the frontier railways in 1885, since when he has been able to profit by the negative lessons taught on the Sind Pishin, the improvement of which railway was entrusted to and carried out by him, after it was handed over to the North-Western Railway to work.

From the reports that have reached us the construction and design of the Mushkaf Bolan Railway are most satisfactory, and can compare with any line in any part of the world; and completely removes all anxiety that, when the stress of war shall unhappily tax England's resources, in the far North-west of India, at any rate, the failure to strike will not be due to the obstruction of the line of railway communication between Sibi and Quetta.

---

The sea-wall at Filey, erected to protect the land from the inroads of the sea, was lately declared complete by Lord Herries, Lord-Lieutenant of the East Riding. Commencing at the North Ravine, the wall runs in two sections to the Crescent Hill, a distance of over 700 yards. A slipway which divides the two portions near the Spa Saloon is spanned by a steel bridge. The foundation of the wall is of concrete, and it is further protected at its base by a concrete apron, backed with a layer of hand-picked stone. The space between this layer and the front of the wall has been filled with concrete, laid in mass, a wide layer of this material being placed with concrete blocks of superior quality to resist the action of the waves. The structure has an average height of 19ft. above the sand, the promenade being 11ft. above high-water mark. A bull-nose ledge placed immediately underneath the coping has the effect of turning the waves from the promenade and throwing them back into the sea, and the coping is surmounted by an iron railing 3ft. 4in. in height. The promenade consists of an asphalted pathway 12ft. wide, leaving behind a large open space, which will be laid out in ornamental plots, and will also afford accommodation for shelters, and, if desired, for a band-stand. The *Building News* says the works have been carried out at a cost of £15,000.

## FYFE'S APPARATUS FOR STEAMING COMPRESSED HAY.

MESSRS. J. & F. HOWARD, BEDFORD, CONSTRUCTORS.

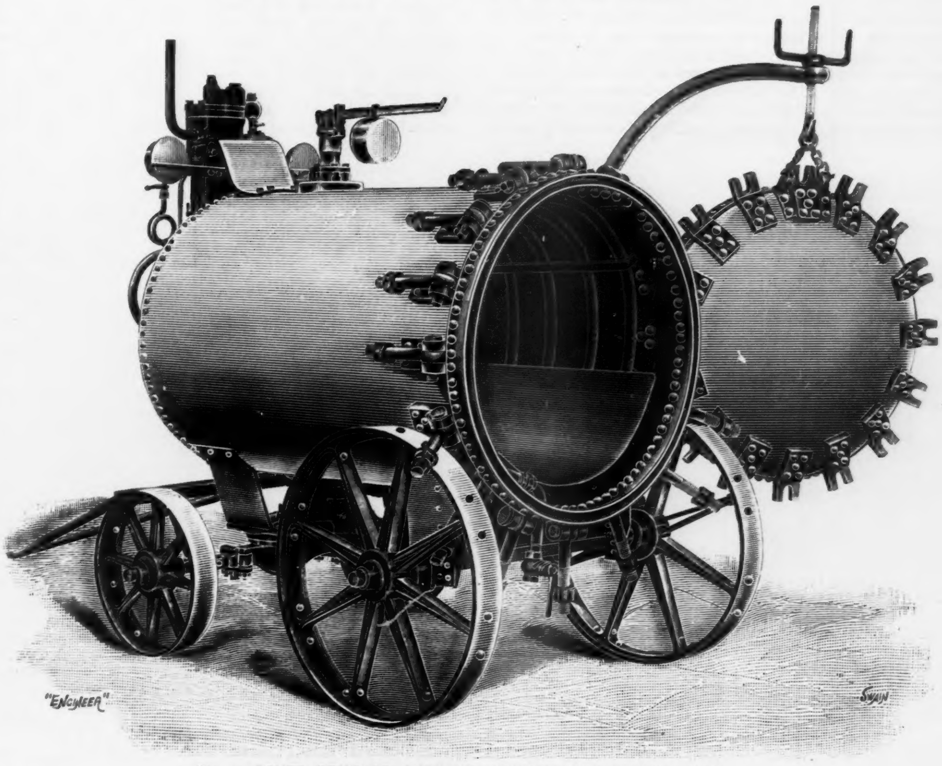


Fig. 1.—COVER REMOVED SHOWING INTERIOR AND STEAM COILS.

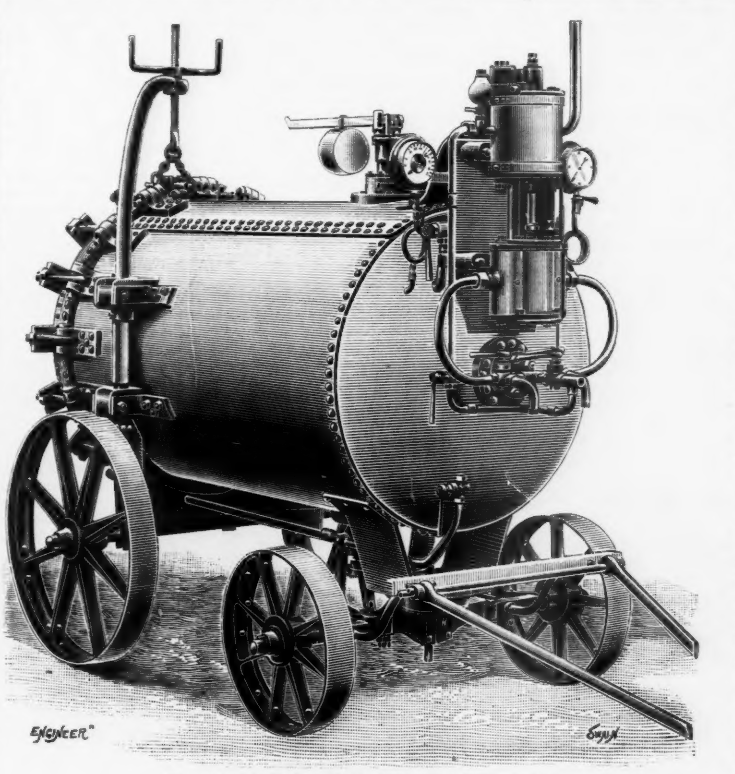
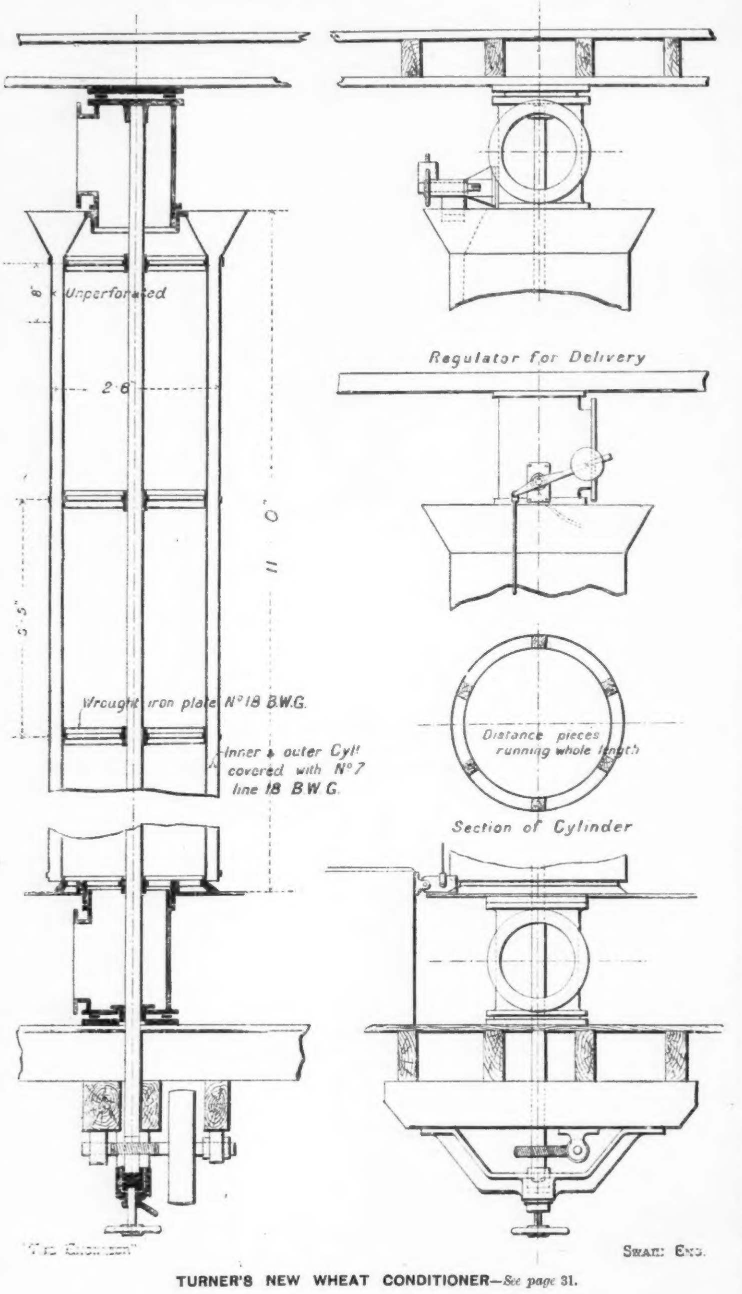


Fig 2.—FRONT END SHOWING AIR COMPRESSOR.

## THE ROYAL AGRICULTURAL SOCIETY'S SHOW.

In our issue of the 29th ult. we described briefly Mr. D. A. Fyfe's new system of hay-making. We are now enabled to place before our readers illustrations of the actual apparatus exhibited—see Figs. 1 and 2. It is generally known that the old-fashioned plan of slowly steaming inferior chaffed hays impregnates them with moisture which is difficult to eliminate; but in Fyfe's system the object is to compress the uncut hay as tightly as possible into bales, with the object of retaining heat for drying it more effectually, and then submitting it to a steam pressure of 60 lb. to 80 lb. Loose or exhaust steam would be useless, as it could not possibly permeate a hard pressed bale; any such attempt would be merely cooking the outside whilst leaving the inside. The apparatus shown consists of a strong steel cylinder, 6ft. long by 4ft. diameter, mounted on four wheels, and with a removable cover at one end for the introduction of the material to be cooked. The other end of the cylinder is cambered, and carries a Westinghouse combined vacuum pump and air compressor, supplied with high-pressure steam. The cover, which is slung from the arm shown when not in use, is provided with substantial steel lugs which engage with hinged bolts secured to the cylinder, and the rim is faced up to form an air-tight joint with the cylinder when the material is placed inside. Inside the cylinder is provided a heating coil and a floor plate. By means of suitable valves and pipes the pump may be employed to create a vacuum in the cylinder, after which steam is admitted, then blown off, and the vacuum pump is again brought into action to exhaust the remaining steam. The process is as follows:—The hay being closely pressed into bales to a density of 20 lb. per cubic foot, is now packed inside the cylinder, and the door being closed, the pump connected with the cylinder is set going to produce a vacuum. Steam under high pressure is then admitted and allowed to permeate the hay for fifteen to thirty minutes' duration, when it is blown off, and what remains is exhausted by means of the vacuum pump. For ordinary requirements the cylinders are made 20ft. long by 6ft. diameter, and are capable of holding from 2½ to 3 tons of compressed baled hay at each operation. In dealing with wet hay under Fyfe's system, hot air under pressure and at a temperature of 300 deg. may be used instead of high-pressure steam. One hour is said to be the time required to put hay through the entire process; fifteen minutes are required to fill the cylinder with hay and affix the door, whilst another fifteen minutes suffice to produce a vacuum and to get steam up to 80 lb. pressure. The cooking requires twenty minutes longer, a further ten minutes are needed to exhaust the steam, the bales are then ready to be turned out in a finished state. Besides possessing the advantage of great economy as regards fuel consumption and labour, this process, it is said, renders feasible the use of new hay for feeding cattle. Moreover the hay being supplied in the form of bales, a railway truck is capable of holding more than twice as much as in the old truss form, thereby reducing proportionately the cost of transit. With the chemical features of this new process we shall not pretend to deal; but we may state that the result of analyses made by Mr. J. Barker Smith, L.R.C.P., Lond., upon different qualities of hay—treated and untreated—serve to show that the indigestible wood fibre is diminished, while the digestible fibre and carbohydrates are increased.

In our general notice of the miscellaneous exhibits reference was made to the new wheat conditioner exhibited by Messrs. E. R. and F. Turner, Ipswich. We now illustrate the machine, which consists of an upright double cylinder, both barrels covered with perforated metal, and revolving slowly upon one central spindle. The wheat falls in a thin stream between the two perforated cylinders, and the upper part of the machine, for two-thirds of its length, is devoted to heating the wheat and evaporating from it any moisture left after treatment on the washing and whizzing process, or in a damping warm. The drying is accomplished by means of a hot-air current, which passes into the cylinder at the top and out through the perforated covers and the wheat between them. The bottom part, about one-third, of the conditioner is supplied with cold air in a similar manner for cooling the wheat before sacking off or storing in bins.


8"
Unperforated
2' 6"
11' 0"
5' 5"
Wrought iron plate N°18 B.W.G.
Inner & outer Cyl' covered with N°7 line 18 B.W.G.
Regulator for Delivery
Distance pieces running whole length
Section of Cylinder
"The Engineer"
Swain: Eng.

TURNER'S NEW WHEAT CONDITIONER—*See page* 31.

A scraper on the bottom table takes off the wheat as it descends from between the covers. The depth of wheat taken off at each journey of this scraper is regulated by its connection with a loose flap on the top of the machine, which travels on the grain in the top hopper, and rising or falling, according as the feed is increased or decreased, causes a corresponding rise or fall of the scraper at the bottom.

## THE DANUBE REGULATION WORKS.

By Bela Gonda.

(*Continued from page* 496, *Vol. lxxvi.*)

THE national economical importance of the Danube for inland navigation was acknowledged, before the beginning of these works, by the Count Stephen Széchényí, who for his activity in the regeneration of Hungary was honoured by his compatriots with the name of the "Greatest Hungarian." He several times visited the Lower Danube, and strived to persuade the Court of the importance of making the cataracts navigable. Meanwhile, the surveys already mentioned were begun on the Lower Danube, under the direction of Paul Vásárhelyi, engineer; and by the indefatigable ardour of Széchényi, the Steam Navigation Company was founded simultaneously with Count Széchényi going, on June 5th, 1833, by the steamer Ferencz to the Lower Danube.

On studying the state of the Lower Danube, Széchényi was convinced that the technical resources of that time were insufficient to render the cataracts navigable; and even with great effort and pecuniary sacrifices the work could not have been carried out completely in the time. But to ensure the maintenance of the traffic on the Lower Danube, he decided to construct a road of communication from the Moldova beyond the Iron Gate, and he proceeded to elaborate the plans under the direction of Vásárhelyi. After the Government had approved of the necessary expenses, Széchényi began, in 1834, the construction of this road, which was opened for communication in 1837. This road had for its object its use as a means of transport when low water impeded the navigation. It is called, after its promoter, Széchényi Road, and is a worthy companion to the Trajan road on the opposite shore, which is also an admirable and magnificent piece of construction. During this time Vásárhelyi finished his plans at Plavisevicza in 1834 for rendering the cataracts of the Lower Danube navigable, on the basis of the precisely and conscientiously executed surveys which, taken on October 23rd, 1834, at unusually low water, gave a true exposure of the state of the cataracts.

Vásárhelyi hastened to make use of the water's unusual lowness by having the rocks removed in the navigable way — as far as this was possible by manual labour—in order to facilitate the navigation in the cataracts. But the plans designed by Vásárhelyi were not adopted on account of the difficulties which were raised in the meanwhile. Later on, the occasion of the Crimean War, when the Austrian armies occupied Roumania, the attention of their leaders was called to the regulation of the cataracts of the Lower Danube.

In view of this object the Austrian Government sent thither in 1854 the engineer, Meusburger, and later the chief engineer, Gustave Wex, in order to study the Iron Gate and to design plans for its regulation. They made several alternative plans, and executed also several surveys, especially at the cataract of the Iron Gate, but the execution of the works was again postponed.

After the Crimean War, the other great European Powers concerned themselves in this question of navigation on the Danube. The treaty dated at Paris the 30th March, 1856, stipulated the right of navigation of the Danube, but without touching the question of removing the hindrances to navigation. In 1871 the Danube Steam Navigation Company took the matter up, and engaged the American engineer, MacAlpin, for the study of the cataracts, who, by reason of the manner in which he carried out the regulation of the Missisippi, had acquired a reputation for this class of work. MacAlpin made a careful study of the Lower Danube, and gave his opinion as to the regulation of all the cataracts, and prepared plans, which again were not executed.

The London International Congress in 1871 gave a new impulse to the regulation of the Lower Danube. The Congress, in maintaining the right of navigation, authorised the littoral States to execute the necessary works for the removal of the navigation hindrances, and to levy customs in order to defray the expenses till the capital and interest were paid back. In consequence of this treaty, the Governments of the littoral States delegated an International Commission, consisting of engineers whose business it was to study the cataracts of the Lower Danube, and to devise plans for rendering them navigable. The Hungarian Government delegated Louis Bodoky, engineer; the Austrian Government, Wawra, engineer; the Government of Turkey, the Bey of Mugel, with a suitable engineering staff. The International Commission having executed the necessary surveys for the plans, determined at first as to the principles of the general regulation, that through the cataracts, everywhere in the channel, possibly out of the navigable way, canals with a bottom-width of 60 metres, and with a depth of 2 metres under the lowest water-mark, should be constructed, and for regulating the direction of fall and the velocity—where it prove necessary—dykes should be built reaching over the inundation surface; and finally in considering the greater velocities also, after the regulation, the question of towage should be studied.

The Commission further, considering the greater pretensions of modern navigation, decided that the sluice-canals should be abandoned, and proposed that open canals should be constructed. On the basis of this principle, and after the plans and surveys of Vásárhelyi, the Commission elaborated new plans, embracing the whole Lower Danube. But the works projected in 1873 and 1874 by the International Commission to render the Lower Danube cataracts navigable, were again postponed, till after the Turco-Russian war, the Congress at Berlin in 1878 deliberated on this important question, which had been so long under consideration. The Austro-Hungarian monarchy concluded on the 8th July, 1878, a treaty with Servia, as one of the littoral States of the Lower Danube, proposing the execution of these works without the pecuniary help of Servia; but in order to facilitate the works in question, Servia was bound to permit the free use of her shores, and being assured from the Austro-Hungarian Monarchy that, in view of the navigation of the Lower Danube, she would be treated as one of the most favoured States, it was determined in the Art. 57 of the Berlin Treaty dated 13th July, 1878, that Austria-Hungary should be charged with the execution of works at the cataracts of the Lower Danube, and that the littoral States of this part of the river should do everything to facilitate this work. The same Article further stated, that conforming to the Art. VI. of the London Treaty, concluded on the 13th March, 1871, Austria-Hungary was authorised to cover the expenses of these improvements out of the custom dues which would be levied.

This very important resolution of the International Congress at Berlin, charging the most interested great Power with the execution of these works on the Lower Danube, approached the realisation of this long debated question. The situation became still more favourable for the great work, when the Governments of Austria and Hungary agreed that the execution of the work should be carried out by Hungary, and consequently the right to levy tolls, in conformity to the Berlin treaty, was conferred upon the Hungarian Government.

From this time the Hungarian professional circles began to interest themselves in the important question of the execution of these works, and in view of their execution in conformity to the requirements of navigation, and to the exact conditions of the river, the Hungarian Government asked the eminent foreign engineers, who were invited in 1879 to give their opinion on the works which were to be executed in consequence of the extraordinary inundations in the valley of the Tisza, to examine also on the spot the plans drawn by the International Commission for rendering the cataracts navigable on the Lower Danube and at the Iron Gate, and to give their opinion about the project. In consequence of this, the foreign engineers made a careful study of this all-important question, and in their report they touched on all the particulars of the projected works, proposing several modifications. Later, the "Donau Verein" (Danube Society) of Vienna developed great activity in this direction, and the Austrian Engineering Society also studied the question. Besides this, the "Donau Verein" published plans and descriptions referring to the regulation, beginning with the plans of Paul Vásárhelyi and other existing ones up to the end of 1879, and deliberated on this work in the Austrian Engineering Society. This contributed also to excite general interest in the movement.

But unfavourable circumstances postponed the execution of the Lower Danube works again; and not until 1883 was the question taken up by the Minister of Public Works, Baron Gabriel Kemény, and especially by the Assistant-Secretary of Public Works, Gabriel Baross, who died in his prime on March 8th, 1892, as Minister of Commerce, and who acknowledged the great importance of the navigability of the cataracts on the Lower Danube, in view of inland navigation, as well as foreign traffic. There was considerable difference of opinion regarding the plans of the International Commission and the proposals of the foreign engineers, and neither the International Commission nor the foreign engineers had time or occasion to execute extensive and particular surveys regarding the channel and the water of the cataracts, as required by the final settlement of the regulation. Accordingly, the Ministry of Commerce engaged Ernest Wallandt in 1883, general inspector of public works, to make a study about the channel and waterway of the cataracts, and to submit a project for the final determination of these works, to examine the projects proposed by the foreign engineers, to prepare plans and estimates, and finally to make experiments for the purpose of ascertaining the expense of blasting the rocks under the water.

Wallandt, having accomplished his mission, presented in the same year—in conformity with the instructions—the plans and surveys executed by him. On the basis of these plans the works were fixed in the following manner:—

Their principal and final object was to ensure the unhindered navigation through the cataracts of the Lower Danube. In order to attain this object two problems were to be solved; the one was to do away with the small depth during the low waters, the other to moderate the excessive velocities. In order to accomplish this, it was suggested to deepen the navigation-channel through the cataracts, with a bottom width of 60 metres, with a depth of 2 metres below the lowest water mark ever observed, namely, on the 23rd October, 1834. According to the opinion of competent authorities, the bottom width of 60 metres will be quite sufficient, even for the greater demands of the navigation which is certain to develope on the Lower Danube, especially as it is noticed that the navigation channel to be executed in the river is projected in straight lines, or, where this is impossible, slight curves will be adopted, so that the entrance of the ships—considering the natural current of the river—should take place without difficulty. The depth of 2 metres in the navigation channel will suffice for the wants of the Hungarian navigation on the Danube, especially seeing that the lower water level adopted as datum low has never been reached since 1834, and that the normal water mark is higher at least with 0 5 metre and more, so that the minimum depth of the navigation channel may be taken at least at 2 5 metres. The canal projected through the Iron Gate, however, will be an exception, as during the construction the originally projected depth of 2 metres was changed to 3 metres.

The principal object of the regulation of the cataracts being, firstly, to construct a waterway meeting the wants of river navigation, and secondly, to moderate the excessive velocities of the cataracts, it was decided to restrict the channel within stone dykes. In consequence of this, the rapid fall of the water will be distributed over greater surface, and the high velocity which impeded the navigation hitherto will be as much as possible moderated. But we must remark, that the moderation of the velocity has naturally its limits imposed by the local circumstances, which cannot be evaded, and, in consequence, it has been found necessary to arrange for a system of towage, especially at the Iron Gate Canal, and for this plans have already been submitted.

On page 34 we publish engravings showing some of the rock smashers and dredgers used on the works.

(*To be continued.*)

Building and Engineering Trades Wages at New Orleans.—According to a recent report of the British Consul at New Orleans, the present rates of wages in the building and engineering trades there are—for bricklayers, 16s. per day; cabinetmakers, 12s. to 16s.; carpenters, house, 10s.; carpenters, ship, 12s.; gasfitters, 10s.; painters, 11s.; paperhangers, 12s.; pipelayers, 10s.; plumbers, 12s.; stonemasons, 10s.; boilermakers, 14s.; coppersmiths, 13s. to 15s.; ironmoulders, 12s.; machinists, 10s. to 14s.; apprentices, 2s.; labourers, 6s.

## RAILWAY MATTERS.

The new Bareilly-Rampore-Moradabad Railway has been opened for regular traffic.

The Brussels Common Council has adopted a plan for an underground cable railroad which is to extend from the upper to the lower town.

A Reuter correspondent, telegraphing from Blantyre, Africa, says the construction of the telegraph is now making rapid strides, and the line will reach Zomba by the end of June.

The secretary of the Imperial Institute of Engineers of Russia notifies that the tramway lines of St. Petersburg are to be equipped with the best street railway motors that can be obtained.

It has now been decided to proceed with the construction of the new railway to Crowland, and thus connect that town with the Great Northern Railway Company's system in South Lincolnshire.

The Anatolian Railway suffered considerably in the recent earthquake at Constantinople, four or five stations being wrecked and others more or less damaged. The traffic, however, was not suspended, and the line itself is in good order.

We understand that the Metropolitan Railway Company have intimated a desire to do something to remedy the present state of the atmosphere in the underground railway tunnels, and have offered to consider schemes for ventilation.

The Pacific section of the Siberian Railroad, which is to extend from Vladivostock north-easterly to the Amoor River, following the Ussuri River a considerable distance, is called the Ussuri Railroad, and a few miles were built in 1892. Last January it was opened 122 miles, to a station called Chernigovkce.

We understand that the Egyptian railway administration have given a contract for twenty-four six-wheeled locomotives and tenders all complete to the Société Franco-Belge at the price of £40,553, delivery to be made within forty weeks. The next lowest tender was that of an English firm at £41,280, delivery within thirty-two weeks.

Another step has been taken toward establishing through railway communication between Calcutta and the Burmese frontier. A special survey of the Madaripur extension of the Bengal Central Railway and of the country and watercourses as far as the nearest point of the Assam-Bengal Railway, is about to be undertaken under the orders of the Government of India.

The Tottenham and Forest-gate Railway has been opened for passenger traffic. The length of the new line is six miles four chains, and there are six stations on the route. The line has been constructed in a most substantial manner, and the stations are convenient and well designed. The chief engineer was Mr. A. C. Pain, and the contractors were Messrs. Lucas and Aird.

At the beginning of the year 1860, Russia only possessed 1250 verstes of railway—verste=·663 of a mile—and in 1865 this total had only reached 3360 verstes. But between 1865 and 1875 an enormous advance was made, and 13,652 verstes were opened for traffic. In 1875 the total length of the system was 17,012 verstes. During the following years 6010 verstes were added. Since 1885 the construction of Russian railways has received a new impulse, and the system now shows a total development of 31,804 verstes constructed, and 3113 in course of construction. This length is not inclusive of the line at present being built in Siberia.

In a paper in the *Schweizerische Bauzeitung*, discussing street railroads with special reference to the new electric road at Zurich, in Switzerland, Mr. P. Schenker points out, among other things, that while in the United States about 60 per cent. of all the street railroads are worked electrically, representing about 7500 miles of road with about 17,000 cars in use, there are at the present time in operation in Europe only about 260 miles of electric street railroad, with an equipment of 720 cars. The *Railroad Gazette* draws attention to the fact that these are divided up among about fifty different companies. A number of roads, however, are now under construction, and will help somewhat to swell this meagre total.

The difficulties which railways sometimes experience, owing to the lights of the tail and side lamps of trains going out from various causes, have been successfully overcome by an officer of the Midland Railway Company, who has constructed a lamp which, by an ingenious arrangement, practically removes all risk of the light being extinguished during the journey. Another advantage claimed for the new lamp is its great simplicity and adaptability to burn petroleum or any other kind of cheap mineral oil, which has not previously been generally used in train signal lamps because no satisfactory lamp has been invented, although such oil has for years been used in fixed signal lamps. The lamp effects, it is claimed a saving in consumption of upwards of 80 per cent. at present prices if the common Scotch paraffin is used as compared with the rape or colza oil burning lamp; and the Midland Railway Company have adopted it upon their system for both passenger and goods trains with most satisfactory results. The use of the lamp is not restricted to tail and side lamps only, as it is also adapted for locomotive engines, tramcars, &c.

The Railway Ammonia Motor Company has recently had built at the works of De La Vergne Refrigerating Machine Company in New York a motor car upon its system, and a trial of this car has been made at the De La Vegne works. Anhydrous ammonia in this car is charged in a reservoir, which is surrounded by a tank filled with hot water. From the reservoir it passes into the cylinder, where it acts on the piston expansively, precisely as steam does. The exhaust from the cylinder is conveyed into the water-tank and compressor, where the ammonia is condensed, liquefied in the usual way, and re-used. In the trial made the reservoir was charged until the pressure was about 150 lb., and the car was run about a mile backward and forward before the pressure ran down to 100 lb. *The Engineering and Mining Journal* says it is to be regretted that the ammonia motor had hardly a fair trial. The cylinders are apparently too small to work the motor and a trailer or tow-car, while the mechanical arrangement of the engine is not good, and the power is transmitted to the axle through an intermediate shaft and gearing, the latter always objectionable in a street car. With a better design of engine, and with cheap ammonia, the motor may be able in some places to compete successfully with the electric road.

According to the acting British Consul-General at Constantinople, the Medua-Ferezovitch railway scheme is still in suspense. The proposals of Mr. W. Leatham Bright have been examined by the Technical Commission of the Ministry of Public Works, and approved except as to the amount of the mileage guarantee. The amount asked for was £643 6s. 8d. per mile, whereas the Technical Commission calculated that the revenues of the proposed line during at least the first ten years of its existence could not exceed £450 6s. 8d. per mile, and the Government would be called upon to provide a large annual sum to cover the deficiency. Considering the large amount of provincial revenue that the Ottoman Government has already pledged for railway guarantees, the desire to get at least one line constructed at the contractor's risk is but natural. The risk on a contractor's part is great; the construction of the line from Medua to Ferezovitch would cost at least £1,250,000, while a revenue of £450 6s. 8d. per mile, if realised, would be under 6 per cent. of that sum, without allowing anything for working expenses. A French syndicate is said to be seeking to obtain the concession for this line, demanding in lieu of the customary mileage guarantee a cession of the principal forests in the districts traversed.

## NOTES AND MEMORANDA.

Under the provisions of the Factory and Workshops Act, the Home Secretary has certified that the processes carried on in the tinning and enamelling of metal hollow ware and cooking utensils are dangerous or injurious to health.

M. Dufour, Professor of Astronomy at the University of Lausanne, has discovered an easy method of ascertaining the exact distance of any object on the horizon. First find the height from which the observation is taken, express it in decimetres, multiply it by one-fourth, and take the square root of the result. Thus, supposing the eye to be 8 metres, or 80 decimetres, above the level of the sea, the quarter of this—20—is added to the 80, and 100 is thus obtained, of which the square root is 10. This, says *Fairplay*, is the solution, expressed in kilometres.

The report of the Astronomer-Royal, Mr. W. H. M. Christie, for the year May, 1893—May, 1894, states that the variations of magnetic declination, horizontal force, and vertical force, and of earth currents have been registered photographically, and accompanying eye observations of absolute declination, horizontal force and dip have been made as in former years. The period has been one of much less magnetic activity than last year, but there was a large increase occurring in February, 1894, at the time of the great sun spot. Copies of the magnetic and earth current registers during the disturbances of February 20th—March 1st and March 30th—April 1st, have been supplied to Mr. Preece for discussion in connection with disturbances on the telegraph lines.

The following is an analysis of Bermuda asphalt:—Specific gravity at 60 deg. Fah., 1·071; bitumen soluble in carbon disulphide, 97·22 per cent.; mineral matter or ash, 1·5 per cent.; non-bituminous organic matter, 1·28 per cent.; portion of total bitumen soluble in alcohol, 11·66 per cent.; portion of total bitumen soluble in ether, 81·63 per cent.; loss at 212 deg. Fah., 1·37 per cent.; loss at 400 deg. in ten hours, 17·8 per cent.; loss at 400 deg. calculated to amount of bitumen present, 18 308 per cent.; softening point, 113 deg.; flowing point, 150 deg. Physical tests give the following results with two separate sets of samples: Average tensile strength, 399 lb. and 508 lb. at 32 deg., 116 lb. and 204 lb. at 64 deg., and 20 lb. and 44 lb. at 108 deg. The ultimate compressive strength per square inch at 32 deg. was 1750 lb., and at 65 deg. 667 lb.

An apparatus for detecting flaws in iron and steel by electricity is the invention of Captain De Place, of Paris. It consists, says the *American Manufacturer*, of a small pneumatic tapper worked by the hand, and with which the piece of steel or iron to be tested is tapped all over. Connected with the tapper is a telephone with a microphone interposed in the circuit. Two operators are required, one to apply the tapper, and the other to listen through the telephone to the sounds produced. These operators, who are in electrical communication, are in separate apartments, so that the direct sounds of the taps may not disturb the listener, whose province it is to detect flaws. In applying the system one operator places the telephone to his ear, and so long as the sounds produced by the taps are normal he does nothing. Directly a false sound—which is very distinct from the normal sound—is heard, he instantly signals for the spot to be marked. By this means he is able not only to detect a flaw, but to localise it.

A new method for determining the pitches of high tuning forks is described by Herr F. Melde in the current number of *Wiedemann's Annalen*. It is, like the vibroscopic method previously described, independent of the ear, and is based upon the resonance of a rod clamped at one end and vibrating transversely. The laws of vibration of such clamped rods have already been so carefully studied that calculations of pitch, based upon their dimensions and the properties of the material of which they are made, are very reliable. The tuning fork tested was mounted in a wooden block, and placed with one prong lightly touching the end of the rod, so that a vibration of the tuning fork when bowed produced a transverse vibration of the rod. Fine sand was dusted on to the rod. If on bowing the tuning fork the sand did not arrange itself in straight lines at right angles to the length of the rod, the clamp was shifted until it did. The mode of vibration, and consequently the pitch, was then calculated from the number of such nodal lines produced.

At a recent meeting of the Royal Society, Professor T. W. Spencer, in a paper on "Niagara Falls as a Chronometer of Geological Time," after describing the topography and geography of the district, and discussing the laws of erosion, gave—*Nature* says—the following sketches of the history of the Niagara Gorge and Falls:—First episode: Water falling 200ft. in volume, three-elevenths of modern discharge; gorge, 11,000ft. long; duration, 17,200 years. Second episode: River descending 420ft., in three cascades; first stage, only the discharge of the Erie waters; length of chasm, 3000ft.; duration, 6000 years; second stage, drainage of all the upper lake; length of chasm, 7000ft.: duration, 4000 years. Third episode: Same volume and descent as in last, but the three falls united into one fall; length of chasm, 4000ft.; duration, 800 years. Fourth episode: Volume of water as at present, the level of lower lake as to-day; first stage, a local rapid making the descent of 365ft.; work particularly hard; length of gorge, 5500ft.; duration, about 1500 years; the second stage as at present; work easy; length of cañon, 6000ft.; descent of water, 320ft.; rate of recession here taken as the full measured amount of 4175ft. a year; duration, 1500 years. Thus the age of the Falls is computed to be 31,000 years, with another thousand years as the age of the river before the nativity of the Falls. The turning of the Huron waters into the Niagara was about 8000 years ago. A difficult question was the amount of work done in each episode. This was in part determined by the position of the remaining terraces corresponding to different stages of the river, and by the changing effects of erosion.

Investigations on the influence of moisture on chemical action are reported in a recent number of the "Proceedings" of the Chemical Society. The various actions spoken of in a preceding report have now been brought to definite conclusions, and are as follows:—Sulphur trioxide does not combine with highly purified lime, but a trace of moisture brings about vivid incandescence, Dry copper oxide is also without action on sulphur trioxide. Purified and dried lime does not decompose dried ammonium chloride, which may be sublimed from the mixture without evolving any ammonia. Purified and dried nitric oxide gives no brown fumes with dried oxygen, but a trace of moist air causes them to appear at once. A mixture of purified and dried hydrogen and chlorine can be exposed to daylight for four days without more than three-fourths of the gases combining. Ammonium chloride, heated in a vacuum in a soft glass tube, leave a residue of ammonia gas; but when dried and heated in a hard glass tube, no gaseous residue is obtained. This led to the investigation of the vapour density of dry ammonium chloride, which was shown to be normal, 28·7 being the mean result of six experiments. With regard to the theory of the subject, the author believes that an electro-chemical hypothesis is applicable. Separation of dried ammonia and hydrogen chloride gases takes place when plates with opposite electrical charges are introduced into the mixture, though the action cannot be electrolytic, since discharge is, under the circumstances, impossible. Similar separation was noticed with air and with a mixture of dried hydrogen and oxygen. Electric discharge, when not of high tension, will not pass in dried gases; but the high-tension discharge does pass, and renders it possible for the low-tension discharge to pass afterwards. With regard to the influence of moisture, it appears that what holds for chemical combination holds also for electrical discharge, and that there is great significance in the apparent similarity in the two cases

## MISCELLANEA.

The Admiralty have ordered all the ships of the Royal Sovereign class to be fitted with bilge keels.

According to intelligence from Vienna, a preliminary concession has been granted to a Russian contractor for making a ship canal between Trieste and Vienna.

We read that experiments with oil for fuel on tug boats are being made at Chicago, under the auspices of the health department, the object being to abate the smoke nuisance on the river.

The old agricultural implement and engineering works of Messrs. Wedlake and Co., Hornchurch, which originated over 100 years ago, are being extended by construction of new works, foundry, and plant.

The Russian Government are about to add to their Navy two powerful ironclads. One, to be named the Grand Admiral Apraxine, 4120 tons, is intended for the defence of the coasts of the Baltic Sea; and the other, called the Rostislaw, 8800 tons, will be attached to the Black Sea Fleet.

The cruiser Crescent has arrived at Plymouth, having completed her voyage to and from Australia. She covered a distance of 25,267 nautical miles on a coal consumption of 6290 tons, and was 82½ days at sea. The longest 24 hours' run was 369 miles on the 5th inst. Her average speed was nearly 15 knots.

The work on the buildings for the mining exposition in Chile, to be held in September, is well advanced, and the probability is that all the arrangements will be completed in good time for the opening. Many exhibits are promised, and there is every reason to expect that the exhibition will be a successful one.

The contract for the construction of the new Trinity Bridge over the Neva, in place of the movable wooden one, has been secured by the French Company at Batignolles. The bridge is to cost five million eight hundred thousand roubles. No English firms appear to have tendered for this valuable piece of work.

The Institution of Naval Architects have issued an official programme for the coming meeting at Southampton, containing a useful map of the district, post-office and railway information, &c. Meetings will be held in the rooms of the Hartley Institute, on the 24th, 25th, and 26th, and for the following two days various excursions and visits have been arranged.

The Tendring Hundred (Essex) Water Company have consented to place at the disposal of the Eastern Counties Coal Boring Association the well which that company bored at Bradfield to the depth of 800ft., and which they then abandoned because no proper water supply was reached. It was at a deep well-boring at Harwich, not far distant, where the first indications of underlying coal were found.

The Corporation of Monmouth called in Messrs. Bramwell and Harris to report on the seventeen competitive schemes submitted for the sewerage and sewage disposal of Monmouth. These gentlemen have now awarded the premiums as follows. The first premium of thirty guineas to Mr. W. H. Radford, C.E., of Nottingham, and the second premium of twenty guineas to Messrs. John Parker and Son, of Westminster.

The question of canal improvement has assumed prominence in the New York constitutional convention. We see among a number of amendments one authorising the transference of the control of the canals to the Government of the United States under certain conditions, one being the enlargement of the canals so as to connect the great lakes with the Atlantic Ocean; another being the construction and maintenance of a ship canal around Niagara Falls.

The Sandycroft Foundry Company, having carefully watched the various developments of electricity in its application to mining work, has now added a department for the manufacture of electrical machinery. This department is under the charge of Professor N. S. Keith, M. Inst. E.E. The Sandycroft Foundry is adapting the Keith system to its own requirements. Preparations are already far advanced for utilising electricity to run every department of the establishment, including the use of electric locomotives, electric cranes, and other appliances.

A new craft is expected to take part in the yacht races at Galveston. She was built in Fort Worth, and may be classed as a whaleback yacht. She is a queer-shaped object, being about 32ft. in length, by about 6ft. beam. She has no straight lines, and is of the shape of a large cigar, pointed at the forward end, and has a whaleback extending from the forward part to about 15ft. aft, and she is claimed to be in all respects absolutely insubmergible. She has air-chambers fitted inside, and her forward bulkheads are air-tight; she also has a centre-board which is very heavy, being of iron heavily weighted with lead, and her rudder is as massively constructed. She draws only 2ft. amidships, and will have but little resisting power, compared with other yachts, when being propelled through the water. She is lugger-rigged.

The official full-power forced draught trial of her Majesty's ship Ferret, built by Messrs. Laird Brothers, of Birkenhead, has been conducted with satisfactory results. The mean speed on the measured mile was 27·62, the maximum speed attained being 28·4 knots. The speed for the three hours was 27·51 knots with 175 lb. steam and 361 revolutions. The Ferret is the first of the new class of 27 knot torpedo-boat Destroyers, her displacement being 258 tons. No. 97 Torpedo Boat, built by Laird Brothers, Birkenhead, on her three hours' full-power trial, made six runs on the measured mile as follows:—Steam, 170 lb.; revolutions, 363; speed, 23·71 knots; and I.H.P., 1690. The speed for the three hours, 23·35 knots, was well maintained. The contract speed is 23 knots. This vessel is 140ft. long, with a displacement of 115 tons.

The deposits of petroleum discovered a few years ago in the Province of Lanhkat, in the northern portion of the island of Sumatra, and along the coast of the Malacca Straits, are being rapidly developed. Concessions have been granted by the Dutch Indian Government to both Dutch and English capitalists, but at present only the Dutchmen have worked their concessions. The area of the lands conceded amounts to 828 square kilometres—318 square miles—and it is believed that this portion of the island is very rich in petroleum. The *Journal* of the Society of Arts says the wells are put down very near to the coast, so that the expense of carriage and shipment are not heavy, and, as the quality of the oil is very good, it is thought Sumatra may, before very long, enter into serious competition with Russia and America, the more so as this portion of the coast possesses a deep and well-sheltered harbour.

Gas motors for pumping purposes are quite extensively employed in Germany, according to the *Journal für Gasbeleuchtung*, which gives a list of forty-two installations, some handling over 4000 gallons a minute. Four of these drive centrifugal sewage pumps at Dusseldorf which together are capable of lifting 16,000 gallons a minute against a head of 16·4ft. The greatest head against which any of the plants is working is at Rottweil. Here a motor of 20 effective horse-power is employed to drive a double horizontal piston pump delivering 132 gallons a minute against a head of 315ft. The two cylinders of the pump are 6·7in. and 6·4in. in diameter, the stroke is 20in., and the revolutions are fourteen a minute. A petroleum motor at Obercassel, installed last year for the waterworks, is employed to raise 110 gallons of water a minute to a height of 230ft. All of the motors are of the Otto pattern from the Gasmotoren-Fabrik Deutz in Cologne. There are numerous instances of this in England.

# THE REGULATION OF THE CATARACTS OF THE DANUBE

## DREDGERS AND ROCK REMOVERS EMPLOYED

(*For description see page* 32)

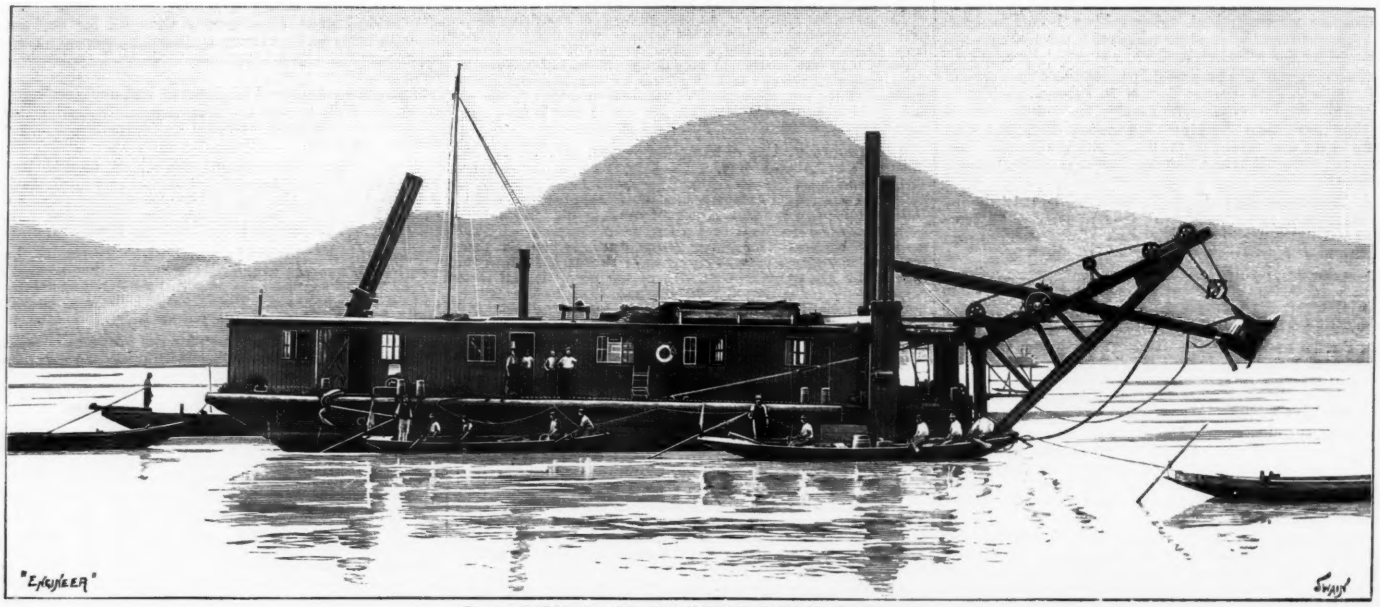

"ENGINEER"
SWAIN

Fig. 1—DREDGER AND EXCAVATOR—DUNBAR SYSTEM

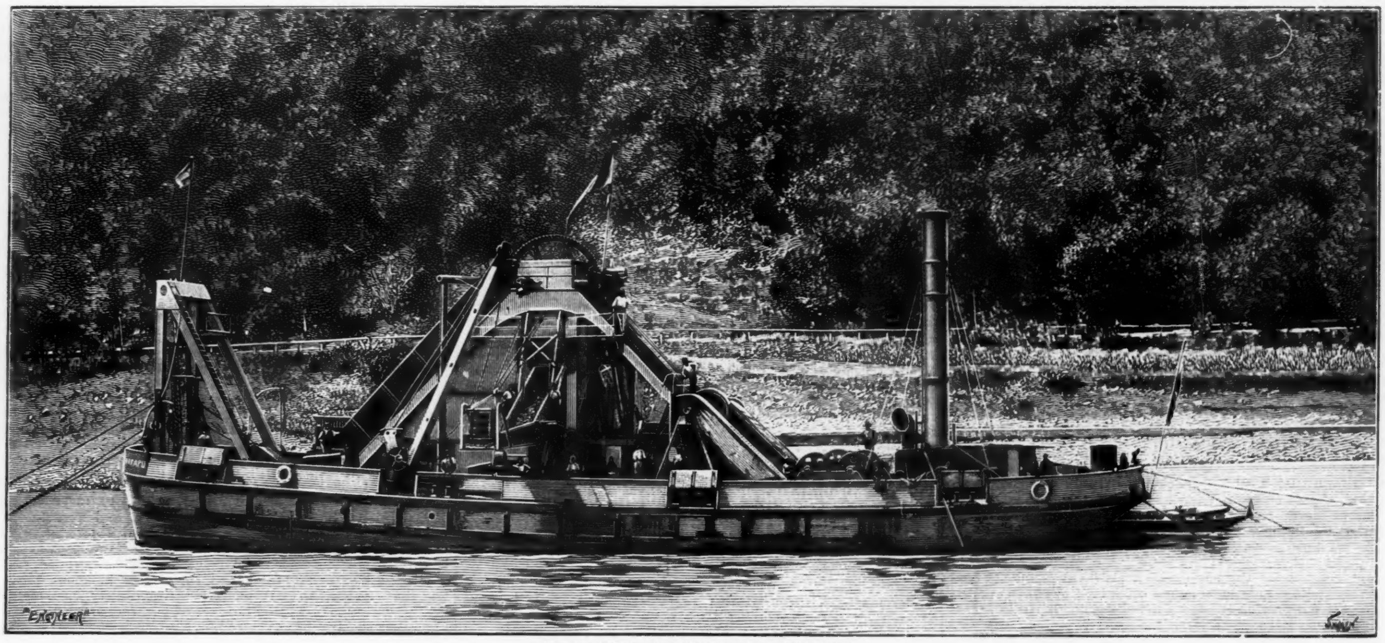

"ENGINEER"
SWAIN

Fig. 2—ROCK BREAKER AND DREDGER

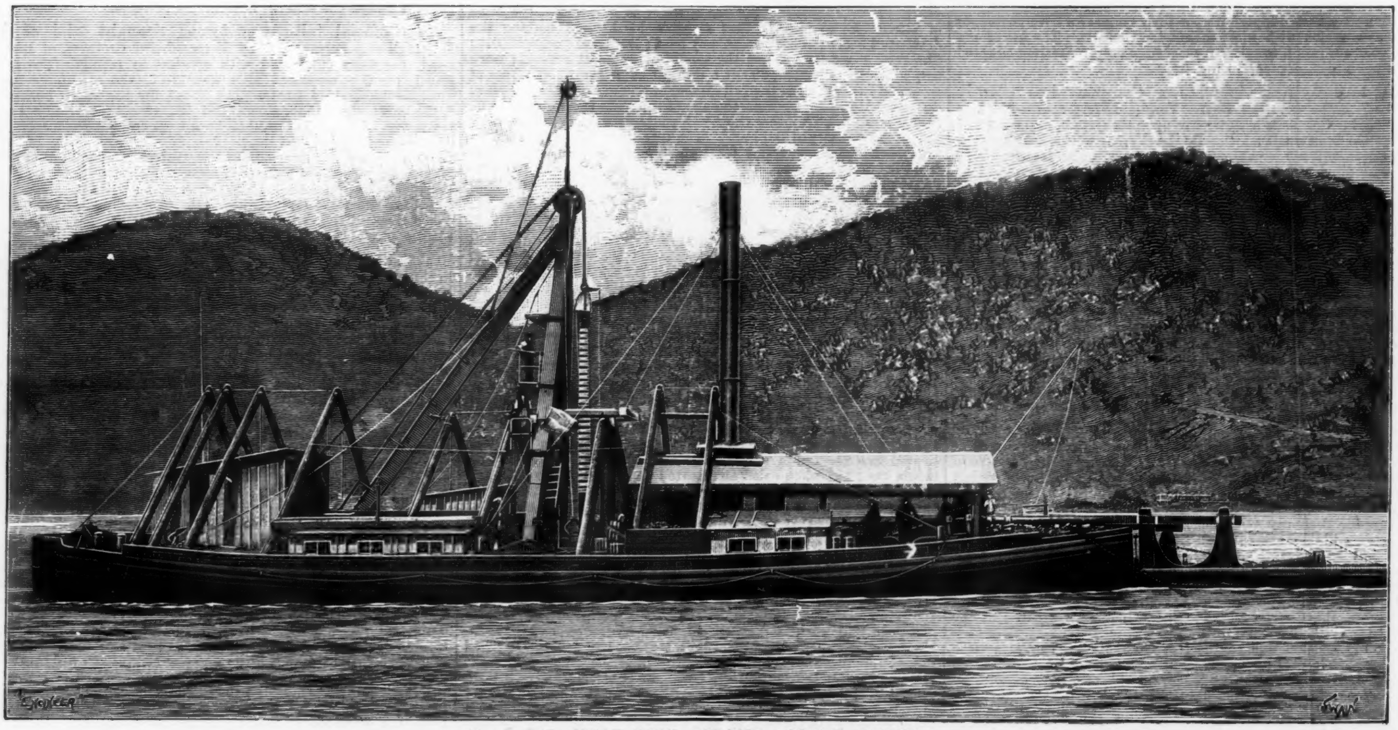

"ENGINEER"
SWAIN

Fig. 3—THE GREAT ROCK BREAKER LOBNITZ SYSTEM

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, July 13th, 1894.

Oil Engines at R.A.S.E. Show. (Illustrated.) .. .. .. .. .. 25
Minerals, Railways, and Roads of Honduras .. .. .. .. .. 28
International Navigation of France .. .. .. .. .. .. 28
Letters to the Editor—Carnot and Modern Heat .. .. .. .. 28
The Majestic and Magnificent—To Advertisers—Engineering as a Profession—Indian Railway Contracts—Vacuum Brakes—Oil Engine Trials at Cambridge—Sewage Disposal .. .. .. .. 29
Bumsted and Chandler's Yacht Engine. (Illustrated.) .. .. .. 30
The Muskaf Bolan State Railway .. .. .. .. .. .. .. 30
The Royal Agricultural Society's Show. (Illustrated.) .. .. 31
The Danube Regulation Works. (Illustrated) .. .. .. .. .. 32
Railway Matters .. .. .. .. .. .. .. .. .. .. .. 33
Notes and Memoranda .. .. .. .. .. .. .. .. .. .. 33
Miscellanea .. .. .. .. .. .. .. .. .. .. .. .. 33
Leading Articles—The American Railway Strike—Superintendents of Government Factories .. .. .. .. .. .. .. .. .. 35
Railway and Street Traffic—The Scotch Oil Trade—A Truce in the Coalfields—Russian "Secret Process" Shot .. .. .. .. .. 36
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. 37
Books Received .. .. .. .. .. .. .. .. .. .. .. .. 37
The Antwerp Exhibition .. .. .. .. .. .. .. .. .. .. 37
Large Log Band Saw. (Illustrated) .. .. .. .. .. .. .. 38
Wilkinson's Valvometer. (Illustrated) .. .. .. .. .. .. 38
A New Incandescent Light. (Illustrated.) .. .. .. .. .. 38
Richmond's Automatic Water Economiser for Hydraulic Lifts and Cranes. (Illustrated.) .. .. .. .. .. .. .. .. .. 38
Are there Certain General Principles Underlying the Proper Connection of Steam Boilers and Engines in a Power Plant. (Illustrated.) .. .. .. .. .. .. .. .. .. .. .. .. 40
American Engineering News .. .. .. .. .. .. .. .. .. 41
Launches and Trial Trips .. .. .. .. .. .. .. .. .. .. 42
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. .. .. .. .. .. .. .. .. .. .. 42
The Sheffield District—The North of England .. .. .. .. .. 43
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. 44
American Notes .. .. .. .. .. .. .. .. .. .. .. .. 44
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. 45
Selected American Patents .. .. .. .. .. .. .. .. .. .. 46

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

G. F. B. (Gloucester).—*Your postcard has attention. We hope to give you the address in an early issue.*

W. A. S. (Birmingham.)—*The steam turbines are made by the Gustav de Lavals Augturbinfabrik, Stockholm. The necessary elastic flexure of the shaft is so small that no special means respecting the bearings have to be made. The flexure takes place only in one direction, and the stress does not change from + to − as in a shaft bent under a pull from a belt. Both the kinds you mention are subjects of patents. There is an outlet for air above exhaust.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)* .. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* .. | £0 18s. 0d. |
| *Yearly* .. | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* .. | £1 0s. 8d. |
| *Yearly* .. | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

Geologists' Association.—Saturday, July 21st. Excursion to Guildford. Leave Waterloo 1.55 p.m. The geology is of five groups of the lower greensand formation.

# THE ENGINEER.

*JULY* 13, 1894.

### THE AMERICAN RAILWAY STRIKE.

The railway strike has assumed remarkable proportions during the past week. It has ceased indeed to be a strike in the proper sense, and has become something like a very important insurrection, capable, if rightly used, of teaching certain truths commonly overlooked. In a special sense, too, it is an experiment, and as such deserves to be watched with care. Chicago was in the possession of mobs who set all authority at defiance. They have already wrecked, burned, and destroyed property to the value of nearly £2,000,000. Nor is the mischief confined to Chicago. The insurrection has extended to California, and San Francisco was not in much better plight than Chicago. Pittsburgh was threatened, St. Louis was scarcely safe. Nor is the convulsion limited to railway men. The building trade and other businesses of various kinds are affected. What we see is a great social upheaval, and we may well ask ourself what it all means. For a long period demagogues, agitators, and semi-lunatics have in Europe and in the United States urged labour, so-called, to attack capital. They have not ceased to goad those who have nothing, to take from those who have something. These men have never ceased to tell their hearers and dupes that benefits of the choicest kind would follow on an open war. We now have war declared; a war on no small scale—war great enough to content our own Tower-hill ranters. Chicago was threatened with destruction. The railway yards were described on Monday as a "sea of fire." Matters are much better now, because the Government has asserted itself more strongly. In every direction the insurrectionists have expended their energies in destroying property. The destruction is worse than wanton; it is not only a crime, it is a blunder. The ruin of the railways means the future starvation of the destroyers. There are but two ways, it may be said, of accounting for the folly of the people: either they must have been seized with a mad frenzy of which history affords not a few examples, or the mischief is being done not by the railway hands, but by the thousands of idlers to be found in every city, who have nothing to lose by violence, and everything to gain by plunder. But we are not sure that either explanation will wholly cover the ground. In San Francisco we are told that the mass of the inhabitants side with the strikers. In Illinois the militia have refused to act. Hundreds of men of the mob are being drilled, and are prepared to fight. The Governor of one State remonstrated with the President of the United States because he sent Federal troops to put an end to turbulence and riot. Is there to be a civil war in the United States? Are the roughs and the labourers going to destroy the middle class? Is bourgeois America to be swept out of existence by the Irish, Germans, Italians, Slavs, and negroes? Is that really the programme of Mr. Debs and Mr. Sovereign? We cannot say. It is scarcely conceivable that the dispute between the Pullman Car Company and its operators is the sole cause of the insurrection. We are disposed to regard it as a spark which has set a forest on fire. Unless matters had been planned beforehand the conflagration could not have assumed its present magnificent proportions. If the great mass of the strikers were asked for what they were fighting, they could not say; in truth, there is no one tangible cause. It can scarcely be argued, we think, that the people of the United States have a quarrel with the railway companies. We cannot find that the companies grind down their servants in any exceptional way. Those who use the railways seem to be fairly content with the rates charged. The only fact lending force to the contention is the action of the people of San Francisco; why they should join with the strikers it is impossible to see, unless indeed they have some special grudge against the Pacific Railway. The siding of respectable folk with the rowdy element of a great city is a notable fact, whatever may be its cause.

We have said that the insurrection is a great experiment. We see the doctrines of the socialist and the anarchist carried into practice, for the first time, without a Government being concerned. The events are those which signalised the Red Terror. There is not a pin to choose between the incendiaries of Chicago and the Commune of Paris. But the people of France fought against a king first, and against a Government afterwards. Most of the mischief was in certain cases perpetrated by the savage element of the population. Probably that is true of the American insurrection, but the difference exists that the people in the United States are not attacking a Government. They are attacking the greatest civilising element the world has seen—the railways. We have, then, that war so long advocated in progress. And what do we see so far? That very largely it is an onslaught of labour on labour. Any attack on capital must be opposed to the interests of labour. To ruin Chicago is not the best means of supplying food and raiment to the poverty-stricken. To wreck the railways can scarcely promote the wellbeing of those who are employed in working them. But there is more than this. The strikers insisted in the first instance on stopping all railway traffic. This they propose to bring about by withdrawing from work. That was war on capital pure and simple, but there was no bloodshed, nor fires, nor shootings. But so long as that condition of affairs exists under which there are two candidates ready for every occupation which can only employ one, it is clear that the withdrawal, resignation, or striking of one set of individuals can inflict little inconvenience on the employer. It becomes necessary, therefore, for the striker to extend the range of his operations. He makes moral war, so to speak, on the capitalist, but he makes physical war on his fellow labourer. This is the second and inevitable result of the attack of labour on capital. The striker soon has his hands full. He has to fight capital; he has to fight his fellow workman, and in the ultimate end he has to fight the forces of the Government. At all events, that is what would happen in Europe. What may occur in the States remains to be seen. The most serious element in the whole affair is that no one knows what is really the cause of it. For what are the working public striking? Is it really a labour question of the normal kind, a common every day matter; or is it an insurrection of the foreign element in the United States against the Americans? We do not believe that the true meaning of the transactions which are taking place is fully realised in this country. History is always repeating itself, mainly because the springs of action alter little, if at all, as time passes. The same end is sought in all cases, only somewhat different means are employed. The log has to be hewn, but a different axe is employed. Our forefathers used one of flint or jade, we use one of steel; but steel or jade, still we hew. The American citizen—and we use the word in its limited not in its national sense—has for a considerable period engrossed the intellectual work of the United States; the manual work he has relegated to the alien and the stranger. It was just the same in old Rome. A Roman citizen never worked, he employed slaves; very largely the slaves were foreigners. In the United States just the same customs hold good, only the workpeople are not called slaves. The railway people who strike, and burn cars, and make mischief generally, are not American citizens of the better sort; they are, as we have said, Scandinavians and Irish and Italians. Are we to take the Chicago riots as a rebellion against the masters? Be this as it may, one thing is certain—it has been certain for a long time—and this thing is that the law has very little power over, and is very little in sympathy with, large sections of the American people. Take, for example, the scandalous and bloodthirsty lynchings that have disgraced the Southern States for years. To us living in a more civilised land, it seems that the one thing wanted just now in the States is a Government that can govern. Napoleon the First said that if he had been in power on a certain memorable morning, no French Revolution would have taken place. "I should simply," he said, "have swept the streets with grape shot first, and heard what the people had to complain of afterwards." It seems to us that, while grape shot is a great evil, a weak-kneed Government may be a still greater calamity for a nation.

### SUPERINTENDENTS OF GOVERNMENT FACTORIES.

After some delay, a Superintendent to the Royal Gun Factories has been appointed—namely, Captain Ingales, R.N. It was reported that Sir G. S. Clarke, R.E., had been appointed to Waltham Abbey; but this, it appears, is a mistake, so that the latter department is still without a Superintendent. The work is in each case very important, and calls for peculiar qualifications, which we trust have been secured in the case of the appointment already made. It may be objected that this officer has never been engaged in making guns, and that officers and civilians might have been found who have experience in such work. To this the natural reply would be that the number of such men is very limited, and that if the special qualifications called for are found in a higher degree outside that number, it may be right to choose accordingly. Time may be expected to show the wisdom of such selection; and from the tone we have adopted it may be inferred that our object is by no means to discuss the selection, or to make further remarks on individual officers than to note the fact that we understand that Captain Ingales has been engaged in organising the armaments, and has had experience and shown special ability, so that high expectations may be justified. Our object, however, is to keep clear of any individual selections, and to take this occasion to consider the general question of our Government manufacturing appointments. The problem of how to work for the best interests of the country is not an easy one. The issues at stake are enormous, involving the application of millions of money and the production of vast engines of war which become more powerful and complicated every year, and whose powers may hardly be fully tried in time of peace, and may only be suddenly called out when the safety of the kingdom depends on them. The root of the question, in our mind, lies in the difficulty of having a man at the head of all the departments possessing sufficient grasp of actual manufacturing matters to judge how each department is really doing its work, and who at the same time has the confidence of the country so completely as to have a free hand to take any step he thinks right. In past days we had, for years without number, superintendents working under Master-Generals, or directors with various titles, who were distinguished officers whose objects and principles were all that could be asked for, who were capable of judging how engines of war answered their purpose when brought to act, but who had no pretence to any knowledge as to the working of factories. They could not tell whether large sums were saved or wasted, or whether factories were well arranged with a view to putting forth the increased powers demanded in war time. Such questions were the business of the superintendents, who had, or were supposed to have, special manufacturing knowledge and experience. Now, without going further, it is clear that from a superintendent so placed much was expected. He was expected to watch the interests of the country, to plan with a view to efficiency and economy in every way like the head of a private factory, but to do so when he gained no profits himself, had no board of directors capable of appreciating his efforts, no rival firms to prove his success by comparison of results achieved, and lastly, no shareholders capable of judging whether they were obtaining a return for their capital invested. Can it be wondered at that in old days the "respective officers," as they were once called, or "Heads of Departments," were liable to be sleepy and conservative? Then came in the Armstrong rifled guns and *matériel* like a flood, and things woke up. In a few years, perhaps, on the principle that "new blood" was the great matter, came in the "five years'" system. As originally intended, we believe that this was not wholly bad; it was no bad thing to have the opportunity of getting rid of an indifferent or moderately good man as a matter of course after a limited trial, without heaping disgrace upon him and making a victim of him, but as a rigid rule it was injurious beyond conception. No officer, however good, could be kept on much beyond five years. How, then, could it be expected that a keen, earnest man would throw himself into the work of a factory, grapple with the details of all its branches, and then be satisfied to be sent off with the hope that after two years' soldiering he might be employed, not in the same department probably, but perhaps in another. Surely the best men would be just those who, having acquired the mastery and love of their work, would wish to keep to it. They were the men who would receive offers of employment from private factories, and would probably accept such offers directly that they found that they were not appreciated, and even if not disgusted and mortified in some way. If any one compares what is the position of Sir Andrew Noble or Colonel Dyer at Elswick, with that of the various superintendents whose services have been retained, the matter will be apparent. If it is urged that "Andrew Nobles" are not to be met with often, the reply is, that all the more reason that we should secure them when we get them, and not have private manufacturers like Armstrong and Whitworth, as it were, walking up when they please, and picking our best men. We can name more recent cases, but we purposely here keep to ancient history to illustrate principles as far as possible, without touching on matters where soreness may exist. The five years' system, however, had evils reaching far beyond what we have indicated above. It threw all manufacturing questions proper very much in the control of the subordinate but permanent manager, instead of the superintendent. We will take a case in point, and we could furnish actual names if we chose to do so. A certain department contained machinery which involved the supply of many thousand pounds worth a year to keep up the plant, to say nothing of furnaces and other features. The workmen employed on them were directly under the manager, who, though under the superintendent, was their permanent head. Can any one suppose that the most scientific and energetic superintendent, with a run of only five years, could possibly hold his own against the manager in such a position in such questions as the working of lathes, furnaces, &c. The manager had a salary of, say, £400 per annum. He was a man of such experience that he would probably command £1000 per annum in a private factory. If he remained in his position under Government, can it be doubted that he would be sorely tempted to accept money from contractors, to oil the machinery and make all go smoothly? As a matter of fact, certain managers and foremen have been discharged, as was inevitable, and the property they possessed is not to be accounted for except on one supposition.

Happily, we have in a measure emerged from the five years' system in its extreme form. Superintendents are not now, so it is said, to be necessarily limited as they were; nevertheless an evil remains that appears incidentally in what we have said above, namely, that we employ both superintendents and managers on salaries far too small for it to be reasonable to expect to retain the services of the best men of the high class that we require. At the present moment our departments are all under Dr. Anderson, the Director of Ordnance Factories. It must be satisfactory to superintendents to have to deal with a chief who understands manufacturing questions from long experience, and who can enter into difficulties, and appreciate manufacturing achievements. There is, from this point of view, much to be said for a civilian who has given his life from childhood to work which an officer can only have taken up at a comparatively mature age. This suggests the question that has come up in the press as to the desirability of appointing civilians instead of officers throughout. On this there is something to be said on both sides. The past life of the civilian, which has given him special manufacturing experience, has in many cases so connected him with manufacturing firms and interests as to make it difficult for him to stand in a position as free from prejudice and suspicion of interest as an officer generally stands. Then there is undoubtedly a great advantage in a man having a strong sense of the actual conditions under which all war *matériel* will be used on service. If this be not so, how comes it that large firms for war *matériel* so commonly secure the services of officers? Witness the recent appointment of Colonel English to Palmer's, and the earlier one of Capt. Tresidder to Brown's. Abroad it is held that the heads of English manufacturing departments are singularly free from corruption. This has been attributed to the high character borne by English officers. We, however, lay stress on the word English, and we believe that the same might be secured by Englishmen who are not officers, making, of course, a proper selection. We think, however, that officers, for the reasons given above, are naturally specially suited for work in war *matériel* factories, if well selected. With Sir A. Noble at the head of Elswick, there can be no question as to the possibility of an officer acquiring the desired manufacturing ability and experience, but they must be treated reasonably. A civilian who has been making, say, carriages, who was suddenly put in charge of a large powder factory, for five years only, and that on a very moderate salary, would hardly be expected to prove a great success. This is much what we have been doing with our officers. On the other hand, we trust that no feeling of corps jealousy may be allowed to come in. We observe that a naval officer is again appointed to the head of the gun factories. If this means that a naval officer is as a matter of course to have the appointment, we think it a most pernicious principle. The late superintendent, Captain Younghusband, R.N., was a singularly able man—in fact, an admirable man for the work. We trust that his successor will prove equally successful, and that it will turn out that the Navy have twice running shown that they have men with the best qualification that could be found. But surely when the importance of our ordnance is considered, and when all the difficulties we have passed through are remembered, no one will urge that when a vacancy occurs we can afford to pass by the best man, wherever he may be found, for the sake of keeping an appointment to any one branch of the service.

### RAILWAY AND STREET TRAFFIC.

In a recent article we brought under review the loss of life occurring on the railways of England and Wales, in comparison with the fatalities arising out of the ordinary road traffic. It appeared, according to the Registrar General's Report for 1892, which had just been issued, that whereas the number of persons killed by vehicles on English and Welsh railways in the year was 925, there were in the same period as many as 1321 persons killed by vehicles other than those of the railway. Adding to the latter the number of persons killed by horses, the fatalities of the road traffic were found to be 1549. It was also apparent that the deaths from the traffic of the London streets in 1892 amounted to more than twice the number of fatalities among railway passengers throughout the United Kingdom, even including those cases in which the latter were themselves more or less in fault. Concerning the vehicular traffic of the metropolis, the Registrar-General has lately given the particulars for 1893. The facts so recorded are remarkable, and lend yet further force to our remarks as to the relative danger of road and rail. Notwithstanding all the care taken by the London police in the regulation of the traffic, last year was eminently disastrous. As many as 304 deaths were caused by vehicles and horses in the streets of London, being 35 more than in 1892, and exceeding the corrected average by about 40. The Registrar-General considers it probable that the 304 deaths thus specifically returned "are far from representing the entire number caused in the streets by vehicles and horses," many deaths being registered under such indefinite headings as "fractures," &c. Comparing the fatalities of the street traffic with the growth of the population, we meet with some startling data in harmony with the statement of the Registrar-General as to an excess over the "corrected average." Thus in 1873 the deaths were one in 15,544 of the population. In 1876 the ratio was one in 16,305, and in 1883 it was one in 17,573. These eleven years therefore showed an improvement, the street "death-rate" undergoing a decline. But in 1893 the deaths became one in 14,165, a much less favourable ratio than that recorded twenty years earlier, and still worse in comparison with 1883. Of course the population varies from year to year, and there are considerable fluctuations. But the broad fact presents itself that between 1873 and 1893 the population of London has increased by rather less than 28 per cent., while the deaths from the street traffic have increased by 40 per cent. Had the intervention of the police undergone no development since 1873, we may ask, What would have been the result as affecting the number of fatal accidents? But a question may perhaps be raised as to whether the action of the police in this matter is not chiefly directed to prevent a block in the movement of the vehicles. If the police were withdrawn from the various centres where the lines of traffic cross each other, the effect would show itself in a frequent deadlock, all progress being for some time arrested. Traffic is now facilitated, but to what extent is it rendered safer? Looking at the figures we have cited, we should say, judging by results, that the danger is greater than ever. How is it that the heavy traffic is so fatal to human life? Vans, wagons, and drays caused more than a third of last year's deaths, and this is frequently their share of the slaughter. These vehicles are often driven at a rapid pace, and are not capable of being readily pulled up. Carts kill less than half as many as the heavier class, and cabs are about the same as the carts. On the whole, carts seem less fatal than in years gone by, and cabs are nearly in the same category. But the heavier or more cumbrous vehicles, which in 1873 killed seventy-nine persons, have slain more than a hundred in each of the last four years. Of course, these accidents are to a very large extent those in which persons are knocked down and run over. The pedestrians are the sufferers, and the practical question is how to enable them to traverse the streets with greater safety to themselves than is now the case. Their position might be worse than it is, but it seems to be getting no better.

### THE SCOTCH OIL TRADE.

Few industries have had a more chequered and interesting career than the Scotch mineral oil trade, and probably in none has continuous and severe competitive pressure been more determinedly met by steady advance in productive methods. It is therefore satisfactory to find that the recently published reports of the leading companies afford considerable ground for hope that the threatened extinction of the industry may be averted, and that the future even promises financial returns to those who have so long struggled against the competition of natural petroleum oils from abroad. The previous financial year was extremely bad; so bad in fact, that not one of the companies paid any dividend. This was mainly due to the breakdown of the combination of the companies with the Standard Oil Company of America, which led, in conjunction with other causes, to a depreciation in the value of products, as compared with 1891, of £200,000. Such an untoward state of affairs recalled the disastrous period between 1864 and 1872, when the appearance of American petroleum reduced the price of burning oils—then practically the only product of the Scotch trade—from shillings to pence per gallon, and nearly swept the home industry out of existence; the pioneer concern, Young's Company, Limited, being the only survivor of that early epoch. Since that time, however, the industry has been put on an entirely different footing by a long series of mechanical and chemical inventions, resulting in the extraction from the shale of a much greater value of products, accompanied by a vastly reduced cost of production. Though little has been done this year in the way of dividend paying, the position of all the leading companies is, as already indicated, considerably better than at the close of the preceding twelve months; and there are several circumstances rendering it probable that the improvement will be easily mantained, if not increased, next year. For one thing it seems probable that the bottom prices for burning and lubricating oils have, in the meantime, been touched, as it is well known that American and Russian refiners have been working for some time past at a loss, or at least without any appreciable profit. On the other hand, the cheapening of production, which has for many years been such a remarkable feature of the Scotch trade, still goes on, and several of the companies expect during the current year to make large savings in this direction. The high price obtaining for sulphate of ammonia, and the increasing use of the intermediate oils for gas enriching purposes, are also favourable to the prospects of the home industry. Legislation on the "flash-point" of burning oils used throughout the United Kingdom, which may reasonably be hoped for, would also tell in favour of the Scotch trade, though perhaps not to the extent expected by some. It is an indisputable fact that large quantities of lamp oil are sent to this country from America which could not be legally sold there; and it is equally indisputable that these low flash oils are largely to blame for the terrible frequency of lamp accidents in England. In Scotland, where the native article is still almost exclusively used for burning purposes, such catastrophes are comparatively unknown. The capital at present invested in the Scottish oil industry is about £3,000,000, and last year over 1,180,000 tons of shale were mined and distilled, producing 45,000,000 gallons of crude oil. From this were obtained 27,000,000 gallons of burning, lubricating, and gas oils and naphtha; 20,000 tons of solid paraffin for candle making; and about 30,000 tons of sulphate of ammonia, the production of the latter article of commerce having now become a highly important branch of the trade. The industry gives employment to many thousands of workpeople, and in all its branches affords ample scope for the improvements of the engineer and chemist, so that on all grounds its improving prospects must be considered a matter for congratulation.

### A TRUCE IN THE COALFIELDS.

Coal affairs in the Midlands have suddenly assumed a most interesting aspect—an aspect fruitful of promise for a two years' truce in the coalfield. Some time ago it was stated that the employers intended to ask the Conciliation Board for a reduction of 10 per cent. in wages. This statement was vigorously denied on behalf of the coalowners. One of them, holding a most influential position in South Yorkshire, volunteered a statement that an application had been made, but that the terms of it were simply "to vary the rate of wages." He said the coalowners would have nothing to do with 10 per cent., or any definite figure, and alleged that Mr. Pickard was anxious to put 10 per cent. in their mouths. The position of the coalowners, it is added, was to go before the Conciliation Board and Lord Shand, produce their figures, and ask them to decide what amount the reduction should be. It now appears certain, however, in spite of what this coalowner said, that 10 per cent. is to be the figure applied for. What is called an informal meeting of the Conciliation Board has been held, at which the proposal takes this form: that the minimum wage shall for two years be 30 per cent. above the prices which ruled in 1888; the men to be asked to submit to a 10 per cent. reduction on the 1st of August next, and wages to remain at that figure until the 1st of January, 1896; from January 1st to August 1st, 1896, wages to be allowed to go up as high as 45 per cent. over the amount paid in 1888, if trade improve sufficiently to justify the miners' demands. These proposals, it will be seen, cover the principle of a maximum and minimum wage. That there is something in them, was evident from the result of inquiries made both amongst coalowners and miners' leaders. They are now confirmed, Mr. Benjamin Pickard, M.P., President of the Miners' Federation of Great Britain, stated at Barnsley, on Monday night, "that he had no hesitation in saying that in his judgment, after the arrangement was consummated, the best interests of both owners and workmen would be accomplished." He did not say expressly that such an arrangement has been made, but he distinctly left it to be understood that it had been proposed, and would come before the forthcoming meeting of the Conciliation Board next week. Now the exact forms of a provisional agreement to that effect are published, the proposal, if acceptable to the coalowners, will certainly be endorsed by the men, for it contains the principle, for which the miners' leaders have steadily contended, under the title of "a living wage." Mr. Pickard, in his unusually peaceful utterance, declared that "the hope of all the leaders was that a permanent settlement would be effected, and that the two years' truce, with a minimum wage realised, would secure for the future a stability in the trade for which they had all hoped for generations in the past. The gist of the proposal will be this:—All the advances, amounting to 40 per cent., secured by the miners' leaders from 1887 until 1891, would be permanently retained, with the exception of the 10 per cent. now conceded. The wages with that reduction would be definitely declared to be the lowest point to which mining remuneration should fall. On the other hand, if trade improves sufficiently to warrant an upward movement, the 10 per cent. will be given back and 5 per cent. added, making 45 per cent. above the 1888 rates, which would thus form the maximum.

### RUSSIAN "SECRET PROCESS" SHOT.

The further trial of the special Russian projectiles took place on July 6th, as reported in the daily 'papers. The general result up to this date is reported to be that the projectiles perforated the 6in. plates at an angle of 20 deg. from the normal, that is, 70 deg. with the plate face, but were broken up at 25 deg. with the normal, or 65 deg. with the plate. On July 6th, however, one shot was stopped and pulverised by Cammell's plate at 20 deg. of obliquity, with a penetration of only 2·3in., while on the other hand, one passed right through Brown's plate and backing at 25 deg. With regard to these results, it will be readily understood that if the "Russian secret" consists in the application of some false point to save the real point of the projectile from the sudden fracture which causes its defeat by the treated plates, there would be liability to uncertainty, for the least departure from truth in direction, or the least accidental irregularity in attachment of point, might cause failure, so that too much stress must not be laid on the variation in the results above reported. The persistent trial at oblique angles of incidence points, we think, to some device which is known to call for such proof to establish its character, though perhaps we may learn something to contradict this supposition from those who witnessed the trials on their return to this country. The actual theoretical effects of the oblique angles of incidence are as follows:—For the shot striking the 6in. plate with a velocity of 1850 foot-seconds, the perforations through steel would be—direct 10·32in.; at 10 deg., 10·30in.; at 20 deg., 9·70in.; and at 25 deg., 9·35in. For the projectile striking the 10in. plate with a velocity of 2400 foot-seconds, the perforations through steel are—direct 13·69in.; at 10 deg., 13·48in.; at 20 deg., 12·89in.; and at 25 deg., 12·41in. It appears, then, that results calculated on the supposition that steel behaves itself with the ever reliable action of wrought iron is misleading, as indeed would have been expected, especially in the case of treated plates. We would call attention to the fact that the Russians do not appear to have tested the comparative behaviour of treated and untreated steel plates attacked obliquely, although this is an important and almost untried experiment, and one that concerns a Power that has not decided which to adopt. The only oblique firing that comes to our knowledge is the test of this Russian device, which appears to be considered specially important, and such as to call for special trial at oblique angles.

## LITERATURE.

*La Flotte de Guerre*. By M. EMILE WEYL. Paris: E. Plon, Nourrit et Cie. 1894.

THIS spirited production, by M. E. Weyl, upon the present position of the French Navy should compel a special interest in the mind of every British subject, as, from beginning to end, it is practically a comparison of the naval resources of the United Kingdom with those of our neighbours across the Channel. At the same time it affords much valuable information as to the advantages and disadvantages of the system pursued in France for carrying on the construction, the maintenance, and the manning of her fleets; there being, moreover, food for reflection for ourselves in a consideration of the same.

The work comprises a number of chapters, each dealing with a specific subject, such as the ministry of marine affairs, the officers of the Navy, the technical *personnel*, the arsenals, and naval construction; finally, with the fleet itself, distributed into three classes, ironclads, cruisers, and the torpedo flotilla. Part of the matter contained in these chapters has already appeared in a series of articles in the *Journal des Débats*, but an important appendix has been added. Not the least interesting feature of this appendix is the original *procés-verbal officiel* of the experimental committee, which was delegated from the Admiralty Board of France, in March last, to witness trials with the Magenta, in order to ascertain whether her angle of heel, with the helm put hard over, whilst the ship was running at full speed, was likely to compromise her stability. The trials were instructive, and appear to have been conducted with the utmost fairness and impartiality.

The Magenta was only ordered to hold herself in readiness on the eve of the day appointed for the tests to be applied. The ship's own company worked the engines and occupied the stokeholds, also training and working the guns. Whilst running at a speed of sixteen knots, the heavy 34 cm. (13¼in.) guns being trained axially, the helm was suddenly put hard a-port, the result being an initial inclination of 9 deg. from the vertical at the moment of careening, the vessel afterwards partially recovering and remaining at a permanent angle of heel of 7 deg. 30 min. during the rest of the turn. Afterwards a second and third experiment was made, with two or more of the heavy guns trained abeam. With three guns thus trained simultaneously on the port beam, and hence of course favouring the inclination of the vessel, the list—with the helm put, as before, suddenly hard over—was at first 14 deg., subsequently remaining at 13 deg. Whilst the ship was in this position, it was ascertained that the guns could be trained round with the utmost facility, the hydraulic gear not being affected by the heel. The experiments were then discontinued, as fears were expressed of the possibility of some of the boiler tubes being too long uncovered, when the ship lay over permanently to this angle. Enough, however, had been done to satisfy the Committee that there was "not a shade of apprehension for the stability of the ship;" and in this conclusion we fully concur. At the same time it is only fair to remark, in justice to those who so severely condemned the Magenta upon her completion, that one glance at her ponderous superstructure—which stretches like a steel screen from mast to mast—shows how terribly handicapped this battleship would be, in a heavy sea, with wind on the beam.

Monsieur Weyl criticises sharply the arrangements made in France for the design and construction of ships of war, both in the Government shipyards and by the trade. In the first place, he objects to a system that leaves, not only the design, but the carrying out of the same—without any control of sea-going officers—practically in the hands of naval engineer architects, whose duties are so laborious and incessant that they never have time or opportunity to proceed afloat, in order to observe the behaviour of the vessels which their genius has created. Here he testifies to the wisdom of the plan adopted by the department of naval construction in Great Britain, pointing out that even the head of that branch can find time to make occasional voyages in his own battleships and cruisers. As he justly remarks:—"Observations on the vessel itself are of infinitely greater value than observations on the plans. In the next place he deprecates the delay and folly of the system by which designs are modified and mutilated between the constructive departments at the various ports and headquarters, entailing, he assures us, a loss of time sometimes extending to six months, before the drawings are subsequently approved, and as often a loss of many valuable features belonging to the original idea. He finds fault also with the absurdity of the plan which makes the officers of the marine artillery responsible for the design and manufacture of weapons for naval warfare, with which they have not in the course of their legitimate military duties any subsequent association.

But perhaps the portion of this work which possesses the greatest interest in our eyes is the comparison which M. Weyl has drawn between the actual and prospective conditions of the French navy, as assumed to exist by the Whitehall authorities, and those which he asserts do really obtain. The only battleships and coastguard ironclads which he recognises as forming part and parcel of the effective and prospective French navy are as follows. In the service:—Amiral Baudin, Formidable, Amiral Duperré, Hoche, Magenta, Marceau, Neptune, Courbet, Devastation, Redoubtable, Caïman, Indomptable, Requin, Terrible, Fulminant, Furieux, Tonnere, Tennant, Tempête, Vengeur. Completing:—Brennus, Jemmapes, Valmy, Bouvines, Trêhouart, Charles Martel, Jaurréguiberry. On the stocks:—Lazare-Carnot, Bouvet, Masséna, Charlemagne, Saint - Louis, comprising thirty-two vessels.

Six other ironclads of an early date and five armoured cruisers are of wood, and will disappear from the navy list very shortly. The Friedland and two remaining armoured cruisers will probably share the same fate. Two or three insignificant wooden ships may be added to this category. Hence M. E. Weyl, who should be in a position to realise the condition of the French fleet, only accredits to it—even at the expiration of the century—a prospective strength of thirty-two battleships and coastguard ironclads, and it is with unfeigned astonishment that he finds in our Admiralty returns no less than fifty-one ironclads of sorts asserted to be afloat or building. He expresses it thus:—"C'est donc une masse de 51 bâtiments que nos voisins d'outre manche nous accordent pour la fin du siècle; en comptant largement, nous n'en trouvons cependant que 32. Cela donne une idée de la façon dont on dresse les tableaux comparatifs; le document parlementaire Anglais comptait parmi nos cuirassés tout navire portant une armure, sans s'inquiéter de l'âge, du système de construction—bois ou métal—des qualités de navigabilité! Un tel procédé n'a rien de scientifique . . ." The probability is that some confusion has arisen in the classification. We observe, for instance, that M. Weyl places the Dupuy-de-Lôme amongst the ordinary cruisers and not amongst the "cuirassés." As, however, we have over and over again maintained in these columns, no system is satisfactory which, as in the Admiralty returns alluded to, divides the ships into classes without giving their names. No two experts agree as to classification, and a nominal roll, such as that given by M. Weyl, is the only clear exponent of strength.

As to the French resources in cruisers built and building, he is equally at loggerheads with our Admiralty figures. Although the return already alluded to, gives seventy cruisers as forming the prospective strength in these classes of the navies of France in three years' time, M. Weyl is unable to make a computation of over forty-four, including twenty-five already in the service, seven now completing afloat, and twelve which are upon the stocks. It is a matter of congratulation to us, however, that the mistake, as in the case of the ironclads, appears to have been made on the right side, and we are happy in finding ourselves richer than we anticipated—rather than poorer.

In speaking of the French arsenals, dockyards, and anchorages for fleets, M. Weyl takes occasion to mention the very exposed position of some of the latter, as liable to torpedo boat attacks, and in most cases to bombardment from the enemy. He points out the defenceless condition of Cherbourg at the present moment in this respect, and states that the works now in progress are undertaken with a view of protecting the anchorage from danger of this nature. It is impossible not to find in these remarks a word of warning to our authorities. At Portsmouth and Portland we understand that arrangements for securing a protected anchorage are already in progress. Much, however, remains to be done elsewhere.

## *BOOKS RECEIVED.*

*Ware's Modern Perspective Plates.* London: Macmillan and Company.

*Wood: Its Use as a Constructive Material.* By William Stevenson. London: B. T. Batsford.

*Belt Driving.* By George Halliday, Whitworth Scholar. London: E. and F. N. Spon. 1894.

*Engineering Construction in Iron, Steel, and Timber.* By William Henry Warren. London: Longmans, Green, and Company. 1894.

*Odontics, or the Theory and Practice of the Teeth of Gears.* By George B. Grant. London: Sampson, Low, Marston, and Company.

## THE ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

PROBABLY no International Exhibition is ever quite finished until the time for closing it arrives. Objects damaged in transit have to be replaced, or exhibitors take up vacant spaces in their vicinity, so that workmen are still to be found during the morning in various parts of the building. Still, these are so few that the Exhibition may now be considered in full working order. In two respects the Machinery Hall is far superior to the main building. As will be seen by the plan on p. 325, April 20th, the passages are wide and straight, whilst in the Industrial Hall the commissioners of some of the foreign sections seem to have tried to construct a maze. The gallery along one side of the Machinery Hall is very convenient, as it enables visitors who are looking for a particular exhibit to see it from above, and to go straight to it. In the Machinery Hall, Farcot's Ventilators, which were illustrated in THE ENGINEER of April 20th, are working very satisfactorily; but in the main building there is a want of air, as the high erections obstruct the circulation, and the awnings prevent the ventilators in the roof from being of much use.

Two of the railway companies in the British Section have made additions to their exhibits since I described them at the end of May. The Lancashire and Yorkshire show a rail fitted with Messrs. Aspinall and Hoy's patent "Electric Lever Treadle Contact" arrangements. The pin, pressed down by the flange of a passing wheel, is connected with a small signal post, so that the operation of the apparatus can be clearly seen.

The South-Eastern Railway has added some more photographs of places of interest on its line; and it also shows a "train describer," by which one signal station informs the next the place from which the train then passing has started. Besides this, it has the apparatus for electric communication between passengers, guards, and driver; and a model of Sykes' block system, practically the same as one of those already described in the London, Chatham, and Dover Railway exhibit.

A stamp mill for crushing gold quartz has now been in operation for a week, and is attracting a good deal of attention. It has been made at the Erith works of Messrs. Fraser and Chalmers, of Chicago, and it forms part of the exhibit of the Transvaal Republic. The material treated is brought from different mines in the Transvaal; they have altogether 150 tons of quartz, and are at present working an hour per day, from 3 to 4 p.m. The chief novelty in this mill is in the method of feeding. A new arrangement of the "Automatic Challenge Feeder" has been adopted, in which the whole of the feed apparatus is hung on iron bars, running from the battery-posts to the framework of the ore-bin, instead of standing on a separate wooden frame. In the Challenge feeder, the ore falls from the bin on to a circular revolving table. An arm from the central stamp of the battery works a lever, which causes this table to turn, so that the delivery of ore is always proportioned to the speed of the battery, which is here set for 92 blows per minute. The ore is crushed wet in the usual manner, and then falls on to an amalgamated copper plate, 12ft. long by 5ft. wide, and set at an angle of 1¾in. to the foot. In the Transvaal, the fall is usually rather less; but here it has been increased as an experiment. The mercury on the copper plate takes up the free gold in the mixture, and the remainder passes through troughs on to two "Frue-vanners." These consist of revolving endless bands of india-rubber ⅛in. thick, with edges turned up an inch. The length of the level upper surface is 13ft., and the slack is taken up underneath by adjustable rollers, in the same manner as with cable car motors. An arrangement at the upper end causes the material to be equally distributed over the surface of the india-rubber, which is caused to travel slowly upwards, and at the same time to oscillate, so that the heavy portions, consisting chiefly of gold mixed with iron pyrites, are carried forward, whilst the slimes flow down the table into a settling reservoir at the end. The concentrates will be sent to England for treatment, probably also the slimes, if they are found to contain sufficient gold to make it worth while; but the free gold from the amalgamating table will be retorted at the Exhibition. In the Transvaal the concentrates are either first roasted and then treated by the chlorination process, or else the gold is extracted by the cyanide process, which is said to give very satisfactory results in that country.

In an adjoining building is the general exhibit of the Transvaal Republic, which has been ready since the opening of the Exhibition; though I thought it better to reserve any mention of it till Messrs. Fraser and Chalmers had the quartz mill in working order. In the entrance hall are pyramids representing the annual gold export of the country. These are exhibited by the Chamber of Commerce of Johannisberg, and range from 230,189 oz. in 1888 to 1,478,114 oz. in 1893. There are also several other examples of the mineral production of the country, such as coal from different mines, a large block of silver-bearing galena, &c. In the hall on the left are chiefly agricultural products, such as grain and tobacco. There are also good samples of ostrich feathers and ivory, a little timber, and some native curiosities. On the right of the main entrance the exhibits are almost exclusively mineral.

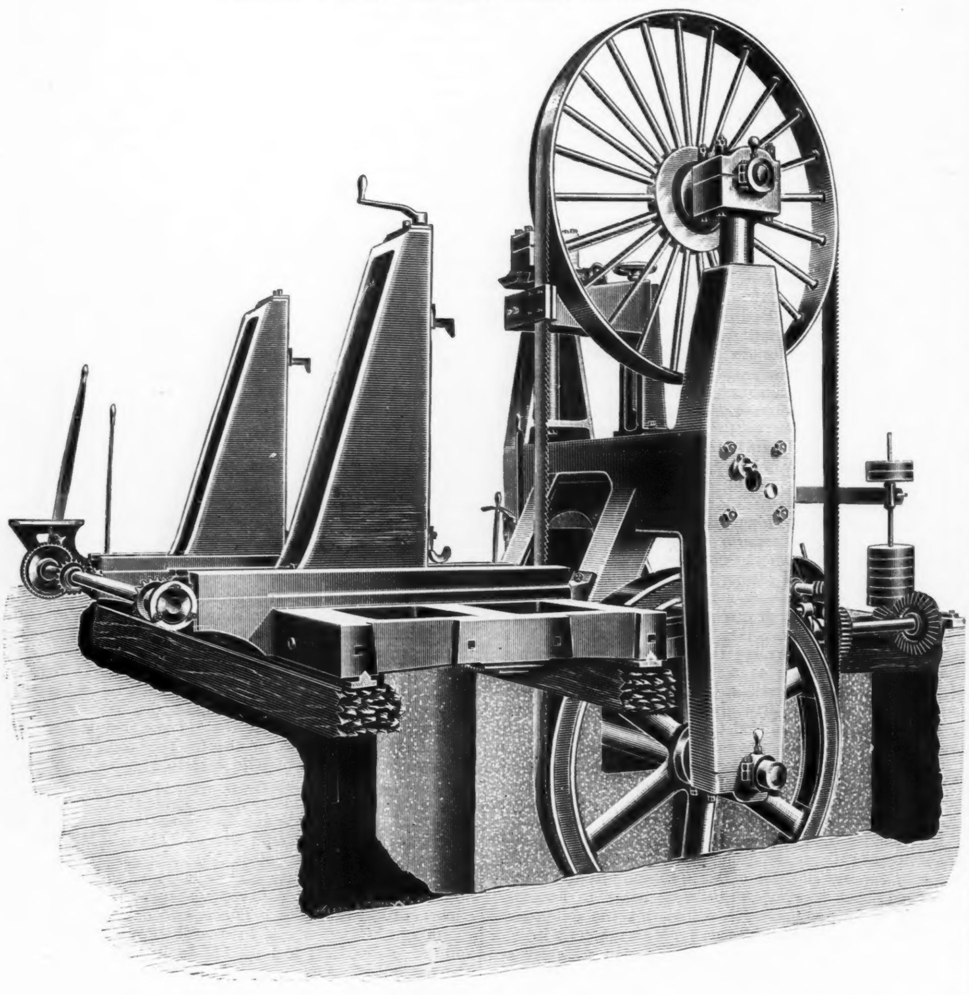
The most interesting is probably a complete section of the Witwaterstrand lode near Johannisberg, with samples taken every few yards along the entire length of the lode. Specimens of various descriptions of gold-bearing quartz, of antimony ore, and of various descriptions of galena, are also shown; but these lose much of their value from the fact that no assay of any of the exhibits has been furnished, and that the explanation on the specimens has only been given in Dutch. The Transvaal Exhibition is so remarkably good, and so well arranged, that a little additional information would be of great value to anyone desiring to study the mineral resources of the country. To take one important branch—the galenas. These are, as far as can be judged by appearance, very free from zinc, and therefore very suitable for smelting; but as appearances are often deceptive, an assay giving the lead, zinc, silver, and perhaps gold contents of each sample would be most useful. A good many specimens of coal are also shown, mostly of poor quality, as is generally the case in the upper seams of a mine. Another very interesting exhibit in the same room is part of the core of a boring put down with a diamond drill at the Witwaterstrand, to the depth of 2442ft. By this they see that they have ore enough in view for another hundred years, at the present rate of working.

The plans of the railway to Johannisberg are also shown. The line commences at Komati Poort, on the Komati River, where it joins the Pretoria and Delagoa Bay Railway, and goes to Leijdsdorp, on the Murchison Range, a distance of 225 miles.

Another interesting exhibit in the grounds is called "The American Gold Mine." It is a model—to the scale of ¼in. to the foot—of the first and bottom levels of the Saratoga Mines, in the State of Colorado, near Denver. Country, rock and ore are in their proper positions, to scale; miners work in the shafts or in stoping, ore trucks run, buckets ascend, and the pump rods rise and fall—in short, the whole work of the mine may be seen at a glance. In the Saratoga Mines the tunnels are run under the ore deposit, and the miners work upwards, timbering where necessary. The scenery on the surface is a good representation of that part of the Rocky Mountain district; and pumping engines, winding engines, and air compressors are all shown to scale. A train of donkeys conveys stores up a mountain path, and a stamp mill—like the one exhibited by the Transvaal—is working in one corner. A Halliday "ropeway" conveys the ore from the pit head to the stamp mill, which is driven by a water wheel. Between the mines and surface there are figures of eighty men at work, and the model is altogether more complete than anything of the sort that I have seen previously.

## LARGE LOG BAND SAW

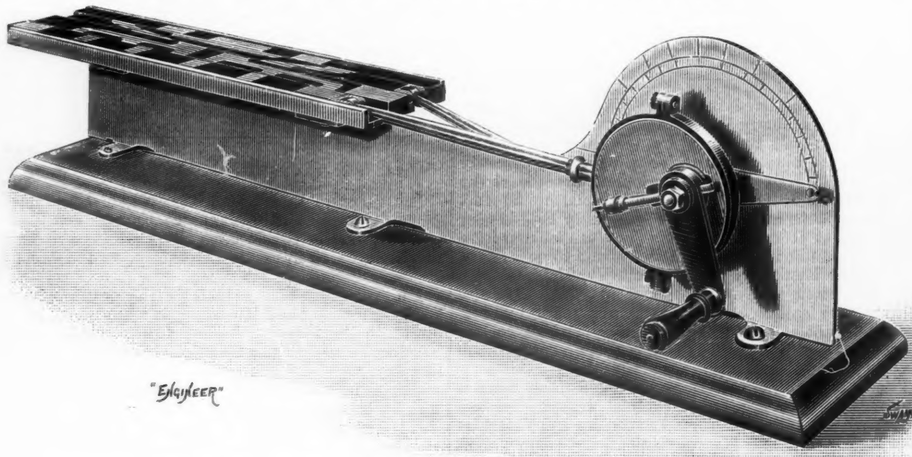
MESSRS. J. PICKLES AND SON, HEBDEN BRIDGE, ENGINEERS



### LARGE LOG BAND SAW.

THE above illustration represents a new design of large band saw with travelling table for the conversion of large logs, either by squaring or opening them through the middle and quartering, or by sawing them into flitches and boards. It is a substantially-built machine, and possesses the necessary features for ensuring truth and facility in manipulation. The main standard is massive so as to withstand the heaviest stresses. The top pulley is of wrought iron, lightly built, while the bottom or driving pulley is very heavy, as it has to act as a fly-wheel. When the machine is stopped there is no back-lash, and the lessened tension on the saw is on the side which is not cutting. Thin saws are used, and both pulleys are so constructed as not to require any covering, the teeth being free from the periphery. Adjustment is provided for the maintenance of the proper position of the saw blade without affecting its set. There is a sensitive tension arrangement allowing freedom for expansion and contraction of the saw, under the restraint of an adjustably-weighted lever. The saw guides are of simple form, and adjustable as to position, as will be seen from the engraving. The travelling carriage is of substantial construction, with screw dogs to hold the log, and is provided with a sliding movement actuated by screws with the bevel gear and ratchet lever shown, to advance the timber to the saw after each successive cut. There is also a simple set-off motion actuated by a lever for withdrawing the log clear of the saw for the return motion. The travelling table is fitted with pulleys and shafting, running upon iron rails fixed to longitudinal timbers, the feed motion being variable by cone pulley, worm, and spur gear. It is also fitted with quick return motion. It is made in nine different sizes, with saw pulleys varying in diameter between 6ft. and 8ft., requiring between 10 and 25-horse power. It is manufactured by Messrs. John Pickles and Son, Hebden Bridge.

## WILKINSON'S VALVOMETER



### WILKINSON'S VALVOMETER.

BY means of this instrument valves and valve motions in steam and other engines can be set out to actual size, and the points of admission, cut-off, exhaust and compression of steam be determined by simple inspection. The instrument is constructed with two slide bars on which the port openings corresponding to the valves are scribed full size. The bars move in slots, the intermediate spaces having scribed on them the port openings in the cylinder and plate. Any form of valve, straight-ported, D-ported, Trick or piston valve can be set out on the bars to full scale. The travel of each bar can be quickly and accurately adjusted by the following means:—On one side, controlling the expansion valve, is an excentric of which the sheave can be adjusted to any given throw or degree of excentricity with the crank, and on the other, controlling the main valve is a slotted crank in which the throw can be adjusted by shifting the pin in the slot. The lead of each valve, or its angle of advance on the crank, can be adjusted separately to any given amount. All adjustments can be measured accurately by a scale of sixteenths marked on the instrument, and the angles of advance and positions of pistons in the cylinder read off on crank circle. The crank can be set to the back or forward centre for observing the lead, or turned to any position for observing the points of cut-off, exhaust and compression. The action of the steam engine governor in making a late or early cut-off according to the lead is readily shown. in all positions of the governor and link; and having two sliding bars, the instrument shows the modern automatic expansion valve and main valve with intermediate plate. The action of the governor and link motion in cutting off steam earlier is shown by shifting the lead of the excentric backward through a given angle and shortening the throw. By changing the lead of the main valve 120 deg. the action of the valve in reversing an engine is readily seen, and all intermediate positions show the effect of notching up by the lever and link. The ports on the valves can be altered to any desired inside or outside lap and any combinations between width and position of ports, and travel and lead of valves set out, and their effects studied.

The instrument is of service in the drawing office for designing valve motions and dimensions, and in the erecting shop, for setting and re-setting valves. It is further of great use when through local conditions, such as change of initial or back pressure, the valves of an engine have to be altered, or where valves have to be adapted. Being provided with means of demonstrating and measuring the effect of any of the above combinations, the instrument is valuable for the use of professors of engineering in demonstrating valve actions in steam and other engines to engineering classes.

The apparatus was designed by Mr. H. D. Wilkinson, M.I.E.E., of Mildmay-road. It is manufactured by Messrs. Nalder Brothers, Red Lion-street, London, E.C.

## A NEW INCANDESCENT LIGHT.

GAS and oil users will be interested to hear of a means of improving their light which is both cheap and simple. It is called an "Incandescer," and consists of a small pellet of some refractory material, the composition of which is not, of course, made known—costing very little, and able to last over a year with absolutely no care or cleaning. It appears to be a chemical composition, the ingredients of which, when passed through a heating process, form a hard solid stick, and when shaped into the desired form according to its intended adaptability, either for gas or mineral oil lamps, is practically unbreakable. Figs. 1, 2, and 3, show three methods of using it. Fig. 1 shows its application to an ordinary Argand burner, which is sufficiently clear without explanation. Figs. 2 and 3 show its adaptability to central button and ordinary round-wick oil lamps.

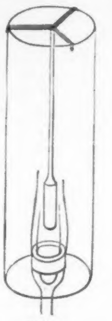


FIG 1

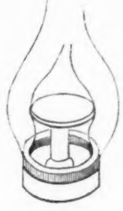


FIG. 2

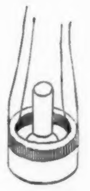


FIG. 3

In its present form it is most suited for use in burners with round flames—the results of its application to flat-wick lamps not being so far determined—although we see no reason why it should not be equally successful with the one as with the other.

The "Incandescer" has been photometrically tested, and the company intend issuing a circular containing a full report of the tests. We have at present to content ourselves with their assurance that it increases the illuminating power of a paraffin lamp by over 40 per cent., and decreases the consumption of oil 33 per cent. Another advantage claimed is the perfect consumption of the carbon, so that ceilings, pictures, &c., are not affected thereby. We, of course, cannot give the why and wherefore of the effect. Even if we knew the composition of the "Incandescer," we would certainly hesitate to lay down a theory, any more than we could explain why *any* substance on being placed in a gas or oil flame causes an increase of its luminosity—a thing which no chemist has ever yet satisfactorily explained. We wonder if the inventor of the "Incandescer"—Mr. L. Chandor, of St. Petersburg—himself could explain it? The "Incandescer" is being introduced in this country by the New Incandescent Light Company, 20, Bucklersbury, E.C.

## RICHMOND'S AUTOMATIC WATER ECONOMISER FOR HYDRAULIC LIFTS AND CRANES.

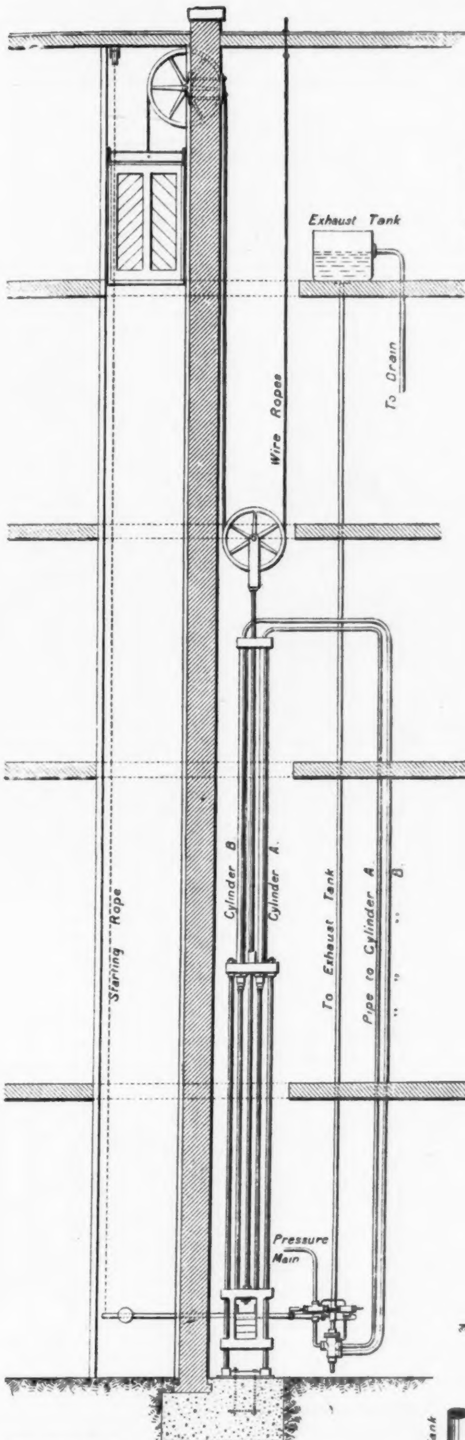
OF late years much attention has been directed to perfecting hydraulic lifts and cranes, as a result of the increased demand for these labour-saving machines which has sprung up since the adoption in many large towns of the system of supplying water at high pressures from a central pumping station. The improvements have mainly taken the direction of obtaining greater safety, increased smoothness of working, and more complete control over the moving parts. In these points it is improbable that the hydraulic lifts and cranes as now manufactured by firms who make a speciality of this class of engineering, will be much improved upon, but there is still one feature which, up to the present time, has not received the attention which its importance deserves, and that is the comparative consumption of water. As at present constructed, the majority of hydraulic machines use as much water to raise a light load—or in the case of a crane to return the unloaded chain and ball—as would be required to lift the maximum weight which the machine is constructed to raise. An exception to this, however, we illustrated and described in a recent issue. As water is paid for by meter at per 1000 gallons, it is a very important consideration that the consumption should be reduced to a minimum.

A machine which will automatically regulate the quantity of water to the work to be done, and be entirely beyond the power of the attendant in charge to alter, and yet simple in construction, cheap in first cost, and not liable to get out of order, has been a desideratum. A machine complying with these requirements is illustrated on page 39. It has been designed by Mr. R. F. Carey, and Messrs. Joseph Rich-

# RICHMOND'S LIFT WITH CAREY'S WATER ECONOMISER

MESSRS. JOSEPH RICHMOND AND CO., LONDON, ENGINEERS

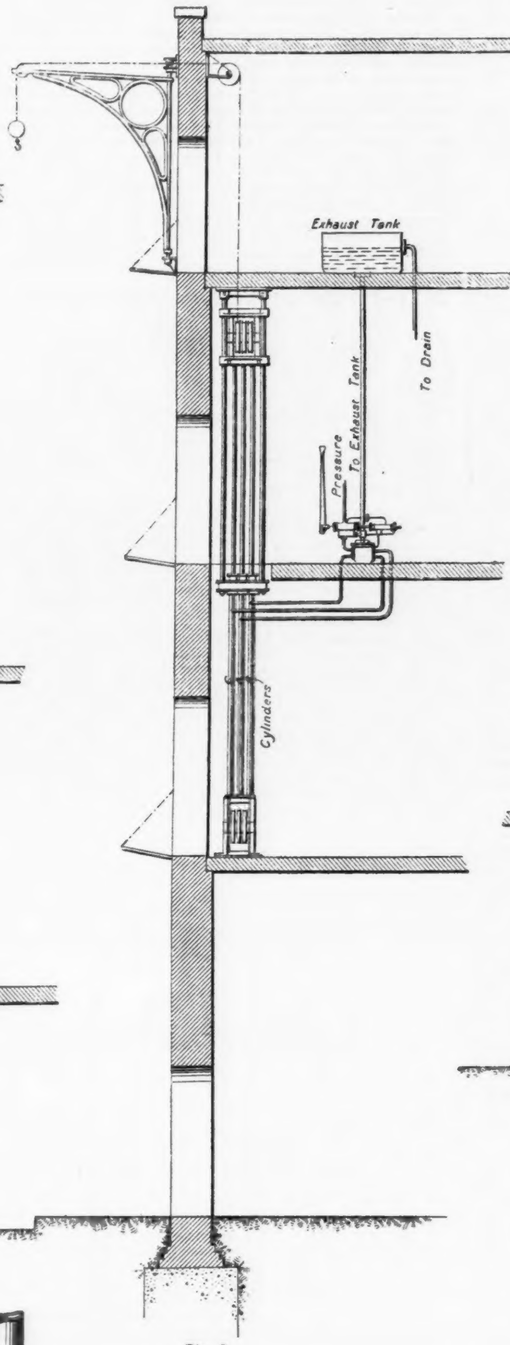
(*For description see page* 38



Exhaust Tank
To Drain
Wire Ropes
Starting Rope
Cylinder B
Cylinder A
To Exhaust Tank
Pipe to Cylinder A
B
Pressure Main

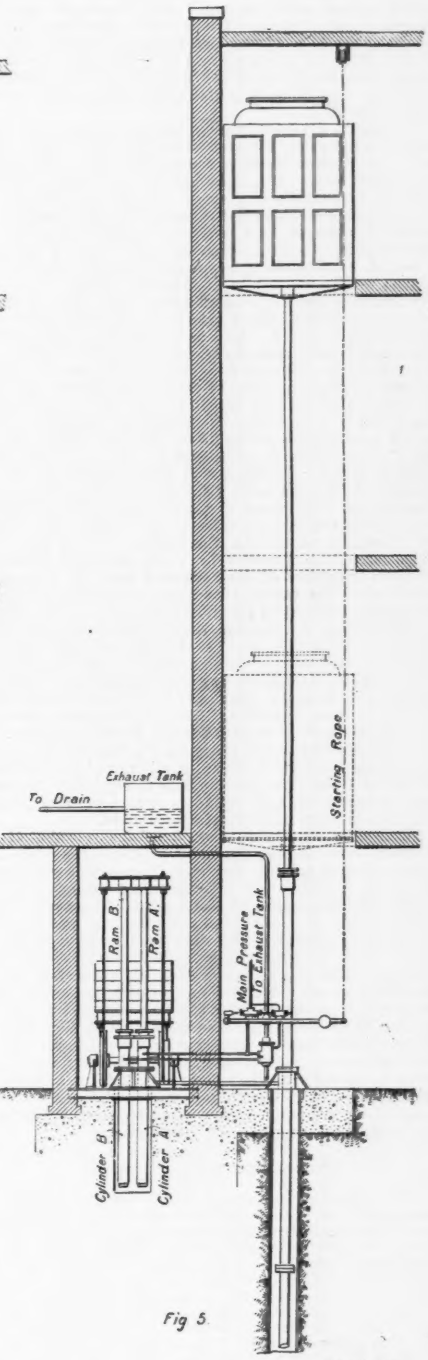
"THE ENGINEER".

Fig. 1



Exhaust Tank
To Drain
Pressure
To Exhaust Tank
Cylinders

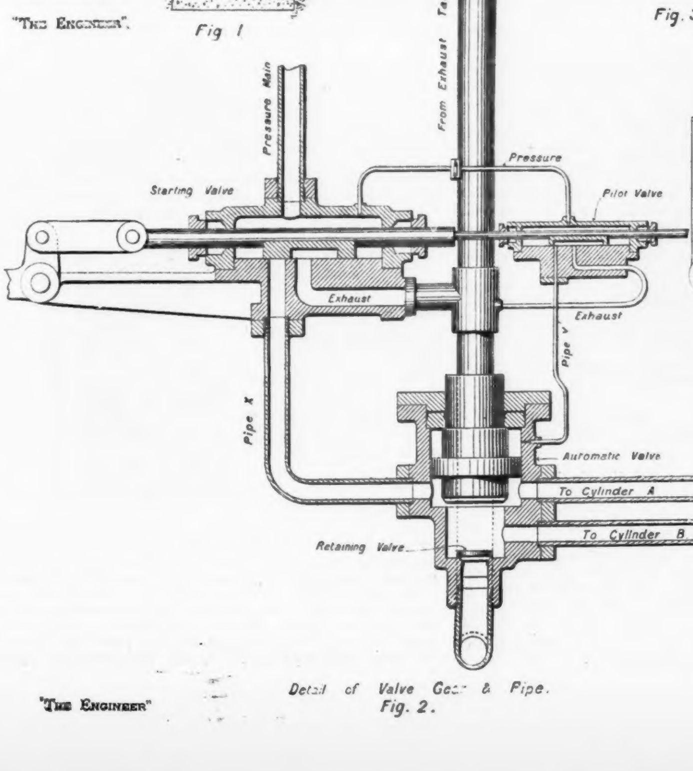
Fig. 3.



Exhaust Tank
To Drain
Starting Rope
Ram B
Ram A
Main Pressure
To Exhaust Tank
Cylinder B
Cylinder A

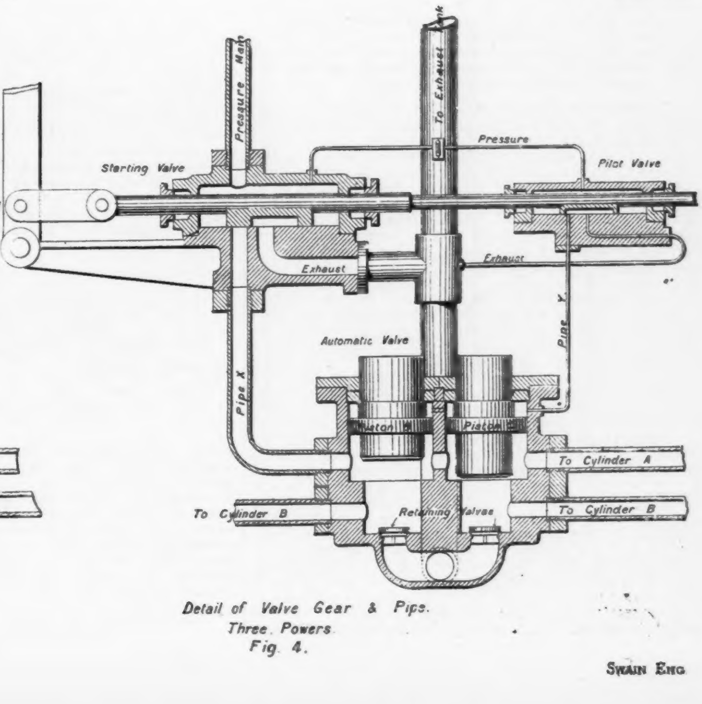
Fig 5.

SWAIN ENG.



Pressure Main
From Exhaust Tank
Pressure
Starting Valve
Pilot Valve
Exhaust
Exhaust
Pipe V
Pipe X
Automatic Valve
To Cylinder A
To Cylinder B
Retaining Valve

Detail of Valve Gear & Pipe.
Fig. 2.



Pressure Main
To Exhaust Tank
Pressure
Starting Valve
Pilot Valve
Exhaust
Exhaust
Automatic Valve
Pipe X
Pipe Y
Piston
Piston
To Cylinder A
To Cylinder B
Retaining Valves
To Cylinder B

Detail of Valve Gear & Pipe.
Three Powers.
Fig. 4.

"THE ENGINEER"

SWAIN ENG.

mond and Co., Hatton Garden, have reduced the idea to practice, with, we are informed, most satisfactory results, by a series of experiments which have been carried out at their works at Bow in the following manner:—A two power hydraulic lift on the suspended principle was erected, fitted with the new automatic gear, and the whole was worked from a small hydraulic plant giving a constant pressure of 700 lb. per square inch, in order that the same conditions might be observed as if the machine were worked from the London Hydraulic Power Company's mains. Exhaustive trials were then made, first with a lift having a cage, and afterwards with a crane. The result of these trials proved so satisfactory in every way that Messrs. Richmond and Co. are now prepared to place these machines on the market, guaranteeing them to meet the required conditions, either at a fixed first cost or on a rental charge proportional to the saving effected.

Referring to the drawings, Fig. 1 shows the general arrangement of a two power lift, such as the experiments were made with. Fig. 2 shows the valve and pipe arrangement in section to a larger scale. The expander or multiplying machine is one of Richmond's long stroke jiggers—Carey's patent—the lifting area in which is divided between two small rams, which are arranged in a compact manner under the top sheaves. The two rams, which are connected to a cast iron crosshead, work vertically downwards, and act as a counter balance weight for the cage. This crosshead is provided with four long Babbitt's metal bushes, which work on turned wrought iron guides, which also form the framing on which the machine is carried. A tie or tension rod is connected to the crosshead and passes up between the two cylinders, and is connected to a wrought iron sling carrying the multiplying sheaves. The arrangement of the pipes and valves is shown so clearly on the drawing that further description is needless. The action is as follows:—To ascend, the starting valve is moved to the right, which admits pressure water through pipe X to an automatic valve, from the top port of which it passes to cylinder A direct, and from the bottom port to cylinder B. At the same time pressure water is turned through pipe Y by means of a pilot valve working in connection with the starting valve to an annular space above the automatic valve. In the case of only a light load to be raised the pressure from the cylinders A and B, acting on the piston of the automatic valve, is not enough to overcome the pressure on the annular space above it. The piston is therefore forced down, and closes the valve of cylinder B from the pressure, leaving the cylinder A open to pressure, and which is sufficient to raise the load. Directly the lift is stopped the annular space above the automatic valve is opened to exhaust by means of the pilot valve, and the pressure from the cylinders forces the valve back to its normal or open condition. The lowering takes place by opening the starting valve to exhaust in the usual way. In the event of a heavy load being raised, the total pressure on the annular space above the automatic valve is not sufficient to close it against the pressure from the cylinders due to the load, consequently both cylinders remain open to pressure and the maximum quantity of water is used.

From recent tests made it was found that a load of 4½ cwt.—or less—was lifted by the ram A only, and the quantity of water was 2·45 gallons, and with the machine exerting its full power a load of 12½ cwt. was raised through a similar height, the consumption of water being 4·65 gallons. Fig. 3 shows the invention as applied to a crane, the machine being one of triple power, and the valve gear for controlling it in detail. Fig. 4, it will be seen, is similar to the valve gear before described, with the exception that the automatic valve is duplicated to suit the additional cylinder, and in a similar manner the automatic valve can be multiplied to suit any number of powers. Fig. 5 shows a direct-acting balanced lift fitted with the economising gear, for which the arrangement of the valves is the same as already described. There must, we should think, be a large field open for alteration of existing lifts, and Messrs. Richmond and Co. anticipate a considerable demand for these machines when the principle and advantages become generally known.

---

TRIAL TRIP OF THE CHARYBDIS. — H.M.S. Charybdis, the latest and largest of the second-class cruisers for the British Navy, has just undergone her official steam trials at the mouth of the Thames with most satisfactory results. She is a ship of 4360 tons displacement, armed with ten guns, and differs from the Apollo class in having an additional upper deck sheltering her main armament and providing superior accommodation for her crew. On her natural draught trial, with an indicated horse-power of 7109, a speed of 19·3 knots was attained, and with 9136 indicated horse-power on the forced draught trial a speed of 20·5 knots, equivalent to nearly 24 statute miles per hour. This is the highest speed achieved with this class of vessel, and is eminently gratifying, as the horse-power in both cases was in excess of the contract, and the machinery worked in a highly creditable manner throughout. The ship has been built at Sheerness Dockyard, and the whole of the machinery has been designed, constructed, and fitted on board by Earle's Shipbuilding and Engineering Company, of Hull, who have now engined five of these second-class cruisers.

THE LATEST POLAR EXPEDITION. — The Windward, lying in Shadwell Basin, has been a subject of considerable interest. The work of shipping the aluminium launch, the sledges, huts, clothing, and stores of food, went on rapidly and without cessation, but the outsides of cases and barrels were most in evidence, and there was little or no opportunity of inspecting details, except as to open articles, such as the Berthon boats, the snow shoes, and the birchwood canoes. This vessel—which carries the Harmsworth-Jackson Expedition—is a stalwart wooden barque, originally a whaler, but strengthened considerably for her present purpose, and very complete in all requirements, from her iron-plated bows to the "crow's nest" hoisted up to the pinnacle of her maintop-gallant mast, and intended for the ice-master's anxious look-out. The land party of eight and the scientific investigators have their cabin in the afterpart of the hull, and their sleeping berths are in contiguity. Special provision is made for the meteorological and astronomical instruments. The former are furnished by the Royal Meteorological Society, and the latter by Mr. Cary, the Admiralty instrument maker. Amongst them a fine 6in. refractor telescope, said to be the largest ever yet taken to the Arctic regions. The ship carries a good spread of sail, and is reputed to be capable of accomplishing twelve miles an hour under canvas, when the circumstances are favourable. She is also supplied with auxiliary steam screw power. The *Standard* says that the crew will consist of twenty-two men, many of them of long experience in the northern regions. They are housed in the forecastle, which has been made as comfortable for them as could be practically done. The lighting, heating, and ventilation have been also as well considered, in view of the possibility of the ship being icebound in the coming winter. The aluminium launch is 18ft. in length, and constructed in several sections, each of which will float by itself, and when fitted up will carry from fifteen to twenty persons. It will be transported on sledges, and used by the land party for crossing open waters. The total weight of this launch is 150 lb.

---

# ARE THERE CERTAIN GENERAL PRINCIPLES UNDERLYING THE PROPER CONNECTION OF STEAM BOILERS AND ENGINES IN A POWER PLANT?*

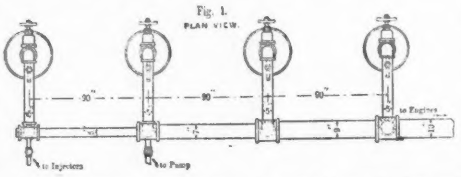
By Mr. THEODORE F. SCHEFFLER.

TOO much cannot be written about the design or construction of boiler and engine plants, either for electric light stations or for power plants, or, in fact, for any kind of a power station. Considerable space may be saved by leaving everything to the manufacturers, as well as economy secured in pipe connection. There certainly is a method for setting the engine connected to the boiler so that the best results may be obtained. For small plants, where there is but one boiler and engine, it is customary to set the engine about 12ft. to 14ft. from the boiler, and put an 8in. division wall between the boiler and engine-rooms, so as to keep all dust accumulating from ashes out of the engine-room. For the best results, engines should be set longitudinally with the boiler, so that direct pipe connections can be made. This is also, in the writer's opinion, the best method on account of the expansion of the steam pipe. In plants where there are three or four engines to be connected to a battery of boilers, and the engines are placed either directly in the rear, or in front of the boiler fire-room, there will be considerable waste of steam pipe, which will amount to quite an item on account of the steam pipe being large in diameter to accommodate the volume of steam from the boilers to the engine.

For the purpose of having some fixed basis to work from, the writer has taken for an ideal plant the following specifications of boilers and engines, and the necessary items to make a complete and modern steam plant.

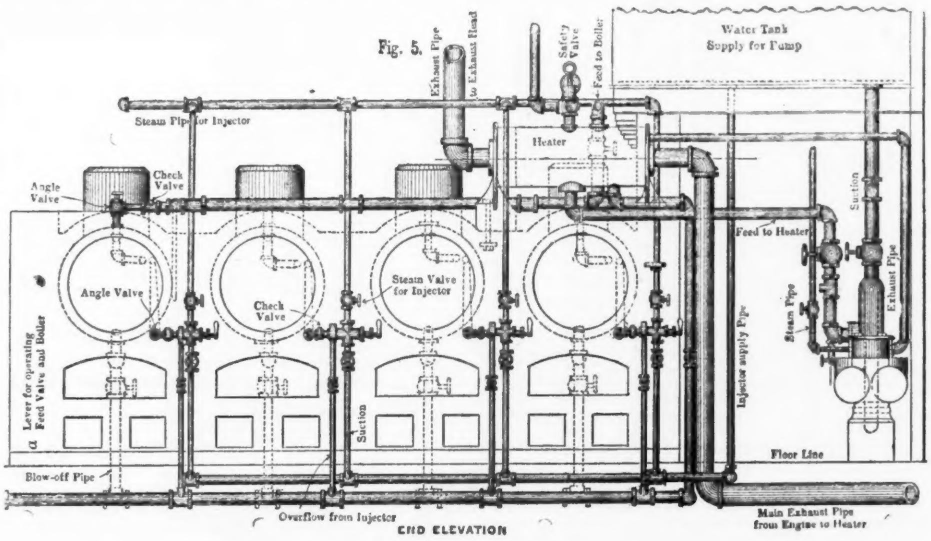
*Boilers.*—Four 66in. by 16ft. horizontal tubular boilers, rated at 100-horse power each, and to be set in one battery with full arch fronts, and all necessary fittings, such as safety valve, steam gauge, and syphon, water-gauge, with stand-pipe fitted to the boiler, three gauge-cocks for each boiler, blow-off valve, two check-valves, two stop-valves for feed-pipe, main gate valve for steam outlet, rocking grates, grate bearers, stack-plate, rear arch bars, and rear ash door and frame. These fittings go with each boiler. One boiler cleaner for all four boilers.

Fig. 1.
PLAN VIEW.



*Engines.* — Four 13in. by 12in. non-condensing, high-speed automatic engines, to develope 90 indicated horse-power each; diameter of steam pipe, 4½in.; diameter of exhaust, 5in.; diameter of pulley, 54in.; face of pulleys, 12½in., with complete set of fixtures, such as throttle valve, large size sight-feed lubricator, full set of sight-feed oil cups, and automatic oiling devices for crank-pin and crosshead-pin, wrenches, crank shield, cylinder cock-drip connection for steam chest, foundation bolts, and one 4½in. steam separator for each engine; feed-water heater to be 42in. diameter with 100 2in. tubes 60in. long. Engines to set 9ft., centre to centre and longitudinally with boiler. Pump required for this plant, one 400-H.P. pump, or a pump capable of delivering 3000 gallons per hour, and all necessary pipe connections. Each boiler to have one injector of 100-H.P. capacity, or equivalent to forcing 800 gallons of water per hour into boiler, and all necessary fittings. In a plant of this size it is customary to use a feed-water reservoir tank. Where there is no city water pressure the tank is supplied with water by a pump, the tank being suspended above the boilers, so that the water will flow by gravity to the boiler feed pump, thereby keeping the pump valves flooded with water. One exhaust head should be connected to the main exhaust pipe after leaving the feed-water heater. Probably right here would be the proper place to say a few words in connection with the engine foundations. The depth of engine foundation should be at least 6ft., unless there is a good rock bottom found before reaching this depth, so that the engine anchor-bolts may be anchored directly into the rock; otherwise, if there is no such rock to anchor to, and the above depth has not been made, there will not be enough weight to the foundation to hold the engine down. The writer is well aware of the fact that there are engines on the market to-day where great care and attention has been given thoroughly to counterbalance the engine, so that the engine will run steadily and smoothly, set upon four pins, and will not jar or shake off the pins, the engine not being bolted to the foundation. The above is all right so far as it goes, but will not answer for large engines, and especially when the engine is very heavily loaded. The length of the foundation on the shaft end of the bed, measured from the centre of the shaft to the end of the foundation, should be equal to the length of the foundation measured from the cylinder end of the bed to the centre of the shaft. The correct proportion for this length of foundation is about seven and one-half times the stroke of the engine. In a great many cases this length of foundation on the shaft end of bed has been very much diminished. There is no better place to throw in brick on an engine foundation than on the shaft end; here is where the weight is required.

Fig. 5.



END ELEVATION

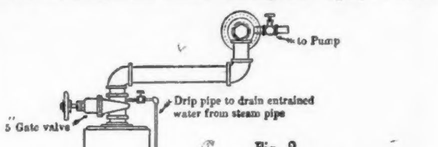


Fig. 2.
END ELEVATION OF MAIN STEAM PIPE.

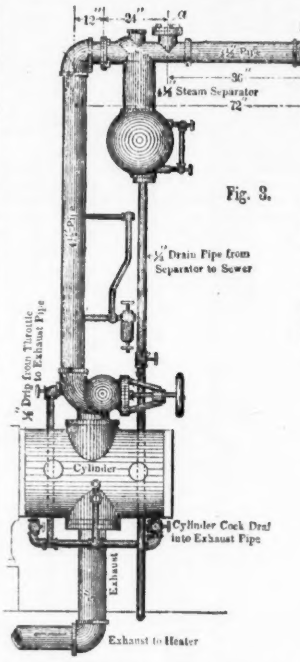

12"
24"
a
10" Pipe
4½" Pipe
36"
4½ Steam Separator
72"
½ Drain Pipe from Separator to Sewer
½ Drip from Throttle to Exhaust Pipe
Cylinder
Cylinder Cock Drip into Exhaust Pipe
Exhaust
Exhaust to Heater

Fig. 3.

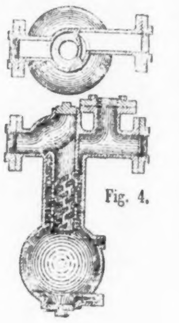
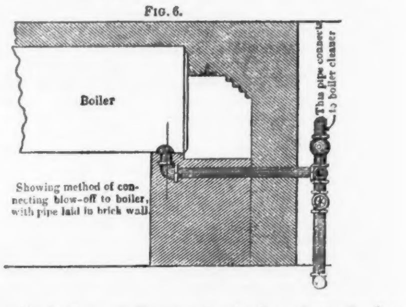


Fig. 4.

The above dimensions which have been given will make the end of the foundation equally divided on each side of the centre line of the shaft, making the centre of the shaft in the centre of the apex of the foundation. The width of the foundation at the bottom should be equal to eight strokes of the engine. In this case, the stroke of the engine is 12in. multiplied by 8in., which would be equal to 96in. The number of bricks which would be required for this foundation is 7500. Having found the proper dimensions of the engine foundations, it will be as well to give thought to the relative proportions of the boiler foundation and settings. The writer has found by experience that 3ft. deep will be sufficient for this size of boiler, below the floor-line. A good, hard sandstone will give good results when brick is not used, which some people prefer. The width of the foundation should be 6in. more on the floor-line than the boiler side walls, which in this case should be 24in. wide. There has been considerable argument about the best height from the floor-line to the fire door opening; 22in. to 24in. is a very satisfactory height, but 30in. is considered much more satisfactory and better adapted to the ordinary fireman. This height has been obtained for these boilers by raising the bottom of the fire fronts 6in. above the floor-line, as the height of opening is but 24in. in the casting. This method of raising the front has proved very satisfactory wherever it has been adopted. Another point to be considered on these boilers is the height from the top of the bridge wall to the under side of the boiler shell. The height in this case is 12in., and this gives an area between the top of the bridge wall and the bottom side of the boiler shell of 1550 square inches, which is equivalent

FIG. 6.



Showing method of connecting blow-off to boiler, with pipe laid in brick wall.

---

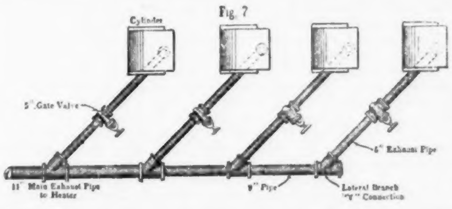
* Presented at the Montreal meeting—June, 1894—of the American Society of Mechanical Engineers.

to double the area of the boiler tubes. For the best results in combustion and efficiency, this height has proved to be very satisfactory. The bridge wall should be made horizontal on top. Some manufacturers recommend the top of the bridge wall to follow the curve of the under side of the boiler shell with the necessary area between the bridge wall and the boiler. Another good point for consideration is the distance from the top of the grates to the bottom of the boiler shell; in this particular case it is 26in. The height has proved to be very satisfactory. Of course there is a wide range of opinion on the height; some manufacturers prefer but 23in. to 28in., and some even prefer 30in. The writer has found this height to suit in almost every possible case. The height given is about the average, and will evaporate more water than if the height was 30in.

The boilers and engines having been set up on their foundations, the next point in view to consider is the main steam pipe and fittings. See Fig. 1 for illustration of the main steam pipe. We will first consider the correct diameter of the main steam pipe. As we have in this case four steam outlets from the four boilers, one from each of the boilers, and as the commercial diameter of each pipe is 5in., we shall require a main steam pipe with an area equal to four times the area of the 5in. pipe. The area of a 5in. pipe is 19·63 square inches. This multiplied by 4 gives 78·52, which is equivalent to a pipe 10in. in diameter. The pipe is constructed on the telescopic method, that is, the diameter of the pipe from the first boiler to the second boiler is 5in.; from second boiler to third boiler 7in.; from third boiler to fourth and last boiler 9in.; and from the last boiler to the engines the diameter is 10in. This pipe will carry all the steam which the four boilers can supply, and with a minimum resistance. Observing the end elevation—Fig. 2—the main steam pipe is at the extreme height. This arrangement allows of all condensed water flowing back towards the boilers. There should be a drip connection placed on the gate valve just above the valve seat, so that condensed water may be drained off. By this arrangement of drip-pipe, considerable water may be saved from getting into the engines. It will also prove to be economical and saving of steam from the boiler after the gate valve is opened; for if this accumulating water is not let out at the boiler after any one of them has been shut down, the steam will condense very rapidly. Of course this is only a small saving of steam.

The main steam pipe is located 36in. from the centre of the dome. This is done so that when the steam pipe expands or contracts, it will not make any strain on the screwed connection at the point marked A, but will naturally swing from the centre of the dome, the centre of the dome becoming the fulcrum of the main steam pipe. The steam pipe connections for the engines are made in the following manner, Fig. 3:—First, a short piece of 4½in. pipe is connected to the main steam pipe, and then to the steam separator. The steam taking a spiral course inside the separator, causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to the centre of the pipe. When it is not convenient to pipe up the separator as shown, steam may be taken into the separator at A. For sectional view of separator see Fig. 4. The separator should be located as close as possible to the engine, so that nothing but clean dry steam will be supplied to the engine. The main steam pipe is located 72in. from the 4½in. vertical steam pipe, which is connected directly to the engine throttle valve. This allows the 4½in. horizontal steam pipe connected to the separator to swing from the elbow B when expansion or contraction takes place. Fig. 3 also shows the exhaust pipe connected to the cylinder. For continuation of exhaust pipe connected to feed-water heater, see Fig. 5.

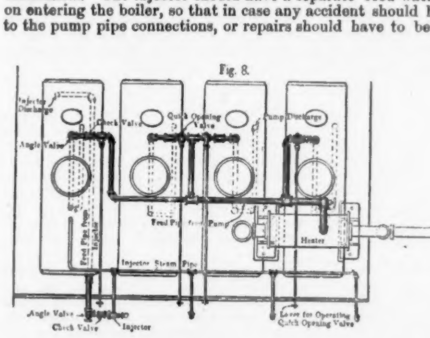
Fig. 7


Cylinder
5" Gate Valve
6" Exhaust Pipe
11" Main Exhaust Pipe to Heater
9" Pipe
Lateral Branch "Y" Connection

The best and usually the most convenient place to locate a feed-water heater is on top of the boiler side walls, placed at right angles to the boiler and set horizontally, the heater being supported at each end by a cast iron leg or bracket, and each bracket anchored into the boiler side walls by anchor bolts.

This method of locating the heater has been, as described above, placed on several large boiler settings which the writer has designed. Any person who is in any way familiar with boiler settings knows how hot it is over the top of boilers, and can readily see the advantage of locating the feed-water heater above the boilers. From 5 deg. to 10 deg. of additional heat will thus be obtained for the feed-water over that supplied, if the heater is set up, as is common practice. To set the heater on top of the boiler will cost a little more, but it will soon pay for itself by being economical. The injector should have a separate feed-water pipe on entering the boiler, so that in case any accident should happen to the pump pipe connections, or repairs should have to be made on the pump or to any of the connections, there will be no loss of time by having to draw off the steam from any of the boilers, in order to make the necessary repairs. If necessary, by closing the main feed-water pipe valve connected to the pump line of pipe, after the water is forced through the heater, and by closing the feed pipe valve over each boiler, the whole line of pump pipe connections may be disconnected, and the boilers fed with the injectors. A check valve should be placed over each boiler for the feed pipe, and also between the pump and heater. This will keep all pressure away from the pump and will be beneficial in case anything should happen to the boiler checks. The blow-off from the heater is connected to the main blow-off pipe, as well as the overflow from the injectors, and the discharge may be connected to any convenient point which will be the nearest at hand, or may be carried to the sewer. To operate the blow-off on the boiler or heater, the globe valve on the injector pipe should be closed. The injectors are supplied with water from the water tanks overhead; this will give a constant supply of water under a head of water at the injector.

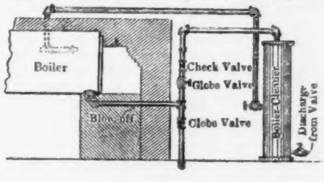
Fig. 8.



The main steam supply is connected to the main line of steam pipe leading to the engines. The idea of doing this is in case anything should happen, so that any one or two of the boilers should be off duty, the supply of steam would be constant, in taking steam from the main line of steam pipe. A good way to connect the blow-off pipe to the bottom of the boiler shell and keep the pipe intact from burning out, is to build a small wall of fire-brick, about 9in. thick, and lay the pipe in the centre of the brick. This wall will not diminish the area of the combustion chamber enough to destroy any of the draught. For illustration of this pipe connected to boiler, see Fig. 6. The exhaust pipes leading from the engines to the main exhaust pipe should be constructed so that there would be a minimum amount of back-pressure. To do this satisfactorily and with the best results, a lateral branch Y connection should be made where the pipe meets the main exhaust pipe. For an illustration of this design, see Fig. 7. A valve should be placed on the pipe leading to the main exhaust pipe, so that in case any one of the engines is stopped for repairs, the exhaust steam from the other engines would not back up into the steam chest, in case the valve on the engine was disconnected from the engine. The Y connection also does away with the short and sharp angle connection and makes a freer passage for the steam.

Referring to Fig. 8, we have a plan view of the pump feed-pipe connections with fittings, also the injector connected to the boiler. It will be observed that the injector pipe runs nearly the whole length of the boiler and toward the rear before discharging the water directly into the boiler. The advantage of this is apparent. The feed-water becomes well heated before discharging into the boiler, and its chilling action on the shell is greatly lessened. There has been considerable discussion about where the feed-water should enter the boiler, and the writer believes that this method is freer from objection than any other which could be selected. The pump feed enters the boiler at one-quarter the whole length of boiler, at the rear, and the pipe is kept as close as possible to the boiler shell, so that there will be room enough for a man between the pipe and the top of the tubes. The pipe then continues ahead about 8ft. and then turns towards the boiler shell on the side, and then turns and comes back where it started from and discharges downwards. Some persons may say there are too many turns employed in this method, but the feed-pipe is made much larger after it enters the boiler to reduce the resistance caused by friction to a minimum. Fig. 8 also shows a plan of the feed-water heater.

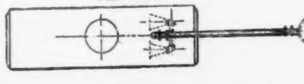
FIG. 9.
Showing arrangement for connecting Boiler Cleaner to Boiler



Figs. 9 and 10 illustrate the method for connecting the boiler cleaner to the four boilers. The reservoir for receiving all of the sediment collected from the boilers is located centrally between the four boilers, in the rear. The action of the boiler cleaner is here described. As the water boils and circulates towards the top and rear of the boiler, the scoops gather all sediment which rises to the surface of the water, and is then discharged by the boiler pressure into the reservoir. The water and steam may be let out of the boiler, independent of the boiler cleaner when it is necessary, by closing the valve connected to the boiler cleaner and opening the valve connected to the blow-off pipe proper. There is a globe valve attached to the bottom of the reservoir, where the sediment which has collected may be let out. This sediment should be let out every other day.

The writer desires to say, in conclusion, that about twenty plants have been connected up as described in this article, although they have not all had boiler cleaners, nor has the injector been connected separately to the boiler, and the engines and boilers were arranged somewhat differently in the setting; but all are giving good satisfaction, and the piping in general was arranged as described here. Further, in regard to piping in general, in case of any accident to any part of the plant, the part which is crippled may be shut off without shutting down the whole plant. The steam will reach the engine with but little drop in pressure, as all pipes are covered with an asbestos air-space covering. Much more can be written on this subject and on this same plant; and the writer desires to say that some time in the future it would be interesting to give an approximate estimate as to the cost of the entire plant. The main object of this article is to create a fruitful discussion.

FIG. 10.
Plan of Boiler Cleaner



LOWNESS OF ITALIAN WAGES.—The British Vice-Consul at Ancona, in a recent report on the trade of that district, gives an additional instance of the very low wages paid in Italian industrial establishments. At the metallurgical works of Messrs. D. Cattro and Co., a firm giving constant employment to over 200 hands, although wages have increased by about 10 per cent. in the last three years, the average rates paid per day of 10½ hours are—to boilermakers, 3s. 2d.; iron founders, 2s. 11d.; riveters, 2s. 11d.; turners, 3s. 2d. The works are being enlarged, and accommodation will be provided for building steamships of any size or tonnage. Coal, coke, pig iron, and all materials for boilermaking are imported from Great Britain.

SHIPPING STATISTICS.—It appears from Lloyd's Register that 2401 iron steamers of a tonnage of 2,769,555 tons and 2063 steel steamers of a tonnage of 4,347,177 tons are classed in the United Kingdom out of a total of 3132 iron steamers of 3,738,340 tons and 2716 steel steamers of 5,505,304 tons. Of sailing vessels 1109 iron ships of 1,416,107 tons and 464 steel ships of 857,591 tons are classed in the United Kingdom; and of wooden ships, including composite vessels, 659 of a tonnage of 119,486 tons are also classed. The total number of vessels classed in the book for the present year is 30,721 with a total tonnage of 24,569,496 tons. This compared with last year's book, which had 32,010 vessels of a total tonnage of 24,258,375 tons, shows a decrease in number of vessels, but an increase in the total tonnage.

COST OF FIRST-CLASS CRUISERS.—At a conference of members of Parliament held at the Westminster Palace Hotel, to consider the excessive cost of the first-class cruisers, the proceedings were commenced by a statement from Sir E. J. Reed, who, while deprecating any general interference between the Admiralty and their contractors, represented that in the case of the Thames Ironworks Company, Earle's Company of Hull, and Napier's of Glasgow, all of whom had been engaged upon the construction of first-class cruisers for the Admiralty, there were very special circumstances which appeared to him to justify the interference of Parliament. We read in the *Times* that numerous questions were asked, both by Sir E. J. Reed and of the representatives of the contracting firms in question. It was felt that the arbitration clauses of the respective contracts had not yet been sufficiently acted upon, and it was the unanimous opinion of the members present that before any further parliamentary action was taken those clauses should be formally enforced.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*A heavy locomotive.*—The heaviest locomotive of the mogul type—six driving wheels and a two-wheel leading truck or bogie—in the world has been put in use for coal service on the Delaware, Susquehanna, and Schuylkill Railway. It weighs 76 tons in working order, has a boiler 6ft. diameter, and driving wheels 5ft. 2in. diameter. The fire-box is designed for lump anthracite coal, and has annealed cast steel plates $\frac{5}{16}$in. thick, with ⅜in. crown sheet, and ½in. tube plate. It has the ordinary link motion, with Richardson balanced valves. The fire-box crown sheet has radial stays 1in. diameter. An extension smoke-box is used, with a short cylindrical smokestack or funnel. The crossheads are of cast steel. Compressed air is used to ring the bell and to operate the Leach sanding apparatus. The coupling and connecting-rods are of iron, with forged oil cups. The boiler is of ⅝in. steel plates, the longitudinal seams being butt jointed, with double riveting and double cover strips. The tender is carried on six 42in. wheels, like the tender of one of the Pennsylvania Railway express engines. The cylinders are 22in. by 26in., with two-bar guides. The cab is of steel plate.

| | |
|---|---|
| Cylinders | 22in. by 26in. |
| Driving wheels | 5ft. 2in. |
| Truck wheels | 3ft. |
| Tender wheels | 3ft. 6in. |
| Driving wheel base | 14ft. |
| Engine wheel base | 22ft. 6in. |
| Engine and tender wheel base | 50ft. |
| Tubes, number | 270 |
| ,, length | 12ft. |
| ,, diameter | 2¼in. |
| Boiler, diameter | 6ft. |
| Boiler pressure | 160 lb. |
| Fire-box, length inside | 11ft. |
| ,, width inside | 3ft. 6in. |
| Journals of driving axles | 9in. by 12in. |
| ,, of truck axles | 6in. by 12in. |
| ,, of tender axles | 6½in. by 10in. |

*Gasoline tramway engine.*—One of the latest of the many engines invented for use on street railways or tramways is the Regan engine, tried recently in San Francisco. The motive power is an internal combustion engine, using gasoline or benzine mixed with air as the explosive mixture, the charge in the cylinder being fired by an electric spark. The engine is vertical, inverted, and runs continuously, driving a shaft lengthwise of the car, which carries a pinion. This pinion gears with a spur wheel on a shaft under the car, which carries at each end a bevel pinion gearing with a bevel wheel on each of the two axles. The power is regulated by the charge, which varies automatically with the load on the car; and starting or stopping is effected by throwing the engine in or out of gear with the lower driving shaft. The experimental car is similar to a cable railway open-grip car, being carried on four wheels and having two lengthwise side seats back-to-back, the working levers being operated by a man standing in the space between the backs of the seats. The car is 13ft. long, seating twenty passengers—ten each side—and is carried on four wheels 28in. diameter, with a wheel base of 6ft.; its weight is four tons. The engine is of 15-horse power, constructed to run at 200 to 350 revolutions per minute, and consumes one-third to one-quarter of a gallon of oil per car mile with speeds of six to eight miles per hour, though it can be speeded up to twelve or fifteen miles. The oil costs 13 cents per gallon in San Francisco, and 5 cents per gallon in New York.

*Railway operating statistics.*—The discussion on English and American railway rates is very largely based on average figures, which are in many ways unsatisfactory, in that they do not represent actual but imaginary conditions, which have little practical bearing. On the other hand, comparisons of specific rates are also unsatisfactory, since rates are not based upon any system—mathematical or otherwise—but depend largely upon circumstances and conditions. The following figures, however, giving the operating details of the Chicago, St. Paul, Minneapolis, and Omaha Railway for the year 1893 are interesting examples of specific results for that one road, which has a length of 1495 miles:—

| | |
|---|---|
| Gross earnings per mile | 5,607·31 dols. |
| Operating expenses and taxes per mile | 3,934·06 dols. |
| Net earnings per mile | 1,673·25 dols. |
| Passengers carried | 1,738,656 number |
| Passengers carried one mile | 86,021,354 number |
| Average rate per passenger per mile | 2·409 cents |
| Freight carried | 3,198,878 tons |
| Freight carried one mile | 524,073,368 tons |
| Average rate per ton per mile | 1·124 cents |
| Engine mileage | 7,477,431 miles |
| Cost of engine and tender repairs per mile run | 3·76 cents |
| Cost of engineman, firemen, and wipers per mile run | 7·42 cents |
| Cost of oil, waste, and tallow per mile run | 0·28 cents |
| Cost of fuel per mile run | 11 10 cents |
| Total cost per mile run by engines | 22·56 cents |
| Mileage per ton of coal | 26·07 miles |
| Mileage per pint of oil | 15·45 miles |
| Mileage per pound of waste | 137·83 miles |
| Average earnings per mile run by passenger trains | 1·27 dols. |
| Average earnings per mile run by freight trains | 1·66 dols. |
| Average earnings per mile run by all trains | 1·53 dols. |
| Average expenses per mile run by all trains | 1·07 dols. |
| Net earnings per mile run by all trains | 0·46 dols. |
| Average cost per ton of coal consumed | 2·87 dols. |
| Average number of freight cars per train | 18 38 |
| Average haul per ton | 163 miles |
| Number of passenger trains run | 24,939 |
| Average number of passenger trains per day | 80 |
| Average number of cars per passenger train | 5 |
| Average haul per passenger | 50 miles |
| Number of freight trains run | 54,416 |
| Average number of freight trains per day | 174 |
| Average receipts per passenger | 1·19 dols. |

*Metallic sleepers for railways.*—A very complete report on the use of metallic sleepers for railways, giving statistics and details of experience in all parts of the world, was prepared about five years ago by Mr. E. E. Russell Tratman, C.E., of New York, for the Forestry Division of the United States Government, and was issued by that department in 1890. Two editions of the report have already been exhausted, and Mr. Tratman is now preparing a supplementary report to accompany a third edition, which is to be issued this year. This new report will bring the statistics and records of experience as nearly as possible up to date, but will also take up the subjects of the use of preservative processes for wooden sleepers, and the use of metal base plates to protect wooden sleepers from wear by flange rails. These two latter subjects are of much more immediate importance in the United States than the former, but while the use of steel base plates has reached a very remarkable development, preservative processes are still comparatively little used. The zinc process is that most generally employed, though creosoting and vulcanising are also employed. Flange rails are used exclusively in the United States, and where laid direct on unpreserved wood, the slight motion of the rail wears and abrades the wood, causing local rot. Some preservative processes harden the wood, but the best prevention against this class of wear is found in the use of the metal base plates, and a permanent way built of heavy flange rails resting on base plates, and well secured to the sleepers by screws or other fastenings, is as strong and secure as that built with bull-head rails and chairs, as proved under the ponderous locomotives and cars and the fast and heavy traffic of the principal lines. In the original report of 1890 actual statistics were given, showing that no less than 25,000 miles of railway, or 13 per cent. of the railway mileage of the world at the end of 1889, were then laid with metal sleepers—including transverse sleepers, cast iron bowls and plates, and metal longitudinals. England had comparatively little, the aggregate being but seventy miles, of which Mr. Webb's steel sleepers of the London and North-Western Railway had fifty-six; the North-Eastern, five miles, and the Midland Railway five miles. This country had, however, a large business in the manufacture of rolled steel and cast iron sleepers for the Colonies and South America, and during the years 1874 to 1889 nearly 4,000,000 sleepers were sent out to the Indian State Railways. Of the Australian colonies only Queensland has used metal to any extent, as there is a large supply of hard and durable timber. In America metal has been very little used, but since the above report was issued, one road has laid 20,000 steel sleepers with 100-pound rails, and expects to obtain a decided saving in expenses for maintenance. This road has had about half a mile of steel sleepers in use for over four years, and they have given great satisfaction. The new report will probably show a decided increase in the mileage laid with metal sleepers, more especially in India and Germany, and on some of the new pioneer railways of Africa.

*Electric traction for canals.*—The authorities of the New York State canals have taken an important step in granting the Cataract General Electric Company a fifty-year permit to put in some kind of an electric plant along the lines of the State canals by which boats can be operated with electricity. The company shall not charge for use of such power by the canal boatmen at a rate exceeding 20 dols. per electrical horse-power for each season of navigation, but that is the maximum charge that can be made, and the rate will undoubtedly be much lower. Even at 20 dols. a horse-power it is claimed that an owner would be saved 50 per cent. a season on the operation of his boat in comparison with the present cost of canal boat propulsion. The operations of the company are not in any way to interfere with boats navigating the canal by steam or horse-power. The company made several experiments on the canals last autumn, as previously noted, and the matter will now be pushed forward to a successful solution of the problem. The electrical power will be obtained from the great water power plant at Niagara Falls, and transmitted by wires erected along the line of the Erie Canal. The permit authorises the company to enter upon all canal lands of the State for the purpose of constructing either on or over or under either canal bank a system for propelling canal boats by electricity, without interfering with the present method of operation. Central power houses may be erected. The rates for towage shall be subject to modification and review by the State Superintendent of Public Works, but such rate shall not exceed 20 dols. per electrical horse-power for any season of navigation. An important provision is that the company may, so long as the wants of the canal are supplied, employ its electric plant along the line of the canal in furnishing electric light, heat and power for distribution to any point or points beyond the line of the canal, and thus may furnish electricity for lighting and power purposes in all of the cities and villages along the canal. The company is to furnish the State, free of charge, sufficient power to operate motors, to open all gateways leading to and from locks, and also electric lights sufficient to properly illuminate such locks at night. The company must have its plant for operating boats by electricity in operation on the Erie Canal between Buffalo and Albany within three years from date, or else the privileges accorded by the permit shall be forfeited. In case the company shall construct along the canals an electrical plant for use, known as the trolley or overhead wire system, it shall be the privilege of the State to condemn and purchase such property at a price equal to the actual original cost to the original constructor, with the 10 per cent. added thereto. All work done by the company shall be subject to the approval of the Superintendent of Public Works. All damages growing out of the use of electricity on the canals shall be borne by the company, and the State shall in no way be put to any expense on account of the granting or operation of the permit. Another electric traction project is that of the Erie Electric Towing and Power Co., which will construct and put in operation as soon as possible half a dozen tug boats, operated by electricity, either on the storage or trolley system, with a view of showing the adaptability of electricity to canal navigation. These tugboats will also tow for a moderate consideration any horse boats, the captains of which desire to avail themselves of such method of navigation.

*Test of rapid-fire guns.*—An interesting test of rapid-fire guns was made recently at the Government Proving Grounds, at Sandy Hook, the guns being of five different makes, namely, (1) the Driggs-Schroeder; (2) the Hotchkiss; (3) the Sponsel; (4) the Maxim-Nordenfeldt; and (5) the Skoda. All of these were 6-pounders, with the exception of the Skoda gun, which was a 3-pounder. The trial showed that the Driggs-Schroeder gun was easier to handle than any of the others, and had the advantage of rapidity of fire. Previously the pieces had been fired to test the action of the mechanism, their accuracy at various ranges, the velocity of the projectile, and the time required to fire 100 rounds. The purpose of this test was to ascertain how many rounds could be fired from each gun in five seconds, and also in three minutes. After the three-minute round, the representative of each gun was required to fire one shot, remove the mechanism, change and replace it and fire another shot, the interval between the shots being the time recorded for the change. In the final test of the number of rounds fired in five seconds, the Driggs-Schroeder gun again distanced its competitors by thrice discharging three shots with a fourth round in the chamber on the last round. The other guns fell slightly behind this record. Many of the Driggs-Schroeder and Hotchkiss guns are already in use in the navy. In the tests the Driggs-Schroeder gun was served by three men; the other guns were each served by four men. The tests resulted as follows:—

*Driggs-Schroeder Gun.*

| | |
|---|---|
| Total number of rounds fired in three minutes .. .. .. | 83 |
| Number fired in the first minute .. .. .. .. .. .. | 34 |
| Time in changing mechanism .. .. .. .. | 2 min. 4⅜ sec. |

*Hotchkiss Gun.*

| | |
|---|---|
| Total number of rounds fired in three minutes.. .. .. | 83 |
| Number fired in the first minute .. .. .. .. .. .. | 28 |
| Time in changing mechanism .. .. .. .. | 1 min. 37⅞ sec. |

*Sponsel Gun.*

| | |
|---|---|
| Total number of rounds fired in three minutes .. .. .. | 73 |
| Number fired in the first minute .. .. .. .. .. .. | 24 |

Mechanism not changed because representative of gun was not present.

*Maxim-Nordenfeldt Gun.*

| | |
|---|---|
| Total number of rounds fired in three minutes .. .. .. | 65 |
| Number fired in the first minute .. .. .. .. .. .. | 20 |
| Time in changing mechanism .. .. .. .. | 3 min. 33⅜ sec. |

*Skoda Gun (for exhibition only).*

| | |
|---|---|
| Total number of rounds fired in three minutes .. .. .. | 55 |
| Number fired in first minute .. .. .. .. .. .. .. | 24 |
| Time in changing mechanism .. .. .. .. .. .. | 33⅜ sec. |

*Compound locomotive.*—The Golsdorf system of compound locomotives, as used on the Austrian State Railways, has been taken up by an American company. By using the Walschaerts valve gear, with which a cut-off of 90 per cent. can be obtained, the counter-effect of the steam on the high-pressure piston at starting can be neglected, and an intercepting valve dispensed with. Small steam ports, uncovered, with the valve at full travel as in starting, admit steam to the low-pressure cylinder if the high-pressure cylinder's steam port is closed by the valve.

## LAUNCHES AND TRIAL TRIPS.

ON Thursday afternoon, the 5th inst., Messrs. Craig, Taylor, and Co., launched from their Thornaby shipbuilding yard, Thornaby-on-Tees, a steel screw steamer of the following dimensions:—227ft. by 33ft. by 16ft. ½in. She is built to the highest class in Lloyd's, and is of the long raised quarter-deck type, with bridge and top-gallant forecastle, and is specially adapted for the coal trade. She will be fitted with triple-expansion engines of the following size, viz., 17½in., 29in., 47in., and 33in. stroke, by Mr. John Dickinson of Sunderland, and will also have three steam winches, steam steering gear, steam windlass, and all the latest improvements. She has double-bottom all fore-and-aft, on the cellular principle for water ballast, and is rigged as a two-masted schooner. She has been built to the order of Mr. John S. Barwick, of Sunderland, for whom Messrs. Craig, Taylor, and Co., have built a number of vessels.

On Tuesday, the 3rd inst., Messrs. Wigham, Richardson, and Co., launched from their Neptune Shipyard, Newcastle-on-Tyne, a finely modelled steel screw steamer, which they are building to the order of the Bulgarian Trading Steam Navigation Company, of Varna, Bulgaria. The steamer has a clipper bow, and will be rigged as a two-masted fore-and-aft schooner; she is 240ft. in length, and 33½ft. beam. She will also have very well-finished accommodation for first and second-class passengers. The engines and boilers are also being constructed by Messrs. Wigham, Richardson, and Co., and are expected to drive the vessel at a high speed. As the vessel left the ways she was named the Bulgaria by Miss Elsie Tweedy, daughter of Mr. John Tweedy, one of the members of the firm of Wigham, Richardson, and Co.

On Saturday, 7th inst., the s.s. Metal, built by Messrs. Cumming and Ellis, Inverkeilting, for Messrs. Wm. Jacks and Co., Glasgow and Grangemouth, ran her trial trip on the Firth of Forth. After several runs the vessel was found to be steaming at the rate of 11 knots, which exceeded the anticipations of the builders and owners. The vessel is designed to carry a deadweight of 820 tons, her dimensions being 180ft. by 27ft. 6in. by 13ft. 6in., and will immediately be put on the trade she was built for, viz., carrying pig iron between Middlesbrough and Grangemouth. All modern appliances for the rapid loading and discharging of cargo, as well as for working the vessel in dock and at sea, have been supplied by the builders. To enable the vessel to make good passages at sea without cargo, she carries water ballast in her fore and after holds and after peak, with an extra large donkey pump fitted so that the tanks may be emptied rapidly. The engines, which are triple-expansion, having cylinders 15in., 25in., and 40in., by 27in. stroke, are supplied with steam by a large multitubular boiler working at 160 lb. pressure; a large donkey boiler is also fitted for supplying steam to the winches. The machinery has been supplied by Messrs. Muir and Houston, Glasgow.

On Wednesday, 4th July, Messrs. Furness, Withy, and Co., launched from their shipbuilding works at Hartlepool a large steel screw steamer, built to the order of the Parks Steamship Company, of London. The vessel is a very substantial type of a modern cargo boat, measuring over 300ft. in length, and built throughout of Siemens-Martin steel, with a large measurement and deadweight capacity, and built to the highest class at Lloyd's. Every care has been taken in designing this ship to construct her as substantial as possible for the heavy deadweight trade. She is built on the web frame system, with cellular double bottom for water ballast, all fore-and-aft, and subdivided at intervals; the after peak being also available as a tank. To further ensure the safety of the vessel, the middle of the main and fore holds are divided by iron water-tight bulkheads, these bulkheads being efficiently stiffened by an iron longitudinal division. It is anticipated that by the extra amount of subdivision in water ballast tanks and holds, with the efficient way the pumping gear is arranged, the vessel will be practically unsinkable by collision or stranding. To get as much strength as possible, the greater portion of the shell plating is in 24ft. lengths, this plating being efficiently backed up by strong sectional framing, carrying the strength to the top of the vessel all fore-and-aft; the topside plating being extra thick to withstand the heavy Atlantic trade, also the bottom plating is thicker in way of all ballast tanks, to allow for the vessel lying aground whilst taking in cargo. To allow for corrosion, the whole of the weather decks, tank tops, floor plates, &c., are of extra thickness, there being practically no thin steel in the ship. She has extra large-sized hatchways, which will take the bulkiest description of cargo, and would be especially suitable for carrying machinery, large guns, torpedo boats, &c. A new design of bilge intercostal keelson is fitted in the holds—Sivewright's patent. By this new arrangement very much of the dunnage and damage to bag cargo is avoided, there being no pockets or receptacles for loose grain, coals, dirt, &c., consequently these keelsons can be more rapidly cleaned down when discharging cargo. The accommodation for the officers is on deck in a large deck-house at the fore part of engine-room, and that of the engineers under the after end of bridge; this ensures a good ventilation in hot climates, and in the heaviest weather all the officers are close to their work. The auxiliary machinery for working and discharging cargo is of the most efficient description—large winches to hatches, patent steam steering gear amidships, with hand-gear aft steam windlass, and the anchors being of the stockless pattern, they can be stowed into hawse pipes, and the whole operation of catting and lifting the anchors can be done by one man in a few minutes. The vessel will be rigged as a pole-masted schooner, and to make her available for bridge and canal work, the topmasts are telescopic. The engines and boilers have been constructed by the well-known firm of Messrs. T. Richardson and Sons, Hartlepool, and are of massive design, with every provision for economical working. The ship and engines have been constructed under the supervision of Captain J. R. James. On leaving the ways the vessel was named Windsor Park, by Mrs. Lloyd Owen, of London.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE quarterly meetings of the iron trade were held here to-day, Thursday, and in Wolverhampton yesterday. There was to-day a good attendance from, as usual, various parts of the kingdom, and a fair amount of business was transacted. The situation was declared to be improved by the more settled prospects of the coal trade, by reason of which iron and steel masters will probably be able to gauge their expenses for fuel for a couple of years ahead. Then another feature which inspired cheerfulness was the passing of the American Tariff Bill through the Senate. Prices just recently quoted were therefore maintained in all departments, though these compared with a quarter ago were generally found to be somewhat lower than at that time. Engineering sections of steel were freely inquired for, and a good deal was on offer, not only from local, but from Welsh and North of England firms. Generally speaking, steel sold well at £5 10s. to £5 12s. 6d., and £5 15s. for bridge and constructive engineering plates, £5 5s. for angles and girders, £6 10s. for boiler plates, £5 2s. 6d. to £5 5s. for plating bars, and £5 15s. for wire rods. Special makes were re-quoted at the prices given last week.

In the manufactured iron trade, marked bars were re-declared at £7 10s., and this being so, other descriptions of marked iron made by the "list" firms were also unaltered on the quarter, rivet iron of this description being £8 10s. to £9; boiler-plates £8 10s. up to £11 10s.; and hoops and angles £8. Indeed, marked iron has not been altered for a year and a-half; but during the same period unmarked iron has greatly declined. Thus common bars, which are now £5 5s. to £5 10s., and merchant bars, which are now £6 5s. to £6 10s., are both lower than eighteen months ago by 5s. A drop of 5s. or 7s. 6d. appears in hoops and gas tube strip during the same period, the former being this afternoon £6 5s. as selling rate, though the Association figure of £6 10s. is nominally maintained. Gas tube strip is £5 7s. 6d. to £5 10s. and £5 15s.

Black sheets for galvanising have also fallen during that time by from 7s. 6d. to 10s. They were quoted to-day £6 7s. 6d. to £6 10s. for doubles, and in some cases £6 5s., with lattens £7 2s. 6d. to £7 5s. Indeed, sheet values are at a very low ebb. Galvanised corrugated sheets are £9 15s. to £9 17s. 6d. f.o.b. Liverpool, with restricted Australian and South American demand. Some good sales were made in Midland pig iron at about 42s. to 42s. 6d. for Lincolns, 41s. to 42s. for Derbyshire, and 39s. to 40s. for Northampton. Staffordshire sorts were quoted 38s. 6d. to 40s. for cinder sorts, up to 95s. for all mine cold blast sorts. Taking the pig iron market as a whole, it was sustained by the coal position, though if the 10 per cent. miners' wages question comes into force this may slightly weaken the market. At present, however, vendors are firm.

A question of much interest to engineers engaged in constructive work has just been raised here in connection with the question of steel-making in Staffordshire. It is pointed out that at the present time buildings are being erected in Birmingham supplied with steel girders, beams, and other engineering steel sections, rolled at Middlesbrough, and imported into this district. The inquiry is raised whether this class of engineering work could not be turned out in this district, seeing especially that local-made girders would have an advantage in the matter of carriage of, say, 10s. or 15s. per ton. Alike solid-rolled and built-up girders are being imported from the North of England, and it is regarded that such manufactures might be equally well made here. For myself I see no sufficient reason why this suggestion should not be adopted, though of course it would mean great expense in the laying down of special machinery; and sufficient credit is not given to English firms for having begun to take this trade from the Belgian ironmasters, which, it will be remembered, was previously wholly in their hands.

Birmingham manufacturers are anticipating with lively satisfaction a visit—which it is this week rumoured is in contemplation—by the Czarovitch, whilst in this country, to Birmingham, Manchester, and some of the other industrial centres, with a view to making a private inspection of some of the leading manufactories. It is thought to be eminently desirable that the Czarovitch should obtain an impressive idea of the industrial energy and enterprise of our large manufacturing centres whilst in this country; hence the intended inspections.

The site of the new works which have been commenced in the Elan Valley, Mid-Wales, to supply Birmingham with water were visited this week by members of the City Council. At present the work is only in the earliest stages of excavation. The scheme has already been described in these columns. The party were conducted over the site by Mr. Mansergh, the engineer, and the spots were pointed out where it is intended to construct dams and reservoirs for providing Birmingham with 27 million gallons of water per day in the driest season and a similar large quantity of compensation water.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—The probability of some permanent settlement of the wages question in the coal trade is necessarily just now the matter which is most largely occupying attention, and there is little doubt that if some such arrangement as that which is embodied in the suggested terms of settlement agreed to by the coal-owners' and miners' representatives at the informal meeting held in London last Friday can be carried into effect, it would be an advantage not only to the coal trade, but also to the large coal-using industries. In some quarters there is a disposition to regard the proposed settlement as too much of a concession to the impracticable demands of the Miners' Federation, but I have reason to know that it is the outcome of much patient conciliatory effort on the part of Mr. T. R. Ellis, the secretary of the Coalowners' Federation, who has been met in a very reciprocal spirit by Mr. T. Ashton, the secretary of the Miners' Federation, both of these gentlemen being exceedingly anxious that some amicable and at the same time satisfactory arrangement should be come to which should prevent further disastrous struggles in the coal trade. Looked at superficially, the proposed terms with regard to the regulation of wages during the ensuing two years might seem to be a concession of the principle of a minimum wage; practically, however, it is simply an agreement to fix both a maximum and a minimum wage over a definite limited period, at the end of which the whole wages question is open for consideration or revision, a very different thing from the demand of the Miners' Federation for a permanently fixed minimum rate of wages, to which the Federated Coalowners and their representatives on the Conciliation Board are as strongly opposed as ever.

The prospect that some definite and binding agreement may be come to on the wages question in the coal trade by the meeting of the Conciliation Board next Thursday, coupled with a present reduction of 10 per cent., has necessarily had a tendency for the time being to check operations in the iron and coal markets, owing to anticipations of the possibility of some easier tone being given to prices, and that also it may bring about a settlement of the miners' strike in Scotland, as any further action on the part of the Miners' Federation with regard to this dispute will necessarily be largely governed by the agreement which may be come to by the Coal Trade Conciliation Board on Thursday.

There was not more than a moderate attendance on the Manchester Iron Exchange on Tuesday, and only a very slow business was reported generally, both merchants and consumers showing less eagerless to buy owing to the more settled outlook in the coal trade. In pig iron there is very little doing, and Lancashire makers remain practically out of the market. Nominally, they still quote on the basis of about 39s. 6d. to 40s. for forge, to 42s. for foundry, less 2½, at the works, but except under very special conditions, they are unable to book orders of any moment at these figures in competition with the much cheaper brands of Lincolnshire. Quotations for Lincolnshire iron remain at about 38s. 6d. for forge, to 39s. 6d. for foundry, net cash, delivered Manchester, but even these low figures are scarcely being realised in all cases. Derbyshire foundry brands are offered at about 44s. 6d., and 45s. up to 46s., according to quality, net cash, delivered Manchester, whilst neither in Lincolnshire nor Derbyshire is there anything of moment doing. Outside brands offering here are still quoted at late rates, but there is rather a weaker tone, and some irregularity in prices in the open market, with little or nothing doing to afford any real test of what sellers are disposed to take. Foundry brands of Middlesbrough nominally average about 43s. 10d. to 44s. 4d. net cash, delivered Manchester, with Scotch iron quoted about 44s. 6d. for Govan, and 46s. to 46s. 6d. for Eglinton, and 50s. to 50s. 6d. for Gartsherrie, net prompt cash, delivered at the Lancashire ports.

Finished iron makers here and there report that if anything there is rather more business stirring, but, taking trade all through, there is no real improvement, forges for the most part being still only partially employed, and prices are weak. Lancashire bars average £5 7s. 6d. to £5 10s.; Staffordshire, £5 10s. to £5 12s. 6d.; Lancashire sheets, £6 17s. 6d. to £7 2s. 6d.; and Staffordshire about £7 5s., with official list rates for Lancashire hoops remaining at £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

In the steel trade only a very limited business comes forward, with prices about as last quoted, ordinary foundry hematites averaging about 52s. 6d., less 2½; ordinary basic billets, £4 net cash, with steel boiler plates quoted at about £6 10s. per ton delivered in the Manchester district.

A very slow business characterises the metal market, with no further change in list rates for manufactured goods.

The position as regards the engineering industries remain very much as reported recently, new work coming forward very indifferently, and establishments only in exceptional cases more than very moderately off for orders. There are a few more inquiries just now stirring in the locomotive trade, but the improvement recently reported amongst boilermakers is scarcely being maintained, whilst it is only on special work that machine tool makers are at all busy, and stationary engine builders are not more than fairly off for work generally.

The reports received by the trades union organisations connected with the engineering industries are also generally to the effect that the condition of trade remains without any appreciable improvement. Stationary engine builders, in some cases, are slightly better off, but marine and shipbuilding centres continue in a very depressed condition; machinists in a great many cases are fairly off for work, but tool makers are only moderately employed. As regards employment, there is no specially noticeable improvement in this direction, and the position with regard to out-of-work members remains very much the same as it has been for the last two or three months.

A very quiet tone continues throughout the coal trade as regards the inland demand for all descriptions of fuel, and the probability that some arrangement may be come to for a reduction of 10 per cent. in wages is rather inducing buyers to hold back in the expectation that possibly this may have a weakening effect upon prices. Any reduction in miners' wages has, however, been already more than discounted by the very considerable fall in prices that has taken place since the commencement of the year, and at the various district meetings, and also at the council meeting of the Lancashire Coal Sales Association held during the week, it was decided that no change whatever should be made upon the present official list rates. For all descriptions of round coal the demand continues extremely poor, either as regards house-fire consumption or requirements for iron-making, steam and general manufacturing purposes, and except where collieries are being kept fairly busy on shipping orders, they are scarcely able to work four days wer week, with stocks accumulating even with this restricted output. Qroted prices, however, remain at about 11s. to 11s. 6d. for best Wigan Arley; 10s. to 10s. 6d. for Pemberton four-feet, and seconds Arley, 8s. to 8s. 6d. for common house-fire coals, and 7s. to 7s. 6d. for steam and forge coals, at the pit mouth. Engine classes of fuel are plentiful in the market, and for these prices are rather easier, common qualities of slack being readily obtainable at 4s. to 4s. 6d., medium sorts 5s. to 5s. 6d., with special descriptions of slack quoted at about 5s. 9d. up to 6s. 3d. per ton, at the pit mouth.

With regard to the proposed settlement of the wages question in the coal trade, on the basis set forth in the suggested terms agreed to by the coalowners and miners' representatives in London last week, there would seem to be a very strong division of opinion both amongst the miners and the coalowners as to the acceptance of these proposals. At a special meeting of the Lancashire and Cheshire coalowners, held in Manchester on Tuesday, very strong opinions were expressed on the part of many of the colliery representatives that there had been too much concession to the demand of the Miners' Federation, and although the preponderance of feeling in the meeting was in favour of accepting the suggested terms of settlement, no really definite decision was come to, and another meeting of the coalowners of the district will have to be held before the Lancashire representatives on the Conciliation Board can be empowered to actually accept the proposed settlement. Much the same feeling exists amongst the miners of the district, and at a special conference of the Lancashire and Cheshire Miners' Federation held in Manchester on Wednesday, there was also a strong division of opinion upon the question, and any actually definite decision upon the matter was left over until the miners at their various pit-head and district meetings have had an opportunity of expressing their opinions, when probably another conference will, if possible, be held to decide upon what definite instructions shall be given to their representatives on the Conciliation Board. Notwithstanding, however, this strong opposition in some quarters on the part of both the coalowners and the miners against the proposed compromise for a settlement of the wages question, there is not much doubt that eventually it will be accepted, and conversing with a well-informed trades union official, representing an important branch of industry, which, although outside, is very appreciably affected by any disruption which may take place in the coal trade, he expressed the opinion that the Miners' Federation officials had made a very good stroke of policy in obtaining the suggested terms of agreement, and that the miners would be very ill-advised if, looking only at the present 10 per cent. reduction in wages, they refused to endorse the very important other concessions which the official leaders had been able to obtain from the employers. Amongst the more responsible official representatives of the miners the opinion is expressed that although not a few of the men might make a show of opposing any reduction whatever in wages, the proposed terms of settlement will in all probability be agreed to.

*Barrow.*—The past week has been a very quiet period in the hematite pig iron trade. There has been no increase in business nor any improvement in the general tone of demand. Makers are indifferently employed, and it is shown that although only thirty-six furnaces are in blast, makers are producing more iron than they can sell at present. The trade doing at the moment is more of a consumptive than of a speculative character. Makers still quote 44s. 6d. to 45s. 6d. for parcels of mixed numbers of Bessemer iron net f.o.b., and warrant iron is quoted at 44s. net cash sellers and 43s. 11d. buyers. During the week stocks have increased 2086 tons, and now stand in warrant stores at 149,852 tons, or 54,959 tons more than was in stock at the beginning of the year.

Iron ore is weaker, at 8s. 6d. per ton net at mines for ordinary qualities. Smelters in the district are only using small parcels.

Steel makers are short of work in most departments. Rails are in quiet inquiry, and makers are not in any sense well sold forward. Prices are easier. The demand for plates is quiet, but makers are fairly well off for orders. Tin-plate bars are only a quiet trade. Orders are scarce for blooms, slabs, wire rods, and billets, while hoops are exceedingly quiet.

Shipbuilders and engineers are busy in practically all departments, and it is obvious that for some considerable time to come there will be marked activity. New work is not, however, coming to hand as briskly as is desirable; but compared with other districts, Barrow is very well off for orders. Very little prospect of new tonnage is afforded, but it is believed one or two large specifications in the market will be fixed at Barrow.

Coal and coke are quiet, and in small consumption at late rates.

The shipping trade shows a slight improvement. There has been an increase in both pig iron and steel. The exports of pig iron during the week have represented 8300 tons from West Coast ports, compared with 5165 tons in the corresponding week of last year, an increase of 3135 tons. The shipments of steel last week were 10,269 tons, compared with 8431 tons in the corresponding week of last year, an increase of 1838 tons. The shipments of pig iron to date this year have reached 203,421 tons, compared with 138,033 tons in the corresponding period of last year, an increase of 65,388 tons; while the shipments of steel to date have reached 204,988 tons, compared with 247,835 tons in the corresponding period of last year, a decrease of 42,847 tons. Shipping freights are scarce, and are at low and unremunerative prices.

There is still a large number of skilled and unskilled artisans out of work.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Scotch strike has so far had much less influence upon the South Yorkshire coalfield than was expected. It has, of course, caused the Northumberland and Durham coalowners to be very active, and their competition with the Yorkshire colliery proprietors has therefore considerably slackened. In that way the dispute has made values somewhat firmer, as well as prevented the falling off in the demand for household qualities, which would have happened in consequence of the present hot weather. The Yorkshire pits, in the thin seams, are working about three days a week. London is taking an average tonnage, and as North-country coal is not available in such large quantities, rather stronger quotations are ruling. London merchants, however, are able to oppose any substantial advance in prices. Silkstones make from 9s. 6d. to 11s. 6d. per ton; Barnsley House 8s. 6d. to 10s. per ton; other qualities from 8s. to 9s. 6d. per ton. Owing to a steady demand for export, as well as for supplies for railway furnaces, steam coal continues in brisk request, all the Humber ports receiving heavy weights, Barnsley Hards make from 7s. 9d. to 8s. 6d. per ton; other qualities from 7s. per ton. Gas coal averages from 7s. 6d. to 8s. 6d. per ton, with a consumption rather under the average. Manufacturing fuel but lightly ordered, owing to the depression in trade. Good slacks are from 4s. 6d. to 5s. 6d. per ton, smudge and small coal from 2s. per ton upwards. Little is doing in coke, quotations ruling from 9s. to 10s. 6d. per ton.

The Hull Chamber of Commerce, in its monthly return, shows that June has been a fairly good one for the Yorkshire collieries shipping at that port. The total weight for the month sent from 176 collieries has been 168,936 tons, as compared with 153,656 tons for June, 1893. For the six completed months the weight is 925,104, against 739,376. The South Yorkshire pits seem to have done exceptionally well. Eighteen of these collieries sent nearly 60 per cent. of the tonnage to Hull during the half-year, which is the largest amount for many years. Denaby Main again heads the list with 98,416 tons, followed by Carlton and Monk Bretton with 53,852 and 53,456 tons respectively. The exports to foreign countries were smaller than might have been expected during June, viz., 60,054 tons, as against 87,652 tons in June, 1893. For the six months, however, the exports reached a total of 297,500 tons, against 235,302 tons in the first half year of 1893. These figures show an increase of over 17 per cent. this year as against last year, and exhibit a recovery of 35 per cent. of the trade lost in the first half of last year, when the Hull Dockers' strike practically lost the larger portion of the business. The diminished exports are accounted for by a falling off in the demand from North Russia, which took only 15,788 tons last month, against 29,161 tons in June of 1893. Sweden and Norway took 23,337 tons, against 32,805 tons. Germany also shows a falling-off, while Holland and Denmark exhibit an increase.

The letting of gas contracts is going forward slowly. The colliery owners decided to demand an advance of 1s. per ton, but the decision of their organisation is considerably modified in the actual placing of orders. The contract for the Birmingham Corporation Gas Works has been settled at a very slight advance. The Leicester Corporation have taken an unusual, though acceptable course. Instead of putting the contract on the market in the ordinary way, they have offered the former contractors an advance of 6d. per ton. The offer has been accepted all round. Leicester last year was in the favourable position of obtaining gas coal at about the lowest prices which ruled that season.

In the heavy trades there is no change to report, and goods are only being ordered to meet immediate requirements. A fair quantity of tires, axles, springs, &c., are being produced for the Indian market. In crucible steel manufacturers report a good continental demand for best brands, but competition keeps down prices to the narrowest margin of profit. While the tendency of prices is thus downward, the tendency of wages is upward, and this makes it increasingly difficult for orders to be completed at a profit. The iron trade of the district is said to be benefiting slightly by the Scotch strike, the inability of Scotch ironmasters to take orders causing the inquiries to be made in this locality. Prices, however, have not yet been appreciably affected thereby. Any improvement in iron will necessarily operate favourably upon steel, and if the strike in the North continues local firms will undoubtedly profit. Quotations for hematites can scarcely be said to have changed for over a month. They remain at from 51s. to 52s. 6d., delivered in Sheffield. Common forge iron fetches 38s.; bar iron, £5 10s. to £5 15s.; common wire rods, £5 5s.; high carbon and rope rods, £8 8s.; ordinary iron sheets, £8 10s.; Bessemer billets—Sheffield made—are at £5 7s. 6d. to £5 10s. per ton delivered at the station; inquiries not up to the average.

The foreign trade in hardware and cutlery during June shows a considerable decrease, the value having been £148,428, against £176,574 during the corresponding month of last year. For the six months ending June 30th, the value was £900,852, against £1,043,711 for the first half of 1893. The increasing markets on the month are Russia, Holland, Belgium, France, and British Possessions in South Africa. The decreasing markets are Sweden and Norway, Germany, Spain and Canaries, United States, Foreign West Indies, Chili, Brazil, Argentine Republic, British Possessions in East Indies, Australasia, and British North America. In steel, unwrought, a slight improvement is reported for June, the value having been £165,473, against £164,508 for June of 1893; for the six months £891,527, against £853,312. Increases are shown by Russia, Sweden and Norway, Holland, France, British East Indies, and Australasia. The decreasing markets are Denmark, Germany, United States, and British North America.

The quarterly return of exports to the United States from the Sheffield Consular District grows increasingly serious. The total value for the three months ending June 30th reached only £73,315 16s. 10d., a falling off of £42,042, as compared with he corresponding quarter of 1893. There has scarcely been anything doing in cutlery, the total value sent during the three months being represented by £6518, against £27,780 in the three quarters of last year. This shows the enormous decrease of £21,262, or more than 75 per cent. The decline, of course, is entirely attributable to the uncertainty created by the proposed tariff changes. There is some hope of the new tariff coming into operation on the 1st of August. It will not be an unmixed blessing, for while several grades of cutlery may be reduced by 60 per cent. to 25 per cent., as compared with the McKinley Bill, in other qualities there will be a positive increase. The greatest relief will be in respect to the very cheap kind of pen and pocket knives which the Americans and Germans produce in the largest quantities. Our cutlery manufacturers state that stocks in America are now so low that as soon as the new Bill has passed there is certain to be a very brisk demand. On the other hand, the pressure which is expected has been considerably discounted by the different houses having been making for stock for some months. The exports of steel to the States last quarter amounted to £51,777 against £69,281 a year ago; thus showing a decline of £17,504. Under the Wilson Tariff the duty on steel will be reduced by several cents per pound. Files and hardwares generally will also be slightly relieved.

The Yorkshire miners have very readily paid the levy imposed upon them on behalf of the Scotch miners out on strike. The amount was 6d. per member, which realised a total for the county of £1250. This has been forwarded to the treasurer for the support of the Scotch miners. The Central Board of the Federation have resolved that the levy must be doubled, making the Yorkshire contribution £2500 per week. A circular has been issued by the officials of the Yorkshire Miners' Association, in which they urge that every member shall pay 1s. per week levy to help the Northern miners. They point out that if the Scotch miners are successful the English miners will be safe for a long time to come. "We know," add the Yorkshire officials, "this is a heavy burden, especially to those who are only working a few days per week, but it would be better to do this than to run the risk of something being taken off our wages. The Scotch leaders believe that if we can support them to the extent we have referred to that they will have victory on their side. We hope every member will pay his 1s. and every half-member his 6d. on Saturday in order to help the miners of Scotland to fight their battle."

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

NO real improvement in trade in this district has yet taken place as a result of the Scotch strike, though the production of pig iron in Scotland has become very small, seeing that only eighteen furnaces are left in operation. No doubt there is less competition for orders from the Continent, and producers in this district are getting a larger share than usual, but this is counterbalanced by the falling off in the demands of the Scotch mills and forges for Cleveland pig, added to which local demands have considerably declined by reason of the moulders' strike in the North-East Coast shipyards and engineering works. Thus, on the whole, Cleveland iron makers are not so well off as they were last month, and the prospects are not encouraging, for the end of these labour difficulties is not likely to be yet.

What is most affecting trade in this district is the strikes of moulders and patternmakers, which have already lasted sixteen weeks. The effects are far-reaching, for while the number of men on strike is comparatively small, their action is throwing out of employment thousands of other men, as shipbuilders and engineers cannot get on further without castings, and the strikers prevent them as much as possible from obtaining these from other districts. They have, therefore, no alternative but to close their yards, and thousands of people are being punished because of the conduct of a few. Thus in Hartlepool there are only some 130 men directly on strike, but their action has thrown 4000 others out of work. The principal shipyards and engineering works in the Tees and Hartlepool districts are closed, and on the Tyne and Wear they are following suit. In addition to the yards mentioned in my last report as having been stopped, Messrs. R. Irvine and Co., West Hartlepool, have closed. Messrs. W. T. Doxford and Co., Pallion, Messrs. J. L. Thompson and Sons, North Sands, Sunderland, Messrs. C. S. Swan and Hunter, Walker, and Mr. James Laing, Sunderland, have also given their men notice. Messrs. William Gray and Co., of West Hartlepool, say their shipyard work is "three months ahead" of the work at the engine works, and that when the latter are again started it will be at least ten weeks before their shipyards can fully re-open. The dispute is causing a great curtailment of operations at the iron and steel works, because shipbuilders have been compelled to ask plate and angle makers to suspend deliveries, and it is impossible under present circumstances to secure other orders to replace them. This in its turn affects the hematite pig iron trade specially, and to a smaller degree the Cleveland pig iron trade, and we have easier prices for the pig generally used at the finished iron and steel works. The moulders express their determination, notwithstanding the suffering that is being caused, to continue the strike; but the masters are equally determined, as the present state of trade and future prospects justify a reduction rather than an advance. There was never—even at the very first—any justification for such an advance as the men demanded, viz., 10 per cent. on piece and 3s. 6d. on time wages; or even for the modified demand of 5 per cent. and 2s., which was made some time afterwards. The men asserted that there was a revival of trade, as a number of orders for vessels had been given out. But the employers were not of the opinion that a revival had set in, although there was undoubtedly an increase of work in some shops; but there was a reduction in others, and prices certainly had not improved. This view of the situation has proved to be correct, and time has shown that many of the orders were purely speculative ones, which have since been cancelled, or are not to be executed at once. If there were no justification for an advance four months ago there is less now. The improvement was a mere "flash in the pan." Yet having made their demand the men will not recede from their position, and refuse the offer of the masters to endeavour to settle the matter by conciliation, resuming work in the meantime at the old rates of wages.

Pig iron is in rather quiet demand, except that for No. 3 Cleveland it is better than it was, and in the hands of the makers that quality is decidedly scarce, as it has recently been wanted largely for shipment. Some producers during the past week were unable to load all the vessels sent to their wharves, and others being altogether out of stock have had to refuse orders for immediate delivery. There is plenty of No. 3 in the district, though it is not in makers' hands — it is in the public warrant stores, but buyers do not care to draw it out, because that might lead to the stock with Connal's decreasing, and it would cause prices to advance. It is surprising to note that while so much difficulty is experienced in getting No. 3 from the makers generally, the stock in the public warrant stores should be increasing. More business could have been done during the last ten days in No. 3, if makers had had it. The pig iron shipments from the Tees last week were almost the largest on record. They reached 34,605 tons, an average of 5767 tons per day, and on one day upwards of 8300 tons were shipped, while more could have been sent if the iron had been available, and there were more vessels waiting cargoes, and could not get up to the wharves. The exports last week were double those of the first week in June last year, and most of the iron was sent to the Continent, a very considerable proportion being hematite, which was despatched to Russia and Italy. The footing gained last year in Russia by our hematite ironmakers when that country and Germany were having their tariff war has not been lost now that the war is over. Exports this week are not on such a large scale as last week, partly because the deliveries to Scotland have been further cut down because the Glasgow Fair holidays have commenced, and the foundries, which have been working in spite of the strike are idle. Pig iron exports this month have reached 40,080 tons, as compared with 27,685 tons last month, and 23,886 tons in July, 1893, all to 11th. The stock of Cleveland pig iron in Connal's stores on Wednesday night was 99,182 tons, or 1151 increase this month.

The price of No. 3 Cleveland pig iron is well maintained, and not less than 35s. 6d. per ton for prompt f.o.b. delivery will be accepted, while some brands that are specially in demand for export have been sold this week for 36s. Cleveland warrants do not fluctuate much, because scarcely anyone will buy them at present, and the closing figure on Wednesday was 35s. 5d., which was 2d. less than the opening price. For the commoner qualities of Cleveland pig, such as are used at the mills and forges, the demand is smaller, partly because of the diminution in the Scotch requirements, and partly because the moulders' strike is causing a lessened consumption at the local finished ironworks. The supply is larger, the demand smaller, and prices weaker. No. 4 Cleveland foundry is quoted 34s. 9d., and grey forge 34s. 3d., for early f.o.b. delivery, but less has been taken, in some cases, even 3d. less. East Coast hematite pig iron is also cheaper; Mixed numbers having been sold at 43s. 6d., and in a few cases at 44s. 3d., as producers are very anxious to get orders now the steel plate and angle works are not doing so well.

The average realised price of No. 3 Cleveland pig iron during the quarter ended June 30th is officially certified to have been 35s. 5·61d. per ton, an advance of 5·78d. on the figure for the previous quarter, and wages at the blast furnaces for the current quarter will be advanced ·75 per cent. — ¾ths of 1 per cent. The men have given the requisite notice for the termination of this sliding scale. The Cleveland blast furnacemen have voted by a very large majority—2600 against 121—to give a legal notice for a proposed twenty-four hours' stand, so that they may hold a demonstration at Middlesbrough, on August 6th, on the eight hours' question. If a stand takes place it will be actually for sixty hours.

Trade is very quiet in the finished iron and steel industries, and prospects are not encouraging. The Scotch shipbuilders are sending a few more orders for plates and angles, which they cannot now procure from native works, but there is a heavy falling off in the number of those received from the shipyards on the North-East Coast, and in many cases the execution of orders already booked is suspended until the yards reopen after the settlement of the moulders' strike. Steel ship plates can be bought at £4 17s. 6d.; steel boiler plates at £5 17s. 6d.; steel ship angles at £4 15s.; iron ship plates at £4 15s.; iron angles at £4 12s. 6d., and common iron bars at £4 17s. 6d., all less 2½ per cent. and f.o.t. Heavy steel rails are quoted £3 12s. 6d. net at works, but trade is very bad.

The Darlington Steel and Iron Company, which produces chiefly rails, reports a loss for the year ended April 30th of £3571 14s. 2d., and not only the ordinary, but also the preference, shareholders will get no dividend. In the previous year the profit was £5121, but no preference dividend was paid, as it had been paid the previous year out of reserve, when there was a loss of £1474. In

1891 a profit of £10,890 was made; in 1890, £3595; and in 1889, £7422.

Both Northumberland and Durham are sending considerable quantities of coal to Scotland, and the exports oversea are good, Sunderland shipping over 90,000 tons and Tyne Dock over 120,000 tons of fuel, both being considerably more than at the corresponding period last year. Last month from the north-eastern ports 1,552,040 tons of coal were shipped, or 147,345 tons more than in June, 1893. The moulders' strike is affecting the coal trade, local consumption being smaller. But Northumberland steam coal is 11s. per ton f.o.b., and small, 5s. It has been officially ascertained that the realised price of Northumberland coal during the three months ending May 31st was 6s. 4·72d. per ton, but there is no sliding scale now. However, a Conciliation Board has been formed, and Mr. John Strachan, barrister, London, has been chosen as Chairman of the Board, the first meeting of which will be held on the 24th inst. Messrs. Ernest Scott, Mountain and Co., Newcastle, have completed the electric pumping plant for Messrs. Straker and Love's Brancepeth Colliery, near Durham. In connection with the colliery to which the plant is to be applied, there is a scarcity of water for the working power of the pit, and the new pumps are to draw a supply from an adjoining body of water, and convey it to the colliery. The distance of the pumps from the generating dynamo will be about 700 yards. The pumping plant is capable of delivering 300 gallons of water per minute through two miles of 6in. pipe, against a head of 250ft. Owing to the friction in the pipes this equals a total head of 410ft. The installation consists of a set of three-throw ram pumps of Scott and Mountain's improved mining type, driven by an electric motor of 55-horse power effective. The dynamo is driven by a horizontal steam engine, developing 80-horse power.

The Scotswood Shipbuilding Yard, on the Tyne, was almost totally destroyed by fire on Saturday afternoon last, and it is believed the fire was started by an incendiary. The yard is situated close to the suspension bridge, and was the first place of the kind commenced on the Tyne above the Swing Bridge at Newcastle. It was originally in the hands of a Scotch company, but afterwards passed into the hands of the Scotswood Shipbuilding Company; practically a branch of a firm in Brazil, who carry on traffic on the great South American rivers, and who took the Scotswood Yard for the purpose of building their own boats.

Mr. C. P. Douglas, the chief of the engineering and designing staff at the Consett Iron and Steel Works, has resigned, and is retiring into private life.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been very quiet this week. Small quantities of Scotch warrants have changed hands at about former prices. For Cleveland iron scarcely any demand has been experienced, and there has been nothing doing in hematite. Indeed, the market is quite disorganised by the strike and by the annual trade holidays which are just beginning, and are likely to be of longer duration than usual.

The strike of the miners is regarded in commercial circles as altogether unjustifiable. From the coalmaster and ironmasters' point of view it is wanton in the extreme, the miners having been in receipt of good wages when they were brought out by the Federation. The object of the leaders of the miners is to compel a certain wage, altogether irrespective of the state of trade, and the unanimity with which ironworks and factories have been closed is evidence of the determination of consumers to resist attempts to raise the price of fuel artificially above what is justified by the condition of trade.

Since last report a number of additional furnaces have been put out of blast, including five at Gartsherrie, which is now quite black, the whole of the twelve furnaces there being silent. Messrs. Wm. Baird and Co. have at Gartsherrie and their other works twenty-eight furnaces in all, and only four of these remain in blast, two at Muirkirk and two at Lugar. There are now only eighteen furnaces blowing in Scotland, compared with forty-nine last week and seventy at this time last year.

Special brands of makers' iron are in a number of cases becoming scarce. The prices are advancing. G.M.B. f.o.b. at Glasgow No. 1 is quoted 43s. 6d. per ton; No. 3, 42s. 6d.; Monkland No. 1, 44s.; No. 3, 42s. 6d.; Carnbroe No. 1, 46s.; No. 3, 44s. 6d.; Clyde No. 1, 51s. 6d.; No. 3, 48s. 6d.; Summerlee No. 1, 52s. 6d.; No. 3, 48s. 6d.; Calder No. 1, 53s. 6d.; No. 3, 48s. 6d.; Gartsherrie No. 1, 53s. 6d.; No. 3, 49s.; Coltness No. 1, 55s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan No. 1, 52s.; No. 3, 48s. 6d.; Eglinton No. 1, 49s.; No. 3, 44s. 6d.; Dalmellington at Ayr No. 1, 47s. 6d.; No. 3, 45s.; Shotts at Leith No. 3, 51s.

The shipments of pig iron from Scottish ports in the past week were 5646 tons, compared with 6847 in the corresponding week of last year. There was despatched to Canada 300 tons, South America 5, India 196, Australia 150, France 25, Italy 45, Germany 732, Russia 400, Holland 375, Belgium 50, Spain and Portugal 10, other countries 115, the coastwise shipments being 3244, compared with 4197 in the same week of 1893.

The market for manufactured iron and steel is very flat, transactions being few and unimportant, and prices nominal. The iron and steel manufactured goods shipped from Glasgow embraced locomotives worth £3880, sewing machines £16,766, other machinery £15,634, steel goods £10,553, and miscellaneous iron goods £11,350.

There has been a sweeping reduction in the coal export trade. The clearances from the whole of the Scottish ports in the past week amount to only 24,849 tons, compared with 153,968 in the corresponding week. Only two weeks ago the shipments were 154,200 tons, so that the collapse has been very severe. Merchants are purchasing very little, and only to meet the most urgent requirements. The home consumption is also rapidly falling away; prices are irregular.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

SEVERAL more bodies have been brought up from the Albion Colliery, and the total loss up to date is 282. Several hundred men are busily employed in clearing away the falls, and in another week or two a resumption of work will take place.

Next week the inquest will be re-opened before the two coroners of both divisions, and a most exhaustive investigation is certain. It is not yet stated who will be sent down by the Home-office; in fact, all details are lacking, and only surmises are discussed as to cause. It was stated a few days ago that an unlocked lamp had been found among the rubbish. Up to the explosion, and to the last visit of the firemen, the condition of the colliery was certified as excellent, and thus it is one of the remarkable suggestions of the scientific world that a large cavity, holding a great quantity of gas, had been accidentally struck into, and this only needed the accidental or rash exposure of light to cause the disaster. Against these things the best skill and caution are useless. Old colliers say that there are constant movements going on in the earth, known as squeezings, and if these are not uniform, say above, cavities would be formed just above the roof, and beyond the action of ventilation, into which gas would exude and remain until broken into. The explosion has brought the subject of electric lighting of mines to the front, and no doubt the thorough adoption of the electric light will do much good.

The steam coal trade continues thoroughly active, and will in all probability continue so for some time. At the Exchange, Cardiff, a few days ago, the impression was strong that, so far, the Scotch strike had not affected the Welsh market, but that the buoyancy of the coal trade was due to the demands for the fleet, and to the withdrawal of the Albion coal from the market. This, I need scarcely say, was not the general view, and it would be a difficult if not an impossible task to substantiate it. In a few weeks again, should the normal sagacity of the Scotsman still remain under a cloud, a better opinion can be given. This is certain, that in all previous strikes in England, there has always been a beneficial reaction in Wales. Several cargoes of 4000 tons were cleared from Cardiff on Saturday last, and quite a numerous fleet with coal consignments ranging between two and three thousand tons.

As may be inferred, the export of coal at all ports continues above the average. Cardiff and Newport show large totals, and at Swansea last week the total was 37,699 tons. During the last six months the total export of coal from Swansea amounted to no less than 171,142 tons over the corresponding period of 1893. Best steam coal at Cardiff this week was in firm demand at 12s. to 12s. 6d., and even seconds were proportionately high. Quotations for best seconds were 11s. 6d.; inferior kinds, 10s. 6d. to 10s. 9d.; small, 6s. 6d. to 7s.

House coals have dropped a little since the beginning of the week. On Saturday quotations for best were 12s. to 12s. 6d., but mid-week best households could be bought at 11s. to 11s. 3d. No. 3 Rhondda remains at 10s. 9d. to 11s.; brush, 9s. to 9s. 3d.; small, 7s. to 7s. 3d.; No. 2, 9s. 6d. to 10s.; through, 7s. 6d.; small, 5s.

Prices of coke remain good, furnace selling at 15s. 6d. to 16s.; good foundry, 17s. 6d. to 18s.; and best foundry, 20s. to 20s. 6d. Pitwood is at 14s. 9d. All these quotations are Cardiff. Iron ore is selling at the following prices:—Porman, 10s. 9d. to 11s.; Tafna, 11s. to 11s. 3d.; Garncha, 11s.; best Rubio, 11s. 6d. to 11s. 9d. Patent fuel continues in good demand, Cardiff and Swansea.

The week has been unusually brisk with iron ore cargoes; the Dowlais Company received four, Cyfarthfa two of large tonnages, 2100 tons came in for Ebbw Vale, close upon 4000 tons for Blaenavon, and two large cargoes for Tapson and Sons. The inference on 'Change is that if no substantial rail orders are in prospect, it is probable that there will be increased vitality in the tin bar trade.

There was an average steel make at the principal works last week, and I was pleased to note, both on the Rhymney and Taff Vale Railway, at the close of last week a marked increase in the rail trucks, which formerly figured almost as briskly as coal wagons. But those were the days when consignments from Dowlais and Cyfarthfa to America and Russia were constant, and now in the matter of rails each is "self-supporting." There is some expectations of foreign orders for rails and sleepers. All iron and steel quotations are practically the same as last week at Cardiff.

It is now tolerably certain that a good spurt in the tin-plate trade is near at hand. The definite announcement that the reduced rates under the new tariff in America will come into force on the 1st of August has quickened expectation in the Swansea district, and this week, on 'Change, it was announced that six steamers for the States and two for Canada are now due, or will be in a few days.

Last month the total export of tin and black plate for the United States amounted to 12,602 tons, and for Russia 1687 tons. The improvement in the Russian trade is shown by the fact that in June, '93, the export was only 280 tons.

There has been no change in tin-plate prices since last week, but an improvement can be depended upon, and those who have secured forward delivery are fortunate. Most of the business is hand to mouth. Tin-plate shipments last week from Swansea amounted to 45,169 boxes only, receipts from works 58,812 boxes. Stocks now amount to 287,245 boxes.

From Harrington last week, Swansea received 419 tons tin-plates, and 440 tons pig iron, and from Ulverston 600 tons pig iron. I instance this to show the vigorous competition going on between England and South Wales.

On 'Change, Swansea, mid-week the following quotations ruled:—Glasgow pig, 42s.; Middlesbrough, 35s. 6d.; Middlesbrough hematite, 43s. 1½d.; Welsh bars, £5; sheet iron, £6 5s. to £6 10s. at works; steel the same, with extras for the higher gauges. Bessemer steel: tin plate bars, £4 to £4 2s. 6d.; Siemens, best, £4 2s. 6d. to £4 5s; second, £4 to £4 2s. 6d., all delivered in the district, less 2½. Tin plates: Bessemer steel cokes, 10s. 4½d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; best charcoal, 11s. 9d. to 12s. 9d., according to finish and brand. Wasters, 6d. to 1s. less than primes. Old sizes, usual extras. Ternes, 28 × 30, 20s. to 23s. All tin plates delivered in Prince of Wales' dock, Swansea, cash, less 3 and 1 per cent.

Other Swansea quotations this week are:—Anthracite coal, 8s. 9d. to 9s. 6d., according to quality; coke, 4s. 9d. to 5s.; steam coal, 10s. to 11s. 6d.; seconds, 9s. 6d. to 10s.; bunkers, according to quality, 7s. 6d. to 10s.; small, 5s. to 5s. 6d.; bituminous coal, No. 3 Rhondda, 11s. to 11s. 6d.; small, 7s. 6d. to 7s. 9d.; coke, furnace, 12s. to 12s. 6d.; foundry, 17s. 6d. to 18s.; patent fuel, 10s. to 10s. 9d.

Last week, Swansea despatched 700 tons patent fuel to France, 1160 to Spain, 1750 to Russia, 1100 to Italy, 1200 to Roumania, and 1400 to Algeria.

Mr. Preece, the chief of the electric telegraph department, G.P.O., London, gave an interesting address at the National Eisteddfod, Carnarvon, this week, on "The Industrial Condition of Wales," touching especially on the mineral development of the country, and corresponding improvement in docks and railways. As it will be republished, I only refer here to the successful way in which the subject was treated. In coal details there was a reference to the originator of the steam coal trade, Mrs. Lucy Thomas, with her level and barge, and the vast growth which has followed her output of a few tons daily.

Twelve million tons of coal now, according to the historians of the Welsh coal trade, are exported from Cardiff alone annually, and the army of coal workers totals close upon 90,000 men and boys.

I am glad to note that the Bute Docks Bill, one of the latest and greatest, by the efforts of Sir W. T. Lewis, is now an accomplished fact.

One gets an insight into the profits of collieries, and at the same time learns the cost of a strike by the published reports of large companies. I have the report of the Abercarne Coal Company before me for the year ended March 31st, 1894. This colliery, it will be remembered, was the scene of the greatest colliery accident that has ever happened in Wales—up to the date of the Albion, which has eclipsed it. The total output for last year was 490,944 tons, and the profit was £8813 10s. 9d. But the report states that the smallness of the profit was due to the strike—which occurred in August and September last—which kept the colliery idle for four weeks, and diminished the output for several months. The estimated cost of the strike was £5461 3s. 10d., which the directors have written off the reserve fund. The amount available for dividend was £9178 0s. 3d., and the directors recommend a dividend of 6 per cent. on the preference shares, and 3 per cent. on ordinary. Mr. J. Green, who has been the manager of the colliery since the commencement, has resigned—to the great regret of the directors, who have appointed Mr. Snape, of the Dowlais Collieries, in his place.

Details of a colliery strike has reached me from Caeran, Maesteg, where the regular workmen have been replaced by so-called blacklegs. A little while ago the men on strike cruelly assaulted the new comers, but the ringleaders were arrested, and on Monday, at Bridgend Petty Sessions, ten of them were committed for trial to the Quarter Sessions.

Another body has just been recovered from the Thorfa Colliery, the result of the great explosion which has now almost been forgotten in the disasters of Park Slip, Llanerch, and the Albion.

It is proposed to spend £7000 at Newport, Mon., building, &c., in connection with technical education. This busy port is exhibiting a good deal of vigour. The tender of Mr. J. Young, Glasgow, £94,596 2s. 4d., has been accepted in carrying out the new waterworks.

Cardiff population has increased 8000 since last year.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

TOLERABLY good accounts can be given of the general iron trade over here, though demand in some departments is not quite so brisk as during former weeks, and prices have in a few instances become easier.

Since last week there is no change to note with regard to the situation of iron business in Silesia. In pig iron a moderate demand is experienced generally, forge pig being in quiet request while in foundry pig only a poor business is being put through. There are decidedly more sellers than buyers, users of pig iron holding back from purchasing more than is absolutely necessary, in the expectation of still lower prices. The position of the finished iron makers is likewise not a favourable one, although they have a moderate weight of work to keep them going for some time ahead; but there is extremely little new business coming forward, and quotations are pointing downwards, so that the immediate outlook is anything but satisfactory. Plates are in very limited request, while sheets have been a trifle more animated this week than last. Steel manufacturers report themselves only insufficiently employed; rails especially are a poor business just now, the few orders that are being secured here and there leaving no profit. The Austro-Hungarian iron trade remains very much as last reported, makers booking a fair amount of new work at satisfactory quotations. Especially bars and plates and the different sorts of structural iron meet with a good demand, while rails are very quiet in tone, with little prospect for improvement in the near future. The hardware manufacturers report themselves well employed, the business done on local account being particularly lively at present.

A normal business continues to be done on the French iron market. Most sorts of pig iron are well called for, and the blast furnace works are quite actively engaged on home and foreign account. For all sorts of manufactured iron there is a fair demand experienced, and makers are hardening a little in their prices. In the steel trade a continued activity is reported, good employment being secured for many weeks to come; an order for 100 locomotives has recently been given out, while fresh contracts for locomotives are still announced. In Paris merchant bars still continue to be quoted 155f. p.t.; while girders can be had at 165f. p.t.

Belgian iron trade is still without improvement. There is very little new work offering; the few orders that are actually secured after a keen competition with German and English firms yield no profit. Forge pig, for instance, has been selling at 37·50f. p.t. The steel trade is reported to be very dull; indeed, some establishments are barely kept going for want of new work. With regard to the Rhenish-Westphalian iron market, affairs in the various districts remain very much as last reported.

Iron ore is in moderate request at unchanged quotations, spathose iron ore still fetching M. 7·40 to 7·90 p.t.; roasted do., M. 11 to 11·50 p.t., while inferior sorts range according to quality from M. 9 to 11·20 p.t. net at mines. For Luxemburg-Lorraine minette, 40 per cent. contents, M. 3·20 to 3·30 p.t. is given, inferior sorts not realising more than M. 2·40 to 2·70 p.t. at mines. For pig iron there have been very few inquiries at all stirring, and although generally quoted rates remain unchanged, sellers, in most cases, have to offer substantial concessions where an order of some importance is concerned. Until now production has kept pace with consumption, so that stocks do not show an increase upon previous months. In the Siegerland small orders for pig iron are pretty numerous, and quotations have been comparatively firm. Spiegeleisen, 10 to 12 per cent. grade, fetches M. 52 p.t.; Rhenish-Westphalian forge pig is in moderate call at M. 46 to 47 p.t. for No. 1, and M. 40 p.t. for No. 3. Siegerland, good forge quality, is to be bought at M. 44 to 45 p.t. Hematite fetches M. 63 p.t.; foundry, No. 1, M. 63; No. 3, M. 54 p.t. Basic is still sold at M. 45 p.t., while for German Bessemer M. 49 to 50 p.t. at works is given. Luxemburg forge pig costs 48f. p.t., free Luxemburg. Upon the week but few inquiries have been coming in for most sorts of manufactured iron. Prices show a want of firmness, which is likely to increase if buyers continue to hold back with their orders as they do now. Bars are in languid demand, home requirements being but small at this time of the year. On foreign account next to nothing has been done for many weeks past. Girders are, on the whole, in fairly good request. In the hoop trade a pretty firm tone has manifested itself lately, and there have been contracts booked up to end of the year. The demand for plates is regular, but prices remain unfavourable, in many instances scarcely covering the cost of production. Pretty much the same can be told of sheets. The wire trade continues extremely dull, with prices unchanged, and there is also not much business done in rivets. Foundries and wagon factories are fairly active on the whole, but there is very little gained at the present quotations. The following may be considered as latest list quotations per ton at works:—Good merchant bars, M. 110 to 110; angles, M. 120; girders, M. 90 to 95, free Burbach; hoops, M. 113 to 120; billets, in basic and Bessemer, M. 81; heavy plates for boiler-making purposes, M. 150; tank ditto, M. 130 to 140; steel plates, M. 125; tank ditto, M. 115 to 120; sheets, M. 140; Siegen thin sheets, M. 130; iron wire rods, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivet iron, M. 130; rivets, good merchant quality, M. 150 to 155; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

Herr Krupp, of Essen, has to pay the highest taxes in the district—Düsseldorf, Essen—having this year stated his income to amount to M. 7,190,000, against M. 6,000,000 in the year previous.

Output of coal in the mining districts of Dortmund was in 1893: 38,615,640 t., against 36,847,146 t. in 1892, and 37,398,561 t. in 1891, which shows production in 1893 to have been higher by 1,768,464 t., or 4·80 per cent. than in the year before. The number of men employed was at the end of 1893 150,386, against 144,328 at the same period in 1892, showing an incease of 6058. In 1893 32,464,250 t. coal and coke were sent by rail from the Rhein and Ruhr district, against 30,678,260 t. in 1892, and 23,203,110 t. in 1891, export in 1893 showing an increase of 1,785,990 t. against that of the year before. From Duisburg Harbour 1,116,997 t. were shipped in 1893, against 1,161,610 t. in 1892, and 1,046,513 t. in 1891; shipments from Ruhrort Harbour were 3,114,100 t. in 1893, 3,040-576 t. in 1892, and 2,779,532 t. in 1891; total shipments being 4,231,101 t. for 1893, 4,202,186 t. for 1892, and 3,826,045 t. for 1891. Of the coals shipped from Duisburg, 225,157 t. went to Holland, against 188,080 t. in 1892; to Belgium, 44,518 t. were exported, against 19,223 t. in 1892; while 847,323 t. were shipped from Duisburg to the Upper Rhine. From Ruhrort 1,232,105 t. were shipped to Holland, against 1,286,209 t. in 1892; to Belgium, 202,830 t., against 245,832 t. in 1892; and to the Upper Rhine 2,796,166 t., against 1,508,535 t. in 1892.

## AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 5th, 1894.

THE business world on this side of the Atlantic sees prospects for an early and general improvement in trade and manufacturing as a result of the end of the tariff agitation. The despondency of the past six or twelve months is beginning to wear off. Stocks of all manufactured products have practically disappeared. Wages have declined 15 to 20 per cent., as compared to two years ago. Further reductions will be announced as soon as the Tariff Bill is signed, if its figures demand. Those who are behind the scenes know there are a few serious obstacles still in the way to its passage. A very large amount of capital is ready for investment in many channels of industrial and commercial activity, but a start will not be made just yet. Railroad managers have roads and bridges to build, equipments to buy. Prices are low and attractive, but a conservative policy will be adhered to. Steel billets are 19·50 dols.; steel rails, 24 dols.; forge iron, 11 dols.; No. 1 foundry, 12 dols.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*27th June*, 1894.

12,427. Devices for Fastening Gloves, G. Enderby, Leicester.
12,428. Machines for Riveting Boots, E. W. Ward, Leicester.
12,429. Water Gauges, C. Billington, sen , and J. Newton, Staffordshire.
12,430. Carbon Printing, W. T. Watson and J. W. Woodifield, Hull.
12,431. Hot Air Mineral Inhaler, T. S. Atkinson, Dublin.
12,432. A New Medicinal Compound, P. R. Reid, Dublin.
12,433. A Trousers Suspender, B. Marwood, London.
12,434. Driving Gear of Cycles, P. McDowall, Glasgow.
12,435. Seats of Vehicles, J. T. Clark and W. Georgeson, Glasgow.
12,436. Cutting Cheese, W. Hayes and S. Wilson, Birmingham.
12,437. Pneumatic Tires, A. M. Hart and A. Smith, Manchester.
12,438. Bands for Curtains, J. Jackson and W. Alexander, London.
12,439. Slide Valves of Steam Engines, J. Illingworth, Halifax.
12,440. Mechanical Feeders for Openers, H. A. Corrigan, Manchester.
12,441. Ladies' Collarettes, S. Robinson, Snaresbrook.
12,442. Stop-motions for Looms, J. Vickerman, Stroud.
12,443. Looms, Mails, and Heralds.—(*Chaize Frères, France.*)
12,444. Displaying Articles, R. R. Beard, Birmingham.
12,445. Hair Curlers, D. Hone, Birmingham.
12,446. Pneumatic Tires, T. Pickin, Manchester.
12,447. Driving Gear for Cycles, G. L. Scott, Manchester.
12,448. Winches, J. Hastie, Glasgow.
12,449. Vegetable Squeezer or Press, W. R. Hall, Stafford.
12,450. Boots and Shoes, W. and J. H. Stafford, Manchester.
12,451. A Lever Spanner, I. Carruthers, Hove.
12,452. Oil Lamps and Glasses, C. F. A. H. Bagot, London.
12,453. Dress and other Guards, H. S. Phillips, London.
12 454. Weaving Pile Fabrics, J. and J. Muir, Glasgow.
12,455 Railway Vehicle Coupling, C. H W. Relyea, J. R. Sutton, and B. Wilbur, London.
12,456. Hoist for Kitchen Utensils, O. J. Baldwin and J. H. Sandstrom, London.
12,457. Spring Socket for Doors, B. W. Heymanson, London.
12,458. Packing Ring for Pistons, W. Lockwood, London.
12,459. Manufacture of Buckles, T. and W. Evans, Birmingham.
12,460. Cycle Saddles, J. E. Noirit, Birmingham.
12,461. Straw Bruising Apparatus, F. H. Livens, Lincoln.
12,462. Horse Rakes, G. E. Rowf, London.
12,463. Steam Engine Govenors, F. W. Wheadon, London.
12,464. Non-exhaustive Power, T. Cooper, Wa'sall.
12,465. A Bust Ring, S. B. Price, Birmingham.
12,466. Coal-dust Furnaces, P. Stiens, London.
12,467. Coke-ovens, A. J. Boult.—(*Franz J. Collin, Germany.*)
12,468. Braces, Bitstocks, W. P. Thompson.—(*Albert Brehm, Germany.*)
12,469. Incandescent Burners, C. Hatry, Liverpool.
12,470. Crates, Boxes, &c., O. Smith, London.
12,471. Reversing Gear for Engines, R. Thornewill and A. Davies, Liverpool.
12,472. Purses, &c , W. P. Thompson.—(*Carl Bauer, Germany.*)
12,473. Hose-coupling for Brakes, A. Wegmann, Liverpool.
12,474 Brakes and Foot-rests for Cycles, J. R. Stoney, London.
12,475. Ejecting the Water of Condensation from Steam Pipes, J. Murrie, Glasgow.
12,476. Electrical Switching Apparatus, J. S. Raworth, London.
12,477. Head Rests for Chairs, W. H. and C. J. Ash.—(*Alexander McGowan Denham, Chili.*)
12,478. Safety Pins, W. Briggs, London.
12,479. Machinery for Seamless Steel Tubes, R. Wootton and F. H. Griffiths, Birmingham.
12,480. Ribbon, G. C. Franklin, Birmingham.
12,481. Heat Indicating Apparatus, F. W. Golby.—(*F. H. and J. G. Hams, Germany.*)
12,482. Folders, F. Lione, London.
12,483. Electric Batteries, C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell, London.
12,484. Steels for Wearing Apparel, Theiler and Schneeli, London.
12,485. Programme for Advertising, C. Jack, London.
12,486. Elastic Fabrics, D. Young.—(*A. Straus, United States.*)
12,487. Petroleum Apparatus, R. P. G. Cornilleau and J. B. F. Guedon, London.
12,488. Tea Packets, S. Topley, London.
12,489. Fluids to Destroy Germs, R. J. White and W. Habgood, London.
12,490. Fish-hook Case, N. C. Lindsay and H. Stanbridge, London.
12,491. Cartridge, N. C. Lindsay and H. Stanbridge, London.
12,492. Electric Lamps, W. U. Hilliar, London.
12,493. Horseshoe Pads, P. A. Newton.—(*P. H. M. B. de la B. C. P. de Beaumont, France.*)
12,494. Punching Machine, F. and F. Squire, jun. London.
12,495. Sketching-box, H. H. Young, London.
12,496. Engine Governors, A. S. F. Robinson, London.
12,497. Purifiers for Wheat, J. Beal, London.
12,498. Shelves for Book Cases, H. Schulz, E. Strubel, and F. Idler, London.
12,499. Bolt Cutters, W. H. Beck.—(*W. L. Dutcher and P. D. Randall, United States.*)
12,500. Brick Presses, A. Rousseau, London.
12,501. Cigarette-making Machines, A. L. Munson, London.
12,502. Applying Oil to the Surface of the Sea, J. Behrmann, London.
12,503. Production of Effervescent Beverages, R. Wichmann, London.
12,504. Production of Haemo-gloain, A. Hommel, London.
12,505. Arc Lamps, J. J. Rathbone and A. Chester, London.
12,506. Cooling and Heating Apparatus, H. Marx, London.
12,507. Bicycle and Vehicle Gearing, W. T. Sudworth, London.
12,508. Plug Checks for Boilers, H. H. Lake.—(*J. H. Crosby, United States.*)
12,509. Vessel Propelling Apparatus, H. C. Vogt, London.
12,510. Electricity Supplying Apparatus, E. Chabeault, London.
12,511. Driving Gear of Cycles, E. G. Sheward, London.

*28th June*, 1894.

12,512. String Holding Stump for Hops, R. Fuller, Hawkhurst.
12,513. Steam Traps, W. Jeffery, Bradford.
12,514. Appliance for Picking Fruit, &c., T. Douglas, Glasgow.
12,515. Rowlocks, A Walker, Glasgow.
12,516. Printing and Perforating Machines, D. Carlaw, Glasgow.
12,517. Photographic Dark Shutter, A. A. Overend, London.
13,518. Rim for Fixing Pneumatic Tire, W. L'Estrange, Manchester.
12,519. Fishing Reels, E. West, Nottingham.
12,520. Engine Piston, J. A. Ewins, Birmingham.
12,521. Sliding Lid Cylinder, T. Johnson, Dudley.
12,522. Self-closing Cycle Mudguard, G. Pearsall, Smethwick.
12,523. Glass Advertising Tablets, W. A. Leadbetter and J. W. Blackham, Birmingham.
12,524. Sheet Suspender, H. Lane and F. W. Witcomb, St. Leonards-on-Sea.
12,525. Attaching Door Knobs to Spindles, C. J. Whitehall, Nottingham.
12,526. Fluid-pressure Brakes, J. G. A. Kitchen, Manchester.
12,527. Boxes, T. Kay, Glasgow.
12 528. Pans, W. W. Percival, Bradford.
12,529. Corkscrew, W. R. Maud, Pontefract.
12,530. Double Hoops for Railway Springs, J. Duce, Sheffield.
12,531. Means for Locking Bicycles, J. Everard, Birmingham.
12,532. Bicycles, J. Hargreaves, Manchester.
12,533. Coal Tipping Wagons, S. Thomas, J. L. Powell, and C. T. Batchelor, Penarth.
12,534. Coal Tipping Wagons, S. Thomas, J. L. Powell, and C. T. Batchelor, Penarth.
12,535. Splinter Bars for Vehicles, R. W. Crichton, Stewartstown, Co. Tyrone.
12,536. Adding Machine, G. Mahlstadt and C. F. G. Kopech, Woking.
12,537. Prime Movers, J. Joyce and S. H. Berry, London.
12,538. Office-return Indicator, J. Woolf, London.
12,539. Shirt-starching Machinery, H. T. Tallack.—(*A. M. Dolph, United States.*)
12,540. Cycle Mudguard, T. McEleny, Glasgow.
12,541. Measuring Alternating Currents, F. H. Nalder, C. W. S. Crawley, and A. Soames, London.
12,542 Tongs or Irons for Curling Hair, A. Morton, London.
12,543. Window Sash Fastenings for Opening In, J. Urie, Pollokshaws.
12,544. Postal, &c., Cards, H. Rowe and J. Clayton, Leeds.
12,545. Shoulder Straps and Appendages, G. H. Smith, London.
12,546. Dust-proof Watch, W. Harris, London.
12,547. Pneumatic Suspension Seat, W. M. Higgs, London.
12,548. Nut Lock, N. Barnes, London.
12,549. Cables for Telephonic Purposes, M. Immisch, London.
12,550. Shooting Gallery, F. H. Urry, J. Price, and G. Haydon, London.
12,551. Spraying Apparatus, A. J. Boult.—(*E. Hochheim, Germany.*)
12,552. Protecting Electric Cables, G. H. Nisbett, Liverpool.
12,553. Automatically-releasing Chains, W. A. Thornton, London.
12,554. Working Annular Kilns, W. P. Thompson.—(*F. Schofer, Germany.*)
12,555. Ratchet Braces, F. A. Willmott, C. W. Cobon, and J. Driscoll, London.
12 556. Cycles, E. J. Newell and J. Hodson, London.
12,557. Luminous Electric Skipping Rope, G. Trouvé, London.
12,558. Stand for Bicycles, T. F. and S. E. Spencer, London.
12,559. Disinfecting Drain Ventilator, L. D. Milnes, Norwich.
12,560. Device for Holding Lengths of Cane, G. Horide, London.
12,561. Boat Seat, W. Jardine and W. A. Jardine, London.
12,562. Spinning Tops, H. Browne, London.
12,563. Developing Tank, W. Rigg and P. Raymonds, London.
12,564. Advertising, J. W. Hurst, London.
12,565. Buckle for Traces, W. Silver and S. Sinauer, London.
12,566. Dust-proof Electrical Switch, A. E. Williamson, London.
12,567. Bungs, T. C. Barraclough and T. T. Heaton, London.
12 568. Attachment for Umbrella Ends, J. Smith, London.
12,569. Railway Rolling Stoch Wheels, F. Smith, London.
12 570. Boot or Shoe Holding Device, E. Leger, London.
12,571. Puzzle Game, J. Ritchie, London.
12,572. Optical Lanterns, H. C. Newton, London.
12,573. Manufacture of Cartridges, D. M. Hawes, London.
12,574. Inkstand, A. Hradil, London.
12,575. Tunnel Constructing Appliances, P. Kraus, London.
12,576. Convertible Box, R. R. von Gryra-Morawski, London.
12,577. Manufacture of Compressed Tea Tablets, The Military Equipment Stores and "Tortoise" Tents Company and A. S. Tomkins, London.
12,578. Attaching Cushions to Mats, A. J. Strachan and C. B. Brown, London.
12,579. Rolling Mill Rolls, O. Klatte, London.
12,580. Manufacture of Metal Articles, O. Klatte, London.
12,581. Rolling Mill Rolls, O. Klatte, London.
12,582. Process for Producing Rolled Bars, O. Klatte, London.
12,583. Construction of Links for Chains, O. Klatte, London.
12,584. Starting Vehicles, P. D. Völker and H. Stammel, London.
12,585. Retaining Heat in Foods, S. M. B. von Szczawinski, London.
12,586. Shields for Resisting Shot, S. W. Yockney, London.
12,587. Tongue Rails of Switches, R. Price-Williams, London.
12,588. Hackling Machines, G. Lowry, London.
12,589. Holding Flax in Hackling Machines, G. Lowry, London.
12,590. Manufacture of Golf Balls, W. Hillman, London.
12,591. Brakes, W. Hillman and C. W. Wheeler, London.
12,592. Bookcases, G. H. Griffiths, London.
12,593. Ships' Winches, M. Colquitt, London.
12,594. Curtains, C. J. Curran, London.
12,595. White Lead, W. B. Priest, London.
12,596. Manufacture of Paper Tubes, A. J. Boult.—(*L. Grote, Germany.*)
12,597. Powders for Beverages, L. and H. G. Roberts, London.
12,598. Book-post Envelope, B. E. Straker, London.
12,599. Quick-firing Guns, G. F. Redfern.—(*E. Ternström, France.*)
12,600. Production of Selvedge on Piece-dyed Cloths, H. Baines, London.
12,601. Roundabouts, H. H. Lake.—(*The Firm of Christiansen and Meyer, Germany.*)
12,602. Casting of Metal Articles, H. H. Lake.—(*Van Riet*,———.)
12,603. Velocipedes, H. Vallée, London.
12,604. A Puzzle, N. Staniland, London.
12,605. Long Distance Telephones, W. A. Nikolajczuk, London.

*29th June*, 1894.

12,606. Producing Gas Oxide, W. E. Kenway.—(*B. C. Kenway, United States.*)
12,607. Floating Docks, L. E. Clark, Westminster.
12,608. Machinery for Type-setting, G. W. Hart, Nottingham.
12,609. Flooring Clamp, J. Hulton, Lancashire.
12 610. Operating Switch Point, H. Williams, Renfrewshire.
12,611. Looms, J. Entwistle and A. Earnshaw, Lancashire.
12,612. Toe-clip for Velocipede Pedals, H. Lucas, Birmingham.
12,613. Kilns for Burning Bricks, &c., H. T. Sully, Bristol.
12,614. Water-closets, A. Dyson, Huddersfield.
12,615. Recording Appliances, J. Shakespeare, Dudley.
12,616. Mangling Machines, H. C. Longsdon and F. Wilkinson, Keighley.
12,617. A New Boot System, The Countess C. Hugo, London.
12,618. Stands for Gongs, C. J. Adie and G. Evans, Birmingham.
12,619. Pneumatic Tires, I. Frankenburg and J. Tinto, Manchester.
12,620. Electric Arc Lamps, J. T. Niblett and M. Sutherland, London.
12,621. Colouring Matters, A. Ashworth and J. Bürger, Lancashire.
12,622. Bottle Washer and Rinser, F. O'Rorke, Dublin.
12,623. Mudguard for Bicycles, J. Anderson, Co. Down.
12,624. Picture Nails, S. Reeves, Birmingham.
12,625. Attaching Elastic Webbing to Trousers, H. Penn, Birmingham.
12,626. Winding Frames, J. Clayton and J. Stephenson, Burnley.
12,627. Safety Switch Signal Apparatus, H. McL. Abernethy and J. M. Graham, London.
12,628. Horticultural Buildings, T. Smithson, Bristol.
12,629. Gear of Winding Engines, J. G. Barclay, Glasgow.
12,630. Valves for Pneumatic Tires, J. Andrew, Glasgow.
12,631. Pneumatic Tires, J. Andrew, Glasgow.
12,632. Boots and Shoes, J. H. Sunderland, Glasgow.
12,633. Machinery for Cleaning Coal, W. Paton, sen., Glasgow.
12,634. Nitrates of Soda of Potash, &c , F. Hamer, Rugby.
12,635. Pickers for Looms, J. Muir and A. Muir, Glasgow.
12,636. Ventilators and Chimney Cans, A. Marshall, Glasgow.
12,637. Ore Roasters, J. E. L. Barnes.—(*A. G. Davis, United States.*)
12,638. Wheel Rims, W. Firth, Glasgow.
12,639. Stop Valve for Liquids, E Slack, Sheffield.
12,640. Watch Glass Substitute, H. Johnson and Co., Manchester.
12,641. Quote or Reversed Apostrophe, G. Terry, Stamford.
12,642. Tents, T. Moore, London.
12,643. Filtering, &c , Apparatus, N. G. Kimberley, London.
12,644. Attaching Caps to Wheels, J. Buffham and W. R. Harrison, London.
12,645. Attaching Springs of Vehicles to Axle Beds, W. R. Harrison and J. R. Porter, London.
12,646. Fish-hook Cases, S. Allcock and A. Stratton, Birmingham.
12,647. Securing Blinds to Rollers, W. Cook, Birmingham.
12,648. Stuffing-boxes, D. Spencer, U. M. Councill, and N. E. Woods, London.
12,649. Detonators, D. Hickie and G. F. Beutner, London.
12,650. Battery Plates, B. M. Drake and J. M. Gorham, Westminster.
12,651. Hinges or Supports for Gates, &c., A. Paillet, London.
12 652. Churns, &c , for Carrying Milk, T. H. Case, London.
12,653. Indicators, &c , for Lamps, G. H. Randall, London.
12,654. Advertising, A. C. Wright, London.
12,655. Conjuring Apparatus, W. P. M. Black, London.
12,656. Tube or Pipe Expander, A. Plenderleith, London.
12,657. Detachable Cup Handle, J. H. Weekes, London.
12,658. Manufacture of Neckties, F. J. Brown, London.
12,659. Thirst and Intoxication Indicator, G. Benevent, London.
12,660. Cycle Saddle Cantle-plates, A. Round, Birmingham.
12 661. Flexible Metallic Tubing, W. H. K. Bowley, London.
12,662. Projectiles for Rifles, &c., W. H. K. Bowley, London.
12,663. Purification of Gas, E. Hermite, C. F. Cooper, and E. J. Paterson, London.
12,664. Watch Dials, C. K. Colby, Wolverhampton.
12,665. Fastening Hats and Bonnets, E. Harvey, London.
12,666. Portable Colour-boxes, &c., T. H. J. Pryce, London.
12,667. Fireproof Building Construction, W. Clark, London.
12,668. Apparatus for Cutting Cloth, W. H. Maker, London.
12,669. Wash-basins, H. H. Lake.—(*W. Scott, United States.*)
12,670. Bath-tubs, H. H. Lake.—(*W. Scott, United States.*)
12,671. Scissors, E. Nowill, London.
12,672. Garter Clips, W. Rowbotham and M. Dickson, Manchester.
12,673. Folding and other Desks, J. E. H. Kunze, London.
12,674. Decreasing Draught of Vessels, W. and N. Pirrie, London.
12,675. Sulphuric Acids, A. Staub, London.
12,676. Holding and Displaying Eggs, J. J. Cousins, London.

*30th June*, 1894.

12,677. Sconce, H. Johnson, London.
12,678. Pickers for Looms, J. H. Webb, Ashton-under-Lyne.
12,679. Railway Signals, I. A. Timmis and G. N. Abernethy, London.
12,680. Non-slipping Pneumatic Tire, W. H. Hindle, Blackburn.
12,681. Air Pump Combined in Cycle Tube, J. Booth, Manchester.
12 682. Bicycle and other Tires, W. Gillespie, Nottingham.
12,683. Liquid Seal Gas and Air Valve, A. L. Rock, London.
12,684 Regenerative Gas Furnaces, A. L. Rock, London.
12,685. Camera Focussing Apparatus, E. M. M Smith, Spalding.
12,686. Cycle Tires, J. W. and J. W. Hancock, jun., Nottingham.
12,687. Labels, A. C. Vice, Nottingham.
12,688. Moulding Plastic Substances, H. Tempest, Keighley.
12,689. Driving Spinning Machines, J. Hargreavss, Keighley.
12,690. Preserving Articles of Food, H. Wilson, Preston.
12,691. Securing Locks of Safety Lamps, D. Evans, Merthyr Tydfil.
12,692. Golf Ball Holder, J. Davidson, Midlothian, N.B.
12,693. Gear for Driving Cycles, W. D. Cameron, Newry.
12,694. Steel and other Vermin Traps, W. Choat, jun., London.
12,695. Transposing Written Music, R. D. Barclay, Edinburgh.
12,696. Covers for Sanitary Vessels, W. T. Seymour, Stockton-on-Tees.
12,697. Rams for any Class of Ship, A. J. Budge, Sunderland.
12,698. Appliance for Use in Pork Pies, G. Wilkinson, Leicester.
12,699. Removing Sludge from Tanks, J. T. F. Bishop, Manchester.
12,700. Loom and Shuttle Guards, J. Grayson, Manchester.
12,701. Hammer and Screw-driver, J. A. Holt, Oldham.
12,702. Tobacco Pipes, R. H. Laing, Glasgow.
12,703. Raising and Forcing Liquids, J. Gilmour, Glasgow.
12,704. Indicating the Weight of Pulp, A. Johnston, Glasgow.
12,705. Address Tablet, A. Littlehales and H. Courtney, Birmingham.
12,706. Draught Preventer, A. and I. Buckley, Manchester.
12,707. Electric Lamp Holders, &c., J. B. Verity, Birmingham.
12,708. Utilising Bye-products, G. Dalton and T. B. Provis, Leeds.
12,709. Ferrules for Sticks and Umbrellas, E. Garlick, Sheffield.
12,710. Ingot Moulds, C. Oxley, Sheffield.
12,711. Organs, C. F. Brindley, Sheffield.
12,712. Transmitting Power, P. L. Renouf and F. Westwood, Birmingham.
12,713. Velocipedes, P. L. Renouf and F. Westwood, Birmingham.
12,714. Linen Fronts and Shirts, G. J. Gissing, London.
12,715. Water Gauges for Steam Boilers, G. Elliott, London.
12,716. Matches, E. G. Nott, Liverpool.
12,717. Tin Openers, T. Wignall and S. H. Thomason, Liverpool.
12,718. Time-checking Apparatus, J. T. Gent, A. W. Staveley, and I. H. Parsons, London.
12,719. Dovetailing Machines, J. Anderson, Newcastle-on-Tyne.
12,720. Curtain-rod Brackets, P. E. Ayton, Birmingham.
12,721. Terminals of Picture-rods, P. E. Ayton, Birmingham.
12,722. Bleaching Calico, Cloth, &c., C. H. Smith, Blackburn.
12,723. Economising Fuel in Grates, G. Shackleton, Bradford.
12,724. Water-closets, W. Bairstow, Bradford.
12,725. Balance Tricycle, E. F. Bellows, Leicester.
12,726. Sewing Machine Attachments, L. H. Smith, Glasgow.
12,727. Baby Chairs, W. McAuslan, Glasgow.
12,728. Wire Fencing, R. R. Main and R. Ramage, Glasgow.
12,729. Paper-making Machines, J. Craig and W Taylor, Manchester.
12,730. Power Transmitting Mechanism, A. E. and H. Robinson, Manchester.
12,731. Hat Attachment, W. A. Thornton, Leeds.
12,732. Billiard Table Cushions, W. H. B. Moorhead, Newry.
12,733. Boat Fall Detaching Gear, F. A. Rodewald, London.
12,734. Means for Propelling Boats, E. F. West, Birmingham.
12,735. Forcing Composition into Pipes, F. J. and A. R. Norman, Widnes.
12,736. Developing Photographic Plates, G. A. Barrett and D. M. Jones, London.
12,737. Cap Spinning, &c., Machinery, J. Pairstow, London.
12,738. Sliding and Swivelling Windows, W. Flitcroft, London.
12,739. Cottage Fire Ranges, J. Heywood, Manchester.
12,740. Billiard Table Cushions, J. E. Hopkinson, London.
12,741. Covers for Rubber Tires, J. E. Hopkinson, London.
12,742. Colouring Matters, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
12,743. Hay-rakes, C. E. C. Townsend and T. Nunan, London.
12,744 Yachts, W. S. Winans, London.
12 745. Nails, A. Erdmann, London.
12,746. Receptacle for Cards and Scraps, P. Baumann, London.
12,747. Excluding Dust, R. C. Gardner.—(*M. Brown, Cape Colony.*)
12,748. Mounting Electric Lamps, W. Newbigging, London.
12,749. Belt or Rope Pulleys, &c., R. Combret, London.
12 750. Stand for Displaying Cards, H. C. Hall, London.
12,751. Hose Couplings for Railway Cars, C. Plettner and O. Lehmann, London.
12,752. Ball-bearings, N. de Gessler, London.
12,753. Flooring, &c , Cramps, J. and J. Hampton, London.
12,754. Lathes, J. Hampton, London.
12,755. Velocipedes, C. Chenet, London.
12,756. Tires, J. Morris, A. Clarke, and S. Andrews, London.
12,757. Scarves, W. Tremlett, London.
12,758. Ejecting Ashes from Ships, F. J. Trewent, London.
12,759. Feeding Bottle for Infants, E. K. Grenfell, London.
12,760. Varying Speed Motion, W. March, London.

*2nd July*, 1894.

12,761. Combustible Material, W. P. Thompson —(*E. Scott, United States.*)
12,762. Coloured Cloths, M. Kalisch, W. A. Rosenberg, and J. Entwisle, Manchester.
12,763. Safes, E. G. Wood and Milner's Safe Company, Ld., Liverpool.
12,764. Game Apparatus, T. Wignall and S. H. Thomason, Liverpool.
12,765. Photographic Exposure Meter, D. and W. S. Provand, Glasgow.
12,766. Carrying Cartridges, C. E. Stirling, Portsmouth.
12,767. Electric Incandescent Lamps, W. H. Willatt, Hull.
12,768. Barrel End, C. H. Matthews and E. Humphreys, Newtown.
12,769. Working Knitting Machines, T., J., and J. W. Kiddier, Nottingham.
12,770. Railway Signalling Apparatus, J. Atack, Blackburn.
12,771. Show Case, R S. and H. J. Vick, Bristol.
12,772. Washing Printers' Blanketing, W. Hadfield, J. J. Sumner, and H. Hadfield, Manchester.
12,773. Screw Propellers, J. W. Boyd, Glasgow.
12,774. Lock Furniture, W. Davies, Birmingham.
12,775. Game or Puzzle, C. W. and P. S. Faulkner, London.
12,776. Gas for Heating Purposes, T. Nicholson, Colwyn Bay.
12,777. Means for Advertising Purposes, J. Wilday Birmingham.
12,778. Churns, R. Wallwork, Manchester.
12,779. Ingredients for Feeding Horses, G. Thwaites, Stockton-on-Tees.
12,780. Locking Device for Cycles, E. Evans, Birmingham.
12,781. Vehicle for Distributing Liquid, D. McIntyre, Glasgow.
12,782. Soaps, W. M. Walters, Liverpool.
12,783. Tips for Furniture, A. U. Rinman, Manchester.
12,784. Separating Oil from Steam, J. G. Kincaid and W. Crockatt, Glasgow.
12,785. Spiral Cutters, H. Smith and J. Dickson, Sheffield.
12,786. Substitute for the Waistcoat, J. R. Churchill, Sheffield.

12,787. Rack for Window Curtain Rods, A. Sanderson, Sheffield.
12,788. Displaying Advertisements, A. R. Upward, London.
12,789. Method of Decorating Glass, J. T. Newell, London.
12,790. Boots and Shoes for Golf Purposes, G. Grant, London.
12,791. Driving Mechanism for Bicycles, R. W. Smith, Birmingham.
12,792. Shoes for Horses, J. Benfield, Birmingham.
12,793. Shoes for Horses, J. Benfield, Birmingham.
12,794. Shoes for Horses, J. Benfield, Birmingham.
12,795. Metal Plate for Furnaces, C. C. Mallett, London.
12,796. Cinchona Preparations, F. W. Fletcher, Middlesex.
12,797. Fixing Wheels to Axles, H. and C. E. Cowtar, London.
12,798. Tea Infusers for Cups, &c., H. W. Turner, London.
12,799. Automatic Cycle Supports, R. B. Chambers, Philadelphia.
12,800. Car Replacers, C. W. Archer, Philadelphia.
12,801. Motors, C. W. Johnston, Philadelphia.
12,802. Releasing Ships' Life Boats, J. Jennings, London.
12,803. Plastic Pipe-making Machinery, A. Noel, London.
12,804. Vermin Traps, J. Cable, London.
12,805. Dust Bin, J. Parsons, London.
12,806. Holding Flowers, A. L. Jones, London.
12,807. Safes, L. Mannstaedt, Barmen, Germany.
12,808. Augur, J. Swan, London.
12,809. Danger Switches for Signals, G. E. Edwards, London.
12,810. Nut Locks, F. Easom and D. W. Bassett, London.
12,811. Artificial Sandstone, J. Pfeiffer, London.
12,812. Tires, J. G. A. Kitchen, London.
12,813. Lemon Squeezer, R. D. Crockford, London.
12,814. Couplings for Railway Vehicles, J. W. Parker, London.
12,815. Furnaces, G. R. Steward, London.
12,816. Marine Engine Telegraphs, B. G. Hjärne, London.
12,817. Incandescent Lamps, A. Zobel and F. Buchmüller, London.
12,818. Manufacture of Glove Leather, L. Cohn, London.
12,819. Propelling Locomotive Torpedoes, H. H. Doty, London.

*3rd July*, 1894.

12,820. Mixing Explosive Gases, A. H. Tyler and J. S. E. de Vesian, London.
12,821. Manufacture of Paper Wires, G. Tankard, Leeds.
12,822. Automatic Advertising Device, S. Bunting, Birmingham.
12,823. Manufacture of Ladder Tapes, T. French, Manchester.
12,824. Constructing Cycle Wheel Hubs, J. W. Bayliss, Coventry.
12,825. Coat Fastener, H. S. Gent, Birmingham.
12,826. Knitting Machines, R. Wallwork, Manchester.
12,827. Mudguards, J. Mullineux, London.
12,828. Thimble, M. Tibbitts, London.
12,829. Removing Cotton Fibre, W. Lord and F. Woodhead, Manchester.
12,830. Wheel for Cycles and Vehicles, J. Buchanan, London.
12,831. Cases for Cotton Silk, T. Morton, Birmingham.
12,832. Coupling for Rods, H. Stone and F. D. Tippetts, Birmingham.
12,833. Perambulator, &c., G. Moore, jun, Birmingham.
12,834. Brick-making Machines, T. C. Fawcett, Halifax.
12,835. Corsets, F. Manks, Halifax.
12,836. Extracting Fat from Wool, C. N. Wilson, Bradford.
12,837. Fixing Sash Windows, H. A. Holmes, Harrogate.
12,838. Slate and Tile Fastener, W. Lynch, Sheffield.
12,839. Administering Medicine to Infants, J. McCullagh, Dublin.
12,840. Cooling Water in Engines, S. H. Terry, London.
12,841. Projecting Flanges, H. T. Clarke and R. Brown, Sunderland.
12,842. Lubricators, D. D. Brown, Glasgow.
12,843. Hay Turners, M. T. Hill, Birmingham.
12,844. Frame for Containing Type Cases, W. Smith, Glasgow.
12,845. Textile Fabrics, T., J., and J. W Kiddier, Nottingham.
12,846. Tube Fastenings for Boilers, J. Haythorn, Glasgow.
12,847. Measuring Apparatus for Liquids, R. Pickwell, Cardiff.
12,848. Window Sashes, &c, T. and J. C. Jones, Aberavon.
12,849. Rope Haulage, T. Heppell, J. Wright, and A. P. Stoker, Barnsley.
13,850. Building Water-tight Tunnels, J. E. Humphris, Oxon.
12,851. Steam Hammers, Carron Company and A. Robertson, Glasgow.
12,852. Wool-carding Machines, F. A. Graul, Glasgow.
12,853. A New and Original Board Game, K. Le Lean, Plymouth.
12,854. Ticket Holder, E. Bornheim and E. Stabenow, Glasgow.
12,855. Kiln for Baking China, J. Sherwin, Manchester.
12,856. Producing Printing Surfaces, A. T. Winkel, London.
12,857. Machine Guns, J. M. and M. S. Browning, London.
12,858. Pulleys of Lifts, Otis Elevator Company, Ld.—(*Otis Brothers and Co., United States*.)
12,859. Paper-making Machinery, E. E. Rawson, London.
12,860. Pipes, H. Brooks, London.
12,861. Fishing Apparatus, E. Poppowitsch and H. Wüstenfield, London.
12,862. Ankle-supporting Boots, J. M. Horn and M. Mayer, London.
12,863. Rotary Action for Machinery, F. E. Hollyer, Brentford.
12,864. Medical Syringes, A. J. Boult.—(*J. Rosenberg, Germany*.)
12,865. Clamping the Ends of Ropes, W. P. Thompson.—(*J. Allenson and A. Adams, United States*.)
12,866. Stocking Dyeing Apparatus, M. Cockcroft, London.
12 867. Telephone Cabinets, T. Weighill and G. Moore, Liverpool.
12,868. Pins for Hats, H. Martin and J. S. Miller, London.
12 869. Furnaces, W. P. Thompson.—(*F. Jimenez-Ulibarri, Spain*.)
12,870. Electric Switches, C. Hamilton, Glasgow.
12,871. Tobacco Pipes, C. Wellin, London.
12,872. Rust Preventive Compositions, F. Evers, London.
12,873. Confection Preparing Machine, J. Ritchie, Glasgow.
12,874. Lock Gates, A. D. F. de Villepigue, London.
12,875. Alternating Current Meter, J. F. Kelly and W. Stanley, London.
12,876. Crimping Machines, H. H. Lake.—(*E. P. Holden, United States*.)
12,877. Controlling Machinery, H. H. Lake.—(*J. D. Williamson, jun., United States*.)
12,878. Woven Fabrics, &c., W. G. Connell and J. H. Lorimer, London.
12 879. Renewing Old Steel Rails, E. W. McKenna, London.
12,880. Cooling or Condensing Fluids, G. Barnard, London.
12,881. Obtaining Ammonia Salts, H. H. Lake.—(*L. Sternberg, United States*.)
12,882. Roundabouts, J. Armitage, A. Herschell, and G. C. Herschell, London.
12,883. Metal Cans, H. H. Lake.—(*E. and O. W. Norton, United States*.)
12,884. Metal Cans, H. H. Lake.—(*E. and O. W. Norton, United States*.)
12 885. Soldering Metal Cans, H. H. Lake.—(*E. and O W. Norton, United States*.)
12,886. Testing Metal Cans, H. H. Lake.—(*E. and O. W. Norton, United States*.)
12,887. Pipe-stem Clearers, J. S. Beeman, London.
12,888. Smokeless Combustion, J. C. Fell.—(*M. M. Armstrong, United States*.)
12,889. Raising Sunken Vessels, &c., A. S. Harrison, London.
12,890. Signalling, W. K. Partington and A. W. Brown, London.
12,891. Fastening for Driving Belts, T. F. Edwards, London.
12,892. Pneumatic Impact Tools, J. F. Clement, London.
12,893. Destroying Garbage, H. E. Newton.—(*The Pinhoe Patent Refuse Destructor Company, Australia*.)
12,894. Channelling Machines, P. A. Newton.—(*The Ingersoll-Sergeant Drill Company, United States*.)
12,895. Liquid Dispensing Apparatus, W. M. Fowler, London.
12,896. Wrapping Newspapers, H. E. Newton.—(*R. Hoe, United States*.)
12,897. Wirework for Cages and Traps, A. M. Morin, London.
12,898. Shirt Cuff Tablet for Notes, &c., T. Coad, London.
12,899. Device for Securing Buttons, J. Tidmarsh, London.
12,900. Apparatus for Obtaining Power, C. Hume, London.
12,901. Stop Motions, C. R. Makepeace and W. Haines, London.
12,902. Cooking Stoves, &c., W. W. and J. England, London.
12,903. Purifying Air, &c., Count H. von Pückler, London.
12 904. Vapour Burning Apparatus, S. Holmes, London.
12,905. Roofing Tiles, C. W. Knox, London.
12,906. Umbrellas, A. H. White, London.
12,907. Pin Fastenings for Ladies' Hats, S. E. Mercer, London.
12,908. Bobbin and Attachment, G. M. Armitage, London.
12,909. Tinder Box, L. Korchikov and M. Machschefcs, London.
12,910. Coin-freed Apparatus, &c., G. Hirschfeld, London.
12,911. Glue-making Machinery, P. C. Hewitt, London.
12,912. Gauge Glass Sight Indicator, R. H. Goldie, London.
12 913. Cycle Rest, F. L. Chambers, E. I. Watson and H. R. Everitt, London.
12,914. Colouring Leather, R. Haddan.—(*A. Avellis, Germany*.)
12,915. Ventilating Railway Tunnels, E. Weidlich, London.
12,916. Separation of Minerals, &c., W. Scott, London.
12,917. Reversing Gear for Motors, A. J. Boult.—(*K. Lausmann, Russia*.)
12,918. Cleat, C. N. Curtis, London.
12,919. Boring and Tunnelling Earth, J. S. Williams, London.

*4th July*, 1894.

12,920. Knives for Cutting Boot Soles, G. T. Phillips, Northampton.
12 921. Carrying Prints in Penholders, J. Otway, Waterford.
12,922. Mechanical Toys, J. W. May and W. Taylor, Gainsborough.
12,923. Tent and Marquee Fastener, A. B. Wilkinson, Ashton-under-Lyne.
12,924. Blind Roller Furniture, W. T. Robertshaw, Manchester.
12,925. Steam Generators, J. Blake, Manchester.
12,926. Feeders for Scutchers, E. Tilston, Manchester.
12 927. Safety Valves for Ranges, &c., J. Kitchen, Derby.
12,928. Commutator Brushes, &c., J. A. Edmondson, Leeds.
12,929. Crushing Ores, D. Embleton and G. Glossop, Leeds.
12,930. Windows, S., J., and J. D. Fletcher, Glasgow.
12,931. Shelves for Shop Windows, J. Macfarlane, Glasgow.
12,932. Indicating Positions of Trains, C. J. Francis, Glasgow.
12,933. Protector for Umbrella Covers, L. Turnick, Stockport.
12,934. Miners' Picks, W. Seedhouse, R. Norbury, and C. E. Trickett, Sheffield.
12,935. Carding Engines, J G. Bamforth and W. H. Bamforth, jun., Huddersfield.
12,936. Packing Fluid-tight Joints, G. E. Adams, London.
12,937. Looms, B. Kay, Halifax.
12,938. Looms, J. H. Bryant, Stonehouse.
12 939. Clips or Bosses for Cycle Saddles, R. Mason, Birmingham.
12,940. Hat-boxes, H. and A. H. Stevenson, Manchester.
12 941. Velocipedes, P. L. Renouf and F. Westwood, Birmingham.
12,942. Luggage Carriers for Cycles, W. L. J. Orton, Leicester.
12,943. Keys, W. W. Hare, London.
12,944. Copper Hot-water Cylinders, J. Radford, Bradford.
12,945. Measuring Apparatus, M. Lydon, North Shields.
12,946. Arc Lamps, S. Sealy-Allin and W. H. Wood, London.
12,947. Attaching Door Knobs, J. J. Sumner, Birmingham.
12,948. Cycle Saddles J. B. Brooks, Birmingham.
12,949. School Drawing Compasses, A. A. Woodward, Birmingham.

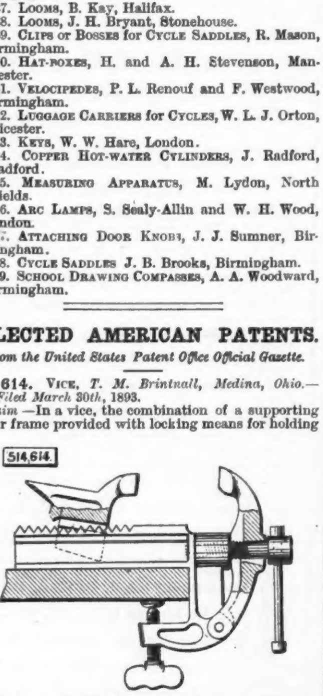
## SELECTED AMERICAN PATENTS.

***From the United States Patent Office Official Gazette.***

**514 614.** Vice, *T. M. Brintnall, Medina, Ohio.—Filed March 30th*, 1893.

*Claim.*—In a vice, the combination of a supporting bar or frame provided with locking means for holding the rear jaw of the vice and having longitudinal flanges or shoulders, a rear jaw having grooves which engage the flanges of the frame and adapted to be slid longitudinally on said frame, a front jaw pivoted at its lower end to the frame, and an adjusting screw which passes through the front jaw and enters the head of the frame for adjusting the upper end of said jaw, substantially as described.

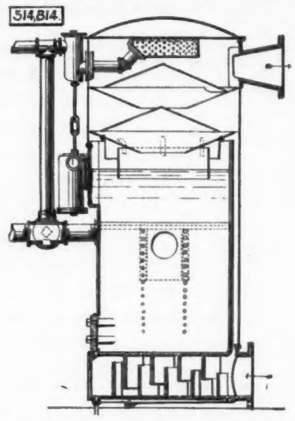
514,614.



**514,814.** Feed-water Heater and Purifier, *J. G. Cooper, Cincinnati, Ohio.—Filed March 30th*, 1893.

*Claim.*—(1) In a feed-water heater and purifier, the combination of a cylindrical base section having a steam inlet, a settling chamber of less diameter than said base section and supported thereon, means for supplying water to the settling chamber, an outer shell or jacket surrounding the settling chamber or inner shell and forming an annular unobstructed heating chamber or space that communicates with the cylindrical base section below and with the settling chamber above, and alternating plates located in the base section and constituting an oil extractor, whereby steam admitted to the base section will traverse a horizontally tortuous course over the plates of the oil extractor and ascend in whirling currents through the heating chamber and enter the top of the settling chamber, substantially as described. (2) In a feed-water heater and purifier, the combination of an inner open top shell enclosing a settling chamber and a filtering chamber which communicate at or near the top, an outer shell or jacket forming a heating chamber around the inner shell and extended above the same, a water inlet pipe leading into the upper part of said outer shell, a valve casing communicating with said pipe and enclosing a valve to automatically control the supply of water, a trapped overflow chamber communicating with the upper part of the settling chamber and enclosing a float chamber, a float placed in said chamber and attached to the rod or stem of the water supply valve, a pipe leading from the filtering chamber and provided with a three-way valve, and a pipe connecting said three-way valve with the water supply pipe, substantially as described.

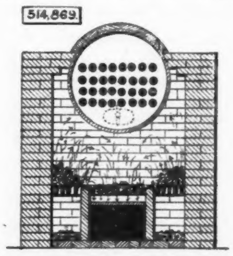
514,814.



**514,869.** Smokeless Boiler, *W. S. Plummer, St. Louis, Mo.—Filed August 9th*, 1893.

*Claim.*—A smoke-consuming furnace having a single down-draught grate, and up draught grates located on opposite sides of said down-draught grate, substantially as herein specified.

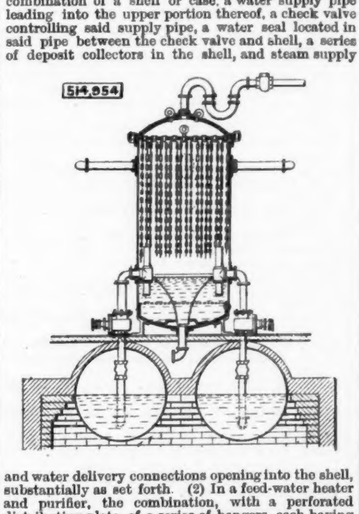
514,869.



**514,954.** Feed-water Heater and Purifier, *R. G. McAuley, Pittsburg, Pa.—Filed June 3rd*, 1893.

*Claim.*—(1) In a feed-water heater and purifier, the combination of a shell or case, a water supply pipe leading into the upper portion thereof, a check valve controlling said supply pipe, a water seal located in said pipe between the check valve and shell, a series of deposit collectors in the shell, and steam supply and water delivery connections opening into the shell, substantially as set forth. (2) In a feed-water heater and purifier, the combination, with a perforated distributing plate, of a series of hangers, each having a centrally perforated hub or boss and a series of peripheral hooks or arms, and connecting bolts passing through the central openings of the hangers and through the distributing plate, substantially as set forth.

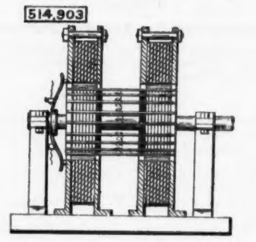
514,954.



**514,903.** Alternating Current Electric Motor, *C. S. Bradley, Avon, N.Y.—Filed September 27th*, 1892.

*Claim.*—(1) An alternating current motor having one element wound to develope progressively-shifting magnetic poles, and the other element provided with a closed secondary circuit inductively related to the shifting poles, means for developing opposing electro-motive forces in the secondary circuit and a common path of relatively high resistance forming a multiple arc circuit for currents due to the opposed electro-motive forces. An alternating current motor having one element wound to develope progressively-shifting poles and the other element provided with a closed secondary circuit of low resistance inductively related to the shifting poles, and means for developing when desired opposing electro-motive forces in the secondary circuit, said circuit being provided with a high resistance shunt forming a multiple arc circuit for currents due to the opposed electro-motive forces.

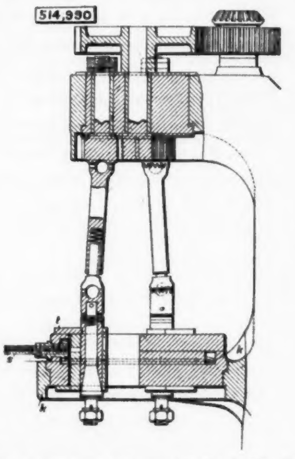
514,903.



**514,990.** Metal Drilling Machine, *W. Habersang and F. Zinzen, Dusseldorf, Germany.—Filed December 11th*, 1891.

*Claim.*—The combination of jointed boring shafts having ball-bearings, with tool holders secured to the shafts, sliding bearings engaging the tool holders, a disc engaging the sliding bearings and with cog-wheels *t*, gear-wheel *k*, and screws *s* operated by the wheels *t* and *k*, substantially as specified.

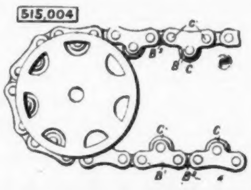
514,990.



**515,004.** Drive-chain, *L. W. Loomis, Carrollton, Ill.—Filed May 19th*, 1893.

*Claim.*—The herein-described drive-chain, consisting of the links B′ each having side pieces or cheeks *c c*, pivot studs *c′* connecting said cheeks at each end of the same and intermediate the said ends, anti-friction rollers C mounted on the intermediate studs *c′* and projecting beyond one of the lateral edges of the said links B′, and links $B^2$ connecting the links B′ and pivotally mounted at their ends upon the adjacent pivot studs of adjoining links B′, said links lying between the cheeks *c*, of the said links B′, all arranged as and for the purpose specified.

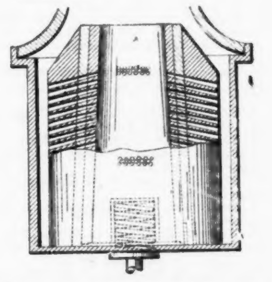
515,004.



**515,053.** Centrifugal Creamer, *F. O. Nilsson, Stockholm, Sweden.—Filed September 28th*, 1891.

*Claim.*—(1) In a centrifugal separator, the combination of a rotary drum, a hollow cylinder therein with a space between it and the drum, said cylinder having inclined openings extending through its walls, substantially as described. (2) A centrifugal separator comprising the rotary drum and the cylinder made up of a series of conical sections having perforations therein, adapted to register, substantially as described.

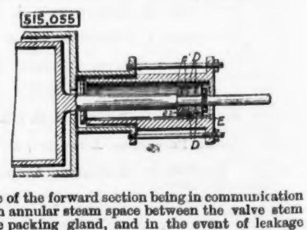
515,053.



**515,055.** Valve Stem Packing, *J. Olson, Two Harbours, Minn.—Filed August 11th*, 1893.

*Claim.*—A spider E carrying packing rings D formed of a rabbeted ring sections E forming spaced packing seats and each having an oblique peripheral steam inlet $e^2$ leading into its rabbet seat below the packing ring, said sections being arranged between a shoulder and an adjusting nut on a valve stem, the steam inlet passage of the forward section being in communication with an annular steam space between the valve stem and the packing gland, and in the event of leakage behind the first packing ring the steam inlet to the channel seat of the second packing ring will also be in communication with said annular steam space, and so on according to the number of rings employed, substantially as decribed.

515,055.



## THE COMPETITION OF SELF-MOVING ROAD VEHICLES IN FRANCE.

(*By our Special Commissioner.*)

THE great increase in the public interest shown in all kinds of outdoor exercises is one of the most striking features observable in French national life within recent years. The visitor to Paris or to any other large town will now see as many cycles as in a similar town in England; he will be struck by the number of ladies who are cyclists, and probably surprised to see the greater proportion of them wearing loose Turkish trousers. Upon the Seine and the Marne he will observe pleasure boats almost as numerous as those on the Thames itself, and these boats are let on hire at very low rates; there are many well-known rowing clubs, and it will be fresh in the memory of most of our readers that an English crew was beaten on the Seine by a French crew. There is no doubt a very strong public spirit, the growth of a few years, which has entered in a most enthusiastic manner into the project of attracting the youth of France from the cafés and other lounging-places of the gay city and encouraging the young people of both sexes to take amusement in the open air.

One of the most potent factors in the creation of this public spirit has been the widely disseminated and, we believe, well-grounded belief that the population of France, if not actually diminishing in number, is at least not increasing at all. In view of the rapid and well sustained increase in numbers of the Germans and other neighbouring populations, this fact is considered worthy of grave consideration, and many of the best men in France are endeavouring to find a solution of the difficulty.

Speaking generally, the youth of France appears to have enthusiastically responded to the invitation to take more exercise in the open air. If football and cricket do not appear so far to have found great favour here, there are many other forms of sport which are well patronised. The proprietors of *Le Petit Journal*, a well-known Parisian paper having, I believe, by far the widest circulation of any French newspaper, have for some years made special efforts to encourage out-door exercises. One of the chief members of the staff of the journal, who is known as "Jean-sans-terre," has been specially occupied with this particular class of work, and the numerous articles which have appeared from time to time are all signed by him.

In the year 1891 a competition of cyclists was arranged by *Le Petit Journal*, and the course was from Paris to Brest and back. This was extremely successful, and immensely increased the interest taken in cycling, and the result has been very gratifying, as the use of the cycle has so largely increased that there is no further need of encouraging it. In 1892 a walking match was instituted between Paris and Belfort, which also had very successful results; and it was a matter of some surprise that, in 1893, no public competition of importance was arranged by the newspaper. There was indeed a competition for the best dog muzzle; but that was of quite minor interest. The reason for the absence of enterprise last year is explained by the fact that it was quite uncertain at what date the elections would take place. It was hoped that a swimming competition might be got up, as it was thought that this branch of athletics has been too much neglected in France; but the fear of one or more cases of drowning occurring during these contests in the Seine or the Marne, has so far kept the journal from undertaking this branch of sport.

This year, however, it was decided that an attempt should be made to encourage the construction of road vehicles which should be actuated by some kind of motor. It was thought that if the use of horses was unnecessary, it would become possible for a family to go out and enjoy a drive in their own vehicle at small expense, and that more use would thus be made of the splendid roads of France, so much praised by all cyclists, whether of native or foreign origin. The construction of such vehicles has made such small progress in Great Britain, and the demand for them appears to be so trifling, that I have been much interested in following the announcements which have from time to time appeared in *Le Petit Journal*. It is well said in the journal that the cycle is all very well for young and vigorous members of a family, but that there is still great scope for inventors to assist the remainder of the family to enjoy themselves economically.

In December of last year the subject was first broached, and it was explained that there would be no question of racing along the high roads, but the object would be to find which vehicles best fulfilled the known requirements of the public. The trials were then fixed for the beginning of June, 1894. The regulations were few in number, and shortly as follows. The competition would be open to all comers, and any kind of motor would be allowed; the vehicles would be judged by a jury consisting of the staff of *Le Petit Journal*, assisted merely in their consultative capacity by consulting engineers. Each vehicle was to be capable of carrying at least four persons, but no restriction was put upon the seating capacity.

Security, easy management, and cheapness were the essential features desired. Each vehicle was to be submitted first of all to a preliminary run, in which it was to cover thirty-one miles in four hours—a speed of 7¾ miles per hour being considered quite sufficient for ordinary use. No notice would be taken of a speed exceeding the stipulated rate. Each carriage was to carry the inventor or builder, one or two members of the jury, and a consulting engineer, and marks were to be given up to 20. No vehicle would take part in the final test which had not obtained 16, 17, 18, 19, or 20 marks in the first run. No note would be taken of costly upholstery or mere superfluous finish; it was desired above all to find a thoroughly good design of vehicle. Entries were received from December 29th, 1893, each entry costing 8s. 4d. All the profits were to go to the Charity Fund of the paper.

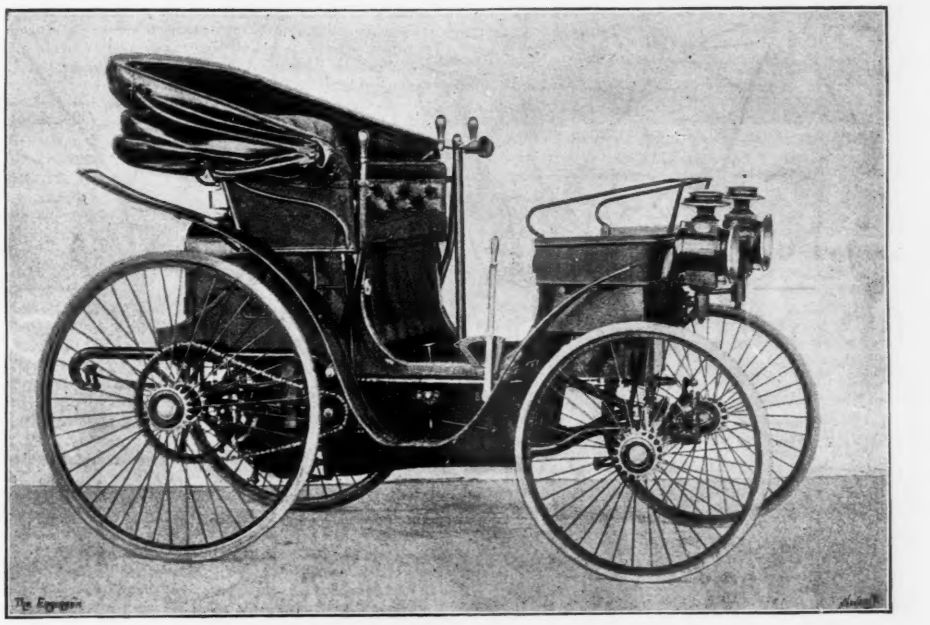


Fig. 3 DAIMLER VICTORIA

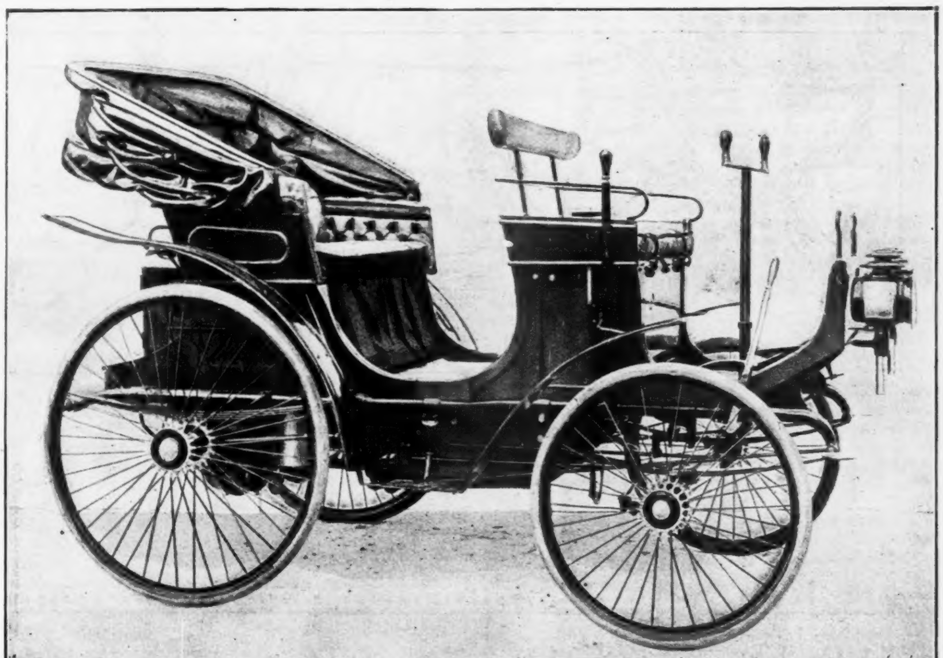


Fig. 4—DAIMLER PHÆTON

The first prize is of the value of £200, and is known by the name of the journal; the others are as follows: second prize, £80; third prize, £60; fourth prize, £40; fifth prize, £20. These latter are known as the Prix Marinoni, and are due to the personal liberality of Mr. Marinoni, one of the proprietors of the paper, who is himself a clever mechanic and inventor. Some persons objected to a jury consisting of journalists, and considered that it would have been preferable to have had the relative merits of the vehicles judged by experts; but the proprietors consider that their staff will well represent public opinion, and will be prevented from being carried away by a too loquacious inventor owing to the assistance derived from the consulting engineers. It was pointed out by some inventors that it would be better not to require each vehicle to carry at least four persons, and a change was therefore made in the rules by which any vehicle was admissible which could carry at least two persons, but that a vehicle carrying less than four people would not be eligible for the first prize, and that only two prizes out of the five would in any case be given to such a vehicle. It may be well to remark that by a police regulation dated 14th August, 1893, no self-moving vehicle is permitted to travel along the public roads in towns at a speed exceeding 7·44 miles per hour—12 kiloms.—nor at a speed exceeding 12·4 miles per hour—20 kiloms.—in the open country. This regulation is applicable to the whole of the department of the Seine.

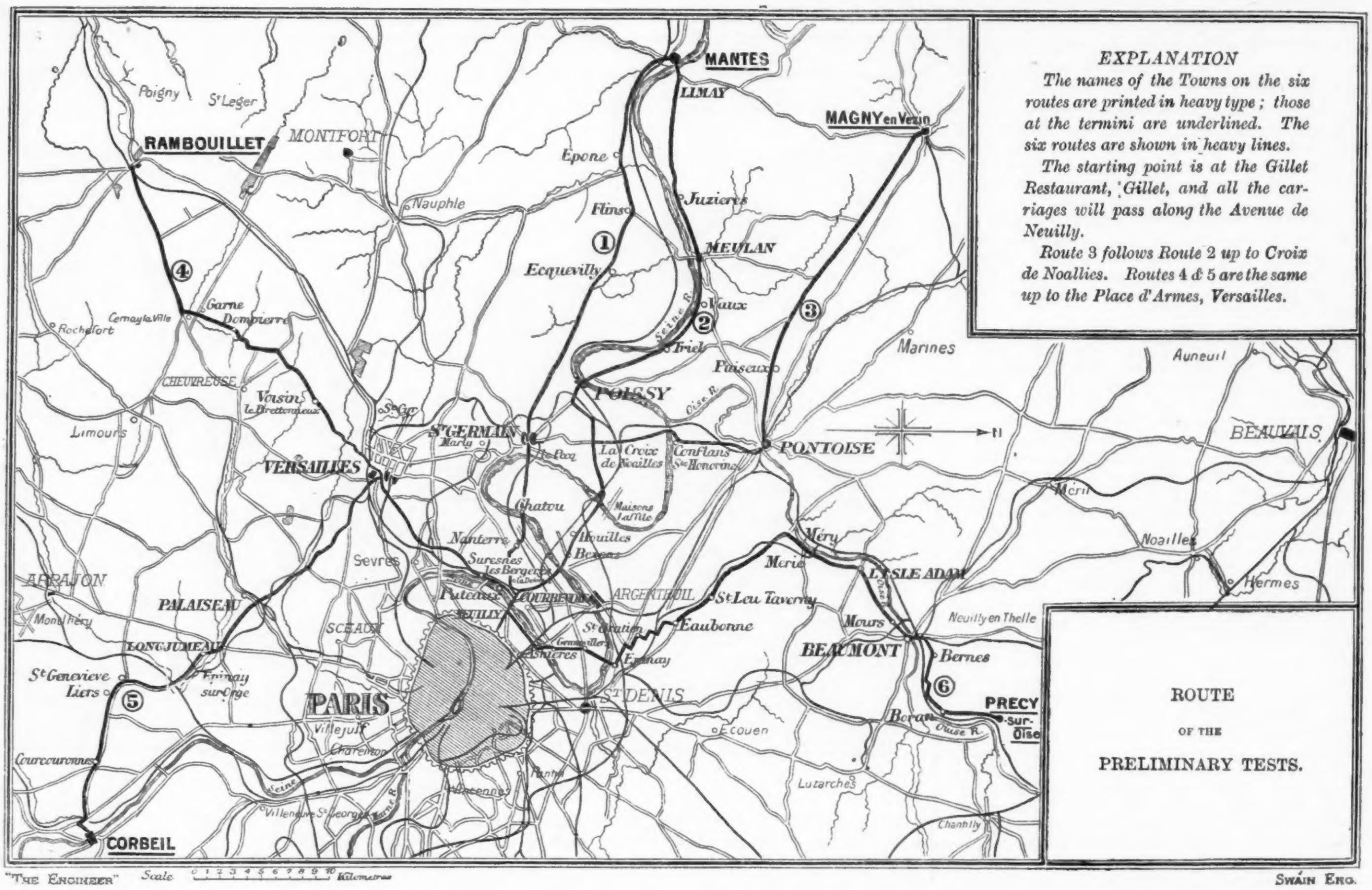
The competition is especially organised to encourage inventors, and therefore the prizes will not be given to the mere possessor of a vehicle unless he shall have made some radical improvement in its mechanism, sufficient in the opinion of the jury to constitute it a distinct type. Having now explained as briefly as possible the origin of the competition, and put your readers in a position to understand the importance of the trials, I will proceed to examine the results obtained in the form of entries. No entry was admissible after April 30th, 1894, the lists having then been open over four months.

So great an interest has been taken in the matter by the public that a pamphlet has been published by *Le Petit Journal*, in which the various articles which have from time to time appeared in the paper are reprinted with the rules and also maps of the route and descriptive matter. These were sold by the thousand at 2d. each, and the profits are to be added to the charitable fund of the paper. There are 102 entries altogether from 93 different persons or firms, and I am surprised to find only one entry from a person in the United Kingdom. There are only two entries from Germany, and I think British engineers will be somewhat surprised to learn that France should be able to produce so many types of self-moving road vehicles.

It was found that some of these carriages could not be ready for competition by June 1st, so a ballot was taken for postponing the date, and this resulted in obtaining an overwhelming majority for a later date. Finally it was arranged that Thursday, Friday, and Saturday, the 19th, 20th, and 21st July should be reserved for the preliminary trials, and that the final trial should take place on Sunday, July 22nd. As it would never do to have a large number of vehicles running in a confused mass upon a public highway, six different routes were chosen for the preliminary tests, and these are shown upon the map, Fig. 1. Each vehicle will start from the restaurant Gillet, at Neuilly, just outside the Porte-Maillot, Paris. The routes will be as follows:—

(1) Paris to Mantes, 29 14 miles.
(2) Paris to Mantes, 31·62 miles.
(3) Paris to Magny-en-Vexin, 32·24 miles.
(4) Paris to Rambouillet, 31 miles.
(5) Paris to Corbeil, 34·72 miles.
(6) Paris to Précy-sur-Oise, 32·24 miles.

Your readers will be able easily to trace upon the map the different routes, and to note the names of the towns and villages through which the vehicles will pass.


MANTES
LIMAY
MAGNY en Vexin
RAMBOUILLET
MONTFORT
Poigny
St Leger
Epone
Juziers
Flins
MEULAN
Nauphle
Ecquevilly
Vaux
Triel
POISSY
Poissy
Paiseaux
Marines
Auneuil
BEAUVAIS
Garne
Dompierre
Cernay la Ville
Rochefort
CHEVREUSE
Voisin
le Bretonneux
Limours
St Cyr
St GERMAIN
Marly
Le Pecq
La Croix de Noailles
Conflans Ste Honorine
PONTOISE
VERSAILLES
Chatou
Maisons Laffitte
Meru
Noailles
Nanterre
Houilles
Bezons
Mery
Meriel
L'ISLE ADAM
Hermes
Sevres
Suresnes
Les Bergeres
Puteaux
COURBEVOIE
NEUILLY
ARGENTEUIL
St Leu Taverny
ARPAJON
PALAISEAU
Montlhery
SCEAUX
St Gratien
Eaubonne
Mours
BEAUMONT
Neuilly en Thelle
LONGJUMEAU
Asnieres
Epinay
Bernes
St Genevieve
Liers
Epinay sur Orge
PARIS
Villejuif
Charenton
ST DENIS
Ecouen
Boran
PRECY sur Oise
Oise R.
Courcouronnes
Seine
Marne R.
Vincennes
Pantin
Villeneuve St George
Luzarches
Chantilly
CORBEIL
①
②
③
④
⑤
⑥

EXPLANATION

*The names of the Towns on the six routes are printed in heavy type; those at the termini are underlined. The six routes are shown in heavy lines.*

*The starting point is at the Gillet Restaurant, Gillet, and all the carriages will pass along the Avenue de Neuilly.*

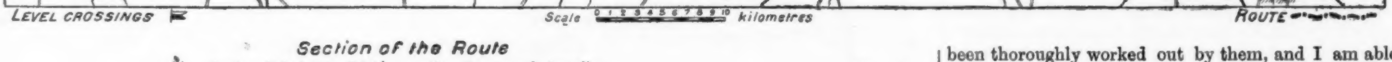
*Route 3 follows Route 2 up to Croix de Noallies. Routes 4 & 5 are the same up to the Place d'Armes, Versailles.*

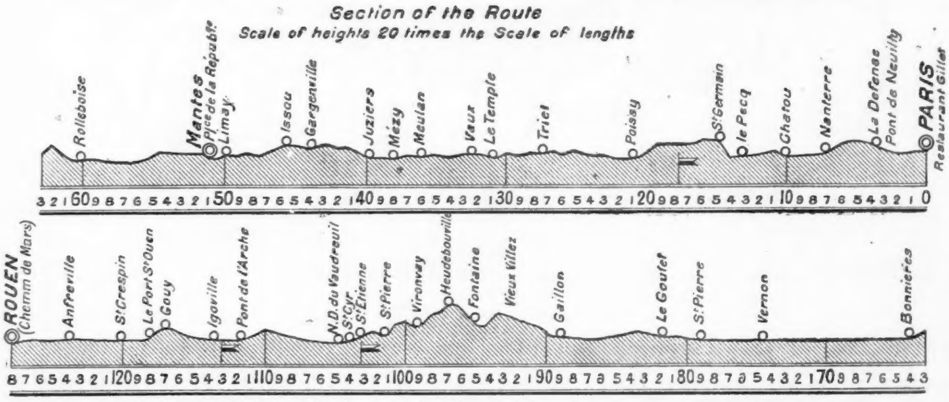
ROUTE OF THE PRELIMINARY TESTS.

"The Engineer" Scale 0 1 2 3 4 5 6 7 8 9 10 Kilometres

Swain Eng.

Each carriage must be provided with four number plates, and these are to be of enamelled iron with figures in white on a blue ground, so that the public by referring to the pamphlet—of which I have just spoken—will be able to know the name of the maker or inventor. The final trial will take place from Paris to Rouen, a distance of 79·36 miles, on Sunday next. This appears to me to be a very sufficient test of any vehicle, and should prove whether the design and manufacture of the apparatus are suitable for the purposes required. A map of this last route is given in Fig. 2; and it will be noted that, in both Figs. 1 and 2 the sections of the roads are given, so that really valuable data will be obtainable. As I have—by the kindness of Mr. Jean-sans-terre—received a special invitation to ride in one of the carriages, I shall, I hope, be able to give you detailed information as to the class of road, wind, and weather, as well as refer to the designs of the various vehicles.


ROUEN
Radepont
Baqueville
MAGNY
Nord
PONTOISE
Argenteuil
Anfreville
Quevreville
Forêt
Jouy
Maison Laffitte
Port St Ouen
Gouy
LES ANDELYS
Arthies
Fremainville
Le Seine
Daubeuf
Vaux
Le Temple
Triel
La Defense
Les Bergeres
Nanterre
Igoville
Pont de l'Arche
Lery
Hennezis
Valcarbon
Vienne
Meulan
Sailly
Mezy
Poissy
Chapet
Chatou
Le Pecq
PARIS
N. D. du Vaudreuil
St Cyr
St Etienne
Herqueville
Bois de Jerome
Seine
Juziers
Gargenville
Issou
St Germain
St Pierre
St Martin
Aigremont
Vaucresson
Tostes
Vironvay
Heudebouville
Gaillon
St Pierre
Vernon
Bonnieres
Mantes
Limay
Morainvilliers
Fontaine
Vx Villez
Port Villez
Rolleboise
Rosny
Bazemont
ELBEUF
LOUVIERS
St Pierre de Bailleul
Ailly
VERSAILLES
LEVEL CROSSINGS
Scale 0 1 2 3 4 5 6 7 8 9 10 kilometres
ROUTE



Plan and Section of the Route for the Final Test from Paris to Rouen, 128 kilometres.

By Article 29 of the police regulations, it is forbidden to use a motor car to draw any other vehicle, so that each vehicle must be self-contained. The time is now close at hand when the trials will come off, and in order to give the public every opportunity of examining the vehicles, they were on view in the Neuilly Park on Wednesday, from 2 p.m. to 6 p.m. The Mayor of Neuilly, General Henrion-Bertier, has made the arrangements for this public view, when the motors will not be shown at work, this being merely a preliminary general view. On Tuesday lots were drawn by the competitors, to determine which of the routes each vehicle is to follow.

As was foreseen by the proprietors of *Le Petit Journal*, a number of the competitors are not ready even now, although six weeks more than was originally intended have been allowed, and I learn after consulting Mr. Jean-sans-terre, that, roughly speaking, about fifty vehicles out of the 102 entered will take part in the trials. This is considered a very satisfactory result, and should lead to a good competition. I find that the only English vehicle entered will not appear. As there are fewer competitors it has been decided not to use route No. 3 at all. This was from Paris to Magny-en-Vexin, and was decidedly the worst of the six routes; and from Pontoise to Magny it was paved in the manner customary in the reign of Louis XIV. Besides this there will be no need to run any trials on Saturday next, so far as can be seen at present, although the weather has been so wet lately that fine days cannot be counted upon. M. Michel Levy, of 26, Rue Spontini, a mining engineer, has been specially appointed by the Prefect of Police to examine the vehicles before they are allowed to run upon the public roads, and he will be assisted by M. Bocher, also a mining engineer.

As it will not be definitely known for a couple of days exactly which vehicles will take part in the contest, I have been unable to obtain all the technical information I desired; but as one firm has entered six separate vehicles, I consider this a proof that the designs have been thoroughly worked out by them, and I am able to illustrate some of the carriages. This firm is Messrs. Les Fils de Pengest Frères, of Valentigney (Doubs), who also have a depôt at 22, Avenue de la Grande-Armée in Paris. The whole of these various types of vehicles are fitted with the Daimler-Gazoline motor—which, I may remark in passing, has been recently introduced into England, and is being fitted into several launches now being built on the Thames. These motors are built by Messrs. Panhard et Levassor, 19, Avenue d'Ivry, Paris, and are of the two-cylinder type. The power of the motor is sufficient to produce a speed of 2·5 to 3·1 miles per hour on inclines of 1 in 12 to 1 in 10, and a speed of 9·3 to 11·2 miles on the level when the road is good and dry, the vehicle being fully loaded with the number of passengers it is designed for, allowing a weight of 165 lb. per passenger. The vehicle can be run at two different speeds, and the gear for changing the speed is easily worked while travelling. In cases where the district is very level, a higher speed can be arranged for if permissible by the police regulations.

Fig. 3 illustrates a Victoria for four persons. The extreme length is 8·86ft.; width, 4·85ft.; gauge, 4·26ft. The wheels are of the cycle type, with pneumatic tires, and it will be seen that the controlling lever is in front. The motor drives on the hind axle. The framework consists of cold drawn weldless steel tubes, joined by wrought or cast steel parts. It serves as a reservoir for the cold water used for cooling the cylinders. The spokes of the wheels are of steel, and so made that they can be replaced in case of accident, while the wheel remains in its normal position. The price of this carriage fitted throughout as shown in Fig. 3 is £268 in Paris.

Fig. 4 represents a second type made by the same firm, which is quoted at £248. The length is 8·4ft.; width, 4·6ft.; gauge, 3·94ft. I have been unable as yet to obtain the weights of these vehicles, but they well represent the work turned out by this firm, who are very well known as cycle manufacturers. All the six vehicles entered for the competition are of different types. The prices, it will be seen, are somewhat beyond the purses of the classes for which *Le Petit Journal* has specially interested itself; but it must be remembered that there is as yet a very small demand for this class of vehicle, and the enterprise of this particular firm is very considerable. The Department of Doubs borders Switzerland, and is therefore a considerable distance from Paris. Still, notwithstanding this, the firm invite intending buyers to go there for instruction in the handling of the motors and guidance of the vehicles.

I have stated that out of the 102 carriages which were originally entered for the competition, I expected about fifty would take part, the rest being for various reasons unable to appear.

I am now able to give a complete list of the "probable starters," which are as follows. The numbers at the left being those quoted in the official list of entries.

3.—Messrs. Dion Bouton et Cie., 12, Rue Ernest Puteaux (Seine). Brake, to seat six. Actuated by steam.

4.—*Idem* Victoria bogie carriage to seat four. Steam.

7.—P. Gautier, 59, Boulevard Arago, Paris; to seat four. Petroleum motor.

10.—J. Scotte, Epernay (Marne), to seat eight to ten. Steam.

12.—Tenting, 46, Rue Curial, Paris, to seat four. Petroleum.

13.—Panhard et Levassor, 19, Avenue d'Ivry, Paris; ordinary type, to seat four. Daimler motor.

14.—*Idem* new type, to seat four.

15.—*Idem* to seat two.

16.—Quantin, 27, Rue St. Amand, Anzin (Nord), to seat six. Petroleum.

18.—Ernest Archdeacon, 121, Avenue de Wagram, Paris, to seat six or seven. Serpollet steam motor.

19.—A. Le Blant, 19, Rue Geoffroy-Saint-Hilaire, Paris, to seat eight or ten. Steam. Built by Messrs. Chastel and David.

21.—Alex. Letar, 58bis, Rue Sainte Anne, Paris, dog cart to seat four. Steam.

24.—Alfred Vacheron, Forges de Phade, near Monthermé (Ardennes), to seat two. Gasoline.

25.—Coquatrix, 74, Boulevard Voltaire, Paris, to seat four. Steam.

27.—Les Fils de Peugeot Frères, Valentigney (Doubs), to seat two. Daimler motor.

28.—*Idem* to seat four *vis-à-vis*.

29.—*Idem* to seat four. Victoria.

30.—*Idem* to seat three. Open cab.

31.—*Idem* brake to seat five.

37.—A. Loubière, Ferté-sous-Jouarre (Seine et Marne), to seat six. Levers.

40.—L. Lemoigne, Fougères (Ille-et-Vilaine), to seat four. Weight of passengers.

42.—A. le Brun, 10, Rue Alsace-Lorraine, Rouen (Seine Inferiure), to seat four. Petroleum.

44.—De Prandières, 31, Place Bellecour, Lyons, to seat six. Serpollet type and petroleum combined.

51.—Lepape, 23, Rue Montaigne, Paris, to seat four. Petroleum.

52.—La Société Parisienne de Constructions Velocipediques, 10, Avenue de la Grande Armée, Paris, to seat four. Compressed air at constant pressure. Durand type.

53.—De Bourmont, Chalet Saint François, Arcachon (Gironde), to seat four. Petroleum.

60.—Maurice le Blant (as above), brake, to seat nine. Steam.

61.—R. de Montais, Beauvoir près de Cloyes (Eure et Loire), to seat two. Petroleum.

62.—Mallarmé, 56, Rue Frileuse, Gentilly (Seine), to seat five. Steam.

64.—Panhard et Levassor (as above), to seat four. Daimler motor.

65.—Les Fils de Peugeot Frères (as above), phæton, 1894 type, to seat four. Daimler.

67.—Lebesque, 22 bis, Rue des Faillandiers, Paris, to seat four. Petroleum.

68.—Garnier et Delarnoy, Beauvois (Nord), to seat four. Combination of manual and mechanical motor.

71.—Th. Klaus, 20, Avenue du Grand Camp, Lyon (Rhone). Tricycle to seat two. Petroleum.

72.—Tamarelle-Capeyron, Bergerac (Dordogne) to seat five. Steam.

74.—Raoul Meyer, Chevenceau (Charente Inférieure), Quadricycle to seat two or four. Steam.

75.—Charles Dessaux, 329, Rue Saint Martin, Paris, tricycle to seat two or four. Levers.

77.—Reverseau, 2, Rue des Lions Saint Paul, Paris, to seat four to six. Automatic.

79.—A. Baudet, 7, Rue Paul Bert, Paris, wagonette-phæton, to seat two to six. Steam.

84.—Plantard, 21, Rue Rousselet, Paris, to seat four. Compressed air.

85.—Roger, 52, Rue des Dames, Paris, to seat two or four. Petroleum.

88.—Jeantaud, 51, Rue de Ponthieu, Paris, to seat five. Petroleum.

91.—Count Carli, Castelnuovo di Garfagnana, Italy, to seat two. Electricity.

99.—L. Bonnefilo, Valence d'Agen, Lot et Garonne, to seat two. Petroleum.

100.—Bellanger, 8, Rue des Noyers, Mans, Sarthe, to seat four. Automatic (?).

101.—Jean Mary, 19, Rue des Fermiers, Paris, to seat four. High pressure gas.

The vehicles up to 44 inclusive will be tried on Thursday, and those from 45 to 101, both inclusive, will be tried on Friday. It is possible that there may be a few vehicles to be tested on Saturday, but this will only occur if it is quite impossible to test them on one of the other days.

It will be seen that there is only one foreign competitor left in the list, and he is an Italian (No. 91). An electric motor vehicle was originally entered by a Mr. Garrard, of Birmingham, but it does not appear to have been actually built. Tuesday afternoon the lots were drawn to determine which vehicles are to run on each of the five routes for the preliminary tests on Thursday and Friday next. In future I shall refer to each carriage by its distinctive number, in order to avoid repetition of names as much as possible.

On analysing the list it will be seen that the competitors who are sending in the greatest number of vehicles are Messrs. Les Fils de Peugeot Frères, and Messrs. Panhard and Levassor—the latter firm has the sole right to manufacture and sell the Daimler motor in France and Belgium, and they have supplied the former firm with all their motors. It will thus be seen that at least ten vehicles will be fitted with the Daimler motor which you described on page 322, Vol. lxxv. I am as yet unable to state precisely how many more of the petroleum motors are of the Daimler type.

The entries may be divided as follow:—

| | |
|---|---|
| Petroleum motors, of which ten at least are Daimler ... | 23 |
| Steam ... | 12 |
| Levers ... | 2 |
| Steam and petroleum | 1 |
| Compressed air | 2 |
| Compressed gas | 1 |
| Electricity | 1 |
| Various | 4 |
| | — |
| Total | 46 |

Electricity appears to be nowhere; and, so far as I am able to judge at present, I believe the petroleum motors are most likely to succeed. I visited the works of Messrs. Panhard and Levassor on Tuesday morning, and was very kindly shown over the various shops by M. Panhard, jun., in the absence of the other partners, who were at the office of *Le Petit Journal*, engaged in drawing lots for their places at the trials.

I send views of some of the vehicles made by this firm, which I fear will be too late for this week's issue. The firm have bought the Daimler patent rights for France and Belgium, from Mr. Daimler, the inventor, who is a German, living in Stuttgart.

I was informed that Messrs. Panhard and Levassor have made, during the last four years, about 350 Daimler motors of various sizes, and that they have themselves built, and fitted with these motors, about ninety vehicles, all of which are in use in Paris or the provinces, and two in Belgium. Messrs. Peugeot have been supplied by them with at least eighty motors, so that it will be seen that the business done in this branch is very considerable. The increase during the last twelve months, I am told, is very large. In walking round the fitting shops, I saw parts of scores of these motors in progress, and the construction seems to form one of the chief branches of the business of the firm, although until recently they devoted themselves chiefly to the building of wood-working machines of various kinds.

The vehicles made by this firm, generally, have the motor placed in front, and in response to a question put by me as to the smell caused when working, M. Panhard took me to see a Daimler motor of 3·5 horse-power under test in an adjoining shop. Although the exhaust was perfectly open, and the pipe itself ended about 6ft. from the ground, so that the whole of the products of combustion were discharged into the building, I noticed no unpleasant smell. It appears that care must be used in the purchase of the oil, which is here known as "essence minerale." I saw at least a dozen vehicles ready to go on to the roads, and parts of about the same number in an unfinished state. I was also shown a vehicle provided with a steam motor designed by a M. Varennes, and entered for the competition. This gentleman, has, however, given up the idea of competing, and has purchased for his private use a vehicle built by Messrs. Panhard and Levassor, and provided with a Daimler motor.

It seems that a great sale is found for the vehicles to country doctors, who are able to do from forty to fifty miles a day, and in some cases the motor has taken the place of four horses, which had to be kept previously, in order to obtain a satisfactory service. The type sold to doctors is usually one to seat two persons, and the carriage is provided with the ordinary hood.

## IN THE ENGINE-ROOM OF THE LUCANIA.

In various issues of The Engineer, and at various times, we have written about the great Cunard steamships the Campania and Lucania, and in our impression for October 13th, 1893, we gave numerous engravings, reproductions of photographs taken on board, which are competent —as far as engravings can be competent—to furnish an approximate idea of what the ships are like. We have also in the same issue illustrated the engines, from a photograph taken in the erecting shop.

Now, accurate as photographs are, they entirely fail to reproduce mental impressions of size. Even when a man is introduced to act as a standard, the realisation of impression is quite inadequate. The views which we give this week are, on the other hand, the accurate embodiment of the impression produced on the mind of a man who is at once a highly competent artist and a trained mechanical engineer. His sketches do more, we think, to enable our readers to realise the vast dimensions of the machinery than anything else short of a personal visit to the engine-room could do. Again, it must not be forgotten that a photograph taken in an erecting shop gives an imperfect idea of the engine-room, because a host of appurtenances of various kinds are left out. They are not part and parcel of the main engines, but they are part of the machinery of the ship.

It will be well here to go over somewhat old ground, and supply a few particulars of the construction of the main engines. They are each intended to indicate 15,000-horse power, and that power has actually been obtained. We believe, however, that the average working power is 28,000-horse power for the two. They are peculiar in arrangement. Each engine has five cylinders and three cranks. There are two high-pressure cylinders 37in. in diameter. These stand each over a low-pressure cylinder, 98in. in diameter, a single piston-rod serving for each pair of pistons. Between the two low-pressure cylinders is placed one intermediate cylinder, 79in. in diameter, into the valve chest of which both the high-pressure cylinders exhaust. The stroke of all the pistons is 69in. The capacities of the cylinders are to one another roughly as 10 : 49 : 75. But, inasmuch as there are two low-pressure and two high-pressure cylinders to one intermediate, the real proportions come out very nearly as 21 : 49 : 150, or as 3·7 and 20·3. If steam were cut off at half-stroke in the high-pressure cylinder, and the effect of clearance neglected, the total expansion would be about 13·5 to 1. The safety valves are loaded to 165 lb., so that if we take the initial steam pressure as 175 lb. absolute, the terminal pressure would be a little under 13 lb. absolute. This is, of course, higher than that obtained in practice, for sufficiently obvious reasons. Various changes have been made in the propellers of the Lucania and Campania, and we do not know what is the precise number of revolutions made per minute now. We shall not be far wide of the mark, however, if we take it at a little more than seventy-one, corresponding to a piston speed of 800ft. per minute. The two high-pressure pistons have piston valves. The propellers are three-bladed, of manganese bronze, cast at Fairfield. The total weight of the six blades of the two propellers is 48 tons, which is the weight of about 5,500,000 pennies, the nominal value of which would be £22,916. We need scarcely add that pennies were not used for the purpose.

The first of our views, that given on page 54, shows the lower or starting platform, between the two engines looking aft. The sliding doors in the intermediate bulkhead are open. One excentric and a link are seen. The crank shafts are concealed by the frames and splashers.

The second view, on page 55, is taken on the second platform. One crosshead of the port engine is seen to the right in the picture, and a piston-rod of the starboard engine to the left.

The third view, on page 58, is taken at the level of the tops of the intermediate-pressure cylinders. A low-pressure valve chest occupies the lower right-hand corner; above it is seen the lever used for working the piston valve of the high-pressure cylinder, the rod of which can be seen entering the stuffing-box on the conical cylinder cover. The tail rod casing of the intermediate cylinder of the starboard engine can be seen to the left. Nearer is shown the stop valve, with its branch pipes going forward and aft to the high-pressure cylinders; the exhaust pipes from these to the intermediate valve chest are also very clearly shown. The central gangway is on the top of the central bulkhead, which is here high above the water-line.

The view on page 51 shows the Brown reversing gear, and gives a very good idea of the enormous scale on which every detail has been worked out. The group of views on page 62 will serve still further to convey an impression of the enormous size of the machinery, the most powerful ever constructed.

We may now proceed to give a few figures, which will serve to bring out this fact in sharper relief. The engines are 47ft. high from the base to the top of the high-pressure cylinders; that is about the height to the top of the roof of an ordinary three-storey house. The crank shafts are each made of three pieces, and each piece weighs 27 tons. The thrust shaft is 16ft. long, and weighs 29 tons; the crank shaft is 26in. in diameter; the propeller shaft, 24in. The total weight of crank and thrust shaft, taken as a whole, is 110 tons; each of the six connecting-rods weighs 10 tons.

No particulars have ever been made public concerning the quantity of coal used per day; but it is not difficult to arrive at fairly approximate figures, and these are startling enough. It is said that the City of Paris and City of New York—now the Paris and the New York—get on with 350 tons per 24 hours. This may or may not be the case; but it is easy to see that the Lucania and Campania must burn much more. As we have said, we believe it to be pretty certain that these ships each require 28,000-horse power to propel them at the enormous speeds which they so regularly maintain. The auxiliary engines in such a ship use a great deal of steam, which is not included in this 28,000-horse power. The main engines are no doubt economical, but we cannot think that we shall be far wrong if we take the weight of steam used, all referred to the main engines, as 16 lb. per hour per horse, which at 8 lb. of water per pound of coal, represents 2 lb. of coal per horse-power, a very good result under the circumstances. It is possible, of course, that the consumption may be less than this, the evaporation higher; but the one cannot be much less, nor can the other be much smaller.

Taking, then, the coal at 2 lb. per horse per hour, we have 56,000 lb., or 25 tons of coal per hour, or 600 tons a day. That is to say, the consumption per day equals the contents of two 30-wagon coal trains.

Through the engines will pass 8 × 25 = 200 tons of steam per hour, or $3\frac{1}{3}$ tons of steam per minute; the feed-water will require to pump it into the boilers about, when allowance is made for pipe friction, &c., 100 indicated horse-power. The feed-water, taking 36 cubic feet to weigh a ton, would fill a tank 10ft. wide, 10ft. deep, and 72ft. long.

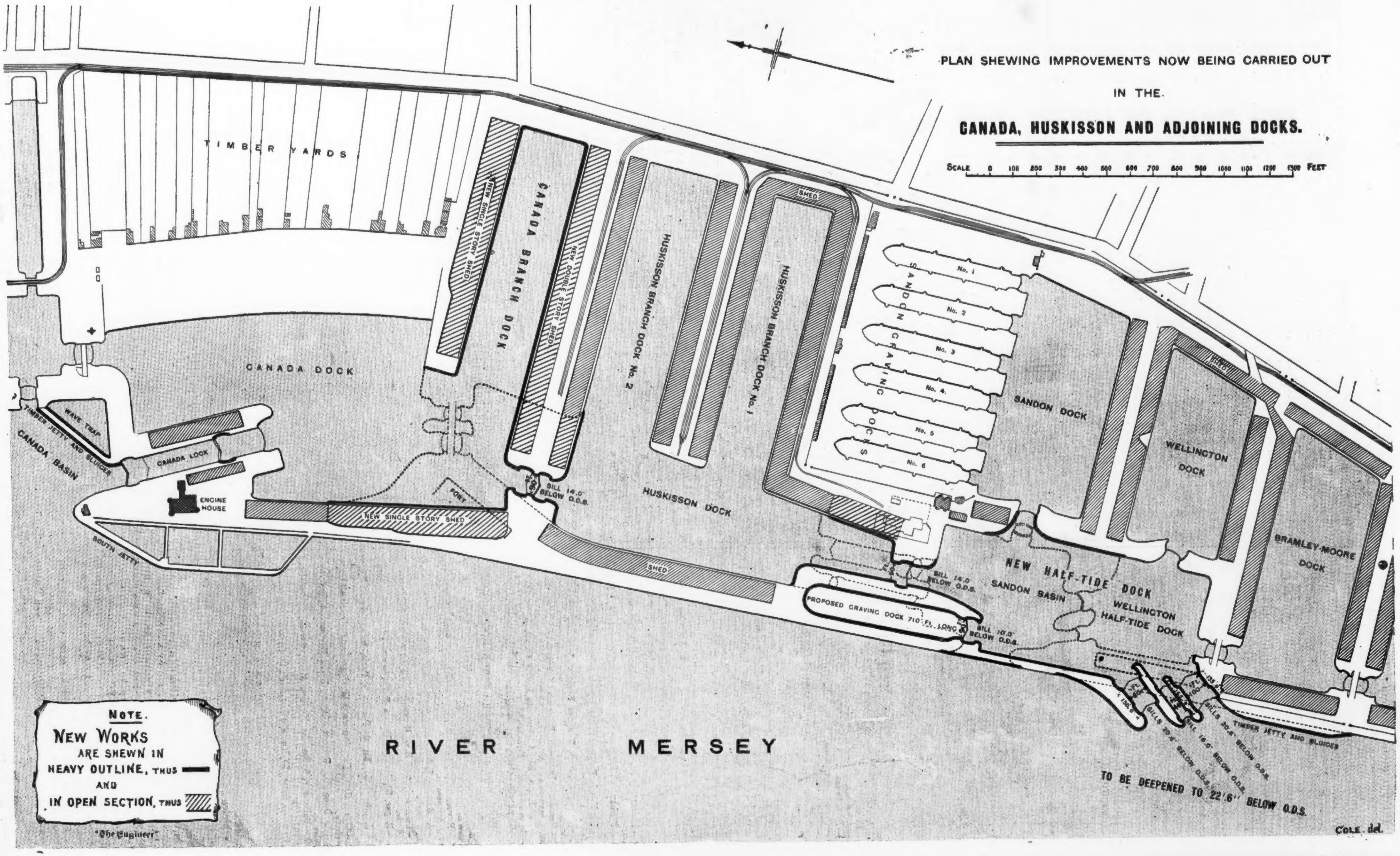
To condense the 200 tons of steam about 7500 tons of water is pumped each hour through the condensers; that is to say, about one half the weight—displacement —of the ship. This water would fill a tank 20ft. wide, 10ft. deep, and 1350ft. long, or it would fill a dock 337ft. long, 40ft. wide, and 20ft. deep. Flowing over a weir, this volume of water would represent a not inconsiderable trout stream. It is moved, however, with a very small expenditure of power, because there is virtually no head against the centrifugal pumps.

In the boilers—twelve main and two auxiliary—there are 102 furnaces. In each there is nearly 26 square feet of grate surface, or, in all, 2625 square feet. That is the area of the floor of a great hall, 52ft. long, and 52ft. wide. Fifty tons of coal are required to charge the furnaces, and that is the quantity burning at one time. To burn 56,000 lb. of coal in an hour on these grates, about 25 lb. of coal must be burned per square foot per hour. This is not more than we should expect, seeing that the tops of the chimneys are 120ft. above the grate level, and that very special facilities have been provided for the supply of air to the fire-rooms, although forced draught is not employed. Allowing 20 lb. of air to burn each pound of coal, we find that 250 tons of air per hour must pass up each of the great chimneys, 19ft. in diameter, and 130ft. apart.

# DOCK IMPROVEMENTS AT LIVERPOOL

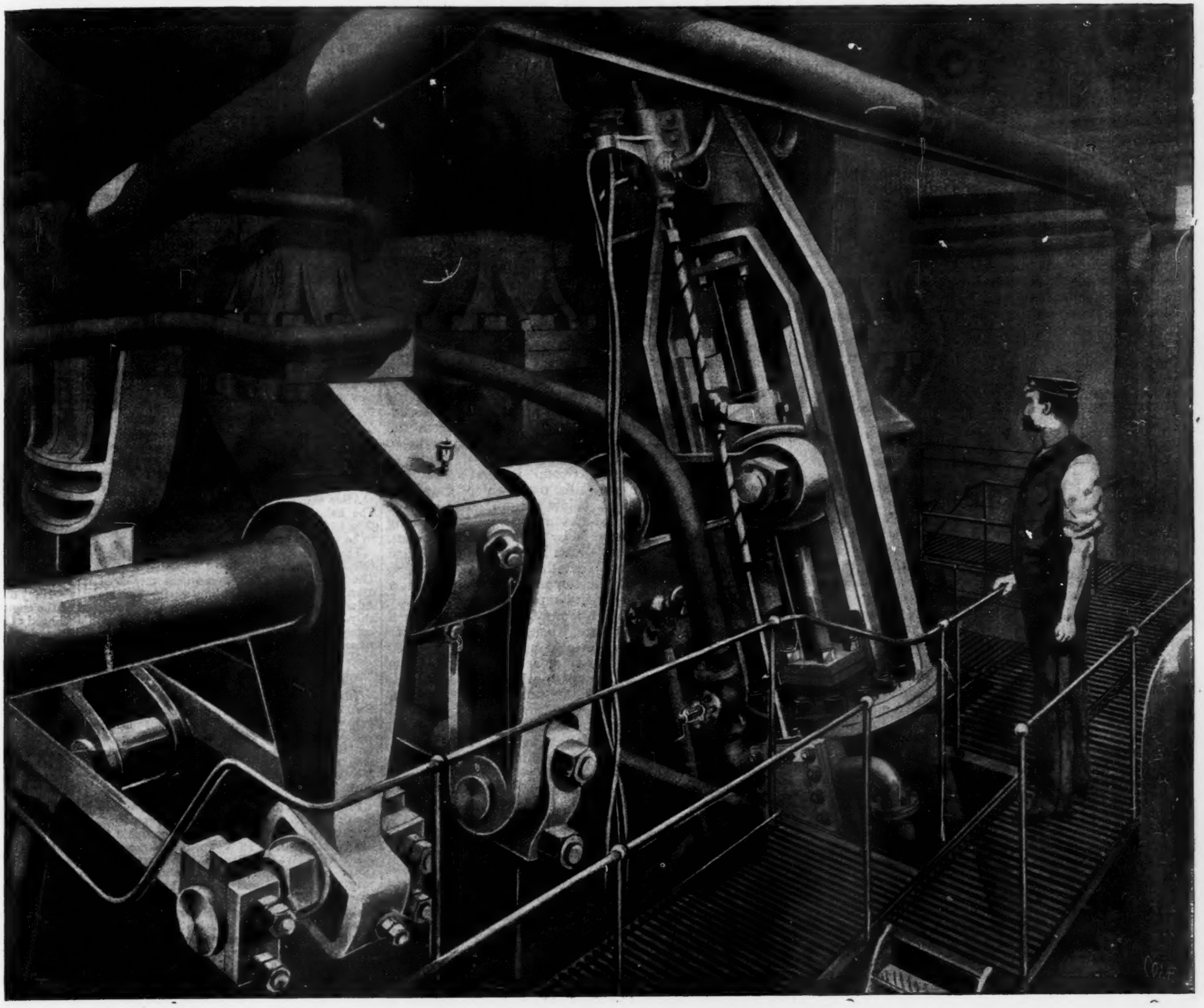
MR. G. FOSBERY LYSTER, M. INST. C.E., ENGINEER

(*For description see page* 48)


PLAN SHEWING IMPROVEMENTS NOW BEING CARRIED OUT
IN THE
CANADA, HUSKISSON AND ADJOINING DOCKS.
SCALE 0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 FEET
TIMBER YARDS
CANADA DOCK
NEW SINGLE STORY SHED
CANADA BRANCH DOCK
NEW DOUBLE STORY SHED
HUSKISSON BRANCH DOCK No. 2
HUSKISSON BRANCH DOCK No. 1
SHED
HUSKISSON DOCK
SANDON GRAVING DOCKS
No. 1
No. 2
No. 3
No. 4
No. 5
No. 6
SANDON DOCK
WELLINGTON DOCK
BRAMLEY-MOORE DOCK
WAVE TRAP
TIMBER JETTY AND SLUICES
CANADA BASIN
CANADA LOCK
ENGINE HOUSE
SOUTH JETTY
FORT
NEW SINGLE STORY SHED
SILL 14.0" BELOW O.D.S.
SHED
PROPOSED GRAVING DOCK 710 FT. LONG
SILL 14.0" BELOW O.D.S.
SANDON BASIN
NEW HALF-TIDE DOCK
WELLINGTON HALF-TIDE DOCK
SILL 10.0" BELOW O.D.S.
SILLS 20.6" BELOW O.D.S.
SILL 16.0" BELOW O.D.S.
SILLS 20.6" BELOW O.D.S.
TIMBER JETTY AND SLUICES
TO BE DEEPENED TO 22'.6" BELOW O.D.S.
RIVER MERSEY
NOTE.
NEW WORKS
ARE SHEWN IN
HEAVY OUTLINE, THUS
AND
IN OPEN SECTION, THUS
"The Engineer"
COLE. del.

# THE ENGINE-ROOM OF THE LUCANIA—THE BROWN REVERSING GEAR

(*For description see page* 48)



This, at the probable temperature at the top of the funnel, would occupy a space of about 11,200,000 cubic feet.

The Campania has steamed from Sandy Hook to Daunt's Rock at an average speed of 21·28 knots per hour. But taking 21 knots as her velocity, she passes over 2130ft. per minute. In the same time her pistons make 800ft. The speed of the ship is thus 2·$\frac{2}{3}$ greater than that of the pistons. If we take the length of the passage as 2812 knots, then each piston passes over a space of 1057 knots, and as there are six pistons, the total distance they make is 6342 knots. Those of our younger readers who are fond of graphics may find it interesting to plot the path in space of one of the pistons from the data we have given. It will be seen that the relation between the speed of a piston and that of a ship is very important. It is evident, for example, that if half the whole power, or 14,000-horse power, were referred to the low-pressure cylinders of each engine, the average total pressure on the piston could not be less than $2\frac{2}{3}$ times half the resistance of the ship. But as in all probability the thrust effort, multiplied by the velocity in feet per minute, does not exceed one-half the whole horse-power, then the piston effort must be twice half the whole resistance. We say half the whole resistance, because there are twin screws. The total thrust on the two blocks will in all probability not much exceed 100 tons, or say 50 tons on each.

It will be seen that we have taken the consumption at 600 tons per day of twenty-four hours, and it may be said that this is an exaggeration, and that the consumption is really much less. This may be the case; but if so then either of four things must take place:—(1) The engines do not use 16 lb. of steam per horse per hour; (2) they do not indicate 28,000-horse power; (3) the boilers evaporate more than 8 lb. of water per pound of coal; or, (4) any two, or all three, of these suppositions are facts. Now as regards the first point. It will be admitted that a consumption of but 16 lb. of steam per horse per hour represents a very good engine indeed. We are quite aware that higher duties by four, or possibly five pounds have been attained, but not at sea, and only under almost exceptional circumstances on land. In this 16 lb. we have included, be it remembered, all the steam used in driving pumping, and electric lighting engines; for heating, and all the thousand-and-one uses to which steam is put in a great ship, and all used, be it observed, more or less uneconomically. As regards the second point, we have every reason to believe that the power exerted is more nearly 30,000-horse power than 28,000-horse power. There remains only the boilers to be considered. There is nothing about them specially economical; nor is Welsh coal used, nor is the feed-water supplied at a high temperature. We hold, therefore, that an evaporation of 8 lb. per pound of coal would be a very fair duty. But it will be seen that even if the boilers evaporated 9 lb. instead of 8 lb., it would only affect our calculations by one-eighth. The Cunard Company, following the example of the White Star, and indeed, of all other Atlantic companies, refuse to make their coal consumption known. We have, of course, no desire to break through this wall of reserve. But, on the other hand, it is open to all engineers to speculate, as we have done, on what the probable consumption of the ship must be, and we hold that if the entire horse-power in the ship, auxiliaries and all, is obtained at the rate of 2 lb. of North-country or American coal per horse-power per hour all round, the result is very satisfactory. Every passage across the Atlantic is in a measure a race against time, and little account of economy is taken as compared with speed.

It is now time to say something concerning the performance of these phenomenal ships, which have been steadily augmenting their speed almost from the first. Last November the Lucania held the record for the fastest westward passage across the Atlantic, the run being made in 5 days 12 hours 47 minutes, the average speed being 20·93 knots. The Campania, on the other hand, held the record for the quickest eastward passage, the run being made in 5 days 12 hours 7 minutes, or at an average speed of 21·28 knots. The figures are as follows:—

*Lucania's Westward Passage.*

| | Knots. |
|---|---|
| Daunt's Rock, 12.55 p.m., October 29th, to noon October 30th ... ... ... ... ... ... ... ... | 481 |
| October 31st ... ... ... ... ... ... ... ... ... | 542 |
| November 1st ... ... ... ... ... ... ... ... ... | 536 |
| November 2nd ... ... ... ... ... ... ... ... | 490 |
| November 3rd... ... ... ... ... ... ... ... ... | 535 |
| To 9.7 p.m., November 3rd, Sandy Hook Lightship | 196 |
| Total ... ... ... ... ... ... | 2780 |

*Campania's Eastward Passage.*

| | Knots. |
|---|---|
| Sandy Hook Lightship, 9.10 a.m., October 28th, to noon ... ... ... ... ... ... ... ... ... ... | 47 |
| October 29th ... ... ... ... ... ... ... ... ... | 491 |
| October 30th ... ... ... ... ... ... ... ... ... | 490 |
| October 31st ... ... ... ... ... ... ... ... ... | 491 |
| November 1st ... ... ... ... ... ... ... ... ... | 505 |
| November 2nd ... ... ... ... ... ... ... ... | 495 |
| To 1.5[illegible] a.m., November 3rd, Daunt's Rock ... ... | 293 |
| Total ... ... ... ... ... ... | 2812 |

These figures may be compared with those of the performance of the rival ships Paris and New York. They represent average, and not exceptional passages, for all four ships:—

*Average Passage.*

| | Queenstown to New York. | New York to Queenstown. | Knots per hour. |
|---|---|---|---|
| Campania ... ... | 5 d. 20 h. 18 m. | ... ... ... ... | 20·06 |
| | | 5 d. 17 h. 27 m. | 20·76 |
| Lucania ... ... ... | 5 d. 14 h. 27 m. | ... ... ... ... | 20·64 |
| | | 5 d. 20 h. 50 m. | 19·90 |
| | Southampton to New York. | New York to Southampton. | |
| Paris ... ... ... | 6 d. 15 h. 14 m. | ... ... ... ... | 19·30 |
| | | 6 d. 22 h. 23 m. | 18·65 |
| New York ... ... | 6 d. 20 h. 50 m. | ... ... ... ... | 18·66 |
| | | 6 d. 20 h. 30 m. | 18·89 |

There is, however, a later performance than any of those we have given. The following extract from the *Liverpool Mercury*, of May 28th, 1894, gives the particulars of a very remarkable round trip made by the Lucania:—"The westward passage across the Atlantic is usually the most trying and protracted, but on rare occasions a vessel will carry easterly winds with her throughout it. The record passage in that direction was 5 days 12 hours 47 minutes, on the northerly route for a total distance of 2780 knots. The passage has now been made in only ten minutes longer time on the southerly route of 2873 knots, or a greater distance by ninety-three knots. It has been done, too, in spite of the fact of six hours' fog being encountered, during which the vessel proceeded at reduced speed. On the 19th instant, the American Line steamer New York took her departure from the Needles at 1.35 p.m. The Cunard steamer Lucania took hers about twenty-three hours later from Daunt's Rock, Queenstown, and arrived at Sandy Hook Lightship about four hours sooner, having averaged over two knots an hour greater speed than her American competitor. The Lucania now excels all records in ocean steaming, in having made the round trip from New York and back again at an average speed of 21¾ knots per hour over a distance of 5784 knots. The fastest railway express in the world could not thus maintain an average speed of 25 miles an hour over a distance of 6660 miles, with only one break on the journey. Had the Lucania sailed on the short route, on which her record voyage was made, her passage would have been 5 days 8 hours 39 minutes. Her sister ship, the Campania, has already averaged close on to this speed on one trip, but on her present homeward voyage met with easterly gales and high confused seas throughout the passage, besides some fog, through which she was delayed leaving New York beyond her ordinary time. Nevertheless, her passengers, the largest number that ever left New York so early in the season, were landed in Liverpool on Saturday afternoon."

Although we have already very fully described the Lucania, it may be convenient to reproduce here the following figures which serve to emphasise the progress which has been made in Atlantic navigation. The first steamer possessed by the Cunard Company was the wooden Britannia, which started on her first voyage—to Boston—from the Mersey on the 4th of July, 1840—that is to say, just 54 years ago.

| | Britannia. | Lucania. |
|---|---|---|
| Length ... ... ... ... | 207ft. | 620ft. |
| Tonnage... ... ... ... | 1150 | 12,950 |
| Horse-power... ... ... | 740 | 30,000 |
| Speed ... ... ... ... | 8½ knots | 21½ knots |
| Consumption of coal per day... ... ... ... | 38 tons | 600 tons |
| Passage ... ... ... ... | 14⅓ days | 5½ days |
| Accommodation ... ... | 115 passengers | 1400 passengers |

The crew of the Lucania is divided into three departments, and numbers all told, sailing 54 hands, engineers and firemen 190, and stewards 179, total 423 hands.

It will be readily understood that such ships as the Lucania and Campania cannot properly be utilised unless the dock accommodation provided for them is adequate. Vast, however, as is the system of Liverpool Docks, it can scarcely be said that they are wholly satisfactory. Very considerable improvements have, however, been in progress for some time at Liverpool under the direction of Mr. Lyster, to whom we are indebted for the plan on page 50, and for the following information. The improvements are being effected in the Canada, Huskisson, and adjoining docks.

The Canada Lock, forming the northern entrance into the Canada and Huskisson Docks, will be lengthened to 602ft., while its present width of 100ft. will be retained. It will be deepened by 5ft. 9in.—*i.e.*, to 14ft. below Old Dock Sill, or 2ft. below the level of the sills of the Langton entrances. The floor of the chamber of the lock and the sills will be very flat in cross section, to suit the modern type of vessels. The bottom of the Canada Basin in the approaches to the lock will be at least 14ft. below Old Dock Sill. An open timber jetty will be constructed across the south-east corner of the basin, and in its base sluices will be provided. By means of these and the existing sluices the proper depth will be maintained in the basin.

The Canada Dock is to be extended southwards, the western quay being straightened so as to afford 1090ft. of straight berthage. On the east side of the dock, at its south end as extended, a new branch dock 300ft. wide will be constructed, parallel with and similar to the Huskisson Branch Dock No. 2. The new quays of the dock and branch dock will have sheds of the latest type on them. That on the south quay of the branch dock will be a double-storey shed of the same class as that on the east quay of the Toxteth Dock. One of the novel features of these sheds is that the discharge of cargo from the vessels alongside them is effected by quick working hydraulic cranes of a design patented by Mr. A. G. Lyster. These are placed on the wharf, and are capable of being moved from place to place as required. The shed on the south key of Canada Branch Dock will be 1360ft. long and 95ft. wide. The upper floor is of tiles and concrete on buckled plates, carried by wrought-iron girders, the columns supporting the same being spaced very wide apart, so as to present the least interference possible with the cargo and the cartwork in connection with it, which is a great feature of the traffic at the Liverpool Docks. The framing of the roof is also of iron, and the covering is of Welsh slates.

The other buildings at these new quays, where there is more space available, are single storey sheds; that on the west quay of the Canada Dock being 1122ft. long and of 115ft. wide for a considerable portion of its length, and that on the north quay of the Canada Branch Dock being 1044ft. long by 125ft. wide for 782ft. and 94ft. wide for 262ft. The new passage between the Canada and Huskisson Docks will be 90ft. wide, with a sill laid at such a level as to give an efficient approach to the Huskisson Dock.

A new half-tide dock will occupy the site of the Sandon Basin and Wellington Half-tide Dock. It will have three entrances from the river, one 100ft. wide, one 80ft. wide, with their sills laid at the level of 20½ft. below Old Dock Sill, which will allow of the largest vessels, such as the Lucania, entering or leaving it on all tides; a smaller passage, with locks, will also be provided for the use of flats and small craft. On the site of the present 80ft. lock entrance to the Huskisson Dock, a new deep entrance, 90ft. wide, will be formed, and on the site of the 45ft. lock entrance will be built a new deep water graving dock, 750ft. long, and having an entrance 90ft. wide.

It is not proposed to alter the depth of the Huskisson or Sandon Docks, or of those southward of the new half-tide dock, but after the completion of that dock they, as well as the Canada and Huskisson Docks, will be impounded over low neap tides, and the whole thus formed into a deep water system, the water being maintained at any desired level, so as to give flotation to the deepest draught vessels in them. The half-tide dock will be worked in the ordinary way to the tide of the day. Soon after high water the outer gates will be closed, after which the half-tide will be levelled up, so as to allow of the free passage of vessels throughout the system.

By this scheme a very large amount of quayage which, by reason of the comparative shallowness of the docks, their entrances and approaches, is not now available for vessels of the deepest draught, will be brought into full use for such vessels at all tides. This is following a system which has been largely adopted at Liverpool, where the demand for deeper water has been answered by adopting the method of impounding and pumping, in preference to any works of re-construction of the old docks, which would necessarily be exceedingly costly, and throw the docks in question out of commission for long periods. The pumping and impounding system has been fully described by Mr. Lyster, as in use at the Brunswick-George's Group at Liverpool, and in the Birkenhead Docks on the other side of the Mersey.

The pumps at Coburg Dock were provided in 1889 with the object of maintaining, during neap tides, an abnormal level of water in the group of docks from Brunswick to George's inclusive. The sills and bottoms of these old docks being laid at levels about 6ft. below Old Dock Sill datum, under normal conditions no vessel drawing more than about 16ft. could remain afloat in them during neap tides. In order, therefore, that they might be constantly available for modern deep-draught vessels, the water is impounded in them over low neap tides, and the installation of pumps now in question takes water from the river into the docks to make good losses by leakage, lockage, &c. By these means the effective depth of the Brunswick - George's Group is made not less than that of the lowest sills over which they can be approached, viz., 12ft. below datum. The passage to and from the impounded system for vessels requiring the extra depth of water is by way of Herculaneum, Harrington, Toxteth, and Union Docks, the last named serving as a lock from the Toxteth Dock at tidal level to the Brunswick Dock at the impounded level. Shallow draught vessels can enter the impounded group by way of the Brunswick half-tide, Coburg, Queen's half-tide, and Canning half-tide, which are, when required, opened to the tide of the day, and levelled up to the impounded level after high water. The total area of the docks in the Brunswick-George's Group to which the additional depth of water is given is seventy-nine acres. A similar installation of pumps at the Wallasey Dock, Birkenhead, erected in 1890, provides the required additional depth for docks there, in which a similar condition of old shallow sills obtains, the area affected in this case being about 160 acres.

The contract for the machinery required that the pumps should be capable of raising 11,400,000 gallons = 1,824,000 cubic feet, through a height of 10ft. in one hour, and this requirement was more than fulfilled. In the trials made, the maximum discharge in any fifteen minutes was at the rate of about 1200 tons per minute for the three pumps, this being through a mean height of 7¼ft. In each case there are three centrifugal pumps driven by vertical inverted compound condensing engines, arranged tandem fashion, and independent of each other, providing the pumping power. The main dimensions of the engines are as follows:—

| | |
|---|---|
| H.P. cylinder ... ... ... ... ... ... | 22in. diameter. |
| L.P. cylinder ... ... ... ... ... ... | 40in. diameter. |
| Stroke ... ... ... ... ... ... ... ... | 30in. |
| Revolutions ... ... ... ... ... ... ... | 90 per minute. |
| And of the pumps— | |
| Fans ... ... ... ... ... ... ... ... | 90in. diameter. |
| Suction and delivery pipes ... ... ... | 54in. diameter. |
| Pump casing... ... ... ... ... ... ... | 16ft. 6in. |

This plant was provided by Messrs. J. and H. Gwynne, of Hammersmith Ironworks, the pumps being of the "Invincible" type. Steam is provided by five Lancashire steel boilers, 30ft. long and 7ft. 6in. diameter. Each flue has four Galloway tubes. The working pressure is 100 lb. to the square inch. The feed-water is passed through a Green's economiser, having five groups of sixty-four pipes each.

Before concluding, we have to express our thanks to the Cunard Company, and especially to Mr. Arthur Moorhouse, the secretary, and to Mr. Bain, the superintending engineer, for the facilities for sketching afforded our special artist. To Mr. Lyster also we have to express our obligations for the information concerning the new dock works.

WRECK RAISING.—The prospectus is issued, as will be seen from our advertisement pages, of the British Wreck Raising and Salvage Company. The object is to undertake salvage of all descriptions of sunken vessels. The capital is to be £100,000 in £5 shares.

HARBOUR WORKS FOR VERA CRUZ.—According to a recent Foreign-office report, the construction of the sea wall for the protection of Vera Cruz Harbour from the heavy seas that during the winter months have so constantly impeded the works in the bay is progressing. The foundation of the outside casings of the wall across the north passage, between the shore and the island of Ulna, is almost completed; but the coping has been nearly all destroyed by the waves. Up to March 2nd, 590ft. of the foundations for the inside casing or wall have been laid, and there remain but two tiers of blocks to be completed before the coping. Sand dredged from the bay is being deposited between these two casings, to fill in the wall. The silting of the sand in the bay, owing to the stoppage of the north passage, is a serious matter. The sand has collected to the southward, and is threatening the Customs Pier. The shoal water at the piers often stops work, lighters being prevented from going alongside the piers through broken water and want of depth. Unless preventive measures are taken in time, much damage may be expected. A hopper dredger and sand pump capable of dredging 200 tons per hour, and of carrying 300 tons in her deposit, has commenced constant work, and is to be supplemented by another. To prevent the entrance of sand from the north, the passage left in the breakwater for the current to pass is to be blocked. There is already a return for the capital and labour expended on the enterprise, and vessels can discharge during weather which previously would have stopped all communication with the shore. As the work proceeds, the number of weather working days in Vera Cruz increases.

## H.M.S. FERRET.

THE official trial of H.M.S. Ferret, built by Messrs. Laird Brothers, of Birkenhead, took place on the Clyde on Tuesday, the 10th inst., in the presence of Mr. Deadman and Mr. Pledge, representing the Constructors' Department of the Admiralty, and Mr. Ellis, the Engineer-in-Chief, and Mr. Hobbs, of Devonport Dockyard. The builders were represented by Mr. J. M. Laird and Mr. R. R. Bevis, jun.

The following tables give the results as recorded for the runs on the mile and for the three hours' continuous steaming, and the regularity of the performance throughout is especially worthy of notice:—

*Six Runs on Measured Mile.*

| Miles. | Steam. | Vacuum | Revs. | Ind. H.P. | Speed in knots | Means. | Second means. | |
|---|---|---|---|---|---|---|---|---|
| 1 | 170 | 25·2 | 351·0 | 4127 | 26·866 | — | — | |
| 2 | 168 | 25·0 | 356·9 | 4375 | 27·170 | 27·018 | 27·178 | 27·612 |
| 3 | 173 | 24·8 | 363·3 | 4542 | 27·506 | 27·338 | 27·581 | |
| 4 | 175 | 24·8 | 369·6 | 4671 | 28·125 | 27·825 | 27·820 | |
| 5 | 172 | 24·8 | 364·1 | 4656 | 27·506 | 27·816 | 27·871 | |
| 6 | 175 | 24·5 | 373·2 | 4672 | 28·346 | 27·926 | — | |
| Means | 172·17 | 24·85 | 363·0 | 4507 | — | — | — | 27·612 |

*Six Half-hours.*

| Half-hours. | Steam. | Vacuum. | Revs. | Indicated horse-power. | | | Speed. |
|---|---|---|---|---|---|---|---|
| | | | | Starb'd. | Port. | Total. | |
| 1 | 173 | 25·0 | 350·1 | 2184 | 2137 | 4321 | Mean speed of ship, 27·51 knots. |
| 2 | 175 | 24·75 | 362·3 | 2367 | 2269 | 4636 | |
| 3 | 170 | 24·75 | 365·1 | 2411 | 2399 | 4810 | |
| 4 | 171 | 24·5 | 362·4 | 2304 | 2204 | 4508 | |
| 5 | 161 | 24·75 | 361·0 | 2222 | 2112 | 4334 | |
| 6 | 163 | 24·75 | 359·5 | 2189 | 2145 | 4334 | |
| Means.. | 169 | 24·75 | 360·07 | 2279·5 | 2211 | 4490·5 | 27·51 |

The three hours' trial was commenced at 10.15 a.m., the vessel having her full normal weight on board, the coal in bunkers being 26 tons, and the average speed for the whole time was found to be 27·51 knots, with 361 revolutions.

After the run, the usual trials as to manœuvring were made. The helm was put from hard over to hard over both ways in less than twelve seconds each at full speed, and the steering was proved to be entirely satisfactory.

There was a remarkable absence of vibration when running at full speed, and no hitch of any kind occurred in the machinery. The speed for the six runs on the measured mile is the highest ever yet recorded by any vessel for her Majesty's Navy on the Admiralty official trial, and seeing that the speed of the engines is only 361 revolutions per minute, there seems no likelihood of there being much difficulty in maintaining this at future times when the vessel is in commission.

THE INCORPORATED ASSOCIATION OF MUNICIPAL AND COUNTY ENGINEERS.—At the annual meeting in London, in June, it was suggested that an endeavour should be made to hold a meeting of the Association in Brussels during the month of August, and at the Council meeting held on the 7th inst. it was decided that such meeting should be held, and that members should leave London on August 17th, subject to necessary arrangements being made in Brussels.

PHOTOGRAPHIC TRACINGS.—We have received from Messrs. Smith and Co., Manchester, some samples of their new "Simplex" sensitised paper, for making photographic tracings with black or nearly black lines on a white background, instead of the blue prints or mauve lines on an imperfectly white paper. The new paper provides the means of obtaining copies of tracings in a very easy manner, and with great clearness. Its chief advantage over the gallic acid and cyanotype processes lies in the fact that it only requires a water bath for development, no chemicals being required. After being sufficiently exposed in the usual way, it is simply immersed in clean water, and in about a minute the lines come out black. To be able to dispense with chemicals is a great advantage, and a good clear black line has been much wanted. There is no doubt this paper will rapidly find favour among engineers and architects.

PARIS EXHIBITION.—Thirty-six projects for what is called the Clou, or main attraction, of the Paris Exhibition for 1900 have been sent in to the special sub-committee. The well-known engineer, M. Armengaud Jeune, proposes the offering of handsome prizes for solutions of the three problems, transmission of sight to a distance, chromo-photography on paper and electric lighting without focus, by cold light with the aid of electric undulations of great frequency. M. Flammarion, the astronomer, proposes a shaft showing the various geological epochs with their inhabitants, and also an arrangement by which the spectator would witness the revolution of the earth as if from the surface of the moon. M. Trouvé, the electrician, advocates a luminous cascade falling from the upper platform of the Eiffel Tower and also a luminous fountain rising to the same height. A bridge, 100 metres, or 330ft. wide, is to be thrown across the Seine opposite the Invalides, and lined on either side with houses and shops like the old Pont Neuf and Old London Bridge.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—The half-yearly meeting of this Association was held in the K Room of the Cannon-street Hotel on Saturday, the 7th inst., at 7 p.m., when the president, Mr. W. H. Bale, occupied the chair. The balance-sheet for the past half-year was submitted, showing the total amounts standing to the credit of the Association on June 30th was £4816 12s. 11½d., and the net increase during the half-year £124 9s. 1d. The auditor reported the books well kept, and the accounts correct, and the president having expressed satisfaction with the result, the balance-sheet was adopted unanimously. After some general business was disposed of, a lecture was given by Mr. Wm. T. Coates, past-president, on "Modern Technical Education." Mr. Coates said he had attended the recent conference in the County Council offices, and was disappointed with the result so far as it concerned the training of engineers. As at present conducted, technical education is a misnomer, as it did not make those taught better workmen, but more often caused foremen much trouble in their endeavour to get work done in a reasonable time, as in schools and colleges the teachers did not appear to consider the time element at all. He was strongly in favour of youths and men being taught the principles of their trade, chemistry, mathematics, drawing, &c., so as to improve their intelligence and increase their aptitude for receiving and carrying out instructions; but was decidedly against actual work being undertaken, especially under the tuition of men with little workshop experience. Several members expressed opinions on the subject more or less in accord with the views of the lecturer, the general feeling being favourable to the old method, by which a youth worked in the shop during the day, learning to use his hands and tools, and in the evening attended classes where he learned to use his brains and utilise them in the assistance of his hands. One gentleman stated that the facilities for obtaining instruction were now so good, and the conditions of labour so much improved since his youth, that if men did not learn to be good workmen it must either be because of natural inability, indifference, or disinclination to make the extra exertion required from all who would obtain knowledge. The proceedings closed by a hearty vote of thanks being awarded to Mr. Coates for the way he had brought the subject before the meeting.

## RAILWAY MATTERS.

The formal opening of the West Highland Railway has been postponed.

The directors of the Gloucester Railway Carriage and Wagon Company have recently appointed as assistant manager Mr. John W. Howard.

The construction of a line from Stavropol to Caucaskaia has lately been completed, and the railway is now being extended from Caucaskaia to Bogaty-Rodnik, about seventy-six miles.

The construction of the railway from Acre to Caiffa and Damascus is completely at a standstill, owing to delayed negotiations between the contractors and an American syndicate. Only the first eight miles have been completed.

The railway from Beyrout to Damascus will not, it is expected, be opened for traffic before the end of 1895, in consequence of difficulties of a technical character, as well as obstacles in the way of obtaining possession of the necessary lands.

The officers of the roadway department of the Union Pacific Railway in Oregon, which was recently washed out, estimate the total loss at 375,000 dols., or less. About half of this is the damage to the road bed, and the rest is to cover damage to cars and engines and loss of business.

A concession for the construction of a line from Beyrout to Biredjik, on the Euphrates, has been obtained by the Compagnie du Chemin de Fer de Beyreuth-Damas. The line will be about 360 miles long. Surveys are being made, but the construction will take eight or ten years.

The Boston Elevated Railroad Bill has finally been passed by the Massachusetts Legislature, and been signed by the Governor. It is also called the Meigs Railroad Bill. There is a provision requiring the whole question to be referred to the voters of Boston before the law can take effect.

A large railway project is said to be on foot in Japan, which will connect Tokyo and Yokohama with Kyoto and Osaka, traversing such rich industrial districts as Tajimi and Nakatsugawa, in the province of Mino. The total distance of the line is estimated at 338¾ miles, and the cost at 21,000,000 dols.

In connection with the London and North-Western tunnel extensions in Birmingham, arbitration is proceeding to assess the compensation to be paid by the company to the trustees of Sir Josiah Mason's Orphanage for property which has been taken by the company compulsorily. The area is 2168 yards. The jury awarded £18,463.

We have received from the Street Railway Publishing Company the first number of "American Street Railway Investments," being a supplement to the *Street Railway Journal*. Its object is to give greater publicity than has hitherto been possible to the condition of street railway securities, and thereby ensure for them a quicker and readier market.

The Budapest Electric Conduit Railway, the success of which has been so often referred to, parts of which have been in operation for nearly five years, has a length of about 7·628 miles of double track, with which are connected about 3·26 miles of double track overhead trolley lines, and about 4·16 miles of single track line, operated by steam motors. The rolling stock consists of eighty-two motor cars and ten trailers for the electric roads and five locomotives, nine passenger and three freight cars for the steam lines. The electric system is run with 300 volts, all of the dynamos being connected to omnibus bars. The leads are made of lead-covered cables, armoured with iron bands and laid directly in the earth. They lead to junction boxes, from which others run along the road, and are connected at intervals by means of short branch conduits to iron leads in the main conduits, which are much like light cable road conduits. They carry two angle-bar conductors, one positive and one negative, from which the current is taken by a double collector projecting down from the car body through a slot rail into the conduit.

There has been for some time an effort to supply the demand in America for a good oil fire-kindler, and a device invented by Mr. J. S. Leslie, of Paterson, N.J., is now being successfully used on several railways. It deserves notice on account of its efficiency, cheapness, and convenience. The *Railroad Gazette* says:—When a fire is to be kindled, sufficient coal is thrown into the fire-box to cover the grate thoroughly, a burner, with two small flexible pipes attached—one each for air and oil—is connected by suitable hose couplings to the combination valve; then, by opening the combination valve, the oil is supplied automatically, and the air and oil are simultaneously admitted to the burner. A small piece of greasy waste is then lighted and thrown into the fire-box on top of the coal; the air and oil are then turned on to the burner by their respective valves, and the necessary quantity of oil is fed automatically by the air pressure, thus making it practically impossible to injure the fire-box sheets by overheating. When the fire has been kindled, the combination valve is closed, and the supply of air and oil is cut off. The oil remaining in the pipe is then automatically returned to the auxiliary tank, after which the burner is disconnected.

On the Northern Railroad of France some experiments were recently made with Serve ribbed boiler tubes in a stationary boiler of the locomotive pattern. In this boiler the grate had an area of 14·4 square feet; the old plain tubes were 166 in number, 1·97in. diameter, and 14·65ft. in length. The heating surface in the furnace had 82 square feet, and in the tubes—before alteration—1151 square feet; the steam pressure was 92·4 lb. per square inch. The boiler under trial was tested alone, and also when working along with the other boilers. The first Serve tubes tried were 2in. diameter and had ribs of a depth of 0·43in., which raised the heating surface from 1233 square feet to 2336 square feet, but reduced the section open to the passage of the gases from 2·84 square feet to 2·56 square feet. The *Engineering and Mining Journal* says that with natural draught the vaporisation per lb. of coal was very slightly increased, the same amount of steam being made in the day with a somewhat reduced consumption. With forced draught, however, the production of steam per lb. of coal was increased by as much as 12·5 per cent., the best effort being got with a draught pressure lying somewhere between 1¼in. and 2¼in. of water. The temperature in the smoke-box was lowered from 518 deg. F.—with smooth tubes—to 338 deg. The temperature of the steam being 322 deg., it is seen that very little more use could possibly have been made of the combustion. The objection, however, to this experiment was that the tubes often got choked with ashes; and therefore a tube of 2·05in. diameter was tried with with ribs 0·35in. in depth, the ribs extending to a length of 8·2ft. only, and the rest of the tube being smooth. The section for the passage of gases was now increased to 2·69 square feet, and less choking of the tubes occurred; the efficiency was much the same as in the preceding case. Tubes of the same size were therefore tried ribs of 0·275in. projection, both extending the whole length of the tube, and also for a length of 8·2ft. only. The results were much the same, whether the rib was of the full length of the tube or not, and showed a vaporisation of 25 per cent. in excess of that of smooth tubes for the same amount of fuel, with a draught of 3in. water pressure. With tubes of this depth all difficulty as to choking disappeared. With the shallower ribs, it was found that a greater draught gave maximum economy than with deeper ribs. The tubes used in these trials have now been fitted on two locomotives under repair, with an increase of weight in one case of 154 lb., and in the other of 220 lb. Fresh experiments in service with these locomotives are now in progress.

## NOTES AND MEMORANDA.

The deaths registered during the week ending the 7th inst. in thirty-three great towns of England and Wales corresponded to an annual rate of 16·1 per 1000 of their aggregate population, which is estimated at 10,458,442 persons in the middle of this year. Croydon and Leicester were phenomenally low, their rates being only 7·9 and 9·6 respectively. Salford was highest and worst with 23·6.

According to a method of detection of traces of chlorine, by MM. A. Villiers and M. Fayolle, the chlorine is liberated by permanganate in presence of sulphuric acid, and shows, *Nature* says, even in small traces, a blue coloration, becoming red-violet when treated with the following reagent in excess: saturated aquaeous solution of colourless aniline 100 cc., saturated aqueous solution of orthotoluidine 20 cc., and glacial acetic acid 30 cc.

At a recent meeting of the Paris Academy of Sciences, a paper was read on "The Principle of Maximum Work and Entropy," by M. Berthelot. A general discussion of the theory of maximum work, treated under the heads—(1) Chemical action and the disengagement of heat; (2) the principle of maximum work; (3) entropy; (4) a comparison of the consequences of the principle of maximum work and those of entropy.

The following has been given in the *Papier Zeitung* as cement for leather belting, in addition to those published last week:—250 parts of gold size, 60 parts of isinglass, and 60 parts of gum arabic are boiled in a water-bath until a homogeneous mixture is formed; 5 parts of Venetian turpentine, 6 parts of turpentine oil, and 10 parts of spirits of wine are then added. The joint, after cementing, is pressed between hot plates and allowed to get quite cold before the pressure is removed.

In London, during the week ending the 7th inst., 2254 births and 1314 deaths were registered. Allowing for increase of population, the births were 329, and the deaths 239, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 16·0, 16·0, and 15·4 in the preceding three weeks, increased again last week to 15·8. During the four weeks ending on Saturday last the death-rate averaged 15·8 per 1000, being 2·0 per 1000 below the mean rate in the corresponding periods of the ten years 1884-93. In Greater London 3095 births and 1656 deaths were registered, corresponding to annual rates of 27·1 and 14·5 per 1000 of the estimated population. During last week the London death-rate rose to 16·3, against 15·9 for the thirty-three great towns.

The beautiful colouring of certain varieties of glass now produced in Germany, and which is said to far excel some of the most noted French specimens, is an art practised, by the glass-blower at the furnace, by means of an apparatus consisting of a sheet iron cylinder 20in. long and 8in. diameter, standing vertically, and having a similar cylinder riveted across the top. In the lower cylinder is an opening into which an iron ladle can pass, and the horizontal cylinder is provided with doors at either end, the one nearest the operator being so arranged that the blowpipes can be supported, when the door is closed, in a horizontal split running to its middle, the object to be treated being held inside. While the glassblower is re-heating his work for the last time in the furnace, an attendant takes the long-handled iron ladle, which has been heated red hot, shakes into it about a spoonful of a specially prepared chemical mixture, and places the bowl of the ladle quickly in the opening provided for it in the vertical cylinder. The *Society of Arts Journal* says the mixture immediately gives off vapour, which rises to the horizontal cylinders, where, meanwhile, the blower has placed his work, supported by the blowpipe and heated to an even red, turning it rapidly in the vapour. In a short time the object is covered with a changeable lustre, is removed from the pipe and tempered like other ware in an ordinary oven, then cut, engraved, painted, or gilded as desired.

"The Conditions in which Carbon exists in Steel" was recently the subject of a paper before the Chemical Society, by J. O. Arnold and A. A. Read. The authors have carried out experiments on the condition in which carbon exists in normal, annealed, and hardened steels on a series of five steels containing 0·96, 0·57, 0·33, 0·16, and 0·06 per cent. of carbon respectively. From the results of a number of experiments the authors draw the following conclusions:—(1) The existence is confirmed of a carbide of iron possessing the formula $Fe_3C$, originally discovered by Abel and Müller by independent methods. (2) The normal carbide exists in two different forms identical in chemical composition. (*a*) A diffused carbide is scattered in granules or very small plates throughout the iron in normal steel. When isolated it is a greyish-black powder. (*b*) A crystalline carbide, arranged in comparatively large distinct plates in well-annealed steel; these plates are chiefly in the form of well-marked striæ, and consist of pure $Fe_3C$. They are identical with the microscopical laminæ of Sorby's "pearly" constituent, and they may be isolated as bright silver plates. (3) The percentage of the total carbon obtained as carbide is greater in hard than in soft steels. (4) The above-mentioned loss does not appear to be due to decomposition, but rather to the presence of a readily decomposed subcarbide of iron—containing less carbon than the normal compound—existing to the extent of about 25 per cent. in mild steel, and capable of existing to the same amount in cold hard steel after the latter has been heated for some time at a white heat. (5) The loss being practically the same in well-annealed steel as in the normal steel, it cannot be due, as supposed by Ledebur, to the presence of "hardening carbon." (6) The carbon in hardened steel exists chiefly as an extremely attenuated carbide, or in solution, leaving on isolation a residue consisting mainly of "hydrate of carbon," mixed to a slight extent with carbide of iron.

We have before briefly alluded to the peculiar features attending the spreading of oil upon water, as set forth by M. M. Richter. We now read in *Nature* that this tendency is only due to the free oleic acid contained in the oil, and that if it were possible completely to purify it from oleic acid, it would not spread at all—which statement endorses our previously expressed views. The following experiment is described in the above-mentioned source:—Provence oil was shaken up twice with pure alcohol, the rest of the latter being carefully removed, and a drop of oil was placed upon the freshly formed water-surface in a small dish by means of a brass wire previously cleaned by ignition. The oil did not really spread, but after a momentary centrifugal movement, during which several small drops were separated from it, it contracted itself in the middle of the surface, and a second drop deposited on the same vessel remained absolutely motionless. Of course the surrounding water-surface proved to be in the anomalous state, the tension determined by the method of separating weights being = 0·82 of the normal value. It has been diminished by the "solution current" of the oil—as is called the "contaminating" current when issuing from a body in contact with a clean water-surface—which may be observed if the surface be dusted over with sulphur or lycopodium before placing the oil upon it. The observation of the solution-current, preceding unpurified oil, is more difficult, because the oil itself covers rapidly the whole surface. As soon as the relative tension 0·82 is attained, the slightest trace of a solution current ceases, whilst ordinary oil still shows solution-currents at much lower tensions. The surface-tension 0·82 is the lowest possible that can be produced on water by pure Provence oil; the surface then may be considered as saturated with oil. Evidently the pure oil does not spread over a surface of the minimum tension attainable by its contact with water, because the sum of its surface-tension and the interfacial tension of oil and water, which we may call "tension of equilibrium," is greater than the minimum tension. Therefore upon a clean water surface the oil is repulsed by its own solution current.

## MISCELLANEA.

The French Naval Manœuvres commenced at Havre on Tuesday morning, the 17th inst.

The new channel leading into Alexandria Harbour, having a depth of 28ft., was officially opened on the 2nd inst., and the harbour lights are now shown from sunset to sunrise.

The new packet-boat Ernest Simons, built for the Messageries Maritimes Company, attained a speed of 18 knots on her trial trip. She has a displacement of 6950 tons, and her engines are of 6000-horse power.

The 37mm. (1·46in.) one-pounder Maxim automatic gun has been tried on board H.M.S. Hero with satisfactory results. It weighs 364 lb., the mounting weighing 336 lb. The shell weighs 1 lb., the powder charge 2·8 oz., and the cartridge case 4·6 oz., so that the total weight of cartridge is 1·46 lb.

The Department of Science and Art has received, through the Foreign-office a despatch from her Majesty's Consul at Bordeaux calling attention to an international exhibition of arts, industries, &c., which it is proposed to hold in that city in 1895, under the patronage of the French Government.

An International Grain and Seed Fair will be held on the 27th and 28th August next at the Exchange for Agricultural Produce—formerly Corn and Flour Exchange—in Vienna. All interested in the grain and flour and allied trades are cordially invited to participate in the fair. Particulars can be obtained on application to Die Kammer de Börse fuer landwirthschaftliche Producte in Wien.

The Cambridge Electric Supply Company give notice that, on and after the 8th day of October next, an uninterrupted supply of current will be available at all hours of the day and night throughout the year. It certainly ought to endeavour to make some reparation to the Cambridge townsfolk for the erection of a chimney which is one of the greatest blots we have ever seen in a landscape. A stranger in the place might have thought that a very large and constant supply day and night had long been available, judging by the size, ugliness, blackness, and smoke emitting powers of this chimney.

The work of mobilisation was carried on with great rapidity at Portsmouth and Chatham on Wednesday, and the ships commissioned at Portsmouth put to sea in the afternoon. The gunboats which hoisted the pennant at Chatham arrived at Sheerness in the evening. The first-class gunboat Onyx had to put back into Sheerness harbour before she could begin her trial on account of a serious leak in her foremost starboard boiler. The trial of the gunboat Sheldrake was successful, and she left Sheerness on Wednesday night for Berehaven. The cruiser Northampton left in the afternoon for Portland.

The quantity of coal raised in the Southern portion of Russia, including the Donetz and Krivo-rog districts, amounted in round numbers to 2,194,000 tons last year against 2,058,000 tons in 1892; that of iron ore to 636,000 tons against 527,000 tons; and that of manganese ore to 76,000 tons and 29,000 tons respectively. The quantity of pig iron turned out rose from 269,000 tons in 1892 to 324,000 tons last year, the make of railway bars increasing from 112,000 tons to 134,000 tons. On the other hand, iron and steel merchant bars show a diminution, the former from what is put at 61,000 tons in 1892 to 33,000 tons in 1893, and the latter from 30,000 to 28,000 tons respectively.

The line of mains with service reservoir, required to enable the Darton Local Board to use water obtained from the well belonging to the Penistone Local Board, is now completed. The distance from the well to the reservoir is between nine and ten miles, and the pressure on the mains equals 425ft. head. The works are now being used. The two contracts for iron pipes and general work amounted to £3000 17s. 6d. and £2150 15s. respectively, or a total of £5151 12s. 6d. The actual cost of the works after adding extras, and making deductions, has been £2707 15s. 1d. and £2226 13s. 6d., or a total of £4934 8s. 7d. The works have therefore been carried out for £217 3s. 11d. less than the total contract amounts, and below the engineer's estimate.

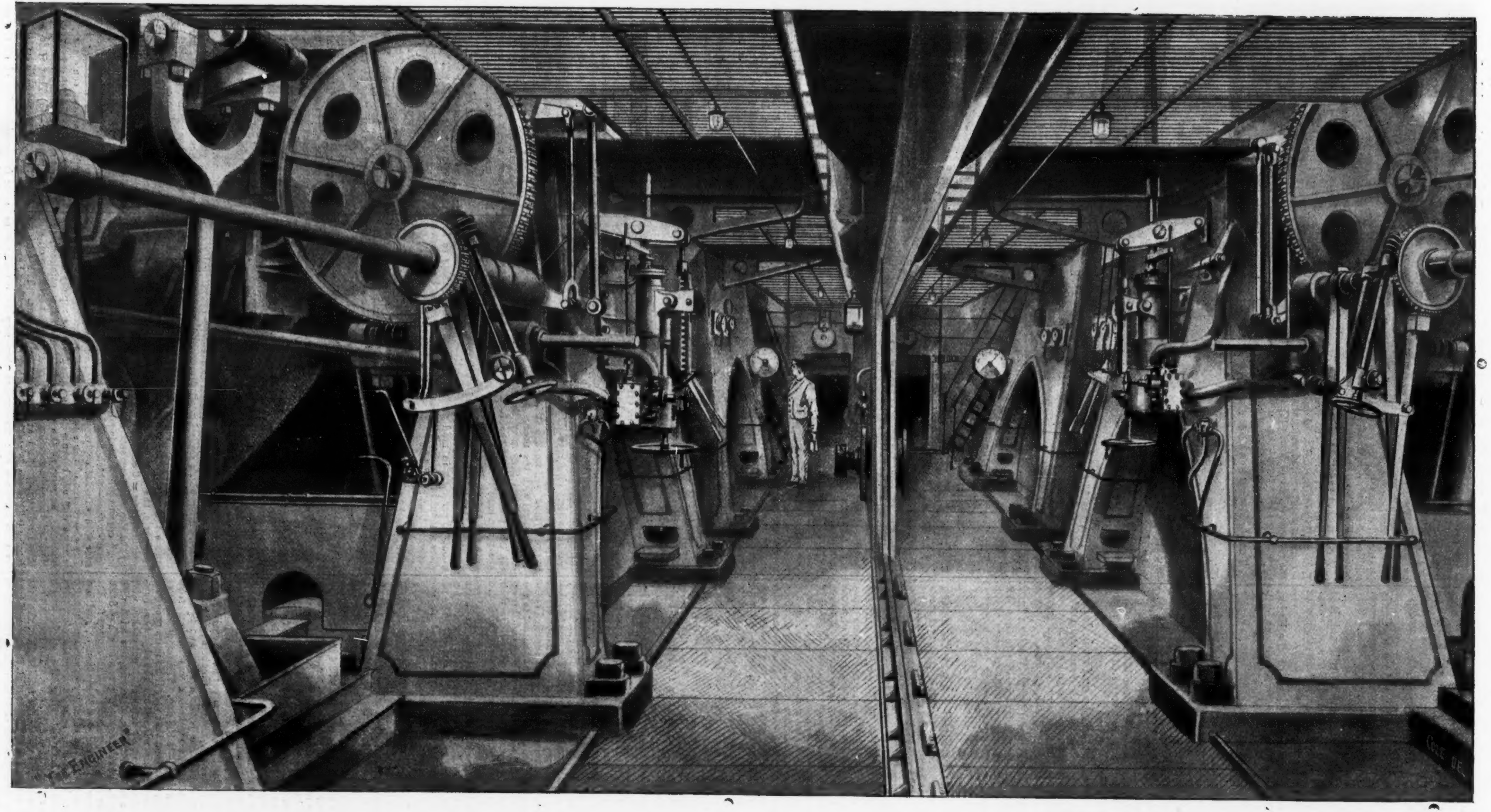
A new fuel gas-making process is in operation at Canisteo, N.Y., by which an excellent gas for heating purposes is distributed to consumers at 25 cents per 1000ft. The process of manufacture is apparently a combined coal gas and water gas process, and the secret of the low price is that the company has to meet natural gas competition. For lighting, the gas is rather poor, though better than natural gas. In the Welsbach burner, however, it gives excellent results. In gas engines it can be used with advantage, and a 10-horse power engine is said to run with it at a total cost of less than 50 cents per day of ten hours. We read in *Engineering News* that the Canisteo Electric and Fuel Gas Company, which owns and operates the plant, is soon to begin laying mains in Hornellsville to supply gas to that place.

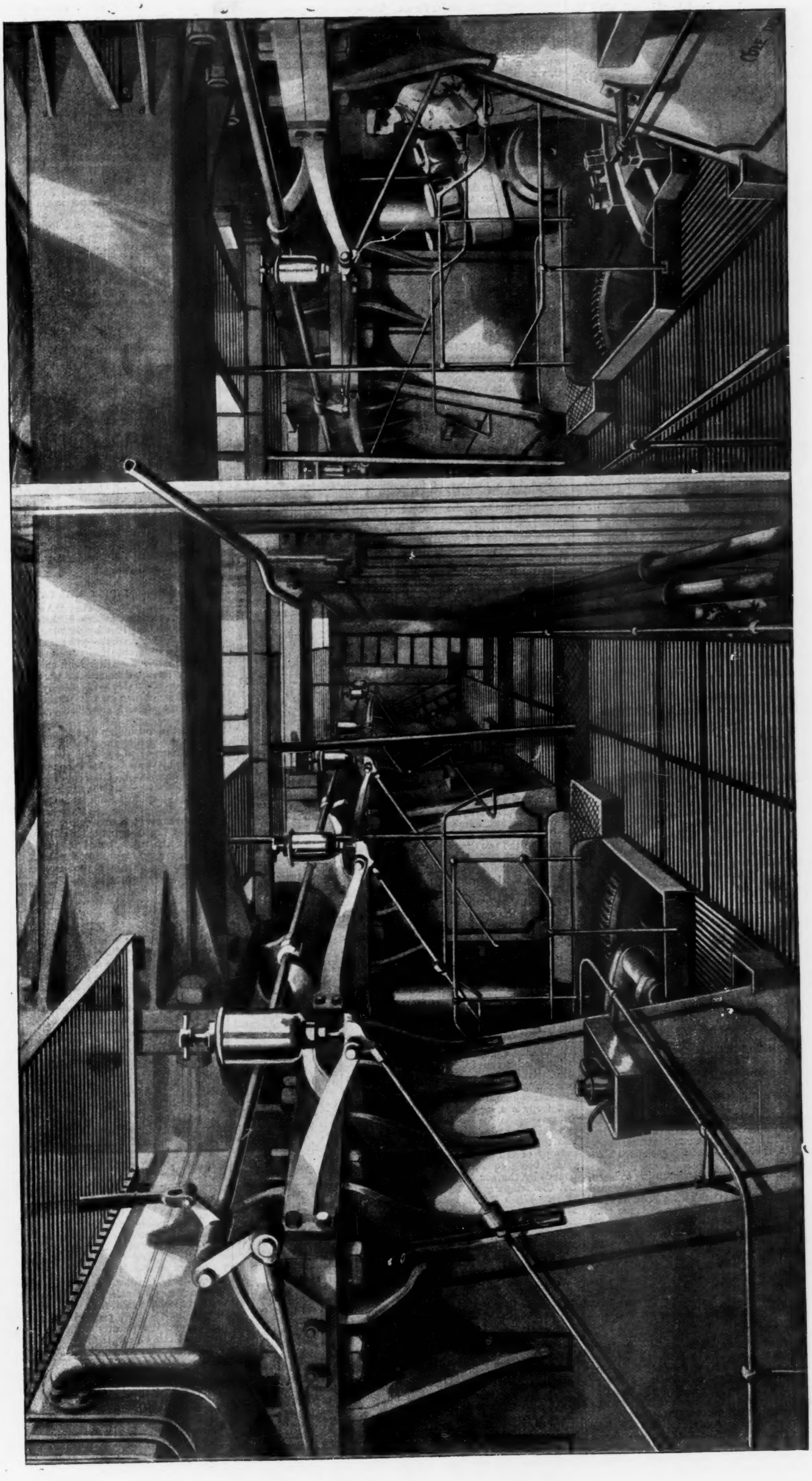
The aggregate of shipping passing through the port of Liverpool in the last year was 9,960,000 tons, being an increase on the previous year of 492,363 tons. The total receipts for the year were £1,128,114, or an increase of £40,231. The report for the year ended on June 30th, 1893, had shown diminished trade, but the excess in the year just closed very much more than recovered the lost ground. The dock board are providing docks capable of accommodating the largest vessels afloat or likely to be afloat—vessels of 700ft. length, with proportionate depth and beam. With respect to the bar, they have already removed, by the help of their monster dredgers, something like seven millions tons of sand, and the result has been to greatly diminish the delays of the very largest steamships at the mouth of the river, while other vessels may now be said to experience no difficulties. It is also expected that early next year a new dock, capable of accommodating vessels even larger than the Campania and Lucania, will be ready for use. Judging from these facts, the conditions and prospects of Liverpool trade appear to be in a much more satisfactory way than was generally expected.

The Admiralty, according to the *Times*, have issued an important regulation with reference to interests in patents or inventions. After reciting the terms of section 27 of the Patents, Designs, and Trade Marks Act, 1883, stating that a patent shall have the like effect as against her Majesty, her heirs, and successors as it has against a subject, the new article notifies that all officers or subordinates who hold staff appointments, or who may be now or hereafter employed in any administrative, instructional, manufacturing, or experimental department under their Lordships, or appointed to any ship for service, are to understand that one of the conditions subject to which they hold such appointment or employment is that they shall not take out a patent, nor seek for provisional protection for an invention, without first obtaining the approval of the Admiralty. Each application must contain a general description of the invention for which protection is desired. Should permission be granted it will be subject to the following conditious, from which there will be no appeal:—(*a*) That if it be at any time desired by the Admiralty the patent shall be absolutely assigned to the Secretary of State for War on such terms as the Admiralty may decide upon, after full consideration of all the circumstances of the case; (*b*) that the invention may be used by or for her Majesty's service, and that the terms of payment, if any, shall be decided by the Admiralty; (*c*) in settling terms either for assignment or use regard will be had by the Admiralty to any facilities in originating, working out, and perfecting the invention which the inventor may have enjoyed by reason of his official position, and all payments will be subject to the approval of the Treasury.

THE ENGINE-ROOM OF THE LUCANIA—LOWER PLATFORM

(*For description see page* 48)


THE ENGINEER



THE ENGINE-ROOM OF THE LUCANIA—MIDDLE PLATFORM

*(For description see page 43)*

# LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

## STRESSES IN A CRANE HOOK.

SIR,—In reply to a correspondent, possibly this will solve his difficulties. Let $\gamma\ \gamma$, Fig. 1, be the vertical straight line through the points of suspension of the hook, and of the load $w$, E F P F the line through the centres of the horizontal sections of the hook, and let P be any point on this line at a distance $x$ from $\gamma\ \gamma$.

Imagine two equal and opposite forces, each equal to $w$, applied at P. These, with the original load $w$, make up (1) a couple of moment $w\,x$, and (2) a force $w$; producing on the area A B H, Fig. 2, (1) a stress $p$, varying from $\frac{w\,x}{z}$ (tensile) at A, to $\frac{w\,x}{z}$ (compressive) at B; where $z$ is the modulus of the section, and (2) a uniform stress (tensile) $\frac{w}{a}$, where $a$ is the area of the section. These two combine in producing stresses whose maximum values are $\frac{w\,x}{z} + \frac{w}{a}$ (tensile) at A, and $\frac{w\,x}{z} - \frac{w}{a}$ (compressive) at B.

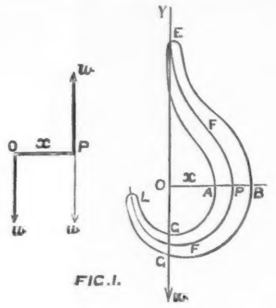


FIG. 1.

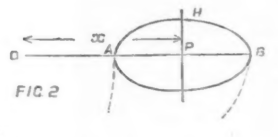


FIG. 2

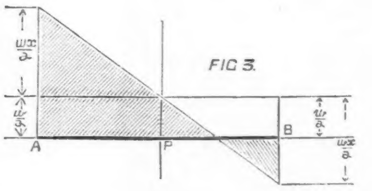


FIG. 3.

The stress diagram for the section A H B is shown in Fig. 3.

The stress therefore is greatest on the line E A G L in Fig. 1. At G, $x = o$, and the stress is $\frac{w}{a}$, where $a$ is the area of the section through G G, and if the hook fails there, assuming there is no flaw in the material, and that it is equally strong under tension and shear, then must $\frac{w}{a_1}$ be greater than $\frac{w\,x}{z} + \frac{w}{a}$,

Or,

$$\frac{1}{a_1} > \frac{x}{z} + \frac{1}{a}.$$

Since the stress along the line E A G $= w\left(\frac{x}{z} + \frac{1}{a}\right)$, it depends on the moment of inertia of each horizontal section, as well as on $x$; it is therefore impossible to give a general diagram for it. Since the bending moment $= w\,x$, the B.M. diagram is evidently the line E F P L, with the straight line $\gamma\ \gamma$ as base.

P. R. K.

July 13th.

## CARNOT AND MODERN HEAT.

SIR,—Just a line before going abroad to say that I fear I cannot help Mr. Oldknow much towards an acquaintance with entropy until he feels clearer about the meaning of more ordinary terms. He asks what I mean by energy, heat, and temperature, and whether I do not confuse the two last together. I can only say I hope not; and that I use all these terms in their ordinary signification. He asks me to explain in a few words the meaning of entropy, and asks if it is not "loss of power to do work." He evidently thinks that people are unnecessarily wordy about something that is really very simple, but I fear he must continue to think so, until he devotes some little time and study to the subject. If energy is power to do work, and for ordinary rough purposes this definition serves well enough, then clearly "loss of power to do work" is loss of energy. It would be ridiculous to invent a fresh phrase to express this childishly easy thing. [I perceive of course that the last word of his query (2) is misprinted.]

One of his questions is definite, and can be answered, viz., what is the change in the value of the entropy of a gas when it receives heat at constant temperature? I answer, the number of heat-units received divided by the number of degrees of the gas above absolute zero.

I would willingly help Mr. Oldknow, or anyone wanting to learn, as far as possible; and perhaps he would carefully and slowly read and analyse the first or easy half of Maxwell's little book on heat, wherein every word is carefully weighed, and every sentence after scrutiny becomes luminously clear. There are so many text-books which are worthy of no more than skimming, that a really precise elementary work like Maxwell's "Heat," or a more advanced one of the same high standard, like Rayleigh's "Sound," is liable not to get its proper meed of careful and reverent study. As to Mr. Bryan Donkin's kind offer of help, I shall very likely be glad to take advantage of it if I continue my articles, as I hope to do, with the theory of the steam engine, somewhere about next October.

OLIVER J. LODGE.

July 14th.

SIR,—I have to apologise to Professor Alexander for not giving him his due title. At the time I wrote the letters, I was not aware of his academic status. I do not fully understand the points at issue between himself and Dr. Lodge, but think I am right in concluding that Professor Alexander admits that he has failed to prove that the scale of an air thermometer graduated with equal intervals, whether the air is subjected to constant pressure or is kept at constant volume, corresponds with Thomson's absolute scale.

What does Professor Alexander mean by saying that two things, very different in kind, may be numerically equal? Does he mean, for instance, that 2 lb. of cherries are numerically equal to 2 lb. of beef? That may be so, but he cannot equate 2 lb. of cherries to 2 lb. of beef, or a number of foot-pounds to the differential coefficient of a pressure, or the difference between a number of foot-pounds and a number of pounds of pressure to a volume, or a number of pounds of pressure to a volume. The illustration he has chosen is very infelicitous, since all the members of the equations cited are of the same dimensions.

Neither Professor Rankine nor Professor Alexander has made a mistake in first obtaining general expressions for the laws, and then deducing particular forms. The mistake they have made lies in the fact that they have not arrived at true general expressions for the laws. I have demonstrated in my work on the efficiency of water-wheels, that Rankine's general equation for the value of the impulse exerted by a jet of water against a vane is utterly wrong, and that only one particular solution can be deduced from it, viz., that of the case of a jet striking a flat vane normally, and that this particular solution can be obtained from the general equation, simply because it is unaffected by the erroneous assumption on which the general solution is based, viz., that the relative velocity after impact is equal to the relative velocity before impact. I am obliged to Professor Alexander for giving me his definition of the meanings of the symbols M and N. Mr. Mansel's definition of M, that it is a number of thermal units of latent heat, admits of a different interpretation. In a letter under the title of "Latent Heat of Steam," with which, however, the contents of the letter have nothing to do, "Student" states that M is the latent heat of dilatation. For the purpose of the present discussion we will assume that all three definitions mean the same thing, and agree with Professor Alexander's definition, so that we have—

M = heat absorbed per unit of increase of volume by a unit of mass of air, whose temperature remains constant when it is expanding.

Now the heat absorbed during isothermal expansion, when the volume is increased by unity, is equal to the heat emitted during isothermal compression, when the volume is decreased by unity. If, then, $v_1$ represents the volume of unit of mass of air at temperature $t_1$ and pressure $p_1$, we shall have

$$M = p_1\,v_1 \log. \frac{v_1 + 1}{v_1}$$

since the product of the volume multiplied by the pressure is constant, so long as the temperature remains constant. For any other pressures and temperatures $p\ t$ the volume is by the law of Boyle and Marriotte equal to $\frac{p_1\,v_1\,t}{p\,t_1}$ and we get for the values $p\ t\ v$

$$M = \frac{p_1\,v_1\,t}{t_1} \log. \frac{p_1\,v_1\,t + p\,t_1}{p_1\,v_1\,t}$$

Not only is therefore M, but also its differential coefficient with respect to $t$, equal to a number of foot-pounds. If the general equation is true, therefore, in the case of air, for which N is constant, we have J equal to the differential coefficient of a pressure divided by a number of foot-pounds. Is Professor Alexander satisfied that his particular solution is true? If this particular solution is not true, the general equation from which it is derived cannot be true.

What justification can Professor Alexander bring forward for insinuating that I have ever professed to be ignorant of mathematics? The acknowledgment that I know very little of Thomson's writings is neither a profession of ignorance of mathematics, nor an acknowledgment that I do not thoroughly understand *fin de siècle* thermodynamics. The nature of the information I have obtained from a slight study of Thomson's writings on heat has been fully expounded in your own correspondence columns and those of the *Electrical Review*.

"Student" should not forget that it is the *rôle* of a student to learn, not to attempt to teach. I wonder whether he ever asks himself the question, Do I understand what I read and write? He states that the first law of thermodynamics gives us

$$J\,dQ = dE + dW \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $d\,Q$ = quantity of heat received by the body $d\,E$ = internal work done, and $d\,W$ = external work done. In my criticism of part of Dr. Lodge's articles, I demonstrated that the second law of thermodynamics is utterly erroneous. Dr. Lodge, in his review of the reviewer, did not attempt to find any flaw in my demonstration, and I am therefore justified in concluding that he was unable to do so. The first law of thermodynamics is simply the law of the convertibility of heat and work. How does "Student" measure quantities of heat except by quantities of work—by a number of foot-pounds for instance? If "Student" measures quantities of heat in this way, equation (1) states that the product of a number of foot-pounds multiplied by a number of foot-pounds is equal to the sum of two numbers of foot-pounds. The whole Clausian system is, in fact, as I stated at the outset, simply a confused jumble of the two theories of heat. Equation (1) is not true either in accordance with Carnot's theory of heat, or with the theory of the convertibility of heat and work. If "Student" will eliminate the factor J from equation (1), the resulting equation will be true, if heat and work are convertible.

If "Student" will compare the closing paragraph of his own letter with the opening paragraphs of Professor Alexander's letter, his spirit cannot fail to feel a salutary chastening influence.

July 9th. WILLIAM DONALDSON.

SIR,—Mr. Oldknow has very little chance of further enlightenment. Dr. Lodge has obviously told all he knows about entropy to your readers. It is not his fault if he is not clear, it is the fault of the subject.

Entropy is derived from two Greek words, signifying "within" and "nourishment." It is the invention of Clausius, and would not have been heard of in this country if the late Walter Browne had not done Clausius into English. There are not at this moment half a-dozen engineers in Great Britain who know what the word is intended to mean. I believe that I am one of them; Mr. MacFarlane Gray is another, the celebrated Theta Phi diagram being a species of graphic representation of entropy. The said diagram is known to the profane as the "Tater Pie" diagram.

Entropy is a negation, it implies the incapacity of something. Let us suppose, for example, that we have a certain quantity of a gas which contains 33,000 foot-pounds of energy. How much of this cannot possibly be utilised? In other words what is the entropy of the gas? Now, the available energy of a gas, other things being equal, varies as its temperature. Divide the foot-pounds by the absolute temperature and you have the entropy. Let the temperature be 760 Fah., then the entropy is 43·4, and so on. When the temperature is lowest the entropy is highest. It is at a maximum at absolute zero.

The whole affair is of no practical value whatever. It is a species of algebraic abstraction of the sort dear to the German mind. It possesses the same interest as some of Professor De Morgan's speculations on a fourth dimension.

X.

Westminster, July 17th.

## THE MECHANICAL EQUIVALENT OF A HEAT UNIT.

SIR,—As it seems to me to be so singular that all your correspondents should be ignorant of the results of the latest researches in that direction, I venture to present the full paragraph written by Commodore Isherwood, U.S.N., in his report made to the United States Navy Department in 1883, regarding his experiments on the Herreshoff steamer Siesta:—

"The mechanical equivalent of 1 deg. Fah. unit of heat is habitually—but erroneously—taken at 772 foot-pounds, as given by Joule; but the later experimental researches of H. Tresca and C. Laboulaye, to determine the true mechanical equivalent of one calorie—endorsed by Regnault, Piobert, Combes, Bertrand, and Morin—a Commission, appointed by the French Academy to investigate and report upon the subject, give 433 kilogrammetres as the mechanical equivalent of one calorie, which is 789·2385 foot-pounds for one Fah. unit of heat." (*Comptes Rendus* of February 13th, 1865, page 326.) "In reaching this final determination by experiments on air, the experimenters took into consideration every possible correction, and used the best methods which the combined science of the time could devise. The apparatus furnished by the French Government was on a large scale, and as perfect in its design and adjustment as mechanical skill could achieve."

WILLIAM H. HARRISON.

Braintree, Mass., July 5th.

## OIL ENGINE TRIALS AT CAMBRIDGE.

SIR,—The figures of the results of trials as given in your issue of July 6th are, in some instances, so different to what persons engaged in oil engine experiments and construction might expect, that I am tempted to ask if the figures given are correct.

Take No. 1 engine—the Britannia Company. The oil used at full power and at half load is practically the same, when engine friction is taken into account the half load trial is much better than the full load, a result which none of the other engines show, and is hitherto contrary to experience. This engine and Messrs. Crossley's are of the same, type, *i.e.*, using lamps always burning to heat the vaporiser; yet contrary to the result obtained with the Britannia Company's engine, the Crossley engine uses ·5 lb. oil more at half power than at full power. It seems impossible that both these results are correct.

The brake horse-power of the Crossley engine should, I think—from the figures given—read 7·09, not 7·3; if the former is the correct reading the oil used would be ·844 lb., not ·82 lb. The so called half loads seem to vary considerably, from just over half load in one case to two-thirds load with another.

I cannot agree with you that the re-lighting of a starting lamp during a run is of little moment. If the engine is used for electric lighting, and, as several engines often are, is left for two or three hours without the attendant going near them, there is nothing to prevent the engine stopping if half or more lamps are switched off. In future trials I should suggest that a trial be made by running the engines for four or five hours without the men in charge being allowed to touch the engines after they are fairly started. This would plainly show how much attention any engine would require.

JOHN HENRY KNIGHT.

Barfield, Farnham, July 14th.

[Mr. Knight is correct in his observation that the different engines gave apparently very discordant figures, but he has not noticed that they ran in very different ways, varying from satisfactory running to different stages of badness, and even stoppage. The oil used includes that which was wastefully used as well as that which was consumed in proper running. An engine which would not govern well on full load, and lost oil from this cause, need not govern more unsatisfactorily on half load, and the full load consumption would then come out higher proportionately. The 7·3-horse power is a misprint for 7·03, which gives 0·82 lb. per brake horse-power. The 7·03 is, however, an incorrect transfer, and the suggested 0·844 would be wrong. The remark to which Mr. Knight refers regarding the use of a fan and lamp during a run must be taken as relating to an agricultural engine. There would no doubt be very considerable objection to such a requirement for electric lighting work, especially on a small scale, when the attendant may find it necessary to be in attendance on other things just when the relighting of a starting lamp might be required.—ED. E.]

## INDIAN RAILWAY CONTRACTS.

SIR,—Your correspondent "An Indian Engineer" does well in drawing attention to this important subject. Surely no useful purpose can be served by drawing the trade out of this country and the Indian markets—yet such appears to be now the misguided policy of our rulers.

Trade is bad enough in both countries, without giving out contracts to foreign countries for work which in many instances could be better and more economically executed in our own; even if this were not the case, it would still be unwise policy to favour foreign competition, as against our own interests and those of our colonies.

With the concluding portion of the letter I also entirely agree, for it is a startling fact that the confidence of the natives of India in the honesty of our administration is being shaken in a great measure by the policy we are pursuing.

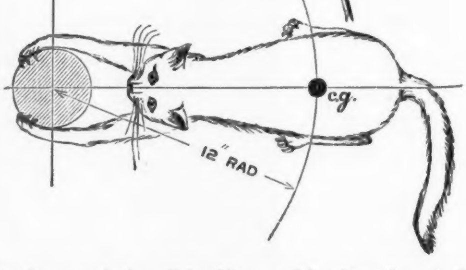
The depreciation of the rupee—more especially as affecting the cotton industry—has already resulted in a marked falling off of our export trade with India, China, and Japan, and is inflicting great hardships upon the natives of India in their dealings with the merchants of this country. Seeing how matters stand, is it not time the Government devised some scheme for raising the value of the rupee, based on the proposals of Indian and home experts, instead of waiting for Dr. Ardenht and other continental financiers to solve the problem, and obtain that credit which should rightly belong to this country, whose interests are most at stake?

AN EX-INDIAN OFFICIAL.

July 18th.

## THE MIDLAND CAT.

SIR,—According to one of the newspapers, upon the arrival of a Midland express at Kettering, a day or two ago, a cat was discovered sitting on the axle of a carriage, and it must have occupied that position all the journey as the train did not stop between St. Pancras and Kettering, a distance of 72 miles. Supposing this paragraph is not the work of some broad-gauge story-teller, and taking the diameter of the carriage wheels at 3ft. 6in., then the pussy-cat must have performed 34,560 revolutions in one hour and twenty-seven minutes. Only a big, powerful, and very determined 10 lb. cat would tackle a job of this sort. Its centre of gravity would fall about 12in. from the centre of the axle. At a speed of sixty miles an hour, pussy would reel off her 480 revolutions a minute, and the velocity of her c. g. would be 50ft. per second. Let $x$ = strain on cat, then



$$x = \frac{10 \times 50 \times 50}{32 \times 1} = 781 \text{ lb.}$$

or about 7 cwt. thrown upon leading claws when travelling at full speed. This is equal to about 17 tons tensile strain per square inch of claw section. Then, again, the wind resistance would be very considerable when she was passing through the top centres. The sketch represents a cross section through the axle, and shows a plan of the cat. Is there room to swing a cat beneath a railway carriage, and do you think that mortal cat could stand this sort of thing? None of my text-books mention a case like this.

Manchester, July 14th. SCRIBER.

## A VOLUNTEER FLEET.

SIR,—I have been interested by the correspondence proceeding in your columns upon this subject. The difficulties in the way of a volunteer fleet—or indeed of any naval tactics by volunteers—are mainly the expense of outfit, &c., and the uncertainties of the sea, causing inconvenience for return to work at a given time. Men who go volunteering mostly work hard in commercial pursuits as well, and they cannot afford to neglect their business appointments. Some years ago I had the pleasure of inspecting the ship Rainbow, off the Thames Embankment, then under the direction of the Royal Naval Artillery Volunteers. The late Lord Ashley took a great interest in this movement, attending drills, &c. The corps organised a summer or autumn cruise, to learn steam tactics and the handling of big guns.

This is the only naval volunteer movement known to me, and I am not aware if any floating fire-engine is worked and navigated by volunteers. Possibly Mr. J. C. Merryweather, whose thoughtful letter originated this discussion, may be able to tell us what has been done in this direction. If a sympathetic attitude were shown by the Admiralty, and a substantial Government grant assured, no doubt many men would enthusiastically take up naval volunteering, in spite of the drawbacks and difficulties. As things stand, we are in danger of having to man our ships with Lascars and Greeks in the next naval war—after the first week's engagements.

West Hampstead, July 11th. JOHN L. LUCAS.

### TO ADVERTISERS.

SIR,—There will be many, no doubt, who on reading the little grumble by "One of the Applicants" mentally remark, "Yes, that is exactly what I think;" many an anxious day or week would be spared to readers of your valuable paper, some of whom occasionally become applicants for the appointments offered in your paper. I am of the opinion that the case is well put by "One of the Applicants." I unfortunately feel the full force of the complaints he mentions, having written for and fulfilled all conditions demanded in advertisement for two months past, and with one exception have not received the slightest notification as to whether or not the vacancy was filled up, after having enclosed stamped addressed envelopes in many cases. But the above is not the only cause for complaint. For instance, suppose that 25 per cent. of the advertisers should apply to the person named for reference, what would be the ultimate result? Let anyone holding an important position answer. How are we to avoid giving offence to those who are at that moment standing between us and our bread, while the present uncharitable system prevails. For myself, I am beginning to adopt the method of "apply in the first instance to A.," but to any honest advertiser this style must appear a little shady, when at the same time I would far rather they applied to "B.," who, as it happens to be in my case, is a gentleman of high standing, to whom I am almost a stranger, yet he has gone out of his way to act most kindly to me. I feel, Sir, that it is ungrateful to trouble a late employer with a number of inquisitive questions by advertisers, some of whom may, through the medium of a *nom de plume*, or Box No., hide the fact that they are fourth-rate employers. I grant that fourth-rate employers have a right to choose, and ascertain that they have got hold of the best man.

Again, how unpleasant it is to think that one's copies of testimonials, so kindly given and of which we are so justly proud, should be either intentionally or unintentionally lying about the office of advertisers, to fall into the hands of office boys or cleaners even, who clear the office of what is considered rubbish. They are precious to me, and have been sent in good faith for return. I trust this will meet the eyes of some of those who have advertised in your paper lately; they need not go to the expense of writing a single word, but for common decency's sake, send the copies of testimonials back, which will be significant of more things than one.

Deptford, S.E., July 13th. ANOTHER OF THE APPLICANTS.

SIR,—I quite endorse all that your correspondent, "One of the Applicants," has to say in regard to answering an advertisement, and would not only utter my complaint in regard to same, but would ask what is done with the stamps enclosed for gaining a reply. It is bad enough to be out of a situation in these days, and though I fully realise the value of an employer's time, I yet think that having asked that his wants should be supplied, it is his duty to express some degree of courtesy towards those that offer their services, instead of allowing his cupidity to assert itself to such an extent that applicants are compelled to suffer in more senses than one. If it is impossible to answer letters, it is possible to do as your correspondent points out, or to advertise that the appointment is filled, and so relieve minds that are in doubt about looking for another situation.

As regards his last item, it speaks for itself, being nothing but a complete subterfuge to test the conditions of the labour market by taking advantage of the fact that the unemployed often forget the value of their services and experience, in the hope of satisfying the demands of home, family, and other ties.

PERFECTLY DISGUSTED.

London, E., July 17th.

SIR,—Your correspondent, "One of the Applicants," has touched upon a very sore point, and I can fully endorse all he says about the indifference that advertisers for managers, &c., show for the welfare of those they seek to employ, and can also add another complaint of quite as serious a nature, if not more so, viz., the advertising for a manager or superintendent by a company, when they have already fixed upon the man who is to be appointed.

I suppose the only reason for advertising is that the secretary may be able to say to any inquiring shareholder, "We advertised in THE ENGINEER, and Mr. So-and-so's appointment is the result."

Southsea, July 16th. ANOTHER OF THE APPLICANTS.

## THE GOVERNMENT OF INDIA NEW MINING RULES.

THE following are the new rules sanctioned by the Secretary of State. They possess considerable interest for those concerned in mining exploration and the promotion of gold mining companies. We may add, that we have been favoured with the advance copy of the rules by the editor of the *Madras Mail*:—

### EXPLORING LICENSES.

A license to explore land for minerals or mineral oil, called hereinafter an exploring license, will authorise the licensee to search the surface of the land specified in the license for minerals of every description, and for mineral oil; and, subject to such restrictions as the Local Government may from time to time impose, to remove any specimens or samples found by the licensee in or upon such land. The surface of unoccupied and unreserved land which is the property of the Government may be freely searched without a license; but the Government does not object to granting a license to explore, when one is applied for.

Such license shall only be granted with respect to land in which the mines, minerals, or mineral oils are the property of the Government, and—subject to the provisions of any law or rule having the force of law, for the time being in force with reference to such land—shall not authorise the licensee to enter upon any land in the occupation of any person without the consent of the occupier.

Such license shall not authorise the licensee to mine or quarry, but he may be permitted to turn up the surface of unoccupied lands, or, with the consent of the occupier, that of land which the Government has granted for agricultural purposes, reserving only the right to minerals to a depth not exceeding 2ft.

Such license may be granted by such person and under such rules as the Local Government may prescribe.

Every such license shall run for one year, and there shall be paid for each license such fee, not exceeding Rs. 10, as the Local Government may prescribe.

A royalty shall be payable to Government on the value of all precious stones found and removed by an explorer, whether he has taken out a license or not. In the case of licenses such royalty shall be at such rate, not exceeding 30 per cent., as shall be fixed by the license, and in the case of an unlicensed explorer shall be 30 per cent. on the value of the stones removed. Neglect to report the discovery of any such stone within a reasonable time shall involve the forfeiture of the license and of all claim to have an application for a mining or prospecting lease favourably considered.

Such license shall give no exclusive or preferential rights, but in considering rival claims for a prospecting license or mining lease, due regard will be had to operations conducted under cover of an exploring license.

### PROSPECTING LICENSES.

(1) A license to prospect for minerals or mineral oil, called hereinafter a prospecting license, shall confer on the licensee the sole right, subject to the conditions contained in the license, to mine, quarry, bore, dig and search for, win, work, and carry away any mineral or mineral oil specified in the license, and lying or being within, under, or throughout the land specified in the license.

(2) A prospecting license shall only be granted with respect to land in which the mines, minerals, or mineral oils are the property of the Government, and which is comprised in a compact block, the area of which does not exceed the area specified in Schedule A, and the length of which does not exceed four times its breadth.

When any area has been explored, and its value as a field for mining sufficiently ascertained, the Local Government may refuse to grant prospecting licenses and may order such area to be demarcated into blocks, and may, subject to such rules as the Governor-General in Council may from time to time prescribe, sell by public auction or private contract the right to win and carry away minerals in and from all or any of such blocks for such term or terms not exceeding thirty years and subjected to such conditions as it may think fit, and may grant mining leases thereof as provided in rules 18 and 19, as it may think fit:

Provided that no such sale as aforesaid shall be made without the previous sanction of the Secretary of State for India in Council if the estimated value thereof exceeds 12 lakhs of rupees.

(1) No prospecting license shall be granted except to a person approved by the Local Government, and such person shall deposit as security in respect of each license such sum, not being less than Rs. 1000, as the Local Government may determine, or give security to the like amount to the satisfaction of the collector. Subject to such deduction on account of compensation for surface damage or otherwise as the collector may order, the amount of any deposit made under this rule will, should the depositor afterwards become the lessee of any mining lease, be carried to his credit as part of the rents and royalties payable under his lease, and should he decline or fail to obtain any such lease as aforesaid, the amount of deposit will be returned to him.

(2) No prospecting license shall be granted to any company or to any syndicate on behalf of a proposed company without the previous sanction of the Governor-General in Council.

(1) Every application for a prospecting license shall, unless the Local Government shall in any case otherwise direct, be made to the collector of the district in which the land or some part of the land with respect to which the license is required is situate.

(2) Every such application shall contain the following particulars, namely:—(*a*) The name, residence, and profession of the applicant; (*b*) a description as accurate as possible, and illustrated by a rough sketch of the situation, boundaries, and area of the land with respect to which the license is required; and (*c*) a specification of the mineral or minerals for which the applicant desires to prospect.

(3) Every application shall be accompanied by a certificate of approval, signed by a Secretary to the Local Government.

On receipt of any such application the collector shall, as soon as practicable, inquire whether the grant of the license applied for is inexpedient either on the ground that the land described in the application is required for a public purpose, or otherwise.

(1) Should the collector be of opinion that it is not expedient to grant the license, or should he find the license has not been approved by the Local Government, he shall refuse to grant the license, and shall forthwith report the matter through the proper channel to the Local Government, which may pass orders as it may think fit.

(2) Subject to the control of the Local Government, the collector, if he finds that there is no objection to the grant of the license applied for, and if the applicant has been approved by the Local Government, may grant to the applicant a license in such form as may be prescribed, and shall report the matter to the Local Government or such other authority as the Local Government may direct.

No licensee shall, while his license is in force, be granted a prospecting license with respect to any other land which lies within such distance of the land covered by his license as is specified in Schedule A:

Provided that the Local Government may, for special reasons, dispense with or modify this condition.

A register of applications for prospecting licenses shall be kept in English in the collector's office, specifying:—(1) Number of application; (2) date; (3) name and residence of applicant; (4) situation of the land; (5) boundaries; (6) estimated area; (7) date of sanction by the Local Government; (8) date of license; (9) rent and royalty payable; (10) period for which granted.

Every prospecting license shall contain such conditions as may in any particular case seem necessary, and shall in all cases contain the following conditions:—

(i.) The term for which the license shall be granted shall be one year or such shorter terms as the applicant may desire. The license may be renewed by the Collector for a further term not exceeding one year, whenever he is satisfied that the licensee has been prevented from completing his search of the land by any cause other than his own default.

(ii.) A moderate rent not exceeding one rupee per acre shall be paid for the land covered by the license.

(iii.) The licensee shall pay a royalty at a rate not exceeding 30 per cent. of the value on all precious stones won and carried away, and a royalty at rates not less than those specified in Schedule C on all other minerals won and carried away over and above such quantity as the Local Government may allow to be taken free for purposes of experiment.

(iv.) No land in the occupation of any person shall be entered upon without the consent of the occupier, and no trees, standing crops, or other private property shall be cut or in any way injured without the consent of the owner thereof.

(v.) The licensee shall make and pay reasonable satisfaction and compensation for all injury which may be done by him in exercise of the powers granted by the license, and shall indemnify the Government against all claims which may be made by third parties in respect of any such damage or injury.

(vi.) The licensee shall not cut or injure any tree on unoccupied and unreserved land without the permission of the Collector in writing.

(vii.) Neither the licensee nor anyone claiming through or under him shall grant or assign any interest under the license to any person without the previous consent in writing of the Local Government, or to any company without the previous sanction of the Governor-General in Council.

(viii.) In case of any breach on the part of the licensee of any of the five last preceding clauses, the collector may summarily revoke the license, and thereupon all rights conferred thereby or enjoyed thereunder shall cease.

(ix.) The licensee shall, within six months next after the determination of the license, or the date of the abandonment of the undertaking, whichever shall first occur, securely plug any bores and fill up or fence any holes or excavations that he may have made in the land to such extent as the collector may require, and shall to the like extent restore the surface of the land and all buildings thereon which he may have damaged in the course of prospecting. Providing that this clause shall not apply to any land held under a mining lease.

(x.) Should any question or dispute arise regarding the license, or any matter or thing connected herewith, or the powers of the licensee thereunder, or the amount or payment of the rent or royalty made payable thereby, the matter in difference shall be decided by the Local Government, whose decision shall be final.

On or before the determination of his license, the licensee shall have a right, subject to the rules hereinafter contained, and provided that the Local Government is satisfied that the prospecting has been of a *bonâ fide* character:—(*a*) In the case of mineral oil or minerals other than precious stones, to a mining lease in accordance with the terms contained in the rules for mining leases; (*b*) in the case of precious stones, to the first offer of such mining lease—if any—as the Governor-General in Council may think fit to grant.

Such lease may include so much land, whether comprising the whole or a part only of the area for which the prospecting license was granted, as shall not exceed the area specified with respect to mining leases in Schedule A annexed to these rules.

### MINING LEASES.

(1) Every application for the grant of a mining lease, not being a lease of a mine of precious stones, shall be presented to the Collector in whose district the land or some part of the land with respect to which the lease is applied for is situate. The Collector shall forward the application through the proper channel to the Local Government.

(2) No mining lease shall be granted otherwise than with respect to land in which the mines, minerals, or mineral oils are the property of Government, and no lease of a mine of precious stones shall be granted except by the Governor-General in Council.

(3) No mining lease shall be granted to any company or to any syndicate on behalf of a proposed company, without the previous sanction of the Governor-General in Council.

19. Every application for a mining lease shall contain:—

(*a*) The name, residence, and profession of the applicant.

(*b*) The name of the mineral for which the applicant intends to mine.

(*c*) A map of the area over which the proposed lease is to extend.

20. On receipt of any such application the Local Government may, if it considers that the applicant should be granted a mining lease, grant the same in accordance with these rules over such one or more blocks, each not exceeding in extent the area specified in Schedule A annexed to these rules, as the Local Government may think fit.

No such lease shall be executed until it has been approved by the Advocate-General or other legal adviser, if any, appointed for the province.

21. Without the previous sanction of the Governor-General in Council, the length of a block shall not be allowed to exceed four times its breadth, nor shall the same lessee be granted either in the same lease or in separate leases more than one block unless the distance between each two of such blocks is not less than that mentioned in the last column of the said Schedule A.

22. The term for which a mining lease may be granted shall not exceed thirty years, and no covenant for renewal may be inserted in the lease without the sanction of the Governor-General in Council.

23. Every such lease shall contain such conditions and stipulations as the Local Government may in each case consider necessary; but shall in every case contain the following conditions, namely:—

(i.) The lessee shall pay a royalty at the rate specified in the lease, which rate shall not be lower than that fixed for the particular mineral in Schedule C; and if any other mineral shall be discovered, then royalty shall be paid therefore at such rate, not being less than 20 per cent. of the value thereof, as the Local Government may determine, until a mining lease has been obtained in respect of such mineral; but the lessee shall be entitled to require and obtain such lease for the term then unexpired of his original lease upon the terms hereinbefore mentioned in Rule 17.

(ii.) The lessee shall also pay for every year after the first year a fixed yearly dead rent, at a rate not less than that laid down in Schedule B; provided that no lessee shall pay both royalty and dead rent in respect of the same lease, but only such one of them as may be the greater in amount.

(iii.) The lessee shall also pay for all land which he may take up, use, or occupy for the purpose of the mine, a surface rent at the rate specified in Schedule B.

(iv.) The lessee shall make, and pay reasonable satisfaction and compensation for all injury which may be done by him in exercise of the powers granted by the lease, and shall indemnify the Government against all claims which may be made by third parties in respect of any such injury.

(v.) The lessee shall not cut or injure any trees reserved in the lease.

(vi.) Neither the lessee nor any person claiming through or under him shall assign the lease, or underlet the whole or any portion of the premises comprised in such lease, without the previous consent in writing of the Local Government; and no such assignment or under-lease shall be made to a company without the previous sanction of the Governor-General in Council.

(vii.) The lessee shall commence operations within two years from the date of the execution of the lease, and shall thereafter carry them on effectually in a proper, skilful, and mining-like manner, unless prevented by unavoidable cause.

(viii.) The lessee shall keep correct accounts, showing the quantity and particulars of all minerals obtained from the mine and the number of persons employed therein, and also complete plans of the mine, and shall allow any officer authorised by the Local Government in that behalf at any time to examine such accounts and plans, and shall furnish the Local Government with such information and returns in respect of the aforesaid matters as it may prescribe. (Note.—All information and returns obtained or furnished under this clause shall be treated as strictly confidential.)

(ix.) The lessee shall allow any officer authorised by the Local Government in that behalf to enter upon the premises comprised in the lease for the purpose of inspecting the same.

(x.) The lessee shall without delay send to the Collector a report of any accident which may occur at or in the said premises, and also the finding therein of any mineral not specified in the lease.

(xi.) Should the royalty or rent reserved or made payable by the lease be not paid within twenty-eight days next after the date fixed in the lease for the payment of the same, the Local Government may enter upon the said premises and seize and sell any minerals or movable property therein, and, if the royalty or rent cannot be so recovered, may determine the lease and take possession of the premises comprised therein.

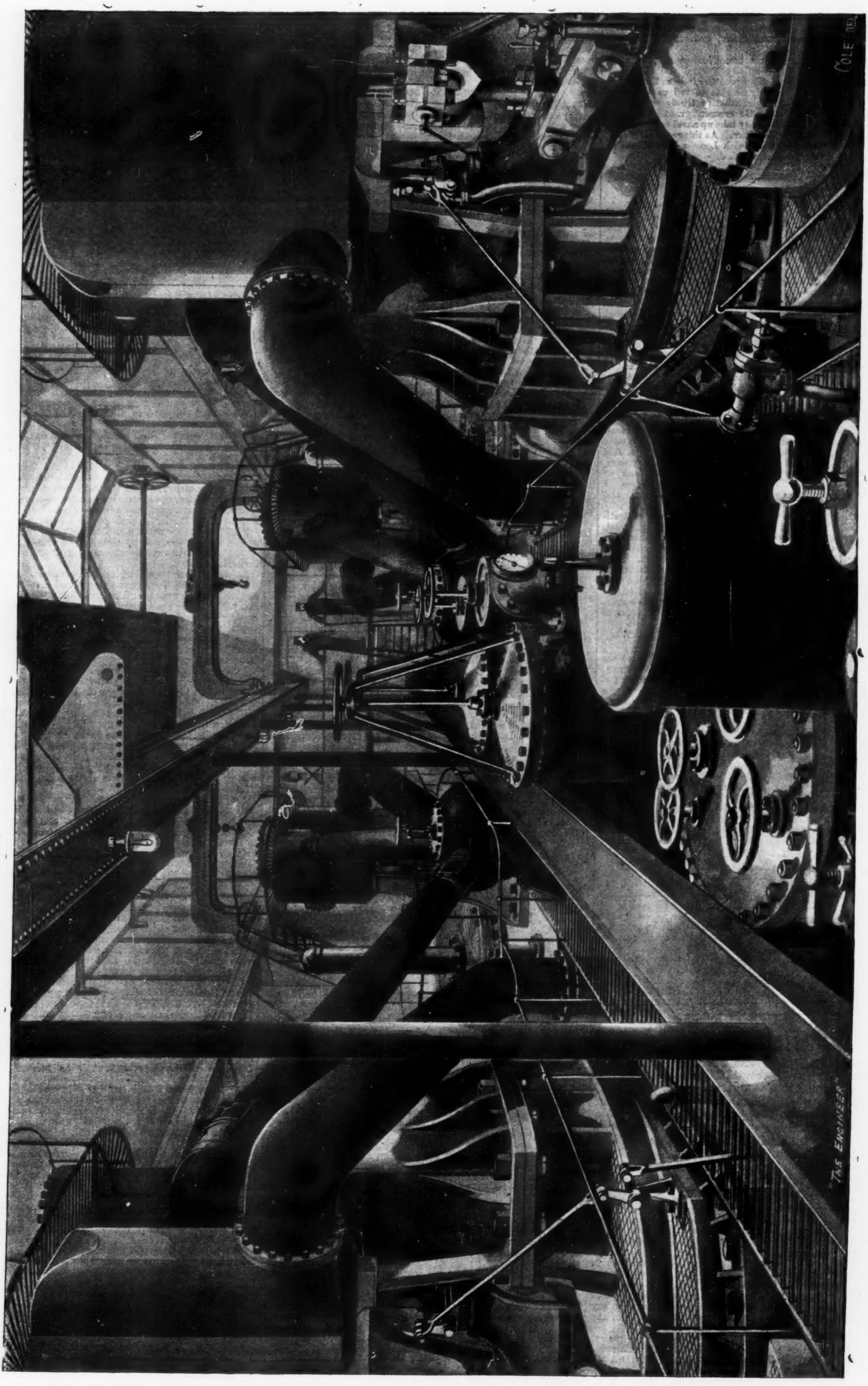
(xii.) In case of any breach on the part of the lessee of any covenant contained in lease, the Local Government may determine the lease and take possession of the said premises.

(xiii.) At the end or sooner determination of the lease, the lessee shall deliver up the said premises and all mines—if any—dug therein in a proper state for working.

(xiv.) Should any question or dispute arise regarding the lease, or any matter or thing connected with the mines and minerals leased or the working or non-working thereof, or the amount or payment of the royalty, or rent reserved or made payable by the lease, the matter in difference shall be decided by the Local Government, whose decision thereon shall be final.

### GENERAL PROVISIONS AS TO LICENSES AND LEASES.

24. No license or lease shall authorise the commencement of any exploration, prospecting, or mining in a reserved forest, unless previous notice of such intended commencement shall have been given to the District Forest Officer; and such exploration, prospecting, or mining shall be subject to such conditions as the said officer may prescribe.


COLE DEL
"THE ENGINEER"

THE ENGINE-ROOM OF THE LUCANIA—UPPER PLATFORM

*(For description see page 48)*

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement the Index to the Seventy-seventh Volume. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it.* Price 1s.

## CONTENTS.

The Engineer, July 20th, 1894.

The Competition of Self-moving Road Vehicles in France. (Ill.) 47
In the Engine Room of the Lucania. (Illustrated) .. 49
Dock Improvements at Liverpool .. 50
H.M.S. Ferret .. 52
Railway Matters—Miscellanea—Notes and Memoranda .. 53
Letters to the Editor—Stresses in a Crane Hook—Carnot and Modern Heat—The Mechanical Equivalent of a Heat Unit—Oil Engine Trials at Cambridge—Indian Railway Contracts—The Midland Cat—A Volunteer Fleet .. 56
To Advertisers .. 57
The Government of India New Mining Rules .. 57
Leading Articles—The Cordite Appeal—Engineering as a Profession 59
Colonial Machinery—The Proposed Cardiff Harbour Trust—Coke Industry Plant in America—Pure Water and its Electric Resistance .. 60
Literature .. 60
Books Received .. 61
Oil Engines at Cambridge. (Illustrated) .. 63
British Machinery and Tools in Honduras .. 63
Pneumatic Grain Elevator and Conveyor—The Mark Lane .. 64
The Beaumont-Wallington High-speed Engine. (Illustrated.) .. 65
Duckham's Pneumatic Grain Elevator and Conveyor. (Illus.) .. 65
Bethlehem Harvey Plates. (Illustrated) .. 66
The "Sundale" Hole Cutter. (Illustrated) .. 66
The New "Kapp" Alternator. (Illustrated.) .. 67
Relation of the Drawing-office to the Shop in Manufacturing 67
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. 68
The Sheffield District—The North of England—Notes from Scotland 69
Wales and Adjoining Counties—Notes from Germany .. 70
American Notes .. 70
Launches and Trial Trips .. 70
The Patent Journal .. 71
Selected American Patents .. 71

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

C. A. H.—*Nothing is known concerning the resistance at enormous speeds. Water must move astern in order that the ship may go ahead.*

A Student.—*If you can procure a copy of Mr. Willans' paper on "High-speed Engines," read before the Institution of Civil Engineers, you will find in it all the latest useful information.*

F. L. W. (Leeds).—*Numerous articles on narrow-gauge railways have appeared in our pages during the last thirty years. You can no doubt consult the volumes of* The Engineer *at the Public Library in Leeds. To give you references would be of little use, as the earlier numbers of* The Engineer *are out of print.*

### KUNENSKI DYNAMO.

(*To the Editor of The Engineer.*)

Sir,—We shall be obliged if any reader will give us the name of the maker of the Kunenski dynamo. J. G. N.
July 16th.

### STRAW PLAIT WEAVING MACHINES.

(*To the Editor of The Engineer.*)

Sir,—I shall be obliged to any of your readers who can give me the name of the maker of straw plait weaving machines? V. G.
Venezuela, June 25th.

### GAUGE BOARD INDICATORS.

(*To the Editor of The Engineer.*)

Sir,—Would you or some of your kind readers please inform me where I can obtain records of gauge-board indications—variations of levels—of any English river, with one of its tributaries, extending over at least thirty years, and much oblige, Constant Reader.
Wickham Market, July 13th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)* .. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* .. | £0 18s. 0d. |
| *Yearly* .. .. | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* .. | £1 0s. 3d. |
| *Yearly* .. .. | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

The Institution of Naval Architects.—Summer meeting at Southampton throughout the week.

# THE ENGINEER.

*JULY* 20, 1894.

### THE CORDITE APPEAL.

The small notice that has been taken in the daily press of the appeal by Nobel's Explosives Company, against the decision given in favour of the defendant, and therefore of the Crown, in the recent cordite case, forms a striking contrast with the space and comment devoted to the original trial. This cannot be ascribed to a conviction that the cause in process of settlement has ceased to be of importance either in its commercial aspects or its national issues, but rather to an impression that in the absence of fresh evidence the prospect of a reversal of the judgment of Mr. Justice Romer must be reckoned remote. That the conclusion is not altogether foregone is due to the ingenuity of the plaintiff's leader, Mr. Fletcher Moulton, Q.C., who has marshalled his arguments anew in a form adapted for supporting the plaintiff's claim of infringement, on lines more tenable, if less inclusive, than those upon which his former attack was conducted. The presentment of a case on appeal necessarily differs in some respects from that best fitted for its earlier stage, when each piece of evidence is delivered by the actual witness responsible therefor. Then, the manner as well as the matter of the witness is a factor of moment, whereas, on appeal, the matter alone is available, and its utilisation depends absolutely on the skill of counsel. It follows naturally from this that the Court assumes a more active *rôle* than that proper to the first hearing of the case, and plays the part of *advocatus diaboli* for each side in turn. In the present instance, a tribunal composed of Lord Esher, Lord Justice Kay, and Lord Justice A. L. Smith, is not to be expected to allow disputable points to pass without expression of opinion, and thus the aspect presented by many of the controversial matters in the case, to intellects legally but not technically trained, becomes clearer than was previously possible. The interpolations by the Court which figure between brackets in ordinary law reports, give but an inkling of the mental fencing between judges and counsel, which saved the appeal from a charge of dulness that could not be readily refuted on other grounds.

The course of Mr. Moulton's argument on appeal was similar to that taken in the trial, and included the now-familiar distinction between a propulsive and a blasting explosive. We must confess to a pleasant sense of relief when Lord Esher intimated his sense of satiety with the famous "pith and marrow" phrase, which did duty to an extent fully equivalent to its merits in the trial; and we may, perhaps, be permitted to hope that it has now been decently and finally interred. Bereft of the phrase, Mr. Moulton nevertheless stuck gallantly to the point which it was intended to emphasise, viz., that Nobel's patent being a pioneer patent, the precise limit of the claims pegged out must not be enforced over rigidly. This is exactly the rock upon which the plaintiffs' case previously split. The whole spirit of English law is opposed to special interpretation to fit the moral needs of a given case, and is indeed in that respect in curious contrast with national character, which constantly achieves rough but real justice, devoid of rule. The constant legal suspicion that an attempt is being made to patent an idea, when some latitude is asked for in the interpretation of a specification, was never wholly dormant at this stage of the procedure, and Mr. Moulton had perforce hastily to disclaim so subversive an intention. A somewhat better point, and one which opens up enticing vistas of casuistry, was made in the statement that admitting the plaintiff's patent to be restricted in claim to the use of nitro-cellulose soluble in ether-alcohol, it followed that as the highest commercial nitrated cellulose containing at least 10 per cent. of soluble nitro-cellulose in every 100 lb. of cordite, about 10 lb. were absolutely and indisputably ballistite protected by previous patent. Seeing that by the ordinary method of preparation, cellulose cannot be so completely nitrated as to be wholly insoluble in ether-alcohol, the contention that the soluble fraction cannot be used to make cordite without infringing the ballistite patent will, if sustained, bring the manufacture of the former explosive to a deadlock. The pound of flesh may be cut, but no blood must be spilt in the cutting. Cordite may be made, but no ballistite must be prepared simultaneously. The adjustment of royalties under these conditions would probably be a task of some intricacy. The argument of a case of the first importance on appeal would be sadly incomplete without the use of copious excerpts from the evidence given at the trial, and Mr. Moulton did not flinch from embarking upon what proved to be a tumultuous sea, difficult of navigation. Possibly the absence of the impression created by the suavity or authority of the plaintiff's experts may have been the cause, but in any case the effect was sufficiently definite, Lord Esher recommending Mr. Moulton to throw his witnesses over like so many Jonahs, if he could not get them to agree passably. The incident would be trivial were it not at once an outcome and an instance of the incurable distrust of expert evidence entertained by many of our judges. The experts are not free from responsibility, but they are blameless in comparison with the system which makes such a state of things possible. Can anyone suppose that if the scientific and technical points in dispute—apart from the legal question of validity of patent—had been referred by the court to a small committee of chemists, absolutely unconcerned with the success of either side, that there would have been the least difficulty in obtaining so clear an expression of opinion that all future argument would have been automatically confined to the discussion of the legal force of a few ascertained facts?

The method by which such a conclusion could be reached would be as simple and effective as the present machinery of summoning advocates in the guise of witnesses, examining and cross-examining them, and using their evidence to demonstrate a single view, and to obscure all others, is cumbrous and wasteful. In listening to a technical trial such as the cordite action, even one familiar with the facts and principles under debate is conscious of a feeling of oppression and warping of judgment in the confused mass of irrelevant opinion interwoven with the simplest issues. Granting this, it is obvious that to expect the Court, to which much is novel and barely intelligible, to sift the essential from the accidental, and to discriminate between matters axiomatic in an art or a science and opinion peculiar to the holder and by him adopted *ad hoc*, is to make a demand that can be met by no human intellect, however keen. The conservatism of the law is proverbial, but it is not proof against the breeches-pocket argument. A crowded profession and a stationary amount of work are not causes of incurious content. Commercial and technical cases are falling more and more into the hands of the arbitrator, who in the best instances is himself conversant with the subject in dispute, and in the bulk of disputes where the cost of settlement is of importance his decision will be increasingly preferred to that of a purely legal tribunal. The appeal in this case has confirmed the decision of Mr. Justice Romer, namely, that there has been no infringement of Noble's patent by the Government.

### ENGINEERING AS A PROFESSION.

The correspondence under the above heading which commenced in our columns some weeks ago seems to be drawing to a close; and we regret to find that, instead of a discussion which might have led to results of some importance, we have had mainly an expression of grievances mingled with a certain amount of contempt for our profession. But there have been two sides to the question, and two parties looking at it from different standpoints; and if we could succeed in drawing a happy medium between the two, some useful work would have been done. The two sides to the question are the professional and the trade. The two parties muster, on the one side under "Pater," and on the other, let us say, "Denarius." Of the different faces presented by the question, the one may be dismissed at once—engineering as a trade has no place in a discussion on engineering as a profession. There are many parents filled with ambitious desires for the future of their sons, and anxious to assume a dignity not inferior to that of a lawyer, doctor, or clergyman; they wish them to become professional men in contradistinction to tradesmen. To them, indeed, it must fairly be confessed engineering does not open a wide and hopeful prospect. The number of professional engineers is comparatively small, and those who can be classed amongst the fully successful are, as a rule, men possessed of a special genius. The most excellent training and the greatest assiduity concerning technical subjects; even the greatest success in the early part of his career does not guarantee to the engineer a sufficient income in later life. For one thing, even professional engineering is always under the influence of trade, and rises and falls with its periods of elevation and depression. The doctor and the lawyer are not so fettered. Ninety per cent. of the population need a doctor's assistance at least twice in their lives, once to bring them into the world and once to send them out of it again; and probably 50 per cent. seek the assistance of a lawyer two or three times during their sojourn here; but the professional engineer—be he ever so able—may spend his life unneeded, and employ his time designing force pumps, or vary the monotony by inventing and taking out patents for improvements which he is not wealthy enough to pursue. It seems that we, too, see the seamy side of engineering as a profession; but there must be a smooth side, both cannot be seamy, and perchance there is a hope yet for the rising technical generation. The title profession is too narrow for engineering—"an employment not mechanical, and requiring some degree of knowledge;" such a definition is totally inapplicable, and either we have no right to employ the word profession, or the meaning needs modification. The work of the engineer must, in its nature, be always more or less mechanical. The title trade is as far wrong on the other side, for it *is* possible to be a successful engineer without either being a professional or a tradesman; there is no adjective in the language which exactly describes the occupation. Our technical colleges would certainly be useless were engineering just what some of our correspondents would make it appear to be—a traffic in machines, a trade not needing as much knowledge as that of a tea dealer, a bare acquaintance with a few technical terms, and sufficient mechanical intelligence to understand comparatively well one's own trade circular. This is not engineering at all, and those pursuing such an occupation should have no right to call themselves engineers. It is certainly to be regretted that the title engineer is not more eclectic. We have suggested before in these columns that good would be done if some of our great institutions would arrogate to themselves and enforce the right to bestow the title of engineer, just as the great medical institutions of the land reserve to themselves the privilege of presenting degrees, and indeed on the Continent some of the great technical colleges alone have the authority to give certain qualifications to their alumni. And again we point out the necessity of narrowing down the title—engineer. The point is surely worthy the consideration of some of the more influential members of our profession.

The attack on our colleges, as we took occasion to remark when writing of this subject before, was not by any means justifiable. The technical schools can no more be expected to make successful engineers out of unpromising youth, than can our universities be called upon to fashion bishops and poet laureates out of their sporting undergraduates. A man's success depends on himself. With prospects the most depressing the able and determined man will rise, whilst with the rosiest outlook the vacillating and inapt one fails. Engineering as a means of livelihood is by no means bad; those who fail in it must look in themselves for the flaw; and to parents we must be allowed to say, however smooth and glossy your sow's ear may seem, do not try to make a silk purse of it; and if a qualification test is needed to distinguish between the genuine and the spurious silk, nothing is in the long run more efficacious and expeditious than a few months in the shops. There is no necessity to send a lad as a premium apprentice to a vast establishment where one pays several hundred pounds for the privilege of walking about the yard and putting the possessive pronoun before a particular vice and tool chest. The smallest country repair shed is sufficient primary test for the mettle of the would-be engineer, and a premium of a few pounds gains an easy entrance. A six months' test is sufficiently long, and though at the end of that time engineering may be discarded, certain very useful lessons will never be forgotten. If some such programme as the following were used, there would, we venture to say, be fewer disappointments in engineering as a profession. From a good school at sixteen to seventeen years of age let the youth enter a little shop for six months, paying only a very small premium, and consequently being made to work; thence, if his taste remains the same, let him go through the course at a technical college, and when he has gained his diploma enter an establishment where good work is done, remain there for three years and qualify himself to receive wages as a first-class improver or as a junior draughtsman in some other works. It is not, we consider, advisable to learn only in one establishment; experience is gained by change. A knowledge of a foreign language or two can be acquired by working in the employment of a continental firm. During the latter part of this course the young engineer will be earning enough to ease substantially the strain on his father's pocket.

### COLONIAL MACHINERY.

We here in England are so accustomed to trained supervision of machinery, and to the comparative freedom from serious accidents which follows, that we cannot readily conceive a condition of things in some of our Colonies altogether the reverse. We were prepared to hear of a good deal of laxity in localities where such trained supervision may be very costly, but certainly the revelations made by a correspondent in a late issue of a colonial contemporary has taken us very much by surprise. We do not propose to give the name of the Colony against the procedure in which this correspondent has made his indictment. It might be invidious to do this, for we expect that the old quotation *ex uno disce omnes* might prove of very general application throughout those of our Colonies wherein the introduction of machinery for industrial purposes has been of recent date. In such of these as have had longer experience, it is no doubt the case that, the evil results having before been felt, the necessity for guarding against further repetition of them has been acknowledged and provided for. In the instance to which we are now referring, it may be as well to quote some of the statements made in the correspondence we have named. After writing as to the faulty design and construction of the buildings in which very costly machinery is housed, the letter proceeds:—"With machinery, matters are even worse, and engines and rollers, sifters and fans, can be heard all over the country knocking themselves to pieces through want of a little trained attention to the bearing surfaces. Heated bearings are common, and thousands of gallons of oil are needlessly wasted in lubricating the machinery in factories—often, too, of oil of the most unsuitable kind. Priming in boilers under the circumstances must be common, and I will be very surprised if we do not hear of boiler explosions over the country with fatal results before long, as the machines get older and weaker."

"On a well-known estate not long ago, with an engine below the power of the work required, the energetic superintendent used *to hang a 56 lb. weight on the safety-valve to increase its power!*" Referring to another case, the letter states that the "whole of the fire bars at the back were melted into a solid mass." He had also known of other instances where "two down-draught siroccos, with all their trays and tea, were being converted into furnaces," and burnt to cinders. The justifiable remark follows:—"How can we expect otherwise when sets of expensive machinery, costing from 60 rupees to 100 rupees per acre, are placed in the hands of superintendents who have had no previous training whatever, and have numerous other duties to perform." Apart from the false economy on the part of proprietors which these publicly-stated allegations against them prove, it may well be asked what are the responsible authorities doing to permit, unchecked, the continuance of a state of things which must, as boilers grow aged and deteriorate, threaten danger to those employed in factories so misconducted. We have ever protested against undue Government interference in the conduct of factories at home; but only because we know that circumstances enforce the employment of trained supervision, and the exercise of constant care, without it. In many of our Colonies, however, the case is altogether different. Changed conditions of agriculture brought about the introduction of a large amount of machinery, and in the one of them to which our quotations apply there are probably now from 100 to 150 steam boilers more or less entrusted to the care of wholly untrained native drivers. Most of these boilers have been introduced within the last ten years or so, and the length of their safe life, under the conditions upon which they have been worked, must be approaching its end. If something be not done, it seems to be probable that the majority of these will ere long in turn put an end to themselves, with perhaps disastrous results.

That some steps should be taken to avert the chances of some such finale must be patent to everyone conversant with the danger of leaving such a powerful agent as steam to the control of unskilled persons. In India the planters have become fully alive to the false economy of such a course, and only recently our own columns have included advertisements for thoroughly competent mechanical engineers to take charge of estate machinery. One would have expected that the owners of estates in our smaller Colonies would have all along realised that the same class of supervision was not only necessary from a humanitarian point of view, but essential to commercial success for themselves. It is high time, if these will not realise this, and act correspondingly, that measures should be adopted by the public authority to ensure safety to those whose lives or limbs may be endangered by the culpable neglect of their employers. Were similar conditions observable in the case of home injuries, we should, far from protesting against Government interference, be the first to call for it. Surely, if individual estate owners cannot afford to provide highly-paid and competent supervision, combined effort might furnish it in sufficient degree to avoid the chance of catastrophe, now only too clearly to be foreseen. Or a system of boiler insurance and its allied periodical inspection might be established by the common consent of all.

The crux of the matter lies in the fact that the time is approaching when the boilers first brought into general use for estate purposes in the Colony under consideration are likely to become fatally weak. The correspondent from whose letter we have quoted foresees the approach of consequent grave danger. The time has therefore arrived when, either by voluntary or enforced effort, this should be guarded against. Probably the day will come when the proprietors of estates will have to realise fully how "penny-wise-and-pound-foolish" their conduct has been. They will find forced upon them an expenditure for renewals largely exceeding in amount the outlay that would have ensured them against it. And what is more, they may yet be called upon to pay, in damages for injuries arising from their neglect, a sum double or treble what it would have cost for a more humane and more economic policy. We are glad to see that the colonial press is doing its part in revealing the state of things that exists. We should be still more glad to know that the Colonial Government has become alive to its own responsibilities in the matter.

◆◆◆

### THE PROPOSED CARDIFF HARBOUR TRUST.

The Cardiff Corporation, at a special meeting this week, resolved to pledge the rates of the borough in support of the Harbour Trust project, to the extent at least of the expenses involved in obtaining reports from engineers and accountants as to the value of the properties to be taken over. Whether the credit of the borough should be pledged was the crucial question on which the further progress of the Trust scheme depended. A Harbour Trust sub-committee had presented several reports pointing to the success of other Trusts, notably the Tyne and the Clyde, and the necessity of such a mode of administering the several dock estates of Cardiff, in order to maintain the port in a first-class position among its competitors. The owners of the Bute Dock, Penarth Dock, Barry Dock, of the Glamorganshire Canal also and neighbouring landowners whose property would be required for possible manufactories and warehouses, were all waited upon. The replies were in all cases favourable to the principle of a Harbour Trust provided that terms could be arranged, although Sir W. T. Lewis intimated that Lord Bute would want very cogent reasons to be shown before he would agree to sell his vacant lands; and the Barry directors foresaw a difficulty about dealing with their docks apart from their extensive and increasing railway system. Negotiations, however, were regarded as having reached so satisfactory a stage that it became time for the municipality to decide whether it would, as a next step, approach Lord Bute and other dock and landowners for permission to examine their books, ascertain the value of the estates to be scheduled, and make out a statement of the earnings over an average of the past three years. It is to this step that the Cardiff Council have consented, and more practical *pour-parlers* with the directors of the Bute, Penarth and Barry docks can now proceed. The estimated value of the docks, dock railways, the canal, and land for building sites, is £7,000,000. The proposal at present is to acquire this property for the Trust on a basis of 4 per cent. on earnings, for an average of three years. With the rateable value of the borough as security for the interest, it is believed that there would be no difficulty in raising the capital at 3 per cent., which would leave 1 per cent. to the credit of the municipality; or a portion of the purchase money could be raised by loan, and the remainder be secured on 4 per cent. bonds, redeemable gradually by means of a sinking fund. One reason why the shipping and mercantile community of Cardiff are combined in support of the Trust scheme is, that there is known to be behind it a project for converting the existing approaches to the docks into a great floating harbour. There is a constant demand for increased dock accommodation in Cardiff, and it is held that the resources of the new Bute Dock, for which Parliamentary powers were granted this session, will be found insufficient within five years of its completion. But all the dock accommodation, as fast as it is increased, is absorbed by coal shipments, or the export trade. What is wanted, it is claimed, is provision, and separate provision, for an import trade, larger quay space, and sites for warehouses and mills unhampered by the restrictions of existing leases. By constructing sea walls between the entrance of the present Bute Docks and Penarth Head, across the mouths of the rivers Taff and Ely, a vast expanse of mud banks would be enclosed, in which docks could be made, and warehouses built, to satisfy all possible demands of the port for many years to come.

### COKE INDUSTRY PLANT IN AMERICA.

In connection with the manufacture of coke and the utilisation of bye-products a movement is just now going on in the United States which may have important consequences. It foreshadows the creation on the other side of the Atlantic of a demand for coke-making plant and apparatus adapted to the recovery of the bye-products. The Technological Department of the American Geological Survey has sent over to Europe specialists armed with governmental powers of inquiry to report upon the whole subject of bye-product coke manufacture. The Commission are now in this country, and later on are to visit the Continent. As yet nothing has been done in the States other than on a small experimental scale in the direction of saving the sulphate of ammonia, coal tar, and other bye-products, which are now proving so valuable a source of income to the coke manufacturers and pig iron makers of England and Scotland, Germany, France, Belgium, and some other parts of Europe. The old beehive oven reigns supreme. Now, however, the coke manufacturers and the iron and steel masters seem to have awakened to a knowledge of what they are losing, and the inquiry of the Geological Survey is the result. Investigation is to be made alike into the horizontal and vertical flue systems. The Commission will return home enabled to pronounce definitely which of the two broad lines of construction is likely to be most acceptable to American practice, the relative production of the varied British and Continental systems, and the special merits of each. If, as appears probable, the Commissioners are able to report that a saving in waste products of 4s. per ton on the coke manufactured can be effected, and that no material deterioration in the quality of the coke for blast furnace purposes ensues, then a great demand should almost at once spring up for ovens built upon the new principle, and for the accompanying plant and machinery for the recovery of the bye-products and converting of the same into ammonia, tar, and other productions of modern chemical and engineering science combined.

### PURE WATER AND ITS ELECTRIC RESISTANCE.

Until recently the purest sample of water that has been physically examined was that obtained by Prof. F. Kohlrausch by distillation in vacuo, and which showed an electric conductivity only one-third of that of water distilled under atmospheric contact. Such low conductivity only endured for a short time, owing to the water taking up foreign matter from the sides of the containing vessel or the electrodes. The distilling apparatus used on that occasion, after standing full of water for nearly ten years, has lately been used by Messrs. Kohlrausch and A. Heydweiller in some new experiments, which have been described in the "Transactions" of the Academy of Sciences at Berlin. The water obtained has, when tested at 18 deg. C., only one-sixth of the conductivity of the former sample; the resistance of one square millimetre at the freezing point being the same as that of a copper conductor of the same section, 25,000,000 miles long, or more than a thousand times the circumference of the earth. The foreign matters contained in this water only amount to a few thousandths of a milligramme in the litre.

## LITERATURE.

*The Naval Annual.* By Lord Brassey. T. Griffin and Co., Portsmouth. 1894.

The "Naval Annual" for 1894, although not containing anything especially startling, keeps up its old reputation and that of its able compiler. The records of the past year—with the single exception of the irreparable loss of H.M.S. Victoria and so many of her gallant crew—afford, perhaps, less subject matter than usual of a remarkable character; nevertheless they contain much that is both interesting and instructive. For the first time, past history, with all its valuable lessons, has been introduced with the view of emphasising certain features of our naval position; and an estimate has been given of the empire's resources for warship building above and beyond those afforded by the Royal dockyards of the United Kingdom. The important questions of "Moderate Dimensions," "Convoy," and "Our Strategic Position in the Mediterranean," are likewise discussed with considerable ability.

As usual, Lord Brassey's own particular and most interesting chapter comes at the end of the volume. But, although his absence in India must have made it exceptionally difficult for him to work up arrears on his return, and to prepare a paper in time for publication, it is, nevertheless, satisfactory to observe that—where quoting *in extenso* the lists of vessels compiled by Lord George Hamilton, showing our urgent naval requirements at the commencement of the current year—the author of the "Naval Annual" appears fully alive to the necessity for keeping the naval strength of the British Empire abreast of that line towards which some of the other Great Powers of Europe are pushing forward so vigorously. Two capital schedules are given, exhibiting the comparative strengths of the fleets of the world built and building, though we must caution our readers against accepting them verbatim, as they are founded upon classification. The impossibility of absolute classification is apparent when we consider—as an illustration—that the Benbow and Centurion, both of approximately similar displacements, have a main armament in one case of 111-ton guns, in the other of 29-ton guns! Under these circumstances, how can the two vessels be compared usefully? But we give the tables for so much as they are worth:—

*Armour-clad Battleships.*

| | Great Britain. | France. | Russia. | Germany. | Italy. | United States. | Combinations of two Powers | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | France—Russia. | France—Germany | France—Italy. | France—U.S. |
| First-class ... ... | 22 | 18 | 10 | 4 | 12 | 4 | 28 | 22 | 30 | 22 |
| Second-class ... | 12 | 13 | 8 | 7 | 4 | — | 21 | 20 | 17 | 13 |
| Third-class ... ... | 20 | 6 | — | 11 | 5 | 2 | 6 | 17 | 11 | 8 |
| Total ... ... | 54 | 37 | 18 | 22 | 21 | 6 | 55 | 59 | 58 | 43 |
| *Armoured and Protected Cruisers.* | | | | | | | | | | |
| First-class ... ... | 22 | 14 | 11 | — | 6 | 3 | 25 | 14 | 20 | 17 |
| Second-class ... | 47 | 25 | 2 | 9 | — | — | 27 | 34 | 25 | 25 |
| Third-class ... ... | 51 | 31 | 3 | 19 | — | — | 34 | 50 | 31 | 31 |
| Total ... ... | 120 | 70 | 16 | 28 | 6 | 3 | 86 | 98 | 76 | 73 |

It will be observed that in battleships we appear to be practically a match for any two European Powers, but, were the obsolete wooden ironclads of France to be eliminated, which is the only reasonable course to pursue, the preponderance would be enormously in favour of the fleets of the British Empire; and it must be borne in mind that the above quoted figures are altogether independent of the seven first-class battleships, six second-class cruisers, and two sloops, to be commenced, or already laid down, in the current financial year. In cruisers we are — comparatively— clearly ahead of our requirements.

Although, however, an inspection of these comparative tables is calculated to inspire confidence as regards our present and prospective positions, the efforts now being made by France and Russia to improve theirs must not be lost sight of. Lord Brassey supplies some interesting totals illustrating this point. The expenditure on new naval construction in France, which stood at £614,460 in 1872-3, amounts for the current year to £3,049,720. That of Russia for shipbuilding in 1894 is £2,255,627. The sum of these two amounts, viz., £5,305,347, must be contrasted with £5,166,110, which is the total available in the United Kingdom for new construction in 1894-95. It will thus be seen that France and Russia combined are pressing us very closely in the laying down of new ships.

Some very convincing arguments from the writings of Admiral Bourgois and Captain Malan are adduced, in order to support the theory that fleets of battleships alone can secure the command of the sea. All the teaching of history appears to be in this sense. When, in the latter years of Louis XIV., and in the reign of Louis XV., fleets of battleships were no longer fitted out, and the efforts of the French by sea were directed solely to privateering, the result was seen in the humiliating conditions accepted in the treaty of Utrecht. Private individuals grew rich by the capture of the merchantmen of the enemy; but the consequences of the disappearance of her fleets from the seas were disastrous to France as a nation. Captain Malan sums up the question as follows:—"On sea as on shore, great results can only be expected by wielding great masses. Upon this conclusion history, too, has set its seal, for the squadron and division warfare of the French navy, seconded though it was by hosts of commerce destroyers, public and private, produced practically no results, had absolutely no effect upon the issue of the war."

We deem, therefore, that the wisdom displayed by our Admiralty authorities in laying down fresh fleets of battleships is not to be called in question.

The narrative of "The Naval Revolt in Brazil," by Mr. W. L. Clowes, is very instructive. Fifty heavy guns, including eighteen 6in. and four 7in. quick-firers, also upwards of one hundred smaller quick-firing and machine guns, were mounted in the insurgent fleet. The chief Peixotist forts were Santa Cruz, with two 10in. Armstrongs and smaller weapons; San Joao, with one 10in. Armstrong; Fort Lage, with three 6in. Whitworths; a work at Nictheroy, with two 32-pounders, &c. As operations went on these were reinforced. Fort Villegagnon, neutral at first, was beneficial to the insurgents. Its thirty-seven heavy Armstrongs and six Whitworth guns would have been a terrible menace to them otherwise, irrespective of its position commanding the channel.

The preponderance of gun power in favour of the fleet under Admiral Mello was, however, counterbalanced by the paucity of sailors and marines. He had, at the outset, only 1500, and all his operations were obviously hampered by his short-handedness; whilst the defences of the Peixotists had 5000 regulars armed with Mannlichers, irrespective of volunteers. The helpless position of the fleet was of course due to the impossibility of occupying places after a landing had been effected.

But an instructive lesson taught by this narrative is one of increased confidence in the modern war vessel as a safe fighting platform. It is true that for the first few weeks the firing was very wild; but practice improved, and the fort gunners learned to aim with precision, whilst with high angle fire they succeeded in dropping many a shell upon the decks of their adversaries. With all this, however, the Javary, an old iron monitor of 3640 tons, with belt and turret plated, was the only ship sunk under fire, and the incident was due to leaks resulting from the working and shaking of her frame with the vibration of her own 10in. Whitworth guns. The details of one action, in which the battleship Aquidaban took part, are interesting. Five projectiles in particular struck the ironclad, amongst others. One heavy one passed through the deck into the admiral's sleeping cabin, and there burst, doing little harm. A 6in. projectile penetrated the starboard side, and exploded another 6in. shell standing in a rack on the battery deck, the latter being ready fused—which it ought *not* to have been. An officer and three men were wounded. Another shell penetrated the admiral's bath room innocuously. A fourth exploded in the coal bunkers on the port side, making holes in the inner wall. A fifth projectile struck the armour shield of the port bow gun without impairing the working of the weapon. Admiral de Mello collected five 6in. projectiles which came on board that day, and set them up as ornaments in his cabin. It is clear, therefore, that wooden battleships do not sink so easily under fire as has been anticipated.

The "Progress of Foreign Navies," by M. E. Weyl, gives particulars of battleships and cruisers building and completing in France, that cannot fail to awaken interest. The armoured protection of the Charlemagne and the St. Louis is afforded by a continuous belt at the water-line, the maximum thickness of which is 15¾in., and above the belt the neighbourhood of the cofferdam is covered with 3¾in. plates. Two armoured decks will be fitted; the first will be of 3½in. steel, and at the level of the upper edge of the water-line belt; the second is 1½in. in thickness, and will join the lower edge of the belt. The space between the two decks will thus form an enormous "caisson," which will be partly filled with coal. Four 11·8in. guns are mounted in closed armoured turrets, forward and aft; and the secondary ten 5½in. quick-firers, and six 4in. quick-firers, are so distributed that six of the former—which are protected by 3in. plates of hardened steel—and four of the latter can be fired simultaneously ahead or astern, independently of the main armament. The principal armament and the turrets can be worked either by hand or electricity. The displacement is only 11,232 tons, 1000 tons less than the Renown; yet upon this smaller displacement an armament of much more powerful character is to be mounted, out of which no less than twelve guns can bear directly ahead or astern against four in the Renown, and the triple screws afford an equal rate of speed to the smaller ship, namely 18 knots.

The cruiser Yoshino, built at Elswick for the Japanese Government, has gone most satisfactorily through her trials. Although of only 4150 tons displacement, the engines developed nearly 15,000 horse-power under forced draught, the largest proportion of horse-power to tonnage in any great cruiser afloat, not excepting the commerce destroyers of the United States. The mean speed was 23·031 knots.

Mr. James R. Thursfield's remarks on the lessons of naval manœuvres of the year 1893 are valuable as usual. It appears to have been demonstrated more completely than ever that "even in default of an active defence adequately organised and skilfully disposed, torpedo boats are very apt to suppress themselves and to attain a very high rate of extinction in the normal course of their attacks on a powerful and vigilant seagoing adversary. The truth seems to be that a torpedo boat ought properly to be regarded not as an independent seagoing unit of naval force, but as a peculiar and very destructive kind of projectile . . . having a considerable liability to be destroyed or intercepted before it attains its mark . . . to say nothing of its very awkward habit of occasionally mistaking a friend for an enemy!"

The paper upon Toulon is accompanied by a sketch map indicating the positions of the great Government dockyard and the private establishment at La Seyne; also the chain of immense heavily-armed forts which command all the approaches, whether by sea or land. The breakwater which separates the outer anchorage, or Grande Rade, from the Petite Rade, is admirably situated to seal the entrances to the latter in time of war. It is honeycombed at either end with torpedo-dischargers, and also provided with destructive batteries of quick-firing guns, to check the admission of the enemy's torpedo-boats. As a completing and repairing station Toulon is, however, very inferior to Portsmouth. Ships after being launched have to be completed at an anchorage afloat, and the expense and labour of transporting all the materials by lighter must be immense.

Mr. Thursfield's remarks upon the foundering of the Victoria are temperate and to the point. He accepts the verdict of the Admiralty minute, which practically lays the blame for the accident upon the failure to close the water-tight doors in time, but shows that, even were only such doors left open as are indispensably so, the interval of time which elapses between the first warning of a disaster and the supreme moment of danger is not sufficient to admit of the necessary action being taken; in other words, that under the existing arrangements for closing water-tight doors, the movement cannot be carried out instantaneously as required. It would appear, therefore, that some more rapid and effectual machinery will have to be applied.

Admiral Colomb feels very strongly as to "our strategic position in the Mediterranean." He thinks that necessity is laid upon us to make every effort to secure and to keep such a command of it in war, as we all admit we must keep of the Channel. But he considers that the great power of quick reinforcement from home is surely a safer policy to pursue than a detachment of force into those waters at all times, which force we are not sure will be ultimately required.

The remarks of a student of naval history upon "moderate dimensions" will find plenty of admirers and detractors. Nevertheless by the light of history, which should be an unfailing guide, he proves unmistakeably that the monstrous battleships with four or five decks and a hundred and thirty guns seldom or never met with success in opposing an equivalent number of seventy-four or eighty-gun ships of the line.

---

*Mountain, Moor, and Loch, Illustrated by Pen and Pencil, on the Route of the West Highland Railway.* London: Joseph Causton and Sons. 1894.

IT is possible that to many of our readers the very existence of the West Highland Railway may be a fact as yet unknown. The line was indeed only recently opened, and the book before us describes the wild, beautiful country through which it passes, hitherto little known, excepting to the few. Starting from Helensburgh, the line takes the tourist on through the softly wooded scenery skirting the shores of Loch Long to Ardlui, at the head of Loch Lomond, thence leaving the lochs behind, through the hill country to Gorton, on the edge of Rannoch Moor, that wild and majestic stretch of table land, strangely impressive in its bleak loneliness to the dwellers in cities, if less strictly beautiful than some of the scenes left behind. Rannoch Moor used to be regarded as an impassable barrier by railway engineers. That the West Highland Railway should have been so constructed as "virtually to float over the moor," may therefore be considered as a considerable achievement in the annals of railway engineering. The moor was deep and cross drained to take off the water, and across the trenches was laid, as at Chat Moss, on the Liverpool and Manchester line, a thick layer of brushwood, as a bedding for the permanent way.

Leaving Rannoch behind, the railway extends itself to Lochaber, which used to be considered "such a far cry," and on to the foot of the mighty Ben Nevis—in all about 144 miles from the starting-point at Helensburgh. It is a land of romance, and the charm of its weird, picturesque beauty is enhanced for the traveller by its association with many of the most stirring episodes in Scottish history, while its romantic and striking natural characteristics have suggested a rich fund of legend and story, with which the author is evidently familiar. His explanation of the reason why a lobster is known in the Highlands as a "Banavie flea" is too good to be lost, and must be quoted:—

> A good many years ago an American was stopping in the Banavie Hotel, and he made himself very obnoxious by his contemptuous remarks on Scottish scenery. "Ben Nevis," he said, "Do you call that a mountain? You should see our mighty Rockies. Loch Linske. Do you call that a lake? You should see our Lake Superior! Rannoch Moor. Do you call that a plain? You should see our Western prairies!" and so he went on to the intense exasperation of the Highland waiter who went and procured a live lobster—for they are caught occasionally in the loch—which he secreted, in requital of the insults, in the American's bed. Hardly had the American gone to sleep when the lobster caught him by the toe with a grasp like a vice. He jumped out of bed with a yell and rang for the Boots. "Boots," he said, solemnly rubbing his toe as he spoke, "you may not have such big mountains and big lakes and big plains here as we have in the States, but you have the most tarnation big fleas I ever experienced."

Altogether, the book forms one of the most attractive guide-books that has lately come under our notice. A glance through its pages will convince those about to visit the regions described that they have a delightful experience before them; while those who cannot hope to do so will find themselves wishing that it were in their power to travel over the ground so pleasantly described by the author, whose graphic word-pictures are admirably supplemented by 230 charming illustrations, reproduced from original drawings executed specially for the work.

## *BOOKS RECEIVED.*

*Theoretical Mechanics: Solids.* By J. Edward Taylor, M.A., B Sc., Lond. London: Longmans, Green, and Company. 1894.

*Concrete: Its Use in Building and the Construction of Concrete Walls, Floors, Roofs, &c.* By Thomas Pitter. Vol. ii. London: B. T. Batsford.

*The Great Eastern Railway Company's Tourist Guide to the Continent.* Edited by Percy Lindley, illustrated. London: 30, Fleet-street, and 61, Regent-street. 1894.

*A Text-book of Ore and Stone Mining.* By C. L. Neve Foster, B.A., D Sc., F.R.S. With frontispiece and 716 illustrations. London: Charles Griffin and Company. 1894.

*Elementary Treatise on Natural Philosophy.* Based on the Traité de Physique of A. Privat Deschanel. By J. D. Everett, M.A., D.C.L., F.R.S. Thirteenth edition. London: Blackie and Son. 1894.

*Modern Perspective: A Treatise upon the Principles of Plane and Cylindrical Perspective.* By William R. Ware. Fifth edition. Boston, U.S.A.: Ticknor and Company. London: Macmillan and Company.

*From Official Lists Supplied by the Authority of the Postmaster-General, June,* 1894. Second supplementary issue to 1894 volume. *Sell's Directory of Registered Telegraphic Addresses.* London: Henry Sell.

*Mountain, Moor and Loch.* Illustrated by pen and pencil on the route of the West Highland Railway. With 230 illustrations from original drawings made on the spot. London: Sir Joseph Causton and Sons. 1894.

*Building Superintendence.* A manual for young architects, students, and others interested in building operations as carried on at the present day. By T. M. Clark. Twelfth edition. London: Macmillan and Company. 1894.

*Select Methods in Chemical Analysis (chiefly inorganic).* By William Crookes, F.R.S., P.P.C.S., P.P. Inst. C.E. Third edition, re-written, and enlarged. Illustrated with 67 woodcuts. London: Longmans, Green, and Company. 1894.

*Conciliation and Arbitration in Labour Disputes.* A historical sketch and brief statement of the present position of the question at home and abroad. By J. Stephen Jeans, M.R.I., F.S.S. London: Crosby Lockwood and Son. 1894.

*The Physical Geology and Geography of Great Britain: A Manual of British Geology.* By the late Sir Andrew C. Ramsay, LL.D., F.R.S., &c. With a geological map, printed in colours. Sixth edition, edited by Horace B. Woodward, F.G.S. London: Edward Stanford. 1894.

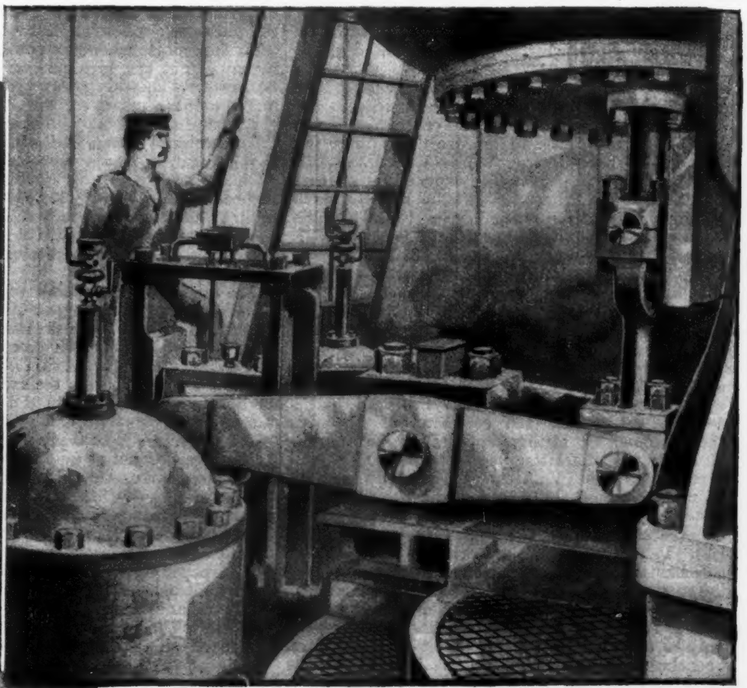
*Safe Building.* A treatise giving in the simplest forms possible the practical and theoretical rules and formulæ used in the construction of buildings. By Louis de Coppet Berg, F.A.I.A. Vol i., fourth edition, revised, and vol. ii. Boston, U.S.A.: Ticknor and Company. London: Macmillan and Company. 1894.

---

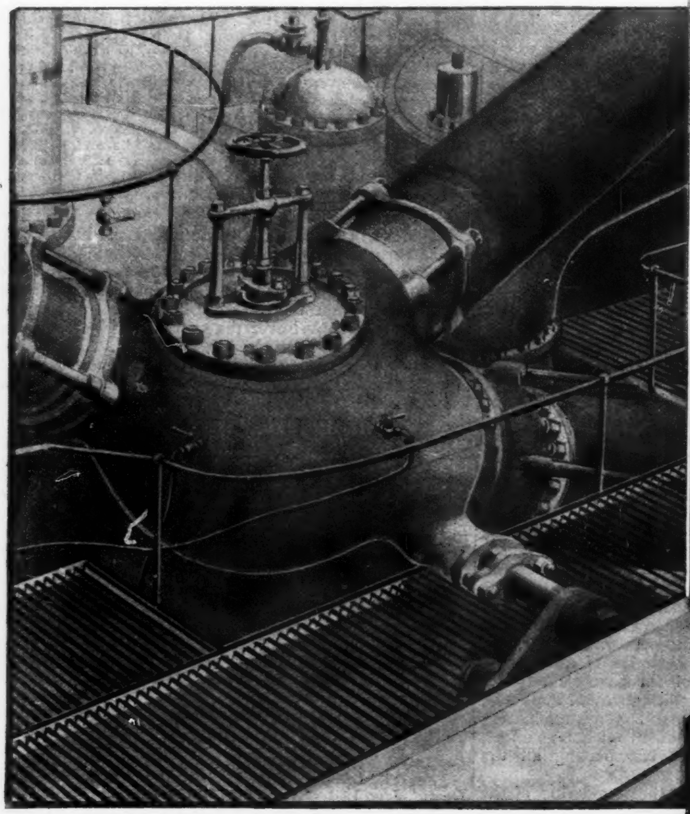
LIGHT RAILWAYS IN CÔTES DU NORD, FINISTERE, AND MORBIHAN.—According to a recent Foreign-office report: in Côtes du Nord, the new line from Guingamp to Carhaix was opened in September last. A new line from Guingamp to Paimpol is in course of construction, and will probably be ready for traffic this year. Work on the new line from Loudéac to Carhaix and St. Méen is to be commenced this year. In Finistère the light railway from Brest to Ploudelmezeau was opened for traffic at the end of last July. A similar line, to Llanilis, was opened at the end of last February. Another light railway, from Audierne to Douarnenez, affording direct communication between the former place and Quimper, on the Orleans and Western lines, was opened at the end of last January. The line from Landerneau to Lesneven and Plouéo-sur-Trez, is nearly finished, and will be opened for traffic at an early date. The traffic on the Ploudelmezeau line has already exceeded expectation, and the receipts from the other lines are expected to be equally satisfactory. Short extensions of the Ploudelmezeau line to Portsal, Llanilis line to L'Abervrach, and the Lesneven line, when completed, to Brignognan, on the Channel coast, are in contemplation, and will probably be carried out soon. These narrow gauge lines, constructed on most economical principles, will be of great service to agricultural, fishing, and other industrial interests. Being situated in good districts, they will naturally tend to create traffic, to the benefit of the community and their promoters. Other short departmental lines are projected, and much interest is being shown in the question. Work on the line from Carhaix to Rosporden is being proceeded with. Nothing has been done towards connecting Morlaix Railway Station with the port, the matter being still under consideration. In Morbihan several light railways are being projected. Plans have been prepared, and concessions will shortly be given for lines from Locminé to La Roche-Bernard, *viâ* Vannes, from Lorient to Gourin, *viâ* Plouay, and from Ploermel to Plouay, work on these lines being proceeded with consecutively. Other light lines are in contemplation. The necessity of doubling the line between Rennes and Brest, a distance of 155 miles, is strongly urged by the local agricultural and commercial interests, the line at present consisting of a single track, except two short sections twenty-four miles long between St. Brieuc and Guingamp and Brest and Kerhuon. A second track would not only afford much needed greater accommodation and quicker transit for the products of this part of Brittany, but would also permit a material acceleration of the through passenger traffic not possible under present circumstances. The estimated cost of the work is £480 000, or £3097 per mile.

## THE ENGINE-ROOM OF THE LUCANIA

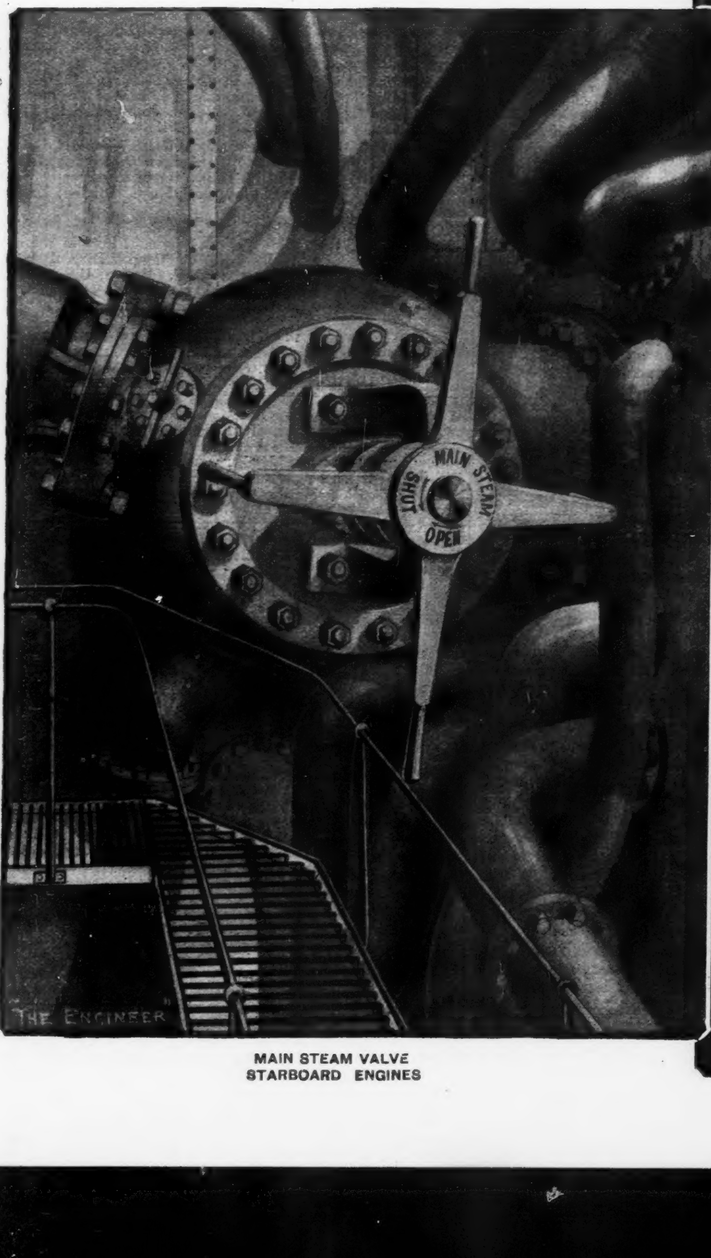
(*For description see page 48*)



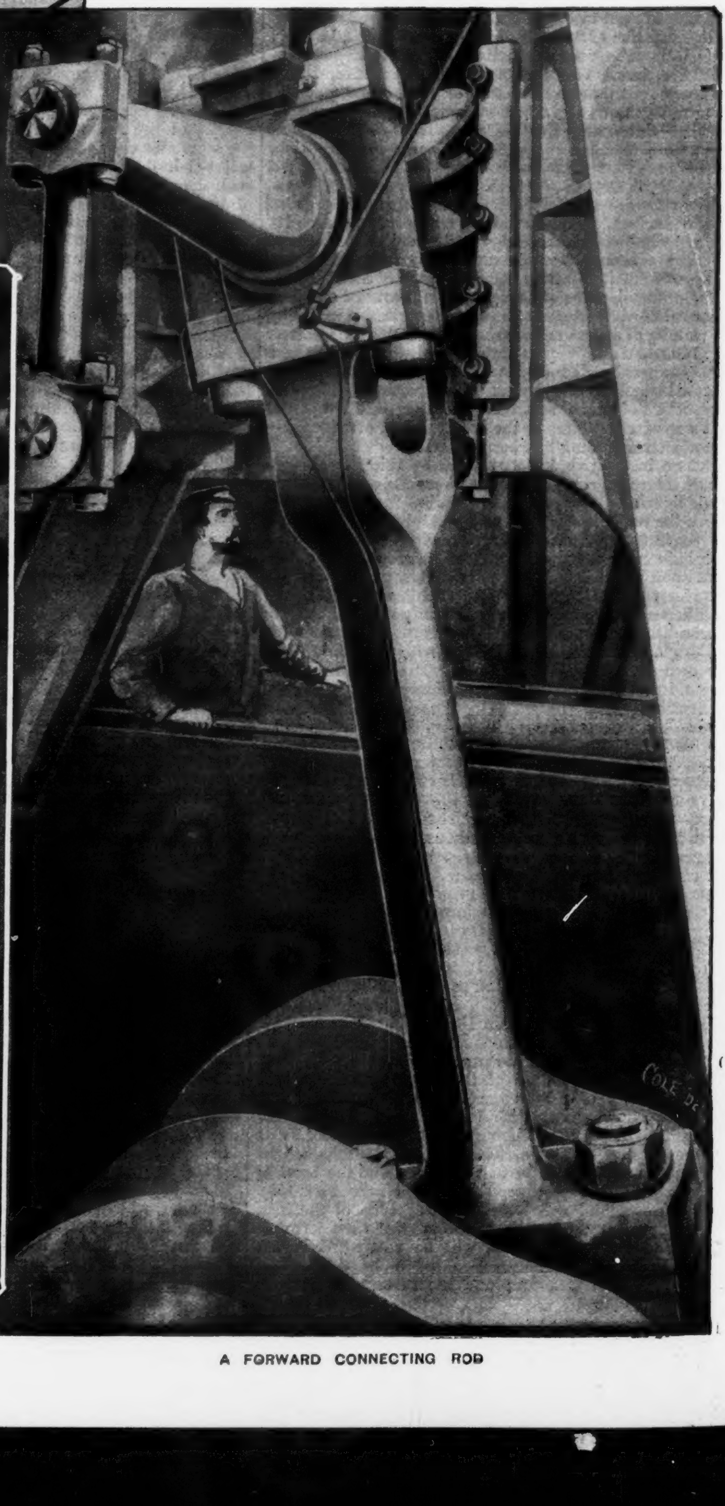
PISTON VALVE GEAR



MAIN STOP VALVE—PORT ENGINES


MAIN STEAM
SHUT
OPEN
"THE ENGINEER"

MAIN STEAM VALVE STARBOARD ENGINES



A FORWARD CONNECTING ROD

## THE CAPITAINE OIL ENGINE, R.A.S.E. SHOW

MESSRS. TOLCH AND CO., LONDON, ENGINEERS

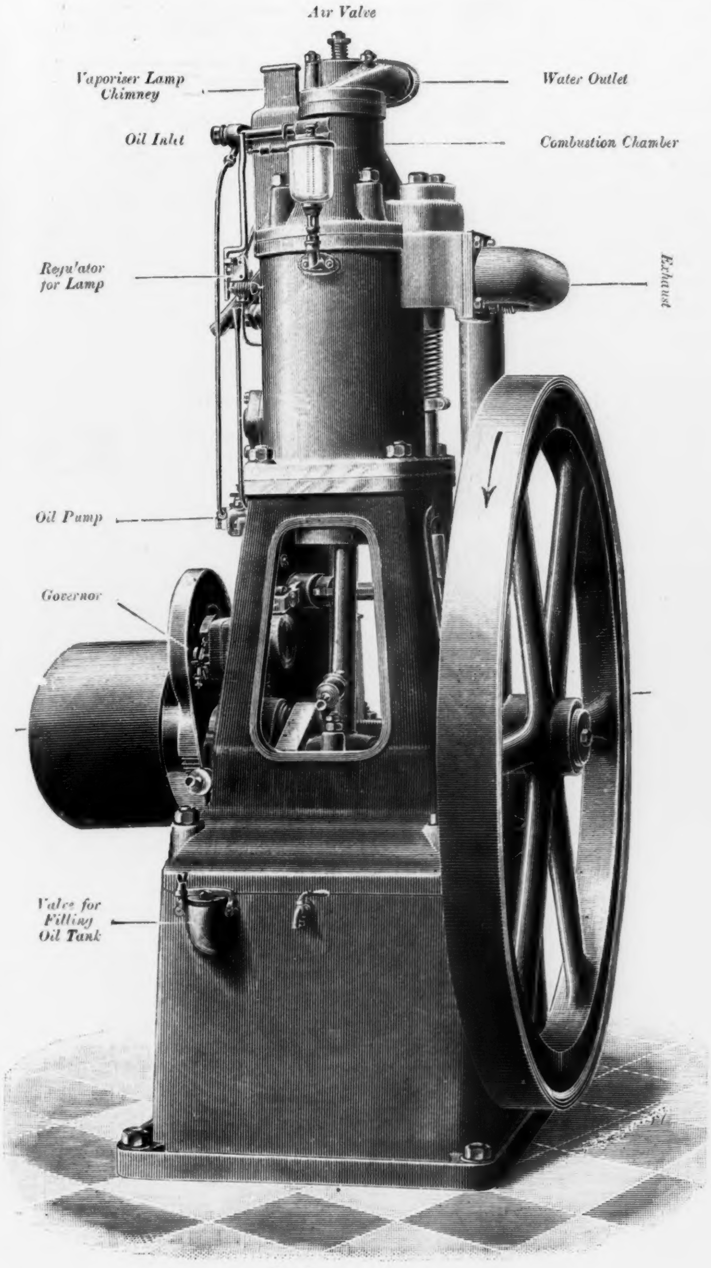


Fig. 2

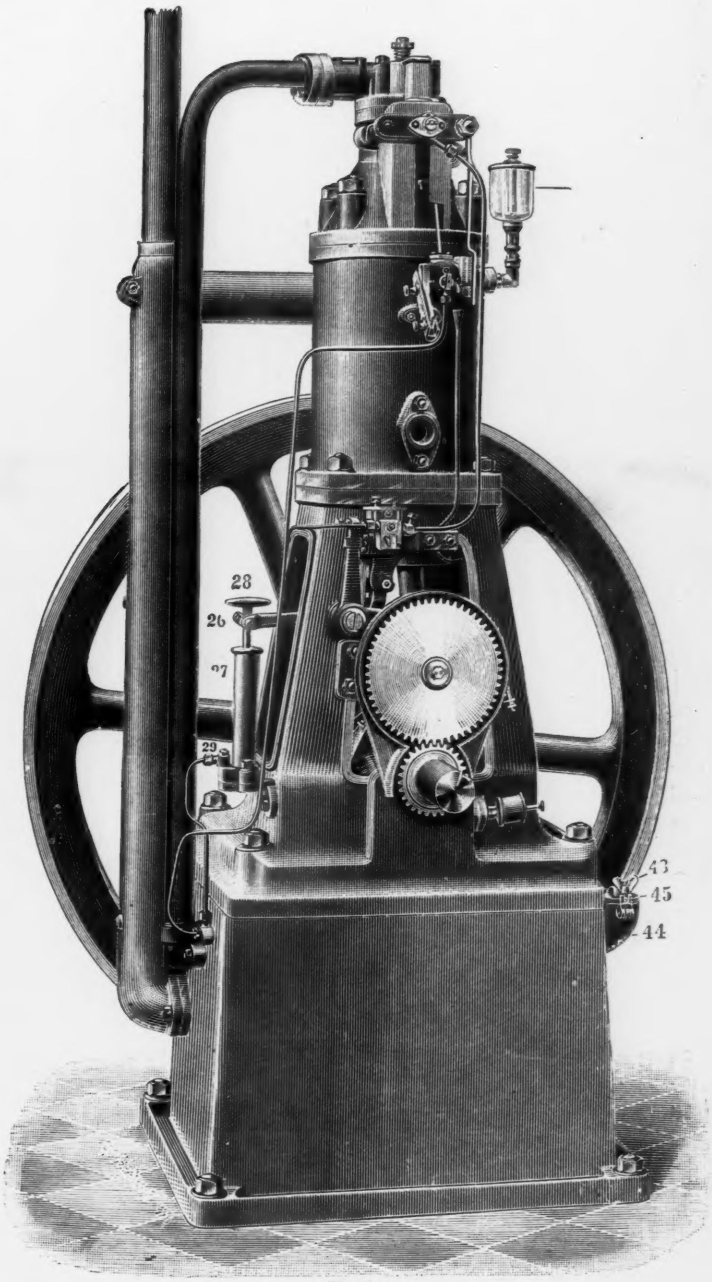


Fig. 3

## OIL ENGINES AT CAMBRIDGE.

There remains one fixed engine which ran in the long duration trials, but of which we have not yet given a description. It is a vertical engine, and belongs to Class 4 of our classification, the vaporiser forming at the same time the means of ignition of the compressed charge. The general arrangement of the vaporiser in connection with the combustion chamber is shown by the annexed diagram section, and the engine is shown by the accompanying engravings.

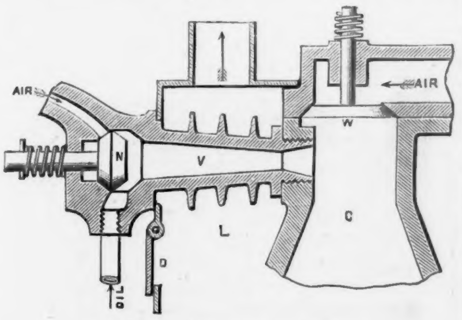


Fig. 1—THE CAPITAINE VAPORISER

The vaporiser V is a small tubular ribbed casting screwed into the side of the combustion chamber C. In our diagram sketch we have much exaggerated its size for clearness. Oil is injected by a supply pump into the space containing the valve N. When the down or suction stroke of the engine takes place, air is drawn in at the main air valve W, and also through the small air inlet at the rear of the valve N, kept normally closed by the spring S. Oil is injected by a feed-pump, and being carried in by the inrushing air, is sprayed into the vaporiser and instantaneously vaporised. It is supposed that the vaporisation is complete before the suction stroke of the piston is completed, so that the vapour is completely cleared of all trace of combustible material. A lamp is placed at L, and access to the flame is obtained by a door at D. The position of the vaporiser and lamp is shown in Figs. 2 and 3. The oil is injected a little before the commencement of the suction stroke of the piston. The lamp which is used for heating the vaporiser and usually kept at work with the engine, though not used in the Cambridge runs, is a simple spray burner, the oil being sent up from a tank in the base, from which it is ejected by a slight air pressure, occasionally renewed by the hand pump at 27, 28, Fig. 3. The base of the engine is partly oil tank and partly exhaust box, so that the oil is somewhat heated by the waste gases. Starting is effected by means of a spirit lamp which heats the petroleum spray burner. To govern the temperature of the vaporiser a small valve is inserted in the oil passage thereto, and the position of this is controlled by the pressure exerted by a piece of iron which rises or falls in temperature with the vaporiser, and by corresponding expansion and contraction affects the position of the oil supply valve. The oil pump is shown at the side of Fig. 2 and in front of Fig. 3. It is worked by an excentric inside the frame as shown. The pump is fitted with a ⊂⊃ distributing valve, and it is filled with glycerine so as to avoid the leakage so usual with petroleum pumps and joints. The pump valve governor is peculiar and ingenious, but could not be described without detail drawings. In Fig. 3 the petroleum inlet valve is shown immediately above the heating lamp, and its position will be recognised by reference to the position marked on Fig. 2.

The engine has hitherto been worked on oils lighter than Russolene, and it was not well prepared for running on the latter, although the length of time that it did run shows that this oil can be used, but possibly it will have to be specially arranged for.

## BRITISH MACHINERY AND TOOLS IN HONDURAS.

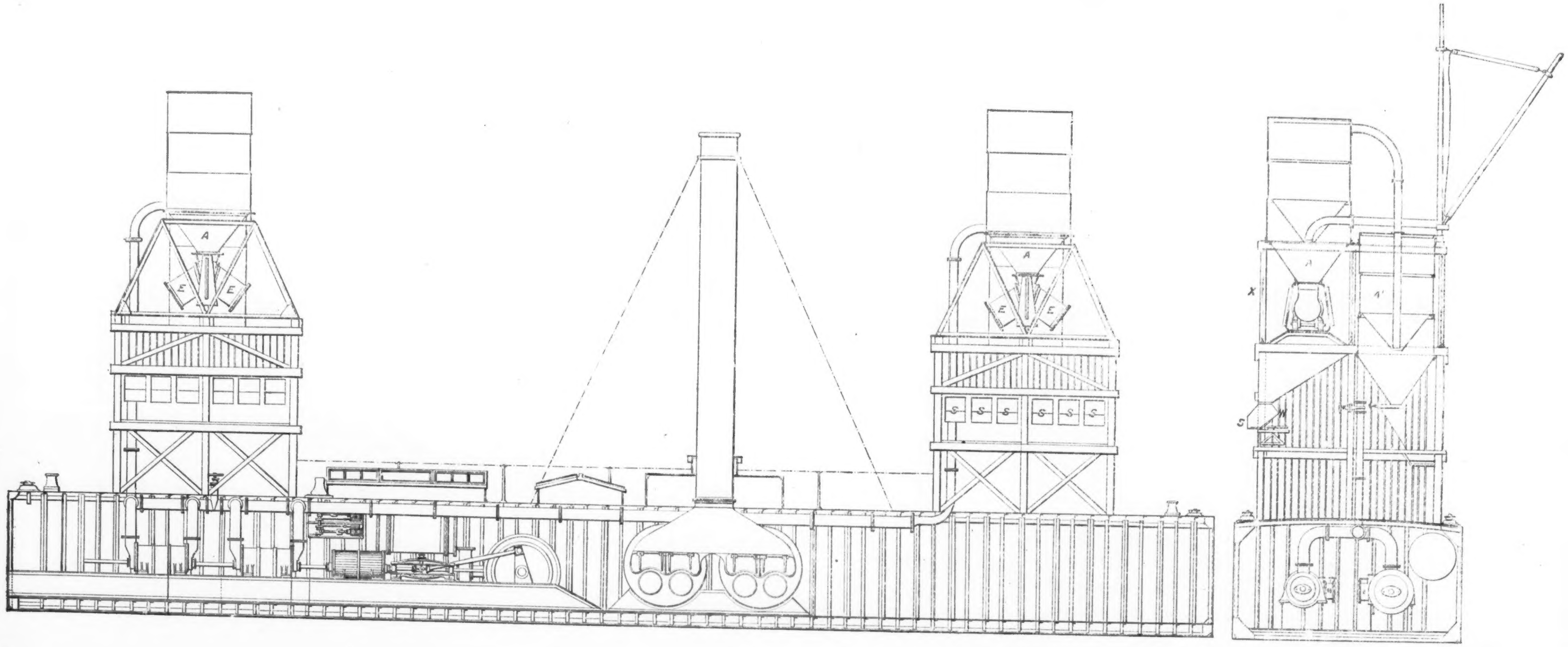
According to a recent Foreign-office report, while in general merchandise English products are as eagerly sought after as ever in Honduras, American manufacturers are making the greatest advances in machinery and general ironmongery. Month after month steamer after steamer unloads tons upon tons of machinery at Amapala, the greater part consisting of mining machinery, pumps, saw mills, steam engines and boilers, and wood-working machinery. The greater number of mining enterprises in this country being in the hands of Americans, it is natural that they should prefer machinery from their own country, but it is surprising that English and French mining companies, after erecting English machinery have abandoned it, and substituted for it either complete or partial American "outfits." Price has in no way entered into consideration in these changes, adaptability to the work required, and economy in performing the same, being the only factors. There seems to be a business deficiency on the part of our manufacturers that should be looked into and remedied as soon as possible. The foregoing state of things is beginning to be the case in edged tools. Formerly Honduras artisans were content with almost any kind of axe, chisel, plane or saw, if the price was sufficiently low, but they now demand a better class of tools, and require quality regardless of price. American edged tools are prominent both in quality and temper, but Germany is bidding for a share of this trade with a stubbornness that bids fair to be successful, while our own manufacturers are content to manufacture what gave them good results in the past, forgetting that others with less facilities are striving continually to improve, and are surely advancing to the front in goods until recently exclusively English.

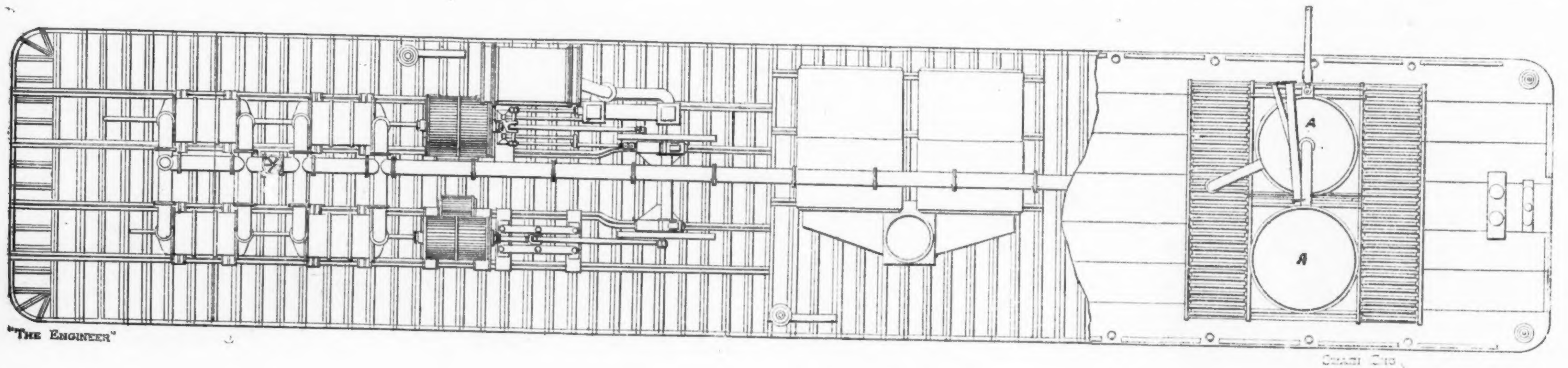
During the last six years trade between Amapala and Germany has enormously increased, owing to two lines of steamers having been established between this coast and Hamburg, *viâ* the Straits of Magellan. As these steamers offer freights lower, and deliver goods direct from wharves in Hamburg without transhipment at the Isthmus of Panama, much merchandise formerly ordered only from England is now bought in Germany. English crockery, iron, and all manufactures of small cost paying high freight are those suffering most from these steamers. According to the latest

# PNEUMATIC GRAIN ELEVATOR AND CONVEYOR—THE MARK LANE

MR. F. E. DUCKHAM, M. INST. C.E., ENGINEER

(*For description see page 65*)


A
E
E
A
E
E
S
S
S
S
S
S
X
A
A'
S
W


A
A
"The Engineer"

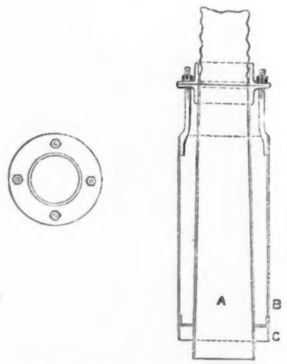
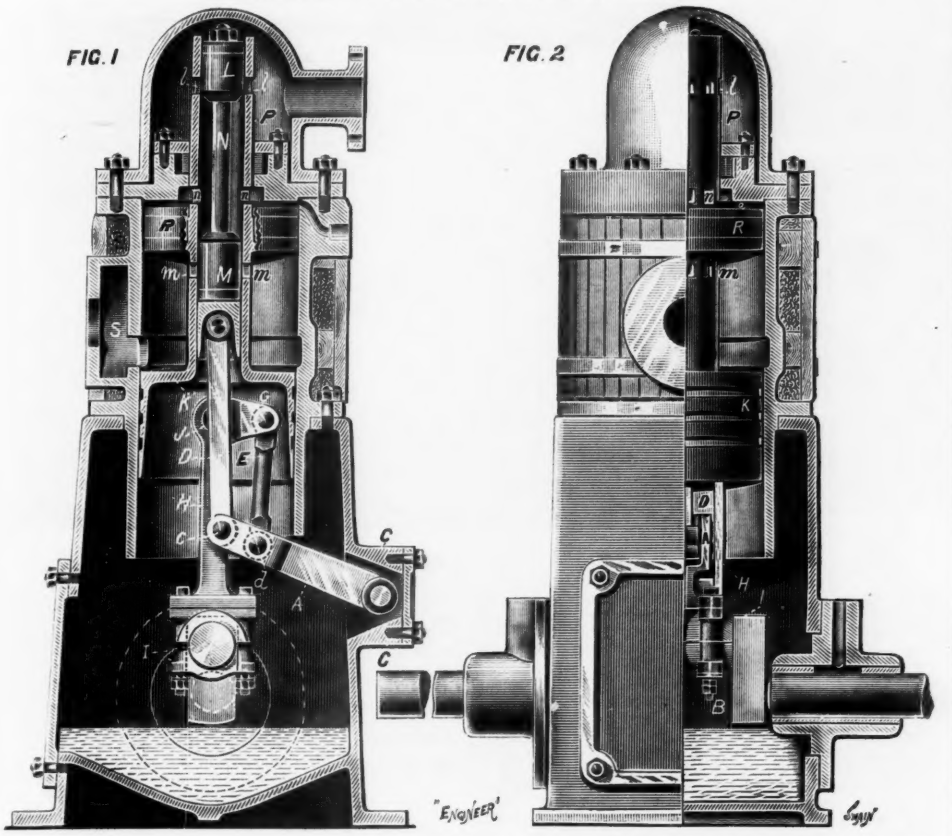


Fig. 3—GRAIN INLET NOZZLE

# THE BEAUMONT-WALLINGTON HIGH-SPEED ENGINE

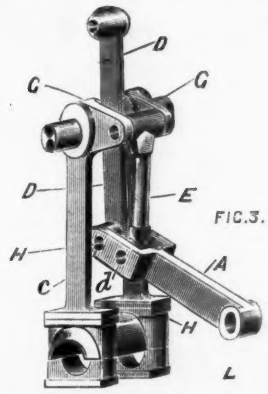
THE BLAIR ENGINEERING CO., PECKHAM, ENGINEERS



available statistics, British imports into Amapala decreased by £26,000, or 35 6 per cent. under the previous year, and in proportion of the whole from 31·8 to 25 per cent., while German imports increased by £11,953, or 115·45 per cent., and in proportion of the whole from 4·9 to 12·5 per cent. It is suggested that a similar line of steamers, established on a paying basis from Liverpool or Manchester, would go far toward protecting many English industries against German energy and enterprise.

## THE BEAUMONT-WALLINGTON HIGH-SPEED ENGINE.

THE engravings above illustrate a new engine of the single-acting description, with central valve contained in a hollow extension of the piston-rod which is actuated by a new radial gear. The latter is also a new departure in this class of engine. This gear gives to the valve a motion which causes a very perfect distribution of steam in the cylinder. During one revolution of the crank there are four distinct movements of the valve: (1) A quick upward movement opening the valve for admission; (2) a quick downward motion performing cut-off; (3) a longer period of comparative slow movement during expansion; (4) another quick movement opening the exhaust port, which remains open till nearly the top of the return stroke, when it closes, forming the steam cushion. On referring to the illustration, it will be seen that the connecting link D is attached to the extremity *c* of a vibrating lever A; an intermediate point *d* in this lever is connected by a link E to a short arm G at right angles to, and forged solid with, the connecting-rod H at the crosshead end.



All the functions of lead, cut-off, expansion, exhaust, and compression are performed thereby in a simple, quick, and accurate manner. In order to show how this is attained, we may suppose the connecting-rod H to be disconnected from the crank pin, and moved from its top position, as shown in the illustration, to the centre of the stroke in a straight line, without swinging the lower end to either side; it is evident that the arm G would move down the same distance as the piston, consequently the intermediate point *d* on the lever A would also travel the same distance, but the extreme point *c* would move a greater distance; the difference of the distance of the travel of these two points *c* and *d* respectively being equal to the lap and lead of the valve. Now, if the connecting-rod be swung to the right until it comes to its proper position in the crank circle, it is evident that the end of the lever G would move upwards, carrying with it the link E, lever A, and the valve link D, together with the valve. The actual movement of the valve relatively with that of piston in half a revolution is therefore equal to the difference between the travels of the points *d* and *c*, together with the motion imparted by means of the arm G. The amount of steam port opening is determined by the length of this arm together with the distance between *d* and *c*, and by varying these any degree of expansion can be obtained. It will be seen that the link D is always in compression and the link E in tension, so that any slight wear in the one is compensated by wear in the other. The gear is therefore self-adjusting.

These engines are made either simple, compound, or triple-expansion, with either one or two cranks. The cranks are of steel and the bearings of phosphor bronze. The crank chamber is closed, as shown in the engravings, and forms a receptacle for the lubricant, in which the crank revolves, as is usual in this class of engine. The engines are made under the patents of Messrs. Beaumont and Wallington by the Blair Engineering Company, Bellenden-road, Peckham, S.E.

## DUCKHAM'S PNEUMATIC GRAIN ELEVATOR AND CONVEYOR.

DURING the ten years ending 1850, the imports of grain into the United Kingdom averaged 1,022,067 tons per annum. During the ten years ending 1890 it averaged 6,157,276 tons per annum. During 1893 the quantity imported was no less than 1,450,000 tons. This increase has undoubtedly been made possible, firstly, by the substitution of grain-carrying steamers of 2000 to 4000 tons and more capacity for the old-time sailing vessels of 300 to 400 tons; and secondly, by the employment of various mechanical appliances for discharging the cargoes and for distributing the imported grain.

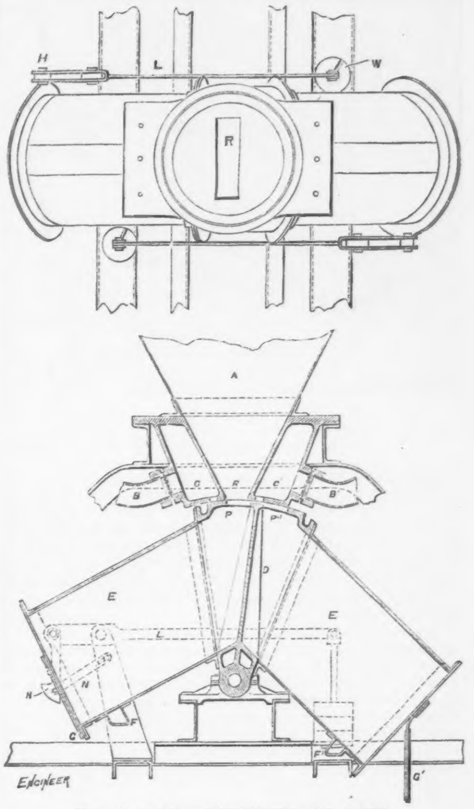
Of the total quantity imported about one-fourth comes to London, and of this nearly one-half is received at the Millwall Docks. It is therefore but natural that the Millwall Dock authorities should be looked to for some improvements in grain-working apparatus.

We believe it was at Millwall Docks that the use of hydraulic cranes, in combination with what is now known as Priestman's grab, was first employed in lieu of the old-fashioned manual process of discharging cargoes by whipping or by grain tub and winch. The self-emptying tub followed, with advantages it possesses under certain conditions over the Priestman. In other ports, notably at Liverpool, the band and bucket elevator found favour, but neither of these was perfect, *e.g.*, in each the grain had to be "trimmed," or moved to within reach of the elevator. Grain stowed in confined spaces could not be touched by the machinery. During wet weather the hatches had to be closed and the discharge stopped. There was always waste from grain dropping on the deck or overboard. There was to the men employed risk and frequent damage, not only from failure of gear, but by working in a cloud of dust, and to the employer there was the element of cost per ton and the difficulties and uncertainties of the labour market.

To lift and convey grain and such like material by the employment of air is no new idea, and it possesses many obvious advantages, but the difficulties have been to get the grain into the conveying tubes, to keep up a constant stream without choking, to separate the grain and other solid particles from the conveying air, to extract the grain automatically from the receiver without reducing the amount of vacuum by which the lifting and conveying is being simultaneously carried on.

The process invented by Mr. F. E. Duckham, and introduced by him at Millwall Docks, seems to have successfully overcome not only the disadvantages of other grain-working machinery, but also the difficulties which have hitherto prevented the employment of air as a medium for grain transmission. This apparatus has got well beyond the experimental stage, for the first machine of this kind, the Mark-lane, has been in almost constant work at the Millwall Docks during the past twelve months, and as a result of its success, a second machine, the Baltic, is just being completed by the East Ferry Road Engineering Works Company for use in the Royal Albert Dock. The general design of this machine is shown by the illustrations on page 64.

To conform with local requirements, the Baltic machinery is in a barge 115ft. long by 22ft. wide by 11ft. deep. It is to be placed alongside the importing ship and discharge grain into, say, four barges simultaneously. Steam is supplied by two boilers of ordinary marine type. The engines are horizontal surface-condensing compound, with cylinders 22in. and 40in. diameter by 48in. stroke. The two piston-rods are prolonged, each to carry the pistons of two air-pumps capable of producing and maintaining a partial vacuum equal to 20in. mercury. On deck are two erections containing the grain receivers, dust catchers, and weighing machinery. When in use each receiver will be connected with the importing ship by a semi-flexible tube, 8in. diameter; and if at the same time the receiver be connected with the air-pumps, there will be an inrush of air through the tubes to the receiver, and from the receiver to the pumps. There were two problems: (1) how to maintain a constant flow of grain through the tubes to the receiver; (2) how to get the grain out of the receiver without reducing the vacuum or otherwise interfering with the suction. The first difficulty has been met by the nozzle, Fig. 3, page 64. This is fitted to the inlet end of the tube, and has an adjustable jacket, so that no matter how much the nozzle may be immersed in the grain, the regular supply of about thirty volumes of air per one volume of grain is kept up by means of the annular passage between the nozzle and the jacket. The second difficulty obviously required an automatic air lock—such as is illustrated by Figs. 4 and 5. This is a twin box, mounted to oscillate on trunnions under the coned bottom of the receiver, one compartment filling while the other empties itself into an open hopper, whence the grain is drawn off through suitable sliding doors to weighing machines, and delivered in sacks or in bulk.



Figs. 4 and 5 — AUTOMATIC AIR LOCK

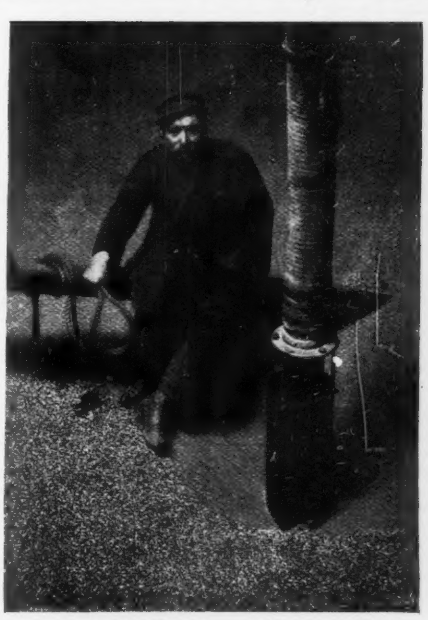


Fig. 6 — GRAIN NOZZLE IN CARGO OF MAIZE

The only disadvantage possessed by this machine, or, at

## BETHLEHEM ARMOUR PLATES

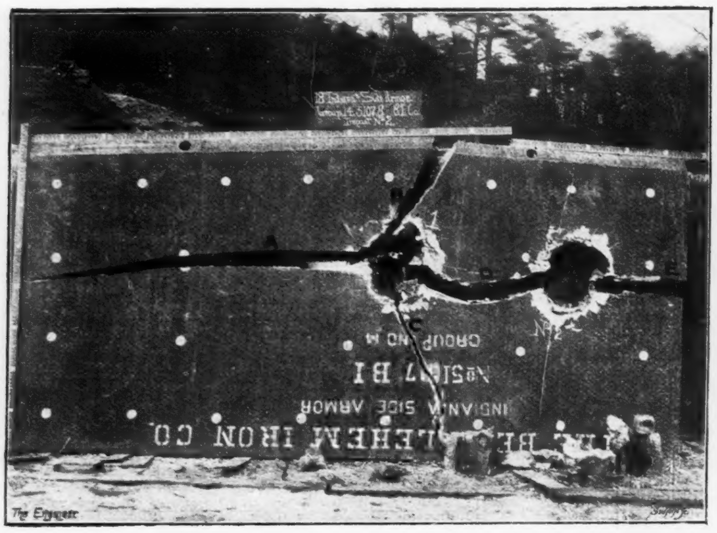


PLATE FOR THE INDIANA

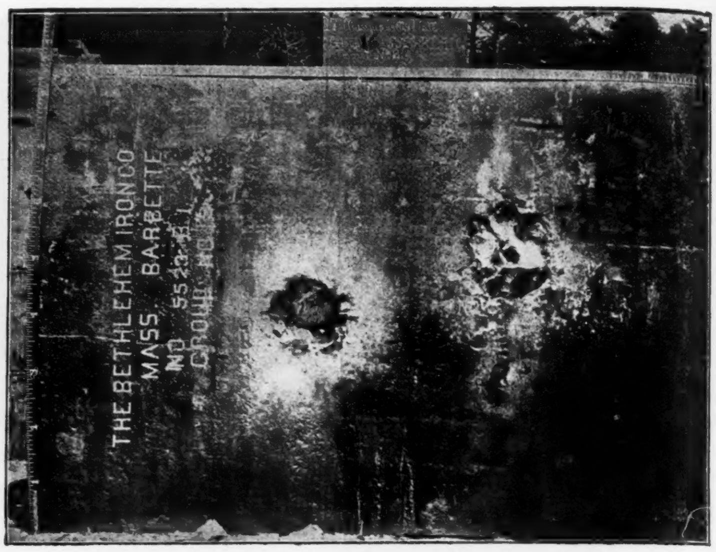


PLATE FOR THE MASSACHUSSETTS

least, the only objection raised by the grain trade, was that the exhaust air carried off some of the dust which is always found in grain, and while its removal improved the quality it reduced the weight of the bulk to a very small extent. The dust catcher is therefore interposed between the receiver and the pumps, and the dust which this contrivance traps is, when desired, returned by a bye-pass into the receiver and re-mixed with the grain, so that the absolute weight of the parcel is then maintained.

The advantages of the process are many. It can be worked in all weathers; its tubes, like limbs of an enormous octopus, reach the grain in any part of the ship; it conveys the grain in enclosed conduits between the ship's hold and the receiving barge or granary, so there is no loss of cargo *en route;* there is to the men no risk; but if one may judge from the reproduced photograph there is comparative comfort, for the only man required per tube may sit and just slack away the fall of the tackle by which the tube is sustained, and so keep the inlet immersed in the rapidly-discharging cargo. The 6in. nozzle shown in the photograph was at that time discharging maize at a speed of 30 tons per hour.

This process may be used not only for the discharge of grain from ships to barges, but also for the loading of ships from barges or granaries. For this latter purpose the apparatus is modified that the grain may first be drawn into the receiver on the machinery barge and discharged thence by air pressure through tubes to any desired part of the export steamer. A machine of this kind is now being made by the East Ferry Road Company for loading grain ex-barge into steamers at one of the foreign grain ports—we hope to refer to this more fully at a later day—and others are being negotiated not only for floating but for land purposes.

As to the capabilities of the process, we understand Mr. Duckham has thereby experimentally raised wheat and maize 80ft. and conveyed the same horizontally 700ft., but has not reached the limits of this method of elevating and conveying.

## BETHLEHEM HARVEY PLATES.

We give herewith a photograph of the Harveyed nickel steel plate tested at Indian head on May 19th last, to which special attention has been called, seeing that it has been thought disappointing as a sample of thick armour subjected to the Harvey process.

The details of the trial are as follows:—The plate measured 15ft. 6in. by 7ft. 6in. It was 18in. thick for a width of 4ft., tapering off for the lower 3ft. 6in. to the thickness of 8in. at the bottom edge. The point of impact of the first shot was 80in. from the right-hand end, and 36in. from the top edge, thus falling in the straight part of the section. The penetration of this shot was about 20in., measured from the face.

The second shot struck 33in. from the right-hand end, and 36in. from the top edge. The penetration was about 24in. from the face of the plate. The projectile penetrated 6in., not 8in. as first reported, into the backing, and broke into small fragments. Cracks A, B, and C—shown in the photograph—were made by the first blow; D and E were opened by the second, but may probably have been started by the first round. The projectile and charge were given in The Engineer of May the 25th, namely, a 12in. Carpenter forged steel projectile, weighing 850 lb., fired with a charge of 269 lb. of prismatic powder in the first round, giving a striking velocity of 1465 foot-seconds, and in the second round fired with a charge of 419 lb. of powder, with a striking velocity of 1926 foot-seconds. The calculated perforations are for the first round about 18·7in. of wrought iron, and for the second, on the English system, 25¼in. of iron, or 20¼in. of steel, and on Krupp's system 27½in. of iron, or 22in. of steel.

The second round was a very severe test. The first round had greatly strained if it had not actually commenced a crack through the point of impact of the second round. At the best it was, in a sense, splitting a plate by driving in successive wedges, and we think that the armour's reputation in no way suffered by the second round. For fracture, the only measure we have is the energy per ton. The energy of the second round was 21,860 foot-tons. The entire plate weighed 33 tons, we believe. This would argue an energy per ton of plate of 662 foot-tons, which is considerable, but seeing that the portion attacked was broken entirely away from the rest of the plate by the first round, the shock must be taken as falling on this mass, which, it may be seen from the figure, formed about $\frac{2}{5}$th of the whole, so that the shock was obviously about 1681 foot-tons energy per ton of plate. This agrees with the estimate made in America, namely, 1683 foot-tons. We noticed in our article the severity of this second round, and the details since received now indicate that we understated the case in absence of full information. This does not, however, apply to the first round, which was undoubtedly disappointing. It is to this that special interest attaches.

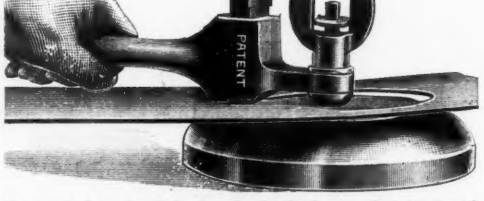
It appears that while this plate was undergoing the hardening process a crack had been heard, and on this account the Government inspectors selected it for test. The makers, we understand, might had they wished it have withdrawn the plate as spoilt work, but they preferred to take their chance. After the destruction of the plate it was seen that the horizontal crack—A D E—was the development of a very large internal crack which had been caused by the water hardening. The extent of this crack was indicated by the discoloration of the fracture. It became apparent, it is said, on the surface of fracture about 12in. to the left of the first hole, and extended nearly to the end of the plate, spreading from ¼in. to ½in. of the hardened surface, to from 1in. to 2in. at the back of the plate. It may be seen that this line is parallel to the angle at the back of the plate, due to the tapering off of the lower part, but it is difficult to connect it with it. The question then arises, How does this bear on the position of Harveyed armour? That the plate was not a sample goes without saying, so that it hardly bears upon whether the Harvey process when completely successful tells less on thick armour than thin. On the other hand, it certainly does apply to the liability of thick armour to suffer in the process, because a plate that the makers were ready to take their chance with under the ballistic test was one that naturally would have been supplied for service. There was no flaw apparent on the surface. Nothing had happened but a loud noise, and it takes a very well-established noise to frighten most makers out of the large sum of money represented by such a heavy plate. After testing and examining, if no defects could be detected in the finished plate, we know practically that the plate would be supplied for the service; nor could makers be blamed, seeing that they had the courage of their choice when brought to face the ballistic test. We may remind our readers that a Tresidder plate failed similarly from a crack in a trial at St. Petersburg more than a year ago; in fact, it is in the water-hardening, which is common to both Tresidder and Harvey treatment, that this trouble has arisen, so that it cannot be fairly traced to the carbonisation process. Can it be connected with the presence of nickel? It would be satisfactory to us in England if we could establish this, seeing that we have discarded nickel partly on grounds connected with such a question. Unfortunately the St. Petersburg plate was a compound one, and contained no nickel. The water-hardening was almost the only element possessed in common by these two notorious plates. Other untreated steel plates have developed flaws at times, and it is clear then that we must wait for further results before pronouncing, in the meantime be specially careful. We think it would be desirable to fire at every plate that makes a noise in hardening, for at present the only alternative would be to reject it. If the finished plate shows no evidence of cracks, purchasers will probably feel that hardening ought to be done in the presence of their inspecting officers. The general tendency of this is to keep up the preference in favour of untreated plates which exists on the Continent. Nevertheless, in spite of any liability to disappointment, the treatment gives such high resisting powers that we cannot but feel that the adoption of treated plates is only a question of time.

Another thick armour-plate of Harveyed nickel steel made by the Bethlehem Company was tested at Indian Head on June 12th last with complete success. The plate was a curved one for the barbette of the Massachusetts. It measures 12ft. 1in. by 8ft. 4¼in. by 17in., and its weight is 30 tons 5¾ cwt. It was attacked like the plate preceding it by 12in. Carpenter forged steel projectiles weighing 850 lb. each. The first round had a striking velocity of 1410ft., implying an energy of about 11,715 foot-tons and a perforation through iron of 17·96in., and through steel of 14·37. A second round had a striking velocity of 1853 foot-seconds, and an energy of about 20,240 foot-tons, implying a perforation of 24·23in. of iron and 19·38in. of steel. The first projectile broke up with a penetration of about 8in., and the second broke up with about 11in. penetration. There was a fine horizontal crack in the plate running from the right side of the second point of impact. The plate was approved, and twenty-six 17in. plates were accepted on its performance. The performance is greatly to be commended. The second blow, it may be seen, represents more than 2in. perforation than the plate attacked, and the shock is 663 foot-tons per ton of plate, the latter being fully as severe as the 18in. plate had been subjected to. The Bethlehem Company is therefore greatly to be congratulated on its success.

We give herewith a copy of the official photograph of the plate after the second round had been fired.

## THE "SUNDALE" HOLE CUTTER.

We here give an illustration of a new hole-cutting tool which will doubtless be of interest to shipbuilders, tank and boiler makers, &c. It will cut a true and clean hole in iron and steel plates up to $\frac{5}{16}$in. thick. The illustration clearly shows the method of handling the tool, which is made in nine different sizes for holes from 3in. to 12in. diameter, by Selig, Sonnenthal and Co., of 85, Queen Victoria-street, E.C. The only preparation necessary for its use is the drilling of the central hole. We have seen the tool, and also some of the work done by it, and unhesitatingly say that it should supply a long-felt want to manufacturers who think anything of economy.



The Port of Algiers.—In view of the importance of Algiers as a coaling station for British vessels, the British Consul-General at that town, in a recent report upon the trade and navigation of the Colony, furnishes a description of the port, with suggestions for its improvement. Algiers holds the eighth place among French ports, and shipping entered last year amounting to 776,111 tons, of which British shipping formed 223,939 tons, or 29·9 per cent. Formerly vessels going to and returning from the East used to stop at Gibraltar and Malta to coal. Algiers has been found a much more convenient stopping place, as it divides the distance better between Port Said and the United Kingdom, and is free from the unusually strict quarantine regulations which are enforced at our own Mediterranean ports. The number of British vessels which called at Algiers, for coal only, exclusive of those which brought or took away cargoes, has increased from 85 in 1886, to 1118 in 1893, and the number increases daily, five or six vessels often being in harbour at once. The port, consisting of a great sheet of water and a small basin, called the Darse, is a military harbour, a fishing port, a harbour of refuge, and a mercantile port. In the opinion of the Chamber of Commerce, the port ought to have a double future as a place of repairs if not of construction, there being two docks which are not sufficiently used, and as a port of supply for English vessels going to the East, in which respect it has greatly increased of late. The water area is 222½ acres, a space sufficient for its requirements, but the length of the quays is by no means equal to the demands of commerce, the amount available being only 1400 yards, or 534 tons of merchandise to each yard of quay. The following works, some of which are in progress, and others under consideration, are necessary to make the harbour commodious and safe: Narrowing the entrance and making a new one in the south part of the Mole; lengthening and widening the northern jetty, and replacing its crowning part by better work; renewing the retaining walls of the Admiralty "*clot*"; creating an inner harbour in the bay to the east. The report, Annual Series, No. 1347, contains examples of the charges for loading, discharging, port dues, &c.

## THE NEW "KAPP" ALTERNATOR.

WE illustrate to-day a new dynamo which has been brought out by Mr. Gisbert Kapp, or, perhaps, it would be more correct to say that the machine which he recently showed to a large and distinguished party of engineers, at the works of Messrs. Johnson and Phillips, Charlton, is an improvement on his well-known type of alternator. As every machine which has for its *raison d'etre* the simplification of the generation of high tension electricity must possess for engineers and electricians at this time a very special interest, we commend the new alternator to the careful consideration of all who are interested in electrical generation.

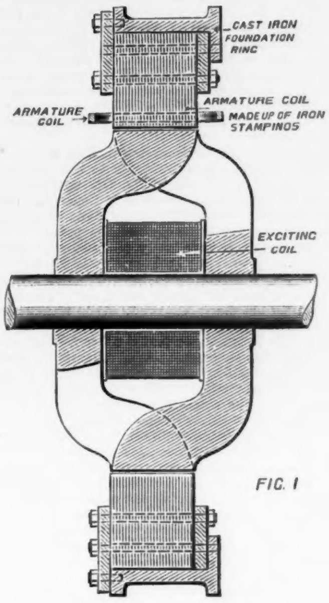

CAST IRON FOUNDATION RING
ARMATURE COIL
ARMATURE COIL MADE UP OF IRON STAMPINGS
EXCITING COIL

FIG. 1

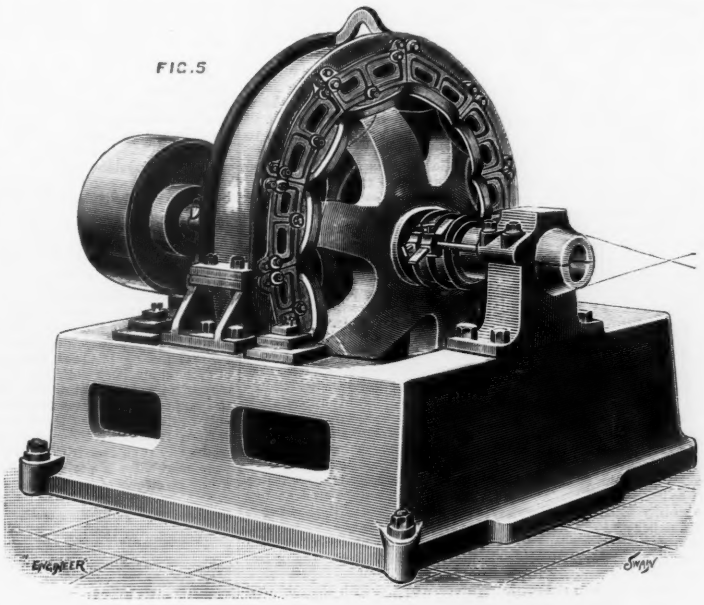


FIG. 5

The machine, which is experimental, is of 20-kilowatts capacity, and when driven at 780 revolutions per minute gives a current of 10 ampères at 2000 volts, and having a periodicity of 93 per second. Unlike his older machines, Mr. Kapp causes the field-magnets to revolve within a stationary armature, a detail of alternator design which, because of its obvious and self-evident advantages, is rapidly becoming universal. The field magnets in the new machine under notice are arranged in a manner somewhat similar to that adopted by Mr. Mordey, in so far as that the winding consists of only one coil and that they are claw-shaped; but unlike the Mordey field, in which the faces of the pole pieces are at right angles to the shaft, in that the faces of the pole pieces are parallel to the axis of the shaft. This is shown in the rough sketch marked Fig. 1. The magnets are of cast steel, made in two pieces, one of which is keyed to the shaft, while the other is held in place by means of a collar. Upon the shaft, and between the magnets, the exciting coil is placed, which makes each pole face alternately north and south, there being fourteen faces, or seven of each polarity in the machine. The clearance between the field magnets and the armature is $\frac{1}{8}$th of an inch, and though this might even be reduced, such a clearance has been found in practice to be sufficient for good regulation. The armature coils are wound over cores formed of charcoal iron stampings, and as each coil is wound separately, and is in the process of its winding thoroughly covered with rubber tape, we can quite understand Mr. Kapp's confidence when he assured his visitors that a hose being played over his machine would produce no evil consequences. The iron core stampings are as shown in Figs. 2 and 3, and they are held in place in the machine by means of bolts which pass through a gun-metal clamp at each end of the bunch, and the method of fixing the whole thing, core and clamps, to the embracing cast iron ring is sketched in Fig. 4. The faces A and B are turned true, and are parallel to each other. The faces of the gun-metal clamps are also machined, so that each section of the armature, as put in place, is kept rigid and quite true, both with respect to the field magnets and to the other sections of the armature itself. As all the coils of the armature are, when fixed in place, connected in series, the machine possesses many advantages over others in which two or more sections are in parallel, and no effect due to difference in electromotive force between halves or quarters need be feared. The points of the greatest difference of potential can be efficiently insulated in a stationary armature in such a way that they can withstand the wear and tear of central station work without any special attention; but indeed the greatest care has been devoted to the design and manufacture of the new alternator, so that it shall require the least amount of skill to keep it in efficient repair and satisfactory working order. The armature is so insulated that there can be no leakage, and if by chance an armature coil should burn out, it is possible to stop the machine—as was shown—take out the damaged coil, replace it by a spare one, connect it up, and be running again in between five and six minutes. As every section of the armature is machined and wound to a template, there is no difficulty in arranging for such an interchange of parts. The coils of the armature are easily wound, require no expensive winding gear, and can be insulated and put together by the switchboard attendant at the station, while the cost of repair of such an alternator must be very small.

FIG. 2

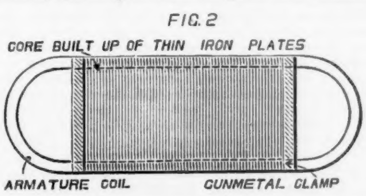
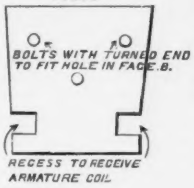


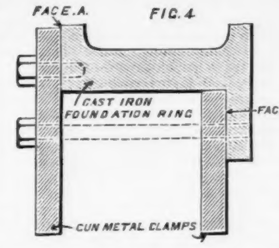
FIG. 3


BOLTS WITH TURNED END TO FIT HOLE IN FACE.B.
RECESS TO RECEIVE ARMATURE COIL

The advantage of the capability of the machine for the replacement of damaged coils so promptly, is one which will recommend itself to the favourable attention of central station engineers, who know what valuable time is frequently lost in repairing alternators owing to absence of interchangeability of the different parts.

One peculiarity of the machine which Mr. Kapp wished especially to demonstrate was the fact that it might be short-circuited without fear of damage—indeed, with impunity, and this he showed in the following way:—The machine, working with an output of 20 kilowatts, was suddenly short-circuited and was left working on the "short." At first the engine ran away, acting as if connected to a shunt-wound dynamo, the armature completely demagnetising the field magnets. Then it slowed down to its normal speed as the governor asserted control, and the dynamo gradually worked on the short until it produced a current of 35 ampères, with no E.M.F. apparent on the voltmeter.

FIG. 4



In the ordinary working of a central station this would mean that, should a pair of mains short-circuit, the dynamo would work on the short circuit without straining the engine, the fuse or cut-out would then fail, and the E.M.F. come up slowly to normal pressure, and not suddenly, as in the case of a machine with very little self-induction. This property of being short-circuited with impunity is, perhaps, of more value in the case of two alternators running in parallel than in any other case, as it is possible to suppose that with two alternators working in parallel and the field of one of them suddenly broken, the second machine would be immediately short circuited, and the consequences in the case of machines without self-induction in the armature would be very grave. But in this machine the effect would simply be that the moment the field-magnet circuit was broken on the alternator there would be a fairly high resistance, viz., the armature of the broken-down alternator in parallel with the external work on the second alternator, and would simply mean an excess of current being supplied by the second alternator, the lights need not necessarily be extinguished, and not any damage done to the machines. It is a question whether this property of being short-circuited will recommend itself to most electric station engineers, their principal anxiety is that the light should be kept going; and with machines such as the Ferranti or Mordey type, a short circuit is so very quickly disposed of that nothing is thought of it; but if it takes ten or fifteen seconds to dispose of one by means of a machine similar to Mr. Kapp's, the patience of the consumers would be very severely tried. On the other hand, the sudden short-circuiting and its sudden removal with very high E.M.F. tends to put a severe strain on the insulation of every part of the system, and the consequence is generally the breakdown of some part of the plant by it, dynamos, mains, and transformers; the first two are not very serious to the consumer, but the latter affects him so long as it is out of order.

The exciting current in Mr. Kapp's machine is 1·3 per cent. of the total load, but this can be made as low as ·6 per cent. in machines of larger size, and the drop in volts from no load to full load is under 12 per cent.

---

## THE RELATION OF THE DRAWING OFFICE TO THE SHOP IN MANUFACTURING.*

By A. W. ROBINSON, South Milwaukee, Wis.

THE purpose of this paper is to describe the system employed by the writer in the drawing-office of his company in the hope that some of the points may be of use to members of the Society. The drawing-office is the origin of thought and action for the entire works as far as the design and construction of its product are concerned. It is responsible for the accuracy of its drawings and orders, and its authority should be unquestioned and above reproach in the shop. The shopman should habitually trust and adhere to their drawings, and their faith should not prove to be misplaced. To maintain this there must be unceasing care and vigilance on the part of the office, and full adaptation to the shop needs and capabilities. It goes without saying that every drawing-office, whether employing one draughtsman or a hundred, should have its system and methods adapted to the needs of the establishment with which it is connected. As these needs vary with each case, it is not to be supposed that the system about to be described will be of universal application. It will be well, then, to state in a general way the conditions which this system is intended to meet. We will assume, therefore, that the office employs from ten to fifteen skilled draughtsmen, and is in connection with a manufacturing establishment, doing a general engineering business in which there is comparatively little duplication of orders, and in which single orders frequently involve a large amount of detail, of which it is essential to keep exact records. It is also assumed that the drawing-office is invested with the sole right and authority to issue orders to the shop for all new work, or all work in which there are changes and variations from previous similar work. The practice of issuing verbal orders or directions for the conduct of work is productive of misunderstanding and confusion. When no evidence of authority exists no responsibility can be fixed. It is therefore advisable to have a system of written orders to all departments whereby the duty of those concerned is clearly defined, and the responsibility can be fixed for dereliction of duty.

*Shop orders.*—An order being once entered on the books of the company, the procedure is as follows:—The business office issues a written order to both the drawing-office and the shop upon a blank which merely states the general name of the machine, the time of delivery promised, and the number of specifications to be worked to, if any, and the number by which the order is to be known. It is the duty of the drawing-office to prepare such specifications beforehand when necessary. On the receipt of these orders in the shop, if it be a repair or duplicate of something already made, so that the shop superintendent has the information by which to execute it, he does so. If, however, it is new, or in any sense special work, he cannot proceed until the orders come down from the drawing-office. The drawing office issues orders upon the pattern shop and foundry by means of blanks headed "Foundry" or "Pattern shop," as the case may be, arranged thus:—

B. S. S. & D. CO. ENGINEERING DEPARTMENT.
FOUNDRY ORDER.

| | | |
|---|---|---|
| ORDER NO. | DATE.<br>189 | DRAUGHTSMAN. |
| | | |
| Countersigned by | Examined by | |

These are manifolded in triplicate, and can be made out by any draughtsman to whom the job is delegated, but must be signed by the chief engineer, or in his absence, the chief draughtsman. The two copies are then sent down to the shop superintendent's office, who keeps one on file for his own reference and information, and immediately sends the other to the foreman of the department for which it is intended. In this way the shop superintendent retains control of his men in the different departments, and has knowledge of the orders that are issued. He alone is responsible for their proper execution, and undue interference of the draughtsman with the foremen or workmen is obviated. It is also the duty of the drawing-office to order all raw material for new and special work, that is not regularly kept in stock. This is done by blank as follows:—

B. S. S. & D. CO. ENGINEERING DEPARTMENT.

| | |
|---|---|
| DATE.<br>189 | Please order the following<br>for order No. |
| Ship | |
| Draughtsman | Countersigned<br>Chief Engineer. |

These are simply requisitions on the business office, and the copy goes to the storekeeper as a statement that the articles noted have been this day ordered. He will therefore be expecting them, and on their receipt will at once know for what order they are intended. His copy of the manifold reads, "The following material has this day been ordered for order No. —." Written orders are not issued from the drawing-office to any other departments, except the pattern shop and foundry. Drawings and sketch sheets are issued to the other departments, as machine, smith, and erecting shop, &c. These pass through the hands of the shop superintendent, and in themselves constitute an order to make what they represent or call for, provided they are covered by the original general order from the business office and bear the same order number.

By means of these written orders to each department, each foreman knows definitely what work he has on hand, and all responsibility for errors or delinquencies is at once traceable to the culprit. The shop superintendent is also empowered to issue written orders to his foremen in all departments, for all work which does not require information from or the authority of the drawing-office. For these he uses his own blanks—those of the drawing-office being labelled "Engineering Department." It frequently happens that on large orders involving much detail, it is desirable to push the construction of parts as fast as they are determined upon before the completion of the general design. In these days of urgency and high pressure this is almost a necessary evil, but should be pursued with caution in the drawing-office, lest difficulty be found in fitting the later part of the design to the earlier. Under this system of written orders the parts can be ordered in as fast as they are ready, even though the shop superintendent is as yet uninformed as to the balance of it, and does not know of what the complete order is to consist. When the drawing-office work on the order is completed an order list is made out and typewritten in duplicate. The order list enumerates in detail all the items making up the complete order, and is divided up into headings, such as—(1) castings; (2) forgings; (3) miscellaneous; (4) special material ordered outside, and so on. For each item is given a reference number of the drawing or sketch sheet on which it is shown, and it is or should be shown thereon so fully and definitely that no further questions need be asked. This order list is essential—first, to inform the shop definitely of what the work consists; secondly, to refer the shop to a source of information concerning each and every item; thirdly, to form a shipping list so that in shipment nothing will be overlooked that should be sent; fourthly, to form a permanent record by which repairs may be readily identified, and from which future machines may be compiled or adapted. These order lists are press copied in a book for the purpose.

---

* Presented at the Montreal meeting—June, 1894—of the American Society of Mechanical Engineers.

*Drawings.*—The primary function of a shop drawing is to answer the shopman's questions, and, indeed, it may be said this is its only function. There are certain things connected with the material, form, dimensions, finishing, fitting, and erecting of a machine and each part of it, that each department needs to know. Sometimes in simple cases the various processes of pattern-making, finishing, and erecting, can be defined on one drawing, and in other cases separate drawings containing separate information for the different processes are demanded. It is important to have all the necessary information conveyed on a drawing in a direct and legible manner, and that the views be so chosen as to represent the object in the simplest way. Let the draughtsman, on beginning to make a shop drawing, say to himself, "Now what does the fellow who is to make this want to know," and then let him put down just that information and no more, but be sure and get it all on. Refrain from all superfluous lines and marks, and make the drawings so plain that "he who runs may read them." The mere ability to make lines and circles and projections is really the least important and least valuable part of a draughtsman's skill. Neatness and accuracy of drawing is desirable, but if it is obtained with the expenditure of an undue amount of time, and does not carry with it a practical knowledge of shop needs and shop processes, it ceases to be a virtue. The following set of rules for the drawing-office have been found to be useful and to work well. They contain some points that a good draughtsman ought to know, but they are incorporated as reminders, and as being necessary to preserve uniformity of practice among changing draughtsmen.

### DRAWING OFFICE RULES.

*Shop drawings.*—(1) All drawings shall be of the uniform size of 23in. by 36in. (2) All detail drawings for use in the shop shall consist of whole standard sheets, half standard sheets, and sketch sheets. Half sheets shall be 18in. by 23in., formed by ruling a line across the centre of standard size sheets as filed, the blue prints only to be cut, and mounted, and varnished when necessary. (3) The sketch sheets shall be 8in. by 11in., and shall be used for all simple details, forgings, for bolt lists, and for all temporary work capable of being shown in this way. All standard machines shall be fully drawn out and blue printed. The sketch sheets shall be made with indelible pencil or copying ink and press copied in the book for the purpose. The information on the sketch sheets shall be as complete as that specified for drawings.

*Character of shop drawings.*—(4) A shop drawing is to be considered as an order or instructions to the shop, and not merely as a statement or illustration. For this purpose it must convey clearly all the information needed to make and finish the article. (5) Every dimension necessary to the execution of the work is to be clearly stated by figures on the drawing, so that no measurement need be taken in the shop by scale. All measurements to be given with reference to the base or starting point from which the work should be laid out. In comparatively simple constructions the several parts are to be shown together complete, although each part must be figured independently, and details supplied, if necessary, by sketch sheet. In more complicated forms each part should be detailed by itself and a general drawing made showing the thing complete. No details should be sent out without putting them together on a drawing, or taking them from a general drawing, so as to ensure their fitness. Unnecessary duplication of views to be avoided, except in display or advertising drawings. (6) All figured dimensions on drawings to be plain, round vertical figures, not less than ¼in. high, and formed by a line of uniform width, and sufficiently heavy to ensure printing well, No thin, sloping, or doubtful figures or diagonal-barred fractions will be tolerated. All figured dimensions below 3ft. to be expressed in inches. (7) All centre lines to be alternate dot and dash in fine black line. All dimension lines to be in continuous red lines with a central space for the figure, and of such strength as to show on blue print more faintly than lines of drawing. Lines of drawing to be bold and clearly defined in proportion to the scale, and to be shade-lined by making the right-hand and bottom lines heavier. No ornamental shading or other "frills" allowed on shop drawings.

*Title.*—(8) Every drawing, whether whole or half-sheet, shall have the title, date, scale, and number of the sheet placed in lower right-hand corner. One man will be detailed for this duty, to secure uniformity. (9) The name of the drawing, as given in the title, is invariably to consist of two divisions in one line, separated by a hyphen. The first division is to state the general name of the thing or machine, and the second division is to clearly designate the part or parts represented—or if a general view, should so state. The wording of the titles should be submitted to the chief engineer or head draughtsman for approval.

*Drawing symbols.*—(10) Detail shop drawings should state:—(*a*) The pattern number of every casting in plain figures of larger size than the dimension figures. (*b*) The number of each piece required for one set. This should be written in one word—not figures—and followed by symbol of material. (*c*) The material of which the parts so ordered are made, using symbols as follows:—C.I., Cast iron; W.I., Wrought iron; C.S., Cast steel; M.S., Machinery steel; H.S., Hammered steel; Bs., Brass; Bz., Bronze, Bbt., Babbitt; V.F., Vulcanised fibre; C.R.S., Cold rolled steel. Other materials write full name. (*d*) The kind of finish on each of the different parts will be indicated by a letter preceding the figured dimensions, as follows:—F. means "Finish," and indicates that the surfaces to which it applies are to be machined or dressed in suitable manner to size stated. F.B. means "Finished bright," or polished. G.F. means "Grinding finish," and indicates that the only finish to be allowed is that necessary for grinding. When no letter precedes the figured dimension it is understood that the part is to be left black or rough. In cases where finish might be presumed but not required, follow the figured dimension by the word "Cast" if a casting, and "Rough" if a forging. (*e*) A reference list of sketch sheets that may be used for detail illustrations.

*Sketch books.*—(11) Each draughtsman will be supplied with a sketch-book by the company, and in which he shall make all his notes, calculations, and data referring to his work, and under no circumstances shall original work be done on loose sheets and transcribed into these books. No effort should be made at neatness or nicety in these books, but each entry should invariably be commenced with the name of the thing and the date, and full notes made of data on which the calculations were based, and the results obtained clearly stated. These books are to be the property of the company.

*Index for drawings.*—(12) An index book for drawings will be kept in the drawing-office by the clerk. This book will be divided into as many divisions as there are drawers, with provision for indexing 100 drawings in each drawer. The names of the drawings will be added to the various divisions according to their classification. The system of numbering shall be as follows:—(13) Each drawer shall be numbered consecutively, and shall contain drawings devoted to a certain class of work, which shall be indicated on the drawer label. The drawing number shall consist of two or more digits with a decimal point between them. The whole number shall indicate the number of the drawer, and the figures after the decimal point shall indicate the serial number of the drawing in that drawer. For example: Drawing No. 5·16 is the 16th sheet in Drawer No. 5, and Drawing No. 75·96 is the 96th sheet in Drawer No. 75. Not more than ninety-nine drawings shall be put in one drawer, except in exceptional cases. (14) Sketch sheets will bear the number of the letter and page of the letter book, preceded by the letter S, to distinguish them from drawings, and will be indexed in their own impression book, but not in the drawing index book. They will be referred to on general drawing of which they are details, and will also bear the number of such drawing. (15) When making a new drawing the draughtsman will apply to the clerk for a number, and will be allotted the first unappropriated number in the division to which the drawing will belong. (16) On completion of every drawing or sketch sheet it must be examined and initialled by the engineer before being issued, and the following entries made in books kept for the purpose:—(A) Record of blue prints and sketch sheets issued to shop, giving date, number, and title. (B) Drawing index—Record in day-book the number, title, and sub-title, draughtsman and date. (C) Pattern index—Record in day-book the number, classification, and correct name of patterns, with remarks and date. Each draughtsman will see that these entries are properly made.

*Patterns.*—(17) All patterns shall be numbered with the number of the drawing from which they are first made, followed by a letter indicating its serial on that drawing. For example, if four patterns are shown in detail on drawing No. 36·50, the patterns shall be numbered 36.50A, 36.50B, 36.50C, 36.50D. When existing patterns are utilised in a new design or machine, their original number is to be noted on the drawing on which they are shown in their new employment. (18) Upon receiving formal notice from the pattern shop that patterns are ready for inspection, the draughtsman connected with the order shall examine same and issue foundry order for the casting. The date of inspection and name of inspector shall be entered upon the pattern maker's report at the time of making such inspection.

The sketch sheets referred to in these rules are 8in. by 11in. in size. They are of stiff cardboard, and the heading is printed in copying ink. The sketch is made with an aniline copying pencil, the "Eagle No. 2" in wood being used. They are press-copied in books for the purpose, and several books are used for different classifications of work. The books are of slightly heavier tissue paper than is commonly used for correspondence, and have 500 leaves each, numbered consecutively throughout the series, so that the number of a sketch sheet is never duplicated. In this system there are six books for copying sketch sheets, representing as many classes of work, and these divisions will readily suggest themselves as required for any particular case. The use of these sketch sheets is especially for work which does not require to be often duplicated, and for giving quick dispatch to emergency work. A freehand sketch can be made, copied, and issued in this way in ten minutes, while the regular process of drawing, tracing, blue printing, and waiting for the latter to dry, or the sun to shine, may consume hours. They have the additional advantage of being more convenient to handle and file away in the shop than blue prints, and they save multiplications of tracings and consequent drawer space. The copies being in book form cannot be lost and are easily indexed and consulted. Sketch sheets are convenient for rapid detailing of forging and small parts, and such parts need, therefore, to be merely indicated on the general or erecting plan, and reference numbers given of the sketch sheets. The sketch sheets will also all appear as items in the order list. In addition to the stiff card sketch sheet, it is convenient to have a "Drawing-office Memorandum" blank. This is a copying-ink heading printed on a sheet of letter paper, and is used for order lists and all sketch matter sent abroad from the drawing-office. After copying, the sketch sheet, if for permanent use, is sized with a mucilage, composed of gum tragacanth and water, and then varnished with white shellac and alcohol. The sizing is to keep the lines of the sketch from running while varnishing.

Two necessary articles of office furniture are the drawing table and the blue-print frame. So many excellent forms of these have been devised that it seems hardly necessary to refer to them in this connection, but sometime hereafter occasion will be taken to describe types which have the merit of cheapness and effectiveness. It is our practice not to finish original drawings, but to trace from them on tracing cloth. These tracings are used only to print from and are filed away in a fire-proof vault. Two prints are made of each tracing as soon as finished, one for the shop—or more if necessary—and one to file away in the drawers of the office. These drawers are 24in. × 38in. × 2in., and are each calculated to hold a maximum of 100 prints. In this way the tracings are preserved from risk of fire and loss and from the wear of frequent handling. As a rule each draughtsman makes his own tracings, and only skilled draughtsmen are employed. The writer does not advocate the employment of cheap draughtsmen to trace shop drawings from the originals of the designer. If this is done the designer must finish his original to entire completeness before turning it over to the tracer, thus consuming additional time and running more risk of errors and omissions than if he traced it himself. A skilled draughtsman will merely block out his entire work on the original and give his whole thought to the perfection of his design. In the tracing he can re-arrange his drawing if necessary, and the time occupied in tracing is usually much less than that employed in working out and perfecting the design, and a draughtsman worth 120 dols. per month will usually trace twice as fast as one worth 60 dols., and do it better. The titles on drawings are mainly done by rubber stamps giving the name of the company, the number of the drawing, and having spaces for the insertion of name, date, and scale. Some experimenting was done to find a suitable stamp ink for tracing cloth. Printers' ink was tried; but it rubs off, and does not dry satisfactorily. A special lithographic ink is used, which is similar to printers' ink, but with the addition of a dryer. It is applied to the stamp by a composition roller, in a similar manner to printers' ink, and gives a black impression which blue prints well. The number stamp has movable type. As a rule, it pays to employ only high-class labour in the drawing-office. A draughtsman puts his own impress on his work, his individuality goes into it, even if closely supervised, and it is upon the perfection of detail that the success or failure of a new design mainly depends; it is important that the draughtsman entrusted with it shall have the necessary skill and ability. We have appliances for testing the efficiency of almost every known mechanism; but who can measure the efficiency of the draughtsman. We appreciate the economic value of good steam distribution and the like; but too often is the efficiency of the draughtsman neglected, and thousands of dollars spent in the construction of work which would have yielded much better results if a little more brains had been used in its design.

In conclusion, the writer would say: Do not have so much system that it is difficult to work to or burdensome to carry out. A few simple rules, faithfully adhered to, are better than the most elaborate system which is loosely or imperfectly carried out. The object of a system is to define the duties of each man and to fix the responsibility of dereliction of duty.

---

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Engineer—A. H. Moysey, to the Australia—lent. Probationary Assistant Engineers—H. J Loveridge, to the St. George; G. H. Dureton, to the Iphigenia; C. J. M. Wallis, to the Rainbow; F. A. Gordon, to the Sybille; and R. C. Cleave, to the Apollo. Assistant Engineers for Temporary Service—F. J. Rockrudge, to the Indefatigable; F. C. Haste, to the Intrepid; G. J. Sisley, to the Victory (supernumerary); F. E. P. Haigh, to the Sappho; W. F. Montgommery, to the Scylla; and T. Pearce, to the Andromache.

---

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

AT the works this week there has been a quickening of activity, and a fair amount of business is in hand for the remainder of the quarter, so that on the whole manufacturers are in a more cheerful mood than for some time past. Harvest prospects are also improving the home demand for galvanised and other descriptions of iron. Should the wheat harvest realise anticipations, the position of the iron trade in a few months time is bound to be greatly improved. Galvanised corrugated sheets at present are quoted nominally by the Galvanised Iron Trade Association £10 to £10 5s. for 24 gauge sheets, f.o.b. Liverpool, but there is no difficulty in obtaining serviceable material of the same gauge at £9 15s. to £9 17s. 6d. Black sheets for use by the galvanisers continue to be quoted in some cases as low as £6 10s., or even £6 7s. 6d. for doubles. Best thin sheets for deep stamping purposes are in good demand at £10, and ordinary coal vase sheets run from £7 up to £8 10s., according to quality; £8 to £8 10s. is asked for boiler plates, and £6 15s. to £7 for tank plates. The demand is somewhat slow in both cases.

In the pig iron trade the furnaces are making a larger production than lately. Cinder pigs are 37s. 6d. to 38s. 6d.; part-mines about 42s., and all-mine hot blast, 57s. 6d. upwards; with cold blast, 97s. 6d. Midland sorts are in fair demand. Derbyshires are 42s.; Lincolnshires, 44s.; and hematite, 53s. Consumers' needs are in some cases covered till the close of the year.

Constructional engineers have lately received some good orders for bridge and roofing work for India and other Eastern countries. The railway wagon building firms have also got a considerable amount of work on hand for lines in India, Egypt, and elsewhere. The axle-tree firms are fairly engaged, though they are experiencing no particular pressure.

I am in a position to announce that the Great Western Railway Company is intending to erect at Wolverhampton, on premises near the main line, buildings for the manufacture of oil gas for the lighting of railway carriages on the company's system, similar to the works having the same object now existing at London, Exeter, Swindon, New Milford, and Bristol. At present, the nearest point for supplying the train service in the Wolverhampton and Birmingham district with the light is London, and the want has long been felt of having a supply nearer at hand. Full operations at the new works will, it is expected, be in progress by the winter, and the method of charging the carriages is so simple that a matter of two or three minutes is all that is required. The illuminant will be conveyed from the works to the station through piping, and storage facilities at considerable pressure will be provided underneath the carriages sufficient to secure a supply for from eighteen to twenty-four hours.

Makers of railway wheels and axles and other railway materials here are interested in the reply of the Secretary of State for India in the House of Commons a few days back to the question of Sir James Kitson. The interrogator called attention to the statement made by the Chairman of the East India Railway, who had asserted that continued difficulties were met with in obtaining funds from the Government of India to meet reasonable requirements of traders for increased or improved accommodation. Mr. Fowler replied that the East Indian Railway Company was at present, under its constitution, dependent for outlay in the nature of capital expenditure on the limited funds at the disposal of the Indian Government for such purposes. It was, in his opinion, very desirable that means should, if possible, be provided by which the requirements of that system might be more largely met in the future, and the subject was now under his consideration in council. The difficulty did not arise in connection with other Indian railways, which possess the power under their constitution to raise funds, with the sanction of the Government, for the purpose of their several undertakings.

At the forthcoming Trades' Union Congress a resolution will be brought forward by the United Chain Makers' and Chain Strikers' Association demanding that all chains to be used where there is risk to life and property shall be subjected to public tests and to the strictest scrutiny and examination. At a meeting of the last-mentioned body at Dudley recently, it was alleged that "under the present system there was a large quantity of chain, unworthy of the name, made by unqualified workmen, and exported under bogus certificates to the detriment of English trade."

---

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—Speculation as to the probable outcome of the suggested terms for a settlement of the general wages question, so far as it concerns the coalowners' and miners' federations, has been one of the most prominent questions during the past week. The general feeling has been that, notwithstanding the strong division of opinion amongst both the coalowners and the miners from their respective points of view with regard to accepting a settlement on the proposed basis, some such arrangement ought to be come to, not only in the interests of the coalowners and the miners, but of the various important industries dependent upon fuel supplies, by which any such disastrous dispute in the coal trade as that of last year might, for a period, at least, be rendered impossible. The injurious effects of the last prolonged stoppage of the pits have not yet by any means been overcome, and the general opinion is that another such disastrous dispute would go very far towards destroying any possibility of improvement in the iron and engineering trades for a considerable time to come.

Only a very limited weight of business was put through in the Manchester iron market on Tuesday, one or two special conditions operating to induce buyers to hold back from placing orders except for absolute immediate requirements. In the first place the strike of miners in Scotland would seem to be very near the point of collapsing, and in the second place the proposed general settlement of the wages question in the Midlands, including a reduction of 10 per cent. on the present rate of wages, and a binding agreement over the next two years, which would prevent any renewal of wages disputes during that period, are looked upon as possibly tending to give an easier tone to prices for pig iron. Merchants and speculative dealers would, at any rate, seem to view the situation in this light, as they are cutting in very low to secure business, and, generally, orders could have been placed on more favourable terms than would have been accepted last week. Lancashire makers of pig iron are so altogether out of the Manchester market, owing to the extremely low prices now ruling for district brands, that their quotations are, as a rule, only nominal. At the works they remain at about 39s. to 40s. for forge, and about 42s. for foundry, less 2½, and where they have exceptionally low rates of carriage they are able to book occasional small orders, but apart from this they are doing practically no business of any moment. With regard to district brands, makers' quotations for Lincolnshire remain about 38s. 6d. for forge, to 39s. 6d. for foundry, net cash, delivered Manchester, but about 3d. under even these low figures is being taken where orders are to be got, and merchants in some cases have been quoting 6d. under the makers' prices.

Derbyshire foundry brands just now meet with very little sale in this district, and 44s. 6d. to 45s. 6d. net cash would represent about the prices which would be taken for delivery here. Outside brands offering in this market, taking them all round, are easier. The leading Middlesbrough makers are still quoting 44s. 4d. net cash for good foundry qualities delivered equal to Manchester, but merchants are sellers at 6d. to 9d. under these figures. There are still very few makers' quotations in the market for Scotch iron, but through second hands Eglinton could be readily bought at 45s. 6d. net prompt cash, delivered at the Lancashire ports.

The manufactured iron trade remains without appreciable improvement; here and there perhaps a little more business is reported to be stirring, but forges generally continue very short of orders, and prices are weak. For Lancashire bars £5 7s. 6d. is now the general quotation, and for Staffordshire £5 10s., but even at these figures there is some little giving way where anything like favourable specifications are concerned. Lancashire sheets average about £6 17s. 6d. to £7 2s. 6d.; and Staffordshire, £7 5s.; Lancashire hoops, £5 17s. 6d. for random; and £6 2s. 6d. for special cut lengths, delivered in the Manchester district.

In the steel trade only a very slow business is still reported, with prices anything but firm; ordinary foundry hematites are still nominally quoted at 52s. 6d., less 2½; ordinary basic billets at £4 net cash, but they are obtainable at less. Makers of steel boiler plates quote £6 10s., with, however, lower sellers in the market, and local makers of steel hoops have reduced their quotations 5s. per ton.

In the metal market business is still only very quiet, but list rates for manufactured goods remain as last quoted.

The position as regards the engineering industries shows no general improvement. Here and there establishments are getting rather busier on special work, and locomotive builders are better supplied with orders than they have been recently, but taking the trade all through, establishments continue only very moderately engaged, and the outlook as regards the future is not at all hopeful.

With regard to the usual monthly reports issued by the trades union organisations connected with the engineering industries, if there is any change at all in the general position it is scarcely in the direction of improvement. The Amalgamated Society of Engineers have this month a considerably increased number of out-of-work members on the books, but this is due mainly to the moulders' strike in the North of England, which has caused some five or six hundred members of the above society to be thrown out of employment, and has brought the number of out-of-work members in receipt of donation benefit to between 9 per cent. and 10 per cent. of the total membership of the society. In the Manchester district the position if anything is slightly better. This is due chiefly to increased activity amongst locomotive builders already referred to, which has resulted in a considerable number of out-of-work members having been taken off the books during the last few weeks. Other trades, however, throughout the district remain much as they were, and reports from other centres do not show any improvement whatever as regards the general position in the engineering industries. As regards the Steam Engine Makers' Society, the monthly reports are not yet fully completed, but it is expected they will show a slight improvement in the general position, except in the marine centres; there are still, however, rather more than 5 per cent. of the total membership on donation benefit.

The second summer excursion in connection with the Manchester Association of Engineers took place on Saturday last, when, with the object of enabling the members and their friends, including ladies, to view the entire route of the Manchester Ship Canal, the Council specially chartered a saloon steamer—the Daniel Adamson—which, with a party numbering about 150, left the Trafford Wharf, Manchester, at noon, and arrived at the landing-stage, Liverpool, at 5 p.m. During the journey the members and friends, who were accompanied by the President, Mr. Thomas Daniels, M.I. Mech. E., had a full opportunity of inspecting all the important works along the canal, and the trip was one of special interest throughout. On arriving at Liverpool the party proceeded to the Bear's Paw restaurant, where they all sat down to tea, and the return journey to Manchester was make by a special express train, leaving the Central Station, Liverpool, at nine o'clock.

In the coal trade business during the past week has to a very large extent been held in abeyance pending the decision of the Conciliation Board with regard to the wages settlement. In the better qualities of round coal the demand for house-fire requirements has fallen off to the smallest possible dimensions, and common round coals have been only in hand-to-mouth request for iron making, steam, and general manufacturing purposes, the depressed condition of the large coal-using industries still largely affecting the demand for steam and forge coals, and for the moment users are not disposed to enter into forward contracts. Quoted prices remain unchanged, but to secure business there is a good deal of very low cutting, and colliery proprietors who hold to late rates are undersold by cheaper supplies offering in the market. Best Wigan Arley averages about 11s. to 11s. 6d.; second qualities of Arley and Pemberton four-foot, 10s. to 10s. 6d.; and common house coals, 8s. to 8s. 6d., with steam and forge coals about 7s. per ton, at the pit mouth. With regard to engine classes of fuel, supplies are still more plentiful in the market, with a tendency to ease down in prices. The lower qualities of slack especially are weaker, and are readily obtainable at the pit mouth at 4s. to 4s. 6d., whilst 5s. to 5s. 6d. is about the average for medium qualities, and 6s. to 6s. 3d. per ton for the best sorts of slack.

For shipment a fair amount of activity is still maintained, but the probability that the Scotch miners' strike may soon be settled tends to check markets which usually get supplied from Scotland placing orders here. Notwithstanding this, however, sellers experience no difficulty in securing the slight advance which they recently put upon prices, and for ordinary Lancashire steam coal, delivered at the ports on the Mersey, about 9s. to 9s. 6d. per ton is being readily obtained.

*Barrow.*—There is a very quiet tone in hematite pig iron, and the sales reported during the week are small and unimportant. Makers are short of orders, and even with only thirty-six furnaces in blast they are acumulating stock. Thirty-nine furnaces are standing idle. Bessemer iron is selling mainly to local users, who are, however, not buying largely forward, most of the business doing is on prompt account. Sales of forge and foundry iron are very small. Prices are easy at 44s. net cash warrant iron sellers, and 43s. 11d. buyers. Makers quote 44s. 6d. to 45s. 6d. for mixed Bessemer numbers, but sales are generally below these figures.

Iron ore finds a very poor market, and the limited extent of local sales is now augmented by the fact that sales to Scotch users have been reduced considerably. Prices, however, do not show any material change; 8s. 6d. is still the quotation for ordinary qualities net at mines. Lower prices are impossible under present conditions.

The steel trade shows no new life in any department. There is a very poor inquiry for steel rails, which are quoted at lower prices—about £3 12s. 6d. for heavy sections. Very few orders are in the market. Foreign and colonial orders are scarce, and it is from this source that most trade is expected. In light rails very little inquiry is experienced. A fair but not brisk inquiry is reported for steel shipbuilding material, and the mills are fairly busy. Billets and hoops are in fair request. Tin bars are quiet. Slabs, wire rods, and blooms are in poor demand.

The shipbuilding trade is brisk, so far as the work in hand is concerned, but very little inquiry is being made in reference to new tonnage. The Naval Construction and Armaments Co. has this week received an order to build a 1000-ton steam sludge boat for the London County Council, for the carriage of sewage out to sea. This is the sixth order which has been placed at Barrow for this class of steamer.

Coal and coke are quiet, and sales are comparatively few, prices, however, being very steady.

Shipping is quiet, and the exports of both pig iron and steel are very small. Freights are low.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A STILL quieter tone pervades the colliery districts this week. The Scotch strike has helped to some extent in tiding over a dull period. The fine weather, on the other hand, has reduced requirements most materially. The proposed reduction of 10 per cent., even with the concessions of a minimum wage at 30 per cent. over 1888 prices, is not quite cordially received by the miners, who have been taught too well the simple formula of "No reduction." It is generally believed, however, that the miners will accept the minimum wage offered to them by the coalowners. If this arrangement should be carried out there is no doubt it would influence the trade to a large extent. House coal is in less demand owing to the causes stated. The London market is not taking such large quantities as was reported a few weeks ago. Quotations are as under:—Silkstones, 9s. 6d. to 11s. per ton; Barnsley house, from 9s. to 10s. per ton; other qualities from 1s. to 1s. 6d. less. The demands for steam coal still continue good, and fetch reliable prices. Barnsley hards unchanged at 7s. 9d. to 8s. 6d. per ton; inferior qualities, 7s. per ton. Manufacturing fuel is dull, and prices are low, being very plentiful at 4s. 6d. to 5s. 6d. per ton. Smudge and small coal in good request at 2s. per ton. Coke quiet and easy to buy at 9s. 6d. to 11s. per ton. An extraordinary weight of coal is at present to be seen on the lines in nearly all the station sidings.

Hematites remain at the same prices as reported last week, namely, from 51s. to 52s. 6d., delivered in Sheffield; ordinary iron sheets £8 10s.; Bessemer billets, £5 7s. 6d. to £5 10s.; bar iron £5 10s. to £5 15s., and common forge iron 38s. The iron trade is excessively quiet. A similar remark applies to marine and railway material, the outlook in shipping circles being exceedingly gloomy. An order from a southern company for wagons has been locally placed, but work is exceptionally scarce all round, and many hands are unemployed, both in the heavy and light trades. The values of local companies on the Stock Exchange lists faithfully reflect the prevailing depression.

The battle of projectiles *versus* plates has received new interest from the reports of the experiments with the Russian shells. It is stated that although great secrecy was observed with regard to the Russian projectile, the Sheffield representatives present at the trials are satisfied that they know how the shell is made. They believe that the only means at present to resist the Russian shell is to use thicker armour. The new Harveyed armour is only two-thirds of the thickness of the plates previously employed to obtain the same degree of resistance. There is thus left a margin of one-third the thickness and weight of the armour before it would be necessary to go beyond the thickness used in the compound plates prior to the Harvey process being adopted.

The annual report of the Yorkshire Miners' Association for the year ending December 31st, 1893, has just been distributed to the various lodges. It exhibits how powerful this great trades union of colliers has now become. The total receipts for the year were £129,087 18s. 5d., which, added to the amount in hand—£163,825 12s. 2½d.—makes up a grand total of £292,913 10s. 7½d. The largest item of expenditure is under the head of "Contributions and donations to Miners' Federation of Great Britain," £22,438 13s. 4d. The salaries of paid officials include £514 19s. 8d., the amount received by Mr. Benjamin Pickard, M.P., secretary. The total expenditure for the year was £268,757 6s. 11d., leaving a balance of £24,156 3s. 8½d., of which £10,508 is the value of the offices and institutions at Barnsley, Leeds, Parkgate, and Hoyland. The Yorkshire Miners' Association numbers 55,000 members, which is precisely the same number as at the end of 1893. There are now very few miners in South Yorkshire who are not members of the Association.

There is no change whatever to report in the lighter staple trades of cutlery, plated goods, or edge tools. Several local firms are busy in the latter class of goods.

On Tuesday, the 24th inst., Mr. Benjamin Pickard, M.P., President of the Miners' Federation of Great Britain, is to be presented with a testimonial from the miners, in recognition of his services during the strike of last year, and the prolonged negotiations which resulted in the settlement. The testimonial, which has been wholly subscribed by working miners, members of the Federation, is to take the form of an illuminated album, accompanied by a cheque for a considerable sum of money, the exact amount of which has not transpired. The presentation will be made by Mr. J. Haslam, of Derbyshire, Chairman of the Sub-Committee.

The Great Northern Railway Company has just completed several new third-class dining carriages for the East Coast service between King's Cross and Edinburgh. These cars, which are built of teak and varnished, are 52ft. 6in. long, and 9ft. wide, with a canopy roof 8ft. 2in. high in the centre. They run on two four-wheeled bogies, with eliptic and bearing springs which are nicely regulated to secure smooth riding. Their outward appearance at once takes the eye through the novelty of their construction, the sides being thrown out to a curved line instead of being perpendicular, as in all other coaches. The effect is handsome, and the curving of the car gives additional room for an extra passenger at one of the sides. The cars hold forty-two passengers instead of twenty-eight, as in the older patterns. They are beautifully fitted with every accessory for the comfort of third-class passengers. On Thursday afternoon a trial trip was made to Lincoln and back with a train in which were two of these dining cars and a third-class saloon carriage, the three coaches having just been turned out of the carriage department of the Great Northern Railway at Doncaster, under the direction and superintendence of Mr. Stirling, the able chief of the locomotive works there. The coaches rode beautifully, not the slightest oscillation being perceptible, although the speed obtained varied from fifty-five to sixty miles an hour. The carriages are fitted with the Gold system of heating apparatus, with regulators so that the temperature can be raised or lowered as desired when the winter season sets in. Although there is seating accommodation for forty-two passengers, the car can be divided into three separate compartments if necessary. There are fourteen dining tables in each car; every passenger has ample room and abundant accommodation for newspapers, books, &c. Over each table is a net rack for holding hats, small hand-bags, &c., and attached to the side is a bottle and cruet to each table, while the car is well supplied with hooks for coats and other garments. The cars are well lighted with six compressed oil-gas chandeliers with steatite burners, giving a powerful and effective incandescent mushroom light. The floor is covered with extra-thick "kork" matting of carpet pattern, with an addition of another "kork" border, running the whole length of the gangway from the tables. The matting is very soft and noiseless to walk upon. The ventilation is maintained by means of the torpedo ventilators, which have been found in practice to work satisfactorily.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE dulness in trade in this district is unrelieved, on the contrary it grows greater, being intensified by the strikes which are in progress. The Scotch miners' strike, which was expected to cause a spurt in this district, and considerably better prices, has failed to produce either, because the stoppage of the pig iron consuming works in Scotland is much more complete than was looked for, and the requirements across the Border are comparatively small, so that there has been less sent than even last month, when there was no strike. It is true that nearly all the Scotch blast furnaces are idle again, and native pig iron is scarce outside the warrant stores, but the consumption as well as the production has been reduced, seeing that nearly all the mills and forges have been stopped. The iron that is now being taken by Scotch consumers is nearly all of foundry quality, as it is only the foundries that are kept going. The average for this month of the pig iron sent from the Tees to Grangemouth is considerably below that of the past half-year; it has only been a little over 1000 tons daily, whereas the average for the last six months was 1400 tons. And yet the expectation was that the deliveries would have been larger when the strike commenced. There seems to be an idea general now that the Scotch strike will last but a short time longer, and then it is thought that prices will decline further, nothwithstanding that the occurrence of the strike has not had any influence in raising prices; on the contrary, it has not prevented a fall, and to-day No. 3 Cleveland pig iron is the only description of iron that has not recently declined in value. Trade is very adversely affected also by the strikes of moulders and pattern-makers in this district. These are pretty nearly paralysing operations at a number of the finished iron and steel works, for they have led to the closing of a considerable number of shipyards, the proprietors of which cannot at present accept delivery of the plates, angles, &c., they have contracted to receive, and specifications are not forthcoming. Manufacturers have plenty of orders booked, but as they cannot proceed with the execution of them, they are compelled to look elsewhere for contracts, and in this they are not very successful, though they have generally reduced their prices. These operations are very irregularly carried on at our mills and forges, and one of the largest of the iron and steel making establishments, which is chiefly employed on orders from the shipbuilders, is expected to be closed in a few days, though there are plenty of orders on the books of the firm, which, however, cannot be proceeded with. Scotch shipbuilders are not doing much in the way of buying from North-country steel-making firms, though their own native works are closed on account of the miners' strike. It was thought that the extra business done on Scotch account would have more than counterbalanced the los caused by the local strikes, but such is not the case, and the situation is most unsatisfactory.

It is to be regretted that after enduring for seventeen weeks the strikes of moulders and patternmakers should be apparently no nearer a settlement than at first, and should still continue to paralyse so many other branches of trade. Not more than 1500 moulders, &c., are concerned in the dispute, but their action throws at least other 16,000 men out of employment, and what is more, the bulk of these must be out for seven or eight weeks longer, even if the strike were settled at once, because the other work is so far in advance of that of the moulders. The men continue to urge that the improved state of trade justifies their claim for advanced wages, yet the report of their own society describes trade as good in only three places, whereas at sixty-two places it is reported to be bad, and very bad. Something ought to be done to bring about a termination of a dispute which is disastrous to so many branches of trade other than that immediately concerned. Mr. Christopher Furness, M.P. for the Hartlepools, has make a suggestion to the masters and men that the dispute should be referred to arbitration, and that Sir Albert Rollitt, M.P., the Chairman of the Associated Chambers of Commerce and of the London Chamber of Commerce, should be selected as arbitrator. As yet there is no reply from either side.

Pig iron, except No. 3 Cleveland, is this week being offered at lower prices than ruled last week, but the demand for No. 3 is fairly well maintained, and the supply at least in makers' hands is hardly equal to the requirements; in fact, shippers in many cases complain of the difficulties they often experience in making up the cargoes of their vessels through the inability of the makers to load them promptly. Not less than 35s. 6d. is now accepted for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron. Cleveland warrants move very little, and the business in them is very disappointing, especially to speculative holders. The price all the week has been in the neighbourhood of 35s. 6d. cash. The stock of Cleveland pig iron in Connal's warrant stores on Wednesday night was 98,704 tons, or 673 tons increase this month. No. 4 Cleveland foundry pig is at 34s. 6d., and grey forge at 34s.; and consumption is decreasing because of the irregular working of so many finished ironworks, owing to the moulders' strike. Mixed numbers of East Coast hematite pig iron have fallen in value, and can be bought at 43s. 3d. per ton, the decline during the last few weeks being at least half a crown. Rubio ore is cheaper, 12s. 1½d. per ton delivered on the Tees being accepted for an average ore, this reduction being due to a fall in freights. The exports of pig iron from Middlesbrough this month to Wednesday were 54,213 tons, against 49,778 tons last month, and 46,130 tons in July, 1893, all to 18th.

The Cleveland blast furnacemen appear determined to take a twenty-four hours' holiday in order to hold a demonstration in favour of the adoption of the eight hours' shift at the furnaces, and they have practically fixed Saturday, August 11th, as the date of their holiday. The employers at a conference with the men's representatives, held at Middlesbrough, protested strongly against this proposed holiday, but they intimated that if the men persisted in their intention they would offer no further opposition, and will not require the usual legal notices to be lodged. They, however, state that the stoppage will involve very far-reaching and serious loss. Fully £10,000 would be sacrificed in wages in the North of England as a result of that day's stoppage alone; but the loss in wages incidental to and consequent upon preparing the furnaces for a stoppage, will more than double this. The employers themselves will be heavy losers. The holding of the demonstration will not, the masters say, weaken their opposition to the eight hours; the grounds for which they are fully prepared to discuss with the men or their representatives. They are convinced that the adoption of the eight hours will increase the cost of making iron, and that is not to be thought of at the present time.

The death has occurred this week of Mr. Edward Robson, who has for many years been connected with the Cleveland iron trade. The deceased, who was a native of Darlington, commenced his business career under Messrs. Pease and Partners, and he subsequently became commercial manager for Messrs. Bell Brothers, at Port Clarence. He was afterwards in Wales, and leaving there he became connected with Mr. Thomas Vaughan, the partners opening out the Woodhouse Close Colliery. They also work and worked successfully the Cragg's Hall Ironstone Mine, near Skinningrove. In association with the late Mr. George Wythes and Mr. Henry Cochrane, the deceased opened out other Cleveland mines, including those at Strongbow and Kilton. He also owned the Cassop, Tyne Main, and Victoria Collieries, and subsequently took a lease of the Dunsdale Mines, after which he founded the firm of Robson, Maynard, and Co., who built the Redcar Ironworks. From this firm he retired in 1880, and the works have since been carried on by the remaining partners under the style of Walker, Maynard, and Co. Latterly Mr. Robson was agent for Mr. Walter Scott's collieries at Trindon Grange, for the Forcett Limestone Co., and for Messrs. Dunford and Elliot, of Newcastle and Middlesbrough. The death is also reported of Mr. Joseph Bond, who for many years was engineer at the Tow Law and Tudhoe blast furnaces for the Weardale Iron and Coal Company, but for the last twelve years he has carried on a steel foundry at Tow Law, where he was well known for the manufacture of tub wheels and general colliery castings.

The manufacturers of finished iron and steel have generally had to reduce their prices, because they have been obliged to seek orders to take place of those the execution of which has to be postponed on account of the closing of so many shipyards. Steel ship-plates can be bought at £4 17s. 6d.; steel angles at £4 12s. 6d.; iron ship-plates at £4 15s.; iron angles, £4 12s. 6d.; and common iron bars at £4 17s. 6d., all less 2½ per cent. and f.o.t. Heavy steel rails are nominally £3 12s. 6d. net at works.

The coal trade is in a fairly brisk condition, there being an improved business on export account, and the better prices are maintained. Collieries generally are working well, except in the house coal trade. Best Northumberland steam coal realises 11s. per ton, and small 5s. f.o.b., while gas coal is 7s. 3d. per ton f.o.b. Blast furnace coke of good quality can be had at 12s. 3d. per ton.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE is very little to notice in connection with the iron trade this week, business being completely suspended in the Glasgow district by the fair holidays and much interrupted elsewhere by the miners' strike.

The Glasgow pig iron market was closed from Thursday to Tuesday. On its re-opening business was done in Scotch warrants at 41s. 9½d. cash, and in Middlesbrough hematite at 42s. 9d., these prices indicating a decline of 1½d. to 2d. per ton. There is no speculative interest whatever in the market, operators having apparently made up their minds to have nothing to do with business in the meantime.

Special brands of makers' iron have been advancing in price, owing to their scarcity and the stoppage of production. G.M.B. f.o.b. at Glasgow No. 1 is quoted 43s. 6d.; No. 3, 42s. 6d. per ton; Monkland No. 1, 46s.; No. 3, 42s. 6d.; Carnbroe No. 1, 45s. 6d.; No. 3, 44s. 6d.; Clyde No. 1, 51s. 6d.; No. 3, 48s. 6d.; Calder and Summerlee No. 1, 53s. 6d.; No. 3, 48s. 6d.; Gartsherrie No. 1, 55s. 6d.; No. 3, 49s.; Coltness No. 1, 57s. 6d.; No. 3, 51s.; Glengarnock at Ardrossan No. 1, 52s.; No. 3, 48s. 6d.; Eglinton No. 1, 49s.; No. 3, 45s.; Dalmellington at Ayr No. 1, 47s.; No. 3, 45s.; Shotts at Leith No. 3, 51s.

The output of hematite pig iron is entirely suspended, and there are only fourteen furnaces producing ordinary and special brands compared with twenty-three last week. The Glengarnock Company has placed four furnaces on basic iron. The total furnaces of all kinds now blowing in Scotland is eighteen, of which there are three at Coltness, four at Shotts, two at Ardeer, five at Summerlee, and four at Glengarnock. The following ironworks are altogether stopped:—Dalmellington, Eglinton, Clyde, Gartsherrie, Carnbroe, Wishaw, Langloan, Carron, Calder, Govan, and Monkland. The ironmasters are resolved not to pay higher prices for coals, and they will keep their works idle until the strike is at an end.

The shipments of pig iron from Scottish ports in the past week amounted to 5932 tons, against 4107 in the corresponding week of last year. The steel works are all closed, and are expected to continue so till the strike is over. It is rumoured that one or two of them may not reopen again. Since the beginning of the year there has been a spell of activity at the steel works, but in a majority of cases no profits have been made, owing to heavy costs and extreme competition, and the business is therefore of a heartless description.

The finished ironworks are closed, and the market is practically idle for the time.

The shipments of iron and steel manufactured goods from Glasgow in the past week embraced locomotives worth £2000; sewing machines, £7957; other machinery, £4000; steel goods, £4050; and miscellaneous iron goods, £12,100.

There has been a further decrease in the coal shipments, the total for the week, coastwise and foreign, having been only 21,052 tons, against 24,849 in the preceding week, and 145,948 in the corresponding week of last year. A peculiarity of the present crisis is that there is no demand for coal for any purpose whatever. Consumers have tacitly made up their minds to keep out of the market, and although large quantities of coals are on offer from England, they cannot at present find a market.

The leaders of the miners have been quarrelling as to matters of policy, and the men are dissatisfied with the strike allowance. They have now been out four weeks, and all the money they have got in the West of Scotland for that period is from 3s. 8d. to 5s. per man. The Fife miners have managed to secure about twice as much by excluding non-unionists from the distribution, and this has caused a great deal of ill-feeling.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE great event, upon which all interest centres, is the Albion inquest, which was reopened on Monday at Pontypridd before two coroners, Mr. Reece, Cardiff, and Mr. Rhys, Aberdare. Mr. Roskill attended from the Home-office, and there was a numerous array of counsel, mine inspectors, mining agents, and representatives of the Albion Company. Plans of the pit were exhibited. Both shafts are 19ft. in diameter; the depth of the downcast is 545 yards to the landing, and the extreme depth 580 yards. The surveyor, in exhibiting the plans, was questioned by Mr. Roskill as to the arrangements for watering the mine. Grover's level was damped by means of a pipe, and leakages from pipes, also by water from old workings.

Mr. Philip Jones, certificated manager of the colliery, stated that his experience included forty-three years underground. For seven years he had been manager of the Albion. Mr. Jones gave a full description of the mine. Questioned about shot-firing, witness stated that dynamite and roburite were used, and generally in blasting out timber the practice was to bore a hole with an auger, 3ft. from the ground, and fill it with about 2 oz. of dynamite. He had heard on the Thursday after the explosion that Wm. Austley had received orders from John Evans, the night overman, to prepare a shot on the double parting on the Cilfynydd side, between the night and day shifts, on the day of the explosion. Monday's evidence ended with the examination of the record books, showing that no gas had been met with for five or six months before the explosion. On Tuesday the examination of the manager was protracted. He gave a full description of the mine immediately after the explosion. He was then questioned by coroner and Mr. Roskill; 286 bodies had been recovered. In the course of the examination it was stated by him that a very heavy fall of rock top had taken place on the Cilfynydd side. There was a 10ft. cavity in the roof of the intake where the solid rock was blown down. Minute questioning took place as to this cavity, shot firing, the latest firing on the day of the explosion, mode of watering, flame following the explosion of dynamite, care of lamps, &c., and there was elicited the manager's impression that the starting place of the explosion was at the fall referred to, and that this, driving down the gas, it had been swept onwards to the naked lights called "comets" on the off side of the lamp station, and the first explosion followed. This was only given as a surmise. In the examination which followed, and was continued on Wednesday, it was evident that the subject is being grappled ably, and that certain good will follow, in better security for the future, even if direct evidence as to cause is not forthcoming.

There is a good deal of vigour in the coal trade, and exports of steam coal are well maintained. Last week over 300,000 tons were sent from the Cardiff ports alone. Prices too, I find, are kept up well, yet I note that here and there it is nothing unusual for the colliers to lose a "turn," and so it is not at all unlikely that we are not far away from the temporary slackness, which comes in fittingly, at a time when coalowners and brokers take the annual run to the seaside and other pleasure resorts. The quotations in Cardiff this week compared well with last week:—Best steam, 12s. 3d. to 12s. 6d.; seconds, 11s. 6d.; dry qualities, 10s. 6d. to 10s. 9d.; best small, 6s. 3d. to 6s. 6d. House coal has shown no change, best is selling at 10s. 9d. to 11s. 3d.; No. 3 Rhondda, 10s. 9d. to 11s.; brush, 9s. to 9s. 6d.; small, 7s. to 7s. 6d.; No. 2 Rhondda, 10s. to 10s. 3d.; through, 7s. 3d. to 7s. 6d.; small, 5s.

Swansea prices:—Best steam, 10s. to 11s. 6d.; seconds, 9s. 6d. to 10s.; anthracite, from 8s. 9d. to 12s. 6d., according to quality.

Swansea coal exports keep up well, and it is estimated that, judging from the trade of the first half of '94, the year will show an increase of 350,000 to 400,000 tons. From Newport, again, the totals are very satisfactory. Foreign coal shipments for the six months ending June show an increase of 376,350 tons, or 41·33 per cent. The large increase at Newport is being accounted for by the diversion of the Powell-Duffryn coal, yet I am glad to add that Cardiff shows no falling off.

In the Caerphilly Valley capital work is being done at Llanbradach, and already an average total of 500 tons daily is being raised from No. 1 pit. It is expected that an output from No. 2 will begin this month. At the "Universal," Aber, both pits are down 150 yards, and already a township is being formed. It is estimated that this colliery will support 5000 persons.

Patent fuel continues in good demand at Cardiff and Swansea. Cardiff, 10s. 9d. to 11s. 3d.; Swansea, 10s. to 10s. 9d. Last week Swansea sent 1955 tons to France, 1600 tons to Russia, 4850 tons to Italy, and 2910 tons to Algeria. Coke at Cardiff is a little weaker, furnace selling from 15s. 6d. to 16s. 6d.; and foundry, 17s. to 18s. Pitwood prices have an upward tendency.

Prospects in the iron and steel trade are more favourable; and ironmasters with good stocks of ore, and a tranquil labour market, are in a good position to meet a large demand. Rails, steel bars, pig, and small goods continue to be the principal things in request. Crop ends are also in demand, and merchant bars. Steel bar make at Cyfarthfa continues active; and for the new manufacture, bricks, the requirement of buyers is greater than can be met—600 tons of rails from the district went to Christiansand last week.

At Briton Ferry the output of pig continues large, and that of steel bars quite up to the average. Sixteen mills are now busily at work, and outlook is encouraging. At Swansea there was a certain amount of depression in pig, and in Glasgow warrants prices are 4d. less than last week, quotations being 41s. 9½d.; Middlesbrough and hematite are better, the former in good demand; hematite warrants, 43s. 8d. for mixed numbers. Other quotations are:—Welsh bars, £5; steel rails, heavy, £3 15s. to £4; light, £4 7s. 6d. to £4 10s.; steel sheets are better, £6 to £6 5s.; iron, £5 15s. to £6 10s. Bessemer steel: tin-plate bars, £4; Siemens, best, £4 2s. 6d. to £4 5s., all delivered in the district; cash, less 2½. Block tin is at £67 5s. to £67 7s. 6d.; this is indicating a drooping condition.

Tin-plates show an improvement in shipments but not in price, and the element of uncertainty keeps business down to short and immediate deliveries. A condition of expectancy is to be noticed, and any day good bookings forward and better figures may come in to relieve the monotony. The autumn is likely to see a marked change, so runs the impression amongst merchants.

On 'Change at Swansea this week the following quotations remained:—Steel coke, 10s. 3d. to 10s. 4½d.; Siemens, 10s. 4½d. to 10s. 7d.; best charcoal, 11s. 6d. to 12s. 6d.; ternes, 19s. to 23s. The shipments last week amounted to 69,456 boxes; receipts from works, 57,317 boxes; present stock at Swansea, 277,106 boxes.

Swansea imported last week 1040 tons pig, 419 tons tin bar, and exported 35,527 tons of coal.

Information has been received on 'Change from America that the new tariff will not come into force until October.

At a hauliers' meeting held in Aberdare, on Saturday, it was stated that the difference at Plymouth collieries had been satisfactory arranged. The hauliers' agent, Mr. Morgan Thomas, made overtures to the meeting to join the Union. The aim, he stated, was to lessen the hours of labour, and secure regular wages of at least 5s. a day. At the close it was agreed to call a general meeting of hauliers on the first Monday in August, and discuss the subject.

The Ammanford men, numbering about 300, are out on strike, the dispute being for a re-adjustment of prices, consequent upon the "pillar and stall" method being exchanged for the "long wall."

An important meeting of colliery representatives—men—has been held at Merthyr a few days ago, when a resolution was passed embodying the opinion of the conference, that only by the employment of sub-inspectors chosen from amongst colliers, and paid by Government, could the lives of the colliers be properly safeguarded. This opinion is to find prompt expression in the House of Commons, and to be reiterated until something is done.

A locomotive boiler explosion took place near Rhymney Ironworks, lately: driver and stoker escaped without injury, but the engine was wrecked.

A working collier has invented an apparatus to show that coal dust cannot originate an explosion. It is stated that he has not quite perfected it, but is confident of doing so.

The Taff Vale Railway records an increased revenue for last week of £837, and the Brecon and Merthyr and Swansea Bay and Rhondda are also improving.

The annual report of the Tredegar Iron, Steel, and Coal Company has been issued, and notwithstanding the stoppage of the iron and steel works, a profit of £20,550 12s. 11d. is shown.

The coal output last year exceeded by 120,000 tons that of the preceding year. The collieries are reported to be in a state of highest efficiency, and sinkings to the deep at the Pochin pits are to be shortly undertaken. The report comments on the continuance of an unsatisfactory state of the iron and steel trades, and no hint is given of a restart, as lately rumoured.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE continental iron market remains quiet, scarcely any business of importance having been transacted upon the week. The demand on foreign account has been particularly dull for some time past, and there is generally but little firmness noticeable in quotations.

Iron and steel trade in Silesia continues very languid, only a small volume of business being done. Orders for export are especially scarce; the home demand is also limited, and the works would be but very poorly occupied if it was not for some good orders formerly booked, which secure pretty regular employment for at least several weeks to come. For the few orders that are offering at present, very low prices have to be quoted; although list rates are nominally the same as in former weeks, makers are practically getting less than if list prices had been officially reduced, because they have to grant substantial concessions in almost every instance.

Good accounts are still given of the iron trade in Austria-Hungary. Prices are firm and even rising, and a satisfactory activity is reported all round. The different sorts of pig iron meet with ready demand, and there is quite a lively tone noticeable in the finished iron department, most articles, with the exception of bars and sectional iron, having been briskly called for.

The steel trade is rather quiet just now, very few orders for railway requirements being given out. The hardware business has slightly improved, especially that done on local account, and a further increase in demand is expected within the course of next month.

Iron business in France shows pretty much the same tendency as during former weeks, prices being firm and demand satisfactory, although there has perhaps been a quieter tone in the pig iron market this week than last, and less speculative business. A fair trade is doing on foreign, chiefly colonial account, which naturally has a stiffening effect on prices in general.

The unsatisfactory condition of the Belgian iron trade, that has so long been reported, still exists, and a despondent feeling prevails all round. Prices have reached the very lowest point, plates being the only article that has shown a trifle more firmness lately, owing to a slight improvement in demand. Girders are in irregular request and prices fluctuating, producers having, in a few instances, obtained rather better prices, while the majority of makers still complain of the utterly weak tone that continues to characterise this branch of the malleable iron trade.

Returns for the first five months of the present year show exports in steel to have increased 14,000 t. against the corresponding period last year. Pig iron also shows a slight increase.

Concerning the business done on the Belgian coal market during the first five months of the present year, the import of coal appears to have decreased 10,000 t. against last year; being 557,240 t. this year, against 567,875 t. in the previous year. The import from Germany shows an increase of 20,000 t., while that from England has decreased 30,000 t. The import in coke from Germany to Belgium was 24,000 t. higher this year than last, the total import in coke to Belgium amounting to 127,110 t., against 101,241 t. for the corresponding period last year. Export in coal during the first five months of the present year only shows a slight decrease of 27,000 t., the total export in coal having been 1,674,086 t., against 1,701,373 t. for the same period last year. Export of Belgian coke to France shows a decrease of 30,000 t.; to Luxemburg, 16,000 t.; the total export in coke amounting to 369,525 t., against 399,043 t. for the corresponding period last year.

Although but a quiet sort of business has been transacted on the Rhenish-Westphalian iron market for some weeks past, the general tendency is yet not without firmness, and there is much hopefulness expressed with regard to autumn business, which is expected to make up for the somewhat sluggish trade that has been done in spring and early summer. For the present but few inquiries are coming in on the pig iron market; prices are, however, tolerably well maintained for almost all sorts. Stocks do not show a change since previous letters; if anything a slight decrease has to be reported here and there. In manufactured iron a steady business has been doing all through last week. Bars have been improving in demand, and there is certainly less reserve practised by local dealers, who apparently wish to replenish their stocks now, when makers are most anxious to sell their articles, and, consequently, agree to pretty large concessions. There is little animation noticeable in girders now that the best part of the building season is nearly over and most orders have been disposed of. Hoops are in regular demand, and the fact that contracts have already been secured for the fourth quarter shows that further reductions in prices are not expected on the part of buyers. Plates and sheets are rather brisk of sale, but remain weak in quotation. Home requirements for drawn wire are still exceedingly small, but there is a fair demand coming forward on foreign account; prices remain, without exception, very low. Both foundries and machine factories are reported to be but irregularly employed, and the activity at the locomotive shops is also decidedly insufficient.

The collieries of the Saar district have produced in June of present year 529,000 t., consumption amounting to 500,340 t.; in June last year output of coal was 450,915 t., while 432,255 t. were slod.

Statistics regarding the Rusian foreign trade during the first quarter of present year show value of export to have been 143,270,000 roubles, against 83,819,000 roubles for the corresponding period last year, while value of import was 81,754,000 roubles, against 62,530,000 roubles for the same period last year.

The export of machines from Switzerland is stated to have been considerably higher in 1893 than during the year before. There were exported in boilers, 794 tons, against 602 tons in 1892; dynamo-electric machines, 1046 t., against 751 t.; constructions in iron, bridges, &c., 14 t., against 184 t.; agricultural machines, 184 t., against 268 t. in the year 1892; flour milling machinery, 3132 t., against 2452 t.; sewing machines, 18 t., against 25 t.; weaving machines, 4534 t., against 4136 t.; spinning engines, 1292 t., against 851 t.; embroidering machines, 618 t., against 544 t.; knitting machines, 46 t., against 45 t.; bicycles, 5, against 5 last year; different sorts of machines, 6827 t., against 5634 t.; in all, 18,510 t., against 15,727 t. in the previous year.

## AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 12th, 1894.

THE strikers, the decline in the volume of business, shrinking of bank clearings, refusal of merchants to place usual autumn orders, and a feeling of general disquiet have had a most depressing effect on manufacturing and commercial interests. The iron trade is on the eve of a moderate improvement, but prices are low, and manufacturers are not, therefore, soliciting late deliveries. Pig iron production is increasing. Twenty furnaces have blown in during the week, six bar iron mills have resumed, and quite a number of smaller concerns. There are inquiries for 50,000 tons steel billets, of which about one-fourth are wanted for eastern delivery during the next four months, but manufacturers are holding too high. The placing of some important bridge iron contracts have been postponed until August. Barb wire, wire rods, nails, and sheet iron are all moving briskly in Western markets, except at Chicago, but to a strictly local trade, shipments by rail being absolutely suspended. The country was in good shape for an upward trade movement when the railroaders' strike was precipitated. With no stocks on hand in any branch, buyers of long experience feel apprehensive of an upward movement. Such things are not new in American markets. But an advance could only be temporary. The long restriction has been a surprise to manufacturers generally. Forge iron has been offered at 10 dols. delivered, and No. 1 foundry at 12 dols., not taken. There can be no movement until the present strike is over. Coal mining has been only partially resumed, and three or four regions have gone out again.

## LAUNCHES AND TRIAL TRIPS.

RECENTLY there was launched from the shipyard of Messrs. John Scott and Co., at Kinghorn, a steel screw steamer, built for the special trade of Messrs. Wilson, Hart, and Co., of Maryborough, Queensland. The dimensions of the vessel are 165ft. by 25ft. 6in. by 11ft. 9in., and has raised quarter-deck, bridge-house and top-gallant forecastle. She is built to class 100 A1 at Lloyd's special survey, and has triple engines to indicate about 500-horse power, with an extra large boiler working at 170 lb. per square inch. The christening was performed by Mrs. Robert Hart, who named the vessel Queensland, and wished her goodluck. The vessel was launched with steam up, and on leaving the ways proceeded to adjust compasses and run the trial trip.

The Geneva Cross, which has been built to the order of the Metropolitan Asylums Board for the purpose of conveying patients from the Board's various wharfs in London to the small-pox hospital ships at Long Reach, was taken to the measured mile on the Thames on the 4th inst., in order that her official speed trials might be made. The result of six runs, with and against the tide alternately, showed that a mean speed of over 15 knots was realised. Further continuous speed trials were made on the Thames on the 13th inst. in order to ascertain the working capabilities of the ship and engines. Both of these trials were satisfactory, and were made in the presence of several of the managers of the Metropolitan Asylums Board, who expressed their entire satisfaction with the vessel and her machinery. She has been built and engined by Messrs. John Stewart and Son, Blackwall. The principal dimensions of the boat are as follows: Length over all, 143ft.; breadth, 22ft.: draught of water, 5ft. The machinery consists of a pair of compound diagonal surface-condensing engines, having cylinders 23in. and 46in. respectively with 42in. stroke, developing over 700 indicated horse-power. The boilers, which are two in number and of the cylindrical multitubular type, constructed of steel to Board of Trade requirements, are each 9ft. 6in. in diameter and 10ft. long, with a working pressure of 120 lb. per square inch. The hull of the vessel is divided into five water-tight compartments by means of four transverse bulkheads, and is also of steel throughout. At the forward end of the vessel the crew are berthed, abaft this there is ample accommodation for fully forty visitors who may be desirous of visiting their friends at Long Reach and are sufficiently convalescent to see them. The machinery space comes next, after which the entire after part of the ship is devoted to hospital accommodation. It will be seen, therefore, that the visitors' saloon is entirely isolated from the hospitals. The hospitals are two in number, the upper and lower, and are each divided in a suitable manner in order to separate the male from the female patients. Accommodation is provided for fifty-two recumbent patients, together with nurses' rooms, reception room, sinks, linen cupboards, w.c.'s., and all other fittings necessary for a vessel of this description. Great care has been observed in securing ample ventilation, as also with regard to the heating arrangements throughout the vessel; indeed, she could, if so desired, be used as a floating hospital. Spacious cabins on the upper deck are also provided for the doctor and captain. She is fitted with Davies and Co.'s steam steering gear amidships, also a powerful hand gear aft. A complete electric light installation is fitted by Messrs. J. H. Holmes and Co., Newcastle-on-Tyne. The vessel has been designed and constructed under the personal superintendence of Mr. John Hudson, naval architect and engineer, of 47, Leadenhall-street, and of Mr. C. Thomson, M.I.N.A., the superintendent of the river ambulance service.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*4th July*, 1894.

12,950. Securing Windows, C. D. Fisher and F. F. Turner, Birmingham.
12,951. Child's Chairs, W. S. McLennan and T. Morton, Glasgow.
12,952. Speed Meter, O. Petterson, London.
12,953. Pneumatic Tires, A. E. Smith, Manchester.
12,954. Waterproof Ventilating Cloth, V. Hendricks, Manchester.
12,955. Portable Cases and Maps, G. A. Macbeth, London.
12,956. Motive Power Production, S. Shiel, Swineford, Co. Mayo.
12,957. Ironing Machines, E. Taylor, jun., Manchester.
12,958. Heating and Ventilating Radiators, J. Keith, Glasgow.
12,959. Ball Cocks, F. Caulfield, Glasgow.
12,960. Regenerative Gas Lamps, W. H. I. Welch, London.
12,961. Wood-planing Machines, T., R., and W. Lees, jun., Manchester.
12,962. Crocheting Machines, J. Köhler, Manchester.
12,963. Selvedge Motion for Looms, H. Harrison and H. Shackleton, London.
12,964. Tube Manufacture, R. Wootton and F. H. Griffiths, Birmingham.
12,965 Switching Electric Currents, G. B. Blanchard and A. Ballance, London.
12,966. Laying Dust in Coal Mines, A. Ross, Manchester.
12,967. Cycloramas, G. Newnes and H. C. Watson, London.
12,968. Refrigerator for Meat and Fish, J. Gillings, London.
12,969. Ball Bearings for Cycles, G. Gibson, Newcastle-on-Tyne.
12,970. Gravy Spoons, A. J. Boult.—(*G. Bay, France.*)
12,971. Gas Engines, H. A. Humphrey, Liverpool.
12,972. Arc Lamps, S. Doubrava and J. Donát, Manchester.
12,973. Casting Electric Accumulator Plates, C. Hampel, Liverpool.
12,974 Air Compressors, La Compagnie de Fives-Lille London.
12,975. Brushes, W. P. Thompson.—(*E. Doernberger, Germany.*)
12,976. Photographic Camera Shutters, E. Pickard, Manchester.
12,977. Bicycles, J. Fineberg and J. Clayton, Liverpool.
12,978. Albumenised Paper, R. Münch, London.
12,979. Looms, S. Braun and M. Schweitzer, London.
12,980. Artificial Musk, C. D. Abel.—(*Fabriques de Produits Chimiques de Thann et Mulhouse, Germany.*)
12,981. Rolls of Perforated Paper, C. A. P. F. Tschofen, London.
12,982. Electric Arc Lamps, J. Brockie, London.
12,983. Appliance for Holding Cigars, H. Salsbury, London.
12,984. Coats, R. Skelton, London.
12,985. Feathers, T. C. Palmer, London.
12,986. Driving Mechanism for Cycles, R. Piwowarski and R. Bularski, London.
12,987. Chemical Compounds, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
12,988. Ankle Supporting Appliance, J. S. Marshall, London.
12,989. Perpetual Calendar, F. J. Waite and M. Simon, London.
12,990. Convertible Tables, T. Alsopp and R. Brown, London.
12,991. Electrical Cooking Appliances, J. A. Macmeikan, London.
12,992. Candlesticks, E. G. Godfrey, London.
12,993. Electrolytic Separation of Gold, A. Cruickshank, London.
12,994. Spice or Condiment Receptacle, A. Schierholz, London.
12,995. Ladders, P. Schmahl, London.
12,996. Fastening for Skirts, E. M. Jackman, London.
12,997. Making Sheets of Wired Glass, G. F. Chance and Chance Brothers, London
12,998. Appliance for Descending a Rope, W. Barret, London.
12,999. Ladies' Dress Pockets, S. Joseph, London.
13,000. Plaquet Holes of Dresses, S. Joseph, London.
13,001. Starting Vehicles, C. Guattari, London.
13,002. Multiple-barrel Guns, B. H. Thwaite, London.
13,003. Food-preparations, H. H. Lake.—(*F. Delangle, France.*)
13,004. Binding Medium for Size Colours, J. Clasen, London.

*5th July*, 1894.

13,005. Syringe Applicable to Fire-hose, W. B. Press London.
13,006. Wool-washing Machines, F. G. Sargent, London.
13,007. Portable Excavating Machine, C. R. Scoles, Canada.
13,008. Railway and Tramway Rails, J. Forsyth, Gateshead.
13,009. Machine for Washing Bottles, W. Ogilvie, Dublin.
13,010. Harrow, J. S. Coates, Co. Wicklow,
13,011. Canvas Tubing for Bicycle Tires, A. Drummond, Guildford.
13 012. Laminated Springs, R. R. Eadon and J. Beatty, Sheffield.
13,013. Covers or Envelopes for Letters, W. Junge, London.
13,014. Monument, C. Downing, Barnsley.
13,015. Letter-copying Books, R. J., T., and E. P. Rowe, Bradford.
13 016. Yarn for Hearth-rugs and Mats, E. Wilkins, Morecambe.
13,017. Process of Decorating Pottery, P. Shelley, Longton.
13,018. Electrical Firing Keys, &c., H. V. Keeson, London.
13,019. Toys, J. Walker, Birmingham.
13,020. Anchors, T. H. W. Beddoes and G. A Newall, Bristol.
13,021. Out-of-door Seats, W. Baker, Bristol.
13,022. Gas Meters, T. Thorp, T. G. Marsh, and J. Haynes, Manchester.
13,023. Automatic Stopping Cock, J. R. Cock, Bristol.
13,024. Heel-burnishing Machines, W. H. Dorman, Stafford.
13 025. Stoppering Bottles, W. H. Wheeler, Birmingham.
13,026. Cases for Ribbons, C. Marx, Manchester.
13,027. Rollers for Wringing, J. Livingston and W. Gibson, Manchester.
13,028. Clip for Attaching Wagons, J. Gill, Wakefield.
13,029. Furnaces for Burning Sludge, S. J. Beaman and J. Deas, Manchestor.
13,030. Lubricator Lifter, J. L. C. Knowles and N. Ellison, Manchester.
13,031. Preservation of Food, H. J. C. Paulsen, Manchester.
13,032. Hinges, R. Wootton and F. H. Griffiths, Birmingham.
13,033. Sheep Dipping Apparatus, R. S. and T. C. Fletcher, London.
13,034. Felt Hat Body Planking Machines, H. H. and A. Turner, Manchester.
13,035. Animal Traps, J. B. D. Brander, Liverpool.
13,036. Suspender for Overcoats, H. J. Trautmann, and F. Stahl, Liverpool.
13,037. Bobbin Holders, W. P. Thompson.—(*J. D. Aiken, United States.*)
13,038. Wrought Iron, J. Lakin and C. H. Page, London.
13,039. Game and Apparatus therefor, H. N. Morgan, London.
13,040. Overflow Fittings for Basins, J. J. Wilson, Glasgow.
13,041. Sinkers for Knitting Frames, C. A. Roscher, Berlin.
13,042. Electric Current Switch, G. B. Blanchard and A. Ballance, London.
13,043. Strainer for Tea and Coffee Pots, F. Mann, London.
13,044. Oil Cans, S. C. N. White, London.
13,045. Indicating Names of Stations, G. W. Robertson, W. S. Page, and C. E. Vernon, London.
13 046. Weighing Scales or Balances, R. Doughty, London.
13,047. Scoring in Billiards, &c, W. Smetham, London.
13,048. Steel, J. Bedford, London.
13,049. Gearing for Lathes, A. E. Hodder and W. Goodacre, London.
13 050. Stop-cocks, J. C. McNabb, London.
13 051. Gymnastic Apparatus, W. Niedieck, London.
13 052. Fasteners for Paper and Cloth, A. Combault, London.
13 053. Cooling Refrigerating Machines, J. Gamgee, London.
13,054. Levigating or Grinding Machinery, A. Maw, London.
13,055. Filters for Water Taps, &c., J. Harvey, Manchester.
13,056. Pedal for Propelling Bicycles, W. P. Jencks, London.
13,057. Butter Making Apparatus, J. H. H. Duncan, London.
13 058. Needle for Combing Machines, G. Fromm and J. Roll, London.
13,059. Multiple Drilling Machines, F. Zinzen, London.
13,060. Life-saving Apparatus, T. Tufnell, Hong Kong.
13,061. Movement of Shuttle-boxes, J. Serre and F. Rostagnat, Twickenham.
13 062. Brackets for Curtain Poles, H. J. Haddan.—(*T. H. Klein, United States.*)
13 063. Indicating Lamp Failures, G. J. T. J. Parfitt, London.
13,064. Fastener for Gloves, &c, C. Hüttemeister, London.
13,065. Frames for Sash Windows, J. A. Glazier, London.
13,066. Plates for Engraving and Etching, J. W. Swan, London.
13,067. Dipping Sheep, A. Blackie and E. A. White, London.
13,068. Paper-feeding Mechanism, G. C. Blickensderfer, London.
13,069. Using Disinfecting Substances, J. H. Starling, London.
13,070. Self-loading Fire-arm, The Eisenwerke Gaggenau Actien-gesellschaft, London.
13,071. Draught Excluder for Doors, W. White, London.
13,072. Nozzles for Syringes, &c., M. W. O'Reilly, London.
13,073. Rotary Pumps, S. M. Cockburn and H. E. Montgomery, London.
13,074. Disinfecting Water-closets, S. Radlauer, London.
13,075. Extension Ladders, P. Schmahl, London.

*6th July*, 1894.

13,076. Tin Opening Knives, C. A. Dainesi, London.
13,077. Flour Sifter, D. McKenzie, London.
13,078. Switch for Lowering Lamps, E. R. Cummins, London.
13,079. Constructing Framework of Furniture, J. Saunders, Liverpool.
13,080. Gear for Hydraulic Valves, G. B. Sharples, Manchester.
13,081. Coin-freed Photograph Machines, P. Mushet, Glasgow.
13,082. Erecting Telegraphic, &c., Wires, C. Shore, Rochdale.
13,083. Crank Pins and Journals, T. S. James, London.
13,084. Pressure Gauge for Tires, T. S. James, London.
13,085. Hinges, J. T. Booker, Leicester.
13,086. Peg for Conditioning Stout, J. T. Booker, Leicester.
13,087. Heat-saving Device, S. Daw, Southampton.
13,088. Frames for Photographs, W. Middlemiss, Bradford.
13,089. Looms, G. H. Hodgson, Halifax.
13,090. Wheel Tire, R S. Thompson, Glasgow.
13,091. Bows and Cravats, H. A. Schmidt, Manchester.
13,092. Disinfecting Powders, F. M. Spence, Manchester.
13,093. Blind Hoist for Windows, T. Sumner, St. Helen's.
13,094. Steering Locks for Cycles, S. F. Edge and C. Sangster, Coventry.
13,095. Ornamental Tubes, C. Willmott, Birmingham.
13,096. Cases for Carrying Bottles, B. Binnington, Hull.
13,097. Sewing Machines, G. Worsley, jun., J. Brelsford, A. E. Worsley, and F. Cree, jun., Manchester.
13,098. Moving Spanner, F. King and W. G. Hayward, Birmingham.
13,099. Ventilated Tourist Legging, J. B. Smith, Birmingham.
13,100. Medico-surgical Cushions, E. R. Fothergill, London.
13,101. Rings for Stuffing-boxes, &c., R. M. Dewar, London.
13,102. Apparatus for External Cleaning of Windows, T. Edmond, London.
13,103. Device for Destroying Weeds, J. Hogg, Glasgow.
13,104. Soap in Tablets, F. Heilbronn, London.
13,105. Razors, C. W. S. McHugh, London.
13,106. Controlling Flame from Burners, &c., W. P. Thompson.—(*C. H. Land and H. J. Caulkins, United States.*)
13,107. Looms, I. Heer, Manchester.
13,108. Straight-bar Knitting Frames, J. and W. Hearth and W. H. Willis, London.
13,109. Spooling Machines, J. McIlreith, Manchester.
13,110. Manufacture of Plates, &c, C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell, London.
13,111. Preparation of Guide Plates, J. K. and C. A. K. Harrison, London.
13,112. New Cloth, W. Townend and W. Townend and Co., London.
13,113. Toe-clip for Cycle Pedals, A. W. Gamage and A. E. Charter, London.
13,114. Manufacture of Heating, &c., Gas, E. Daus, London.
13,115. Telephonic Transmitters, G. A. Nussbaum, London.
13,116. Making Glazed Bricks, J. Gordon, London.
13,117. Handles for Bicycles, J. Roura and F. Forgas, London.
13,118. Feeding Money in Bulk into Coin-sorting Machines, M. Hearn, London.
13,119. Mangers for Horses, R. F. Prangley, London.
13,120. Domestic Sanitary Appliance, R. S. Burn, Edinburgh.
13,121. Lubricating Stuffing-boxes, G. E. Adams, London.
13,122. Hydraulic and Foot-step Bearing, G. E. Adams, London.
13,123. Tops for Furnaces, C. Martini, London.
13,124. Fountains for Varnishes, F. T. Hemming, London.
13,125. Liberating Horses from Vehicles, E. T. Hughes.—(*I. Briggs, United States.*)
13,126. Banjoes, E. T. Hughes.—(*H. C. Middlebrooke, United States.*)
13,127. Apparatus for Flushing Water-closets, C. Righini, London.
13,128. Curtain Hooks, T. Gaze, London.
13,129. Wrappers for Cigars, T. Gaze, London.
13,130. Breakdown Guns, W. Nobbs, London.
13,131. Manufacture of Blank Cartridges, O. Brzostowicz, London.
13,132. Feed Bag for Horses, L. M. Thudichum.—(*T. P. Terry, United States.*)
13,133. Railway Signalling Apparatus, A. Gregory, London.
13,134. Handles for Heated Objects, W. H. Beck.—(*W. F. Greene, United States.*)
13,135. Purifying, &c, Rain-water, R. Pringle, London.
13,136. Submarine Telegraph Cables, H. A. Taylor and J. A. L. Dearlove, London.
13,137. Multiple Wheel and Hand Stretcher Ambulance, J. J. A. V. C. Raye, Banbury.
13,138. Bearings, F. E. Thormeyer, London.
13 139. Films Imitating Mother-of-pearl, S. Hahn, London.
13,140. Bobbins of Ring Spinning Machines, G. F. Ruttloff and B. R. Dietrich, London.
13,141. Flexible Driving Shafts, J. Y. Johnson.—(*C. J. Fravega and A. Janet, France.*)
13,142. Air Pumps, R. F. Hall, London.
13,143. Machinery for Rolling Rims of Wheels, R. F. Hall, London.
13,144. Supporting Attachment for Bicycles, G. H. Fortune, London.
13,145. Luminous Paint, L. E. Josset, London.
13,146. Lighting of Tunnels, &c., A. G. White, London.
13,147. Gauge for Carpenters, &c., C. Bainbridge, London.
13,148. Electrical Measuring Instruments, H. T. Harrison, London.
13,149. Billiard Cues, W. H. D'Oyly, London.
13,150. Hand Fire-extinguishers, C. B. Murray, London.
13,151. Automatic Closing Devices for Tap-holes, J. C. Steele, London.
13,152. Utilising the Force of Waves, T. M. S. English, London.
13,153. Purification of Alcohol, E. Hermite, E. J. Paterson, and C. F. Cooper, London.
13,154. Washing Fabrics, O. Imray.—(*H. Treichler, Switzerland.*)
13,155. Systematic Washing of Impure Sugar, O. Imray.—(*R. Folsche, Germany.*)
13,156. Manufacture of Naphthylendiamine Sulpho Acids, C. D. Abel.—(*A. Fischesser and Co., Germany.*)
13,157. Insulating Electric Cables, G. E. Heyl, London.
13,158. Electric Fuses, G. E. Heyl, London.
13,159. Window Fasteners, A. W. Dadson, London.
13,160. Electric Cables, G. G. M. Hardingham.—(*Felten and Guilleaume, Germany.*)

*7th July*, 1894.

13,161 Slotted Shackle, &c., for Weighing Purposes, T. Cheshire, Liverpool.
13,162. Rife-barrel Coolers, H. Bates, Birmingham.
13,163. Automatic Closing Safety Receiving Box, E. Cadman, London.
13,164. Cutting Mechanism for Rotary Printing Machines, C. J. Watkins, Dublin.
13,165. Portable Vessels for Liquids, T. H. Case, London.
13,166. Steam Traps, W. Shore and G. E. Coupe, Manchester.
13,167. Collecting Refuse, M. Ingram and A. F. Morrison, Manchester.
13,168. Radiators for Oil Stoves, H. V. Rippingille, London.
13,169 Ball Bearings, C. H. Sims and E. Sykes, Halifax.
13,170. Ambulance Shells for Hospitals, T. Lloyd, London.
13,171. Treatment of Towns' Refuse, F. W. Lacey, Bournemouth.
13,172. Gear for Cycles, W. D. Bohm and J. Sander, London.
13,173. Preparing Cotton, J. W. Scott and J. Parkinson, London.
13,174. Connecting Buckles to Ladies' Belts, J. Bird, Penarth.
13,175. Bib Taps, T. G. Dowson, London.
13,176. Machines for Finishing Hat Moulds, R. Wallwork, Manchester.
13,177. Gravity Railway, W. T. A. Emtage, Nottingham.
13,178. Food for Cattle, A. M. Millot, London.
13,179. Ferrules for Walking Sticks, F. Lodge, Bradford.
13,180. Gas Engines or Motors, T. G. Normanton, Barrow-in-Furness.
13,181. Syphon Cisterns, G. Brindley, J. McEwen, and S. Thompson, Manchester.
13,182. Electric Light Ceiling Roses, C. Richardson and E. Herbert, Manchester.
13,183. Oil-cans, S. Johnson, London.
13,184. Making Steel, T. Hampton, Sheffield.
13,185. Stoppering Bottles, W. H. Baines, Sheffield.
13,186. Class Desk, J. J. D. Paul and G. Dannock, Norwich.
13,187. Box for Displaying Velvet, &c., J. Wright, Manchester.
13,188. Winding Machines, B. and F. A Holt, Manchester.
13,189. Slubbing and Roving Frames, T. F. Dunn, Manchester.
13 190. Bicycle Lock, J. Power, Manchester.
13,191. Corset Fasteners, H. H. Leigh.—(*R. Hinrichsen, Germany.*)
13,192. Digging Machines, T. C Darby, London.
13,193. Producing Photographs in Colours, H. A. Fardell, London.
13,194. Refrigerating Liquid, M. Wanner, London.
13,195. Tanning Skins and Hides, T. H. L. Bake and H. A. Leverett, London.
13,196. Photographing in Colours, J. Joly, London.
13,197. Candlesticks, J. Fraser, Liverpool.
13,198. Treatment of Waste Materials, J. H. Lester, Manchester.
13,199. Metallic Phosphate Compounds, C. Raspe, Liverpool.
13,200 Fittings for Band-boxes, &c., E. A. Cole, London.
13,201. Box-nailing Machines, W. S. Doig, London.
13,202. Manufacture of White Lead, H. Wilcox, London.
13,203. Making Acids, C. D. Abel.—(*A. Fischesser and Co., Germany.*)
13,204. Level Surface Hinge, W. Veitch, Kansas City, U.S.A.
13,205. Making Knitted Vests, J. H. Woodward, London.
13,206. Heaters for Curling Irons, F. J. Gascoigne, London.
13,207. Brakes, W. H. Beck.—(*The Fox Safety Block and Signal Company,* ———)
13,208. Dynamos, W. H. and R. W. Allen and C. C. Hawkins, London.
13,209. Glue-pots, W. Keeble, London.
13,210. Printing Textile Fabrics, H. W. Sanderson, London.
13,211. Device for Billiard Tables, J. F. Marshall, London.
13,212. Horseshoes, L. Grünfelder and E. Hauviller, London.
13,213. Lamp Bracket for Cycles, A. Davey, Manchester.
13,214. Adjusting Pictures, J. H. and A. H. R. Major, London.
13,215. Appliances for Holding Papers, E. Drechsler, London.

*9th July*, 1894.

13,216. Magnetic Separator, W. H. and J. I. Ryder, Birmingham.
13,217. Tents and Marquees, &c, W. Hatchman, London.
13,218. Wine and other Bottles, &c, H. I. Ingham, Leeds.
13,219. Skates for Use on Roads, R. J. Stanley, Bristol.
13,220. Golf Iron, A. L. Goodall, Derby.
13,221. Condensing Exhaust Steam, B. H. Thwaite, London.
13,222. Advertising Device, A. S. Ford and H. Tulloch, London.
13,223. Displaying Advertisements, S. Bunting, Birmingham.
13,224. Twiners, H. Bayley, Son, and Co., and W. Swindells, Manchester.
13 225. Coin-counting and Indicating, E. A. Brown, Keighley.
13,226. Railway Safety Appliance, J. Bennett, Burton-on-Trent.
13,227. Screw-conveying Windlass, J. Bennett, Burton-on-Trent.
13,228. Lock and Latch Staples, &c., J. Taylor, Willenhall.
13,229. Rabbit Traps, J. N. Lester and H. Lavender, Walsall.
13,230. Cycle and Carriage Tires, J. Wilson, Manchester.
13,231. Shafting Bearings and Hangers, J. Caygill, Bradford.
13,232. Device for Sharpening Knives, H. F. Chope, London.
13,233. Fastening for Gates and Doors, J. E. Morton, Peterborough.
13,234. Friction Clutch, T. Metcalfe and W. Ambler, Bradford.
13,235. Grain Drying Apparatus, W. Holland, Birmingham.
13,236. Reducing Carriage Vibration, S. H. Stubbs, Manchester.
13,237. Stop Motion for Hay Elevators, T. W. Cook, Yaxley.
13,238. Velocipedes, S. Humber and F. Edwards, Nottingham.
13,239. Excentric Ball Cock, J. Templeton, Dublin.
13 240. Springs for Seats of Furniture, J. W. Drury, Eastbourne.
13,241. Mechanical Stokers, W. D. Grimshaw, Manchester.
13,242. Securing Pedals, W. Bown and J. H. Hughes, Birmingham.
13,243. Atmospheric Gas Burners, G. E. Wright, Birmingham.
13,244. Railway and other Couplings, F. Seeger, Liverpool.
13,245. Fastening for Axle-boxes, L. Hagmeyer, Liverpool.
13,246. Picture Books, H. Munslow, London.
13,247. Reflectors for Street Lamps, W. P. Brown, Manchester.
13,248. Golf Handles or Shafts, &c., F. Bryan, London.
13,249. Joints for Earthenware Pipes, J. Farley, London.
13,250. Stone Breaking Machinery, G. Lowry, London.
13,251. Cases for Needles and Pins, E. Johnson, Birmingham.
13,252 Cigar and Cigarette Holders, J. Favets, London.
13,253. Game, M. Cole, London.
13,254. Direct-acting Pumping Engine, G. de Laval, London.
13,255. Hat Fastener for Ladies' Hats, A. C. Herts, London.
13,256. Explosives, T., S. H., and H. Hawkins, London.
13,257. Applying Power to Vehicles, F. O'C. Prince, London.
13,258. Wave Mills, C S. Snell, Saltash.
13,259. Automatic Electric Exchange, R. Pippette, London.
13 260. Prussiates, O. Imray.—(*Goerlich and Wichmann, Germany.*)
13,261. Disinfection, W. Rowbotham and M. P. Dickson, Manchester.
13,262. Welding Metals, A. V. Newton.—(*A. Nobel, France.*)
13,263. Lubricators, A. Mills, London
13,264. Preserving Paintings, H. Rangeley and F. J. Butcher, London.
13,265. Lamps, W. Perkins, London.
13,266. Lamp Wick, W. Perkins, London.
13,267. Galvanometers, J. Hopkinson, London.
13,268. Paper and Card Suspender, S. H. Crocker, London.
13,269. Traps for Flies and Insects, T. Klussmann, London.
13,270. Steam Boilers, H. Lane and J. Pullman, London.
13,271. Billiard Cue and Tip, &c., T. J. L. Box, London.
13,272. School Calculating Apparatus, E. Scholler, London.
13,273. Lasts and Trees for Boots, H. T. Brockwell, London.
13,274. Hat Press, W. J. Fallon and H. P. Onslow, London.
13,275. Support for Curtain Rods, C. E. Bulling, London.
13,276. Match Igniting Composition, H. Priester, London.
13,277. Typewriter, F. von Eulenfeld, London.
13,278. Loom and other Shuttles, J. W. Champion, London.
13,279. Belts, Braces, Garters, &c, W. Rothschild, London.
13,280. Armour-plates, H. H. Lake.—(*E. M. Fox, United States.*)
13,281. Regulating Temperatures, F. N. Mackay, London.
13,282. Securing the Ends of Boot Laces, A. Hecht, London.
13,283. Purifying Water, R. Haddan.—(*C. J. Leroy,* ———.)
13,284. Fire-escapes, V. Hembacher, London.
13,285. Jacks, J. Silbereisen, London.
13,286. Apparatus for Stopping Horses, C. Pack, London.
13,287. Marking Lawn Tennis Courts, W. Jackson, London.

*10th July*, 1894.

13,288. Combined Clock and Calendar, T. Slaiter, London.
13,289. Piece Boards, Sir T. Salt, Sons, and Co. and H. H. Spencer, Bradford.
13,290. Blowing Glass, H. B. Barlow.—(*J. J. Power, United States.*)
13,291. Wickets for Playing Cricket, J. C. Shaw, Manchester.
13,292. Water-closets, T. W. Twyford, Birmingham.
13,293. Connecting Earthenware, T. W. Twyford, Birmingham.
13,294. Folding Seats and Chairs, &c., A. Plant, Glasgow.
13,295. Applying Ball Bearings, J. T. Fenwick, London.
13,296. Goffering or Creasing Machine, H. Trotman, London.
13,297. Magetta, H. Jonas, Edinburgh.
13,298. Gas and Oil Motor Engines, &c., S. Griffin, Bath.
13,299. Fuel, J. B. Taylor, Bath.
13,300. Weldless Chain Links, G. Stevenson, Glasgow.
13,301. Dumb Caddie, Earl of Wemyss and March, Glasgow.
13,302. Smoke Cowls and Ventilators, H. Miller, Glasgow.

13,303. Pumping Engines, E. de Pass.—(*The G. F. Blake Manufacturing Company, United States*)
13,304. Spring Clip for the Waist, H. T. Hallam, Birmingham.
13,305. Kite, M. Wattleworth, M. A. Mason, and J. M. Brindle, Manchester.
13,306. Combined Brush and Liquid Spray, J. Y. Duckworth, Huddersfield.
13,307. Refuse Destructors, W. Radcliffe, Huddersfield.
13,308. Brace Fittings, A. Breese, London.
13,309. Line Drier for Fishing-rod Lines, G. Grey, Northumberland.
13,310. Pessary, J. C. Conolly and L. Strong, Dublin.
13 311. Fastenings for Field Gates, F. P. Potter, King's Lynn.
13.312. Ball Bearings, C. H. Sims and E. Sykes, Halifax.
13,313. Machine for Making Hexagon Nuts, H. and F. Bennett, Staffordshire.
13,314. Propelling Bicycles, A. R. Sawyer, Newcastle-on-Tyne.
13,315. Manufacture of Ammonia, W. McD. Mackey and J. F. Hutchinson, Leeds.
13,316. Receptacles for Tobacco Ashes, M. Vernon, Birmingham.
13,317. Burners for Oil Lamps, G. H. Middleton, Birmingham.
13,318. Wood-working Machines, J. M. Burke, Liverpool.
13,319. Electric Arc Lamps, P. Kirkegaard, Manchester.
13,320. Roll Turning Machine, G. Vine, London.
13,321. Hand Bag, E. Lycett. Birmingham.
13,322. Sweeping Machines, H. Groeger, London.
13,323. Starting, &c., Tramcars, &c., J. Rawlings, London.
13,324. Pessary with Disinfecting Receptacle, F. W. Golby.—(*Weissgerber, Germany.*)
13,325. Boring Tool, F. W. Golby.—(*W. Knispel, H. Schott, and H. Otto, Germany.*)
13,326. Attaching Flowers to Dresses, E. Tyrrell and J. A. Riley, London.
13,327. Window Brackets, F. R. Martin, London.
13,328. Kilns for Drying Bricks, &c., J. Onions, London.
13,329. Cycle Bosses, T. Middlemore, J. Beesley, and C. Rossiter, London.
13,330. Valves for Heating Coils, G. Ashwell and D. M. Nesbit, London.
13,331. Electrically-controlled Lubricating Device, L. W. de Grave, Derby.
13,332. Wood and Iron Girder, H. Moldenhauer and P. Seidig, London.
13,333. Gas Engines, G. C. Marks.—(*F. Hirsch, United States.*)
13,334. Casement Stay and Hook, A. T. Fitchew, Ramsgate.
13,335. Gas-burners, F. Reiset, London.
13,336. Pedo-locomotive Machine, L. Armanni, London.
13,337. Dies, A. J. Bradley, London.
13,338. Water Heater, V. I. Feeny.—(*Parke and Lacy Company, United States.*)
13,339. Edging Machines, E. Cornely and R. Cornely, London.
13,340. Hair-clipping Machine, V. I. Feeny.—(*C. Greene, United States.*)
13,341. Tongue-cleaner Attachment for Tooth-brushes, Will and Finck Company and M. Fredrick, London.
13,342. Joints for Wires, T. C. Batchelor, London.
13,343. Shuttle Swell, T. A. Leigh.—(*J. Bannister, Mexico.*)
13,344. Pins or Fasteners, J. E. Needham, Liverpool.
13,345. Textile Fabrics, W. P. Thompson.—(*P. C. D. Castle, Germany*)
13,346. Dental Chairs, W. P. Thompson.—(*D. Stuck, United States.*)
13,347. Horseshoes, W. P. Thompson.—(*H. H. Gibbs, United States*)
13,348. Rotating Devices for Rock Drills, P. A. Newton.—(*The Ingersoll-Sergeant Drill Company, United States.*)
13,349. Time-stamp Motors, J. S. McCoy, London.
13,350. Artificial Horizon, H. A. Gadsden, London.
13,351. Type-setting Apparatus, W. H. Beck.—(*L. K. Johnston and A. A. Low, United States*)
13,352. Pneumatic Tires, E. Peverall and S. Roberts, London.
13,353. Calculating Rules, M. J. B. P. Laurand, London.
13,354. Flanged Dutch Tiles, &c., M. Harczyk, London.
13,355. Ball Bearings for Heavy Loads, P. Davies, London.
13,356. Egg Beaters, A. J. Saltsman and E. E. Howe, London.
13,357. Ferrule-making Machines, W. Cannell, London.
13,358. Electrolysis, H. H. Lake.—(*I. L. Roberts, United States*)
13,359. An Instantaneous Water Heater, W. Tallett, London.
13,360. An Improved Clock, W. Jerger, London.
13,361. A Human Nail Trimmer, F. J. Mockler, London.
13,362. Galloway Boilers, C. J. Galloway, London.
13,363. Plate for Voltaic Batteries, W. A. B. Buckland, London.
13,364. Apparatus for Preparing Wort, C. Rach, London.
13 365. Incandescent Gas Burner, C. H. M. H. Delamarre, London.
13 366. New or Improved Pipe Cleaner, P. Elford, London.
13,367. Hat Pins, T. H. Slater and H. Brooks, London.
13,368. Roses for Watering Cans, &c., C. Sachs, London.
13,369. Clarifying Glue, &c., P. C. Hewitt, London.
13,370. Stringed Instruments, B. E. Woollenhaupt, London.
13,371. Switches for Pneumatic Tubes, C. M. Johnson, London.
13,372. Specimens of Natural History, S. F. Denton, London.
13,373. Cycles, W. Foss, London.
13,374. Device for Making-up Bouquets, C. W. Titterington, London.
13,375. Boot and Shoe Fastenings, J. A. Bown, London.
13,376. A New or Improved Toy, J. C. Macnab, London.
13,377. Treating Salt, P. Jensen.—(*H. C. F. Störmer, Norway.*)
13,378. Mounting Speed Gears, P. L. Renouf and F. Westwood, Birmingham.
13,379. Preparing Bristles for Brushmaking, A. S. Miles, London.
13,380. Dough-dividing Apparatus, A. Mohr, London.
13,381. Oil Engines, H. Cook, London.
13,382. Combined Bricks and Tiles, W. F. de Morgan, London.

*11th July*, 1894.

13,383. Syphon Cisterns, J. E. Rogers, Birmingham.
13,384. Method of Drawing-off Liquids, C. Witz, Germany.
13,385. Generating Combustible Gas, B. H. Thwaite, London.
13 386. Cranks for Cycles, G. Pirnie, Dundee.
13,387. Stone-sawing Machinery, G. Anderson, Dundee.
13,388. Grates for Steam-boiler Furnaces, E. C. Mills, Manchester.
13,389. Flyers of Spinning Machinery, J. Macortney and W. J. Larkin, Glasgow.
13,390. Smoke-consuming Apparatus, J. Hutton, sen., Sheffield.
13,391. Metal Boot Protectors, W. Freeman, Leicester.
13,392. Skirt and Blouse Fastener, E. E. Cox, Birmingham.
13,393. Cycle Tires, A. and E. Normanton, Manchester.
13,394. Windows, M. L. Puzey, New Barnet.
13,395. Ventilating Sewers, J. T. Neech, Manchester.
13,396. The Combination Collar and Tie, J., J., and G. R. Bevins, Leicester.
13,397. Carding Engines, W. Lord and W. Rhodes, Manchester.
13,398. Golf Clubs, A. G. Hogg, Manchester.
13,399. Spinning Machinery, &c., S. Thompson, Manchester.
13,400. Hydraulic Motor, Sir W. Arrol and W. Foulis, Glasgow.
13,401. Prevention of Down-draughts, C. Hitchcock, London.
13,402. Manufacture of Street Lamps, A. M. Wade, Birmingham.
13,403 Pivot Hoe Land Cleaner, &c., T. Jamieson, Aberdeen.
13,404. Flushing Apparatus, A. and J. Tutcher, Bristol.
13,405. Induction Coils, A. Cheetham and F. Brown, Birmingham.
13,406. Brushes, W. Pritchard, Sheffield.
13,407. File Handles, H. S. Havenhand, Sheffield.
13,408. Repairing Pneumatic Tires, W. and H. Guest, Sheffield.
13 409. Heating Boiler Feed-water, T. Sykes, Manchester.
13,410. Electrical Switches, C. M. Dorman and R. A. Smith, Manchester.
13,411. Biscuit Boxes, J. Collins, Glasgow.
13,412. Chair Money-box Puzzle, R. Stubbert, Liverpool.
13,413. Street Vehicles Driven by Motors, J. Adam, Liverpool.
13,414. Colouring Tanned Hides by Smoke, A. Herrmann, Liverpool.
13,415. Roller Trawl Ports, R. E. Ellis and A. Kay, Leith.
13,416. Continuous Electric Brakes, A. Young, Edinburgh.
13,417. Overalls for Workmen, W. G. and J. B. Leatherbarrow, Manchester.
13,418. Combination Windows, H. B. Jones, Manchester.
13,419. Incandescent Gas Lamp, &c., C. Schinz, London.
13,420. Fastening Device for Drawers, K. Haupt, Liverpool.
13,421. Valves for Hydraulic Apparatus, W. James, London.
13,422. Electric Relays, W. P. Thompson.—(*C. E. Maréchal, P. C. H. Rigollet, and the Société E. Ducretet and L. Lejeune, France.*)
13,423. Buckle for Braces or Suspenders, J. S. Römpler, London.
13,424. Pumping Engines, J. G. Barclay, Glasgow.
13,425. Filling Ginger Beer, &c., Bottles, J. Bullen, London.

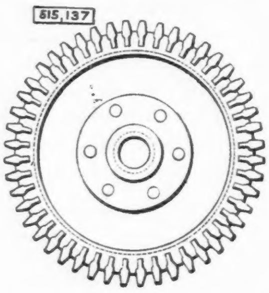
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**515,137.** Gear-wheel and Method of Making same, *C. E. Beck, Allegheny, Pa.—Filed August 9th*, 1893.

*Claim.*—(1) The method of manufacturing gear-wheels, consisting in inserting teeth in a mould, placing a paper composition in the mould, and compressing the same about the teeth, whereby they are firmly embedded in the wheel body, substantially as described. (2) The method of manufacturing gear-wheels, consisting in inserting teeth in a mould, placing a stiffening plate therein, and compressing the paper composition about the teeth and plate, substantially as described. (3) The method of manufacturing gear-wheels, consisting in inserting separate teeth in recesses of the mould, placing a paper composition in the mould, and compressing the same about the teeth, whereby they are firmly embedded in the wheel body, substantially as described.

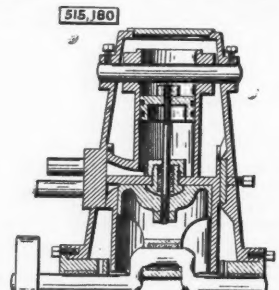
515,137



**515,180.** Oscillating Steam Engine, *E. E. P. Truesdell, Belvidere, Ill.—Filed September 22nd*, 1893.

*Claim.*—(1) In an oscillating steam engine, the combination of a suitable casing, a crank shaft, high and low-pressure cylinders arranged tandem having a pivotal connection with the casing, a steam supply port for the high-pressure cylinder, an exhaust port for the low-pressure cylinder, a port connecting the two cylinders, and pistons for each cylinder having a connection with the crank shaft. (2) In an oscillating steam engine, the combination of a suitable casing, a crank shaft, high and low-pressure cylinders having a pivotal connection with the casing and having a centre partition provided with a stuffing-box, the opposite ends of the cylinders being open, a piston for each cylinder having a piston-rod connection and a connection with the crank shaft, a steam supply support for the high-pressure cylinder, an exhaust port for the low-pressure cylinder, and a port connecting the two cylinders. (3) In an oscillating steam engine, the combination of a suitable casing, a crank shaft, high and low-pressure cylinders provided with ports on one side, the casing provided with a steam supply port, a steam exhaust port, and a port forming a communication between the high and low-pressure cylinders, a piston for each cylinder having a connection with the crank shaft.

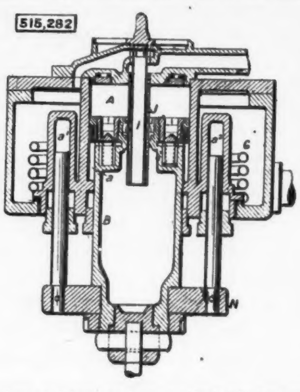
515,180



**515,282.** Air Compressor, *P. Brotherhood, London, England.—Filed October 18th*, 1893.

*Claim.*—(1) In an air compressor, the combination of the cylinder A having an annularly valved cover, the trunk piston B connected to a reciprocating cross-head N and having through it valved passages into the annular space *a* around the trunk, several smaller cylinders $a^1$ $a^2$ having plungers attached to the cross-head N and valved passages, from the space *a* to them, and valved passages from them to a pipe coil G, the water tank H and the concentric pipes I and J, substantially as and for the purposes set forth.

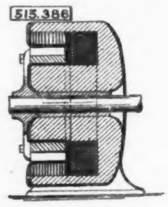
515,282



**515,386.** Dynamo-electric Machine, *J. Wenström, Orebro, Sweden.—Filed March 6th*, 1893.

*Claim.*—In a dynamo-electric machine, the combination with the two poles of a field magnet, of an armature attached to one of said poles and having a continuous uninterrupted surface adjacent to the air gap, and a keeper of solid magnetic material, revolving in the air gap between the said armature and the other pole, substantially as described.

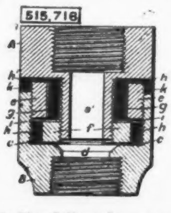
515,386



**515,716.** Insulated Pipe Coupling, *G. Peeples, Philadelphia, Pa.—Filed June 5th*, 1893.

*Claim.*—(1) The combination in an insulated coupling, of the upper section, a threaded neck thereon, a ring adapted to such threaded neck, the lower section, a threaded ring adapted thereto, and insulating material provided between the meeting faces of the rings, and the meeting faces of the rings with the sections, substantially as specified. (2) The combination of the section A, having a threaded neck *a′*, a ring *f*, adapted thereto, the lower section B, having an internally threaded portion *d*, a ring *e* adapted thereto, insulating rings *g* and *h*, located between the rings and the adjacent faces of the opposite sections, and insulating rings *c*, *i*, and *h′* located between the rings *e* and *f* and the sections A and B, substantially as specified. (3) The combination of the section A having a threaded neck *a′*, a ring *f*, secured thereto, the lower section B the ring *e* secured thereto, and rings of insulating material, *c*, *g*, *h*, *h′* *i*, and *k*, disposed between the rings *e* and *f*, and the sections to which they are secured, substantially as and in the manner set forth.

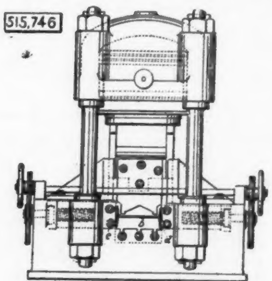
515,716



**515,746.** Machine for Cutting Sections of Metallic Beams, *M. H. Cameron and W. Snape, Salford, England.—Filed July 18th*, 1893.

*Claim.*—(1) In combination, the pair of bottom knives *b b′* arranged opposite each other with a space between, the pair of opposing knives *c c′* arranged at one end of the knives *b b′*, and the pair of opposing knives *d d′* arranged at the other end of the knives *b b′*, said pairs *c c′*—*d d′* forming side cutters, and the shear blade *a* arranged to enter the space between the pairs of knives, substantially as described. (2) In combination, the pairs of bottom knives *b b′* arranged opposite each other with a space between, the pair of opposing side knives *c c′* at one end of the knives *b b′*, the pair of opposing side knives *d d′* at the other end of the bottom knives *b b′*, the means for adjusting the side knives lengthwise of the bottom knives, and the shear blade *a* arranged to enter the space between the pair of knives, substantially as described. (3) In combination, the opposing bottom knives *b b′*, the pairs of side knives *c c′ d d′* at the ends of the bottom knives, the means for adjusting each of the knives *c c′ d d′* independently and the shear blade *a* arranged to enter between the knives, substantially as described.

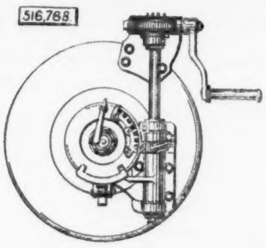
515,746



**515,768.** Feed-water Filter, *A. Harris, Middlesbrough, England.—Filed May 11th*, 1893.

*Claim.*—(1) In a filter an inclosing chamber provided with a removable cover, and having in its lower part a sludge chamber and outlet and a seat for filtering frames, in combination with a series of superimposed annular filtering frames, each clothed with upper and lower sheets of filtering material, said frames having passages at one side opening into the spaces between adjacent frames and passages at the opposite side communicating with the spaces between the filtering sheets of the individual frames, the passages at one side being connected with a fluid supply and those at the opposite side with an outlet passage, and means for clamping said frames together. (2) In a filter the combination of an inclosing casing provided with a removable cover, and having at its bottom a sludge outlet, a fluid outlet, and a seat for filtering frames, a series of outwardly inclining, or cone-shaped, superimposed annular frames each clothed with upper and lower sheets of filtering material, the interior chamber formed by the frames communicating with the fluid outlet of the casing, and a removable cap closing the top of said chamber, the said frames having openings between them connecting an exterior fluid passage, with the spaces between adjacent frames, and openings through their inner walls connecting the spaces between the filtering sheets of the individual frames with the said interior chamber and fluid outlet.

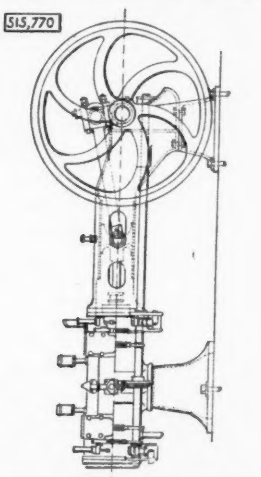
516,768



**515,770.** Gas Engine, *J. W. Hartley and J. Kerr, Kilmarnock, Scotland.—Filed March 9th*, 1893.

*Claim.*—In combination, the cylinder and piston, the two charge inlet valves, the single gas valve with branch pipes leading to both the charge inlet valves, the valve stems depending through their casings, the cam shaft extending under the valve stems to operate the same directly, the governor for the single gas valve located between the two charge inlet valves, the gearing for operating said governor directly, said gearing extending from the cam shaft, the ignition valves arranged on same side of the engine with the cam shaft and over the same, and having their stems actuated directly by cams on the cam shaft, the exhaust valves arranged on the opposite side of the engine from the cam shaft and inlet valves, and the levers extending from the cam shaft to the stems of the exhaust valves, substantially as described.

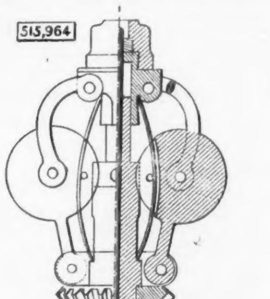
515,770



**515,964.** Steam Engine Governor, *S. P. Lathrop, Montclair, N.J.—Filed May 18th*, 1893.

*Claim.*—(1) In a governor having weights jointed both to a head upon the spindle and to a collar fitted movably to the same, the combination, with the head, the collar, and the weights, of a flat leaf spring held at its ends adjacent to the head and collar and bent transversely between its ends as the weight moves outward, as herein set forth. (2) In a governor having weights jointed both to a head upon the spindle and to a collar fitted movably to the same, the combination, with the head, the collar, and the weights, of spring fulcrum pins in opposite sides of the head, flat leaf springs fitted thereto and extended upon the inner sides of the weights to the sliding collar, and the pins *p* inserted through the weights to engage the middle of the spring, as set forth.

515,964

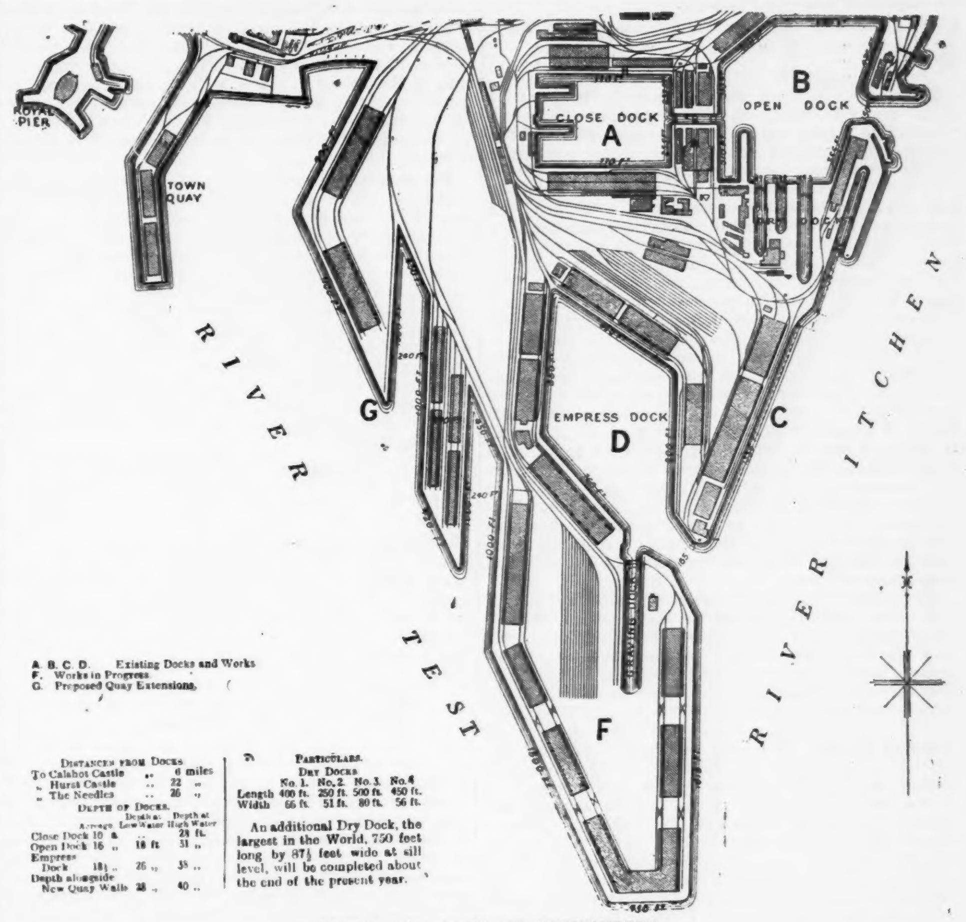


## THE INSTITUTION OF NAVAL ARCHITECTS.

The summer meeting of the Institution of Naval Architects is being held this year at Southampton, a town which, by all its associations and its considerable shipping trade, is admirably suitable. We have pointed out before now the great value of these summer excursions to the Institution, and so far they have fully justified all that we have said. Mr. Holmes, the secretary, is an admirable manager, and the cities visited have met the Institution more than half way. The Institution has now 1100 members, and is still growing in numbers and importance. As at Cardiff last year, so at Southampton this year, a very influential local committee has been formed, with the Mayor, Mr. W. Bone, as chairman, and a most efficient executive committee, of which Mr. Bone is also chairman. The hospitality of the people of Southampton has been unbounded, and a distinct advance has been made in the Cardiff proceedings in that two garden parties, one given on Wednesday by the Mayor, and the other, on Thursday, by Sir Steuart and Lady Macnaghten, to which ladies were invited, and an excursion round the Isle of Wight, on Friday, in the London and South-Western Railway Company's Jersey steamer, Frederica, was planned and carried out with special regard and consideration for ladies.

The proceedings began on Tuesday morning at 10.30 a.m. in the Hartley Institute, with a reception by the Mayor, the President of the Southampton Chamber of Commerce—Mr. T. Morgan—and the members of the reception committee. Afterwards, Lord Brassey took the chair. He delivered an introductory address.

Lord Brassey said he desired, on behalf of the Institution, to express to the Mayor and to the President of the Chamber of Commerce, as well as to the community of Southampton generally, represented by these gentlemen, their most sincere and warm acknowledgments of the kindness they were manifesting to the Institution on the occasion of its visit to Southampton. They would have, he knew from the programme, many hospitalities accorded to them in the course of the week, and, therefore, he should have many occasions to renew that expression of thanks which he now desired most heartily and sincerely to give. He much regretted that Mr. W. H. White was not able to be there. He was for the time obliged to take a rest, which was abundantly earned by his devoted service to the Navy of this country. Reviewing the recent progress in shipbuilding in this country, he said they were building ten battleships of the first class, two first-class and nine second-class cruisers, two sloops, and thirty-six torpedo boat Destroyers. These vessels were in addition to those completing under the Naval Defence Act. The new battleships were, as they were all aware, of unprecedented displacement. The increase of size had been necessary in order to add to the coal capacity, while retaining the armour protection and armament of their immediate predecessors. On the present occasion critical observations were entirely uncalled for; they would not come suitably from the president of the Institution, who had certainly not been selected for that office on the ground of technical qualification. If they admitted the necessity for increased dimensions, which had been adopted, it might confidently be affirmed that the new ships represent, and worthily represent, all that can be accomplished in the present state of naval science. While recognising the fighting power of the new ships, he might be permitted to speak not less approvingly of the Barfleur and the Centurion, as admirable examples of a small type of battleship. These ships give an excellent combination of all the elements of fighting capacity, and in speed showed a decided superiority over the larger ships. Comparisons were given showing the qualifications of different vessels, and reference was made to the increasing necessity for strengthening the torpedo flotilla both in numbers and efficiency. Being at Southampton, his lordship said it was proper to mention that some of the new boats had been entrusted to a firm in the immediate neighbourhood. In referring to Mr. John Samuel White, of East Cowes, it was almost unnecessary to remind them that that gentleman and his father had for several years been largely engaged in providing the Navy with steam and other boats. The firm deserved especial honour, as they all knew the remarkable evolutionary qualities displayed in the type, which was appropriately known as the turn-about. Reference was made as to the speed of these vessels; and Lord Brassey went on to speak of the mercantile marine, and was glad to be able to congratulate the Institution on the continued maintenance of the maritime supremacy of this country, which was largely due to their skill and enterprise. Their merchant navy had been advancing at a rate incomparably exceeding that achieved by any maritime rival. Unfortunately, the profits had not grown in proportion to the tonnage. Rarely had the returns to shipbuilders and investors in shipping been so unsatisfactory as in recent years, the fluctuations in the amount of building had borne no relation to the demands for freight. He expressed the opinion that sailing ships should not be allowed to disappear. He spoke not only under the inspiration of sentiment, because it seemed on the strictest economic grounds desirable that the cheap power of the wind should be utilised under all suitable conditions. A comparison was drawn as to the advantage of sailing ships over steamers, it being added that if the sailing fleet disappeared the best school of training for seamen would be lost, while the career of the sailor would certainly be deprived of much that was interesting and attractive. He pointed out that, taking the sailing ships of all sizes, British ships were distinctly better manned in relation to tonnage than either the German, Swedish, and Norwegian ships, and a careful investigation into the manning of steamers gave similar results. He alluded to the assistance he had received in preparing his statistics from Professor Biles, and went on to state that the Board of Trade returns showed the tonnage removed from the register of the United Kingdom on account of wrecks fell from 263,000 tons in 1883 to 163,000 in 1892. They had seen in what marvellous proportions the tonnage of their shipping had advanced. They saw in every port splendid examples of what the skill of the members of that Institution, and the splendid enterprise of their shipowners could produce, and it was a source of high satisfaction to know that, with the increased facilities of communication between nation and nation, greater safety had been secured. He then referred to the postal contracts, and the recent discussion at Ottawa. They had been able to dispense with the heavy expenditure incurred by other Powers in supplying mail services as auxiliaries to their navies. The general growth of tonnage under the British flag was sufficient to show that the assistance of the State was not greatly needed by the merchant service. When, however, they looked away from the main lines of trade to the opening of the new routes, aid might often be given with advantage; it was sometimes indispensable. The pleasure fleet should not be wholly omitted. They were meeting in the headquarters of the yachting fraternity. In the present year they had not seen that great cutter, the Meteor, sailed in former years in their own waters with such sportsmanlike spirit by the German Emperor. The Britannia, however, built by the Prince of Wales specially to promote a distinctive national sport, the Valkyrie, and the Satanita had been contending in many exciting matches. During the last few weeks the famous American champion, the Vigilant, had entered the lists. The Valkyrie had met with a disaster, but the Britannia had succeeded in scoring numerous victories. For the first time since the arrival in this country, in 1851, of the famous America, British designers and yachtsmen had been able to produce a champion capable of beating the American centre-board type. The power of sailing, and especially of beating into the wind's eye, which had been recently exhibited by British yachts, was truly remarkable. He knew that he was expressing the general sense of the members of the Institution when he said that Mr. Gould, as the owner of the Vigilant, might be assured that his visit to this country was most warmly welcomed.



A. B. C. D. Existing Docks and Works
F. Works in Progress.
G. Proposed Quay Extensions.

Distances from Docks

| | | |
|---|---|---|
| To Calshot Castle | .. | 6 miles |
| ,, Hurst Castle | .. | 22 ,, |
| ,, The Needles | .. | 26 ,, |

Depth of Docks.

| | Acreage | Depth at Low Water | Depth at High Water |
|---|---|---|---|
| Close Dock | 10 a | .. | 28 ft. |
| Open Dock | 16 ,, | 18 ft | 31 ,, |
| Empress Dock | 18½ ,, | 26 ,, | 38 ,, |
| Depth alongside New Quay Walls | | 28 ,, | 40 ,, |

Particulars.

Dry Docks

| | No. 1. | No. 2. | No. 3. | No. 4 |
|---|---|---|---|---|
| Length | 400 ft. | 250 ft. | 500 ft. | 450 ft. |
| Width | 66 ft. | 51 ft. | 80 ft. | 56 ft. |

An additional Dry Dock, the largest in the World, 750 feet long by 87½ feet wide at sill level, will be completed about the end of the present year.

HARBOUR AND DOCKS AT SOUTHAMPTON

The first paper read was by Mr. Dixon.

### On "The Harbour and Docks of Southampton."

The author began by sketching the history of Southampton, and went on at once to describe the modern works. The Harbour Board maintains two lightships; one, the "Itchen" light, at the mouth of the river Itchen, and near the southern extremity of the New Dock works; the other, the "Spit" light, just outside of Calshot Castle, marking the entrance to the Southampton Water. The buoys are in accordance with the uniform system of buoyage, and are shortly to be supplemented by four gas buoys—Pintsch's system. Three of these are to be put down by the Trinity House, in the Solent, to mark the approach to the port from the westward, and the other by the Harbour Board in Southampton Water. All four are to be lighted and maintained by the Harbour Board, the London and South-Western Railway Company making a considerable contribution towards the expense incurred. The Royal Pier, which has lately been reconstructed by the Harbour Board, is used for excursion and steamboat traffic, and the South-Western trains go alongside the steamers, which run in connection with them, for Cowes, Ryde, and the Isle of Wight traffic generally. A spacious pavilion has also just been completed on the pier. The Harbour Board are also engaged at the present time, with the South-Western Railway Company as their contractors, in the important work of bringing the five-fathom line right up from abreast of Netley to the entrance of the Empress Dock, so as to afford a minimum depth of 30ft. at low water of ordinary spring tides, and thus allow any vessel at present afloat to come up to our quays at any time of the tide.

The Harbour Board (or Commissioners) consists of the members of the Corporation of Southampton, and ten Specific Commissioners, who are practically life members of the Board. The Mayor, who is also Admiral of the Port, is elected chairman of the Board, with a virtually permanent deputy-chairman re-elected annually. The statutes which now govern the Board are those passed between the years 1863 and 1891. The debt of the Board is upwards of £200,000, and their revenue from all sources about £18,000 per annum. Although, as already stated, powers were obtained for the construction of docks as far back as the year 1803, nothing was done in this direction till 1836, when an Act was obtained by the Southampton Dock Company giving them similar powers. This was two years after the Act had been obtained for the construction of the London and Southampton Railway, and the two undertakings—so dependent on each other—were carried out almost simultaneously, the railway being opened throughout in 1840, and the sixteen acres of tidal or open dock completed and opened in 1843. The inner or Close Dock was not opened till 1851. This dock is the only one possessing a pair of gates. It is ten acres in extent, and has a depth of 25ft. to 28ft. of water, the depth in the open dock varying from 18ft. at low water to 31ft. at high water of ordinary spring tides. The Extension Quay on the river Itchen was completed in 1876, is 1720ft. in length, and has a depth of 20ft. at L.W.O.S.T. This quay is principally used by the Cape mail and other steamers of the Union Steamship Company.

Next in order of completion is the Empress Dock, opened by her Majesty in 1890. This fine dock is 18½ acres in extent, and has four quays of 850ft. each in length, with 26ft. depth of water alongside at L.W.O.S.T. This dock is used by the steamers of the American line, and by the larger steamers, such as the Nile and Danube of the Royal Mail Steam Packet Company, and the Scot of the Union Steamship Company. It is no uncommon thing for these steamers to dock and undock at dead low water, a feat which cannot be accomplished at any other port in the United Kingdom. A large warehouse is approaching completion on the north side of the inner or close dock. This building, 300ft. in length and 100ft. in breadth, and consisting of eight floors and a basement, is designed for the accommodation of grain, flour, and general merchandise, including bacon, cheese, and American provisions generally, also champagne, which is shipped in considerable quantities from France, *viâ* Havre, and is stored in the various vaults of the company. This warehouse, like the others adjacent, will be fitted up with elevators and conveying machinery of modern design, capable of dealing with 100 tons of grain per hour, either from ship, lighter, or railway truck.

In the close and open docks there are three sets of sheer legs, varying in power from 20 to 100 tons, and a large number of hydraulic cranes of various powers. The boilers and engines for this installation, as also the miles of pressure pipe used for the distribution of the hydraulic power over the dock estate, were supplied by Messrs. John Abbot and Co., of Gateshead-on-Tyne. The boilers —three in number—are of the Galloway type, 30ft. long by 7ft. 6in. in diameter, and are worked at a pressure of 120 lb. per square inch. The pair of tandem compound surface condensing engines are capable of pumping 300 gallons of water per minute at 750 lb. per square inch accumulator pressure. The plant is capable of working about thirty cranes of lifting power, varying from 20 cwt. to 100 cwt., as also the elevators, grain conveyors, coal hoist, and capstans. Some of the cranes were constructed by Messrs. John Abbot and Co., the makers of the engines, and the remainder of the cranes, together with the large shiphauling capstans, by Messrs. Sir William G. Armstrong, Mitchell and Co., of Newcastle-on-Tyne. There has also been put down by the railway company at the docks a very complete installation of electric lighting plant.

On the south side of the tidal basin are four dry docks of the following capacity, affording unusual facilities for the inspection and repair of ships:—

| | | | | |
|---|---|---|---|---|
| No. 1 ... | 400ft. long | 66ft. wide | Depth on sill, | 17ft. H.W. Neaps |
| No. 2 ... | 250 „ | 51 „ | „ „ | 11 „ „ |
| No. 3 ... | 500 „ | 80 „ | „ „ | 21 „ „ |
| No. 4 ... | 450 „ | 56 „ | „ „ | 21 „ „ |

The water is pumped from these docks by powerful steam engines, driving centrifugal pumps — Gwynne's "Invincible" type; and, owing to the convenience of the arrangements, coupled with the fact, almost peculiar to Southampton, that there is a double high tide—practically a state of high water lasting about four hours—it has been found possible to undock as many as three large vessels, and to dock an equal number on the same tide. This double high water at Southampton appears to be caused by the tidal wave being divided on its way up the English Channel by the western or Needles end of the Isle of Wight, one portion proceeding up the Solent and Southampton Water to Southampton, and the remainder continuing on its course on the southern side of the Island. By the time the first high water is over, and the tide shows signs of ebbing at Southampton, the flood tide has worked its way round by Spithead, and, meeting the ebb, practically dams, and holds it up so long as the tidal stream is working westward. As soon as the tide turns at Spithead, and the stream begins to work to the eastward, the real ebb commences from Southampton Water, and runs strongly out, having so much less time in which to do its work than is allowed for the flood tide. This increased rate of the ebb, as compared with the flood, has also no doubt a great deal to do with the scouring of the various channels in connection with the harbour and Southampton Water.

The author then proceeded to give a short account of the works now in progress for the provision of deep water quays on the rivers Itchen and Test, and of the new graving dock situated between the two. This graving dock will be, when completed, the largest single graving dock in the world. Its length on floor is 750ft., which could be extended to 1000ft. or more if ever required. The width at entrance is 87ft. 6in. at sill level, and 91ft. at cope. The depth on blocks will be 29ft. 6in. at high-water neaps. It will be provided with a ship caisson carrying road and railway from the Empress Dock to the Itchen New Quays. There will be a recess provided for the reception of the caisson during the operation of docking or undocking a vessel. There will also be hydraulic capstans and a large travelling crane, capable of lifting 30 tons from the centre of the dock. The caisson stop and sluice faces are of Cornish granite patent axed, the walls and invert of Portland cement concrete faced with brickwork, and the altars and steps of granite. The walls are founded 53ft. and the bottom of the invert 59ft. below cope level. The trenches for the walls necessitated very heavy timbering—in some cases as much as two cubic feet per cubic yard excavated. They were kept dry by two 24in. and two 18in. rocker pumps, throwing jointly between 3000 and 4000 gallons of water per minute. The capacity of the dock at high-water neaps will be about 14½ million gallons, which, with a ship in, can be emptied in from one and a-half to two hours by a pair of Gwynne's 48in. "Invincible" pumps, capable of delivering 112,000 gallons per minute. The discharge will be through two culverts 8ft. by 6ft. 9in., and all valves and sluices will be worked by hydraulic power. Provision is made for additional hydraulic pumps, accumulator, &c. Steam will be provided by four Galloway boilers 30ft., by 7ft. 6in. diameter, space being left for two extra boilers. The exhaust from the engines will be carried up the chimney shaft—which will be 120ft. high—to increase the draught. The chief feature in the construction of the pumping plant was the large excavation for pump foundations and well, a space nearly 90ft. square and 58ft. deep having been taken out and timbered in one piece. The greater portion of the graving dock site was reclaimed from the estuary by a chalk enclosing bank, the area within which was thoroughly drained, and the walls built in trenches. This enclosing bank was completed twelve months ago, since which time 136,000 cubic yards of excavation in trenches and otherwise has been done, and 55,000 cubic yards of Portland cement concrete put in. (*a*) The guide stage, reaching from the south dock head of the Empress Dock, about 300ft. long, is composed of piles and timber framing and deck, and is filled up to low-water level with concrete. (*b*) The east or Itchen Quay is also composed chiefly of a timber and concrete structure similar to the preceding, in all 1600ft. long. (*c*) The South Quay, 430ft. long. (*d*) The Southwest or Test Quay, 1500ft. long. In all, 3830 lineal feet of quay.

About 1150ft. of the Test Quay will be enclosed by a chalk bank, and the wall put in in the dry, as in the case of the graving dock. Another method of construction will be necessary for the outer and deeper portion. There will be 28ft. at L.W.O.S.T. alongside these quays, necessitating dredging upwards of one and a half to two million cubic yards of material. This depth can at any time be increased to 30ft., the foundations being put in deep enough to admit of dredging to that extent. The extension works are being carried out by Messrs. Lucas and Aird, Messrs. Galbraith and Church, of Westminster, being the engineers. The contractors are represented on the spot by Mr. William Coulson, C.E., and the engineers by Mr. Maurice F. G. Wilson, C.E.

The following items will be interesting, showing the number — approximately — of men, machines, and materials required in the execution of the works:—1100 men; 85 locomotives, cranes, &c.—(7 locomotives); 10,000 loads timber; 40,000 tons of cement; 2,000,000 bricks; 3 dredgers; 26 barges and hoppers; 5 tugs and launches. The paper concluded with long appendices sketching the career of the various large steam shipping companies using Southampton.

We have already very fully illustrated and described the Southampton Docks, but the map, which is a reduced copy of one given by Mr. Dixon, is needed in order to show the new graving dock and other works, which are pretty fully described by Mr. Dixon.

No discussion followed. Indeed, Mr. Dixon took care to explain that he had carefully avoided all controversial matter. For example, we may say that he scarcely alluded to cement concrete. Sir E. J. Reed proposed a vote to Mr. Dixon in a few well-chosen words, calling special attention to the important part which great railway companies have played in later years in developing dock accommodation. A vote of thanks was passed unanimously.

The next paper read was by M. Normand. Certain explanations were given by M. Normand, in order to save his hearers the trouble of asking questions. The trials named took place under the auspices of the French Naval Commission, and were not contractors' trials. The boats were small, 118ft. long by 13ft. beam. They were all tested with sufficient coal on board to carry them 1500 miles at ten knots. The contract speed was twenty-one knots. The actual speed during a four hours' trial was twenty-four knots. The boilers evaporated 37 lb. of water per hour per square foot of grate surface. The consumption of coal at full speed was 70 lb. per hour per square foot of grate; at ten knots it fell to 8 lb. M. Normand gave a table, from which we extract the following figures:—

| No. of boat. | Reduced speed—knots. | Consumption of coal in pounds per knot. | |
|---|---|---|---|
| | | Without heater. | With heater. |
| 149 | 10 | 15·20 | 12·03 |
| 152 | 10 | 17·0 | 12·4 |

The saving effected was at the rate of 20 per cent. The weight of the machinery with one boiler came out at about 48 lb. per horse-power. With two boilers for the same power it came out a little heavier, viz., about 53 lb., but in certain boats now being built by M. Normand, it was hoped that the weight would be yet further reduced. The following is an abstract of M. Normand's paper:—

### ON THE IMPORTANCE OF ECONOMY OF FUEL IN VERY FAST VESSELS, AND ON THE ADVANTAGES TO BE DERIVED FROM HEATING THE FEED WATER.

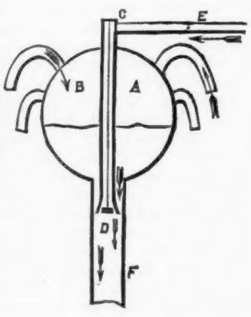
The author said that economy of fuel is universally admitted to be of great importance from a commercial point of view. It has, however, not always been acknowledged as a means for attaining extraordinary speeds. In the cases where very high speeds are to be attained some engineers dispense with steam jackets, feed heaters, &c. in order to save weight, overlooking this important fact that the necessary increase in the weight of boilers is greatly superior to the saving thus effected. Economy of fuel is not less important when looked at in regard to the bunker space occupied, and especially to the length occupied in the boat by the machinery and boilers, as well as by the necessary number of stokers to be carried. Between two sets of engines one requiring six boilers and the other only four, there can be no hesitation which to choose if the reduction may be obtained by making a few simple and practical additions to the machinery. Such differences in the boiler power required, as above mentioned, are not unusual. Taking, for instance, the consumption of my last torpedo boats, which ranged, according to official trials, from 1·1 lb. of coal per indicated horse-power per hour up to 15 knots and to less than 2 lb. at 25 knots, this consumption is certainly not more than two-thirds that of a number of similar craft. The total weight of engines and boilers of the boats above alluded to is about 48 lb. per maximum indicated horse-power; this weight has been still further reduced in the Chevalier, and notably in the the Forban, now under construction in my yard. From this it is evident that economy in coal really means economy in weight on account of the large reductions that are possible in the boiler power.

The author showed in 1885,* and this rule has been since verified in a number of cases, and is now generally assumed to be true, that, in cruisers, torpedo gunboats, torpedo-boats, &c., if the speed, steaming distance, weight of armament, and general conditions remained unchanged, a reduction in the weight of any part of the ship allows the whole displacement to be reduced by about 4½ times the weight saved. We see therefore that in light war-vessels, for instance, any given problem may be solved with widely different displacements according as the engines are, or are not economical; in fact, the necessary displacement may be as one to two, according to the weight and economy of the engines, and when extraordinary speeds are imposed exceedingly economical and light engines become a necessity. The remarkable economy of his own engines may be ascribed to several causes, but more particularly to the feed heater. This apparatus, whereby the temperature of the feed may be as much as 240 deg. Fah. at full speed, gives an economy in fuel consumed of at least 20 per cent., as has been officially proved by comparative experiments on four different boats. The principle of the feed heater, enunciated for the first time in 1856 by his brother Benjamin, is a direct application of the first law of thermodynamics. The heating steam is taken, in compound engines, at mid stroke from the low-pressure cylinder by a special valve, and in triple and quadruple engines direct from the low pressure casing, all the work previously given up in the engine by the heating steam being a direct gain. The advantages of the surface-feed heater over the injection feed heater seem to be as follows:—(1) The temperature of the steam is not limited to some degrees under 212 deg. Fah. (2) No particular head or height of the heater above the pumps is necessary. (3) No trouble is experienced with the feed pumps having to pump hot water, as the heating of the feed water takes place under pressure between the delivery of the pumps and the boiler.

Now, the economy of 20 per cent. above referred to, and which has often been challenged, requires some explanation. It may be ascribed to two causes:—(*a*) That which results from the number of thermal units saved by using, for heating the feed, steam which has already done work; this may amount to from 10 per cent. to 14 per cent., according to the pressure. (*b*) That which results from the better circulation of the water in the boiler, a greater proportion of that water being at a boiling temperature. The upward motion of the water in the heating tube by the bubbles of steam is purely mechanical—as in the "Pohle" air lift pump so much spoken of now—and the resulting increase in the transmission of heat is quite consistent with the well-known experiments described by Ser in his "Traité de Physique Industrielle," from which he draws the following conclusion (vol. i. p. 227)—"The transmission of heat for the same difference of temperature is more than tripled when the liquid is boiling, which is due to the greater speed in the circulation of the heated liquid." Greater speed in circulation means greater agitation, and the same cause may explain how, by placing baffles in the tubes of my feed heater the transmission of heat has been more than doubled. These baffles are removable, so as to allow of the cleaning of the tubes. Whatever may be the true explanation of the economy realised, its existence is beyond all question. On a trial of one of the first-class torpedo-boats the valve of the automatic trap attached to the heater had been left closed, and the heater was not in action: in spite of every possible exertion the revolutions could not be made to exceed 305 per minute. When the error was discovered the feed heater was put into action, and immediately the revolutions rose to 335; but, unfortunately, the trial had to be abandoned, as some minutes later some of the fire bars fell into the ashpit, on account of the heavy firing that had previously taken place when the heater was not at work.

There was practically no discussion. Mr. Thornycroft said that he congratulated M. Normand. These gentlemen had the advantage not possessed by English firms of being constantly employed on torpedo work, and were, therefore, able to make steady because continuous progress. The weight named—48 lb. per horse-power—was about that of the machinery of the Daring. A few words from Sir N. Barnaby, and a vote of thanks to M. Normand, ended the discussion. Possibly something more will be heard of the remarkable statement that an economy of 20 per cent. is realised by the use of live steam for heating the feed. Of course, nothing like this is possible in theory. The phenomenon is akin to the startling results attained by Mr. Kirkaldy, and confirmed not only by the reports of numerous superintending engineers, but by our own experiments on board the Thames steamer Oriole, and fully reported in our pages at the time. Let the explanation be what it may, there are, as M. Normand says, the facts. We may add that full particulars of all that M. Normand has done in the way of compression, the construction of tubulous boilers, &c., has already been fully described at various times in our pages.

As time permitted, a short paper by Mr. Thornycroft on "Circulation" was read. This paper we give in full on page 80. The discussion which followed amounted to very little. After a few remarks by M. Normand, Mr. Watt said that it was quite possible to have over-circulation, which resulted in leaving the tubes for a period dry. This would have little effect but that the tubes were galvanised. As soon as they became over-heated the zinc was attacked by the dry steam, hydrogen was liberated, and rapid corrosion set in. Mr. Watt was followed by another speaker, who explained how it is that Mr. Maxim has attained such wonderful results with his flying machine boiler, which weighs 4 lb. only per indicated horse-power. The boiler is in type Thornycroft's, but the copper tubes are only $\frac{3}{8}$in. internal diameter. It was found at first that the boiler could not be forced, as the tubes boiled dry, because the water did not descend the down pipe fast enough to make up the quantity discharged upwards by the steaming tubes. He overcame the difficulty in the way shown in the annexed sketch. A is the steam drum, B is a pipe reaching some distance down the down feeder pipe F. The feed water comes in through E. There is a valve at D, kept up to its seat by a spring at C, where there is a stuffing-box for the valve rod to pass through. Matters are so arranged that the pressure on the boiler being 300 lb., the pressure of the feed necessary to pass D is 350 lb. The result is that the feed comes in in a thin stream at a high velocity,



---

* Etude sur les Torpilleurs.

# TERRY AND FLANNERY'S SYSTEM OF VENTILATING OIL TANK STEAMERS

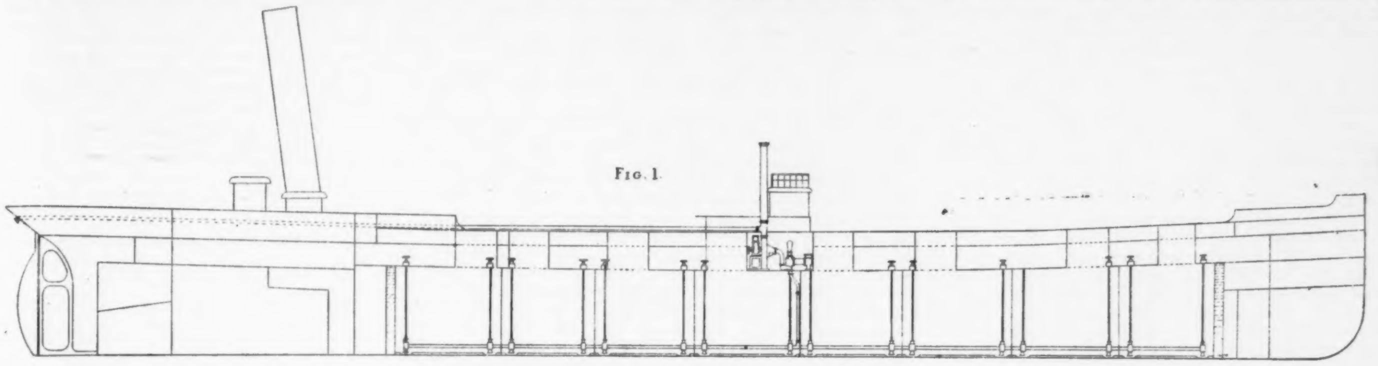


FIG. 1.

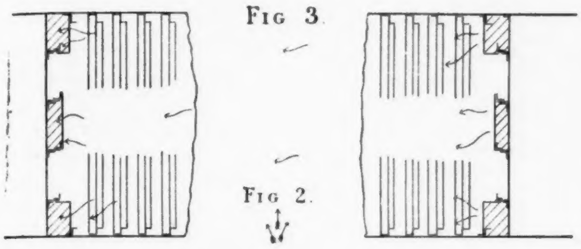


FIG 3.

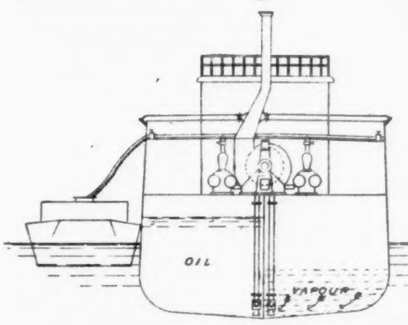
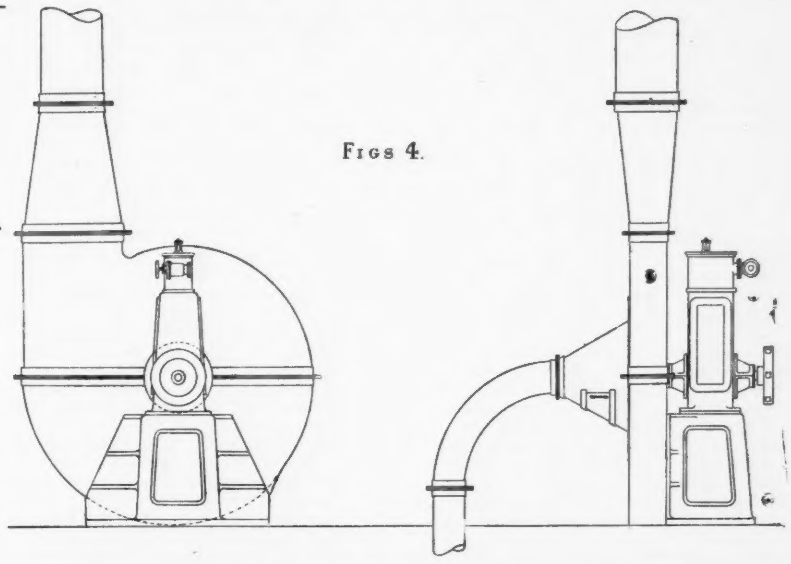


FIG 2.



FIGS 4.

and induces so powerful a down draught in B that it is impossible to keep any water standing in A. This is a complete success, and enables the boiler to be forced to an unlimited extent.

Mr. Thornycroft said that he had used $\frac{3}{8}$in. tubes with success, but he had not gone further. The circulation in a small tube boiler could not be too violent. In a large tube boiler the water did not get changed, because there was room for the bubbles of steam to pass up. They did not fill the tube, and the water slipped past them. Such boilers would fur up. The circulation in them was quite insignificant as compared with that in a small tube. He had found tubes in his boilers in good condition after five years' work. Originally the tubes were 15 B.W.G., now they were about 16 B.W.G.

The proceedings now terminated, and the members proceeded to the pavilion on the new Royal Pier, by the invitation of Mr. Morgan and the members of the Chamber of Commerce. Here an admirable luncheon was served, and the members and visitors subsequently went on board the Solent Queen and proceeded round the docks, landing those who wished at the new dock works described in Mr. Dixon's paper. Here much of interest was seen. Unfortunately a dense fall of fine rain interfered much with everyone's comfort.

In the evening about 300 of the members and visitors dined at the Royal Victoria Rooms. Many speeches of the usual type were made, and the proceedings did not terminate till a late hour.

On Wednesday morning the proceedings began at 10.30 with the reading of a paper by Professor Biles "On the Designs of Mail Steamers, with special reference to their use for War Purposes." The paper does not admit of being abstracted, and the issues it raises are very important. It is a long paper, too. We shall publish it in our next impression.

The discussion was opened by Lord Brassey, Mr. Morgan taking the chair. Lord Brassey began by saying that he did not intend to touch on technical points, but that while others were reading and digesting the paper he could say a little as to its general scope. The commerce of Great Britain was enormous, and to protect it an enormous number of cruisers was needed. Was it desirable to build a number of vessels to be used as war ships in times of war, as mail ships in time of peace? He answered, Yes. The Admiralty had already accepted the principle by subsidising mail steamers under certain conditions. There were obviously financial difficulties in carrying out Professor Biles' plans. These should be met by the State. But very great care should be taken that ships built to meet Admiralty views, and subsidised by the Government, must not be sold to foreign Governments or sailed under the flag of another nation, as had occurred in the case of two large steamers. He hoped that Professor Biles' important paper would receive proper attention from the authorities. He held that the Government treated the mail service on principles of utterly undue economy. The whole sum spent on the postal service by Great Britain, France, Germany, and Italy was £3,331,000 per annum, and of this Great Britain spent only 20 per cent. As compared with the annual revenue, the expenditure of Great Britain was as one to 1161, and that of the other nations named as one to 336; and France spent besides very large sums on subsidies.

After a few words from Mr. Morgan, Sir Edward Harland continued the discussion. It may be well to explain here that one of the essential features of Mr. Biles' scheme is that the sides of the ship should be recessed along the water line, 5ft. above it and 5ft. below it, and that within these recesses when fitted for war, armour-plates and backing kept in readiness should be put and secured; protection is also to be afforded by the coal bunkers.

Sir Edward Harland began by saying that he had not had time to read and consider the paper, but he could congratulate the author on the way in which he had handled a very complex question. He was glad to find that the views of the Bulkhead Committee were adopted. The subdivision of large ships was very much more easily carried out, without interference with cargo, than that of small ships, and as Mr. Biles contemplated a ship 500ft. long, the bulkhead part of his scheme presented few difficulties as to the boilers. Firing fore and aft presented so many advantages, that he wondered the Admiralty had not adopted it long since. No trimming worth mentioning was required; none of the expense incurred in dragging sacks of coal to the stokehold plates. The 'thwartship system of firing would not be tolerated for a moment, because of the expense, in the Mercantile Marine. He could not at all endorse Professor Biles' views in favour of short stroke engines; it was too terrible a sacrifice to contemplate with equanimity. The Great Eastern had screw engines whose stroke was so short that great loss of power was incurred by friction. As to the recesses for the armour plates, he held that they would sacrifice the longitudinal strength of the hull, which lay in the skin, and any loss there could scarcely ever be made up. Again, he held that the interest on the cost of the plates would be an enormous item. As to the value as protection of fore and aft bunkers, he doubted that it would be worth having. If a shot went through, the coal would prevent any steps being taken to plug the hole. The Admiralty had, he believed, carried out some experiments years ago to test the value of coal protection, but the results had not, to his knowledge, been made public. The Admiralty were much to blame for the delay in publishing the results of experiments. The extra weight to be carried—600 tons—would be a severe tax in the merchant service, and he did not think that the double bulkhead, with a space of 3ft. between the two, could possibly find favour with shipowners. The paper was no doubt valuable, in that it would raise the question whether it was better to build mail steamers which could be converted into war ships at a large expense, or to spend the same money on real men-of-war. We did not go to war once in six years, or in sixty years, and he really thought that as regarded Mr. Biles' schemes the game was not worth the candle.

Mr. Martell followed with an amusing speech, which, however, left the subject much as he found it. He held that there would be no difficulty in making a ship strong enough in spite of the recesses. There was a great deal of nonsense talked about protecting and arming mail boats. Mr. Biles had taken this and crystallised it, so that it could be criticised. The British Government was not only mean, but dishonest. After getting ships on the Admiralty list, holding out as a reward, that if the Government wanted ships, those on the list would be ememployed, they, the moment some vessels were wanted for trooping, took ships which not only were not classed on the Admiralty list, but were not classed at all anywhere. As for coal armour, experiments had proved that it was useful. He saw nothing impracticable in Mr. Biles' scheme but the cost.

Admiral Boys agreed with Sir E. Harland, that they had not had time to master the paper. Everyone, however, knew, that a battleship was a compromise, and Mr. Biles would produce ships which were more a compromise than ever. He held that the proposed ships would not be in any way first-class cruisers. Far from it. The proper functions of a mail boat in war time would be to carry a light armament for her own defence, and trust to her heels for the rest. No attempt should be made to render her an offensive weapon. Coal targets had been tried by the Admiralty, and their value had been abundantly proved.

Mr. Sydney Barnaby said that the paper did not embody the views of an idle dreamer, but of a man who knew very well what he was about. Sir N. Barnaby had advocated a somewhat similar scheme before the Institution of Civil Engineers, and Sir F. Bramwell denounced it, saying that such a scheme for a compromise between a man-of-war and a merchant ship was to him like a red rag to a bull. It seemed to him that Mr. Biles had not included all the objections to the scheme in his paper. Thus the beam of the ships and her resistance would be increased. He thought that instead of using side armour weighing some 1300 tons, it would be better to use two decks, one a little above, the other a little below, the waterline, and pack the space between with a water-excluding material weighing about 330 tons. He did not think that in war there would be time to put on armour, but the space between the decks might be packed in a couple of days. Before sitting down, he would like to ask for information about the Russian Vounteer Fleet.

Mr. Denny said that his firm had built two Russian ships, but there was nothing exceptional about them except that the bulkheads were rather more numerous than usual. They were only to carry a few light guns. There was nothing impracticable in Mr. Biles' scheme; it was all a question of expense, and he thought that such ships would be less likely to come to grief than men-of-war, because the machinery would be constantly at work, and the crew would know all about it. He would rather be in such a ship than in one of the terribly complicated cruisers, with an engine-room crew on board who had had no acquaintance with the ship or her machinery. He feared Mr. Biles, in calculating weights, had forgotten water ballast. There was no difficulty in making the ship strong enough. He did not like wells in double bottoms, with non-return valves which never acted.

Mr. Swan corroborated Sir Edward Harland about the recesses. Instead, he would use a permanent shelf, on which the armour could be carried when necessary. This would be cheaper, and quicker to use in time of war. Flat armour-plates might be kept in stock, which would fit any ship.

Professor Biles, replying, said that he was quite aware that he was going to arouse opposition. He had summarised what had no doubt been on men's minds before. He was certain that if we went to war we should want many cruisers, and that we could not produce them fast enough. Something must be sent to sea. Was it not best to recognise and act on this early enough, and design our great mail steamers accordingly? If Sir Edward Harland would read his paper carefully, he thought Sir Edward's views would be modified. After all, there was not very much change entailed. As to the 600 tons extra, he did not think that a matter of much consequence in a large ship, especially as much of the goods carried were measurement, not dead weight. As to short stroke, the term was fairly comprehensive, and the tendency was all to reduce stroke. Sir Edward could no doubt remember a ship indicating 10,000-horse power, built about fifteen years ago, in which the stroke was 6¼ft., while now ships of 20,000-horse power had a stroke of only 5ft. Short strokes answered very well in warships. Coal did give wonderful protection. Sir Edward had said he would like empty bunkers, that he might be able to plug the holes, but a shell would blow a hole 6ft. square in a ship's side. How would he plug that? Mr. Barnaby's suggestion was very useful, only where was the material needed to be got? Mr. Swan's notions about a shelf Mr. Biles had considered very carefully, but he liked the recesses best, because less skill would be needed at a time when skilled labour would be scarce, in putting on the armour plates.

Mr. Morgan concluded the discussion by saying that coal had proved of wonderful value in quenching the effect of small shells from quick-fire guns, which would otherwise wreck a ship's side in a few minutes, and destroy her inboard.

A vote of thanks to Mr. Biles was passed unanimously.

Mr. Denny then read a paper on "A Rapid Method of Calculating Wetted Surfaces." It is a mathematical paper, and will not bear compression. No discussion followed.

The members then adjourned to the mail steamer Scot, a magnificent ship which has already been very fully described in our paper. On board her a superb luncheon was served, the hosts being the chairman and directors of the Union Steamship Company, and at 4 p.m. the members and guests proceeded to Bassett Hall, where a garden party was given by the Mayor. This terminated the day's proceedings.

Yesterday two papers were read, namely, one by Mr. F. Gross, descriptive of the results obtained from the use of cylindrical boilers fitted with Serve tube, and what is described as the "Ellis and Eaves suction draught" for steamships. To this paper we must return in another issue. The second paper was by Mr. Stephen H. Terry and Mr. Fortescue Flannery, of which the following is an abstract:—

### "The Ventilation of Steamships and Bulk Oil Steamers."

This paper is a description of methods of ventilation invented by the authors. Having referred to the principles of colliery ventilation, the authors of this paper approached the subject of ship ventilation. They were aware that various arrangements and appliances have been proposed and are more or less largely adopted; under these air is blown into cargo and passenger space, by the use of various forms of windsails and cowls, and by specially patented forms of these. More elaborate systems in which air—under slight pressure due to the use of jets of steam or compressed air jets—has been caused to pass into various parts of a vessel have also been used to some extent, and in some cases have given fairly satisfactory results. Exhaust ventilation with these appliances has also been to some extent adopted. A special class of vessel, carrying cargoes of a nature where risks are, or were, so considerable that the premium of insurance used to be, and still is in some cases, 7 per cent., came under the notice and attention of the authors, namely petroleum tank steamers. In these vessels, after the cargo has been removed by pumping, vapour of considerable density is formed by the evaporation of such of the liquid as remains adhering to the surfaces of the skin and frames, &c., of the vessel, such vapour having a specific gravity up to three and a-half times that of air, or twice that of carbonic acid gas. In the endeavours made by others to ventilate vessels carrying this sort of cargo, the desired end was sought in blowing fresh air, by means of fans or jets, into the holds or tanks, under the impression that the foul air would thus be displaced and expelled. With colliery practice in their minds, the authors conceived that a more efficient ventilation per cubic foot of air or vapour moved would be attained if suction instead of pressure were adopted when dealing with vapours of high specific gravity. Their reason for holding this view being that the vapour to be removed is, owing to its weight, found lying in the lowest parts of the vessel in a dense condition, and that when suction is employed the fan draws it down as water in a well is lowered by pumping, the fan being engaged for some time after starting in passing almost pure vapour, only drawing fresh or comparatively fresh air after complete removal of the foul vapour has taken place.

To meet the conditions laid down by the authors, namely, the suction of a very large volume of air through a relatively small pipe,* Mr. Chandler designed a special type of fan some 6ft. in diameter by 10in. wide on the face, with a single inlet and reducing nozzle; the fan and engine—the latter single-acting—capable of running continuously at 500 revolutions a minute, giving a water gauge of 12in., and the theoretical air velocity of 13·738ft. per minute; the water gauge was guaranteed. At the trial, however, with steam at 120 lb. pressure, exhausting to the atmosphere, a water gauge of 16in., with a delivery of some 8000 cubit feet per minute was easily attained. The capacity of a 5000-ton oil boat, at 40 cubic feet per ton, is 200,000 cubic feet.† By this system, and with an apparatus of the dimensions named, the whole of the air in a vessel of this size would be removed and changed once in twenty-five minutes, or nearly two and a half times per hour.

The system designed and patented by the authors consists of ventilation by suction through the oil pipes provided in tankers for discharging cargo. Such pipes are found sufficiently large for the purpose in modern bulk oil steamers, where they are generally 10in. in diameter. In cases where large bilge pipes or ballast pump suction pipes are fitted, good results as to ventilation of ballast tanks are attained by putting them in the fan suction circuit. An important feature in the achievement of success by this system is the high efficiency of Mr. Chandler's fan and engine, which gives a relatively high water gauge (16in.) at a moderate speed of engine. In this way a machine has been combined capable of exhausting at a water gauge such as might have been looked for in a pump, whilst the volume dealt with has been that due to a fan. It is the old story of centrifugal pumps *versus* reciprocating pumps, the former have almost entirely ousted the latter for circulating purposes.

The diagram—p. 75—illustrates the application of this system to a vessel with a capacity of 5000 tons of oil. In the diagram it will be seen that there are the usual coffer or caisson dams at the forward and after ends of the oil spaces. There is a longitudinal bulkhead running from the machinery space to the forward bulkhead. The oil suction horizontal mains are laid in duplicate fore and aft, on each side of the central bulkhead. Suction pipes with bell mouths draw from the fore and aft end of each tank. The horizontal mains are connected with the oil pumps—which are in duplicate—by two vertical suction pipes, of which one only is shown in the drawing; these, again, are connected by cross-over pipes, so that either pump can draw from any tank, forward or aft, port or starboard. Aft of the pumps is shown the engine and fan, with its reducing nozzle to bring the suction side casing down to the required 10in. diameter—the size of all the pipes. Oil-tight, double-seated valves are provided to connect and disconnect the pumps and fan as required. In this case provision has only been made for blowing the air and vapour from the fan straight upwards or right aft, where, issuing at a high velocity, it rapidly mixes with the surrounding atmosphere. This arrangement has already been fitted in about a score of vessels. In the case of some other vessels provision has been made—by means of a four-way flap-valve air trunk—for diverting the issuing vapour to whichever side may be desired, either to port or starboard or straight up. This arrangment is shown in the transverse section of the vessel—Fig. 2. The port pump is at work discharging cargo into the tank lighter alongside, whilst the fan is removing vapours from the recently-emptied tank on the starboard side. In the longitudinal section—Fig. 1—although only one vertical suction pipe is shown on the starboard or nearest side of the longitudinal bulkhead, there is a second pipe on the port side; and it would perhaps be advisable to fit four of these vertical pipes instead of two only, as it gives a greater number of combinations for pumps and fan at one and the same time. As shown in the diagrams, the additions needed for the ventilating system have been limited to the engine and fan, as no alterations or additions to the pipe system were made, except the fan coupling pipe and valve. The cost of the complete system has been less than ·01 of the cost of the ship.

There was only a brief discussion on these papers, and at its conclusion the members adjourned for a visit to the steamship Paris. This concluded the day's programme.

## PLANING MACHINE.

We illustrate on page 82 a planing machine by Messrs. Joshua Buckton and Co., of Leeds, not so remarkable for its large size as some former machines of theirs, noticed in our pages, but remarkable—(1) For its special driving gear, which will run the table at 10ft. per minute, 20ft. per minute, or 40ft. per minute; (2) for its patent double-cutting tool-holders; (3) for the transverse planing action to one of the boxes on the cross slide. The large use of steel castings for machine tools and other engineering work at the present day makes it desirable to have the command of a slow and powerful motion to the table of a planing machine; but as the same machine may be used for planing ordinary cast iron, time would be lost if a rate of travel suitable for steel were used for cast iron.

In the machine illustrated gearing has been introduced which is well shown in the engraving, and in which a change of speed from 10ft. to 20ft. per minute is effected by merely throwing a lever, which draws one pinion out of gear and puts another into gear. If the double cutting tool boxes are in use, the same rate of speed is maintained on both strokes of the table, and plane surfaces are therefore finished without any time lost by an idle return stroke, and they are finished as truly by the first cut over, divided as it is between two cutting edges, as it could be by a second cut over if effected by a single cutting edge. Where, therefore, the double cutting principle can be applied, surfaces can be finished in less than half the time that would be occupied in finishing them in the ordinary way, with a single cutting tool and a quick return motion; but one hindrance to its adoption has hitherto been that there are certain pieces of work which do not permit of sufficient over-run to give room for two tools to work. To meet such cases, without losing time by a slow return of the table, a pair of wheels is provided, which when in gear, as shown in the illustration, bring back the table at the rate of 40ft. per minute, whether the 20ft. or the 10ft. cutting speed is in use. For the transverse cutting action on the cross slide, the same double tool box is used as for the longitudinal action. It is simply turned on its side, and so bolted to the tool slide.

The illustration shows the nearer tool-box fixed for longitudinal planing and the further one for transverse cutting. When the transverse cutting is in use, the feed motions either self-act the tool-box vertically downwards or will traverse the table horizontally with a feed motion which takes effect at each end of the transverse stroke, so as to feed each tool with a fresh cut. The machine illustrated will plane 20ft. long, 8ft. wide, 8ft. high; all its four tool-boxes are fitted with feed motions for horizontal, vertical, and angular cuts. This machine has been purchased by the Vulcan Works, of Vienna, from Messrs. Buckton, who have now in hand another one exactly like it, as well as smaller machines on the same principles. The approximate weight of the machine is 40 tons.

## BOILER EXPLOSIONS.

We have received a copy of the report of the Chief-engineer to the National Boiler and General Insurance Company, which is well worth perusal. After stating that the company has added the insurance of steam engines to its other business, Mr. Hiller says that "the total number of thorough examinations of insured boilers made during the year shows that 89·5 per cent. of the boilers were so examined during the twelve months. This is equivalent to an interval of fifty-eight weeks between the consecutive examinations of each boiler. This result is satisfactory, taking account of the fact that the boilers insured by the company are situated in all parts of the United Kingdom, from the most sparsely populated and remote rural districts to the great industrial centres, where the boilers are situated near together. There is little doubt that if the steam boilers could be prepared for examination at periods equally distributed in the course of the year, we should be able to examine every boiler thoroughly once in twelve months; but in many cases where firms have not more than one boiler, and also in several of the industrial centres, it is the practice to prepare the boilers for inspection at general holidays. At these times the requests for examinations are far in excess of what it is possible to undertake, even though we concentrate our staff in the district, to meet as far as practicable the demands upon us. In some districts it is the practice, where firms have a number of boilers, to prepare the boilers for examination in rotation during ordinary working periods of the year, and this course is the most satisfactory one. It allows time for the boilers to be properly cleaned, and for the fittings to be carefully overhauled and examined, and there is not that pressure of work which always interferes with examinations at general holiday times. It is greatly to be desired that the practice of having one spare boiler should be more generally adopted, and we believe that those firms who make this provision in their plant will find it to their advantage in every respect."

During 1893, 27 explosions of steam boilers in the United Kingdom were reported, which caused the deaths of 9 persons and injury to 22 others. The ordinary vertical boiler as usual heads the lists. Some of the causes which have contributed to this undesirable predominance are pointed out in the particulars given of some of the explosions, and also in the cases of external corrosion. The exploded boilers were of the following descriptions:—

| Description. | Internally fired. | Externally fired. | No of explosions |
|---|---|---|---|
| Vertical, with internal fire-box | 11 | — | 11 |
| Lancashire | 2 | — | 2 |
| Cornish | 2 | — | 2 |
| Locomotive | 2 | — | 2 |
| Portable (locomotive type) | 1 | — | 1 |
| Cylindrical, dish-ended | — | 2 | 2 |
| Cylindrical, egg-ended | — | 2 | 2 |
| Cylindrical, one-flued | — | 1 | 1 |
| Water-tube | — | 1 | 1 |
| Combined flue and tubular boiler | 1 | — | 1 |
| Irregular shaped cross section, two internal tubes | 1 | — | 1 |
| Cylindrical return flue | 1 | — | 1 |
| Totals | 21 | 6 | 27 |

*Causes from which the Explosions Arose.*

| | Persons killed. | Persons injured. | No. of explosions |
|---|---|---|---|
| Defective condition— | | | |
| External corrosion | — | 4 | 8 |
| General deterioration | — | 1 | 1 |
| Internal corrosion | — | 1 | 3 |
| Internal grooving | 3 | 3 | 4 |
| Mistake, negligence, or mismanagement— | | | |
| Over pressure | 1 | 6 | 2 |
| Deficiency of water | 4 | 3 | 5 |
| Overheating through deposit | 1 | — | 1 |
| Defects due to external firing— | | | |
| Fractures at riveted seams | — | 1 | 1 |
| Causes not ascertained— | | | |
| Information incomplete, evidence not conclusive | — | 3 | 2 |
| Totals | 9 | 22 | 27 |
| Total explosions, &c., from July 1st, 1864, to December 31st, 1893 | 1285 | 2265 | 1278 |

Brief particulars of some of the explosions included in the above table are given in the report. In one case a vertical boiler used in a coal pit exploded, owing to the safety valve becoming jammed by reason of the gradual rising of the ground at the part of the mine where the boiler was placed, until the safety-valve lever came into contact with the brickwork of the arch over the boiler. A somewhat similar accident nearly occurred in the case of a boiler under a building in a large city. There the floor above the boiler sank until the safety valve was in danger of being jammed. In this case the defect was fortunately detected in time, and it was found necessary entirely to reconstruct the floor.

The report contains a section on the construction of new boilers, with details of the procedure followed, where the advice and assistance of the company is sought in the construction and laying down of new boilers.

The North of England Institute of Mining and Mechanical Engineers.—The annual general meeting of the members will be held in the Wood Memorial Hall, Newcastle-upon-Tyne, at two o'clock on Saturday, August 4th.

The Late Mr. Alfred Williams.—The death is announced of Mr. Alfred Williams, C.E., the head of the firm of Alfred Williams and Co., of Bankside, Southwark, who has been for many years closely identified with gas engineering. His death took place on the morning of July 20th, at the age of 68, he having been in failing health for some time past. Mr. Williams was one of the founders of the Society of Engineers, and since its inauguration in 1854 has held the position of honorary secretary and treasurer, in which capacity he has rendered the society marked service.

Examinations for Naval Engineer Students.—The local examinations for engineer students will be held at Manchester and Birmingham, as well as other centres, in April next, but the exact date will not be fixed until January, and may then be obtained from the Civil Service Commissioners who conduct the examination. Candidates must not be less than fourteen nor more than seventeen on the 1st of May next. Successful candidates will be entered as engineer students in the Navy on the 1st of July, and will pass through a course of five years at the training school for engineer students at Keyham. The cost to parents is £40 for each year of the course.

---

* It being found desirable to provide means of changing the whole cubic contents of a ship every half hour, the pipes in the case of a vessel of 5000 tons oil capacity being 10in. in diameter, and consequently having a sectional area of 78in., or more than half a square foot.

† If the oil be of the density of ·9, or 9 lb. per gallon, refined oil, there will be 40 cubic feet, or 250 gallons to the ton. If the oil be unrefined, and weigh only 8 lb. per gallon, there will be 45 cubic feet, or 280 gallons to the ton.

## RAILWAY MATTERS.

THE Indian Government has sanctioned the doubling of the line between Karachi and Pipri Stations, twenty-six miles.

WE understand that it is expected that the West Highland Railway will be opened for passenger traffic in a day or two, as the signals and telegraphs will then be completed.

THE construction of the electric tramway at Champel-Petit-Saconnex, Geneva, which is being carried out for the Compagnie des Tramways Suisses, is being rapidly pushed forward.

THE Compagnie Générale des Omnibus is laying down in Paris the Mekarski compressed air system. We learn that three of these cars have been tried in Westfield, Mass., for about a month, and are giving excellent results.

NOTWITHSTANDING the heavy floods in India the work on the Jhelum Railway Bridge is being vigorously pushed on. The first girder has been placed on the first and second piers and all the necessary machinery erected to complete the fixing of the other girders.

THE Indian Government have repeated their orders to the Bombay-Baroda and Central India Railway Company for the renewal of the Warren girder bridges on their line. The representations of the company and their proposals for strengthening these structures have had no effect.

CONSIDERABLE railway progress is being made in Caucasia, chiefly in the direction of building lines to connect the agricultural and mining districts of that region with the sea coast or with the Russian trunk lines. The Austrian Consul at Batoum has reported the opening of about 200 miles of railroad in Caucasia last year. The most important of these extensions is a line—about 165 miles long—from Beslany to Petrovsk.

THE Mari-Attock Railway, one of the most difficult lines in India, is rapidly progressing. All the alignments have been found, and the bridges and viaducts have in most instances been completed. This railway is remarkable for the heavy nature of the works, and despite the difficulty of obtaining labour and the obstacles encountered, it is anticipated that the whole line of 96 miles will be completed by the end of 1895.

IT is stated that the Metropolitan Elevated Railroad Company of Chicago has placed contracts for equipping its line, five miles in length, with electric motive power. At the start fifty-five motor cars will be put in service, each equipped with two 100-horse power motors. For the power house, engine and dynamos aggregating 6000-horse power are planned. It is hoped to have the line in operation some time this autumn.

THE City line—Vienna Town Railway—which was originally given to the "Steam Tramway Company"—Kraus—is now to be constructed by the State, the Lower Austrian provincial authorities, and the Vienna Municipality unitedly. The physical position of the city is such as to have made the negotiations unusually prolonged and tedious. Vienna being situated in a valley encircled on three sides by undulating hills, greater difficulties are presented than were at first expected.

FLOODS have caused considerable damage to railway property in India, that to the Great Indian Peninsula Railway being the most extensive. A large iron bridge near Asirgarh has been carried away and the line breached in several places between there and Kalyan. It will consequently be some days before trains can run regularly. Further reports show that this is the most serious disaster that has happened since the line was opened. Several landslips have occurred on the Ghauts, the mouths of some tunnels have been blocked, and embankments have been swept away. One train was detained sixty hours between a broken embankment and a landslip, but it is believed that no lives have been lost, although some trains narrowly escaped destruction. Other railways have also suffered more or less injury. The traffic on the Bombay and Baroda Railway will be interrupted for some time. The North-Western Railway has been breached at Ruk, and the mouth of the Khojak Tunnel is blocked by landslips.

THE following are some important extracts from the general statement of the Director-General of Railways Administration Report on Railways in India for 1893-4:—The classification of railways in the report remains practically unchanged. During the year sanction was given to the construction of additional mileage to the extent of 154½ miles. Among the principal events were the bringing in of the automatic vacuum brakes on mail trains on the East Indian Railway and the accelerated mail service which has been generally introduced. There are sixty lines now under survey or projected, and these will be taken into consideration by the Government of India at an early date. The contribution this year for sinking funds will amount to about 38 lakhs, so that the net loss to the State will probably be about 121¾ lakhs of rupees. During 1893 the average gross earnings per total train mile were Rs. 4·20 on the standard gauge, and Rs. 3·12 on the metre gauge. The net earnings realised in 1893 were Rs. 12,73,65,012, against Rs. 12,32,57,767 in 1892. The increase this year in the number of passengers killed is due to the accident of November 9th, on the Nilghi branch, Madras Railway

IN an article on "Light Railways and Australian Progress," by R. Price-William, M.I.C.E., published in the *Engineering Review*, we read that the mileage of railways in operation in New South Wales, which in 1875 was only about 400 miles, increased in the following five years to nearly double that number; and that the annual gross receipts—about £600,000, or roundly £1500 per mile—also doubled in the same period, leaving the receipts per mile practically the same. Between 1880 and 1885 the mileage of railways opened again nearly doubled, 1700 miles, the gross traffic receipts increasing during that time to nearly £2,200,000, or very much in the same proportion. From 1885 to 1890, however, the mileage of railways opened and the traffic receipts increased much less rapidly. Although there was no addition made to the mileage from the beginning of 1890 to the middle of 1892, the amount of the traffic receipts has, as might be expected, continued to increase, but at a less rapid rate, the increase being due in a great measure to the natural growth of the traffic consequent upon the mileage of new railways opened in the previous years; and partly to the able management which, during the last few years of almost unexampled commercial depression, has characterised the railway administration in that colony.

THE damage to the South-Western line near Portsmouth has been repaired, and the ordinary traffic resumed. It will be remembered that on Monday evening last the 6.35 train from Havant left the rails, killing the guard and injuring three of the passengers. The permanent way was torn up for some distance, and the telegraph poles were broken. Had it not been for the presence of mind displayed by the engine-driver Hillier in promptly drawing the fire, and thus preventing an explosion, the water being low in the boiler, grave consequences might have ensued. Further report says that at the inquiry, the railway officials express the opinion that soon after passing the switch, where it was turned from the main line on to the branch line, the engine commenced to force the metals out of the straight. On arriving at the V point it left the rails. The reason of the engine leaving the metals was discussed at length, one juryman maintaining that the cause of the accident lay with the check-rail, a piece of metal by the side of the point and intended to force the engine's wheels to take the point. It has been found that the large chair holding the V point was broken, and that it had a flaw in it which, however, was not perceptible until after the fracture. The inquest has been adjourned until to-morrow week. Major Marindin, of the Board of Trade, opened an official inquiry on Wednesday.

## NOTES AND MEMORANDA.

IN a paper in the *Comptes Rendus* "On the Influence of Fluorine Compounds on Beer Ferments," by M. J. Effront, it is shown that ferments which have gradually become inured to the action of fluorine compounds give more alcohol and less glycerine and succinic acid than ordinary yeast from a given quantity of glucose.

IN their report on the composition and quality of the water supplied to London, for the month ending June 30th, 1894, Professor Crookes, F.R.S., and Dr. Odling, F.R.S., state that:—"The quality of the Thames-derived waters has remained excellent during the month of June. The analytical results are practically identical with those of the previous month, and also with those for June, 1893, the differences being in most instances confined to the third place of decimals; each unit in that position representing one part of extraneous matter in 70,000,000 parts of pure water; a fraction which, translated into units of length, is equivalent to about six yards in the distance between the earth and the moon—a wholly negligible quantity."

A METHOD for instantaneously removing iron parts shrunk on hot, like a crank on a shaft, has been communicated by M. N. J. Raffard to the *Bulletin Technologique* of the French Société des Anciens Elèves des Ecoles Nationales d'Arts et Métiers. An endeavour had been to take off the outer hoop of a Laval turbine by heating it with a gas blowpipe; but the heat was communicated too quickly throughout the whole mass to give a sufficient difference of expansion in the hoop alone, so as to loosen it, and there appeared no alternative but to cut it. In such a case, M. Raffard recommends that molten lead be run round the part to be detached, a method which he applied with success in 1860, at the Soho Foundry, Melbourne, in removing a crank that had been shrunk on a shaft of 8in. diameter.

THE following are given in the *Journal* of the Society of Chemical Industry as suitable cements for making joints in leather driving belts:—(1) Equal parts of good hide glue and American isinglass, softened in water for ten hours, and then boiled with pure tannin until the whole mass is sticky. The surfaces of the joint should be roughened and the cement applied hot. (2) 1 kilo. of finely-shredded gutta-percha digested over a water bath with 10 kilos. of benzol until quite dissolved, when 2 kilos. of linseed oil varnish are stirred in. (3) 1½ kilos. of finely-shredded india-rubber is completely dissolved in 10 kilos. of carbon bisulphide by heating. Whilst hot 1 kilo. of shellac and 1 kilo. of turpentine is added, and the solution heated until the two latter ingredients are also dissolved. (4) 1 kilo. of best glue is dissolved at a moderate heat in 1½ kilos. of water, and thickened to the consistency of syrup. 100 grms. of thick turpentine and 5 grms. of carbolic acid are carefully stirred in whilst hot. The mixture is poured into flat tin pans and allowed to cool, then cut into pieces and dried in the air. The cement is made liquid with a little vinegar and applied to the joint with a brush. The two ends of the joint are then placed together and pressed between two iron plates heated to about 30 deg. C.

A CORRESPONDENT writing to *Indian Engineering*, and referring to a selected paper of the Institution of Civil Engineers on the subject of "Hard Wood Pavements in Australia," by Mr. W. A. Smith, says:—"It has always struck me as very strange that soft wood should ever be used in a large city for carriageways. For ordinary roads the hardest and most refractory rocks are employed, *i.e.*, granite and trap—not sandstone nor soft limestones; why not the hardest woods for pavements? Probably the cheapness of Norwegian pine has led to this extraordinary practice; but even so the cost per square yard of soft wood pavements, as laid in London, is 5s. 6d., exclusive of concrete foundations, and the annual cost of maintenance is 5d. per square yard; and as this pavement only lasts seven years, the cost for twenty-one years of laying, relaying, and maintenance comes to 25s. 3d., not 17s. 9d., as stated in Mr. Smith's paper. This compares most unfavourably with the cost in Sydney, viz., 9s. 9d. for a close-jointed pavement, and 10s. 8d. per square yard for pavement with ¼in. to ⅜in. asphalte joints; these pavements last, as already stated above, twenty-one years, and that under a daily traffic of 1200 tons per yard width of road." From this it would appear that we are making a mistake in London in using such soft wood as we do for our pavements.

THE wires between St. Margaret's and the General Post-office, London, were on last Sunday afternoon and evening used for the purpose of experimenting with the teautograph—the invention of Professor Gray, of New York—the time for the experiments being selected owing to the wires being comparatively idle on Sundays. "Special instruments were fixed up at both ends, the messages transmitted being, in every respect, most successful, the instruments working without the slightest hitch over a distance of eighty-three miles. The principle of the instrument is that it automatically records an exact *fac simile* of the writing contained in messages. In the experiments yesterday the receiving pencil recorded with ease and clearness different handwritings, giving thick and thin strokes, dotting i's, and crossing t's very correctly." A correspondent writing to the *Times* points out that more than forty years ago the copying electric telegraph, invented by the late Frederick Collier Bakewell, successfully transmitted autographic messages between Brighton and London. Invisible messages, which could be rendered legible by the recipient, were also transmitted by that system. The copying electric telegraph was subsequently exhibited at the great Exhibition of 1851, and received the highest award, viz., the Council Medal. The late E. A. Cowper also invented and exhibited a writing telegraph.

A PAPER on "The Buckling and Wrinkling of Plating Supported on a Framework Under the Influence of Oblique Stresses" was recently read before the Royal Society by Mr. G. H. Bryan. The present investigation is chiefly interesting as forming an addition to the small class of soluble problems in which the question of stability arises in connection with the theory of elasticity. In a previous communication the author discussed the kind of buckling which arises when a rectangular plate has to support thrusts in its own plane, applied perpendicularly to its edges, and of sufficient magnitude to render the plane form unstable. The problem now considered is that of a sheet of plating of indefinite extent supported on equidistant parallel ribs, or on a rectangular framework formed by two such sets of ribs crossing each other, and which is compressed by thrusts applied in any direction not necessarily perpendicular or parallel to the ribs. Let the plating be supported on parallel ribs at distances $b$ apart, and let it be compressed by a thrust P—per unit length measured in the plane of the plate—in a direction making an angle $\alpha$ with the ribs. Then using C to denote the cylindrical rigidity of the surface, the conditions of instability may be summed up as follows:—(1) If $\alpha < 30$ deg., the plane form will become unstable when $P > 4 \pi^2 C \div b^2$, and wrinkles will then appear on the surface. These wrinkles will run in directions perpendicular to the direction of P—*i.e.*, at an angle 90 deg. $+ \alpha$ with the ribs, and will consist of alternate elevations and depressions, the lines separating which will be at distances $b$ apart. In other words, the wrinkles with the ribs will divide the plate into rhombi, in which the displacements will be alternately to one side and to the other of the plane form. (2) If $\alpha < 30$ deg., the same form will become unstable if $P > \pi^2 C \div b^2 \sin^2 \alpha$, and the plating will then buckle into simple corrugations running parallel to the ribs, the displaced form of the plate being a cylindrical surface, of which the section perpendicular to the ribs is a curve of sines. The corresponding results are also worked out for a plate supported on a rectangular framework. A simple rough-and-ready illustration of these results is afforded when a sheet of paper is thrown into wrinkles.

## MISCELLANEA.

A NEW lighthouse has been erected on Cape Antifer, Seine Inférieure, France. Mineral oil is used, and the light is white, with an interval of 20 seconds between each flash.

NOTICE is given that the business of the Baker Blower Engineering Company will in future be carried on by Mr. Thomas Somers, Messrs. Ambrose Firth and John Bowns having retired from the concern.

THE Maschinenbau Actien-Gesellschaft "Vulcan," of Stettin, Germany, have made arrangements with Messrs. Yarrow and Co. for the adoption of their patent water-tube boiler in some of the vessels they are now building.

THE Admiralty have awarded the contract for the supply of metallic and other asbestos jointing materials of various kinds to the United Asbestos Company, London. This is the tenth time this company has received this contract.

THE twenty-fifth annual prize competition, under the auspices of the Turners' Company, will be held, by permission of the Lord Mayor, on October 24th, 25th, and 26th, at the Mansion House. The competition this year will be in turning in wood and stone.

THE large dam across the Colorado River, work on which was begun some months since, has been completed. The dam is located three miles above the city, and it is stated 100,000-horse power will be the capacity of the electrical power transmission plant.

THE aluminium torpedo-boat which Messrs. Yarrow and Co. are constructing for the French Government is rapidly approaching completion and will be launched shortly. We gave dimensions of this vessel when describing Messrs. Yarrow's works in our issue of June 22nd.

THE following is a recipe for making a fireproof insulation in electrical wiring:—Forty proportions by weight of magnesia, 28 of tallow, 15 of pulverised asbestos, 30 of liquid glue, 15 of glycerine, and ¼ of chromate of soda or potassium; to this may be added an additional ¼ of lampblack if it is desired that it should be black.

THE Delta Metal Company have in hand orders for the propeller blades of several of her Majesty's new torpedo-boat Destroyers, to be cast in their No. 1 Delta alloy. Twelve blades have already been delivered. The tensile strength of the cast Delta metal—mean of twelve specimens—proved to be 36·45 tons per square inch, with an elongation of 20 per cent.

THE steel works now being constructed by the Donetz Forges Company at Constantinovka, in South Russia, with a capital of £400,000, will include a large Bessemer steel making plant, a rail rolling mill, foundry, forge and an engineering shop. It is hoped that the plant will be put in operation this year, as orders have already been secured for the supply of 100,000 tons of rails to the Russian State railways during 1895, 1896, and 1897.

AT the meeting of the Mersey Docks and Harbour Board, on the 19th inst., the Marine Committee recommended that the buoys on the Mersey Bar, which indicate the channel through the bar, be widened from 1000ft. to 1400ft. Mr. Crow, in proposing the adoption, said the channel's least depth was 20ft. to 25ft., so that a vessel of ordinary draught could come in at any time; and in fact, on Saturday last the Umbria, which was drawing 24ft. of water, crossed the bar at dead low water. The recommendation was adopted.

THE Home Secretary, acting under the powers of the Factory and Workshop Act, 1878, has issued an order, operative from the 5th inst., permitting male young persons of sixteen years and upwards to be employed at night in factories where the process of iron ore washing is carried on, it having been proved to the satisfaction of the right hon. gentleman that the nature of the business requires the work to be conducted throughout the night, and that such employment will not injure the health of the young persons engaged therein.

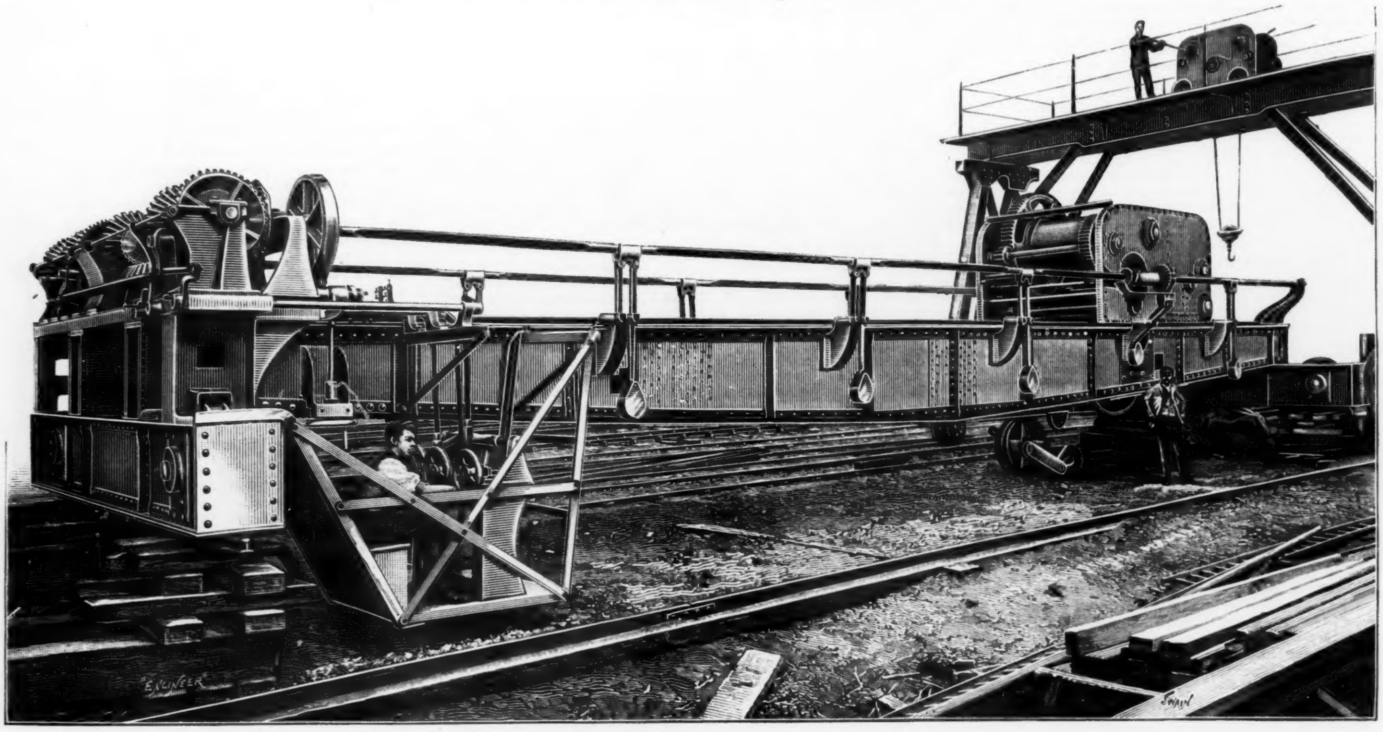
MR. BENJAMIN PICKARD, M.P., President of the Miners' Federation of Great Britain, has been presented with an illuminated address and a cheque for £752, in recognition of his services to the miners in the recent prolonged struggle. The presentation was made by Mr. Haslam, of the Derbyshire Miners' Union, and Mr. W. Ramsden, of Hourton, handed Mr. Pickard a crystal sword, remarking that "It was the sword of justice and of peace." Mr. Pickard, in reply, laid stress on the miners having secured recognition of the principle of a living wage. That obtained must now be maintained. If the miners maintained it for two years, they might be confident that the president of any Conciliation Board would decide in favour of its being decreed permanent.

THE work accomplished by the Millers' National Association in the course of the past twelve months resolves itself into a hearty co-operation with the National Transportation Association, a body which has effected tangible good for the Western manufacturer. The association, says *The Miller*, has also to its credit a great deal of work in opposing patent claims, which are reported to have been pressed more vigorously and in greater numbers last year than has been the case for a long time past. To resist the patent shark was one of the original reasons for the existence of the association, and it is clear that the shark is far from having been killed. In a discussion on this subject, Mr. Seamans, the treasurer, stated that on the file of the United States Patent Office there were about 200,000 patents which were worthless, except for "illegitimate purposes," whereby he, no doubt, meant purposes of extortion. He proposed, that for the protection of industry, a small tax should be imposed on all patents. If the patent were being worked this impost would not, he argued, be felt, but if the owner of the patent had not enough faith in or use for his invention to pay the duty, then the patent should, is was suggested, be made public property.

WITH regard to the new Act concerning the width of London streets, the *Builder* says:—"In regard to this one item of the width of streets for London, the provisions of the London Streets and Buildings Bill are miserable, and are calculated to stereotype one of the greatest mistakes that can be made in a town, both for appearance and for sanitary conditions—viz., that of having streets too narrow in comparison with the height of the houses. Chancery-lane represents what the Bill proposes as the average and usually accepted width of street for London for the future. Is that the kind of street which we ought to contemplate as the regulation width for future London streets? Sixty-three feet is the width of the eastern portion of Oxford-street, which represents very well that class of street which 'forms part of an important line of communication'; and that street, besides not looking like a first-class street according to modern ideas, is manifestly too small for its traffic; but that is rather wider than we are to expect from the London County Council's new Bill for the largest and best London streets of the future. The widest part of High Holborn is 115ft., and even there the space is often insufficient for the free progress of the traffic, partly, no doubt, in consequence of the cab-rank and one or two other obstacles in the centre, but these at the most cannot deprive the roadway practically of much more than 10ft.; say, however, that they represent the odd 15ft.; that leaves 100ft. for a road that is not in the least too wide for its position. But according to the County Council's Bill we can never have such a street as that again; we can never by any possibility have such a street as Portland-place—the only street in London which at all recalls the ample proportions of the best Paris streets."

# SIXTY-FIVE-TON OVERHEAD TRAVELLING CRANE

THE SOUTHGATE ENGINEERING COMPANY, NEW SOUTHGATE, ENGINEERS



## 65-TON OVERHEAD TRAVELLING CRANE.

THE accompanying engraving illustrates a 65-ton overhead travelling crane built for the gun factory of the naval arsenal of a foreign Government, and works inside a building 300ft. long and 60ft. wide. The crane, which is driven by square shafting, is specially designed for handling guns up to 30 c.m. bore and 40 calibres, and for placing them in and removing them from the various machines arranged along either side of the factory for which it has been constructed. Power is transmitted through a short vertical shaft and bevel gearing from the square shaft, which runs in tumbling bearings along the side of the shop and behind the driver's cage to a friction shaft carried in brackets across the ends of the main girders. These brackets are all fitted to an independent bedplate, which in its turn is fitted to the end of the main carriage. The friction shaft carries three sets of double friction cones and mitre wheels of the ordinary type. These wheels have all been made of large size, so that the friction clutches might be of as large diameters as posssible, and have big bearing surfaces.

Thus very little power is required to be applied to the screwed hand-wheels by which the clutches, through a series of levers, are put in and out of gear, and the large bearing surfaces prevent the clutches from binding. One set of friction gearing is connected through spur gearing to two of the main carriage axles, one at each end of the crane, for the purpose of travelling the whole structure. The other two sets of friction gear drive two long square shafts which run along the full length of the main girders, one on either side of the crab. One shaft travels the crab along the main girders, the other one drives the hoisting gear, and is fitted with a powerful screw brake. Both these square shafts are carried in tumbling bearings of an improved and simple type. Power is applied to all the friction clutches by means of screwed hand-wheels. These all work in brackets bolted to the top of a table casting, which is secured to the floor of the driver's cage in front of his seat. The hand-wheel for applying the brake is also close at the driver's hand, as he sits to work these other wheels, so that he has complete control of all the motions of the crane without leaving his seat. He also has an unobstructed view of the whole area of the shop over which he is travelling. The travelling crab is built with cheeks of steel plates and angles. It is so constructed that the centre of the hook can be brought very close to either wall of the shop, so that it commands nearly the whole of the space over which it travels. The girders are built of steel plates and angles, and are of box section. The long girders are each built in three pieces, and will be riveted together when the crane is erected complete in its place. The total span between rails is 57ft. 8in., and it has a travel down the building of 280ft. Total weight 54 tons.

The illustration given is from a photograph of the crane as it was erected complete in the construction yard of the builders, the Southgate Engineering Company, on the Great Northern Railway at New Southgate.

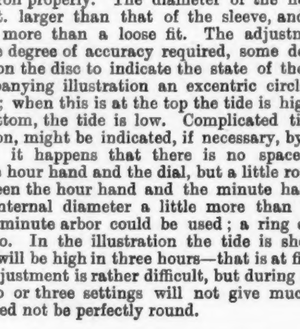
## A DOMESTIC TIDE INDICATOR.

DURING a holiday at the seaside, it is often asked: When is low water to-day? Bathing, boating, walks on the beach, and other matters depend on the state of the tide; some are trivial, and others, such as "the point of cut-off" of a rocky headland, may be of importance. The usual course is to ask a sailor, or to consult a newspaper, or "Bradshaw," "Whitaker's Almanack" being generally left at home. While the Thomson tide predicter is one of the most complicated instruments that have ever been made, the following device, by Mr. A. P. Trotter, B.A., has at least the merit of extreme simplicity, and is accurate enough for the domestic purposes of a holiday maker.

Without going into the theory of tides, it is sufficient to say that during a period of fifteen days, the tides alter about twelve hours, that is, they are about forty-eight minutes later each day. The problem is to apply a simple contrivance to a clock to lose forty-eight minutes a day. A cheap clock is better for the purpose than a good one, for the space between the hour hand and the dial is to be utilised, and this, like the noise of the tick, varies inversely as the price of the clock.

Since it is illegal to deface the Queen's coin, a disc of metal, of about the diameter and thickness of a penny, must be procured, a French penny will answer very well. Take off the hands of the clock, observe the diameter of the sleeve which carries the hour hand, and drill a hole through the disc, to make an easy fit. If the clock is personal property, the sleeve, with its wheel, may be taken out, but if the timepiece is an item of furniture in "apartments," this need not be done, for it is not absolutely necessary. The size of the hole must be adjusted so that when the sleeve makes thirty revolutions, the disc rolling on it makes twenty-nine revolutions. To test this without removing the hour wheel and sleeve would entail 360 revolutions of the minute arbor, but as no great accuracy is needed, it is sufficient to make a mark on the disc, bring this mark opposite the hour hand, and turn the hand round $2\frac{1}{2}$ times, that is, through thirty hours; the mark ought then to move, relatively to the hour hand, through the space of one hour division.

A thin disc, say of tin or cardboard, is rather too light, and is inclined to lean against the dial or the hour hand, and will fail to roll properly. The diameter of the hole is only $3\frac{1}{3}$ per cent. larger than that of the sleeve, and does not amount to more than a loose fit. The adjustment being made to the degree of accuracy required, some device must be painted on the disc to indicate the state of the tide. In the accompanying illustration an excentric circle is shown on the disc; when this is at the top the tide is high, when it is at the bottom, the tide is low. Complicated tides, as at Southampton, might be indicated, if necessary, by a special device. If it happens that there is no space available between the hour hand and the dial, but a little room is to be found between the hour hand and the minute hand, a ring having an internal diameter a little more than $12\frac{1}{3}$ times that of the minute arbor could be used; a ring cut out of tin would do. In the illustration the tide is shown to be rising, and will be high in three hours—that is at five o'clock. Accurate adjustment is rather difficult, but during a month's holiday two or three settings will not give much trouble. The hole need not be perfectly round.



## HIGH SPEED VERTICAL ENGINES.

WE illustrate on page 79 two forms of a high speed vertical engine, each being one of a series recently introduced and manufactured by Messrs. Ransomes, Sims, and Jefferies, of Ipswich and London. The engine is of the open double-acting type, and has been specially designed for driving dynamos, fans, pumps, and other high speed machinery, either coupled direct or by belt. Before finally adopting the design shown, Messrs. Ransomes have carefully studied the special requirements of high speed engine users, and they have made costly experiments to ascertain the best manner in which these requirements can be met. The engine under description is the result of their experience; a considerable number have already been supplied, and are, we are informed, giving great satisfaction. The general design of the engine will be understood from the illustration, but it may be built with the valve chest and fly-wheel reversed in position.

In calculating the strengths and wearing surfaces of the various parts, a very high boiler pressure and an ample margin of safety has been allowed for. The engines may be worked direct from the boilers of triple expansion engines without risk of breakdown or heating. All reciprocating parts are accurately balanced. The crosshead is of cast steel, and the gudgeon is so fitted that the loosening of one nut and a slight tap will release it, and admit of the examination of the brasses. The crosshead gudgeon and the crank pin are both of very large diameter, and the width of each of these bearings is equivalent to twice the diameter; the shaft bearings are also of exceptional size. All bearings are provided with screw adjustments, and can be got at without the slightest difficulty. The lubrication of all working parts is automatic and continuous; the cylinder is provided with a self-acting cup, and the crank-pin is fitted with a centrifugal oiler. This oiler and the cups at the top ends of the rods are supplied from a central oil box conveniently placed and provided with a sight-feed arrangement to each supply pipe. A splash guard, not shown in the illustration, is provided.

The engine illustrated is fitted with a throttle-valve governor on the Pickering principle, but an automatic expansion "shaft" governor—patented and manufactured by Messrs. Ransomes—is also used as shown in the larger engraving. The shaft governor acts direct upon the piston slide valve, and varies the cut-off in proportion to the load. The speed can be adjusted as desired while the engine is running with the Pickering governor, and a special attachment can be provided with the shaft governor to secure the same object. Messrs. Ransomes manufacture this engine in six standard sizes, and another series of engines with enlarged cylinders suitable for working at moderate boiler pressures.

The automatic expansion "shaft" governor is shown by Fig. 2. This governor acts directly upon the piston slide valve, and varies the cut-off in proportion to the load. The engine illustrated has a cylinder $8\frac{1}{2}$in. diameter by 8in. stroke. It is coupled to a dynamo manufactured by Messrs. Laurence, Scott, and Co., of Norwich. The electrical output is 180 ampères at 65 volts and 270 revolutions. The field magnets are constructed of magnet steel cast in one piece. The armature is built up in the usual way with charcoal iron discs, each of which is driven by three keys from the shaft. The conductors, of pure copper strip well insulated with mica, are let into slots milled in the discs.

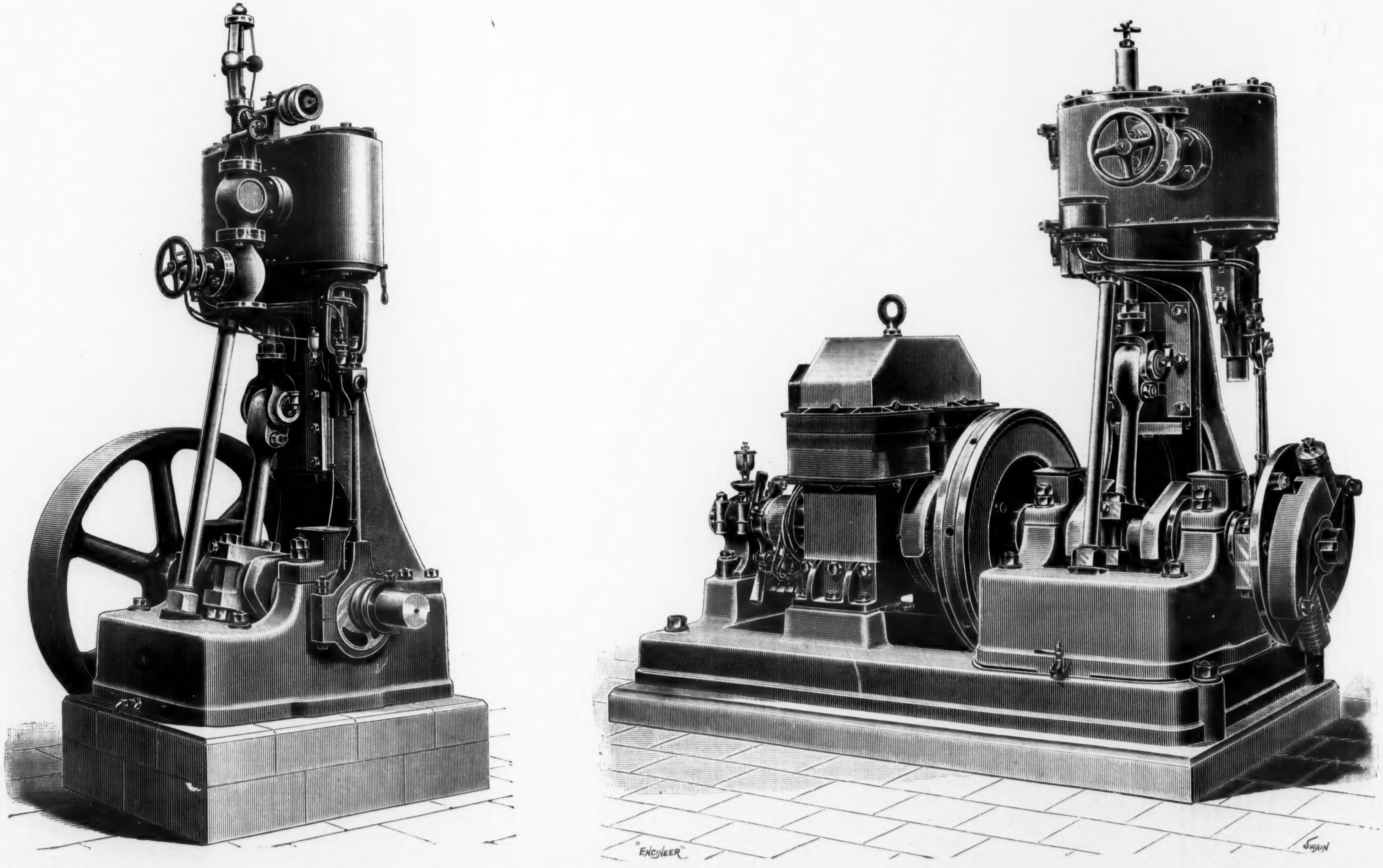
BRITISH INSTITUTE OF PUBLIC HEALTH CONGRESS, 1894.—The general programme has been published of the above Congress, which will meet from the 25th to 31st of this month, and which will be attended by over 3000 delegates appointed by the various local authorities in the United Kingdom. The Congress will be opened by a conversazione on the evening of the 25th at King's College, and the Engineering and Building Construction Section will meet at King's College, at the undermentioned times and dates for the discussion of the papers mentioned in the programme:—Thursday, the 26th, 2 p.m. till 5 p.m.; Friday, the 27th, 10 a.m. till 12 p.m.; Monday, the 30th, 10 a.m. till 12 p.m.

ELECTRIC POWER TRANSMISSION FOR SOUTH AFRICA.—Last week, Messrs. Johnson and Phillips of Charlton, invited a few of their friends to inspect the electrical machinery they have just completed to the order of Messrs. Davis and Soper, London, for the Sheba Gold Mining Company for the transmission of 200-horse power over a distance of five miles. The generators, of which there are two, are of the new Kapp type, illustrated by us last week, but with the armatures arranged to give a two-phase current at 3300 volts. The output of each generator is 132 K. W. These machines will be worked by turbines, and at the delivery end of the line step down transformers will be used by which the current will be supplied to the motors at 100 volts.; the latter are of the Brown self-starting type. One alternator, two transformers, and one motor were shown in action at the time of the visit above mentioned. Having so recently described the new generators, it is unnecessary to say anything concerning them in detail, but it may be mentioned that an inspection of them impresses one most favourably as a remarkably simple and strong machine, which can hardly be put out of order even by short circuiting. A machine which commends itself as peculiarly adapted for work where there are no facilities for repairs, and where the attention or assistance of trained electrical engineers is not to be had.

# HIGH-SPEED VERTICAL ENGINES FOR ELECTRIC LIGHTING

MESSRS. RANSOMES, SIMS, AND JEFFERIES, IPSWICH, ENGINEERS

(*For description see page* 78)



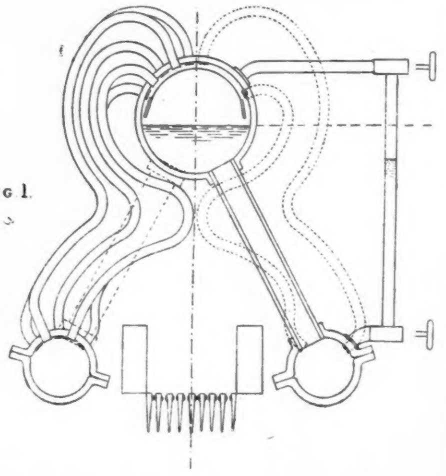
## THE INFLUENCE OF CIRCULATION ON EVAPORATIVE EFFICIENCY OF WATER-TUBE BOILERS.*

By Mr. John I. Thornycroft, F.R.S., Vice-president.

To obtain the highest evaporative duty from a given tube service, it is necessary that the contents of the tube should consist of, as far as possible, water only; and to attain this result the steam must have the freest possible egress from the tubes, and must also be carried from them by an energetic circulation of water in a constant direction. To some of the leading features which affect these conditions I would now call your attention. Considering the boilers shown in Figs. 1 and 2, if the pressure in the lower vessel—that is, at the bottom ends of the generating tubes—is due to the full depth of water in the boiler, in addition to the steam pressure, then any reduction of density in the generating tubes will all be available for causing circulation; and thus any reduction in pressure in the lower vessel, below that due to the head of water in the boiler, is a direct loss to the energy of circulation, so that variations of this pressure are of great importance. These variations can be conveniently measured by a pressure column formed of a long gauge glass connecting the steam space of the upper vessel with the lower vessel. The difference of the water-level in this glass from the water-level in the upper vessel is a direct measure of any reduction of pressure in the lower vessel.

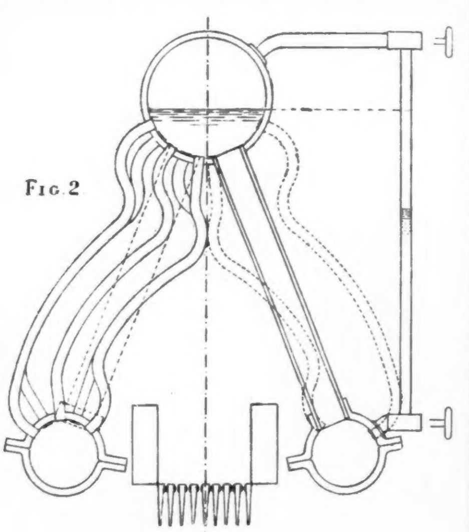
I have made experiments, taking observations from such pressure columns fitted to the boilers shown in Figs. 1 and 2, when they were working under different conditions. The rate of evaporation and steam pressure being varied for the several arrangements of boiler, which were:—(1) Generating tubes delivering above water. (2) Generating tubes delivering below water. (3) Generating tubes delivering below water—without any special downtake tubes.

Fig 1.



The curves given in diagram 3 show graphically the results of these experiments; the falls of pressure in the lower vessels are plotted as ordinates, and the rates of working as abscissæ. It will be seen that the rate of working has been taken up very high, probably more than double ordinary working, the object in doing this being to ascertain up to what rate each arrangement can be worked with safety. In the first series of curves, the results recorded are obtained from the boiler, Fig. 1, with the generating tubes delivering above water. It will be seen from the curve that, as the rate of working is increased, the pressure column falls slightly, and at an evaporation of 20 lb. of water per square foot of heating surface stands at 85 per cent. of the maximum; and by halving the working pressure the results are not sensibly changed.

Fig 2.



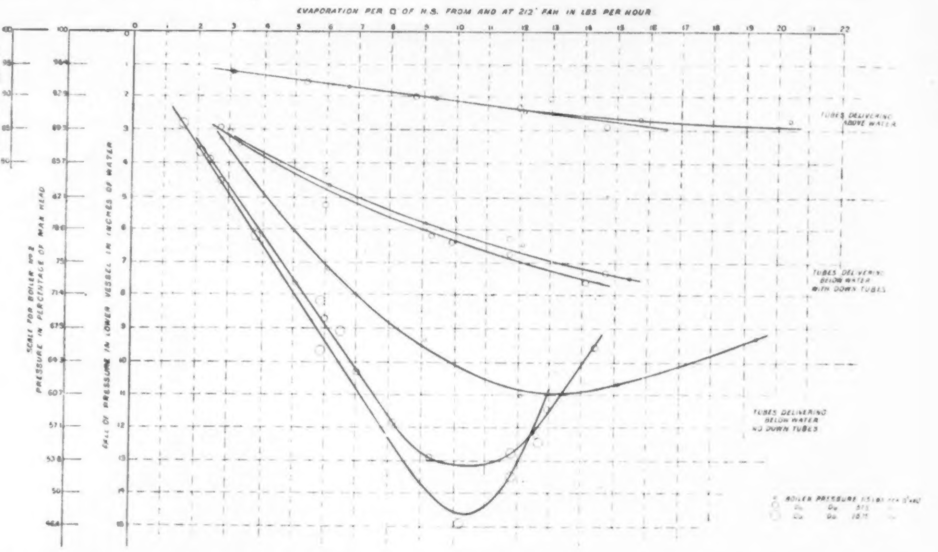
The next series of curves is taken from the boiler, Fig 2, which has the same heating surface, &c., as Fig. 1, but the top ends of the tubes deliver below water. It will be seen that the curves fall much more rapidly than the first series, and that by halving the working pressure the pressure is distinctly reduced in the lower vessel.

The third series was obtained from the boiler, Fig. 2, by plugging up the down tubes, so that some of the generating tubes had to act as down tubes for the supply of the others; the feed water all being delivered into the upper vessel. In this case the character of the curves changes from the first two series very much. A diminution in pressure of working causes the pressure column to fall very much; in the case of the pressure being only 28·75 lb. per square inch absolute, it fell to about 46 per cent. of the maximum. The most important point, however, apart from this low pressure, but a result of it, is that for any given pressure a critical rate of working is arrived at when the pressure column begins to rise again with increased rate of working, thus showing an increased pressure in the lower vessel, caused by the steam being unable to get out at the top ends of the tubes fast enough, and so comes out at the bottom ends as well. It will be seen from the curves that the lower the pressure of working the sooner this critical point is arrived at, and I found that when the evaporation was pushed beyond this critical point the tubes were not safe from overheating; but, by taking the tubes intended for downtakes, and extending their upper ends above the water surface so that water could not go down, and the steam in the lower vessel could readily get away to the separator, it was possible to increase the rate of evaporation somewhat, inasmuch as the facility for the tubes getting rid of their steam was increased.

Contrasting the different conditions of working of the water tubes in the three series of experiments I have described, and noting what slight differences these conditions may necessitate in the design of a boiler, the nearness to success which a boiler intended for hard forcing may be, and yet fail, is clearly shown.

In conclusion, I would submit that the absence of special down tubes limits to a great extent the amount to which a boiler can be safely forced, and shows that to obtain the highest rate of working with safety and efficiency these special down tubes must not be neglected; and still further, the tubes should deliver above water, as then the circulation, as I have previously shown, is double that when the tubes deliver below water. So that this rapid circulation is a most important condition for hard working.

Fig. 3.



THE JUNIOR ENGINEERING SOCIETY.—The members of this Society recently visited the electric and hydraulic installations of the Great Eastern Railway at and in the neighbourhood of Liverpool-street, by permission of the engineer, Mr. John Wilson, on whose behalf the district engineer, Mr. H. Wilmer, received the party and superintended the arrangements for their guidance over the extensive area included in the visit. The electric lighting station, situated in Norton Folgate, contains three 100-horse power and four 200-horse power compound vertical steam engines, each driving a dynamo. Steam is supplied by five Lancashire boilers working at 140 lb. pressure. The lights will consist of 212 arc lamps; and 4773 16-candle power, 272 32-candle power, and 55 50-candle power incandescent. The hydraulic engines and pumps, of which there are two sets, are placed at Bishopsgate-street low level station, and to meet the demand occasioned by the extension of the system, are about to be duplicated, as are also the two boilers and accumulator, &c. There are numerous capstans, truck hoists, parcel lifts, and cranes operated throughout the passenger stations and goods yards and warehouses, and a 50ft. diameter engine turntable has lately been connected up to be worked by hydraulic power. At the conclusion of the inspections, Mr. W. H. De Ritter, member of Council, expressed the members' acknowledgments for the reception accorded them on the occasion.

THE NORTH SEA AND BALTIC CANAL.—It appears from the latest advices of a German official Gazette that the works of the canal uniting the North Sea with the Baltic are sufficiently advanced to warrant the expectation that the new water communication may be successfully inaugurated about this time next year. The project was first introduced to the notice of the Government in 1869, but it was not until nearly twenty years after that it received the sanction of an Imperial decree. Launched under such authoritative and favourable auspices, the question of cost was the next consideration. The sum total, allowing for contingencies, which in engineering works of this character require a fairly wide margin, amounted to a little over £8,000,000. A third of this was either contributed or guaranteed by the Government, and the remainder raised by loans, bonds, and other well-known financial means available for the prosecution of national enterprises, backed up by the approval of the State and its monetary assistance. The advantages of this new waterway are of a double character. It will enable vessels of all tonnage to navigate the northern seas, without encountering the difficult, dangerous, and often tempestuous passage of the Cattegat. It will also serve the purpose of protecting, in a strategic point of view, the coast line of the country in its vicinity. It is estimated that the amount of the commercial traffic accruing from the facilities afforded by the canal will not fall far short of 12,000,000 tons.

RAILWAYS IN FORMOSA.—There are two lines of railway in Formosa, the northern and southern branches, both having their termini in the capital Tai-peh-fu. The northern branch between Twa-tu-tia—a suburb of the capital—and Kelung, a distance of 19¼ miles, now works regularly; the gap at Patu—caused by the destruction of a wooden bridge during a heavy freshet—having been filled at the end of last October by the erection of a steel bridge on stone abutments. The southern branch runs from Twa-tu-tia to the district city of Hsin Chu, a distance of 43½ miles, where the line stops, the continuation being hindered probably by the serious difficulty and expense of bridging the Tyka River. Between Fêng Shan Chi and Hsin Chu a good deal of bridge work has been done by the Chinese under a Cantonese, called the "bridge builder." The first bridge immediately south of Fêng Shan Chi consists of one span of 200ft., one span of 120ft., three spans of 50ft. each, all of steel, and six wooden spans of 30ft. each. The next bridge, at T'o Tzŭ P'u—a mile further on—consists of two steel spans 200ft. and 50ft. respectively, and a number of wooden spans. The Hung Mao Tien Bridge—a mile further on—consists of two steel spans 150ft. and 50ft. respectively, and several small timber spans. During 1893 three new engines, four passenger coaches, and six wagons were received from Birmingham, and a telephone system was installed on the northern branch. In the summer the superintendent doubled the rates, the result of which was that the traffic fell off. According to the Acting British Consul at Tamsui, there seems to have been a partial recovery since; but no information, even of the most general kind, as to the receipts of the lines is obtainable.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### ADAM'S BRIDGE REEF.

SIR,—A short time ago you published an interesting article, headed "Adam's Bridge Reef," describing the proposal of a London Syndicate to join India to Ceylon. In this article it is stated:—"Just about the present time the surveying ships of the Indian Government are commencing the systematic examination of the site of the proposed railway crossing, in order to further the scheme lately made public. It will be a question largely affecting the amount of the estimate for the intended bridge, should this examination result in establishing the supposition that the layer of coral along the line to be dealt with is of sufficient thickness to afford a holding for the pier piling." This statement I believe to be wrong. The Government survey ships are instructed simply to examine the Palk Strait to find out whether deep channels exist such as would enable large vessels to reach the Bay of Bengal, if a ship canal were constructed through Rameswaram Island. No instructions were given to them in connection with the railway project. The survey is intended to include only the area contained between the meridians of Point Pedro on the east and Delft Island on the west, and that portion of the Straits lying between the north coast of Ceylon and Point Calimere. This comprises all the most shoal water in the Straits, and contains an area of about 1200 square miles. Besides a detailed survey for the use of vessels at present trading to the northern ports of Ceylon and through Pamben Pass, a careful examination is being made for a channel of sufficient depth to allow ocean steamers to pass through. Fortunately, March and April are the finest months on this coast, so that the work in Palk Strait progressed rapidly. Working from Point Pedro to the westward, the survey was carried on as far as Karativo before the vessels were called to Bombay.

A glance at the Admiralty chart of the Strait shows that along this portion of the coast the former survey indicates a general depth of six to seven fathoms for from five to seven miles off shore, but with shoal patches off Karativo, and it seems probable that along the north coast of Ceylon the least depth to be met with would be five and a-half to six fathoms. The track to carry this depth passes five and a-half miles north-west of Karativo, close round Point Pedro, then south-east past Ethiopia shoal, and so to seaward. There may be another tract to seaward through the shoals north of Valvettiturai, but this is as yet only partially explored, and the few soundings obtained here by Commander Carpenter in 1887 gave a depth of five and a-half fathoms. It is evident that if the channel round Point Pedro should prove the only available one for ocean steamers, part of the advantage of a ship canal through Rameswaram Island would be lost. It is also a question whether the captains of ocean steamers would take their vessels through a channel exposed to the strength of the monsoon, whose least depth is five and a-half fathoms, with a bottom of hard sand. During the next visit of the Investigator to the Strait the survey will be continued to the northward, when it is hoped a good channel may be found. The chart of the Strait will then be drawn and the results published. This will decide the feasibility of canal project, but I cannot see how it will decide the feasibility of the railway project.

Madras, June 26th.

HENRY BEAUCHAMP,
Editor *Madras Mail.*

### THERMOMETRIC MEASUREMENTS.

SIR,—I shall feel obliged if you will allow me to give a few explanations of the method of using thermometers graduated so that equal increments and decrements of temperature correspond with equal increments and decrements of heat, for determining the differences between the quantities of heat possessed by bodies in different thermal states. In my letter of May 15th, in which I demonstrated that Thomson's absolute scale of temperatures is simply a scale in which equal increments and decrements of temperature correspond with equal increments and decrements of heat, I pointed out that $\frac{H}{T}$ represents the difference between the quantities of heat possessed by a body at temperatures T and $T - 1$, if H represents the heat added to the body during the isothermal expansion stage of the Carnot cycle at temperature T, or abstracted during the isothermal compression stage at the same temperature, and that therefore if $H = T$ thermal units, each increment or decrement of one degree of temperature would correspond with the increment or decrement of the heat possessed by the body by one thermal unit. My object in writing that letter was simply to prove that in accordance with Thomson's absolute scale of temperatures, equal increments and decrements in temperature correspond with equal increments and decrements of heat. If, instead of putting $H = T$ thermal units, we put $H = m S_v T$, thermal units, where $m$ is equal to the number of thermal units of mass of the body, and $S_v$ its specific heat at constant volume, a rise or fall of one degree of temperature would correspond with the addition of $S_v$ thermal units to each unit of mass. A thermometer is an instrument for ascertaining the variations in the thermal state of bodies from some known standard state. If, in the case of one particular substance, we know the difference between the total quantity of heat possessed by the substance in two known thermal states, for instance, in the case of water in the thermal states of melting ice and boiling water, the same difference in the case of another body will be in the ratio of its specific heat at constant volume to that of water. If the specific heat of water is adopted as the standard, the difference between the heat possessed by the water at temperatures $t_1$ and $t_2$ will be equal to $(t_2 - t_1)$ J per unit of mass, and by any other substance $S_v$ $(t_2 - t_1)$ J.

---

* Institution of Naval Architects.

July 20th. WILLIAM DONALDSON.

## THE KINETIC THEORY OF GASES.

SIR,—Referring to the formula, given in my letter in THE ENGINEER, of the 13th of April last, for the pressure of a gas, viz.: $P = \frac{m \bar{u}}{t\, l^2} \times \frac{N \bar{u}\, t}{2l}$; where $m$ is the mass of a single molecule; N the number of molecules, $\bar{u}$ the velocity of their mean square resolved parallel to one of the sides, $l$, units in length of the cube box containing the gas, and $t$ is *half* the time occupied by the impact of a molecule. I think it will be generally admitted that the expression $\frac{m \bar{u}}{t\, l^2}$ in the above equation correctly represents the pressure on the side $l^2$ of the box due to the impact of a single molecule during the time $t$. It will also, no doubt, be generally admitted that this expression multiplied by the number of molecules in contact with the plane during the time $t$ will give the total pressure on the plane at the time. But it may be thought that the number in contact with the plane should be $\frac{N \bar{u} \times 2t}{2l} = \frac{N \bar{u}\, t}{l}$, and not $\frac{N \bar{u}\, t}{2l}$ as given above, since each molecule is in contact with the plane during the time $2t$. The object of this letter is to show that this is not the case.

In investigating this problem, Waterston commences by supposing that a small *rigid* elastic plane is supported by a succession of impacts from molecules striking against it immediataly below its centre of gravity, the plane rising and falling under the influence of the impact and gravity through some indefinitely short distance. Thus one necessary condition, owing to the plane being rigid is, that to secure what Waterston terms statical equilibrium, one impact must be completed before the next commences. Obviously, instead of a succession of single molecules impinging at regular intervals, there may be a large number of molecules impinging simultaneously, followed by another set of molecules, and so on, the impact of each set being finished before the next set impinge. For the plane to be kept in equilibrium by a succession of such impacts, one commencing as the other leaves off, it is clear that the upward acceleration of the *plane* due to the mean pressure during impact must be exactly equal to the downward acceleration due to gravity. Thus we may suppose each impact divided into four periods. At first contact of the molecule with the plane, the pressure commencing at zero will rapidly rise to its mean value, the downward acceleration during this, the first period, will be in excess of the upward acceleration. During the second period, the pressure increases from its mean to its maximum value, and the upward acceleration will be in excess of the downward. The third and fourth periods will correspond with the second and first respectively, both as regards pressure and acceleration. If the plane is at rest at the highest point of an oscillation at the commencement of an impact, during the first period it will fall, during the second it will gradually be brought to rest, during the third it will rise, and during the fourth period its upward velocity will be retarded and the plane will come to rest at the end of this period in precisely the same position at which contact first commenced. And this action will be repeated at each successive impact when the plane is in statical equilibrium.

If N be the number of molecules in a cube box, the top of which is an oscillating rigid plane in statical equilibrium, $N^{\frac{1}{3}}$ will be the number in a line parallel to any side of the box at any instant of time, and $N^{\frac{2}{3}}$ will be the number of molecules in each layer. As half the molecules in each horizontal layer will be moving in an upward, and half in a downward direction, $\frac{1}{2} N^{\frac{2}{3}}$ will be the number in contact with the plane at any instant. Also, $\frac{1}{2} N^{\frac{1}{3}}$ will be the number of molecules in a vertical line or elementary vertical column having an upward motion. As the molecules are supposed to impinge at intervals of $2t$ against the plane, the time intervals between the molecules having an upward velocity in each elementary column must be $2t$. If T equal the time for a molecule to move with the given velocity $u$ through a distance $l$, the length of the side of the cube box, then $2t = \frac{T}{\frac{1}{2} N^{\frac{1}{3}}}$, or $t = \frac{T}{N^{\frac{1}{3}}}$. Again, the number of impacts made by a single molecule in unit time against the plane is $\frac{\bar{u}}{2l}$, and the total number of impacts will be $\frac{N \bar{u}}{2l}$. Let $x$ be some factor which when multiplied by $\frac{N \bar{u}}{2l}$ will give the number of molecules in contact with the plane at any instant, then

$$\frac{N \bar{u}\, x}{2l} = \tfrac{1}{2} N^{\frac{2}{3}}$$

$$\text{or } x = \frac{l}{N^{\frac{1}{3}} \bar{u}}.$$

But $\frac{l}{\bar{u}}$ is obviously equal to T, the time taken by a molecule to move through the distance $l$ with a velocity $\bar{u}$. Hence:

$$x = \frac{T}{N^{\frac{1}{3}}} = t.$$

Hence $\frac{N \bar{u}\, t}{2l}$ is the number of molecules in contact with the plane at any instant. It has been tacitly assumed in the above proof that the duration of an impact is insignificant when compared with the time of the free path of any molecule.

If with Waterston we suppose that the impacts between the molecules and the plane occur when the plane has acquired a certain downward velocity, then there must be an interval of time between the impacts, during which no molecules are in contact with it. In this case if $t$ equal *half* the time of impact and $(v + g\,t)$ the velocity of the molecule and $-\left(\frac{v}{n} + g\,t\right)$ that of the plane at impact—the mass of the plane being $n$ times as great as that of the molecule—then from the action of gravity and pressure the velocities of both plane and molecule will be zero at the end of time $t$, and after another interval $t$ the plane and molecule will separate with the same velocities with which they impinged, but, of course, with opposite signs.

Now let T be the interval from the end of one impact to the beginning of the next; during which time there are no molecules in contact with the plane. This interval of time must equal the time required by gravity to destroy and reproduce the velocity $\left(\frac{v}{n} - g\,t\right)$ of the plane. Hence

$$T = \frac{2\left(\frac{v}{n} - g\,t\right)}{g} = \frac{2\,v}{g\,n} - 2\,t \quad . \quad . \quad . \quad . \quad (1)$$

Now the value of T depends upon the velocity of the impinging molecule, and by making $v$ very great, $n$ being constant, and reducing proportionately the number of molecules T may be made as great as we like. But in this problem we require its minimum value only which can be shown to be equal to $2\,t$.

For if a succession of molecules at time intervals of $2t$ apart impinge against a plane in the manner described, it is obvious that by choosing a suitable velocity for the molecules the plane can be kept in statical equilibrium. In this case, $2\,t$ is the time of impact, and $T = 2t$. the interval from the end of one impact to the beginning of the next. If now a change is made and T becomes less than $2\,t$, then either the molecules must be closer together than before or their velocity must be increased; in either case the statical equilibrium of the plane would be disturbed, and the plane would rise to a higher level. On the other hand, if T is made greater than $2\,t$, which can only be effected by either increasing the distances between the molecules or decreasing their velocity, then the plane will fall. Then since T can be neither greater nor less than $2\,t$, it must be equal to $2\,t$. Substituting this value of $2\,t$ in equation (1) we get

$$T = \frac{v}{g\,n} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

and the number of impacts per unit of time will be

$$\frac{g\,n}{v} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Waterston gives $\frac{2\,v}{g\,n}$ as the interval between the impacts, but in obtaining this value he has omitted to take into consideration the effect of gravity on the plane during the time of impact. That is he considers each impact to be an absolutely instantaneous phenomenon, which is a physical impossibility. And here I should like to take the opportunity of correcting an error contained in my letter of April last on this subject, regarding the *vis viva* required to raise a plane of mass $n$ to a height of $\frac{2\,w^2}{g\,n^2}$. The amount required should be $\frac{4\,w^2}{n}$, as given by Lord Rayleigh in his note to page 19 of Waterston's paper, and not $\frac{2\,w^2}{n}$ as stated by me.

But the proof given for the former value is inadmissible as the action of gravity during the time of impact of the molecule with the plane is omitted. The simplest method of finding the expenditure of *vis viva* under the given conditions is as follows. The *vis viva* expended in lifting a body through a given distance in the same as the body would acquire in falling from rest through the same distance. Here $\frac{2\,w^2}{g\,n^2}$ is the height and $n$ the mass of the body, hence the *vis viva* acquired in falling will be

$$n \times \left(\sqrt{2\,g \times \frac{2\,w^2}{g\,n^2}}\right)^2 = \frac{4\,w^2}{n}.$$

The above correction does not however affect the result given by Waterston for the ratio of the *vis viva* expended in the act of increasing the volume of a gas with the increment of the *vis viva* required to support the increased volume. For—Waterston, page 22—the increment of *vis viva* required to support an increase of volume equal to $\frac{2\,w^2}{g\,n^2}$ is—

$$\Delta^3\,v^2 \times \frac{2\,w^2}{g\,n^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where $\Delta^3$ is the density and $v$ is the velocity of the mean square without regard to direction; $w$ is the velocity resolved normal to the plane and $n$ is the mass of the plane, the mass of the molecule being taken as unity. To find the value of $g\,n$ in the above expression we have from (3) the number of impacts in unit of time $= \frac{g\,n}{w}$. Also the impacts in unit of time is given by the expression $\frac{1}{2}\,\Delta^3 w$—Waterston, page 21. Hence

$$\frac{g\,n}{w} = \tfrac{1}{2}\,\Delta^3\,w,$$

$$\text{or } g\,n = \tfrac{1}{2}\,\Delta^3\,w^2 = \tfrac{1}{6}\,\Delta^3\,v^2.$$

Substituting this value of $g\,n$ in (4) and remembering that $w^2 = \frac{1}{3}\,v^2$, the increment becomes $\frac{4\,v^2}{n}$. But $\frac{4w^2}{n} = \frac{4\,v^2}{3\,n}$ is the *vis viva* expended in increasing the volume by $\frac{2\,w^2}{g\,n}$. Hence the ratio of this to $\frac{4\,v^2}{n}$, the *vis viva* required to support the increased volume, is manifestly $\frac{1}{3}$, and it follows from this that the amount of *vis viva* required to produce an increment of molecular *vis viva* in the two cases of constant pressure and constant volume is in the ratio of 4 : 3.

C. E. BASEVI.

8, Norfolk-square, W., July 19.h.

## *re* ENTROPY, MODERN HEAT, ETC.

SIR,—Dr. Lodge and others of your contributors have, in the writer's humble opinion, laboured to invest this matter of entropy with much unnecessary obscurity. As a matter of fact, a perfectly sufficient treatise on the theory of thermodynamics may be written without introducing the term entropy or its congeners at all. The thermal condition of a body is defined by the volume, temperature, and pressure of a given quantity of it. If any one of these quantities be given, a relation subsists between the remaining two, which, for practical engineering purposes, depends simply on certain constants determinable with more or less accuracy experimentally.

Now, the entropy (*sic*) of a body is simply the expression of a relation between any two of the three quantities—pressure, volume, and temperature.

If such of your readers who feel any confusion of ideas, due to the introduction of the term entropy, &c., will contrive to forget all that Dr. Lodge has written with reference to it, and take the above simple view of the matter, the writer thinks they will be benefited. Whatever view they may take they will have finally, for practical purposes, to come back to the fundamental and readily measurable quantities—temperature, volume, and pressure.

HENRY CHERRY.

Putney, S.W. July 25th.

## TO ADVERTISERS.

SIR,—On opening my ENGINEER of 20th inst. I was pleased to learn that I was not alone in complaining against the indifference of advertisers, and to find that others consider the present system of advertising most uncharitable and reprehensible.

"Another of the Applicants" remarks very justly on the matter of testimonials. For myself, I have a decided aversion to mine being spread broadcast, not knowing into whose hands they fall; and under the present system we cannot know, for if they be returned it is generally without note or comment, and we remain in ignorance of their destination beyond the post-mark on the wrapper. I hold it is better never to send testimonials until specially asked to do so, and in no case to send stamped envelopes for reply.

There is another system fast gaining ground, and which to my mind is more to be deprecated than the indifference of which we complain—that is, the demand for a stated number of recent testimonials. If a man possess testimonials of one, two, or three years ago, they ought to be considered sufficient. It is not to be expected that an applicant can, without a feeling of being and appearing troublesome, importune his late employers for testimonials for a specific appointment, when perhaps the applicant already holds one or more from the said employers. To a man with any sense of decorum such a thing is most distasteful. Again, in the majority of cases testimonials are asked for, yet the applicant is likely to be told in the course of a personal interview, if he be fortunate enough to obtain one, "Your testimonials are very good, but really we don't attach much importance to testimonials." To what, then, is importance attached? Let some habitual advertiser enlighten us. Under the existing system, draughtsmen are the greatest sufferers. Why? Is it because they are as plentiful as blackberries, or more so, that they can be looked over so indifferently? When I mentioned draughtsmen in my former letter, I meant draughtsmen, whose cause I voice—and not draughtsmen (?), otherwise fledglings of the Board or local schools of art, but staid men with experience matured by years of practical work.

In my younger days—and I am not by any means an old man yet—draughtsmen and works managers were deferred to as superior beings, and treated accordingly. Alas! now-a-days the draughtsman is looked upon as a necessary evil, and I fear that in many cases the works manager is not always regarded as a valuable adjunct to an establishment. At any rate, events which have come under my experience go far to prove conclusively what I state.

To return to the point; all that we ask is that our communications be acknowledged, if not individually, then collectively. The suggestions contained in my previous letter, if adopted, will answer our purpose very well, and will involve neither trouble nor expense to the *bonâ fide* advertiser.

In conclusion, I fail to see the necessity of advertisers occupying from four to eight weeks or more in selecting a candidate for any appointment. A week or ten days should be ample in the case of a draughtsman, and a fortnight or three weeks for a works manager. The manager can take care of himself—a handful of days may be neither here nor there to him, but to the draughtsman the case is different. The stipend accorded to him even in good times is not conducive to grandiose pecuniosity, and when he is unfortunately thrown out of gear, the purse is not always in that plethoric condition that he can afford to "hang about," Micawber like, waiting for something to turn up. Trusting that my suggestions may in one way or another be adopted by those who have any sympathy at all for the applicants, I am,

Newcastle-upon-Tyne, July 24th. ONE OF THE APPLICANTS.

## IRON PLOUGHS IN MADRAS.

SIR,—I enclose a letter from the Deputy Director of Agriculture, Madras, on the subject of iron ploughs. It seems a pity that Sweden should get the benefit of this trade. What are our English manufacturers about that they do not compete with their Swedish brethren in British markets?

HENRY BEAUCHAMP,
Editor *Madras Mail*.

Madras, July 4th.

Gentlemen,—I have the honour to draw your attention to the fact that during the past season there has sprung up a very brisk demand for heavy iron ploughs all around Bellary, and that the demand that existed could not be met at the time. This has led certain local dealers to order considerable numbers of ploughs from Sweden, where the manufacturers grant very liberal discount on all considerable orders. That the demand during the next season, which may be expected to open about November next, will be considerable there is every reason to believe. I have myself heard of orders for as many as 140 large ploughs being placed within the last few days, and from what I gathered at Bellary many more orders will very soon be registered there. At present the bulk of these orders are being placed in Sweden, and considering the excellence of the ploughs supplied, and the prices at which they can, in consequence of the very liberal discount given, be supplied, this is only natural. It therefore appears to me that if the manufacturers of Madras desire to obtain a share of this business, their prices must be such as will compete with those for imported articles. I am able to give, for your information, the subjoined figures, based on an actually invoiced lot of ploughs now lying in Bellary, which will enable you to judge at what rates the favourite patterns could be profitably laid down there, after allowing a reasonable profit in the transaction:—

| | Ofverum's Buck Plough. | | | |
|---|---|---|---|---|
| Particulars. | No. 1 | N. 2 | No. 16 | |
| Initial cost in Sweden .. .. .. | 26 75 | 33 5 | 41 5 | Shillings net |
| Packing and freight to Madras at 12·5 per cent.. .. .. .. .. | 3 35 | 4·2 | 5·2 | „ |
| | 30·1 | 37 7 | 46 7 | |
| Duty 5 per cent. .. .. .. .. | 1·5 | 1·9 | 2 3 | „ |
| Approximate cost ex-ship at Madras .. .. .. .. .. .. | 31·6 | 39 6 | 49·0 | „ |
| = to Rs. at 1s. 1d. per Re. .. .. | 29 2 | 36·5 | 45·3 | Rupees |
| Landing and forwarding to Bellary at 9 per cent. .. .. .. | 2·6 | 3·2 | 4·1 | „ |
| Net cost at Bellary.. .. .. .. | 31 8 | 39 7 | 49 4 | |
| Add for interest pending realisation, fitting, &c , 10 per cent.. | 3 2 | 4·0 | 4·9 | „ |
| Gross price Bellary Rs... .. .. | 35 0 | 43·7 | 54·3 | |

All except the last item are rates based on an actual set of transactions, the percentages for freight and packing, and for landing and forwarding being slightly in excess of the actuals in the case referred to.

The prices at present asked by the only holder of the ploughs in Bellary are far in excess of the rates given above, but the ryots, knowing they have four or five months before them in which to make arrangements for importing what they require, are in several cases combining to send orders to Sweden at their own risk through commission agents, who are agreeing to work for a very small fixed commission on each plough imported, by which plan, unless exchange falls heavily, they will obtain those ploughs probably at lower rates than those I give above.

## A VOLUNTEER FLEET.

SIR,—I have noticed some correspondence in your paper respecting a "Volunteer Fleet," and your correspondents do not appear to be aware that there was in existence for several years a corps of "Royal Naval Artillery Volunteers," with brigades at London, Brighton, Hastings, Portsmouth, Plymouth, Bristol, Swansea, Liverpool, Glasgow, Hull, Yarmouth, and other ports. The training was hard, consisting of heavy gun, rifle, cutlass, and pistol practice, rowing, sail drill, knotting and splicing, and a certain amount of seamanship was taught, while the officers had to pass severe examinations.

Drills and tuition were frequent all the year round, and a fortnight's training in one of Her Majesty's gunboats formed part of the annual curriculum. Both officers and men threw themselves heart and soul into the training necessary to gain a thorough knowledge of the duties performed in the service, and that a high state of efficiency was attained was amply testified to by successive admirals of Naval Reserve.

But in spite of this the Government, for some reasons best known to themselves, disbanded the corps about two years ago, in spite of the protests of the very efficient members at that time enrolled. That a corps of this character, composed of men with a knowledge of the coast and of sailing, would be very useful in time of war, especially in the present under-manned condition of the navy, is a fact upon which there can scarcely be two opinions, but as long as it is the policy of successive Governments to discourage and hinder all volunteer movements, and to throw cold water on all schemes of volunteer defence, I very much doubt whether young men will be found to devote the time and energy necessary to efficiency in a somewhat arduous branch of Her Majesty's service.

ERNEST WHITE.

Wolverhampton, 19th July.

SIR,—With no adequate naval reserve of able seamen, and no considerable number of British sailors in our ports without employment, it seems to me that the present conditions are a national scandal, which at any time may become a national peril.

I should like to know how many aliens are now employed in her Majesty's Navy. The education of a man, to become capable of serving on a British warship, cannot be imparted in a day, or even in a month.

If Mr. J. C. Merryweather, who started this correspondence in the influential columns of THE ENGINEER, has any remedy worked out in detail, it is incumbent upon him, as a patriotic business man, to lay the same before your readers.

F. A. DINHAM.

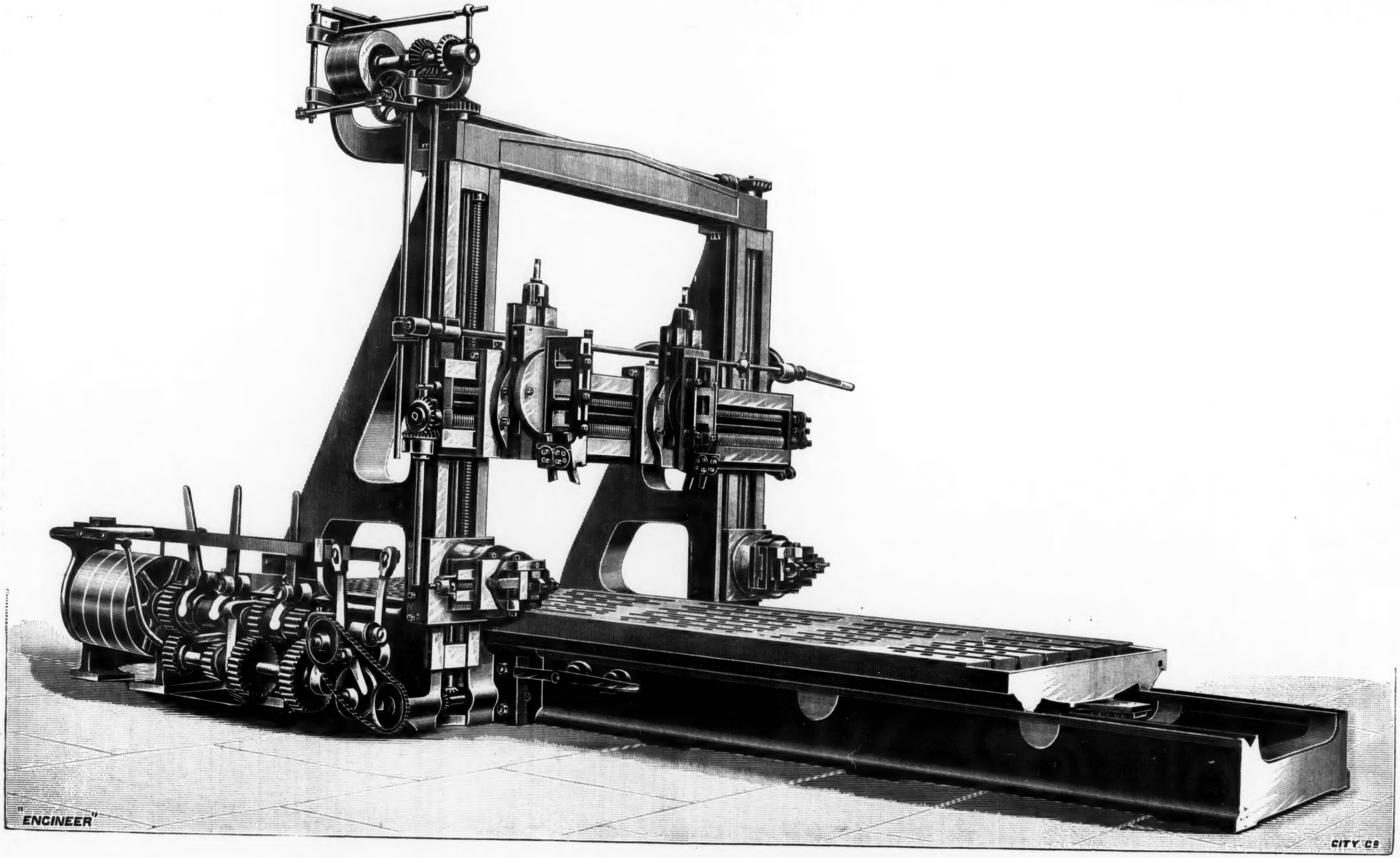
141, Mount View-road, Crouch Hill, N., July 24th.

IT appears from the annual report of the Comptroller of Patents that in 1893 applications were made for more than 25,000 patents, 19,400 designs, and 8675 trade marks.

# DOUBLE CUTTER AND TRANSVERSE ACTION PLANING MACHINE

MESSRS. JOSHUA BUCKTON AND CO., LEEDS, ENGINEERS

*(For description see page 76)*



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND Co., 5, *Unter den Linden.*
VIENNA.—GEROLD AND Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85,
*Duane-street.*

## CONTENTS.

THE ENGINEER, July 27th, 1894.

THE INSTITUTION OF NAVAL ARCHITECTS. (Illustrated.) .. .. .. 73
PLANING MACHINES. (Illustrated.) .. .. .. .. .. .. .. .. .. .. 76
BOILER EXPLOSIONS .. .. .. .. .. .. .. .. .. .. .. .. .. 76
RAILWAY MATTERS .. .. .. .. .. .. .. .. .. .. .. .. .. 77
MISCELLANEA .. .. .. .. .. .. .. .. .. .. .. .. .. .. 77
NOTES AND MEMORANDA .. .. .. .. .. .. .. .. .. .. .. .. 77
65-TON OVERHEAD TRAVELLING CRANE. (Illustrated.) .. .. .. .. 78
A DOMESTIC TIDE INDICATOR. (Illustrated.) .. .. .. .. .. .. 78
HIGH-SPEED VERTICAL ENGINES. (Illustrated.) .. .. .. .. .. .. 78
THE INFLUENCE OF CIRCULATION ON EVAPORATIVE EFFICIENCY OF WATER-TUBE BOILERS. (Illustrated.) .. .. .. .. .. .. .. 80
LETTERS TO THE EDITOR—Adams' Bridge Reef—Thermometric Measurements .. .. .. .. .. .. .. .. .. .. .. .. 80
The Kinetic Theory of Gases—*Re* Entropy, Modern Heat, &c.—To Advertisers—Iron Ploughs in Madras—A Volunteer Fleet .. 81
DOUBLE-CUTTER AND TRANSVERSE ACTION PLANING MACHINE .. .. 82
LEADING ARTICLES—Utilisation of the Nile—The County of London 83
The Manchester and Sheffield Railway Extension—The Situation in the Coalfield—International Inland Navigation Congress—Engineering Contracts for Australia .. .. .. .. .. .. .. 84
LITERATURE .. .. .. .. .. .. .. .. .. .. .. .. .. .. 84
THE ANTWERP EXHIBITION .. .. .. .. .. .. .. .. .. .. .. 85
LAUNCH OF H.M.S ECLIPSE .. .. .. .. .. .. .. .. .. .. .. 85
THE "PETIT JOURNAL" ROAD CARRIAGE COMPETITION. (Illustrated.) 86
WEALTH STATISTICS .. .. .. .. .. .. .. .. .. .. .. .. .. 88
THE NEW SOUTH AFRICAN STEAMER NORMAN. (Illustrated.) .. .. 89
A COMBINED AMMETER AND VOLTMETER. (Illustrated.) .. .. .. 89
THE CARDIFF ELECTRIC LIGHT WORKS.. .. .. .. .. .. .. .. 89
AMERICAN ENGINEERING NEWS .. .. .. .. .. .. .. .. .. .. 90
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. .. .. .. .. .. .. .. .. .. .. 90
The Sheffield District—The North of England .. .. .. .. .. 91
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. .. 92
AMERICAN NOTES .. .. .. .. .. .. .. .. .. .. .. .. .. 93
LAUNCHES AND TRIAL TRIPS .. .. .. .. .. .. .. .. .. .. 93
THE PATENT JOURNAL .. .. .. .. .. .. .. .. .. .. .. .. 93
SELECTED AMERICAN PATENTS .. .. .. .. .. .. .. .. .. .. 94

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

### CAST IRON FOR GRINDING MILL PLATES.

(*To the Editor of The Engineer.*)

SIR,—Can any reader inform me the name of the brand or brands of pig iron which, when cast into grinding mill plates, will give a thoroughly hard surface? I have tried several mixtures and can get them quite hard in the low places, but the ridges, which should be hardest, always seem to be softer than the body of the casting.

J. B.

July 24th.

### RURAL WATER SUPPLY PLANT.

(*To the Editor of The Engineer.*)

SIR,—In working out a scheme to provide a very small agricultural village with a common pump for the supply of good drinking water, the only practicable position for the storage system is 500 yards away—where the water is found—and 20ft. below the level of village street, where the pump is wanted. Would an ordinary suction pump, with a small galvanised iron pipe to the cistern, draw the water the 500 yards, and at the same time lift it the 20ft. required, without being too hard work for the villagers to fill their pails? If so, what type of pump would be most reliable and what size suction pipe would it require?

This village has any amount of water too hard for drinking, and at present has to collect rain water for this purpose, while the only alternative source to that suggested would be a deep boring, which it could not afford to pay for. Advice on this would greatly oblige

July 21st. RURAL SANITARY INSPECTOR.

### SUBSCRIPTIONS.

THE ENGINEER *can be Kad, oy order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

THIN PAPER COPIES—
*Half-yearly* .. .. .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. .. .. £1 16s. 0d.
THICK PAPER COPIES—
*Half-yearly* .. .. .. .. .. .. .. .. .. .. £1 0s. 8d.
*Yearly* .. .. .. .. .. .. .. .. .. .. .. £2 0s. 6d.

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

## MEETINGS NEXT WEEK.

THE JUNIOR ENGINEERING SOCIETY.—Saturday, July 28th Visit the Windsor and Eton Waterworks and the Windsor Gasworks. Train leaves Waterloo at 9.38 a.m.

LIVERPOOL ENGINEERING SOCIETY.—Friday and Saturday, August 3rd and 4th. Excursion to the Oswestry and Filter Beds, Masonry Dam and Tower at Lake Vyrnwy, by the kind permission of the Water Engineer of Liverpool, Mr. Joseph Parry, M. Inst. C.E.

NEWCASTLE-UPON-TYNE ASSOCIATION OF STUDENTS OF THE INSTITUTION OF CIVIL ENGINEERS.—Friday, August 3rd, by invitation of Mr. C. A. Harrison, M.I.C.E., President of the Association. Visit to the widenings of the North-Eastern Railway between Pelaw and Felling, and also between Central Station and Manors.

# THE ENGINEER.

*JULY 27, 1894.*

## THE UTILISATION OF THE NILE.

WE learn that the International Technical Commission appointed by the Egyptian Government to advise on the proposals for the utilisation of the Nile has brought its labours to a close, and its report, after three months' investigation, is now in the hands of the Government. We had hoped that the publication of this report would ere this have enabled us to deal with the subject at first hand; but as we have already indicated, delay seems to be the inevitable result of this appeal to a commission, and we must await a still further revelation before we are in a position to proceed with our examination of the details of such project as may be selected by the Government.

In a recent article in the *Nineteenth Century* on "Nile Reservoirs and Philæ," Sir Benjamin Baker, the British Commissioner, draws aside, partially, the curtain of official reticence, and from him we learn authoritatively that the Commission has not been quite unanimous in its verdict. The whole of the Commissioners, it turns out, were unanimous in rejecting the Waddy Rayan project, and in recommending the construction of a reservoir in the Valley of the Nile itself, but here the unanimity ceased. The majority of the Commission were convinced that it would be practically impossible to place the dam elsewhere than at the head of the Assowan Cataract below Philæ, but to this the French Commissioner could not agree, and he continued his objections to the whole of the proposals.

He thought that European engineers and contractors should be invited to study the Nile reservoir question, and submit competitive designs for the work; but the majority of the Commission were satisfied that this proceeding would only be useful if delay were the object, as the question had been exhaustively considered by the engineers of the Egyptian Government for four years. And moreover, the members of the Commission having exceptional advantages for obtaining information, and after going over the whole of the ground, were themselves unable to suggest any reasonable alternative.

The French Commissioners made, it is true, certain suggestions as to alternative schemes; but in the end approximate estimates showed that, even if practicable, the cost of the cheapest of their alternatives would be millions more than that of the Philæ dam. Neither could his colleagues nor the Government engineer accept the type of dam proposed by him, which was an open dam, or *barrage-mobile*, made up of isolated narrow piers, 16ft. apart and 80ft. high. Truly a weak and card-house style of construction, open to easy destruction by convulsions of nature, enemies, or revolutionists; and under which, considering that it was to uphold 3000 million of tons of water, it would be scarcely fair to ask the people of a country to live. Despite the fact that the question of the temples was not referred to the Commission at all, the French members rejected the Philæ site *in toto* on the sole ground of their presence; and we are inclined to read between the lines a political bias as influencing his objection more than any archæological conservatism.

Sir Benjamin Baker notes with satisfaction that their French colleague did not base his objections to the Philæ scheme on engineering grounds, and sees in his disagreement the advantage which the more inquisitorial criticism of a talented dissentient would bring with it, inasmuch as his opposition to the scheme would tend to make his scrutiny more thorough and searching. In consequence the Egyptian Government is complimented on the more complete attainment of their aim in having an ample and unbiassed examination of the entire question, with a view to the more complete elicitation of the whole truth; and the triumphant result announced, that no engineering or financial blot has been discovered in the project of their engineers for the dam at Philæ.

As regards details of construction, however, several modifications of designs were required by the British and Italian Commissioners with a view to increased security, and these were accepted without reserve as improvements on the original designs. The openings through the dam for the discharge of the Nile floods, which may reach the enormous quantity of half-a-million cubic feet per second, have been reduced in size, and correspondingly increased in number, so that the force and mass of the issuing water may be more distributed. These openings are to be lined with cast iron 1½in. thick, so that no stone can be torn out and the work destroyed piecemeal by the water at a high velocity. The width of base of the dam, moreover, is to be increased, so that the pressure on the masonry will be less, and the factor of safety greater than on any existing structure of the kind, thus doubling the security of the structure at a cost of about £400,000, or about 25 per cent. of the original estimate. On these points we shall have some remarks to make when in possession of details, which may be expected with the report of the Commission. Meanwhile, with our present information, we concur in thinking that a dam must be built at Philæ, and that with the least possible delay, as in the event of the occurrence of one or two "bad Niles," and the heavy consequent loss of summer crops, the moral responsibility of the advisers of delay will be beyond dispute, and it might be better, as the English Commissioner puts it, that the stones of Philæ Temple should be broken up for concrete than that Egypt should be involved in financial ruin, so long as his countrymen have a leading voice in the management of its affairs.

Very little light is thrown on the proposal for raising the level of the temple, which seems to have been Sir Benjamin Baker's own idea. He writes:—"As regards the Philæ Temple, the matter stands thus: The Under-Secretary of State and the Commissioners have stated, in no equivocal terms, their appreciation of the importance of the question. The British Commissioner has personally examined the ruins, and is in possession of plans showing every detail. He is of opinion that the solidity of their construction, the absence of windows, and the solid rock foundation, render it far easier to raise these temples bodily than any of the buildings he has seen so dealt with in America. The well-drilled garrison at Assowan would be delighted to work the elevating screws with military precision, and no doubt can be entertained as to the success of the operation. Half the wonder and admiration excited by the monumental works of ancient Egypt arises from the magnitude of the masses handled and transported by the Old Egyptians, rather than from their artistic merit. From the archæological point of view, the condition of the temples when raised would be unchanged, as every stone would remain as originally laid by the builders, and as shown on every drawing and photograph. From the artistic point of view the appearance would be enhanced, because the temples would rise out of a wide, placid lake, whereas when now visited by tourists, the Nile is low, the stream insignificant, and the Philæ island appears to stand in a hollow."

In this matter the writer, we fear, claims too much. We think—no doubt with others—that too much may be made of the archæological and artistic value of the Philæ temples; but we fear that the removal would cause sentimental as well as physical injury to the buildings, that raising them would be more costly than is expected, and that when so raised they would lose their artistic value for several months of the year, when the lake was drained off to meet the agricultural requirements of the country. We still hold to the idea, and shall do so till it is proved practically untenable, of isolating the site of the temples by a series of subsidiary dams, thus obtaining the most suitable site for the reservoir while preserving the archæological remains intact.

On the other hand, it should be noted that the signatories to a recently-published letter to the Earl of Kimberley assign to this part of the subject an importance which they are loth to attach to the great and humane problem, the solution of which it was the object of the Commission to achieve. The world will respect and attach value to the expression of opinion of the representatives of art and of literature and dilletanti science; but it will also assign a place to the recommendations of those who would in the best way accomplish a work which the amelioration of millions demands. These recommendations are made by men who, with knowledge of the country and of the requirements, and who have expressed deliberate opinions as to means of providing for them, opinions which are backed by the responsibility which a man accepts when in saying a task is a possible and necessary one, he virtually undertakes it.

## THE COUNTY OF LONDON.

THE work done by the London County Council, and what London has to pay for it, has just formed the subject of an elaborate address delivered by the present chairman of the Council, Sir John Hutton. Professedly a review of the year ending last March, the chairman's address nevertheless travelled over the five years, and more, during which the County Council has been in existence. Dealing in the first instance with the year just past, it was shown that the gross debt for which the Council has to account exceeds £33,000,000, a sum which is about equal to the entire rateable value of what is called the "county," a term including the City as well as the wider area lying outside it. The word "metropolis" is sometimes employed in a popular sense as meaning all London. At other times it is understood to be London minus the City. The term "county" is convenient as covering both areas, only it happens that the City is a county of itself. Perhaps "London" is the most convenient phrase, and we find it generally employed by Sir John Hutton, though the official headquarters at Spring Gardens bear the appellation of the "County Hall," and everything must needs be in harmony with that designation. After realising the fact that the gross debt of the county is very nearly equal to its rateable value, there is the further consideration that while the rateable value is growing, so also is the debt. The net amount of this encumbrance is under £19,000,000; but this itself is an increase of £1,200,000 in the space of five years. When the budget of the Council was brought up last April, the chairman of the Finance Committee, Mr. Evan Spicer, stated that the expenditure of the Council was bound to grow year by year. Only let the incidence of taxation be changed, and then various improvements and schemes, now "looming in the distance," and involving large expenditure, will be carried out. What then will be the debt, and what the rate, nobody seems prepared to say.

It will be observed that throughout his address Sir John Hutton speaks of a rate of 13d. in the pound. That is true for the year which ended on March 31st, but the rate which London now bears is one of 14½d. The rate of last year, at 13d., was itself an advance of a halfpenny on the year before. The Council is spending at the rate of £3,000,000 per annum, of which one-half arises out of the debt, and it is only fair to observe that half a million goes in the shape of grants to Boards of Guardians. Exchequer contributions come in aid of revenue, the sum raised by rates last year being thus made £1,783,000. The last rate levied by the Metropolitan Board was 10d. in the pound, or 3d. less than the impost of last year, and more than 4d. under that of the current year. But the Council is every way bigger than the late Board. It is adding house to house to accommodate its continually increasing number of officials, and there are seventeen hundred workmen in its employ, with all the appropriate accompaniments of buildings and plant. Thousands a-year are spent in rent, and the only remedy for this, which Sir J. Hutton describes as "wilful waste," is the erection of a huge municipal palace to house all the central officials under one roof. Let the waterworks be transferred to the County Council, and the tramways, with possibly the

Thames Conservancy, and not one palace but two or three may be wanted. But the Council would like to have the police, and they even propose to go into the pawnbroking business. The "Universal Provider" is a Lilliputian compared with these giants of the municipality. There is nothing they are not prepared to undertake, and that on the largest scale. Already the duties of the Council are so multifarious that we only wonder how all the work is done, even with the aid of 444 officials, permanent or temporary, in and about Spring-gardens, besides others elsewhere. We are less surprised at the money that is spent, for that is a comparatively easy process. Establishment charges exceed £107,000 per annum, and the "services" take £666,000 in the year.

But can all this last, and whither is London going? We do not say there is nothing to show for the money. It is true the County Council did not construct the main drainage, nor the Victoria Embankment, nor the Holborn Viaduct, nor the Tower Bridge. Sir J. Hutton says that five years of the Council's work and policy have "left their mark upon London." We should say that nowhere was this more conspicuous than in the rate-book. Still, there is something to be seen elsewhere. The Council has a squadron of sludge ships on the Thames, discharging some 40,000 tons of residuum per week in the deeps beyond the Nore. The river is unquestionably improved, but this would have been the case had the Council never come into existence, for the plans which have proved so successful in purifying the Thames were initiated by the Metropolitan Board years ago, though that body was stupid enough to half decry its own work. In the matter of parks and open spaces, the Council has done well, and deserves commendation. It promises something in the shape of bridges by-and-bye. The subaqueous tunnel at Blackwall is described as making "fairly satisfactory progress." The reconstruction of Vauxhall Bridge is to be included in the Council's Improvement Bill next year. Lambeth Bridge is to come afterwards, and perhaps will tumble down in the meantime. But in regard to many metropolitan improvements, the Council is holding its hand, until "betterment" is granted, and until the basis of taxation is altered. The Fire Brigade has been strengthened, but the Committee having charge of that department have thought it prudent "to deal cautiously" with the comprehensive report suggesting additional protection from fire in London generally, involving a capital expenditure of £100,000, and an ultimate increase of £30,000 per annum for maintenance. It was always the unfortunate policy of the Metropolitan Board to starve the Fire Brigade. It is to be hoped that the Council will eschew so dangerous a policy. There has been an immense improvement in the Brigade, but it seems sometimes as if the force was scarcely equal to such a contingency as may possibly arise. A powerful Fire Brigade is essential to the very existence of London.

We cannot pretend to go over all the topics comprehended in the work of the London County Council. How such a body can ask for more to do, is only explicable on the ground that the request is for work that will "pay," as in the case of the water supply and the tramways. We can also conceive that the acquisition of power has charms for the Council, so that to multiply the legions in its employ feeds a kind of municipal ambition. The parks and open spaces require a staff of 700, and the present strength of the Fire Brigade is 846. If the Council on some particular day were to muster all its forces in Hyde Park, and have a species of review, the spectators would probably be astonished—and might entertain a feeling of thankfulness that the County Council rate was no higher than it is. That it is destined to be still higher seems inevitable, unless the elections next year should bring about some change in the policy that is pursued.

### THE MANCHESTER AND SHEFFIELD RAILWAY EXTENSION.

THE Manchester, Sheffield, and Lincolnshire Railway is one of the most interesting of the British lines at the present time, because it has in view the construction of the greatest extent of main line, and also because it has before it the early completion of that undertaking, which will be of vast importance to several systems of railway. It has already expended some £32,154,774 on its lines and works, and it has before it the expenditure of £11,646,714, of which the London extension claims the larger proportion. Even in the present year it is the official estimate that £500,000 will need to be expended on that great line, so that it is evident that the rate of expenditure after the contracts are let must be rapid. Last half-year the total capital expenditure of the Manchester and Sheffield Company was £226,954, after allowing for the receipts of a sum that had been invested in the Hull Docks, which have passed into the possession of the North-Eastern Railway. Of the amount just named, there was expended £89,050 on lines and works open for traffic; and the further sum of £17,252 was spent on working stock—most of the latter being for additional locomotives; whilst in subscriptions to other railways such as the Cheshire lines, in which the company is interested, £65,681 net was expended; the remainder of the capital expenditure being on docks and allied special items, chiefly in the Grimsby district. As the total estimated expenditure for the current half-year is £845,000—including, of course, the large amount on the London extension, it is evident that there will be for the Manchester and Sheffield a large current capital expenditure for some time to come. But its income of late has been an increasing one, the past half-year showing a total increase for the parent line, apart from its joint lines, of £67,579. The half year now entered on should show even better results, because it will contrast with the worst known in railway history. But at the same time there has been of late rather a rapid increase in the expenditure. The Manchester and Sheffield has now before it the making of the extension on which so much of its future depends. There is no doubt that it will in the meantime derive benefit from the extension it has made into the Nottinghamshire and Chesterfield district, whilst the vast expenditure that will be made on its London extension should give it some revenue in the course of construction. But there is no doubt that it will need the full development of the resources of the company to enable it to complete that great line to the Metropolitan Railway, though any revival of trade such as some expect will lighten the load, and will help forward the completion of that great link in the chain of communication between Lancashire and Lincolnshire, and the metropolis.

### THE SITUATION IN THE COALFIELD.

PERHAPS the best thing that can be said about the arrangement made in the coalfield is that it seems to please neither party. An agreement, which affords both parties ground to grumble, gives evidence that it is not one-sided. This also suggests a rough kind of equity in its main points, and affords, therefore, some promise of permanency. It is no secret that the coalowners were gravely divided upon the crucial question as what is known as the "living wage." This has been the point upon which Mr. Pickard and the other miners' leaders have persistently and consistently insisted during and since the prolonged strike of last autumn. It was the point which the employers said could not be conceded, and no doubt the arrangement is in the nature of an experiment, an experiment about which a very influential number of the coalowners are very dubious. The employers' representatives on the Conciliation Board urge that the principle is only to be recognised for two years, but many hold with Mr. Bidder, Q.C., that "a principle recognised for ten minutes is a recognised principle," and that conceded now it can never be withdrawn. It is further contended that the conditions of colliery working vary so much in different coalfields, and even in parts of the same coalfield, that one coalowner may work profitably where another cannot make a profit at all. Since the arrangement was come to, leading coalowners, both in Yorkshire and Derbyshire, have been saying severe things about it. They all, however, admit that the surety of two years' peace is worth some sacrifice, and make up their minds to give the arrangement a fair trial. On the other side the men are not at all enthusiastic. They object *in toto* to the 10 per cent. reduction, which may be taken as Mr. Pickard's sweetening of "a living wage Bill" for the employers. It is not surprising that the men should take this attitude. They have been taught to shout no reduction against every demand made for the reopening of the wages question, and now when they are told that the first step towards obtaining quiet work and the recognition of a minimum wage is a reduction of 10 per cent. from what they are now receiving, they openly express dissatisfaction and discontent. At the same time they admit the importance of the agreement, particularly in regard to the minimum rate of wages being taken at so high a level as has been arranged. On the whole, there is little reason to doubt that the agreement will be loyally tried on both sides. The manufacturing and general public are glad of any agreement which puts strife beyond doubt for two years, and if at the end of that time some method to continue amicable relations in the coalfield cannot be devised, the result will augur little for the good feeling entertained between capital and labour in this great industry.

### INTERNATIONAL INLAND NAVIGATION CONGRESS.

THE Sixth Congress was opened at the Hague on Monday, the 23rd of July, and will continue during the week. Excursions have been arranged for visiting Rotterdam and the Hook of Holland; Amsterdam and the new dock at the entrance to the Canal at Ymuiden; to Lake Haarlem; to the new docks at the mouth of the Meuse and the Wahal; to the Zuyder Zee and the Island of Wit and to Zwalle. On Sunday the members of the Congress were received by the Committee of Organisation at the Botanic Gardens; on Monday a reception was given by the Minister of the Waterstaat; and on Thursday an official dinner is to take place at Schevingen. The English Section is represented by Sir Edwin Jenkinson and Mr. Philip Stanhope, M.P., who appear officially; by Mr. Vernon Harcourt; Mr. W. H. Wheeler; Mr. L. B. Wells; Mr. Hunter, of the Manchester Ship Canal; Mr. Wake and others, numbering about 25. America will have 200 members, who have all come over as representing the Institution of American Engineers. There are 150 French names on the list; 250 German; 40 Russian; and in smaller numbers Italians, Austrians, &c., making a total of about 700. The papers which have been sent in to be read include: "Taxes and Tolls on Canals in Belgium," by M. A. Dufourny; "Tides and Navigable Waterways in France," by M. Renaud; "Taxes on Canals," by A. K. Dura; "Organisation of Traction on Canals," by M. A. De Breviet; "The Port of Amsterdam," by T. A. Schuurman;" "The Port of Rotterdam," by C. T. de Tough; "The Equipment of the Interior Ports of Navigation," by M. Monet and M. Dardenne; "Means of Preventing Stoppages by Ice," by A. A. Bekaar and T. Nelemans; and Reports on the same subject by M. Camére and P. Rigaux; "Traction and Propulsion on Canals and Canalised Rivers," by M. B. de Mas and T. Hirsch; "The Cataracts of the Dnieper," by M. V. E. Timunoff. Abstracts of these papers will be given in a future number.

### ENGINEERING CONTRACTS FOR AUSTRALIA.

BRIDGE work and other constructive engineers doing a colonial business are much affected by a new clause just inserted in the regulation of Government contracts with South Australia. It is to the effect that no delivery will be acknowledged without the certificate in writing of the engineer-in-chief that the materials have been delivered in proper condition, and the fact that they have been approved by the consulting engineer in England is not, in the future, to be considered as evidence. Nor is it to be accepted as implying that any particular quantity of work has been executed. Indeed, the Government now enact that "it shall not in any way relieve the contractor from any of his liabilities under the terms of contract." This involves an entirely new departure in colonial contracting. Hitherto, any bridge or other engineering work ordered for the South Australian and other Governments have been tested and passed by the Government inspector at the makers' works in England or elsewhere. Now, however, all this is to be changed, and acceptance is to depend upon inspection at the other end. Why the necessity should have arisen for this serious alteration of policy it is difficult to see. Certain it is that the new regulation will be very irksome to contractors, and must in the long run cause the Government of South Australia to have to pay in the future a higher price for its engineering requirements. The matter is of the more importance since railway extension is just now the order of the day in certain of the Australian colonies outside South Australia, and some of the other Governments may follow the example of South Australia. Representations should be made to the Government at Adelaide by English engineers, with a view to inducing them to reconsider the position.

## LITERATURE.

*The Twenty-third Annual Report of the Railroad and Warehouse Commission of Illinois.* H. W. Rokker, State Printer and Binder, Springfield, Illinois. 1894.

THIS Report for 1893 is now published in book form, and can be obtained free on application to the publisher. Though naturally confined mainly to matters of local interest, it nevertheless brings to light certain facts with regard to American railroads and railroad practice which are worth reproducing.

The permanent-way equipment of English roads has very properly been taken by the Commissioners as a standard wherewith to compare those of Illinois. Referring to the importance of the block system and double tracks, the Report says:—"Our views in regard to the importance of safety devices of this character are substantiated by comparative statistics, which show that about five and a-half times as many people are killed in this country as in England, and the reason, in our judgment, is this: In England, 57 per cent. of the roads are double tracks, while in this country the proportion is only 5·5 per cent. In England, nearly 90 per cent. of the railroad mileage is protected by block systems, while only 5 per cent. is so protected in this country; but on the mileage in this country protected by block systems, the percentage of accidents is quite as low as in England." The State of Illinois has 10,427 miles of road in operation, of which only 400 miles are equipped with "block signaling devices which are especially constructed;" but a considerable percentage of the total mileage is protected by "block systems operated by means of telegraph train order signals," which will probably remain in use for some time to come—until, as the report says, "the traffic conditions warrant and demand special devices for train protection."

In 1893, 9,300,000 more passengers were carried over Illinois roads than during the previous year, and the total number of fatalities and injuries shows an increase; but relative to the number carried there is a decrease. This must be considered a creditable showing, when the enormous difficulties of dealing with the World's Fair traffic are considered. The fatalities and injuries to employés show a considerable increase, however; thus in 1892 for every 305 employés there was one death, and one injury for every 38; in 1893 one death occurred for every 292 employés, and one injury for every 27.

A very primitive conditions of affairs still obtains on a few of the roads, even in a comparatively densely-populated State like Illinois. For instance, the road of the Indiana, Illinois Southern, is, say the consulting engineers of the Commission, laid with cross rails, 35 lb. to the yard, of various lengths up to 30ft., "and much worn, shivered, and bent." The fish-plates were originally 21in. long, but many of them have been broken in service till they are only 3in. long. At this length "they are connected by a bolt inserted between the rail ends, and the nut tightened." The road is used largely for coal transport, and it is not surprising to learn that the derailments of gondola cars, having a load capacity of 30 tons, are frequent, even though the schedule is only 8½ miles an hour. The schedule for passenger trains was 15 miles an hour, but for both freight and passenger service the Commission have ordered a 25 per cent. reduction. Finally, the usual form of station building is old box car bodies.

In this report interesting data of the cost of hauling passengers and freight on the various lines is given. The average cost of carrying one passenger one mile, in cents, is 2·386; on the Grand Tower Cape Girardeau Railroad this cost reaches no less than 5·302, whilst on the Lake Shore, Michigan Southern it is reduced to 1·028. The average cost of carrying one ton of freight one mile, in cents, is ·68,291. On the Indiana and Illinois Southern, referred to before, to do this costs 2·337 cents, whilst one ton can be hauled a mile on the Lake Erie and Western for ·336 cents.

*The Zambesi Basin and Nyassaland.* By DANIEL J. RANKIN, F.R.S.G.S., M.R.A.S. With Maps and Illustrations. William Blackwood and Sons, Edinburgh and London.

THIS book consists of descriptions of expeditions made by the author at various times in those regions of Africa expressed by the terms Zambesi Basin and Nyassaland. The opening chapters are devoted to an account of an expedition joined by Mr. Rankin at the request of Captain Foot, who, having been appointed first British Consul for Central Africa, started from Quillimane in October, 1883, with the intention of reaching Lake Nyassa. How and why the party failed to get there is very graphically described, and Mr. Rankin's pages give a very clear idea of the dangers to be faced and the difficulties to be overcome by the pioneers of a new colony through the hostility of the natives, as well as from the obstacles presented by the natural features of the country. In later expeditions these drawbacks, incidental to all early colonisers, were complicated by the hostile attitude assumed towards the British by the Portuguese—an attitude which threatened to take on such formidable proportions that at one time it seemed probable that the expedition would have to be abandoned, owing to the forcible detention of its leaders. This was four years ago, however, and Mr. Rankin is able now to report a much more satisfactory state of feeling. He is, moreover, very much impressed with the advantages offered by the Zambesi Basin as a field for emigration, which may, he thinks, with great usefulness be directed thither. He points out that nothing tends so effectually and rapidly to develope the commerce and civilisation of new countries—always assuming them to be possessed of latent resources—as cheap water-carriage; and a glance at the map given in this work shows what a limitless horizon is open to the future of Central Africa on this account. With comparatively few miles of road, there exists a good water-way, reaching through Lakes Nyassa, Tanganyika, and Nyanza, and on through the Nile from Chinde to Alexandria—a natural feature the importance of which can scarcely be over-estimated in any scheme for opening-up the country. At a time like the present, when everything South African is invested with unusual interest, and when Africa, according to many, is the El Dorado of the future, all works on the subject are likely to be received with respectful attention; and Mr. Rankin's book should form no exception to the rule. His long residence in the country, his keen observation and wide experience of both natives and settlers, qualify him to pronounce with authority on many points in dispute, as well as to correct some of the errors which exist in the minds of those to whom *Central* Africa, at any rate, is still little more than a name.

## THE ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

ALL British exhibits in the Machinery Hall which were in working order at the end of May were described in THE ENGINEER of June 1st. Several others are now ready, and as some of them are attracting a good deal of attention, it will be well to mention them before pointing out novelties in machinery of Belgian or German make.

The Linotype, though it is extensively used in England, seems quite unknown here, and many English visitors will probably see it at work in Antwerp for the first time. Though originally invented twenty years ago, the makers have continued to introduce small changes and additions; and they say that the machine now exhibited is able, owing to recent improvements, to do thirty per cent. more work than the one which was illustrated in THE ENGINEER a few years since. Its main features are the same, and it may be described as a type-setting, type-casting, and type-distributing machine. The operator sits in front of a key-board, like that of a type-writer, but larger. Above the key-board is a case containing matrices of all the letters or characters used. Each matrix is a small flat plate of brass, having the letter which is to be cast in a groove at the side, whilst the upper end has a series of teeth cut in it, like the key of a lever lock. Spare matrix-magazines can be inserted when it is desired to work different sizes of type with the same machine. By depressing one of the finger-keys the operator causes the corresponding matrix to slide down from the magazine and assume an upright position on an assembling block to his left. A separate box contains wedge-shaped distance pieces, which are brought into position by a bar, like the spacing-bar of a type-writer. Any length of line up to 5½in. can be produced. The operator can see the matrices as they come into position, and when the line is ready the distance pieces are pressed up, so as to ensure equal spacing, and the whole is then turned towards a mould wheel, behind which is a melting pot containing a special type metal, consisting of a mixture of lead, tin, and antimony, with a small amount of bismuth. The mould, on arriving opposite a slot leading to the melting-pot, is automatically locked, the pressure of a lever forces a plunger into the melting-pot, causing enough metal to pass through the groove to cast the line. The metal in the pot is kept fluid by three Bunsen gas burners, consuming ten feet per hour. The cast line, automatically pared by knives to an exact length and thickness, is again brought where it can be seen by the compositor, who has meanwhile been setting the matrices for the next line, and the spacing pieces return to their own box, whilst the matrices are first lifted vertically to the top of the magazine, and then pass along a steel bar, fitted with ribs or wards, in which the teeth at the top of each matrix enter. As these differ in each letter or character they are only released when over the mouth leading to their proper place in the magazine.

By a recent modification the knives can be set to cut the lines slightly narrower at the bottom than at the edge which bears the type, thereby enabling the Linotypes to be used for circular printing machines. As much as 16,000 ens per hour have been turned out by one machine, but the usual rate is 8000 to 11,000. The machine, in working order, weighs about 17 cwt., and can be driven by a quarter horse-power, though half horse-power is recommended. The advantages of being able to keep matter in type, and of remelting the metal directly it is no longer required, are obvious; and also the fact that when the same line is required a number of times it can be recast without being reset. Several leading London and provincial papers printed by this process form part of the exhibit. The exhibitors say that they have 450 men engaged solely on the manufacture of these machines. Adjoining the stand of the Linotype Company is that of the Steel Forging and Ball Bearing Company, of Chancery-lane and Wandsworth. The products of this company are a combination of three inventions: the manufacture of the balls, their hardening, and their application. The balls are made by a vertical rolling machine, the one shown at Antwerp being from the manufactory of Sir J. Whitworth and Co. It can be used not only for balls but for fish bolts, taper pins, plugs and similar articles. Dies, to the form of the articles required, are set by gauge an exact distance apart, and a reciprocating motion is given to them by means of racks, the length of whose travel can be regulated as required: then with three or four strokes up and down the ball, pin, or other object is rolled, with a smooth, shining surface, and exact to gauge. When balls are being made, the machine can produce a hundred a minute. The sizes most generally used are ¼in. to ⅜in. diameter, and the makers guarantee for these an accuracy of one ten-thousandth of an inch.

The hardening of the balls and other articles is not shown at the Exhibition, but the company state that it consists firstly in a special converting or carburising furnace, in which objects made of soft, tough, Bessemer steel, or even of iron, can be converted into a hard steel, high in carbon, and suitable for cutting tools. Those parts which are to be left soft are simply painted over with a preparation. By this means the piece can be more readily brought to its required shape before hardening, and this need only take place on the surface, or on part of the surface, leaving the non-wearing parts, and the whole of the interior soft, and consequently tough. The second part of the hardening process consists in a double bath, in which the object under treatment is first plunged into brine, and then direct into oil, without coming in contact with the air. The dies for rolling the balls, &c., are prepared in this way; and the exhibitors show files and other objects which have been made of iron or soft steel, and hardened in this manner.

The third invention of this company is the method of arranging the balls which form the bearing. In ordinary bearings of this description the balls frequently run in grooves, thus causing a tendency to jam. Even when flat surfaces are used, the same balls are required to take both radial and end-thrust pressure, when the vehicle, be it tram car or bicycle, is going round a curve. This must necessarily cause a grinding action, cut the bearing surface, and render the balls no longer spherical. In the bearings shown the balls are arranged in cages, which keeps them in place; small cages, with openings at the sides, being provided to take the lateral thrust. For tram cars, instead of large balls, rows of four or five ⅜in. balls are used for the vertical pressure. One of these bearings, which has run 16,000 miles in Philadelphia, forms part of this exhibit, and does not show any signs of wear. A small model to illustrate the working of cable cars is also shown.

Messrs. Smith and Coventry, of Manchester, have a large display of machine tools, the most conspicuous being a horizontal and vertical milling machine. This instrument has a table 10ft. long by 3ft. 6in. wide, and a bed 15ft. long. The milling cutter is 6in. diameter by 12in. wide. The machine exhibited was ordered by a German firm, and similar, but with 18ft. bed, are now being made for the Cie. Industrielle Electrique, and for Messrs. Siemens Bros., of Greenwich.

Another heavy machine is a 5ft. radial drill. The one shown is fitted with a clutch motion, reversing on the spindle, so that it can be used for tapping.

The boring and turning mill is a strong and well-designed tool. The object to be turned is bolted to a revolving table 4ft. 6in. in diameter, driven by very powerful gearing. There are two cutters, with independent feed, each driven by friction wheels, and a quadrant on either side to set the angle of the tool.

They also exhibit a very handy tool, called "Quince's six-spindle drill." This has six drill arms set round a central disc, so that each may contain a different sized drill or tap; and any one may be brought into use by simply turning the disc. This machine is especially intended for small works, such as electrical appliances, bicycle fittings, &c.

A 9in. capstan-lathe for turning and chasing bolts, &c., is a very powerful machine. Five tools are set round the capstan, and by revolving this any one can be brought into position. The same firm show several other lathes, a key-seater, and a good deal of smaller machinery, including a duplex brass-finishing or cock-turning lathe. This machine consists of two complete and independent lathes on one bed, and it is so arranged that plugs and barrels of brass cocks or taps may simultaneously be turned and bored to any desired taper, so as to ensure accurate fitting. Pressed steel axle-boxes, made by the Steel Railway Journal Box Company, Limited, of Manchester, are also exhibited on this stand, and seem capable of standing any amount of hard usage.

Messrs. Tangyes Limited do not make a very large display; they only show two gas engines. They are both on the Otto principle, Pinkney's patent. The larger one is a 30 horse power nominal, 73 actual; the smaller 3-horse power nominal and 6 actual. Both are self-starting. The smaller one is driving a Siemens dynamo, but the larger one is not doing any work. Both are supplied with "antipulsators." These take the place of the gas bags which are generally used with gas engines, and are a much neater arrangement. A diaphragm of india-rubber is stretched over a cast iron pan, which is then placed with the india-rubber side towards the wall. The connections are made in the same way as with a gas bag.

Tilghman's sand-blast apparatus is another British exhibit which is a good deal noticed. An improved form of the original invention, adapted for cleaning castings, was recently described and illustrated in THE ENGINEER; but those shown here are only being used for engraving on glass.

The Central Cyclone Company shows a disintegrator and a pulveriser, both at work. The disintegrator beats the substance to be treated through steel screens, so that the fineness of the product is regulated by the size of the mesh. In the pulveriser the beaters grind and throw up the material fed into the hopper of the machine, when all that has been reduced to powder is drawn up by an exhauster into a bin or collector. Particles which have not been ground fine are too heavy to be drawn up, so fall back for further treatment.

The Hardy Patent Pick Company, of Sheffield, shows the well-known "Devil" disintegrator, which took first prize at the Royal Agricultural Show at Plymouth in 1890. They also exhibit their new "Multiple Grinder." This is a series of four drums, each 2½in. wide, and with internal diameters varying from 10in. to 18in. These drums are in one casing, and each is provided with four beaters, the same shaft running through the whole machine. The material to be ground first enters the smallest chamber, and is gradually driven into the second, third and fourth. As the speed of the beaters increases with the diameter, hard pieces which are not pulverised in the first chamber are ground with increased force in each successive one.

Another exhibit of the same company is the "Magnetic Separator," a machine for removing iron or steel from grain, bones, coal, or any other substance. It consists of a wrought iron cylinder 4ft. long set at an angle slightly out of the horizontal. Twelve magnets placed round the circumference are connected with a dynamo, the connection being intercepted when they arrive at the top of the machine. A tray, supported from the outside, passes through the cylinder near the top. As every piece would have to pass 120 times over the magnets, it is impossible that any should escape; in fact it is found that all iron is usually intercepted within 8in. of the upper end of the machine. The magnets are sufficiently powerful to hold pieces weighing up to 18 lb. The dynamo requires 1½-horse power, and ¼-horse power is needed to revolve the cylinder.

The Hardy Pick Company also exhibits picks and shovels of various descriptions, and some boring machines for coal.

Messrs. Copley, Turner, and Co., Limited, of Middlesbrough, show one of their Harris Feed Water Filters, and a bottle with grease and other impurities extracted by it from the feed-water of the Cunard steamer Campania. They also exhibit a series of pile-shoes, all made of chilled cast iron, with wrought iron straps cast in. These vary in weight from 11 lb. to 99 lb., the larger ones being 21½in. long by 4in. wide; the point is wedge-shaped, and tapers towards one end. This shoe is very well designed for keeping the joints of sheet piling close.

Both in the British and the general machine gallery there are still a few exhibits which are not quite ready. Though the authorities had refused to receive anything more after the end of May, it is perhaps as well that they have not adhered strictly to this rule, for one interesting German machine, a decided novelty, only arrived in the building this month. I propose to send you particulars of this and other German machinery exhibits next week.

## LAUNCH OF H.M.S. ECLIPSE.

THE first vessel of the new naval programme, H M.S. Eclipse—one out of nine cruisers of the second class, three of which are building in the Government dockyards, and the remainder in private establishments—was successfully launched at Portsmouth on the 19th instant. It is just seven months since her first keel-plate was laid.

As a material improvement, in many respects, upon the Astræa type, a few remarks may be made upon her construction. She is wholly of steel, with the exception of the stern-post, rudder frame, and ram-shaped stem, which, as is usually the case, are strong phosphor bronze castings. The framing is a combination of the bracket and transverse systems throughout the length of the double bottom, but before and abaft it, and above the protective deck, the frames are formed of "Z" bars, with intermediate angle frames worked between them above the protective deck. The double bottom extends for a length of about 152ft., and is well subdivided into water-tight compartments, but the water-tight flats to magazines and shell-rooms practically extend the double bottom well towards the ends of the ship. A strongly built protective deck, whose maximum thickness is 2½in., extending throughout the whole length, affords protection to the vital parts, such as magazines, shell-rooms, and machinery, the cylinders of the latter being further protected from shell fire by a sloping Harvey-armoured coaming. The armoured deck is shaped like that of the Vulcan, with a curve so deep as to extend down far over the sides, thus protecting a vertical streak of some 6ft. or 7ft. in width. The angle which this amoured deck makes with the side plating is about 45 deg., hence the 2½in. plates with which it is covered present a horizontal thickness of 3½in. of steel to the fire of the enemy. Thus the difference in displacement between the 5600 tons of the Eclipse and the 4360 tons of the Astræa—viz., 1240 tons—is not only distributed over the longer and broader hull, but has given an extra thickness of nearly ¾in. diagonally through the steel armour—a very important consideration indeed. The French cruisers of corresponding type have a protective deck of about 2⅜in.

The Eclipse has a balanced rudder, which can be actuated by hand power below the protective deck, and by steam power from the bridge, conning tower, and steam steering engine compartment. The steam steering gear is sufficiently powerful to put the helm over from hard-a-port to hard-a-starboard and *vice versâ*, or through a total angle of 70 deg., in thirty seconds, when the vessel is proceeding at full speed of 19¼ knots, with a pressure in the steam pipes not exceeding 100 lb., and the engines exhausting into the atmosphere.

The conning tower is built of 6in. nickel steel armour, the top plate being 1in. thick; the upper part will be fitted with hinged covers all round for sighting purposes. The after shelter deck and forecastle will be connected by a fore-and-aft bridge. Two steel masts with wooden pole topmasts will be fitted, but only slight sail power will be provided.

The engines, which are under construction in the yard, will be of the triple expansion type, designed to develope 9600 and 8000 indicated horse-power, with and without forced draught respectively. In each of the two boiler rooms, four single-ended cylindrical boilers will be placed, any one of which may be used independently of the other, with steam up to 155 lb. 1000 tons of coal can be carried.

The dimensions, &c., are as follows:—Length, 350ft.; beam, 53ft. 6in.; draught, forward, 19ft. 6in; aft, 21ft. 6in.; displacement, when fully equipped, 5600 tons. She will be sheathed with teak, and coppered. Anticipated speed, 19·5 knots. The armament will consist of five 6in. quick-firing guns, and six 4·7in. quick-firing guns, which will be carried on the upper and forecastle decks, sponson ports being constructed so as to afford a better end-on fire than is obtainable in the Astræa class. The minor armament will contain eight 12-pounder quick-firing guns, one 3-pounder Hotchkiss, and four ·45in. Maxims. Three torpedo tubes will be fitted, and ten 18in. torpedoes will be carried. The total complement of officers and men will be 436.

THE railways between La Guaira and Caracas and Puerto Cabello and Valencia, Venezuela—in the hands of British companies—are in full activity; but the works on the Central Railway have been discontinued since the failure of Messrs. J. E. and M. Clarke and Co. Costly bridges have been carried away by the flooding of the rivers over which they were constructed, and the enterprise is reduced to plying between Caracas and Petare, a town twelve miles distant; but an agent has arrived at Caracas, with a view of coming to an arrangement with the Government for the resumption of the work. The German or Great Railway of Venezuela was inaugurated on 1st February last, and according to the British Consul at Caracas, this line will be a great boon to Caracas, Valencia, and the intermediate towns of El Consego, La Victoria, Turmero, and Maracay, as well as to at least half-a-dozen more towns of less importance.

# THE "PETIT JOURNAL" ROAD CARRIAGE COMPETITION.

(*By our Special Commissioner.*)

PARIS, Wednesday, 18th July.

IN my last letter I stated that lots would be drawn at the office of the *Petit Journal* to decide which carriages were to run upon each particular route. I will not trouble your readers with mere list of numbers, as possibly all the carriages may not arrive although entered.

The public exhibition of the vehicles took place on Wednesday, the 18th inst.,, and soon after noon crowds of people collected at the Rond-Point D'Inkermann, at Neuilly, making it difficult to approach the carriages. Twenty-six vehicles were present, differing greatly in size and form. The Daimler motor was very well represented by the two firms Panhard et Levassor and Les Fils de Peugeot Frères. My first impression as to the entire absence of smell of this motor when working has become considerably modified. The fact is, that in such a building as that used for testing the motor to which I previously referred, the air is still and the products of combustion, rising in a vertical pipe which terminates above the head of a person, escape upwards, but when the motor is placed in a carriage the smell of the exhaust is noticeable, and although while the vehicle is travelling it may not be noticed for long periods, still in mounting inclines it becomes at times very unpleasant, and this will occur more particularly if the lubrication of the motor is not carefully attended to. The most serious objection to the carriages fitted with these motors is the great vibration which takes place while the carriage is at rest. If the carriage is fully loaded the movement is not so noticeable, as the bearing springs are of course compressed, but if it is empty the vibration is excessive. In case of a stop of a few minutes, it is always preferable to stop the motor altogether, and to use the hand lever for starting it. If the jets under the platinum tubes are left on there is no difficulty at all about this.

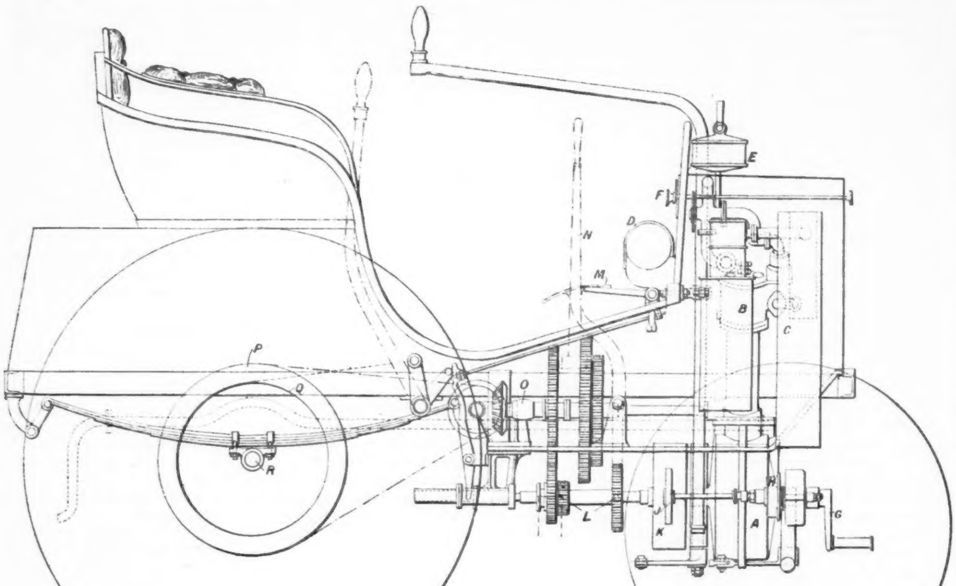


Fig. 1—MESSRS. PANHARD AND LEVASSOR'S CARRIAGE—GENERAL ARRANGEMENT

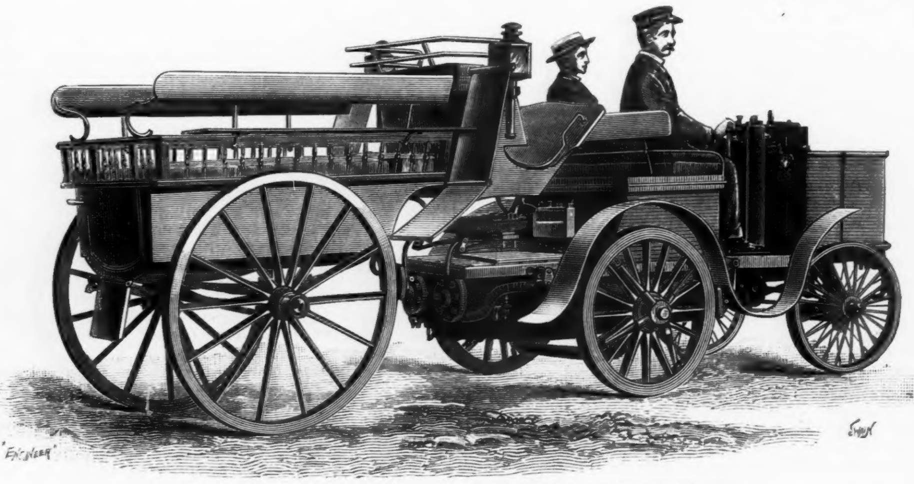


Fig. 4—DE DION, BOUTON AND CO.'S STEAM BOGIE CARRIAGE

The two cylinders are set so that their axes are both in the same vertical plane, and each axis makes an angle of about 15 deg., with a vertical line passing through the crank shaft. The motor is placed upright in the carriage, and the plane containing the axes of the cylinders is at right angles to the length of the carriage. The two trunk pistons drive on to one crank pin through connecting rods, and at full load there should be an explosion in each cylinder alternately; the result is that when the motor is running light and many explosions are missed, an excessive vibration is set up, owing to the fact that the pressures on the crank-pin cannot be balanced. I hope to illustrate the general arrangement of the motor and gear as applied to a carriage. The application of the motor to the carriage is practically the same by the two firms, Panhard et Levassor and Les Fils de Peugeot Frères, except that the former usually seem to prefer to place the motor in front of the vehicle, while the latter put it behind. In my opinion the rear position is decidedly the better, as the smell is more readily carried away from the passengers by the wind when the carriage is moving. But it is somewhat difficult with some types of carriage to obtain a proper balance of the parts, and this leads to slight differences in design. All the vehicles exhibited by Messrs. Peugeot had come along the roads a distance of 372 miles from Valentigney (Doubs) which is itself a proof of the practical utility of the Daimler motor, and also of the good construction of the vehicles.

By the kindness of Messrs. Panhard et Levassor, I am able to illustrate in Figs. 1 and 1A the general arrangement of the Daimler motor in a carriage; the particular vehicle happens to be for two persons only, but there are only slight changes in the application of the motor to other types. The motor A is entirely enclosed; the lower part is a cheese-shaped iron casing, from which branch the two cylinders. B is the carburator. C is the box into which the exhaust escapes, so as to deaden the noise. D is the gazoline reservoir. E is the vessel feeding the burners for heating the platinum tubes. F is the regulating cock. G is the handle for starting the engine. H is a centrifugal pump for the circulation of water. J is the pulley which drives the circulating pump. K is the special driving clutch, which forms the subject of a special patent. This is illustrated more clearly in Fig. 2. The shaft *c* carries one conical part *b*, covered with leather *a*, the part *b* is driven by *c*, but can slide on a feather, and is supported by spiral springs *d*. The other part *b'* is fixed on the shaft, and covered with leather *a'*. It will thus be seen that the surface *a* comes first into gear with the other half of the clutch, and afterwards the part *a'*. The wheels marked L are all made of gun-metal, and represent four different speeds at which the vehicle can be driven. Before altering the speed the pedal M is pressed down, and thus the gearing is brought to rest by means of the lever N; the speed is then altered. The upper shaft O drives through bevel wheels a chain wheel on each side of the vehicle, and this actuates the chain wheel P. The pulley Q is that upon which the brake acts so as not to damage the india-rubber tires. R is the axle which is provided with differential gear so that sharp curves can be turned. In Fig. 3 is given a sketch of the steering—*f f'* are the wheels, each wheel pivotted at *ee'* respectively; *b* is the steering lever moving the vertical shaft *a*, upon which is keyed the tee-shaped lever *c*; the joints *d d* are all Hooke's joints.

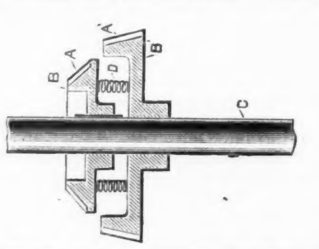


Fig. 2—PANHARD AND LEVASSOR'S FRICTION CLUTCH

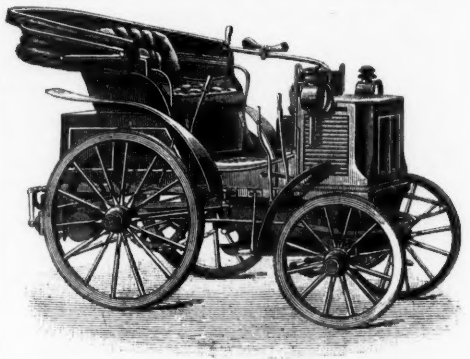


Fig. 1a—PANHARD AND LEVASSOR—TWO SEATS

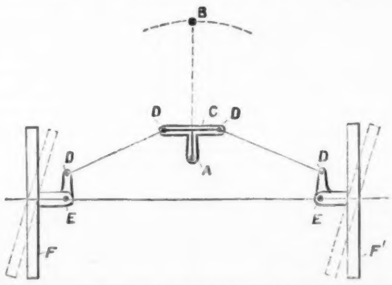


Fig. 3—PANHARD AND LEVASSOR'S STEERING GEAR

The speeds are usually regulated so that a maximum of 11 miles an hour can be obtained. With the lowest speed gear—3·5 miles per hour—it is stated that the carriages will ascend a gradient of 1 in 10 if the road is dry and in good condition. Ordinary gasoline, or essence of petroleum, is used with a specific gravity of 700 to 705. This can be bought almost anywhere in France. The main reservoir contains enough oil to run the carriage fifty miles, but there is a separate compartment in which a store may be kept so as to enable a journey of 186 miles to be accomplished without obtaining more oil. The water tank contains about 7½ gallons, which are used for circulation round the cylinders. This should be renewed every thirty miles. The tubular frame of the vehicle is used for this water supply. The cost of the gasoline is at present, in Paris, 12·8d. per gallon, petroleum being about 9d. per gallon.

The carriages to carry four persons are provided with motors of 3.5-horse power, and the consumption of such a motor with loaded carriage may be taken at 0·35 pint per mile, which is at the rate of about 0·56d. per mile. The consumption of gasoline is stated to be 1·14 pints per brake-horse power per hour. The total weight of the 3·5 brake-horse power motor and gearing is 440 lb., exclusive of oil, and the total weight of the carriage for two persons, as illustrated in Fig. 1A, in working order with motor, store of oil and water, is about 1300 lb., while a carriage for four persons, complete, will weigh from 1500 lb. to 1600 lb. The motor will run at speeds up to 800 revolutions per minute, and always in the same direction; but the carriage can be backed by changing the gearing. The two platinum tubes for causing the combustion cost 28s. each. The price of the carriage to seat two persons and fitted with hood is about £180, and to seat four persons, about £225. These are prices taken from the catalogue of Messrs. Panhard et Levassor.

The weather has been splendid, and at 7 a.m. on Thursday, the 19th inst., the competitors and spectators began to collect at the Porte Maillot, Neuilly, just outside Paris. The carriages which were to take part in the first day's trials arrived between this hour and 7.45 a.m., and they were arranged in single file at distances of about 50 yards apart. The whole of the course near the starting-point was lined with spectators, who were with difficulty kept in order by the police. Scores of bicyclists, both ladies and gentlemen, prepared to accompany the carriages. By reference to the map already published, the routes can easily be seen, and the following were the carriages which took part:—Route No. 1, Paris to Mantes, Nos. 3, 13, 21, 30. Route No. 2, Paris to Mantes, Nos. 10, 15, 28. Route No. 4, Paris to Rambouillet, Nos. 7, 18, 19, 42. Route No. 5, Paris to Corbeil, Nos. 4, 27, 29. Route No. 6, Paris to Précy-sur-Oise, Nos. 12, 14, 31.

By the invitation of M. Giffard, whose *nom-de-plume* is "Jean-sans-terre," I took a seat in carriage No. 4, that of Messieurs de Dion, Bouton and Co. The carriages were started at intervals of thirty seconds and I soon found that our progress was much more rapid than any of the others. The carriage is shown in Fig. 4, except that a Victoria was used instead of a wagonette, and it consists really of two parts, one a bogie with two axles and four wheels, which carries in the front a small vertical boiler, which is fed with coke from above into a central tube which communicates with the fire grate, and is closed above all round the boiler; the coke is stored in a chamber provided with hinged lids, the steam actuates a compound horizontal engine placed underneath the footboard of the bogie and partially behind the front seat; this will be seen from Fig. 4. The driving shaft passes through the hollow axle boxes of the wheels, and the latter are perfectly loose. Upon each end of the driving shaft is fixed a boss with four arms of wrought iron, and these drive against small stops securely fixed to the rim of the wheels. It will thus be seen that no stress is put upon the spokes of the wheels at all. A reservoir of water is provided also beneath the foot-board. All the controlling levers and brake are placed near the hand of a person sitting on the right side of the front seat. At the back of this bogie is a centre pin and cross springs suitable to accommodate the front lock of an ordinary carriage or coach, so that the same bogie is applicable to several carriages. The question might arise as to what is the proper definition of a self-moving carriage, and whether it is legitimate to include in this category a separate motor, but without stopping to define the exact requirements of a self-moving carriage, I will record the results.

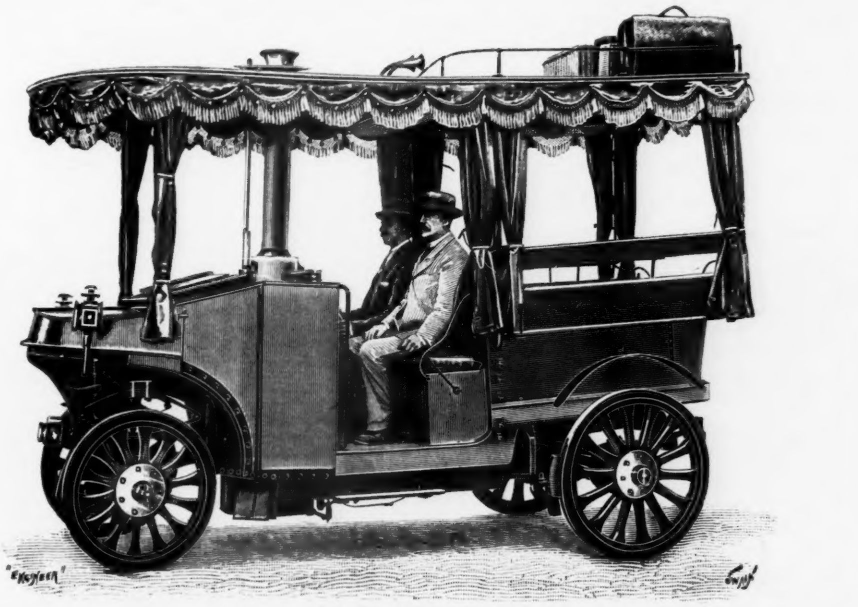


FIG. 6—SCOTTE'S STEAM CARRIAGE

We passed the Octroi of Suresnes at 8.35 a.m., and speedily overtook Nos. 7, 18, 19, and, in fact, we mounted the very severe inclines on this route without the least change of speed. The fore wheels of the bogie were covered with india-rubber about $\frac{5}{8}$in. thick, put on in separate pieces about 10in. long; while the back wheels were provided with the usual iron tires.

The steam pressure at starting was 163 lb. per square inch, and it never fell below about 140 lb. The weight of the bogie loaded is two tons, and this is said to be capable of drawing a load of 1·2 tons at a speed of 12·4 miles per hour up a gradient of 1 in 12·5. Sufficient coke is carried for a journey of sixty-two miles. and sufficient water for about twenty-five miles. It was stated that steam could be got up in fifteen minutes. The exhaust steam is carried away at the back by a tube under the bogie. This discharge is somewhat annoying to any persons coming immediately behind, and, of course, at starting there is always a considerable discharge of steam from the cylinder cocks. No chains are used for transmitting the power to the axles, as the driving shaft is connected to it by Hooke's joints. The engine is said to develope 20-horse power, and we travelled at a speed of twenty-one miles an hour very often. At Versailles we stopped ten minutes for water, and started again at 11·5 a m. At St. Geneviève des bois we made a second stop for water, and there saw a vehicle with a Daimler motor, which I was told had been used for three years by the commercial traveller to whom it belonged. This vehicle was taking no part in the competition, but it served to show that the petroleum carriage is a recognised conveyance in France. We reached the Place du Marché at Corbeil at 11.42 a.m., which, allowing for stops, made a journey of thirty-five miles in three hours. There were three persons in the carriage proper, which was a Victoria with the front wheels taken off, the Count de Dion and the driver were upon the seat of the bogie carriage. We arrived an hour before No. 27, and No. 29 reached Corbeil at 1.35 p.m., having been delayed by running into a bank at the side of the road; this caused it to be disqualified, as it arrived too late. The bogie of Messrs. de Dion et Bouton is very well suited for drawing goods wagons of moderate weight, but I fear that it is hardly suited for family use at all, as a skilled mechanic is absolutely essential. The distance of 35 miles was accomplished by No. 27, built by Messrs. Peugeot, in 4 hours 30 mins., including stops, this makes an average of at least eight miles per hour.

While waiting at Corbeil, before returning to Paris, I had, through the introduction of Mr. Lamy, of the *Petit Journal*, the opportunity of visiting the immense paper mills of Messrs. Darblay Père et Fils. These mills are said to be the largest in the world, and make wood-pulp paper only. The *Petit Journal* is supplied thence with its entire stock.

Looking now at the other routes; upon No. 1 all went well for about half a-mile, and then No. 21, a steam motor carriage belonging to Mr. Letar, broke down altogether. This carriage had a vertical boiler in the front, and the exhaust and steam was led away below; the engine was of the compound type, underneath the foot-board. Coke was used as fuel, and it was charged into the top of the boiler, as in the case of that of the Count de Dion. The top of the boiler was then closed by a tightly-fitting cover. The tires of the wheels were of solid india-rubber. The other vehicles went on to Ecquevilly without accident; but there No. 3, built by Messrs De Dion et Bouton, broke a connecting-rod; the engine was of the compound type, and similar to that of No. 4. The connecting-rod appears to have been of cast steel, and to have broken at a point where the metal was spongy.

On Route No 4, the steam motor No. 19, of Mr. Le Blant broke a slide-valve rod; but, after an hour's delay, this was put right in a temporary manner, and the carriage arrived at its destination.

On Route No. 6, the carriage No. 12, belonging to Mr. Tenting, broke down and could go no further.

The general result was, that out of seventeen starters thirteen remain in the list for the final, two steam engines and two petroleum motors having been disqualified.

On Friday, July 20th, only six carriages in all presented themselves at the Porte Maillot for the competition, although there were a number of private carriages of similar type there to see the start. The weather was magnificent, and but for the dust which rose in clouds all along the route, the journey would have been most enjoyable. The vehicles present were Nos. 44, 60, 61, 65, 64, 85, and in order to simplify the conditions, as there were so few competitors, it was decided to reduce the number of routes to two. Nos. 61 and 85 were sent off to Corbeil, and the rest to Mantes. There is very little for me to note here, as the whole of the vehicles arrived within the specified time, and were therefore all eligible for the final heat. Although it was at first decided that on Saturday no carriages should run at all, this rule was changed to allow seven vehicles to have a chance of competing, and the route was changed to enable the vehicles to get back to Paris early. Only two carriages presented themselves on Saturday morning, these being No. 24, Mr. Vacheron, petroleum motor, and No. 53, Mr. de Bourmont, also a petroleum motor. Both these ran over the course specified, and were admitted to the final test.

---

PARIS, Monday, 23rd July.

Sunday was a very busy day for all concerned in the competition, for the final heat was to be run. I feel that I am hardly justified in speaking of it as a heat, for the competition is in no sense a race, and no notice will be taken of speeds exceeding $7\frac{3}{4}$ miles per hour.

On Sunday morning, at 7 a.m., I presented myself at the Porte Maillot, and at 7.45 a.m. I found that the whole of the twenty-one vehicles still in the competition had arrived. "Jean-sans-terre" and his assistants very kindly set themselves to work again to find places for the engineers who were acting in a consultative capacity, and by 8 a.m. every one was seated. The trembling of the carriages fitted with petroleum motors ceased, and the procession proceeded between rows of people down the Avenue de Neuilly.

Several of the vehicles still in the list, Nos. 18, 19, and 44, were provided with Serpollet boilers, and Nos. 18 and 19 were both very heavy vehicles. No. 18 was entered by Mr. Archedeacon, of the Avenue Wagram, Paris, and was an omnibus bearing the description Société de Transport de la Guadeloupe, Service de la pointe-à-pitre au Moule, and No. 19 was a large parcel delivery van, built by Messrs. Chastel and David, and belonging to "La Belle Jardinière," a large general store; the latter had a steam engine of the Le Blant type, with three cylinders all working at the same pressure, and the whole car weighed $3\frac{1}{2}$ tons. The motor was stated to be able to develope 10-horse power; the width of the van was 7ft. $4\frac{1}{2}$in.; and the wheels were actuated by link chains of the Galle type. The Serpollet boiler was fed with briquette fuel, and the smoke produced was at times excessive.

At 8 a.m. I took my seat in No. 13, a carriage for four persons, two being seated looking forward, and the other two with their backs to the former. The vehicle was built by Messrs. Panhard et Levassor and Mr. Panhard, jun., was driving. In travelling along the road in a carriage going somewhat more rapidly than several of the others, I had a good opportunity of noting the movements of the springs and of the guiding apparatus. I shall give details in a future article of some of the methods of steering. That of Messrs. Peugeot appeared to work exceedingly well, and while allowing a very easy motion did not seem to be affected by the passage of the wheels over small stones. Both Messrs. Panhard et Levassor, and Messrs. Peugeot use a radial lever for steering, and it seems to act perfectly for these light carriages. No. 24, a petroleum motor belonging to Mr. Vacheron, was provided with a steering wheel instead of a lever, but this did not appear to me to be so satisfactory. The lead was taken throughout by No. 4, the carriage in which I went to Corbeil on Thursday last, and so far as could be seen all went well until we reached Nanterre at 8.40 a m., where we found that No. 44, belonging to Mr. de Prandiéres, had broken its driving axle close to the wheel, and was, therefore, useless. This particular portion of the road is very bad, consisting of uneven paving sets for some distance. After this we reached the incline of St. Germain, of 1 in 12, and the steepest on the whole route. This ascent was made slowly, but without accident. All the petroleum motors used the slowest gear of the four with which they are provided.

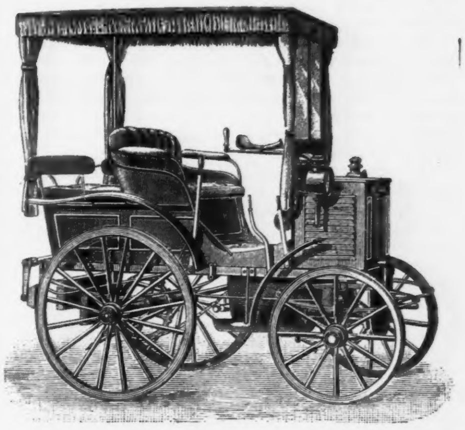


Fig. 5—PANHARD & LEVASSOR'S CARRIAGE-FOUR SEATS

At the end of the wood of St. Germain a stop was made to allow a change of places to be made.

No. 4 crossed Mantes Bridge at 11 o'clock. At 11·03 a.m. No. 65 arrived, belonging to Messrs. Peugeot, and after that No. 15 of Messrs. Panhard and Levassor, within ten minutes afterwards Nos. 28, 64, 30, 14, and 10 arrived. All but Nos. 4 and 10 being fitted with Daimler motors. Between 11.30 and 11.45, Nos. 13, 24, 27, 18, 53, and 42 arrived. At noon No. 60, at 12·05 No. 85, and at 12.15 No. 31. All within the time allowed—noon—except two. The vehicles were put up in the yards of several hotels, and luncheon was taken, and meanwhile No. 61 arrived at 12.30 p.m., No. 7 at 12 44, and No. 19 at 1.16 p.m.

Mantes was left at 1.30 p.m. by almost all the carriages, and the journey proceeded through a number of small villages to Vernon. Along the whole of the road from Paris groups of people were stationed, who offered bouquets and fruit to the persons in the vehicles; and it appeared that entire schools in many cases had been brought out to see the sight. An examination of the route will show how steep the hills are in many places. In most of the villages the principal streets are paved with large sets, which it is necessary to travel over at a moderate pace, but the rest of the road is macadam. Almost the entire distance was in splendid condition, and for miles as smooth as possible; this is accounted for by the fact that the "routes nationales" are under the direct charge of the State, and are looked after by engineers of the Department of the Ponts et Chaussées. At Mantes I had changed my carriage, and taken a seat in No. 64, Fig. 5, and we reached Vernon at 2.40 p.m., leaving again at 2.45 p.m.

Before reaching Pont de l'Arche we came to a piece of road which was under repair, the whole width was covered with flints which had not been rolled. The carriages had some difficulty in passing over this portion, and the result was that some of the india-rubber tires were badly cut. Our driver had brought rather too small a quantity of lubricating oil, and before we could buy more the motor was beginning to heat. As soon as this occurred of course a smell could be noticed, which was not observable at all while the lubrication had been good. The brake upon the driving wheels pressed direct upon the india-rubber in No. 64, and in other cases also. This, I think, is not a good arrangement with wheels of this class, and the separate disc brake with strap, used upon some other carriages built by Messrs. Peugeot appears preferable. India-rubber tires must be a somewhat heavy item in the repair bill, if work is done over the roughly-paved streets of country towns, or down the steep inclines with the brake on.

No. 4 mistook the route and mounted a very steep hill, and in turning to descend again, went into a potato field, and aid had to be obtained to get it on to the road again. For some distance before reaching the centre of Rouen, the route was decorated with flags, and after mounting an incline as steep as that at St. Germain, the carriages reached the Champ de Mars in the following order. The limit of time for arrival was specified as 8 p.m.:—

| No. | | |
|---|---|---|
| No. 4. | de Dion, 4 persons, steam ... ... ... ... | 5.40 p.m. |
| 65. | Peugeot, 4 persons, petroleum ... ... ... | 5.45 ,, |
| 28. | ,, 4 ,, ,, ... ... ... | 5 50 ,, |
| 13. | Panhard et Levassor, 4 persons, petroleum | 6.03 ,, |
| 31. | Peugeot, 5 persons, petroleum ... ... ... | 6.07 ,, |
| 42. | Le Brun, 4 persons, petroleum... ... ... | 6.24 ,, |
| 15. | Panhard et Levassor, 2 persons, petroleum | 6 30 ,, |
| 64. | ,, ,, 4 persons, petroleum | 6.49 ,, |
| 53. | de Bourmont, 4 persons, petroleum... ... | 7.01 ,, |
| 30. | Peugeot, 3 persons, petroleum... ... ... | 7.02 ,, |
| 24. | Vacheron, 2 persons, petroleum... ... ... | 7 03 ,, |
| 27. | Peugeot, 2 persons, petroleum ... ... .. | 7.05 ,, |
| 14. | Panhard et Levassor, 4 persons, petroleum | 7.10 ,, |
| 85. | Roger, 4 persons, petroleum ... ... ... | 8 09 ,, |
| 60. | Le Blant, 8 persons, steam... ... ... ... | 8 50 ,, |

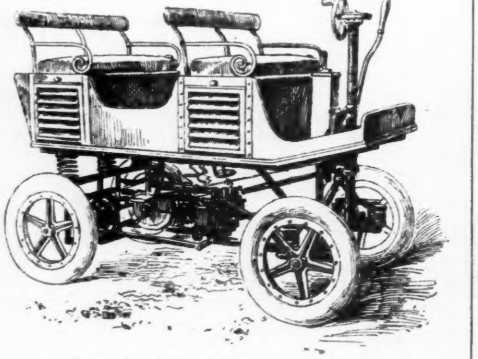
It is somewhat instructive to note that only one carriage out of the thirteen which arrived before 8 p.m. was driven by steam; all the others being petroleum motors, mostly of the Daimler type.

My own opinion is that steam is quite unsuitable for private persons who wish to drive their own carriages. The objections to the use of petroleum, or rather gazoline, are, first, the smell, which, when the motor is running properly, is almost absent; and, secondly, the vibration while at rest. I was anxious to see the electric motor which was entered, but it did not appear.

It was, of course, impossible to know what was happening upon the road, but I learnt this morning that a serious accident had happened to No. 10, the large steam carriage belonging to Mr. Scotte, of Epernay, Fig. 6. It appears that at Gaillon, which is marked upon the map, one of the "Field" tubes inside the vertical boiler burst, and there was an explosion which caused some injury to the vehicle and slightly injured the driver.

After the arrival of the bulk of the competitors, dinner was served at the Hotel de l'Angleterre, and "The continued prosperity of *Le Petit Journal*" was proposed by Captain de Place, who has been present throughout the trials. We described some time ago a special instrument resembling a telephone, invented by Captain de Place, who has taken much interest in the competition. The greatest surprise is expressed that so little has been done in England in the construction of self-moving vehicles suitable for private families. The roads in many parts of England are good, although certainly not so well kept as those I have just passed over. The authorities in the United Kingdom appear to do what they can to hinder the use of such carriages, whereas in France, which we usually consider as under bureaucratic rule, everything possible seems to be done to encourage their use. Should the use of these vehicles increase to the same extent as that of cycles, the business will be exceedingly important. The petroleum carriages can go as fast as any ordinary cyclist cares to travel, as can easily be seen from the times quoted.

The engraving below illustrates the carriage which has been referred to, as made for Messrs. Blumfield and Garrard, Coventry, by Messrs. Taylor, Cooper, and Bednell, Coventry. It carries four persons, and takes the form of a self-propelled mail phaeton, in which electricity is the motive force, and in which points which have proved valuable in cycle construction have been embodied. The *Cyclist* says:—"Messrs. Garrard and Blumfield's patent is for the combination of the known elements of (1) pneumatic tyres, (2) balance gear, (3) steel tubing, (4) ball bearings, and (5) electric power, and the machine in question has been devised to embody in the most practical form these several elements." The mechanism of the carriage and its framework are built throughout of weldless steel tube. There are four wheels, the two front being steered by means of a long ball socket head, actuated by a wheel and tangent screw. The wheels are the same size, *i.e.*, 24in., with 4in. pneumatic tires. The wheels and all working parts run upon ball bearings, and the current is obtained from twenty-four accumulator cells, in boxes arranged beneath the seats. These cells are connected with a motor carried upon the framework beneath; the motor spindle carries a roller on a feather, so that it can be moved to and fro several inches by means of a lever, placed in contiguity to the rider's left-hand. The roller runs between two discs. The discs are connected by toothed gearing and a chain with the balance gear which drives the two back wheels; the disc and roller driving gear being thus once more on its trial. The body of the carriage is placed upon the framework of the machine. The accumulators weigh some 500 lb., and the completed vehicle with accumulators about 1000 lb., or roughly speaking about half a-ton. The electric motor runs constantly at the same speed, the graduation of power or speed of propulsion being made by the shifting roller referred to. A powerful band brake acting on the balance gear is worked by a foot lever placed conveniently to the right foot of the "engineer." The machine is calculated to run at speeds varying from 3½ to 13½ miles per hour, according to the gradient over which it is running, or the wish of the occupants. It is stated to have run a trial trip to Birmingham, a distance of eighteen miles, at a speed of ten miles an hour over many parts of the road. One charging of the accumulators is calculated to be sufficient for a run of from seventy to eighty miles, and it is estimated that the cost of re-charging will not exceed 3s.; 2-horse power being the maximum discharge capacity required.



Garrard and Blumfield's Electric Carriage

The prizes were awarded last Monday, July 23, after a meeting of the whole of the twenty-five persons on the staff of *Le Petit Journal* who had formed the jury during the trials. The 1st prize, known as the "Prix du *Petit Journal*," and of the value of £200, is to be equally divided between Messrs. Panhard and Levassor, and Les Fils de Peugeot Frères. The carriages exhibited by both firms appeared equally good, both being fitted with Daimler gasoline motors. The second prize of £80, known as the "Prix Marinoni," was awarded to Messrs. De Dion Bouton et Cie. for their steam bogie, suitable for use with any class of vehicle. Although, as the jury remarked, this class of motor is not looked upon so favourably as those which can be placed upon the carriage itself, and which require no skilled attention. The 3rd prize of £60, Priz Marinoni, was awarded to Mr. Maurice le Blant, for his carriage to seat nine persons, and fitted with steam engine and Serpollet boiler. This type the jury consider specially adapted for heavy traffic such as omnibus work. The fourth prize of £40 was equally divided between Mr. Vacheron and Mr. Le Brun. Each of these gentlemen used the Daimler motor; but the jury consider that each has made important improvements in the methods of employing the motor. The fifth prize of £20 has been awarded to Mr. Roger for his improvements in the mechanism used with a petroleum motor. An additional consolation prize of £20 has been awarded to Mr. Scotte for his steam carriage No. 10, which was prevented from reaching Rouen by the bursting of one of the "Field" tubes. This could not be replaced on the Sunday.

## WEALTH STATISTICS.

FROM an interesting article under the above title in the last number of our able contemporary the *Statist* we extract the following schedule of fortunes left during the past seven years. In its commentary upon these figures the *Statist* holds that it would "probably be safe to say that such fortunes are not in the making in any of these great industries at the present moment."

### COALOWNERS AND MERCHANTS, IRONMASTERS, MACHINISTS, ENGINEERS AND CONTRACTORS.

| 1887. | £ |
|---|---|
| George Benton, of Benton and Woodewiss, contractor ... | 605,000 |
| Charles Waring, of Waring Brothers, contractor ... ... | 522,270 |
| Sir John Kelk, Bart., contractor ... ... ... ... ... ... | 408,352 |
| Sir Joseph Whitworth, Bart., steel manufacturer ... ... | 393,602 |
| John Swift, Powell Duffryn Collieries... ... ... ... ... | 384,000 |
| Joseph Firbank, contractor ... ... ... ... ... ... ... | 298,000 |
| Ald. Matthew Curtis, of Curtis, Sons and Co., Phœnix Works, Manchester ... ... ... ... ... ... ... | 206,845 |
| Henry Wm. Schneider, M.P., Barrow Hematite Steel Co. | 204,940 |
| John Pearson, Golborne Park, Lancashire, ironmaster ... | 188,866 |
| Richard Ravenhill, of Miller & Ravenhill, engine works... | 186,940 |
| Stephen Thompson, Wolverhampton, ironfounder ... ... | 126,988 |
| James Edward Hunt, of Seager, Hunt & Co., contractor | 115,115 |
| Charles Binns, Clay Cross Coal and Iron Company ... ... | 68,000 |
| Henry Crowley, Birkdale, coalowner ... ... ... ... ... | 57,984 |
| Joseph Cockerell, Purfleet Wharf, coal merchant ... ... | 52,722 |
| Thomas Knowles, of Knowles, Houghton & Co., Gomersal, machine maker ... ... ... ... ... ... ... ... ... | 13,240 |
| 1888. | |
| Sir John Hardy, Bart., of the Low Moor Ironworks ... | 1,033,482 |
| Thomas Jessop, of Wm. Jessop & Sons, Ltd., Sheffield ... | 656,450 |
| Benjamin Piercey, Denbigh, promoter of Welsh railways | 324,574 |
| Charles Joseph Lambert, Crosby-square, copper smelter | 274,900 |
| Alfred Krupp, Essen Steel Works (English personalty) ... | 273,125 |
| Henry Brace, of Henry Brace and Co., Walsall, and the Cannock and Sandwell Colliery Companies ... ... | 268,014 |
| Crawshay Bailey, Aberaman, ironmaster and banker ... | 219,387 |
| Samuel Roberts, Sheffield, steel manufacturer ... ... ... | 201,247 |
| Robert Hadfield, Hadfield Steel Foundry Co., Sheffield... | 191,510 |
| Henry Robertson, M.P., Monmouth, coal and ironmaster | 185,528 |
| William Brass, of Brass and Son, contractor ... ... ... | 162,940 |
| Herbert Clarke, King's Cross, coal merchant ... ... ... | 157,357 |
| William Webster, contractor for Thames Embankment ... | 131,945 |
| Walter Holland, of Mackenzie, Clunes, and Holland, Vulcan Ironworks ... ... ... ... ... ... ... ... | 104,022 |
| Robert Hall, Bury, machinist ... ... ... ... ... ... | 63,885 |
| Henry Perry, Tredegar Works, Bow, contractor ... ... | 33,765 |
| 1889. | |
| Sir Daniel Gooch, Bart., Chairman, Great Western Railway Company ... ... ... ... ... ... ... ... ... | 653,492 |
| David Hulett, Holborn, gas engineer ... ... ... ... ... | 243,000 |
| Charles Thompson, of Spiller & Co., Cardiff ... ... ... | 238,000 |
| Robert Fowler, Leeds Steam Plough Works ... ... ... | 219,617 |
| Richard Peacock, M.P., Gorton Engineering Works ... | 204,157 |
| William Hedley, Lanchester, Durham, coalowner ... ... | 174,120 |
| Robert Stirling Newall, F.R.S., Gateshead, submarine cable maker ... ... ... ... ... ... ... ... ... ... | 166,981 |
| Charles Sacré, Manchester, civil engineer ... ... ... ... | 166,514 |
| Alfred Penn, of Penn & Sons, Engine Works ... ... ... | 151,217 |
| Edwin Lucas Pease, Skerne Iron Works, Darlington ... | 142,694 |
| James Hobson, Sheffield, steel manufacturer ... ... ... | 120,000 |
| Philip Henry Muntz, M.P., Birmingham, sheathing metal manufacturer ... ... ... ... ... ... ... ... ... | 95,552 |
| Charles William Nevill, M.P., Llanelly, copper smelter... | 57,823 |
| Sir Charles Lanyon, M.P., Belfast, civil engineer ... ... | 55,785 |
| James Farrer, Bury, civil engineer ... ... ... ... ... | 46,909 |
| 1890. | |
| William Hargreaves, of Hick, Hargreaves and Co., Soho Ironworks, Bolton ... ... ... ... ... ... ... ... | 586,456 |
| Thomas Andrew Walker, C.E., contractor for the Severn Tunnel and Manchester Ship Canal ... ... ... ... | 551,694 |
| Andrew Knowles, Swinton Old Hall, coal and ironmaster | 317,399 |
| Prince Smith, Keighley, machine maker ... ... ... ... | 305,539 |
| | £ |
| David Davies, M.P., Llandinam, coalowner and railway contractor ... ... ... ... ... ... ... ... ... ... | 260,135 |
| James Nasmyth, C.E., inventor of the steam hammer ... | 243,806 |
| Thomas Richardson, M.P., Hartlepool, ironmaster ... ... | 238,451 |
| Joseph Mills, Staffordshire, coalowner ... ... ... ... | 140,842 |
| Henry Bleckly, Pearson and Knowles, Limited, Manchester | 74,592 |
| Mrs. Harriet Bolckow, widow of W. H. F. Bolckow, M.P. of Bolckow, Vaughan and Co. ... ... ... ... ... | 29,281 |
| Hutton Vignoles, Manchester, civil engineer ... ... ... | 22,179 |
| Madame Schneider, Creuzot Ironworks and collieries (English personalty) ... ... ... ... ... ... ... | 14,828 |
| John Ericsson, inventor of the caloric engine, born 1803 | 176 |
| 1891. | |
| Nathaniel Clayton, of Clayton and Shuttleworth, machinist ... ... ... ... ... ... ... ... ... ... ... | 1,364,496 |
| John Bullough, Globe Iron Works, Accrington, machinist ... ... ... ... ... ... ... ... ... ... ... | 1,091,835 |
| Henry Arthur Brassey, Preston Hall, Kent, contractor's son ... ... ... ... ... ... ... ... ... ... | 1,042,611 |
| Stephenson Clarke, Ruabon Coal Company, colliery owner and coal factor ... ... ... ... ... ... ... | 941,208 |
| Augustus Frederick Lehmann, of Naylor, Benzon, and Co., iron merchant ... ... ... ... ... ... ... ... | 542,017 |
| John Jackson, Clements's-lane, contractor ... ... ... | 295,978 |
| Sir John Hawkshaw, F.R.S., civil engineer ... ... ... | 218,460 |
| Sir Joseph William Bazalgette, civil engineer,... ... ... | 151,229 |
| William Marston Warden, Edgbaston, iron merchant ... | 142,000 |
| Alderman Joseph Musgrave, Bolton ... ... ... ... ... | 132,877 |
| Robert Marland, Hollingwood, colliery owner ... ... ... | 124,955 |
| Sir Thomas Fairbairn, Bart., Bambridge... ... ... ... | 63,544 |
| William Perch, Cardiff ... ... ... ... ... ... ... ... | 62,526 |
| 1892. | |
| Egerton Muspratt Bainbridge, Newcastle-on-Tyne, colliery owner and draper ... ... ... ... ... ... | 392,410 |
| John Rickett, of Rickett, Smith and Co., coal merchant | 307,000 |
| Alexander Druce, London and Llanelly, copper smelter... | 270,971 |
| Sir James J. Allport, general manager, Midland Railway | 193,074 |
| William Hugil Walker, Sheffield, iron founder... ... ... | 181,000 |
| William Thomas, Lanelly, Llangennech Tin Plate Works | 129,411 |
| John Cookson, Morpeth, colliery and lead mine owner ... | 92,789 |
| Thomas Green, Smithfield Iron Works, Leeds ... ... ... | 63,695 |
| Sir John Coode, chief engineer of Portland Breakwater... | 55,070 |
| Samuel Henry Byrne, Halifax, wire manufacturer... ... | 31,567 |
| Sir James Brunlees, Wimbledon, civil engineer ... ... | 31,312 |
| 1893. | |
| George Alexander Baird, Newmarket and Stricken, N.B., ironmaster's son... ... ... ... ... ... ... ... ... | 831,719 |
| Nicholas Wood, M.P., Durham, coalowner... ... ... ... | 293,966 |
| Dr. Ernst Werner von Siemens (English personalty) ... | 287,280 |
| Charles Henry Firth, of Firth and Son, Sheffield ... ... | 171,300 |
| Henry Wright, Saltley Carriage Works, Birmingham ... | 137,400 |
| Benjamin Scarf, King's Heath, Birmingham, coalowner and ironmaster ... ... ... ... ... ... ... ... ... | 81,197 |
| Samuel Henry Burrows, Sheffield, iron manufacturer ... | 47,500 |
| Jonas Lindow Burns-Lindow, Egremont, iron mine owner | 37,480 |
| Alfred Longsden, agent for Krupps of Essen ... ... ... | 35,127 |
| Sir George Findlay, General Manager, L. & N.W. Railway | 15,200 |
| 1894. | |
| Earl of Bective, grandson of Alderman William Thompson, M.P., iron merchant ... ... ... ... ... ... | 594,319 |
| John Knowles, Pendlebury, colliery owner ... ... ... | 531,604 |
| Sir George Elliott, Bart., colliery owner and wire rope maker ... ... ... ... ... ... ... ... ... ... ... | 483,970 |
| Robert Heath, M.P., Staffordshire, ironmaster ... ... | 276,611 |
| John Perry, Tredegar Works, Bow, contractor ... ... | 193,434 |
| Thomas Barber, of Barber, Walker, and Co., Nottingham, colliery owner ... ... ... ... ... ... ... ... | 157,757 |
| John Hick, of Hick, Hargreaves, and Co., machinist ... | 149,190 |
| John Galloway, of Galloways, Manchester, engine maker | 143,117 |
| George Burt, of Mowlem, Burt, and Freeman, Westminster, contractor ... ... ... ... ... ... ... ... ... | 121,823 |
| John Rogerson, Croxdale Hall, Durham, civil engineer ... | 121,814 |
| Daniel Whitehouse, Newport, Monmouth, tin-plate manufacturer ... ... ... ... ... ... ... ... ... ... ... | 99,965 |
| Hugh Nettlefold, of Nettlefolds, screw manufacturer ... | 59,167 |
| Thomas Burrows, Sheffield, ironmaster ... ... ... ... | 33,000 |
| William Bullough Gray, Globe Works, Accrington, machinist ... ... ... ... ... ... ... ... ... ... ... | 25,712 |
| John Bailey Denton, Westminster, civil engineer ... ... | 12,954 |

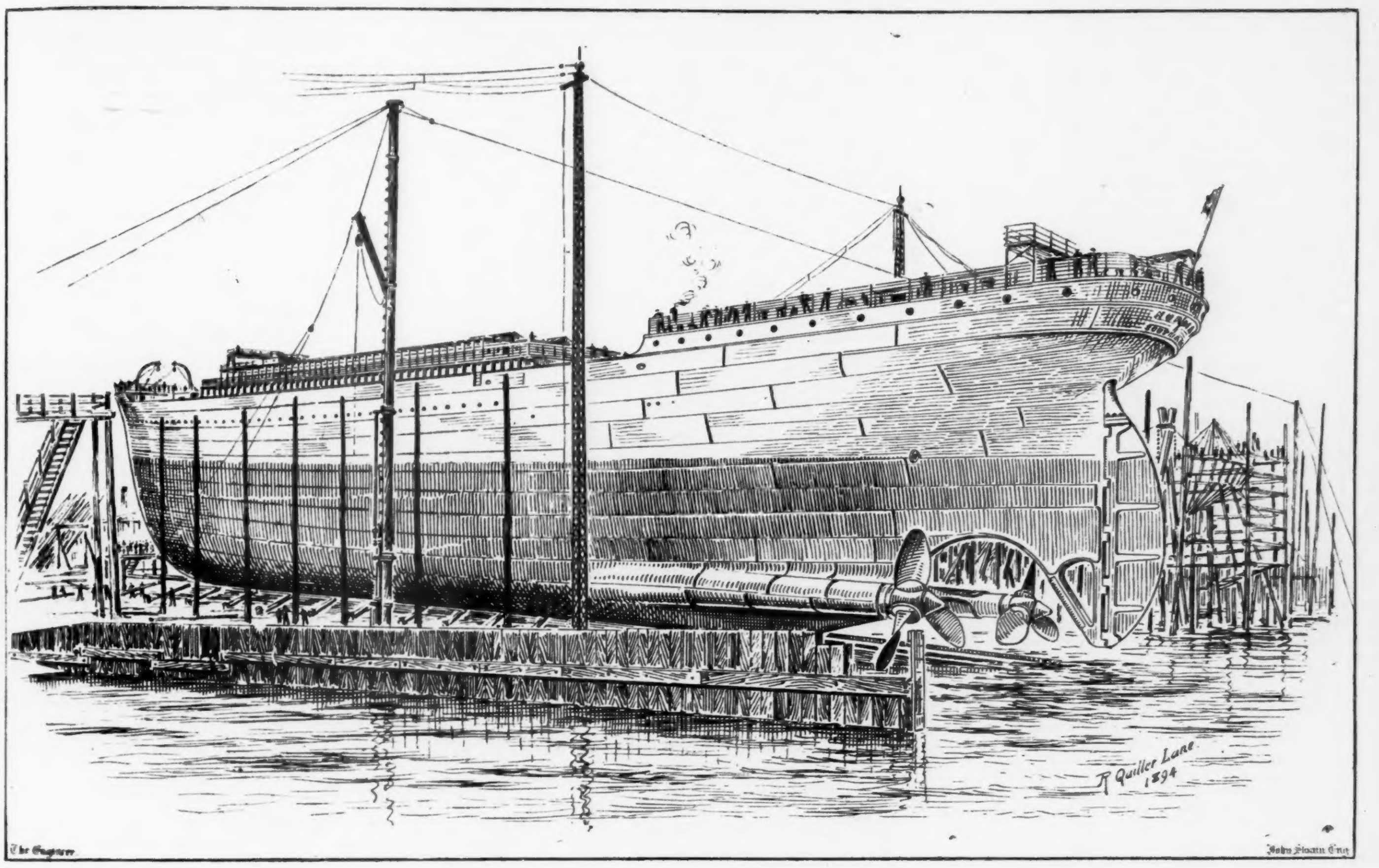
NAVAL ENGINEER APPOINTMENTS.—Engineers: E. J. Murphy, to the Renard; Wm. R. Parsons, to the Hasty; R. W. Parry, to the Edinburgh; John H. Jenkin, to the Gibraltar; James A. Roye, to the St. George; Walter Coleman, to the Magnificent. Assistant-engineers: W. E. Townsend, to the Theseus; E. J. Campbell, to the Barfleur; Thos. J. Dawson, to the Naiad; W. H. Page, to the Devastation; Charles Stevens, to the Northampton, to date July 16. Probationary Assistant-engineers: Charles G. Ware, to the Apollo; T. W. Richards, to the Sappho; H. R. S. Hughes, to the Tribune; A. E. J. Murray, to the Thetis; G. A. Sisley, to the Latona.

ELECTRIC RAILWAYS IN THE UNITED STATES.—According to the British Consul at Philadelphia, electric railways appear to be the method that is most generally adopted for locomotion through the streets of cities, and numerous franchises have been granted to such railways during last year. Some of the lines are working satisfactorily, and others are in course of construction, the trolley system of overhead wires being the one adopted. The franchises are granted in exchange for contracts concerning the paving of the streets through which the electric railways pass. In Philadelphia, and all over the country, the increase in electric railways has been enormous. Three years ago the mileage of horse tramcar roads was 5713; of electric roads, 1641; of steam roads, 554; and of cable roads, 527. Now electric roads exceed all others, with a total of over 7000 miles; horse-car roads have fallen below 5000 miles; cable roads have reached 1000 miles; and steam lines in cities have not materially increased. The cost of constructing a mile of cable road in a large city is put usually by engineers at £12,000. An electric road costs about £3600 per mile. The cost of working horse-car and steam street railways is about the same per mile. The cost of working cable and electric roads is about one-half of it. Electric roads are 10 per cent. cheaper to work than cable roads, and their cost of construction is 60 per cent. less.

THE NEW BRIDGES AT BUDAPEST.—In July, 1893, an international competition was announced for designs for two bridges over the Danube at Budapest. The first prize of 30,000 crowns was awarded to the design of the Esslingen-Stuttgart Machine Company, for the design of M. T. Ruebler, chief engineer of the company, and MM. Eisenlohr and Weigle, architects. Their design is for a wire suspension bridge with one span. The second prize of 20,000 crowns was given for the design of John Feketehazy, engineer at Budapest, for designs for a cantilever bridge with three spans. A third prize of 10,000 crowns was awarded for the design of the Reschitza Ironworks, with H. Schmuhl, architect, and Gregersen and Sons, contractors. The following designs were also bought for 5000 crowns each:—(1) The design of Brother Redlich and Berger, architects in Vienna, Francis Pfeiffer, chief engineer, Francis Podhsjaky, engineer, and Alexander Graf and Baron Krausz, architects. (2) The design presented by A. Rieppel, director of the Nürnberg machine manufactory, and Thiersch, architect. (3) The design presented by the machine manufactory of the Hungarian State Railways, Sfaléz Cathry and Son, engineers at Budapest. (4) The design presented by the Société de Construction de Levallois-Perret. The other designs are at the disposal of the competitors according to the notification in our advertising columns of this issue.

## THE NEW SOUTH AFRICAN MAIL STEAMER NORMAN

MESSRS. HARLAND AND WOLFF, BELFAST, BUILDERS AND ENGINEERS

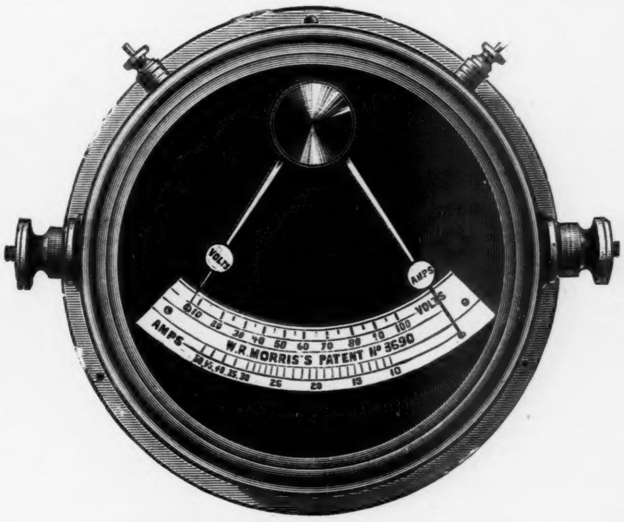


## THE NEW SOUTH AFRICAN STEAMER NORMAN.

On the 19th inst. the new twin-screw Royal Mail steamer Norman, which has been built for the Union Steamship Company's South African Mail Service, was successfully launched at Belfast by Messrs. Harland and Wolff. The ceremony of naming the Norman was performed by Lady Evans, wife of Sir Francis Evans, K.C.M.G., M.P., deputy chairman of the Union Steamship Company. The measurement of the Norman will be about 490ft. long (between perpendiculars); breadth, moulded, 53ft.; depth, 37ft. 6in.; and her gross tonnage will be about 7,500. She is constructed of steel, and fitted with twin screws like five others of the Union Company's fleet. The Norman will be fitted with two sets of triple expansion engines, and is designed for carrying a large cargo or considerable numbers of troops. Large numbers of passengers will be provided for in each class. The first and second class accommodation will be amidships, thus ensuring comfort, quiet, and ample ventilation, the third class being located on the main deck forward, and in this connection it may be mentioned that the Norman will be capable of berthing 160 third-class passengers on the main deck forward, with the saloon between them. The first-class saloon will provide seating accommodation for 250 passengers, and is to be situated on the upper deck. It will be beautifully decorated. The second-class saloon will be situated on the main deck aft, and will furnish seating accommodation for 100 persons. As regards the smoking rooms both for first and second-class passengers, nothing has been spared to make them as up-to-date as possible, and luxurious in the extreme. The former will be situated on the promenade deck amidships, between the funnels, and will be in dark Spanish mahogany, the walls being richly decorated in embossed leather, and the floor covered with Sir Edward Harland's patent india-rubber tiles. The ceilings of this room and the library adjoining will be artistically decorated, and both rooms will be 10ft. 3in. high. The Norman will be constructed with poop and forecastle, and will have central deck houses containing dining saloons, &c., over which will be an exceptionally fine promenade deck. Electric light will be installed throughout, and there will also be refrigerating engines and machinery, and cold chambers for ship's stores, as well as for the conveyance of fruit and other perishable goods. There will be nine watertight bulkheads, and the ship will be provided with water ballast and with all the most recent appliances and fittings. She will be provided with boats in excess of the Board of Trade requirements, and altogether the Norman will be a vessel of which the Union Company and the builders will have reason for being proud. The steamer leaves Southampton on her first voyage on the 10th November, 1894, and will leave Cape Town homewards on the 19th December.

## A COMBINED AMMETER AND VOLTMETER.

THE instrument we here illustrate is a very useful and compact meter. It consists of a strong brass case, 8in. in diameter, with four terminals; the two small terminals are used for the volts, and the two large terminals for the ampères. It has two hands or pointers; on each pointer is a disc, with the word volts on one disc and ampères on the other. By this plan there can be no mistake in the readings, and it will be noticed in the illustration that the disc on one pointer is fixed higher than the disc on the other. This arrangement allows both discs always to be seen, as one disc cannot come in front of the other and eclipse it. Another feature is a double scale. The top part is used for the volts, reading from left to right, and the bottom part for ampères, reading from right to left. It is not very easy to look at two instruments at the same time, even though they be placed side by side, but in this instrument we see at a glance what is going on, and by mentally multiplying the reading of one pointer by the reading of the other, we at once get the number of watts being used. This makes it also a wattmeter. As each pointer is separate and distinct from the other, it can be used separately as an ammeter or a voltmeter, as the ampère and volt circuits are entirely insulated from one another. No printed dials are used. Each scale is of large size, and is marked by hand during calibration, and afterwards engraved. This method prevents any errors caused by the use of printed scales or dials, and is a point of importance. The principle of the instrument is the action of a solenoid on a suspended piece of iron wire—which weighs only a few grains—and, as there are no permanent or electro-magnets or springs used in them, it is not expected that they will ever require recalibrating. The instrument is a gravity one and direct reading, and can always be left in circuit.



MORRIS'S COMBINED AMMETER AND VOLTMETER

To use the instrument it is screwed up vertically, so that the hands point to zero. The two top terminals are connected across the mains, and the two large terminals are connected in the circuit. The instrument is made by the inventor, Mr. W. R. Morris, 34, Livery-street, Birmingham.

## THE CARDIFF ELECTRIC LIGHT WORKS.

CARDIFF is to be lighted by electricity next month, for the first time from the station of its own Municipal Corporation, which supersedes, after an interval of time, the brave but brief enterprise of a private company. For more years than need be now recounted, the Council had been negotiating with the local gas company for the acquisition of its property. The borough had secured the control of the water supply by purchase from its private owners, and had exhibited its public spirit by tapping new sources in the Breconshire hills from thirty to forty miles away. It wanted to municipalise the gas supply, but the chartered monopolists seem to have regarded themselves as in a position to demand their own price. Four years ago the Corporation offered their ultimatum to the gas authority. As that was not accepted, they took the necessary steps to provide the town with its own works for the supply of electric illumination and power. The merest abstract of the history of the installation will be sufficient to instruct other municipalities in a similar plight, and other borough engineers placed in the like circumstances. An experienced electrician was sought out as adviser, the result being that Mr. W. H. Massey, M. Inst. C.E., was appointed consulting engineer. A committee was nominated, and it made an agreeable and instructive peregrination—quoting the words of the report—to London, Deptford, Bath, Havre, Paris, Brussels, Antwerp, Cologne, and Frankfort, "with the object of obtaining the latest available information as to the progress of electric lighting and the application of electricity to general industrial purposes." On a supplementary exploration the sub-committee visited Manchester, Bradford, and Leeds, not to omit the Electrical Exhibition at the Crystal Palace. Committees of this kind are the more omnivorous in their appetite for facts in proportion as their quest runs in pleasant places. The Cardiff sub-committee during 1891 and up to May, 1892, gathered, besides a great many delightful experiences, a mass of important details as to the newest forms of electric installation, which guided the Corporation to a decision. One or two passages from the report of the Committee to the Council may be usefully quoted:—"The conclusions that your sub-committee have so far arrived at are, that the promise of advantage to the community at large, to be derived from the development and application of electricity in the future, is such that a prudent municipality will not allow the control of what must practically be a monopoly to pass into the hands of any private individual or company established for the purpose of profit. This is altogether apart from the still graver consideration of allowing any other body than the Corporation to come into the borough armed with parliamentary powers to tear up the streets and pavements of the Corporation." Then, on the point as to the distinction between public and domestic illumination:—"The members of the Corporation are doubtless aware of the difference between incandescent and arc lighting. The one—incandescent or glow lamp—is generally utilised for domestic purposes, and the other—the arc light—for street lighting and the illumination of large areas, such as railway stations, manufactories and workshops; and different electrical processes are generally used for each of these methods of lighting, what is called the low-tension current being employed for domestic purposes, and high-tension for arc lighting, or for primary transmission. Without going into any technical details, it may be broadly stated that, for economical reasons, high-tension currents are necessary when it is required to distribute electricity to long distances or over large areas. It has already been demonstrated that this high-tension current can be transformed into low-tension, and thus made available for incandescent lighting by a very simple appliance; and your sub-committee are hopeful, from what they saw at Frankfort, and from what they gathered in conversation with electrical engineers abroad, that this transformation can be accomplished in an economical manner. In that case it is obvious that the most practical method of lighting a scattered district like the borough of Cardiff would be by concentrating the machinery in one spot, and distributing the electrical energy at a sufficiently high pressure over the given area, such currents to be transformed as and where required. The objection to high-tension currents consists principally in the danger to life and property which unprotected cables having such currents are likely to cause. By a proper system of installation, and laying the cables underground, however, this can be entirely obviated; but the higher the tension the greater is the cost of insulating and providing safety appliances, and that is one reason why your sub-committee call special attention to the moderate pressures likely to be required for distribution in Cardiff." In a subsequent report the sub-committee point out that "in laying down the requisite plant in the first instance, it is quite easy to so arrange it that by making additions to the building and the machinery, the whole may be formed into a generating station suitable for the supply of electrical currents for both light and power throughout the entire borough, and by this means establishment charges—expenses for staff and maintenance—would be reduced to a minimum." On another point of interest to the electrical engineer, which has particular reference also to the local opportunities of Cardiff, the sub-committee further remark:—"The utilisation of water power in connection with the new Taff Vawr (the Breconshire) water mains, and the adaptation of refuse destructors, by passing the waste heat and gases through boiler furnaces for the purpose of raising steam to drive electric light machinery, are schemes which may all be realised to some extent in the not distant future, and yet they do not in any way modify the present needs." Through these passages of the reports the guiding hand of Mr. Massey is, or ought to be, distinctly traceable, and it is upon the plans thus outlined that the Corporation installation in Cardiff has been made.

The site of the works is a piece of Corporation land on Canton Common, about a mile from the centre of the borough, and connected by a private siding with the Great Western Railway. Here there is a plentiful supply of good water, pumped from 10ft. below the surface, and this, if necessary, can be supplemented to any extent from the Corporation mains. The station to be made use of next month is one-fourth of its ultimate size, the idea being to extend it gradually as the demand for light and power increases. The buildings at present cover 80ft. by 80ft., and comprise an engine-room 80ft. by 30ft. on the street front; a boiler house of similar dimensions; together with a coal shed, 14ft. wide, facing the railway siding, and covered by a water storage tank running the whole length of the structure. The chimney stack is octagon in form, 150ft. high, 64 square feet in internal section, and capable of taking the draught of ten boilers, of which, so far, three are laid down. These are of the Davey-Paxman pattern, as also are the engines. The engines now in place are two compound 65-horse power direct, coupled to Siemens' 40-kilowatt alternators, and two triple-expansion 300-horse power direct, coupled to Siemens' 180-kilowatt alternators, the small to run to a speed of 200 revolutions, and the large to 133 revolutions per minute, all having their own exciters directly coupled on the same shaft, and delivering a current, at a pressure of 2500 volts, to concentric mains running to the centre of the compulsory area of supply, a mile away. It may here be noted that the compulsory area includes a small portion—little more than a fourth—of the widespread and rapidly growing town. It practically embraces no more than the streets occupied by the chief hotels, banks, and offices, and places of business. It leaves outside the pale the leading residential districts and almost all the working class suburbs. The idea of the municipal committee is, perhaps too timidly, to give the experiment a fair trial first of all in the zone where the demand is likely to be greatest. There are already many signs that as soon as the heart of the town is lighted in September, an immediate extension of the mains to places further afield will be required. For example, the authorities of Aberdare Hall—the house of residence of women students in the University College—are even now asking to be supplied with the light, and it is confidently predicted by persons who have had experience of electric lighting in other towns that the Corporation will not long be allowed to confine itself to the compulsory area; and under these circumstances the question is being raised whether the Municipality would not be wiser to enlarge its lines at once on a uniform plan rather than meet contingent applications by a series of patchwork processes.

The mains from the Canton station, though they run through a populous region and skirt the walls of Cardiff Castle, Lord Bute's occasional home, are untapped until they enter the chief thoroughfares of the borough. Then they communicate with six Siemens' transforming stations, placed without any particular regularity of interval, and where consumption is expected to be greatest. The transformers are connected in parallel, and feed the low-tension network at a pressure of 100 volts for the supply of hotels, offices, shops, or private houses. The mains also supply current to Ferranti rectifiers for the distinct arc lights of the public lamps. The rectifiers consist of a small self-starting synchronous alternating motor, with a commutator at each end of the shaft for changing the alternating into a direct current, and rectifying the two currents. Every direct current machine, as is well known, is an alternator and rectifier combined. Recent experience has shown that there is no difficulty in separating the two portions by a reasonable distance, with the advantage that the plant at the station is of one pattern; that this necessity of keeping spare plant in stock is reduced to a minimum; that separate mains for arc lighting are dispensed with; and still there is obtained the continuous current, so much preferable for arc lighting, owing to the action of the crater in the positive, or upper carbon, as a natural reflector, throwing the greater mass of the light on the street below. Each transformer station is connected to a separate low-tension network of wires in its own immediate district, and all of these independent centres are easily capable of being connected one to the other at will. The pipes and surface-boxes in which the cables run are of cast iron metallically jointed together, so as to provide for an efficient earth connection in case of a fault appearing; and thus all danger is precluded of such an accident as was some months ago reported from Bournemouth, and has, though in less serious form, occurred in other places where such safeguards were not provided. The street illumination is supplied by Siemens' "band" arc lights, arranged as a beginning in four series of twelve lamps each, the current being taken alternately from different circuits, so as to permit of every second lamp being extinguished at midnight when desired. The lamps stand 22ft. high, and are placed for the most part on the edge of the footway, though in a few instances they are in the middle of the road. For the rest, it describes them sufficiently to say that they are of the same pattern as those erected in the City of London, with reference to which the Cardiff Committee say in one of the reports:—"The best example of electric street lighting we have seen in England is that carried out by the Brush Company in Queen Victoria-street, where the arc lamps are placed at an average distance of forty-five yards apart." All the cables, it may be added, are from the Silvertown works. As to the question of cost, it is safer to deal with the estimates than the actual outlay, which cannot yet be reckoned up. The original figures were: for the mains, £8000; the transformers, underground chambers, &c., £2000; arc lights, lamp-posts, &c., £3000; buildings and chimney stack at Canton Common, £5600; boilers, £2500; engine steam pipes, condensers, £3500; an item set down as accessories, £5000; site credited at £1500; railway siding and turntables, £400; contingencies, £1000.

The works have been executed entirely by the Cardiff Corporation, under the direction of the borough engineer, Mr. W. Harpur, C.E.; but the credit, and in some sense the responsibility, of the installation rests mainly with Mr. W. H. Massey, M. Inst. C.E., of Queen Anne's Gate and Twyford, who has been retained from the first as consulting engineer. Mr. Massey has been most efficiently represented in Cardiff, throughout the progress of the work, by Mr. R. H. Fletcher.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Railway operating statistics.*—The latest report from which I have been able to take details of actual operating expenses of railway operation is that of the Chicago, Rock Island, and Pacific Railway for the year ending March 31st, 1894. This road operates 3571 miles of railway, or 4472 miles of single track, including second and third track and sidings.

| | |
|---|---|
| Gross earnings—dols. | 21,039,073 |
| Operating expenses—dols. | 14,137,267 |
| Net earnings—dols. | 6,061,594 |
| Percentage of operating expenses to gross earnings | 67·20 |
| Passengers carried | 5,768,441 |
| Passengers carried one mile | 329,360,986 |
| Average journey per passenger—miles | 57 |
| Average rate per passenger per mile—cents | 1·9 |
| Earnings from sleeping cars—dols. | 92,902 |
| Earnings from dining cars—dols. | 114.879 |
| Total passenger earnings—dols. | 6,538,568 |
| Average receipts per passenger—dols. | 1·13 |
| Freight carried—tons | 7,056,569 |
| Freight carried one mile—tons | 1,288,576,685 |
| Average rate per ton per mile—cents | 1 |
| Number of loaded cars | 556,061 |
| Average load per car—tons | 13 |
| Total freight earnings—dols. | 12,852,978 |
| Number of men employed | 12 117 |
| Payments to employés per month—dols. | 659,443 |
| Passenger train mileage | 6,601,512 |
| Freight train mileage | 10,898,552 |
| Total train mileage | 22,174.795 |
| Earnings per freight train mile—dols. | 1·18 |
| Earnings per passenger train mile—dols. | 1·11 |
| Expenses per mile run—dols. | 0·68 |
| Cost of maintenance of track and bridges per mile run—dols. | 0·13 |
| Number of passengers carried one mile for each mile run by passenger trains | 50 |
| Average mileage per engine | 39,317 |
| Locomotives, cost of repairs per mile run—cents | 3·28 |
| Locomotives, cost of fuel " " | 6·41 |
| Locomotives, cost of oil and waste " " | 0·26 |
| Locomotives, cost of engineman, fireman, and wipers per mile run—cents | 6·58 |
| Locomotives, miles run per ton of coal | 29·64 |
| Number of cars per passenger train | 5·27 |
| Number of cars per freight train | 17·90 |
| Number of locomotives | 564 |
| Number of cars, passenger service | 462 |
| Number of cars, freight service | 15,840 |
| Gravel, hand, and work cars | 1,517 |

*Relining tunnels.*—On the Louisville, Evansville, and St. Louis Railroad the old timber lining and dry packing of some of the tunnels is to be removed, and the tunnels lined with brick. The ballast will also be removed, and the rails carried on wooden stringers, 12in. by 12in., while the invert is being built. The centreing ribs will be composed of four thicknesses of 2in. planks, with the extrodes trimmed to the arch radius. Upon these will be 2in. by 4in. lagging, breaking joints on the ribs. The lining will be of smooth, hard burned "paving" brick, of 4000 lb. per square inch crushing strength, laid in cement mortar composed of one part cement and two parts sand, with a tensile strength of 100 lb. per square inch seven days after mixing. The bricks will be thoroughly wet before laying, and all spaces will be filled in with mortar or grouted. In the side walls the bricks will be laid in English bond, with five stretcher courses to one header course, but there will be no headers in the arch rings. Where dry rubble masonry is built, as at the portals, &c., one fourth of the stones must be headers the full thickness of the wall. The packing will be of concrete composed of four parts of stone, two of sand, and one of hydraulic cement, mixed with water and rammed in layers. Weeper holes will be left in the tunnel walls, connecting with stoneware drain tiles laid in the concrete backing. The portals will be of first-class masonry, with brick or stone parapets and wing walls. The work must be carried on without interfering with the traffic, the track being cleared ten minutes before any train is due.

*Steel fire-boxes.*—There is considerable difference of opinion as to the best grade of steel for use in fire-boxes, as shown in the recent report at the convention of railway locomotive superintendents. Some prefer a soft steel of 50,000 lb. to 58,000 lb. ultimate strength, while others prefer a harder steel of 55,000 lb. to 65,000 lb. From the records of several hundreds of worn-out fire-boxes it was found that the tensile strength varied from 77,000 lb. to a little over 50,000 lb., while the mileages varied from 500,000 to a little over 50,000 miles. The results of the examination were quite conflicting, as was to be expected, considering that the use of the fire-box on the road had more to do with its life than the original quality of the metal of which it was constructed. It was found, however, that hard and soft steel might be found in both long and short-lived fire-boxes. The weight of evidence was, however, toward steel having a tensile strength of 60,000 lb., as giving the best results. There is a prejudice against hard steel as being more liable to crack, but improved methods of manufacture—such as machine flanging—and more careful methods of washing out boilers, are found to be removing many of the difficulties formerly encountered, and, after it has once been flanged, steel of 60,000 lb. tensile strength will give better results than that of 50,000 to 55,000 lb., while the harder steel holds the screw threads better and is less liable to bag between the stay bolts. The specifications recommended were as follows:—Fire-box steel is to have a tensile strength of 55,000 lb. to 65,000 lb., with 60,000 lb. desired, and an elongation of 28 per cent. in 8in. preferred. The chemical composition desired is: Carbon, 0·18 per cent.; phosphorus, not above 0·03 per cent.; manganese, not above 0·4 per cent.; sulphur, not above 0·02 per cent.; silicon, not above 0·02 per cent. Plates will be rejected having a tensile strength less than 55,000 lb., or over 65,000 lb.; an elongation less than 22 per cent. in 8in., and in ¼in. plates less than 20 per cent.; a failure to stand bending and quenching test as given for shell steel; any seam or cavity more than a ¼in. long in any of the fracture or homogeneity tests. Plates shall also be rejected having carbon over 0·25 per cent., or below 0·15 per cent.; phosphorus over 0·035 per cent.; manganese over 0·45 per cent.; silicon over 0·03 per cent., or sulphur over 0·045 per cent. The homogeneity test shall be made in the following manner: A portion of the broken test piece shall be nicked with a chisel on opposite sides alternately, the nicks being about 1in. apart, and the piece broken by a number of light blows, the bending being away from the nicks. If the laminations are more than ¼in. long, the piece shall be condemned. The object of this is to open and reveal seams, due to failure to weld up, or to foreign interposed matter, or cavities due to bubbles in the ingots. Shell plate steel is to have a tensile strength of from 55,000 to 65,000 lb., and an elongation of not less than 20 per cent. in 8in. Test pieces having rough edges removed by filing, grinding, or machining, shall, without annealing, bend over itself both while cold and at a cherry red heat and dipped in water at 80 deg. Fah. without showing cracks and flaws in the outside edge. There shall be no chemical requirements.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

In connection with the important engineering question mentioned in my letter of a fortnight ago, regarding the possibility of Staffordshire becoming a producer of steel girders of H section for warehouse and other similar building purposes, interesting information is forthcoming in the announcement that steel girders are already rolled in this district in the ordinary bar mills, and that the Staffordshire Steel and Ingot Iron Company is producing girders up to 7in. by 4in. If there were sufficient demand, the Staffordshire works would be ready to put down machinery for the rolling of larger sizes, but, as I before pointed out, this is a very expensive matter, and it is estimated that the requisite rolls necessary to engage in all departments of the trade would cost fully £20,000, and probably £25,000 or £30,000. A good girder mill will turn out from 100 to 150 tons of girders per shift, according to sizes on order, or 50,000 to 75,000 tons per annum. It is understood here that the mills of Messrs. Dorman, Long and Co., of Middlesbrough, would do this, and that the firm have in stock about 10,000 tons of steel girders in England, besides large stocks abroad. A great portion of the trade is export. As regards iron girders, up to the present no English firm can compete with the Belgians in price, but in steel the English makers fairly command the whole market.

Steel makers report more business doing on account of the Scotch strike, and the inability of the Scotch steel masters to execute orders. One leading local concern has just taken a big line of steel sheets for gasometer construction, and the way in which steel is increasing in favour among constructive engineers as a gasometer material, is a very gratifying experience of the steel makers at the present time.

Last week I announced that the Great Western Railway Company was intending to erect at Wolverhampton new works for the manufacture of oil gas for the lighting of railway carriages. I am now in a position to state that not only is this so, but that the company is also intending to enlarge its engine-building works at Wolverhampton. It has just purchased about seven acres of land adjoining the present works, with the object of putting down additional boiler-making and fitting shops, as the present plant is unequal to the strain in output put upon it. The wages paid at this large works now amount to about £2500 per week, and the new extension will mean the employment of a considerable number of additional hands.

It has this week been intimated that the notice which has already been served—as previously mentioned—upon the men of the Corngreaves Ironworks, of the New British Iron Company, Cradley Heath, and which was to expire on the 31st inst., will have to take effect, as all efforts to sell the works have been unavailing. Messrs. Barnett and Son, of Wolverhampton, the auctioneers, will therefore be instructed to prepare forthwith for the dismantling of the works, and for the disposal of the various portions of the estate by means of a forced sale. The works were founded in 1825, and are now among the largest and best equipped in the kingdom. In the prosperous years, between 1873 and 1880, when trade was good, and best Staffordshire iron was in great demand, a golden harvest was reaped, but this has been more than discounted by the depression of trade since then. At present there are about 1700 workpeople employed under the company, who receive something like £1500 to £2000 in wages weekly. The aggregate freehold surface area is about 230 acres, with a mineral area of 530 acres. Some years ago a steel making branch was added and fitted up with the most modern appliances, and as time went on a chain factory, a brick works, and other departments were entered into. Six collieries have also been acquired.

All interested in the progress of coal mining in South Staffordshire are expressing satisfaction at the fact that the South Staffordshire Mines Drainage Bill, which has already passed through the House of Lords, has now also passed its committee stage, and will in due course be reported for its third reading. By the Act of 1891 the Commissioners were authorised to raise a money loan of £100,000 for pumping operations to clear South Staffordshire mines from water. They have already expended a large sum of money for that purpose, and the whole of that expenditure is likely to become useless unless the works can be kept going and the water in the mines actually overcome. The Commissioners have previously obtained powers to create a new charge of £100,000, but on application to the Public Works Loan Commissioners and others to lend this money, it was considered that the security under the Act was not sufficient. Therefore, after a great deal of negotiation between the parties concerned, the term of the Bill has been agreed to, the effect of it being to make certain mines up to a certain figure collateral security for the money advanced.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—The wages settlement in the coal trade has necessarily been a matter of considerable discussion during the past week. So far as the colliery owners are concerned, it can scarcely be said that the agreement come to by the Conciliation Board has given general satisfaction, and although practically it has been ratified by the Federated Coalowners, not a few of them are very dubious as to the wisdom of the step that is being taken, whilst outside the Coalowners' Federation, and even on the part of one or two of its prominent members, there is a strongly expressed opposition to being bound to the proposed fixed rate of wages over the next couple of years, and it is not improbable that some of the collieries in the district may decline to commit themselves to the Conciliation Board agreement. The question has consequently arisen whether the Miners' Federation will take any action with regard to the collieries that decline to be bound by the agreement to the extent of not allowing the miners in such cases to work at the 10 per cent. reduction, until such collieries signify their assent to be bound to the agreement. Upon this point I do not hear of any really definite arrangement having been come to; but it is not improbable the official leaders of [illegible] Miners' Federation may co-operate with the Federated C[illegible]wners to secure a general acceptance of the terms of agreement—and there would almost seem to be some sort of tacit understanding that those collieries which have hitherto been the cause of the underselling in the market, shall be dealt with one way or another, so that a check may be given to the excessively-low cutting in prices. On the part of the miners in Lancashire there is also no very general satisfaction with regard to the agreement, so far as it carries out a reduction in wages; but there seems to be very little doubt that—on the advice of their official leaders—they will, like the Federated Coalowners, give their assent to the proposed terms of settlement.

Business in the Manchester Iron Market drags on in a lifeless hand-to-mouth fashion, and the continued absence of any indication of improvement is inducing rather a despondent tone as to the future. In pig iron buying is restricted to the smallest possible quantities, and for local and district brands prices continue low and weak. Lancashire makers, to meet the competition of Lincolnshire iron, have to give way considerably upon the nominal quoted rates, and with regard to forge qualities these would seem to be more a matter of offers than of any actually fixed price; 39s. to 39s. 6d., less 2½, at the works, is what local makers have been quoting, but considerably under these figures would have to be taken to secure business. For foundry qualities, occasional sales to special customers are made at something like their quoted rates, but 41s., less 2½, represents more nearly the figure which has to be taken. Lincolnshire brands are now being quoted at 38s. for forge to 39s. for foundry, net cash, delivered Manchester, and 3d. under these low figures would, in some cases, be accepted to secure orders. Derbyshire foundry varies considerably according to quality, ranging from about 43s. 6d. up to 45s. and 45s. 6d., net cash, delivered Manchester. The continuance of the miners' strike of Scotland is necessarily tending to keep up a firm tone for outside brands offering here, but except that in one or two cases Scotch makers have put up their quotations for special brands, late prices are not much more than maintained, and certainly business is extremely difficult at any higher prices. For good foundry Middlesbrough prices still average 43s. 10d. to 44s. 4d., net cash, delivered Manchester. There is so little Scotch iron offering, that prices can scarcely have much value, but it may be stated that Eglinton is quoted at 46s. 6d. to 46s. 9d.; Glengarnock, 49s. 6d., and Gartsherrie, about 50s. to 50s. 6d., net prompt cash, delivered at the Lancashire ports.

The manufactured iron trade remains generally in a very depressed condition, makers still reporting no weight of new business coming forward, and it is difficult to keep works going more than three to four days per week. Quotations for Lancashire bars remain at £5 7s. 6d., and for Staffordshire £5 10s., delivered here, but in special cases something under these figures would be accepted. Lancashire sheets are still quoted about £6 17s. 6d. to £7 2s. 6d., Staffordshire about £7 5s.; Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Nut and bolt makers report trade as becoming, if anything, more and more unsatisfactory. Very few orders are to be got, and these are competed for at continually receding prices.

In the steel trade only a very limited weight of business is being put through, and prices are somewhat irregular. For ordinary foundry hematites, 52s. 6d., less 2½, delivered Manchester, remains about the average quoted figure; ordinary basic billets do not average more than £4 net cash, delivered here, and could be bought at under this figure, in some cases, while Bessemer acid billets are reported to have been offering at as low as £4 net cash, delivered. In steel boiler plates, quotations vary, ranging, according to circumstances, from £6 7s. 6d. to £6 10s., and £6 12s. 6d. per ton, delivered in this district.

The outlook in the engineering trades remains much as reported for some time past. Only in exceptional cases are establishments at all busy, and this mainly upon work of a special character. The general run of engineering continues for the most part very quiet, and new work comes forward but slowly—with the result that very few engineering establishments are kept more than moderately going from hand to mouth; and there is still no indication of any revival of activity, at any rate in the immediate future.

In the coal trade business during the past week has been to a very large extent practically in abeyance, owing to buyers holding back in the expectation that with the reduction of wages, which comes into operation next month, there will be some corresponding further giving way in prices. It is not improbable that the large stocks held at many of the collieries, and which there will now be no necessity to retain, will be a source of weakness, as it is not at all unlikely that these in many cases will be forced upon the market, and that to effect clearance sales some concessions upon current rates may be made. With regard, however, to the general quoted pit prices, although the tendency of the market will no doubt be in a weakening direction, it is scarcely probable that there will be any very material change as regards lower prices in this direction, as the exceptionally low point to which prices have been gradually forced down ever since the commencement of the year has much more than discounted the reduction in wages that has been agreed to by the Conciliation Board. In anticipation that amongst buyers there would be a good deal of pressure for some further concessions in prices, to accompany the reduction in wages, special meeetings of the various districts of the Lancashire Coal Sales Association were held in Manchester on Tuesday to consider what action should be taken with regard to prices, and in all cases resolutions were passed that the official list rates should remain unchanged—these resolutions afterwards being confirmed by the Council, and in the afternoon, at a general meeting of the Coal Sales' Association, a resolution was unanimously passed "that as the prospective relief in wages has been already discounted by the prices of fuel having been so materially reduced during the last few months, there be no further reduction in wages." Prices, however, are just now scarcely really tested, as there is so little business stirring, and they are for the moment barely more than nominal; quotations, however, remain at about 11s. to 11s. 6d. for best house-fire coals, 10s. to 10s. 6d. for second qualities, 8s. to 8s. 6d. for common house-fire coals, with steam and forge coals quoted at 7s. to 7s. 6d. at the pit mouth, although the minimum figures may be taken as representing more nearly the prices at which actual business would be done. With regard to engine fuel, supplies have become very plentiful in the market, and rather lower prices would be taken, common slack being obtainable at 3s. 9d. to 4s. 3d.; medium sorts, 4s. 6d. to 5s. 3d.; with best qualities quoted at 5s. 9d. to 6s. 3d. per ton at the pit mouth.

A general holding back from placing out further orders has also been noticeable in the shipping trade, this being due to the prevalent expectation of a reduction in prices, and very little business has been doing during the past week. Quotations, however, remain as last given, and for delivery at the ports on the Mersey about 9s. to 9s. 6d. per ton is still quoted for Lancashire steam coal.

Messrs. James Russell and Sons, of Wednesbury, have opened a warehouse at 33, King's-street, West Manchester, for the convenience of customers in this district.

*Barrow.*—No change can be noted in the condition of the hematite pig iron trade. Makers are very indifferently supplied with orders, and their trade is not sufficient to dispose of all the iron they make, even with only thirty-six furnaces in blast. The only department in the trade which is in any sense active is that of the local demand on the part of makers of steel. Prices are not practically changed. Hematite is still quoted at 43s. 11d. for warrants, sellers net cash, and 43s. 10d. buyers. Makers quote 1s. to 1s. 6d. per ton above these figures, but it is only special brands which can be sold at these figures, and all parcels are of small dimensions. Forge and foundry iron is extremely quiet.

Iron ore finds a poor market at present in Scotland, and the local trade is also very quiet. Old quotations are ruling, average qualities being at 8s. 6d., net, at mines, but it is impossible to get ore cheaper, as practically no profit is left to the raiser at this price.

Steel makers are busy at the plate mills, and to the ordinary home trade, a foreign and colonial business is being gradually added. There is a fair demand for shipbuilding material, and makers are still fairly supplied with orders. Heavy rails, are however, in quiet demand, and there is practically nothing doing in light, colliery, or tram sections. Only a poor business is reported in billets and tin-plate bars, while blooms, slabs, and wire rods are scarcely ever inquired for. Heavy steel castings are still in demand, and large forge work is brisk. Steel wire is very little worked in the district.

Shipbuilders and engineers are still very busy. The Barrow Company launched on Saturday the first of three torpedo-boat Destroyers of the Havock type, which are being built at Barrow. She was named the Sturgeon. This is the first torpedo-boat Destroyer which has been launched out of the twenty-seven which were ordered at the end of last year by the Admiralty. The Sturgeon, which is to steam 27 knots an hour, is being fitted with Bletchynden's patent water-tube boilers. The Naval Construction and Armaments Company has secured another order from the London County Council for a sludge boat to carry 1000 tons of sewage out to sea. This is the sixth order for this class of vessel which has been placed with the Barrow Company. The Unioni, a Norwegian oil ship, built at Barrow two years ago, has been brought to the Barrow yard for repairs after a collision with an iceberg in the Atlantic.

The coal and coke trades are very quiet. The demand is small, and the consumption is limited. Prices are steady.

Shipping is still further depressed. The exports of pig iron and steel from West Coast ports during last week were 22,352 tons, compared with 38,892 tons in the corresponding week of last year, a decrease of 16,540 tons. The shipments to date this year have reached 430,756 tons, compared with 424,760 tons in the corresponding period of last year, an increase of 5996 tons.

Stocks of iron in warrant stores have increased during the week 6024 tons, and now represent 155,606 tons, an increase since January 1st of 60,983 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE strike in the North has not had the stimulating influence upon the South Yorkshire coal industry that was looked for. Large manufacturers and merchants appear equally disposed to wait for reductions, a circumstance which clearly indicates the real condition of the coal trade in this locality. The demand is about as it was before the Scotch strike occurred, the fluctuation in values which that dispute brought about for a short time having entirely disappeared. The fine weather, with recent developments in the wages question, has had considerable effect in restricting business. It has already been stated that the men strongly disapprove of the action of their leaders in conceding the 10 per cent. reduction, whilst many of the coalowners feel that the 30 per cent. minimum wage for two years will be a great drag on the trade. There is every evidence, however, that opposition will gradually be lessened and ultimately evaporate.

House coal is in quiet demand. No better reports are received from the London market, and quotations remain the same as last week. Prices have a downward tendency and merchants are not disposed for business at the present rates. The quotations for Silkstone house coal are 9s. 6d. to 11s. per ton; Barnsley house, 8s. 9d. to 10s. per ton; inferior qualities from 8s. 3d. per ton. The demand for steam coal is still well maintained, and accounts continue good from the Humber ports, the local ports having a large proportion of the trade. Barnsley hards are at 7s. 9d. to 8s. per ton; lower qualities, 7s. per ton. Gas coal is in moderate request at 7s. 6d. to 8s. 6d. per ton. Manufacturing fuel can be easily obtained at from 4s. 6d. to 5s. 6d. per ton. Poor demands are still reported for smudge and small coal, which is quiet at 2s. to 3s. per ton. Coke in fair request at 9s. to 11s. per ton.

Reports from abroad still confirm what has already been heard about trade depression in America and elsewhere. A Sheffield manufacturer, who has just returned from the United States, says that the production of pig iron in that country has fallen from over 9,000,000 tons per annum, when the Iron and Steel Institute were visiting the States, to between 3,000,000 and 3,500,000 tons. Mr. Abraham Hewitt, who is one of the leading ironmasters in America, states that in his opinion the cause of the falling off is over-production, and that until some of the old works have been weeded out, and the demand again increases, there will be but little change in the commercial situation so far as the American pig iron industry is concerned. Pig iron for steel-making costs in America about the same as it can be bought in England, but the price paid by American manufacturers for fuel is much lower than the price paid in this country. One firm in the United States, who bring their fuel a distance of 400 miles, actually pay less than Sheffield manufacturers, who buy it on the spot. This is one of the reasons why the Americans put their productions on the market at such rates as would barely leave any profit for their English competitors.

It was mentioned some time ago that a dispute had occurred at the works of Messrs. John Crowley and Co., ironfounders, Meadow Hall, and Kelham Ironworks, Sheffield. It terminated in the labourers coming out on strike for an advance of 2s. per week, and the moulders ceased work in sympathy with the labourers. It was pointed out at the time how unreasonable and how untimely the strike was. Work was very slack, and the condition of trade did not warrant any increase in wages. The men appear at last to have taken this view, for they have asked to be permitted to return to work at the old rate of wages, the company promising that when there is a revival in trade they will then consider what can be done. Business has been proceeding as usual during the dispute, and the firm will take on as many men as they can, consistently with dealing justly towards the new hands, who had offered their services and are now in their employment.

In last week's ENGINEER it was mentioned that Sheffield makers of military material had discovered the secret of the new Russian shell, which had given such good results against the Harveyed plates at Ochta, near St. Petersburg. Messrs. Thomas Firth and Sons, Norfolk Works, have written to the War-office and the Admiralty offering to supply samples of these shells in a few days if the authorities will undertake to have them fired. The improvement in the Russian projectiles is said to be one that can neither be patented nor kept long secret. At the same time the shell is admitted to be an advance upon anything that has been manufactured up to the present time. Shells on the new system are being prepared in Sheffield and are ready for trial. Experiments are shortly to be made with shells manufactured by the Hadfield Steel Foundry Company and other Sheffield firms.

Anxiety continues to be felt in commercial circles respecting the delay in passing the United States Tariff Bill. The Wilson measure proposes important reductions in the duties on various classes of pig iron, and makers in the Sheffield district are hoping that these changes will be effected. If the present proposals become law an active demand for iron for the American market is anticipated. As many furnaces are now idle and stocks are very low, a perceptible increase in the demand would at once send up prices. A revival in the iron trade would have the further gratifying effect of benefitting the coal industry. At present the inquiry for finished iron in its various classes continues dull, the consumers contenting themselves with ordering for immediate requirements. Hematites are still quoted at 51s. to 52s. 6d.; common forge iron from 37s. 6d. to 38s. per ton; bar iron £5 10s. to £5 15s.; iron sheets, £8 10s.; common wire rods, £5 5s.; Bessemer billets of guaranteed temper £5 7s. 6d. to £5 10s.

An improved demand is reported for heavier railway material, due chiefly to the setting in of a demand from railway companies, both in these and foreign parts. Rolling stock had been allowed to get so low, that the accession of fresh orders was merely a question of a short time. There is an idea that we are on the verge of an improvement in the railway material trade. Shipbuilding, on the other hand, continues as dull as ever. There is not sufficient employment for anything like the number of existing ships. Grain and wool, as well as silver, remain so low, that no improvement is possible until there is a change. No new ships will be placed upon the stocks so long as freights remain at these unprecedentedly low rates.

Our local firms concerned in the production of articles required for husbandry are still well off for work, in view of an expected abundant harvest. The outlook in the country is most gratifying on every side, and farmers are buying very freely the newest appliances for rapidly dealing with the getting and storing of the crops.

The lighter trades of the city continue as last reported. The American houses chafe over the suspense caused by the delay in the American Tariff; their heavy stocks still being increased to prevent discharging their men. Travellers give very poor reports of the London and leading provincial markets. The special season trade in prizes for competitions is keeping one department of several of our best electro-platers and silversmiths fairly busy. Edge tools are again in increased demand; the season in garden implements has also been a good one, and in the kindred departments there is no lack of work.

Mr. John Barker, manager of the Grimesthorpe Steel Works, belonging to Messrs. Charles Cammell and Co., has just retired after forty-five years' service. The managers and staff presented him with an address and a purse containing fifty guineas. Mr. Barker, in acknowledging the gift, gave some interesting facts. Amongst other things he mentioned that the annual production of steel in his department alone has for some time past exceeded the whole output of Great Britain when his business life commenced.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

WAGES questions form the chief subject of attention in connection with the trade of this district, and as long as the strikes continue there is not much chance of improvement. Though the Scotch miners' strike has caused such a marked decrease in the production of pig iron, it has led to very little increase in the demand for pig iron made in this competing district, indeed it has caused a decrease in the sale of all kinds of pig, except No. 3, as it has stopped so many local as well as Scotch works consuming Cleveland forge and hematite pigs. The strikes, however, which most injuriously affect the business of this district, are those of the moulders and patternmakers, which have now been in progress nearly nineteen weeks, and which, though directly affecting only some 1500 men, have thrown over 16,000 out of employment. Some efforts have during the last few days been made to bring about a settlement of the difficulty, but unfortunately they have as yet led to no result. The desirability of forming a Conciliation Board seems to be conceded by both sides, but they do not appear to be able to agree upon the terms. In the first place, the men's representatives suggested the Mayor of Newcastle as mediator, and offered to at once resume work if the employers would agree to the formation of a Conciliation Board with a neutral chairman. The employers thereupon offered that ten of their representatives should be appointed to meet an equal number of the representatives of the men under a neutral chairman—the Bishop of Newcastle—to arrange for the formation of the Conciliation Board, but they required that the men should at once return to work, and that they should entirely abandon the present claim for an advance of wages, while they stipulated that there was to be no interference with any men who have worked during the strike, and intimated that they could not, owing to scarcity of work, undertake to find employment for all the men now on strike. The following were the gentlemen appointed to act with the men in forming the Conciliation Board:—Sir Andrew Noble, Sir B. C. Browne, Messrs. George Clarke, J. H. Irwin, E. Towers, G. H. Baines, T. Richardson, T. Westgarth, J. Pilling, and Dalrymple. This offer of the employers was generally regarded as a fair one, but the men did not so esteem it, because they are not prepared to abandon their present claim for advanced wages, but want that to be referred to the proposed Conciliation Board. Nothing further has been done to bring about a termination of this most disastrous strike, a strike from which so many more than those immediately concerned are serious sufferers, and for their sakes alone something more should be done without delay to effect an adjustment of the difficulty.

The Cleveland ironstone miners set the moulders an example, for, seeing that trade has gone back, they have abandoned their claim for 7½ per cent. advance of wages, which they made several months ago, and have renewed since. With regard to the eight hours' movement at the blast furnaces in the North of England, the men have decided to hold their demonstration on Saturday, August 11th. They had intended that it should take place on a Wednesday, but finding that such an arrangement would lead to the stoppage of the Eston, North-Eastern, and Consett steel works, they decided to have it on a day of the week which would cause the least inconvenience to consumers, but whenever it may be held it is calculated that it will cause a loss of £30,000, because the men will sacrifice £10,000 in wages for their day's holiday, and the masters will lose £20,000. It was suggested at the recent conference of masters and men that if one of the firms connected with the Cleveland Ironmasters' Association would undertake, at the joint cost of the whole Association, to experiment on the eight hours' shift, with a view to its general adoption if it was found to answer, the men would forego the demonstration. But the employers were not prepared to agree to this. A Middlesbrough firm, outside the Association, is about to adopt the eight hours' shift, and two other firms—non-members—have started it. Under these circumstances it would appear the wiser course for the men to wait and see how the scheme works out, and then they would have an unanswerable case when, if successful, they claimed the general adoption of the eight hours. It is admitted that at present the matter is a question of experiment in the North of England, and the proposed demonstration is not likely to bring about its earlier adoption.

Owing to the strikes and the smaller consumption the pig iron trade is dull, and only for No. 3 Cleveland pig is there anything like a fair demand. That quality is needed more largely for export to the Continent; so much so that the shipments oversea this month are the largest that have been reported in July for many years, and are the heaviest of any month this year. The Continent is taking more than usual from this district because there is less to be had from Scotland, and, moreover, both prices and freights are low, and the carriage of the iron from the coast to the inland works is more easily and cheaply effected than is general at this time of the year, when usually the rivers are very low, and the barges can only be loaded to half their capacity. The total pig iron shipments from the Tees this month have reached 74,264 tons, as compared with 67,678 tons last month, and 65,650 tons in July, 1893, all to 25th. On account of the extra foreign demand for No. 3 the supply has been considerably reduced in makers' hands; in fact, the stocks at some of the works is entirely exhausted, and there are cases where makers are not able to deliver all the No. 3 they have contracted to supply. Yet in spite of this the value of No. 3 does not improve, because if it were put up consumers would buy warrants, and makers' iron can hardly advance when warrants do not move upwards. Thus the quotation for No. 3 Cleveland G.M.B. pig iron is kept at 35s. 6d. for prompt f.o.b. delivery, and not less is taken. No reliable price is ascertainable for forward delivery, as people are not prepared to buy. Cleveland warrants have moved very little this week, not more than a halfpenny, the quotation being 35s. 5½d. cash sellers. Little iron is being taken out of the public store, and on Wednesday night

Messrs. Connal and Co. held 97,594 tons of Cleveland pig, or 437 tons decrease this month. The demand for all other quantities of pig iron than No. 3 has slackened, and forge qualities have again become rather a drug upon the market, for while the output has been increased, the consumption owing to the strikes has fallen off, both locally and in Scotland. No. 4 forge is 34s. The same may be said of hematite iron, mixed numbers of which can be obtained at 43s. per ton, f.o.b. Foreign ore has dropped considerably in price, and whereas for months nothing less than 12s. 6d. per ton, delivered Tees, was taken for best Rubio ore, there have been sales at 11s. 9d., and 12s. will now be taken for forward delivery. Most of the makers of hematite iron are now well stocked with ore, and merchants who have cargoes coming in which are unsold, have some difficulty in getting rid of them if they stick out for more than 11s. 9d. The freight Bilbao-Tees has further fallen to 4s. 10½d.

The finished iron and steel manufactories are badly employed, especially the former, few doing more than run half time, and reductions in prices have no effect in tempting consumers. The nominal prices are:—Common iron bars, £4 17s. 6d.; best bars, £5 7s. 6d.; iron ship angles, £4 12s. 6d.; iron ship plates, £4 15s.; steel ship angles, £4 12s. 6d.; steel engineering angles, £4 17s. 6d., and steel ship plates, £4 17s. 6d., all less 2½ per cent., and f.o.t. Heavy steel rails are nominally £3 12s. 6d., and steel sleepers, £4 17s. 6d., both net and at works. The Consett Iron Company will pay 9s. per share to the ordinary shareholders, and the Consett Spanish Ore Company 5s. per share, which are £1 paid. The members of the North-East Coast Institution of Engineers and Shipbuilders visited the Consett Works a few days ago.

The half-yearly meeting of the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trades of the North of England, which has been in existence since 1869, is to hold its half-yearly meeting at Newcastle on Monday.

The shipbuilders of the North-East Coast have agreed with the Executive Council of the Boilmakers and Iron and Steel Shipbuilders' Society—the action of the latter being confirmed by the general body of the men, 15,950 being for and 11,940 against—that a Conciliation Board shall be formed, the scheme to be tried for five years, and to be afterwards terminable by six months' notice on either side. As to alterations in wages, it is agreed that no general alteration shall be made until after six calendar months have elapsed from the date of the last alteration, and that no single alteration be more than 5 per cent. A standing committee of three on each side—exclusive of the delegates on each side—shall be appointed for each river to consider local disputes.

The members of the Cleveland Institution of Engineers on Friday last visited the waterworks now in course of construction in Baldersdale for the Stockton and Middlesbrough Corporations.

A fair business is being done by the coal trade of this district, but the shipments are not equal to what they should be at this time of the year, especially when the whole of the Scotch collieries are idle. The Northumberland coal trade have established a Conciliation Board for the purpose of settling wages disputes. At the first meeting held on Tuesday, it was officially reported that the average realised price of Northumberland coal during the three months ended May 31st had been 6s. 4·72d. per ton, and the masters claimed a reduction of wages, as this figure was considerably below that of the previous quarter. It was decided that the reduction should be 5 per cent. The Northumberland and Durham Coal Sales Association has now been fully established, and among the subscribers are the Marquis of Londonderry, the Earl of Durham, Sir James Joicey, Bart., Sir Charles Mark Palmer Bart., Mr. Lindsay Wood, Mr. David Dale, and Mr. W. Stobart. The price of best Northumberland coal this week is 11s. per ton. Good Durham coke is firm in price, and 12s. 6d. per ton delivered Middlesbrough, can readily be got, while 12s. 9d. is generally asked.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been very little doing in the Glasgow iron market this week. The transactions in warrants have been confined mainly to what was incident to former accounts. Operators continue to keep out of the market and consumers are quite indifferent, their wants at the moment being few and unimportant. There is comparatively little change in the price of warrants.

The special brands of makers' iron show a decided advance, owing to their scarcity and to so many furnaces being out of blast. G.M.B. f.o.b. at Glasgow No. 1 is quoted 43s. 6d. per ton; No. 3, 42s. 6d.; Monkland No. 1, 47s.; No. 3, 42s. 6d.; Carnbroe No. 1, 48s.; No. 3, 45s. 6d.; Clyde No. 1, 54s.; No. 3, 48s. 6d.; Calder No. 1, 54s. 6d.; No. 3, 48s. 6d.; Summerlee No. 1, 55s.; No. 3, 48s. 6d.; Gartsherrie No. 1, 57s. 6d.; No. 3, 48s. 6d.; Coltness No. 1, 57s. 6d.; No. 3, 52s. 6d.; Glengarnock at Ardrossan No. 1, 52s.; No. 3, 48s 6d.; Eglinton No. 1, 50s.; No. 3, 45s. 6d.; Dalmellington No. 1, 49s.; No. 3, 45s. 6d.; Shotts at Leith No. 1, 55s.; No. 3, 51s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 3600 tons, against 4821 in the corresponding week of last year. There was despatched to Canada 207 tons, South America 100, Australia 130, France 315, Germany 140, Holland 921, Belgium 40, other countries 115, the coastwise shipments being 1632, against 2712 tons.

Since last report seven additional furnaces have been put out of blast. There are now in operation three at Coltness, four at Shotts, and four at Glengarnock, total blowing in Scotland eleven, as compared with eighteen last week, and sixty-two at this time last year.

The market for manufactured iron and steel continues quite inanimate. Very few of the works have yet resumed, and there is no change in the position of business, which is that of complete stagnation.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced sewing machines worth £8645; other machinery, £27,233; steel goods, £4880, and miscellaneous iron goods, £21,145.

At most of the shipyards in the Glasgow district the holidays are now over, work having commenced on Tuesday last. It is reported that many builders and engineers have good supplies of coal in stock, which will last in some cases four or five weeks.

The prospects of the locomotive engineering department are fairly satisfactory. Messrs. Neilson and Co., of Glasgow, have received an order for ten heavy locomotives for the Great Indian Peninsular Railway, and Messrs. Dubs and Co., of the Glasgow Locomotive Works, have obtained an order for engines from Russia, as well as from the Midland Railway.

The coal market continues disorganised owing to the miners' strike, which has now lasted for about five weeks. The holidays have of course greatly curtailed the demand, but those who are in want of coals have little difficulty in obtaining supplies, there being plenty on offer both from Fifeshire—where considerable stocks are kept—and from England and Wales.

Great distress already prevails in a number of mining districts, the miners and their families being reduced to the necessity of begging for their daily bread. The support sent from England, although no doubt generous enough from the point of view of the English miner, has proved altogether inadequate to meet the necessities of from 60,000 to 70,000 miners and their families. As for the employers, they appear quite resolved to wait until the men ask to be re-admitted to the mines, and so much injury has been done to trade by the strike, that it is doubtful whether the miners will be allowed to resume at the old wages. The pig iron industry has of late years repeatedly been subjected to very serious loss by strikes of miners, and the almost complete stoppage of the manufacture, on this occasion, shows how resolute the ironmasters are, and how hopeless the position of the men on strike. The miners' leaders have, so to speak, struck down the iron industry for the time, and in iron circles any proposals for arbitration are regarded as utterly futile.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE inquiry into the Albion explosion still continues, and a mass of evidence has been given by the various witnesses, including one or two survivors, who were able to describe the actual state of things just previous to the disaster. The under-manager, examined on Tuesday, had formed a similar opinion to that expressed by the manager, as to the starting point of explosion in Grover's level, and to the probable cause—a large collection of gas dislodged from a cavity by a great fall. Upon this head, methods of blasting, watering, "bashing," sending out rubbish instead of building them up, testimony is borne that will be of importance in assisting to give a decision, and no doubt will be valuable in directing operations in the future. The very fact that there were men in the first shift, who went on again in the second shift, points out one probable cause—the haste of the men to "rush out coal," and possibly to the neglect of wise precautions for their own safety. Another body was brought up this week.

There has been no falling off in the coal trade, and in every direction a good deal of vigorous work is being done, both with regard to existing collieries and in sinking new ones. The Tredegar Company, by sinking to the deep at the Pochin Collieries, will inaugurate another bold winning of the lower measures of Monmouthshire, a good deal of which remain practically intact, considering the large area. It is interesting to note that great iron companies, such as Gadlys, Abernant, Plymouth, Rhymney, and Tredegar, are now solely devoted to coal getting, and the "iron works" are represented by a few fitters, smiths, and others.

It is a debateable subject in the district, that an ironworks laid by rarely, if ever, resumes operations. Still, with regard to Rhymney and Tredegar, which are well equipped with the best steel plant, I do not see any reason to doubt but that a restart might follow in the track of better times in steel. The public will be in a position to form a shrewd judgment regarding the steel work on the hills when the full completion of "Dowlais-on-sea" has been brought about. This is being rapidly done. It would have been very opportune to have finished the works, and completed the sinking of the Dowlais Cardiff Collieries at the coming of age of the heir of Lord Wimborne, but I do not think that this is practical.

A local authority comments with some force upon the various schemes of the year, illustrating the industrial progress of South Wales. These I have touched upon as they have been brought to the front. First among these is the Bute Docks addition, which, when completed, will give Cardiff a high position amongst the leading ports of the country. One significant point concerning this addition is the deepened channel which is intended, and is to be constructed with a view to admit of steamers of 5000 to 10,000 tons, which the commentator justly observes, "are to be the boats of the future."

Next in importance come the Port Talbot Dock and Railway. This, and a railway to Maesteg, will bring a great tract of coal country into full development. It is pointed out that at present coalowners shipping from this district at Cardiff pay 1s. 4d. to 1s. 6d. The Maesteg line, connected with Port Talbot, will do this for 6d. per ton. Some may think that this will tell seriously upon Cardiff, but I have a strong belief that, as in the case of Barry, there will be ample business for all.

The prophets, who anticipated a decline in steam coal prices, are "out" completely. Present quotations on Cardiff Exchange are as firm as ever. Latest mid-week prices were: Best steam, 12s. to 12s. 6d.; seconds, 11s. 6d.; best Monmouthshire, 11s. to 11s. 6d.; dry kinds, 10s. 6d. to 10s. 9d.; small, 6s. to 6s. 6d. House coal keeps up unusually well, and the slack and depressed season, both in quantity and price, appears to keep aloof. It was noticed on 'Change this week that booking forward was exceptionally brisk. Latest prices are:—Best, 11s. to 11s. 3d.; No. 3, Rhondda, 10s. 9d. to 11s.; brush, 8s. 9d. to 9s.; small, 6s. 9d. to 7s.; No. 2, Rhondda, 10s. to 10s. 3d.; through, 7s. 3d. to 7s. 6d.; small, 5s. to 5s. 3d.

Coke has begun to show greater firmness; the demand is better, and prices firm. Latest are:—Cardiff: Furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; and special, 20s. to 21s. Pitwood and patent fuel in moderate request; prices unchanged. Swansea has had another good week of patent fuel shipments, France taking 2130 tons, Turkey 2200, Italy 3950, and Algeria 1550 tons. Swansea price, 10s. 6d. to 11s. For iron ore the requirement is less. Good cargoes continue to arrive, the principal going to Tapson and Son, La Société Commerciale, Ebbw Vale Company, and Blaenavon. Figures are lower. Rubio is quoted at 11s. to 11s. 3d.; Tafna and Garucha, 10s. 6d.; and Porman, 10s. Pig iron stocks are large at various places, and the import also is large from Middlesbrough and other quarters. Last week Swansea imported 590 tons.

Swansea coal quotations are:—Steam coal, from 11s. 6d.; No. 3 Rhondda, from 11s.; anthracite, from 8s. 9d. to 12s. 6d., according to quality.

There is little or no change in the iron and steel trades, and make continues moderate, even in steel bar. Steel rails, though admittedly at the lowest point in price, are only in slight demand. The latest quotations on 'Change, Swansea, this week were as follows:—Glasgow pig, which has taken a stationary position, 41s. 11d. to cash buyers; Middlesborough, 35s. 5d.; hematite, 43s. 7d. for mixed numbers f.o.b.; Welsh bars, £5; sheet iron, £5 15s. to £6 10s.; steel sheets, £5 to £6 5s.; steel rails, heavy section, £3 15s. to £4; light, £4 7s. 6d. to £4 10s.; sleepers, angles, channels, &c., according to section and specification.

Bessemer steel:—Tin bars, £4 to £4 2s. 6d.; Siemens best, £4 2s. 6d. to £4 5s. Cardiff prices vary slightly from this. Bessemer blooms are offered at £3 17s. 6d.; tin plate bar, £4 5s.; and Siemens best, £4 5s.

I am glad to continue favourable reports of Briton Ferry. This week six mills were at work at the Villiers, four at Vernon, three at Baglan Bay, and three at Gwalia. The make of pig iron and steel bar is well maintained, and demand, I hear, is quite up to the make.

The history of the iron and steel trade of Wales, from earliest times to the present, is one of the forthcoming works, uniform with the history of the coal trade. In it, amongst a variety of interesting annals of men and works, we are told all that is known of Trevitheck, and his labours in Wales. Our South Wales correspondent mentioning it, says, I have lately been upon the track of his earliest locomotive, which ran along the Merthyr tramway in 1804. Many persons imagine that it is in the Kensington Museum, and several have declared that it was exhibited at Tynemouth Museum. The fact is that, after doing duty on the tramway, it was relegated to pit work. The Penydarran Company, in sinking their deepest pit, utilised it at Winch Vaun, by the side of the Penydarran incline, and there it was to be seen, old people aver, "with the piston fastened in the boiler, and with three cocks doing duty instead of safety valves." Then it was put to work at the incline, was "restored" bit by bit, and finally disappeared. I do not despair, however, yet, of getting a fragment.

Swansea harbour trade continues satisfactory, the only decline being in tin-plate, which is going through a course of "ups and downs." Short delivery continues to be the leading feature, and the thirty-six box rule promises to assume a critical form, leading to important stoppages, unless the men exercise common sense. The engineer to the Trust has been instructed to prepare working plans for the extension of the Prince of Wales Dock. Permission has been given to the executors of the late Mr. Walker to make an entrance from the Prince of Wales Basin to their proposed Commercial Dry Dock. Mr. Westlake proposes to construct a pontoon, gidiron, &c., for the repair of vessels of the largest channel capacity.

A meeting of the Albion colliers was held on Monday to consider a proposal from the manager of the colliery, that they should revert to the system which was in vogue before the explosion, of working daily shifts of ten hours. This was discussed and refused, so a temporary halt has been the result. Mr. W. T. Crawshay has generously given £100 in aid of the widows and orphans of the calamity.

Newport coal trade is very brisk. The Plymouth strike, which has lasted seventeen weeks, to the grave detriment of funds, has come to an end, with some slight but acceptable concessions.

Tin-plate shipments last week only amounted to 37,079 boxes; receipt from works, 49,570 boxes; present stock, 289,597 boxes. Latest prices tin-plates, Swansea:—Bessemer cokes, 10s. 3d. to 10s. 4½d.; Siemens, 10s. 4½d. to 10s. 7½d.; best charcoal, 11s. 6d. to 12s. 6d.; ternes, 19s. to 23s. Wasters, 6d. to 1s. less than primes; odd sizes, usual extras; all delivered in Prince of Wales Dock, Swansea. Cash, usual discount.

Block tin is at £66 15s. to £67 5s.

The Western Wagon Company, Bristol, again show good results. The directors recommend a dividend of 8 per cent.

Coal and iron shares are moderately good. Albions are about 11¼, W. Dawes and Sons 13$\frac{5}{16}$, Norths £2 12s. 6d. Rhymney iron, old, 32s. The new shares are brisk at 17s. and 16s. 9d.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THOUGH general iron business over here does not show much animation, the tendency of prices may still be called a pretty firm one. For export there have been very few inquiries stirring, but the demand experienced on home account remains fairly satisfactory, so that the majority of the works report themselves tolerably well engaged.

A somewhat better tone has manifested itself on the Silesian iron market this week. The orders that come in for bars and sectional iron, though of small weight generally, have increased in number. The business in heavy plates continues weak, but that in sheets is decidedly improving. Tube foundries as well as wire mills are likely to be well engaged for some time to come, a fair amount of new work having come to hand lately, while at the machine factories but very few orders are being booked.

In Austria-Hungary the iron industry continues well employed in all departments. The demand for pig iron is good, and that for malleable iron has been decidedly satisfactory all through last week. Here and there fair orders for building requirements have been secured, and it is now considered as tolerably certain that autumn business will develope quite favourably. An advance in quotations has not yet been taken into consideration, but it is very probable that prices will soon show an inclination to rise.

The situation of the French iron business remains pretty favourable, for both raw and finished iron orders are coming in regularly; and although the prices paid leave, on the whole, but little profit, the tone of the market is hopeful and firm, the more so as there is good reason to expect a lively autumn business.

In Belgium the pig iron trade is still languid, and there has been next to no inquiry coming forward in the finished iron department. Prices are, nevertheless, pretty firmly maintained this week, and the general tendency is, perhaps, less despondent than formerly. Comparing the quotations of June and July of present year, no change whatever is noticeable except in plates, No. 2 having advanced from 130f. p.t. on 132·50f. p.t., while No. 3 rose from 150f. on 152f. p.t.; steel plates also advanced from 140f. on 142·50f. p.t.; sheets are still quoted 160f. p.t., and steel rails also remain on 95f. p.t. The number of blast furnaces in blow on the 1st of July was the same as in the beginning of June. The following shows the production of pig iron in Belgium for June and during the first quarter of 1894 and 1893:—

| | June. | | January to June. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | Tons. | | Tons. | |
| Forge pig.. .. | 36,600 .. | 34,350 .. .. | 189,220 .. | 211,670 |
| Foundry pig .. | 7,050 .. | 6,600 .. .. | 47,415 .. | 39,820 |
| Basic.. .. .. | 34,500 .. | 21,300 .. .. | 207,150 .. | 127,625 |
| Totals .. .. | 78,150 .. | 62,250 .. .. | 443,785 .. | 379,115 |

Although the Rhenish-Westphalian iron market has but slightly changed since last week, that change has, generally, been in the direction towards improvement. Prices for raw as well as finished iron are, as a rule, decidedly unremunerative, and in no proportion to those of the raw materials, but as there has been an improvement in the demand for some sorts lately, the more sanguine ironmasters think an advance in quotations is very likely to follow. The iron ore trade is quiet, but all things considered, there is not much cause for complaint, consumption being about equal to production, while prices show a pretty firm tendency, both in Siegerland and Nassau. Spathose iron ore fetches M. 7·40 to 7·90 p.t.; for roasted do. M. 11 to 11·50 p.t. is given. Nassau red iron ore, 50 p.c. contents, costs M. 9·20 p.t. free Dillenburg.

A fair demand is experienced in Luxemburg-Lorraine minette, and prices have stiffened a little; for red minette, 40 p.c. contents, M. 3·40 p.t. is given, while inferior qualities are noted M. 2·40 to 2·70 p.t. net at mines. For crude iron the demand has, in a few instance, improved, and the further development of the pig iron business is looked forward to with confidence. In the Siegerland the demand for some requirements has been steady, and prices are fairly maintained; orders from abroad still come in very slowly.

The price noted for spiegeleisen, 10 to 12 p.c. grade, is still M. 52 p.t.; Rhenish-Westphalian forge pig, No. 1, M. 46 to 47; No. 3, M. 40 p.t.; Siegerland good forge quality, M. 44 to 45 p.t.; hematite, M. 45 p.t.; foundry No. 1, M. 63 p.t.; No. 3, M. 54 p.t.; basic, M. 45 p.t.; Bessemer, M. 49 to 50 p.t.; iron for making steel, Siegerland sorts, M. 45 p.t.; Rhenish-Westphalian brands, M. 47 p.t. at works; Luxemburg forge pig costs 48f. p.t. free Luxemburg. Makers of manufactured iron report themselves fairly well occupied, the demand for bars having slightly improved upon the week. Girders are in moderate request, and prices continue depressed, Hoops are rather brisk of sale and pretty firm in quotation. The plate and steel trade is in exactly the same position as during former weeks, and there is also not the slightest change noticeable in the wire department, demand and sale remaining extremely limited. A pretty large outturn is going on at the tube mills, prices have shown a stiffening tendency; the machine and wagon factories, on the other hand, are extremely short of orders, and complain of unremunerative quotations.

The following are the latest list prices per ton at works:—Good merchant bars, M. 110; angles, M. 120; girders, M. 90 to 95; hoops, M. 113 to 118; billets in basic and Bessemer, M. 81; heavy plates for boiler-making purposes, M. 150; tank do., M. 130 to 135; steel plates, M. 125; tank do., M. 115 to 120; sheets, M. 140; Siegen thin sheets, M. 130; iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivet iron, M. 130; rivets, M. 150 to 155; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

The total production of pig iron in Germany, including Luxemburg, was for June of present year 471,922 t., of which 127,430 t. were forge, pig, and spiegeleisen; 54,059 t. Bessemer; 214,473 t. basic; and 75,970 t. foundry pig. Output in June, 1893, amounted to 409,473 t.; in May, 1894, production was 468,981 t. From January 1st to June 30th, 1894, 2,649,071 t. were produced, against 2,401,960 t. for the same period the year before.

THE GEOLOGISTS' ASSOCIATION.—This Association will commence their long excursion to the County of Shropshire on July 30th, at Wellington, ending up on August 4th, at the same place. Members who wish to join excursion should notify their intention to the excursion secretary, Mr. Thomas Leighton. They should also apply for the programme, which is most complete, including all necessary maps, sections, &c., and railway arrangements.

## AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 19th.

THE situation from the manufacturing standpoint can be clearly seen by reference to the report of railroad earnings for June, which shows them to have been 21·84 per cent. below gross earnings of June last year. The railroad strike is said to be over, but the strikers have not formally yielded. Railroad earnings fell by one hundred million dollars for the first six months. During that time 25 per cent. of the reporting railroad mileage went into receivership, which is temporary bankruptcy.

Prices are declining. The iron trade is dull. Blast furnace production is increasing. Forge is 10 dols. to 11 dols.; Bessemer, 13 dols.; billets, 19 dols.; steel rails, 24 dols. There is no disposition to enter into contracts for full delivery. The rolling mill facilities were never in more complete shape for cheap and rapid work. The industrial stagnation may be terminated very suddenly, and buyers will then find themselves facing an empty market. Prices cannot much longer continue at almost the cost basis.

## LAUNCHES AND TRIAL TRIPS.

On Thursday, the 19th inst., there was launched from the yard of the Tyne Iron Shipbuilding Company, of Wellington Quay-on-Tyne, a steel screw steamer, built to the order of Messrs. Burrell and Sons, of Glasgow, and of the following dimensions, viz.:—Length, 350ft.; breadth, 43ft.; depth, 30ft.; and to class 100 A1 at Lloyd's on the spar deck rule. This vessel has water ballast fitted right fore and aft, on the cellular system, and is also fitted with all modern improvements for the rapid loading and discharging of cargo, including six double-cylindered steam winches, direct-acting steam windlass, large multitubular donkey boiler, steam steering gear by Messrs. Caldwell and Co., and Hastie's screw gear aft. The engines, which are to be supplied by the North-Eastern Marine Engineering Company, are of the triple-expansion type, having cylinders 24in., 40in., and 66in. by 45in. stroke, with two single-ended boilers fitted with Howden's system of forced draught, to work at a pressure of 170 lb. The vessel on leaving the ways was named the Strathneyis, by Miss Bone, of North Shields.

On Thursday, the 19th inst., Messrs. Palmers' Shipbuilding Company launched from their yard at Jarrow-on-Tyne the steamer Ranza. She is of steel, build on the three-deck class, and her principal dimensions are: — Length, 410ft.; breadth, moulded, 49ft.; depth, moulded, 34ft. She is constructed to carry fully 8000 tons deadweight on Lloyd's summer freeboard. The owners are Messrs. the Caledonia Steamship Company, of Liverpool, one of whose steamers, the Ratho, built in the same yard and with the same general features, has run with special success and economy. The engines will have cylinders 27in., 44½in., and 73in. in diameter by 48in. stroke, and steam is to be supplied by three large single-ended boilers. The engines and boilers are also built by Messrs. Palmers, and the hull and machinery are being constructed under the superintendence of Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool, who are the owners' regular consulting engineers. Exceptional facilities will be offered for loading and discharging the cargoes, and there are six winches and portable derrick posts in addition to the usual fittings at the masts. She will be one of the finest and most modern equipped cargo steamers afloat, and has been laid down for quick service, and is designed for high speed at sea.

A few days since there was launched from the yard of Earle's Shipbuilding and Engineering Company, Hull, the new steel twin screw steamship Vienna, the fourth of a fleet of handsome vessels built by them for the Great Eastern Railway Company's new route to the Continent, *viâ* the Hook of Holland. The previous boats now on the station are the Chelmsford, Berlin and Amsterdam. The Vienna is 302ft. long, 36ft. beam, and 16ft. 3in. depth of hold, and she is built with a long partial awning deck and poop, under the former of which are situated the first-class dining saloon, ladies' room, state-rooms, lavatories, and the accommodation for officers, together with pantries, bar, galley, &c. On the lower decks, and entirely forward of the machinery and boilers, are the first-class state-rooms, with separate compartment for ladies where desired; and in a large deck-house on the awning deck are the saloon entrance, state-rooms, and captain's room, with a spacious trunk skylight for light and ventilation to the saloon. The total number of first-class passengers provided for is 218, and the whole of the fittings and equipment for these are of the most modern and complete description, every detail being carefully considered which might add to the comfort of the passengers, and the arrangement is generally the same as in the Chelmsford, but with various additions and extensions with the object of increasing the efficiency, amongst these being a handsome state-room capable of being divided, when required, into two, and constructed of polished hard woods of special design, this being intended for the accommodation of distinguished passengers. The system of fan ventilation now adopted in all the Great Eastern Railway steamers is in this one extended and elaborated so as to obtain a most ample supply of fresh air to the various spaces, and steam coil stoves are provided for heating the vessel throughout. The second-class accommodation is of a very comfortable kind, and established in the poop and after 'tween decks for 120 passengers. The Vienna will be schooner rigged with two light pole masts. Three powerful winches, with derricks and gear, are fitted for working the cargo, which, although quite subordinate to the passenger accommodation, requires to be handled with great despatch. Provision is also made in the 'tween decks forward for the carriage of horses. Water ballast for trimming purposes is also provided, and the equipment of boats will be stowed on a boat deck overhead, which will afford rain shelter for passengers besides forming a promenade on top. There are two sets of triple-compound engines to develope 4500 indicated horse-power collectively, steam being supplied by five large steel boilers. For use in calm weather and to ensure a good supply of air to the furnaces large fans will be fitted in the engine department, and the machinery generally is of the most modern type, and designed to meet all the requirements of their high rate of running. The speed expected to be attained by the Vienna is 18 knots.

On Tuesday, the 17th, the steel screw steamer Ceylon left the Cleveland Dockyard of Sir Raylton Dixon and Co., Middlesbrough, for the purpose of testing the general working of the vessel and her machinery by a run along the coast. This steamer has been built for the Peninsular and Oriental Steam Navigation Company, of London, being the third which these builders have constructed for the same company, and the Ceylon is fitted and finished in a very similar manner to the s.s. Aden, completed about two years ago for the same company's Eastern Line. The principal dimensions are: Length 390ft., beam 47ft., depth moulded 30ft. 10in., with a deadweight carrying capacity of about 6000 tons. The steamer is of the three-decked type, and takes Lloyd's highest class, but many of the scantlings are in excess of Lloyd's rules. She has also been built to fulfil the Admiralty requirements for unarmoured transports. The midship part of the vessel is very handsomely fitted up for the accommodation of first-class passengers, the saloon being tastefully decorated and panelled in white oak. Bath-rooms, lavatories, awnings, pneumatic bells, &c., are in sufficient number to ensure the comfort of the passengers at sea, and a spacious promenade deck extends the whole length of the bridge-house. The vessel is lighted throughout by electricity, and the 'tween decks are available for carrying troops or third-class passengers, being fitted with the necessary latrines, cooking and washing arrangements, &c. All the exposed decks are of teak, and the main deck is of steel sheathed with pitch pine, the orlop deck being of pine. The deck machinery for the working of cargo comprises seven large steam winches and two powerful cranes, the masts being fitted with double derricks and outriggers. The engines are by Messrs. Thos. Richardson and Sons, of Hartlepool, the cylinders being 30in., 49in., 77in., by 48in., with two large double-ended steel boilers, the propeller being of manganese bronze. The hull and the machinery of the steamer have respectively been constructed under the supervision of Captain C. E. Baker, who will command the ship, and Mr. J. W. Sellex, chief engineer. A large party of friends were present, at the invitation of Sir Raylton Dixon, and the owners were represented by Captain Angove, marine superintendent, and Mr. Manuel, superintending engineer, who expressed themselves very highly satisfied with the manner in which the contract had been carried out in every respect. The speed attained was 14·3 knots per hour, everything working satisfactorily. At the termination of a most successful trial trip, the steamer returned to the Middlesbrough Dock, where she will ship about 3000 tons of iron and coal, and then proceed to London to complete her cargo for India and China.

LEEDS ASSOCIATION OF ENGINEERS.—On Saturday, July 14th, the members of this Association visited Wakefield, and proceeded to the works of the Seamless Steel Boat Company, when they were met by Messrs. Richardson and Wright. The seamless steel boats, the manufacture of which was commenced at these works in 1890, are made in various sizes, from 15ft. to 30ft. in length. The 15ft. boats are pressed out of one sheet, but larger boats are composed of two plates, one on each side, with a strong T bulb bar between, forming the stem, stern, and keel. The two sides and keel bar are punched and riveted by hydraulic pressure. The press in which the boats are made is about 34ft. long, worked by six rams of 15in. diameter each, with a pressure of 875lb. per square inch. This press and the whole of the hydraulic machinery are by Messrs. Henry Berry and Co., of Leeds. There is also a very large plant for the deposition of zinc on the boats by electrolysis, which prevents corrosion in sea-water, and is, of course, applicable to any kind of ironwork required to withstand the weather. The boats are now in large demand by leading steamship companies. The party next proceeded to Messrs. Spurr, Inman, and Co.'s Calder Vale Boiler Works, where they were met by Mr. Sheard, managing director. The first machine to which he drew attention was a bending machine with four rollers, which would bend a plate 1⅛in. thick by 7ft. wide right up to the extreme ends, no hammering being necessary, as was formerly the case with the three-roller machine. The rollers are vertical, so that the edges of the plates are not damaged. After the plates are bent, they are placed in a machine built like a vertical lathe, which turns up the edges, and afterwards, by means of a slotting arrangement, slots each end. The shell courses thus prepared for drilling are lifted on to the drilling machine by a powerful travelling crane. There are three of these machines, enabling the firm to drill 15,000 rivet holes per week. The riveting is done by hydraulic machinery having pumps recently supplied by the Leeds Engineering and Hydraulic Company. The flues are welded by a steam flue-welding hammer made by Messrs. Pilkington, of Accrington. After being flanged, they are turned up on their edges, drilled, and riveted, a pressure of 45 tons being put on each rivet. The circular-end plates having been flanged and turned up on their edges, flue openings cut out, oval manholes cut out at one operation, and the boiler completed, a huge travelling crane lifts it to its place in the yard. The party had also been invited to inspect the works of Messrs. J. Rhodes and Sons. There they were met by Mr. George Rhodes, who drew their attention to the numerous improved presses, dies, and special machines designed by his firm for producing with great rapidity almost every description of sheet metal goods, from match-boxes to travelling trunks, &c. Metal casks to contain from 36 gallons are stamped out in four pieces, ingeniously bent, and securely fastened together. Other specimens of work were equally novel and interesting.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

*11th July*, 1894.

13,426. Sley Caps, L. Bulcock and W. J. Threlfall, London.
13,427. Fixing Broom Handles, L. Bulcock and W. J. Threlfall, London.
13,428. Pneumatic Tire Pumps or Inflators, A. E. Moore, Dublin.
13,429. Automatic Door Holder, A. E. Moore, Dublin.
14,430. Puzzle, R. G. Graham, London.
13,431. Preventing Pipes Bursting, C. M'Carthy, London.
13,432. Hair-curling and other Pins, J. Leoboldti, London.
13,433 Electric Telegraphy, C. J. A. Munier, London.
13,434. Optical Lanterns, S. J. Levi and A. J. Jones, London.
13,435. Stud for Wearing Apparel, H. H. Lake.—(*A. F. Richter, Germany*)
13,436. An Ointment, E. Hopkins and E. Frost, London.
13,437. Camera "Magazine Backs," J. McL. Dobson, Lanarkshire.
13,438. Trousers Protector, H. M. Lynn and R. E. Caunter, London.
13,439. Apparatus for Drying Tea, H. Hemans, London.
13,440. Destroying Insects on Plants, P. P. Gieve, London.
13,441. Cycle Adjusting Pins, F. and E. Warwick, Birmingham.
13,442. Puzzle or Game, J. G. East, London.
13,443. Fast Dyes, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
13,444. Curtain Poles, W. Woolf, London.
13,445. Signal Whistles, Alarms, &c., L. P. Garrett, London.
13,446. Siccative Drying Ointments, O. Troplowitz, London.
13,447. Sash Fastener, A. J. Ball and J. C. Hickton, London.
13,448. Ships' Hatches, J. Lefeuvre, London.
13,449. Perambulators, W. Andrew, London.
13,450. Breech Mechanism for Guns, A. Welin, London.
13 451. Velocipedes, S. Dyson, London.
13,452. Garment Supporters, F. G. Davis, London.
13,453. Miners' Safety Lamps, J. A. Noel, London.

*12th July*, 1894.

13,454. Appliances for Shipping Coal, C. R. Soar, Derbyshire.
13,455. Anchor, A. E. Muirhead, Glasgow.
13,456. Preventing Yarn from Twisting, D. and J. Smith, Blackburn.
13,457. Wire Fabrics, W. Waterhouse and T. W. Blantern, Birmingham.
13,458. Pannier Net Shafts, H. W. Rowland, Liverpool.
13,459. Clearers for Spinning Machines, G. Paley, Preston.
13,460. Velocipedes, G. L. Scott, Manchester.
13,461. Water-closets, J. Shanks, Glasgow.
13,462. Manufacture of Wood Pulp, T. Thornley, Manchester.
13,463. Rests for Billiard, &c., Cues, G. Moore, jun., Birmingham.
13,464. Construction of Waistcoats, W. C. Butler, Edinburgh.
13,465. Construction of Shirts, W. C. Butler, Edinburgh.
13,466. Divider Attachment to Scale Rules, E. H. Blake, Reading.
13,467. Rail Joints for Railways, E. Rees, Blaenavon, Mon.
13,468. Shuttle Guard for Looms, T. Ashworth, J. Rawson, and J. T. Cornall, Rochdale.
13,469. Dark-room Lamp, J. Davies, Birkenhead.
13,470. Iron Picker for Looms, A. Mosley, Huddersfield.
13,471. Wood Pavements, T. Gare, Manchester.
13,472. Construction of Cloth, J. G. Brook and A. Beaumont, Huddersfield.
13,473. Clothes Pegs, J. R. Brailsford and Vann and Co., Birmingham.
13,474. Apparatus for delivering Goods in Exchange for Coin, H. Millar, Newcastle-on-Tyne.
13,475. Stoppering Barrels, &c., J. S. Lowe, Birmingham.
13,476. Steam Boiler Furnaces, W. McG. Greaves, Manchester.
13,477. Automatic Barrel Tilters, J. Ames, Manchester.
13,478. Electric Arc Hood, S. G. Brown, Chelmsford.
13,479. Bottom Brackets for Bicycles, W. Smith and W. R. Fletcher, Birmingham.
13,480. Newspaper Reading-stand, H. A. Shuttleworth, Birmingham.
13,481. Driving Gear for Cycles, C. B. Lawson, Glasgow.
13,482. Preventing Vibration in Road Vehicles, W. Jones, Glasgow.
13,483. Cord for Window Blinds. A. Bell, London.
13,484. Trusses for Surgical Purposes, W. D. Lewis, London.
13,485. Alarm Bell, G. Leclercq.—(*F. Marti, France*)
13,486. Puzzle Game, J. Benford, E. J. Hayball, and H. Harcourt, London.
13,487. Towel Roller, J. Titley, Staffordshire.
13,488. Cycle Pedals, R. Wootton and B. Hewitt, Birmingham.
13,489. Steam Trap, J. Schofield, Manchester.
13,490. Counting Apparatus for Typewriters, W. Ollerhead, London.
13,491. Lock as a Sash Fastener, C. Barr, London.
13,492. Manufacture of Alcohol, R. Zdarck London.
13,493. Anchors, F. A. Crispin, London.
13,494. Soles for Boots and Shoes, T. Newman, London.
13,495. Portable Stands, J. R. Selbach, London.
13,496. Stirrup, W. P. Thompson.—(*J. M. L. Haddorf and H. F. H. Egyers, Germany.*)
13,497. Combined Walking-stick and Pipe, W. P. Thompson.—(*H. Wimmel, Germany*)
13,498. Fastening Scythes to Scythe-poles, W. P. Thompson.—(*C. F. L. Grabner, Germany*)
13,499. Decomposition of Alkali Salts, A. Sindin-Larsen, London.
13,500. Artists' Easels, A. Slocombe, London.
13,501. Metal Letters for Shop-signs, E. E. and C. F. Gloss, London.
13,502 Ladies' Veiling, A. A. Smith, London.
13,503. Holder for Dominoes, R. W. Hassom London.
13,504. Resiliency of Pneumatic Tyres, R. E. Phillips.—(*The Overman Wheel Company, United States*)
13,505. Crank Axles for Cycles, R. E. Phillips.—(*The Overman Wheel Company, United States.*)
13,506. Manufacture of Explosives, H. H. Lake.—(*Dynamite-Actien-Gesellschaft vormals A. Nobel and Co., Germany.*)
13,507. Tobacco Pipes, S. R. English, London.
13,508. Mouthpieces for Tobacco Pipes, S. R. English, London.
13,509. Coal Boxes, H. E. Newton, London.
13,510. Ships' Berths, E. Lawson and J. Harvey, London.
13,511. Furnace Grates, M. F. Mulready, London.
13,512. Axle Bearings of Tramway Trucks, A. H. Wallis, London.
13,513. Filters, J. N. Carey, London.
13,514. Railway Carriage Door Guard, C. W. Martindale and S. Handscombe, London.
13,515. Holder for Twine Thread, &c., J. N. Carey, London.
13,516. Printing, J. H. Corthésy, Richmond.
13,517. Pianos, H. Wagner, London.
13,518. Stone Crushing Apparatus, C. W. Thompson, London.
13,519 Cooking, &c., Stove, A. J. and A. A. Stonely, London.
13,520. Locking or Securing Cycles, E. Beebee, Birmingham.
13,521. Floor Clamping Apparatus, T. H. Wyatt, Birmingham.
13,522. Facilitating the Turning of Vehicles, H. Carmont, London.
13,523. Electric Arc Lamp Reflectors, C. Coerper, London.
13,524. Gas Engines, A Vermersch, London.
13,525. Sewing Machine Attachments, W. Ross, London.

*13th July*, 1894.

13,526. Cycle Driving Gear, P. L. Renouf and F. Westwood, Birmingham.
13,527. Construction of Washing Coppers, W. Smith, Crayford.
13,528. Brakes for Bath Chairs, &c., A. Squire, London.
13,529. Inlet and Outlet for Lavatories, W Matthews, Manchester.
13,530. Cycle Wheels, H. Montgomerie, Newcastle-on-Tyne.
13,531. Device for Catching Beetles, G. E. Winter, London.
13,532. Upright Piano Action, R. Burn.—(*F. E. Wood, United States*)
13,533. Cases for Holding Fishing Flies, T. F. Edgeworth, Bristol.
13,534. Securing Window Cords, A. E. Hacking and R. A. Hall, Nottingham.
13,535. Fishing-line Winder and Drier, H. Brooke, Liverpool.
13,536. Lubricators, C. Ankers, Leicester.
13,537. Lamps, J. T. M. Hircock and J. T. B. Bennett, Birmingham.
13,538. Metal Bath Casting Moulds, J. McAllister, Glasgow.
13,539. Cycle Cranks, G. Pirnie, Dundee.
13,540. Propelling Ships, J. M. Gorham and A. V. Gifkins, Westminster.
13,541. Couplings for Railway Vehicles, J. Fyfe, Glasgow.
13,542. Cuff Links, T. Morton, Birmingham.
13,543. Railway Carriage Windows, W. Purdon, Leeds.
13,544. Engine, J. W. Gall and J. Penn, Leicester.
13,545. Tobacco Pouches, S. I. Whitfield, Birmingham.
13,546. Controlling Gas or other Motors, P. Burt, Glasgow.
13,547. Locomotive Steam Boilers, F. W. Webb, Crewe.
13,548. Bleaching Fibres, K. T. Sutherland and G. Esdaile, Manchester.
13,549. Working Electric Tramways, C. Anderson, Leeds.
13,550. Working Electric Tramways, C. Anderson, Leeds.
13,551. Driving Apparatus for Velocipedes, J. W. Flavell, Birmingham.
13,552. Hooks, G. E. Hughes, Wolverhampton.
13,553. Fencing Jackets, W. Johnston, Co. Kildare.
13,554. Nails, C. Schmidt, London.
13,555. Clips for Wearing Apparel, H. B. Birnbaum, London.
13,556. Closing, &c., Windows, S. Hill and R. Hodges, London.
13,557. Coin-freed Apparatus, S. F. Cohen and H. Rowse, London.
13,558. Puncture-proof Tire Covers, C. F. Newman, London.
13,559. Oiling Apparatus, W. L. Wise.—(*J. H. Turner and J. M. McKnight*, ——.)
13,560. A New Musical Toy, L. C. Heyermans, London.
13,561. Manufacturing Infants' Boots, A. Cunnington, London.
13,562. Filters, A. Smith, London.
13,563. Music Stools, H. Brooks, London.
13,564. Attachments for Shirts, H. S. Cawthorn, London.
13,565. Manufacture of Cigarettes, A. G. Goodes, London.
13,566. Stencil Sheet Printing, J. Joseh, J. Fordham, and G. H. Smith, London.
13,567. Planimeters, W. F. Stanley and A. Amsler, London.
13,568. Electric Switch, F. and F. W. Tallack and L. Hendlé, London.
13,569. Railway Signalling Apparatus, J. Johns, London.
13,570. Apparatus for Weaving Carpets, I. Ginzkey, London.
13,571. Brooms for Washing Purposes, W. Fairclough, London.
13,572. Ladies' Shirt Fronts, &c., F. W. Mugford, London.
13,573. Book-mark, R. H. Campbell, London.
13,574. Drawing-off Liquids, F. H. Nalder, C. W. S. Crawley, and A. Soames, London.
13,575. Self-steering of Ships, &c., Nehmer Bros, London.
13,576. Sovereign Purse, C. and W. T. Smith, Birmingham.
13,577. Nitrosamines, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
13,578. Rotary Pumps and Turbines, O. Reynolds, London.
13,579. Coin-controlled Apparatus, J. O. Frost, London.
13,580. Window Curtains, W. P. Thompson.—(*A. Ockler, Germany.*)
13,581. Electric Cables, S. P. Thompson, Liverpool.
13,582. Mangling Machine, W. P. Thompson.—(*H. Dührkoop and A. Bogaske, Germany.*)
13,583. Shaping Machines, T. J. Wilkie, London.
13,584. Apparatus for Weaving Carpets, I. Ginzkey, London.
13,585. Cans, W. Pratt, London.
13,586. Steam Superheaters, J. Grouvelle and H. Arquembourg, London.
13,587. Vegetable Food, T. H. L. Bake and H. A. Leverett, London.
13,588. Hair Brushes, J. Knowles, London.
13,589. Manufacturing Bedstead Mounts, W. H. Bagley, London.
13,590. Clinical Thermometers, L. Peroni, London.
13,591. Cycle Tires, B. J. B. Mills.—(*P. B. Carante and J. Bocuze, France.*)
13,592. Stick for Carrying Umbrellas, &c., A. Bachmann, London.
13,593. Chimney Cowl, E. W. Lovegrove, London.
13,594. Electric Heating Apparatus, H. Helberger, London.
13,595. Files for Papers, E. Edwards.—(*W. Beller, Germany.*)

*14th July*, 1894.

13,596. Artificial Whalebone, J. P. O'Donnell.—(*J. A. Schweitzer, France.*)
13,597. Smoke Extractor, J. H. Ashworth and A. and W. Gillespie, Oldham.
13,598. Burners for Hydrocarbon Oils, W. H. Parker, Birmingham.
13,599. Finishing Woven Fabrics, J. Duxbury, Manchester.
13,600. Bobbins, H. W. Wilson, Manchester.
13,601. Golf Clubs, H. Fawsitt, Manchester.
13,602. Air-inflated Horse-collar, C. A. Garvie, Leith.
13,603. Finishing Velvets, J. and R. Dutton, Manchester.

13,604. Propulsion of Ships, E. J. Warmington, Southminster.
13,605. Wire Mails and Healds, J. A. Greenwood, Bradford.
13,606 Displaying Tickets on Boots, &c, W. Potter, London.
13,607. Wooden Blocks for Paving, R. Y. Ardagh, Birmingham.
13,608. Ejecting Mechanism of Small-arms, W. Baker, Birmingham.
13,609. Lamp-wick Winding Mechanism, W. T. Webber, Birmingham.
13,610. Jacquard Machines, A. Lockwood, Keighley.
13,611. Pipe Joints, E. Chrisfield, Milton-next-Sittingbourne.
13,612. Filters, A. Turnbull, Glasgow.
13,613. Hanging Garments, M. W. Frosch. —(*B. Walter, Germany.*)
13,614. Wrapping Card Fillets on Cylinders, F. G. Dransfield, Manchester.
13,615 Cooking, &c, Appliances, J. H. Ross, Birmingham.
13,616. Brush for Photographic Negatives, J. B. Brooks, Birmingham.
13,617. Syphon Cisterns, P. Hitchcock, Liverpool.
13,618. Looms, The Chlidema Company, Ld, and E. Burgham, Birmingham.
13,619 Combined Ruler and Rule, W. Evans, sen., Birmingham
13,620. Apparatus for Washing Rags, J. Joiner, London.
13,621. Machine for Scattering Manure, E. Scheiblich, London.
13,622. Wire Mattresses, W. McLaren and H. E. Brown, London.
13,623. Invisible Electric Switch, T. E. Waltham, London.
13,624. Dust Bins and the like, F. S. Salberg, London.
13,625. Window Sash Fasteners, G. W. Pollard, Liverpool.
13,626. Making Abraiding Covers, W. H. Staynes, London.
13,627. Preventing Bad Smells, F. A. Bates, Manchester.
13,628. Dry-hopping Apparatus, H. B. Hollis, London.
13,629. Manufacture of Sardine Boxes, E. R. Peltier, London.
13,630. Putting Matches in Frames, &c., F. Durant, London.
13,631. Carriage Harness, &c., C. H. Burgess, London.
13,632 Heating Apparatus, A. G. Bessemer, jun., London.
13,633. Roller Skates, C. J. Markey, London.
13,634. Arc Lamps, J. W. Rogers, London.
13,635. Machinery for Locomotives, A. E. Hodder and F. W. Matthews, London.
13,636. Transmitting Messages, &c., H. Whawell, London.
13,637. Registering Physiological Subjects, De B. Birch, London.
13,638. Apparatus for Walking, &c., J. Lewthwaite, London.
13,639. Shirt Collars, J. E. Jack, London.
13,640. Medico-electric Pad or Bandage, A. Owen, London.
13,641. System of Musical Notation, W. S. Seaton, London.
13,642. Hot-water Apparatus, F. B. Hill and R. D. Brett, London.
13,643. Heating Apparatus, L. Degache, London.
13,644. Machines for Writing in Cipher, R. Harte, London.
13,645. Manufacture of Barrels, E. Redman, London.
13,646. Manufacture of Barrels, E. Redman, London.

*16th July*, 1894.

13,647. Duplex Teapot, J. Crabtree, Lincoln.
13,648. Flying Apparatus, E. J. W. P. Birnbaum, London.
13,649. Movable Stretching Back, W. J. Irvine, Belfast.
13,650. Testing Fabrics, J. W. Fawcett and W. Shambrook, Huddersfield.
13,651. Treating Irons for Ironing, J. A. Holmes, Leeds.
13,652. Electric Switches, C. Esson, London.
13,653. Paper Testing Machines, G. O. Woolley, Gloucester.
13,654. Footstool and Fire-escape, R. Loescher, London.
13,655. Hand Circular Saw, J. W. and G. Cuffling and R. Hudson, Chesterfield.
13,656. Iron or Steel Roller Frames, J. Bousfield, York.
13,657. Pressure Gauge, J. R. Jackson and E. L. Mare, Manchester.
13,658 Cycle Saddle Securing, J. B. Brooks, Birmingham.
13,659. Press-drills for Attaching Ploughs, E. Bennett, Great Driffield.
13,660. Velocipedes, A. T. Andrews, Birmingham.
13,661. Toy Windmill, R. Wattleworth, M. A. Mason, and J. M. Brindle, Manchester.
13,662. Marine Governor, A. Wilson and W. Morrison, Hull.
13,663. Combination Cot Chair Bedstead, T. Pool, Birmingham.
13,664. Lamp Chimneys, J. and J. Hinks and Son, Birmingham.
13,665. Covers for Vessels, A. W. Montgomery-Moore, London.
13,666. Ventilating Railway Vehicles, B. H. Thwaite, London.
13,667. Candied Lemon and other Peel, C. Greenhalgh, Manchester.
13,668. Compressing and Sewing Jute, W. E. S. Garde, Accrington.
13,669. Railway Tickets, &c., F. A. Ludlow, Birmingham.
13,670. Elastic Tires for Wheels, &c, J. Tonks, Birmingham.
13,671. Binding Framework of Windows, R. Cussons, Bradford.
13,672. Extracting Suint from Wool, E. R. Lagerie Manchester.
13,673. Paper-marking Rollers, R. Brown, Glasgow.
13,674. Projectiles, H. V. Keeson, London.
13,675. Gas, Oil, and other Stoves, H. V. Rippingille London.
13,676. Negatives for Raised Type, W. Cordeaux, Yorks.
13,677. Extracting Potash from Grease, F. R. Lagerie, London.
13,678. Selvedge Motions for Looms, &c, J. Cork. London.
13,679. Portable Copying Press, &c., E. Smith, London.
13,680. Tablet Memorandum Case, &c., E. Smith, London.
13,681. Instructing Children in Colours, L. Smith, London.
13,682. Egg-cruet, M. Emanuel and A. Pappenheimer, London.
13,683. Chemical Extraction of Copper, J. P. Ploeg, London.
13,684. Lifting and Feeding Paper, A. Reisser, London.
13,685 Automatic Closing of Valves, B. Hannen, jun., London.
13,686. Preventing Bottle Accidents, G. Stubbs, Worthing.
13,687. Fastenings for Bracelet, J. W. Rohde, London.
13,688. Attaching Handles to Bowls, A. R. MacLean, London.
13,689. Syphon Waste Preventers, E. G. Highton, London.
13,690. Pendulum Clocks, B. J. B. Mills.—(*La Société Anonyme pour l'exploitation des Brevets Dardenne, Belgium.*)
13,691. Protecting Pastern Joints of Horses, J. Fabry, London.
13,692. Arrangements of Buildings, J. F. Spencer, London.
13,693. Hydraulic Lifts and Appliances, M. T. Medway, London.
13,694. Sewing Machines, P. A. Newton.—(*The Keats Maschinen Gesellschaft, Germany*)
13,695. Anthraquinone, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany*)
13,696. Ensuring Safety on Railways, &c, E Tyer, London.
13,697. Sodium Persulphate Disinfectant, L. Lederer, London.
13,698. Armoured and other Hose, J. Thompson, London.
13,699. A New or Improved Fining Funnel, G. Porter, London.
13,700. Switch-board Mechanism, J. E. Kingsbury.—(*The Western Electric Company, United States*)
13,701. Spring Centres for Swing Doors, T. Pearl, London.
13,702. Ventilation for Public Buildings, W. Perry, Tottenham.
13,703. Apparatus for Printing Tickets, P. Reiner, London.
13,704. Automatic Delivery Machines, P. Reiner, London.
13,705. Jacquard Card Punch-selecting Machines, J. Hough, London.
13,706. Electric Light Shade, A. H. Entwistle, H. J. Stephens, and A. Dubber, London.
13,707. Cover for Velocipedes, B. Vichmann and C Pawlin, London.
13,708. Elastic Tires, C. K. Welch, London.
13,709. Forcing, &c., Liquid Substances, J. Taylor, London.
13,710. Generating Steam from Refuse, T. W. Baker, London.
13,711. Cigars, A. J. Boult.—(*A. Bollard, Canada*)
13,712. Sterilisation, &c, of Milk, R. G. Nash, London.
13,713. Air Propellers, J. D. Sutcliffe and W. Casmey, Manchester.
13,714. Blasting Charges in Mines, L. Jaroljmek, London.
13,715. Fastening for Cellar Flaps, E. G. Coumbe, London.

*17th July*, 1894.

13,716. Automatic Disinfector, C. G. Picking, London.
13,717. Turning Over Leaves of Music, F. S. Whittell, Huddersfield.
13,718. Game and Vermin Trap, C. E. P. Groth, London.
13,719. Wheels for Road Vehicles, J. Dakers, Aberdeen.
13,720. Tab for Braces, G. Buckley and F. Buckley, Halifax.
13,721. Manufacturing Fibrous Materials, T. Sloper, Devizes.
13,722. Producing Butter from Milk, S. H. Wright, Hereford.
13,723. Serving Rigging with Yarn, C. Searle, Stockton-on-Tees.
13,724. Twine Holders, A. Cole, Dublin.
13,725. Cycling Gear, W. P. Smith and E. Gear, London.
13,726. Belt Fastener, C. C. Walker, Walsall.
13,727. Connecting Warp to Warp Beams, G. D. Sykes, Halifax.
13,728. Pole for Overhead Wires, A. Dickinson, Darlaston.
13,729. Producing Designs or Surfaces, J. Scott, Glasgow.
13,730. Feeding Paper to Printing Machines, G. Duncan and T. W. T. Carran, Liverpool.
13,731. Turn-screw, W. Ward, Bristol.
13,732. Water-closet Apparatus, &c, J. Shanks, Glasgow.
13,733. Steam Boilers, A. Stirling, Glasgow.
13,734. India-rubber and Ink-eraser Case, M. Jeffery, Wombwell.
13,735. Driving Gear for Bicycles, F. L. Heeley, Birmingham.
13,736. Machine for Planing Wood, S. S. Hazeland, Cornwall.
13,737. Vehicles, A. Fehlen and The Princess Company, Ld., London.
13,738. Printing Blocks, F. I. Getty and National Chromatic Printing Company, Manchester.
13,739. Printing Blocks, F. I. Getty and National Chromatic Printing Company, Manchester.
13,740. Tubes for Feeding-bottles, &c., G. Raines, London.
13,741. Watch Glasses, E. Alawebb, London.
13,742. Medical Bags and Cases, &c., T. Bailey, London.
13,743. Wickless Safety Oil Lamp, J. Patterson, London.
13,744. Electro-magnetic Massage Roller, J. E. Spratt, London.
13,745. Fastening Boots and Shoes, J. Burgess, London.
13,746. Obtaining Power from Water, W. R. Bigsby-Chamberlin and W. M. Baker, London.
13,747. Electrical Coupling, W. H. Stevenson, London.
13,748. Machine-strap Fasteners, W. H. Chase, London.
13,749. Electric Signalling Apparatus, C. A. Allison.—(*The Standard Electric Signal Company, United States*)
13,750. Electric Signalling Apparatus, C. A. Allison.—(*The Standard Electric Signal Company, United States.*)
13,751. Electric Signalling Apparatus, C. A. Allison.—(*The Standard Electric Signal Company, United States.*)
13,752. Construction of Boxes and Cases, G. A. Farini, London.
13,753. Serving Boards, &c., W. Armstrong and A. H. Sansum, London.
13,754. Lamp for Advertising, G. C. Downing.—(*E. and L. Charlot, France*)
13,755. Zinco Plate Bevelling Machine, A. Shiner, London.
13,756. Electrolytic Cells, C. N. Waite, London.
13,757. Oil Cans, J. Schwiebert, Germany.
13,758. Apparatus for Manufacturing Gas, F. Mayer, London.
13,759. Machines for Filling Bottles, S. B. Smallwood, London.
13,760. Grain Driers, I. G. Hooper, London.
13,761. Regenerative and other Furnaces, S. M. Trapp, London.
13,762. Electric Railways, C. D. Jenney, London.
13,763. Brake Shoes, W. D. Sargent, London.
13,764. Handles of Golf Clubs, &c., C. H. Clarke, London.
13,765. Electric Railways, E. H. Johnson and R. Lundell, London.
13,766. Cash-registering Machines, J. J. Webster and C. H. Little, London.
13,767. Coin-freed Machines, G. A. Brachhausen and P. Riessner, London.
13,768. Displaying Advertisements, A. F. Bird, London.
13,769. Mechanical Musical Instruments, J. Schanz, London.
13,770. Shoulder Straps and the like, E. Rice, London.
13,771. Electric Railways, E. Lachmann, London.
13,772. Spinning Machinery, A. R. Erbslöh, London.
13,773. Parallel Rules, C. H. Beeler, jun., London.
13,774. Valve Gear, J. E. Wallis and Wallis and Steevens, Ld., London.
13,775. Manufacture of Boots and Shoes, D. Bryan, London.
13,776. Manufacture of Wheel Rims, C. S. Dikeman, London.
13,777. Purifying Effluent Waters, W. J. Pughsley, London.
13,778. Mimeograph Sheets for Copying, W. J. Peart, Birmingham.
13,779. Middlings Purifiers, R. Lund, London.
13,780. Carrying Military Accoutrements, W. S. Oliver, London.
13,781. Manufacture of Flanged Tubes, H. Howard, London.
13,782 Water-closets, S. Jennings and J. Morley, London.
13,783. Presses, O. W. Ketchum London
13,784. Twisting Machines, G. L. Brownell, London.
13,785. Pens, W. C. Hawtin, London.
13,786. Pneumatic Tires, G. Pickhardt, London.
13,787. Fire-arms, A. J. Boult.—(*P. B. Latrige France*)
13,788 Steam Engines, W. P. Thompson.—(*E. Gschwind, United States.*)
13,789. Boiler and Steam-pipe Covering, J. Douglas-Foulis, Liverpool.
13,790. Process for Making Paper Boards, W. N. Cornell, Leeds.
13,791. Electric Lamps, W. L. W. Williams and G. H. Morgan, Liverpool.
13,792 Water Heaters, W. P. Thompson —(*A. H, F. J., and H. S. Humphrey, ———.*)
13,793. Velocipede Bearings, J. F and D. H. Lewin, London.
13,794. Electric Conduits, &c., J. W. Eisenhuth, R. Herman, and E. M. Herman, Liverpool.
13,795. Electro-plating, W. P. Thompson.—(*C. M. Barber, United States*)
13,796. Balancing Devices, &c, H. P. Lavender, London.
13,797. Moulds for Casting Glass Balls, J. Slaytor, London.
13,798. Preservation of Photographs, &c., A. H. Church and W. S. Simpson, London.
13,799. Wheels for Cycles, W. Gilliam, London.
13,800. Hot-water Apparatus, D. J. Ross, London.
13,801. Tipping Gear for Road Wagons, C. Davis, London.

*18th July*, 1894.

13,802. Locking the Triggers of Fire arms, C E. and J. W. Batcock, London.
13,803. Automatic Nosing Motion, &c, L. Rushworth, Manchester.
13,804. Connecting Metal, &c, Pipes, T. Robinson, Lancashire.
13,805. A Game, J. M Porter and A. Mitchell, Leeds.
13,806. Chimney and Ventilator Hood, E. W. Astle and C. E. Terry-Terry, Derby.
13,807. Cooling Beer, &c., J. Scouller, Glasgow.
13,808. Beaded Fabrics, J. A. C. Leistner, Manchester.
13,809. Bearings for Spinning Spindles, A. Hitchon, Accrington.
13,810 Reversible Window Sashes, E. G. Kendall, Staffordshire.
13,811. Pneumatic Tires and Pumps, P. A. F. Pratt, London.
13,812. Blowers, T. Duncan, Oldham.
13,813. Brick-making Machinery, W. Wilkinson and H. Alexander, Leeds.
13,814. Brick and Tile Presses, W. Wilkinson and H. Alexander, Leeds.
13,815. Pirn-winding Machines, W. Whiteley, Halifax.
13,816. Securing Pneumatic Tires to Cycle Rims, T. Guthrie and W. T. Hall, Newcastle-on-Tyne.
13,817. Securing Studs to Garments, J. Walker, Birmingham.
13,818. A Motor, H. Tee, Liverpool.
13,819. Anchor, H. O. Dunn, Liverpool.
13,820. Air-heating Apparatus, J. A. Wade, Liverpool.
13,821. Expanding Pulleys, R. Pippette, London.
13,822. Cask Tilter, J. H. and W. F. Filbee, Birmingham.
13,823. New Compound, O. Thiele, Liverpool.
13,824. Bag Locks, J. B. Brooks, Birmingham.
13,825. Caloric Engines, W. Arschauloff, Glasgow.
13,826. Uniting the Frames of Velocipedes, W. F. Taylor and G. J. Philpott, Croydon.
13,827. Kitchener, W. E. Fox, Eastbourne.
13,828. Rim for Lawn Tennis Racket, C. Burrows, Workington.
13,829. Boxes for Carrying Hats, C. Blyth, Manchester.
13,830. Flexible Pipe Couplings and Clips, J. Kippax, London.
13,831. Appliances for Preventing Sea-sickness, M. Runkel, London.
13,832. Brace or Suspender Buckle, J. S. Römpler, London.
13,833. Self-acting Tongued Harp, E. Lamprell, Northamptonshire.
13,834. Protecting Clothing, J. Nadler and R. Merkelt, London.
13,835. Nicotine Trap Pipe, F. Watts and R. W. Shepherd, London.
13,836 Apparatus for Collecting Gases, C. J. Yarnold, London.
13,837. Cycle Gears, S. G. Tripp and S. J. Clay, London.
13,838. Artificial Cork Manufacture, G. Hagemann, London.
13,839. Expanding Lock, M. H. Newtoh, London.
13,840. Double-action Safety Valve, G. W. Linford, London.
13,841. Gas Making Retorts, A. Scott and P. McLean, Galashiels.
13,842. Pistons, E. E. Wigzell, London.

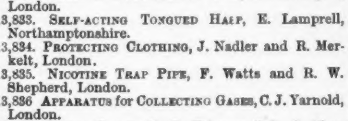
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**516,014.** Mortising Machine, *D. Hepp, Chicago, Ill. —Filed November 28th, 1893.*

*Claim.*—(1) A mortising machine, comprising a central bit, side bits geared to the central bit and of less length than the said central bit, and hollow chisels incasing the side bits, substantially as described. (2) A mortising machine, comprising a central bit, side bits geared with the central bit and provided with extensions of less diameter, said side bits being of less length than the central bit, and hollow chisels incasing the large portion of the side bits, substantially as described. (3) In a mortising machine, the combination with a bearing box, a central bit mounted in the box and provided with a gear wheel, side bits, shafts mounted in the box and provided with gear wheels meshing with the gear wheel of the central bit, and bits carried by the said side shafts, of hollow chisels secured to the box and inclosing the said side bits, the said chisels being apertured, substantially as described.

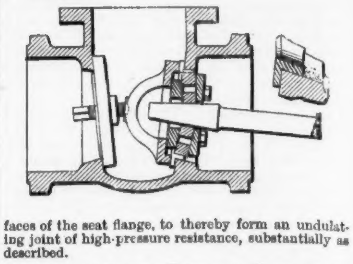
516,014



**516,658.** Process of Seating Valve Bodies, *F. H. Richards, Hartford, Conn.—Filed July 11th, 1892.*

*Claim.*—The herein-described process of seating valves, which consists in casting the valve body with an annular undercut seat flange having rough or unfinished surfaces, making a seat blank with a seat ring and anchorage flange having rough or unfinished surfaces, applying the seat blank with the seat ring resting upon the seat face of the seat flange and with the anchorage flange projecting below said seat face, and simultaneously pressing the seat ring to its bearing and internally rolling the anchorage flange outward on lines at an inclination to the plane of the seat ring, and at the same time bedding the roughened faces of the seat blank into the roughened faces of the seat flange, to thereby form an undulating joint of high-pressure resistance, substantially as described.

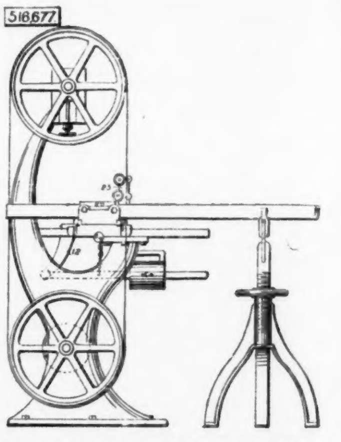
516,658



**516,677.** Automatic Feed for Band Sawing Machines, *F. E. Cross, Waterbury, Conn.—Filed May 15th, 1893.*

*Claim.*—(1) A feeding attachment for band sawing machines consisting of a frame 17 having an opening, a carriage provided with fixed and movable jaws adapted to travel in said opening, suitable means for adjustably securing the frame in place, and suitable means for moving the carriage forward. (2) A feeding attachment for band sawing machines consisting of a frame having a standard extending upward therefrom, an arm 25 adjustably secured to the standard and guide rollers on the arm between which the saw runs, a carriage adapted to travel in the frame, suitable means for moving the carriage forward, and a clamp, bolt, and set screw by which the frame and carriage may be adjusted at different angles to the normal plane of the saw, the operative portion of the saw being at the same time twisted into a plane at right angles to the plane of the carriage. (3) A feeding attachment for band sawing machines consisting of a frame having an opening 16, suitable means for securing the frame in position, a carriage for the bar to be operated upon adapted to travel in said opening, a bracket 10 having a pulley 9 and an arm 12, a lever pivoted to said arm and carrying an adjustable weight, and a chain passing over said pulley and connected to the carriage and lever. (4) In a band sawing machine the combination with the table, saw, and standard, of a movable carriage for the bar to be operated upon, suitable means for adjusting the line of travel of the carriage at different angles to the normal plane of the saw and for twisting the operative portion of the saw into a plane at right angles to the line of travel of the carriage, a carrier B having rollers 35 for supporting the outer end of the bar, a support 34 having stops 36 upon which the carrier travels, a suitable stand for said support, and suitable means for raising and lowering the support on the standard.

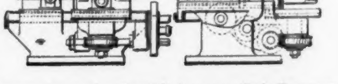
516677



**516,678.** Slide Rest for Lathes, *H. Eckhardt, Dortmund, Germany.—Filed May 11th, 1892.*

*Claim.*—(1) In a tool rest slide, the combination of the main frame, two or more slides mounted and adapted to slide thereon, a screw for moving the slides to and from each other and connections from said screw to the cam for moving the slide transversely to the screw, substantially as described. (2) In a tool rest slide, the combination of a main frame, slides mounted and adapted to slide thereon, seats for the cutting tools adapted to slide on the slides, means for moving the slides to and from each other, and cams to slide the tool seats independently of each other, substantially as described.

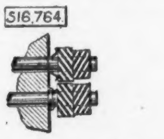
516,678



**516,764.** Apparatus for Forging Screws by Rolling, *C. Fairbairn and M. Wells, Manchester, England.—Filed July 28th, 1893.*

*Claim.*—(1) In screwing machines in which the screws are forged between rotary grooved rollers, and in which the grooves are formed upon the peripheries of the rollers, a roller divided transversely into two or more parts, of which the front part only is fixed upon the roller spindle, substantially as and for the purpose hereinbefore described, and as illustrated by the accompanying drawings. (2) In screwing machines in which the screws are forged between rotary grooved rollers, and in which the grooves are formed upon the peripheries of the rollers, the combination with transversely divided rollers, the front portion of which alone is fixed upon the spindle, of a spring tending to resist the longitudinal motion of the back portion or portions of the roller, substantially as hereinbefore described, and as illustrated by the accompanying drawings.

516,764



## INTERNATIONAL NAVIGATION CONGRESS.

(*By our Special Commissioner.*)

The sixth Congress has been occupied during the past week in considering the papers which have been sent in. Nearly five hundred members out of the total number of subscribers have put in an appearance. Only a very small proportion of the large number of Americans who were guaranteed as members have attended at the Hague.

The first section has been occupied chiefly with matters relating to the construction and maintenance of canals and navigable waterways, under the presidency of M. Van Bosse. The second section, of which M. Van Zuylen is president, has been occupied with papers relating to stoppages on waterways in winter from ice, and the best means of preventing them. The third section, over which M. Deking Dura is president, has dealt with tolls on navigable waterways; and the fourth section, of which M. Van Diesen is president, has dealt with tidal waterways, and the relation which exists between the curves in channels and the depth and width.

On Monday the members of the Congress were received by the Minister of the Waterstaat, and on Wednesday by the Municipality of the Hague, at the Town Hall. On Thursday evening an official dinner took place at Schevingen.

On Monday there was an excursion to Rotterdam and the Hook of Holland, in which more than four hundred members were present. The party left the Hague by train at 7.30 a.m., and went to the new station at the Hook of Holland, where they embarked on a steamer, and were taken a short way down the river to look at the jetties which train the river into the North Sea. On the way the Amsterdam, the last new steamboat put on the Harwich line by the Great Eastern Railway Company, was passed. The party were then taken up the river to Rotterdam and through the harbour, all the ships and barges lying there being dressed with flags for the occasion. The new iron bascule bridge was opened, and the boat steamed through into the Deephaven and back again. The party then landed, and were entertained with lavish hospitality at luncheon by the city of Rotterdam; after which they proceeded in a long procession of carriages through all the principal streets of the town, back to the steamboat, and then up the Maas to Gorinchen; here the lock on the new Merwede Canal was inspected. It is a very fine piece of work, and varies from most structures of the kind in having a double set of gates at each end, each pair of gates pointing different ways, so as to be adaptable to the condition of the water on whichever side, a flood in the river might be the highest. In passing up the river an object lesson was given which, if only the British workman had the sense to see it, would show him the harm that is being done to England by strikes and high wages. At a shipbuilding yard on the banks of the river was to be seen the dredger which is being built for the River Wear Commissioners, the contract for which was placed in Holland, because owing to the lower rate of wages it could be supplied at a price several thousand pounds below the lowest tender that could be obtained in England. After being received by the authorities at Gorinchen, the party proceeded by train to Dordrecht, where they were entertained at dinner by the town authorities. The arrival at the Hague was not accomplished till midnight. The following particulars of the port of Rotterdam are taken from the paper contributed to the Congress, and read on the previous day by M. De Jongh, Director of Public Works, and the paper of Mr. W. Gustav Triest, of New York.

### THE PORT OF ROTTERDAM.

The Netherlands owe their development and prosperity principally to their geographical position. Situated between the countries bordering on the Baltic and those of Southern Europe, and at the mouth of a river which penetrates to the very heart of the Continent, they were in the Middle Ages the most important market of the world. Bruges, Ghent, Antwerp, were at that time the great meeting-places for merchants from all countries. Spanish and Portuguese ships brought to these cities the varied merchandise of the South of Europe and the Indies, and the products of Russia and the countries of the North found their way thither by the navigation of the Baltic, as well as by the Rhine and Moselle.

Rotterdam at one time was but a fishing village. The discovery of the art of salting and packing herrings in barrels, so that they could be exported, opened a new era to the Netherlands. In 1562 the number of boats, called buses, engaged in conveying the salted fish to other countries, was estimated at 700, and the merchant vessels nearly 1000. The Dutch at that time had acquired the pre-eminence at sea. In Elizabeth's reign the two provinces of Holland and Zealand possessed more vessels and seamen than the whole of Great Britain. By the help of their ships the Dutch were able to hold their own against the Spaniards, and while commerce forsook Antwerp and the Belgian cities, the trade of Holland was regularly maintained in the Spanish and Portuguese ports, and the Dutch traders sent there grain and timber, and even munitions of war. Owing to the seizure of Dutch ships in Spanish ports, and the Dutch being hindered from buying the produce of India in the markets of Spain, they resolved to go in search of it in the land of its production, and thus laid the foundation in the East Indies of the opulent colonial empire, and of the establishment of the Dutch East India Company, which paid an average dividend for several years of 35 per cent., and in which 20,000 persons were interested. Thus was shown the remarkable fact in the seventeenth century of a small strip of land which, with enormous labour, had been rescued from the sea, and with great difficulty was maintained in safety, making war upon—at that time—the most formidable kingdom of the world, who had the disposal of the treasures of both the Indies, and seizing from Spain her monopoly. This small country of Holland was then overflowing with merchandise which she did not produce, growing very little corn. Yet no country in the world had its granaries more richly supplied; growing little or no flax, yet largely engaged in weaving; with small flocks or herds, still abounding in woollens and cloths; with no vineyards, yet affording a market for wine from Germany and France; with no forests, yet building more ships than all the rest of the continent. This prosperity was reflected in the extension of her harbour and shipping accommodation. At the beginning of the 17th century Rotterdam could boast of eight docks, some of them over 200ft. in width. After this, the navigation of the port received a check, and it was only towards the middle of the present century, when steam navigation was established, that it became necessary to develope the works of the port. Between 1850-60 the Boompjes were provided with quays of masonry, and several wharves were built along the river. The dredging of the Voorne and Putten Canal, in 1820-27, rendered Rotterdam accessible at high water to vessels drawing 18ft., but the locks did not admit of the passage of larger vessels than 155ft. in length and 45ft. beam. In 1863 it was decided by the Government to open out a new mouth to the river Maas by cutting through the sand dunes at the Hook of Holland. The navigable depth of water up to Rotterdam was increased from 13·88ft. at high water in 1875, to 31·65ft. in 1893, the rise of tide being 5¼ft. The number of vessels in the meantime has increased from 1970, with 393,393 tons burden, in 1850, to 4770 ships, with 3,614,654 tons burden, being an increase of 80 per cent. in the tonnage of the maritime shipping; while at the same time the inland shipping has increased 75½ per cent.

The method of carrying on the shipping trade has entirely altered since the introduction of steam. Formerly, after a voyage to the Indies, the vessel lay up very much at her ease, and it was only after several months that her cargo was disposed of and she again put to sea. Navigation was then very profitable, and often in two or three voyages the profits were sufficient to pay for the building of the ship. Now, despatch in the loading and unloading of steam vessels is one of the first essentials of a port, and the machinery and equipment necessary for this purpose must be provided. For this purpose a large number of steam and also hydraulic cranes have been fixed on the quays, and coal-tips on Sir William Armstrong's plan provided. An experiment made in the use of electricity for working the cranes was so satisfactory that this system is to be extended. The electricity is obtained from the Tower electric light station. A contract has been entered into for the supply of six cranes, costing £920 each, warranted by the makers to run at 315 watts while engaged in the following work:—A load of 1500 kilos. deposited on the quay to be lifted to the maximum height, lowered 48½ft., then replaced on the quay on the other side of the crane. It is anticipated that the power which by the descent of the load will be returned to the cable, will reduce the consumption to 240 watts. The electricity is to be produced for this work under a tension of 700 volts in a continuous current, and first directed to two accumulator stations, one on each side of the harbour, whence it will be divided upon the system of five conductors. The cranes work with a tension of 440 volts. The engines will be always ready to work, and only use electricity when lifting or turning round. Upon the descent a certain quantity of the electricity will be returned to the system, the motors then revolving in opposite directions.

The development of the inland navigation has had to be taken into account in the plans for the enlargement of the works of the port. The sea-going vessels which have to tranship their cargo into the boats of the Rhine are not moored at the quays, but in the middle of the harbour, so that the barges can lie on both sides. For this purpose moorings have been laid down for twenty ships. The construction of the Riju haven and of the Katendrecht docks has been designed with the same object, the width reaching over 1300ft.

The paper of Gustav Triest dealt principally with the construction of the new waterway from the Hook of Holland to Rotterdam.

Four papers were contributed on the "Means of Preventing Stoppages on Canals by Ice," by M. Camerée and M. Rigaux, engineers of the Ponts et Chaussées, respectively at Paris and Charleville; and by M. Bekaar and Nelemans, engineers of the Waterstaat in Holland. The importance of this subject may be inferred from the fact that during the winter of 1890-91 the interruption of the navigation of the Seine by ice continued for forty-three days from the 14th of December to the 26th of January. On the Seine near Surenes, above Rouen, one large ice bank extended over a length of about half a mile, by a width of 350ft., and was composed of a layer of strong ice, varying from 6in. to 10in. in thickness, from under which pieces emerged on the up-stream side at an angle of 30 deg., forming projections 2ft. thick, and below this layer the thickness was increased by a mass of fragments frozen together, and mingled with a quantity of rotten ice. In order to get rid of this block, which by stopping the flow of the ice from up stream had become dangerous to a railway bridge, recourse was had to the simultaneous use of ice-breaking boats and blasting. A channel was first made along the side on which the ice was thinnest by a boat protected by iron sheeting, which was hauled by four horses, a rolling motion being given by twelve men on board. When their passage was opened out, holes were dug in a line parallel with it, by means of pickaxes, to a depth of 15in., and at distances apart of 9ft. to 10ft. In these were placed charges composed of cartridges of melinite connected together by fuses united by a single fuse ending in a Bickford match. With this main line of fuses transverse lines at about 100ft. apart were connected. The charges were covered with broken ice by way of tamping. After the discharge, blocks from 900ft. to 1000ft. long, and 40ft. to 50ft. wide, were detached from the ice bank, which were sufficiently small to allow of their passing through the opening of the bridge, their progress being assisted by a tug boat protected by iron plates.

Where the ice was less densely packed, single cartridges placed at intervals of about 10ft., in holes about 5in. deep, were found sufficient to break up the mass. By this operation the bank was broken up and the channel opened in one day. Other blocks were dealt with in the same way, and a total length of 2·66 miles was cleared by a week's work, at a cost, including the explosives, of £600—equal to 31·75 pence per yard lineal.

Before the general breaking-up of the ice, the whole bank which covered the basin above the locks of Bougival over an area of about 6000 square yards was dislodged by a gang of workmen in a boat, a steam-tug boat, and cartridges laid on the surface. The melinite cartridges, containing from 100 to 135 grains, were attached, at intervals of 3ft. apart, to wooden rods 13ft. long, and joined together so as to form lines from 160ft. in length, and laid in grooves cut with pickaxes, filled with snow and ice. By this means a channel about 10ft. wide was opened in a coating of strong ice, from 6in. to 1ft. in thickness. The detached blocks were then broken up by the boat and by men with axes. During the explosion several windows were broken in the houses, at a distance of 650ft. This plan was therefore abandoned, and the following substituted:—In the middle of the channel to be opened holes were bored every 16ft., through which charges composed of five cartridges were let down below the ice, and fired by a Bickford match. The explosion of these cartridges formed holes 10ft. to 12ft. in diameter, which remained separated by strips of dislodged ice, which the workmen demolished with axes. Above the Dam or Marly the ice was dislodged by the use of saws, worked by two men in cuts 13ft. apart, the pieces sawn through being broken up by axes. A trench 13ft. wide and 2354ft. long was made in a day and a-half by twenty workmen, and cost about 5 cents a lineal yard, including the purchase and hire of materials. The use of dynamite placed on the surface has been tried, but not found to answer.

Several other examples of ice breaking are given, but the above gives a sufficient representation of the methods adopted. The second paper dealt chiefly with the method of breaking ice by means of boats having their bows protected by strong wooden frames cased with sheet iron. The boat, being weighted in the stern, is drawn along by from ten to fifteen horses going at a trot and run at the ice, so that the stem rises on it and breaks it down, a rolling motion at the same time being given by the men in the boat. This method is not adapted for ice of more than 6in. thick. The ice breakers attached to the boat cost from £6 to £30.

The paper by Messrs. Bekaar and Nelemans deals with the means taken to break up the ice on the North Sea Canal and the Tiernenzen Ship Canal. Between 1828 and 1891 there were twelve winters in Holland when the ice was sufficiently thick to stop navigation, the temperatures on these occasions varying from 2 deg. to 11 deg. Fah. On the North Sea Canal a company was formed in 1879 for the purpose of keeping the waterway free from ice. They had constructed an ice breaker, which was attached by chains to one or more tug-boats. This ice breaker was 45¼ft. wide, having at its stern a cavity to receive the bow of the tug-boat, its total length being 64½ft., and the height varying from 6in. at the stem to 7·84ft. at stern. The weight was 82½ tons, and cost £2190. The results obtained were satisfactory in ordinary winters, when the thickness of the ice did not exceed 8in. For a thickness of from 4in. to 8in., two tugs of 50-horse power were required. The expenses mounted up to as much as £37 a day. A charge of 3d. per ton was levied on vessels navigating the canal from November to March, to cover the cost. This company was dissolved, as it was found that when the frost was severe this method did not answer, the ice in the winter of 1890-91 reaching nearly to 1·86ft. in thickness. During this winter attempts have been made to open a channel by cutting through the ice by hand labour, and dispersing the pieces thus broken by a steamer. Subsequently two torpedo boats were sent by the Government to break the ice by means of explosives. Charges of powder of from 8 lb. to 20 lb. were placed from 3½ft. to 4ft. below the ice at distances of about 35ft.; the holes made by the explosion were 13ft. to 30ft. in diameter. Altogether 838 charges were exploded, using 11,057 lb. of powder. The company spent in the winter of 1890-91 £3750. Subsequently another company was formed which had constructed two special ice-breaking boats, of which the larger is 139ft. long, and 35ft. beam, having engines of 830-horse power, and costing £15,950; and the other 103ft. long, 27½ft. beam, with engines of 350-horse power, and costing £6800. The keels have an inclination so that the stern of the boat may run on to the ice and break it down. The expense of working the larger boat is reckoned at £11 10s. a day, and of the smaller £7 10s. Since the construction of these boats the winters have not been sufficiently severe to test their efficiency in breaking the ice where it is very thick.

On the Tiernenzen Canal the passage of the waterway was to a certain extent kept open by the steamers going to and from Ghent. Of these the Ouse, running between that port and Goole, did most service, and when other boats refused to run, went down the canal and opened out a passage in "a splendid way." Leaving Ghent at 7 a.m., she reached Tiernenzen at 5 p.m., the distance being 21 miles. The cargo had been stowed so as to make the steamer down at the stern by 1ft. When the ice resisted the progress of the steamer it glided slowly on to it, and broke it down by the weight.

In ordinary winters it has been found that the constant passage of the steamers up and down the canal has been found sufficient to prevent the ice forming to any thickness and to keep the waterway open.

The Sixth Congress was brought to a close on Saturday, the 28th ult., by a general meeting of all the members present, when it was decided, after a discussion, by a large majority, that the two congresses of interior and maritime navigation, which hitherto have been separate, and met at different times, should be united, and that in future the title should be simply the International Navigation Congress. It was also decided to form a permanent organisation having a representative for each country, from whom information as to the proceedings may be obtained, and to whom communications could be addressed. The necessity for this, if the Congress is to be permanent and representative, is obvious. As regards the Congress which has just terminated, it was impossible in England to obtain information at a period sufficiently early to be of service as to when and where the Congress was to be held, or as to the nature of the proposed subjects to be discussed; consequently there was not a single paper contributed by English engineers, and very few were present.

Invitations were read at the meeting from the representatives of Italy and Portugal inviting the Congress to meet at one of those places, and it was decided that the meeting in 1896 should take place in Italy.

## INSTITUTION OF MECHANICAL ENGINEERS.

### MANCHESTER SUMMER MEETING.

The summer meeting of the Institution of Mechanical Engineers, which is being held this week in Manchester, has proved the most successful gathering of the kind that has been held for a number of years past, nearly five hundred members intimating their intention of taking part in the proceedings, and there has not been so numerous an attendance since the London meeting in 1886. No doubt the exceptional interest attaching to Manchester as the centre of one of the most important engineering districts in the kingdom has been a great attraction, and certainly a programme of visits to engineering and other works in the immediate neighbourhood was provided which would much more than completely occupy the whole of the time the members had at their disposal.

The proceedings were formally opened on Tuesday morning with a reception of the President, Professor Alexander B. W. Kennedy, LL.D., F.R.S., and the Council and members of the Institution, in the Owens College, by Mr. Alderman Joseph Thompson, the Chairman of the Council of the Owens College, who acted as deputy for the Lord Mayor of Manchester, who had been unavoidably prevented from carrying out his original intention of being present to receive the President and members, and by Alderman Sir Wm. H. Bailey, the Mayor of Salford.

Alderman Thompson having explained that he had been requested by the Lord Mayor of Manchester to act on his behalf in receiving the members, said it gave him the greatest pleasure to extend to them a very cordial welcome to the city, and by virtue of the official power given to him by the Council of the Owens College, he bade them a cordial welcome to that building and to its use during their meetings. With regard to the Institution of Mechanical Engineers, although the study of their special branch of science did not go back to the beginning of things, its history spoke of times upon which memory fondly lingered. He thought it was not too much to say that the work which tended to make life happy was that which came from such societies as their own, which bridged their rivers, and made their streams, which gave them ease of locomotion and safety. This was the work which was entrusted to them, and they would receive their reward for it. He thought it peculiarly fitting that they should meet in the Owens College, where they taught not only the theory, but, to some extent, the practice of mechanical engineering. Then they knew that their branch of science was associated with various separate forms of training; the engineer must be a mathematician, and this they taught in the college, both applied and pure mathematics; the engineer must also be a chemist, and know something of the composition and mixture of his metals, and with regard to this branch of science, he must not forget to tell them that in the very hall in which they were assembled, the teaching of Roscoe, Schorlemmer, Thorpe, and others, in the past, and of Dixon and Dawkins at the present, had been heard. Engineering was also allied to electricity, and in the Owens College they had Professor Schaffer, as electrician, holding crowded classes. He repeated his words of welcome, in the name of the Corporation of Manchester, and on behalf of the Council of Owens College.

Sir Wm. H. Bailey (Mayor of Salford) welcomed the Society on behalf of the borough he represented. As Mayor of Salford, "the little borough across the stream," it was, he said, his duty to welcome the members of the Institution to the district, and he thought it would be difficult for them to find a place which possessed more interest to mechanical engineers than the district they were now visiting. Whether they looked at the historical development of mechanical tools, or even of the modern locomotive, they would find that the inventors of the district had exercised a remarkable influence. He would mention the names of Nasmyth, Whitworth, and Joule (who was born in Salford) as amongst the local inventors who had done service to engineering. The most successful engineers of the present were those who were well acquainted with the doings of the engineers of the past, and it was only by the study of the failures of those who had gone before that they could achieve success. In conclusion he joined with Mr. Thompson in giving them a cordial welcome to the district of Manchester and Salford, and they would, he must assure them, do their best to make their visit both pleasant and profitable.

The President—Professor Kennedy—thanked Alderman Thompson and Sir William Bailey on behalf of the Institution for their welcome to the city. It gave them great pleasure to meet in Manchester, which was, perhaps, the most interesting city in the country from the Society's point of view, and it was therefore extremely gratifying to be welcomed so heartily by the municipal and academic authorities.

The Secretary then read a paper by Dr. John Hopkinson, F.R.S.,

### On New Electric Lighting Works, Manchester.

The system adopted is a direct continuous current, with five conductors supplying consumers at a pressure of 100 volts, the total pressure between the outer conductors being 400 volts. The conductors are partly bare copper in concrete culverts, and partly india-rubber insulated cables in cast iron pipes. The arrangement of conductors is very similar to that which has been adopted in many other places, but is here carried out on a somewhat more extensive scale, the Portland-street culvert containing a total area of copper of 9¾ square inches. It will be observed that the sectional area of the three intermediate conductors is small, only ¼ square inch for each; whereas the total sectional area of the outer conductors in this case is no less than 4½ square inches. As might naturally be expected, such small intermediate conductors are in themselves inadequate to effect a perfect balance; the balance is therefore perfected by means of motor-generator machines fixed in outlying parts of the system. Each of these machines is wound with two circuits, so that the pair contains four circuits, each circuit being connected with two conductors of the five-wire system. The two machines being connected mechanically with each other by a coupling, any excess of current demanded from one section will be supplied by the circuit connected thereto, and the power required to effect this supply will be derived from one or more of the other circuits. As a compensating device this arrangement is found to work perfectly; it does not claim any originality, as it has been in use for some time in many places. Electricity can be supplied to customers at four different pressures, according to their requirements.

The system of bare conductors has the disadvantage that the general insulation is poor; but this really causes no trouble, as it is a general small leak over the whole system, and does not tend to get worse. There is one curious fact in connection with this defective insulation—the insulation of the positive conductor is always good, while that of the negative is always bad. The fact has been generally known for some time, but the author did not realise its importance till he experienced it. Electrolysis will deposit upon the negative conductor hydrogen from the moisture on the insulators; hence, this exceptionally defective insulation is not calculated to injure the conductor. The explanation, so far as the author is aware, was not known. The difference in insulation between the positive and negative conductors arises from electric osmosis, which may be explained as follows:—Suppose two vessels containing water to communicate by a cotton wick, and two electrodes differing much in potential to dip into the two vessels; then it is found that water passes over continuously from the vessel into which the positive electrode dips to that into which the negative electrode dips. This fact has long been known to physicists as a laboratory experiment. Next suppose two electrodes to be carried on porcelain insulators which dip into water, and the water to be maintained at earth potential, and the two electrodes to be one positive and the other negative; then, if the current leaking from each electrode into the water be measured, it is found that the leak from the negative is many times the leak from the positive. This experiment the author has himself tried. The action of bare conductors is the same upon a large scale. The main source for moisture is from the walls and floor of the culvert; this moisture will constantly creep over the porcelain insulators towards the negative conductor, but will creep away from the positive conductor, drying the neighbourhood of the latter and improving its insulation. With the five-wire system the troubles have been few, and all easily met; with the bare conductors there have been no troubles at all.

In the first instance, six engines and six dynamos of about 100-horse power each were put up, and also four engines and four dynamos of 400-horse power each. The six smaller dynamos give nearly 600 ampères at a little over 100 volts; the four larger give 600 ampères at a little over 100 volts. The engines are all vertical compound condensing, and drive their respective dynamos by link belts carried under jockey pulleys. The jockey pulleys work in every respect as well as simple belts of adequate length; and the loss of power is increased to only a very small extent, if at all. Compared with ordinary belt driving the saving in space is considerable. In comparison with high-speed direct driving, there is the advantage of entire freedom as to speed, both of engines and of dynamos; and there is less liability to vibration. On the other hand high-speed engines take less space, and the author thinks if single acting they make less noise. In his opinion there is no great balance of advantage in one system over the other. The condensers are ejector condensers, the condensing water being lifted some 30ft. in order to give an adequate head. These condensers have been found effective, giving a vacuum of 25in.; and they prove most convenient. The regulation of electric pressure is effected by adjustment of the governor whilst running. Two more engines and dynamos of 400-horse power, exactly like those already erected, have been ordered after the experience of last winter.

The boilers are of Lancashire type, 30ft. long and 8ft. diameter; at present they are six in number, and a seventh is now being added. They work at a pressure of 125 lb. per square inch, and are fitted with mechanical stokers, and the water is heated by economisers. The steam-pipes, feed-pipes, valves, and economisers are all in duplicate. The boiler-house, 77ft. long by 70ft. wide, is covered from end to end by a steel water tank weighing about 160 tons, constructed in seven compartments, and holding 205,000 gallons of water.

In addition to the engines already on order, there is room for eight more large engines and five additional boilers. Hitherto no accumulators have been used; but, in the author's opinion, the present reduced price of these, and their increased durability, justify their introduction into large stations as well as small. There will, of course, be no difficulty in adding them when it is desired.

There are connected to the mains 18,600 incandescent lamps of 16-candle power, 250 arc lamps, and motors to the extent of 16-horse power. This is an encouraging result when it is remembered that a preliminary supply on the two-wire system was begun only just a year ago. The average price to the consumer up to March 31st was about 5½d. per unit.

Mr. Alderman Higginbottom, at the request of the President, added a few further particulars. When the works were first laid out they were intended to supply the demand in Manchester for at least three years; but after five months' working the whole power laid down was virtually taken up, and they had to make a large extension for the next winter. Commercially, the results had been satisfactory, as they had close upon £5000 revenue on the five months' working, and he contemplated they would this year have £25,000 revenue.

Mr. Parker said he should like to know something more about the motor generators. When he had applied them—at Chelsea, Crystal Palace, and Oxford—they had done good work, but the manner of application was different from that followed in Manchester by Dr. Hopkinson. At first sight it appeared to him that by their method of application in Manchester, they would prove inefficient, and he would therefore like some particulars as to their behaviour.

Mr. Charles Hopkinson, in reply to a request for some particulars as to the buildings of the installation, said their arrangement was very simple, the plant was easy to keep clean, and no space whatever was wasted. The foundations were one solid mass of concrete, and there was consequently no vibration transmitted outside the building.

Mr. Jeremiah Head said he should like to know, in view of the great extensions contemplated, whether it would not be better to alter the engines to triple-expansion, with a much higher pressure to the boilers; this had been done in other parts of the country. He noticed that the engines they were ordering were simply duplicates of the present ones.

Mr. Gresham Francis, in reply to a question, said that ball bearings had been fitted to the motor generators with a view to economising power by reducing the friction, and to overcome as far as possible any liability to stoppage through inattention on the part of the attendant. They had a small dynamo fitted with these bearings, running at 1300 revolutions per minute continuously from 9 a.m. to 6 p.m. without oil or any attention whatever, and without any signs of heating. Readings taken from the ammeter every fifteen minutes during the day showed a gain in pressure of about 10 per cent. over similar readings taken the day before, under as nearly as possible the same conditions when the dynamo was fitted with the ordinary bearings. In designing these bearings, both the balls and their races must be made from the highest grade of steel, and as hard as possible, as owing to their small bearing surface they would speedily wear out of truth if soft iron case-hardened was tried, but proved a failure, the surfaces soon giving out, and thus causing far more friction than ordinary bearings. The bearings had to be entirely self-contained and easy to adjust, so that any ordinarily intelligent fitter could fit them in place, and adjust for running without any special training. In these bearings the balls were readily got into position by slipping the first of the rings over the flanged sleeve, which was held with the flanged end uppermost. The first row of balls was then placed on the ring and held in position between the ring and the flange, while the whole was turned the other way up. The second row of balls and the second ring were then added, and so on; finally the loose flange was put on and the whole held together by two nuts.

The complete bearing could then be put on to the bracket or pedestal, which was bored to fit the rings, and could be sprung slightly open to allow them to adjust themselves properly, and the whole adjusted by the nuts until the sleeve turned freely, without the slightest shake. The bearings were then ready to be fitted to the shafts. The sleeves were made to fit the shaft snugly unless lateral motion was required, which was sometimes advisable in dynamos, &c. In this case they were arranged to fit freely, and were kept in position by a small sunk key. The number of cored rings depended upon the number of rows of balls required to carry the load, and they were all ground to an angle of 45 deg. with the axis of rotation of the balls. By this arrangement each series of balls was adjusted from a single pair of nuts; the balls were readily put into position, and the whole could be made for a reasonable sum, considering the high quality of the work required. With regard to the thrust on the bearing, there was rubbing at the point of contact between the flanges and the balls; but in bearings where the thrust was light it was so slight, that if the balls were properly hardened the wear was inappreciable.

Mr. Maw asked whether the jockey pulleys were weighted.

Mr. Wordingham, the engineer of the station, did not think the five-wire system any more difficult to work than the three-wire. The bare copper mains were in every way satisfactory, and in his opinion were a better system than any other put down.

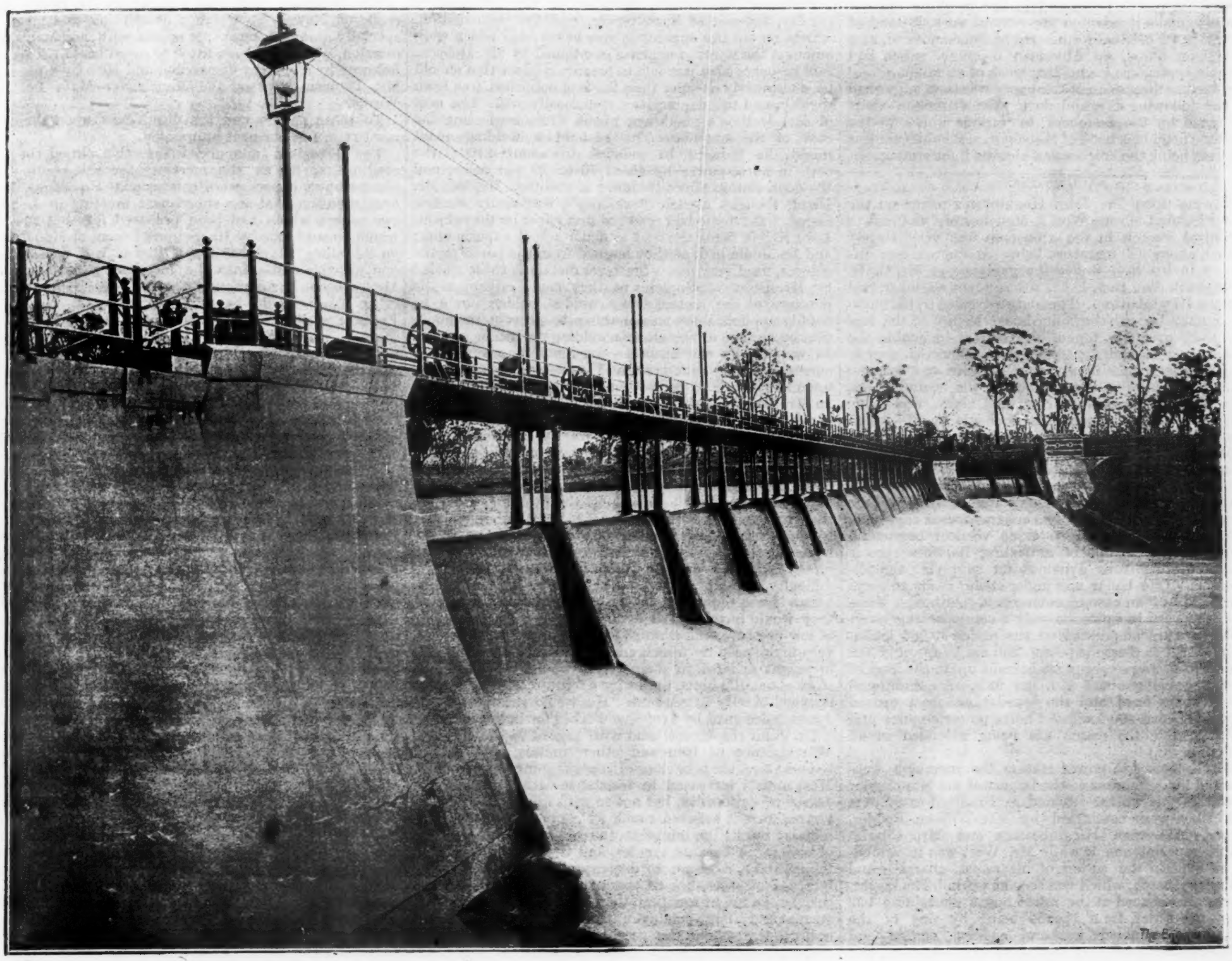
Dr. Edward Hopkinson said, in regard to the ball bearings, he thought they contributed very materially to the good results of the machines.

Mr. C. Richards suggested that to avoid friction in ball bearings, but more particularly in roller bearings, free rollers should be inserted between the balls, and of somewhat less diameter, and this would get over the dragging often experienced.

After several other members had spoken, Dr. John

# THE GOULBURN RIVER WEIR, VICTORIA

(*For description see page* 100)



Hopkinson, in replying on the discussion, said with regard to ball-bearings, of which a great deal had been said, these acted to his entire satisfaction. As to the motor generators, a good deal of the advantage secured was due to the high speed at which they ran—about 1400 revolutions. The motor generators had given them complete satisfaction, and annihilated all cause of trouble from inequality of loads in different sections of the stations. Mr. Head had suggested that triple-expansion engines should be used. Without going into the question of whether it would have been advisable to put triple-expansion engines down in the first instance, he considered that it would now be very doubtful policy to change, when the present engines had run satisfactorily. The jockey pulleys were not weighted or loaded, but set up solidly by means of a screw. There, was, he knew, a strong prejudice amongst mechanical engineers against jockey pulleys, but he might say his experience of them was perfectly satisfactory. With regard to the coal consumed, this would be much less in future than it had been, as the coal strike and other causes had made the cost larger than it would otherwise have been. With regard to the ejector condensers, they knew of course they could not get so good a vacuum as in a jet condenser or surface condensers, but there was greatly increased convenience.

The President called attention to the arrangement of the steam pipes, which was very convenient. He was glad to hear of the good results obtained by using bare copper, as he was personally a very strong believer in that system.

A vote of thanks was then passed to Dr. Hopkinson for his paper.

The Secretary, Mr. Alfred Bache, next read a paper by Mr. B. A. Dobson on "Electric Welding"—an abstract of which will be found on page 99.

In the course of discussion Mr. Saxon said the system of electric welding described by the author was, after all, somewhat limited in its application to smithy work in general engineers' workshops. For instance, they were told that the machine was not capable of piecing bars of iron and steel of more than 2in. diameter, and they were called upon, in breakdown and other work, to piece bars of steel from 2in. to 4in. diameter in an engineer's smithy. It seemed to him that it would be less expensive to couple shafts than to apply such a system as had been introduced to them by the author, particularly in designing new work, they might introduce couplings where they could not get bars of iron of a suitable length; but owing to steel makers and iron manufacturers producing bars of greater length than they formerly did, there was not now so much difficulty in that direction. It appeared to him that the mechanical power required for piecing the bars of iron or steel would be excessive. If 80 indicated horse-power were required to weld a 2in. bar, the power for a 5in. or 6in. bar would be enormous. The expenditure for such a plant as that described would be very great for the requirements of a forge or ordinary engineer's smithy. It was a luxury, not a necessity for such a purpose.

Mr. Cockrill said, with regard to the welding described in the paper, he could only say they could do anything if they had power sufficient. Mr. Saxon had spoken of the large cost which would be incurred in piecing a 5in. or 6in. shaft, but he—Mr. Cockrill—thought the cost was very moderate, as it would only take 130 or 140-horse power for a 6in. shaft, and it would only require a few minutes to piece. It could, therefore, hardly be called a luxury.

Mr. Jenkin said it was a very undesirable thing to put down an electric welder to run from a main shaft. Mr. Dobson had, however, succeeded. Concerning the tests for the power, the great difficulty with an electric welder was estimating the time. He would suggest to Mr. Dobson that a continuous recorder should be put on the steam engine, such a one as Mr. Storey, of Manchester, had, which, if put on a machine for electric welding, would give a very accurate estimate of the horse-power for each weld. The proportion of failures was certainly remarkably small—not one out of 500. At Crewe the percentage was much larger.

Mr. Worthington said he thought the method adopted by the firm of finishing the welds, swaging was to a large extent the cause of its success. In irregularly shaped bars which were sometimes welded by electricity it was impossible to swage after the welding had been performed. Mr. Dobson had pointed out that the largest sizes he had welded were 2¼in. in diameter. It had been his good fortune to witness the welding of much larger sizes, although he was sorry to say he could not give the exact power absorbed. Three square inches were frequently welded in making the crossings of electric street rails. The machines used were really treble machines, one being a large welder carried on a crane and simply deposited on the top of a section; then a horizontal machine on either side was brought forward, also in contact with the surface, each welding machine being under the control of a man. The arrangement was such that immediately one weld was finished another section was ready to bring round to the machine, and in this economy of time would lie the success of electric welding machines. With regard to the arc welding, this was very successful for ordinary commercial and other purposes. It consisted of a carbon arc light, one part of which was held in the hand, and screened from the face of the operator by a large semi-opaque disc. The operator had four powers under his control, *i.e.* he could bring one, two, three, or four measures of current to bear upon the work. This process was used chiefly for local welding.

Mr. Webb bore testimony as to the quality of the work done at Messrs. Dobson and Barlows'. The system would not, however, do for a jobbing shop.

Mr. Jeremiah Head thought the term electric "welding" was inapplicable to the process it sought to name; would not electric "fusion" be a better term? What had generally been understood by "welding" was the property of metals, such as iron, of becoming plastic at a temperature somewhat short of fusion, and if the surfaces were perfectly clean, and brought together by some form of pressure, they would apparently become homogeneous. They could scarcely conceive of wrought iron and cast iron being brought together and united in the same way as by what had generally been called "welding." It was more, it seemed to him, a fusion of the surfaces. Some kinds of iron were exceedingly difficult to weld, and the curious thing was that it was the purer or "drier" irons that were the most difficult to weld, because they did not contain any of that silicate of iron or flux which enabled the surfaces to be kept perfectly clean when brought together. How Mr. Dobson managed without the flux he (Mr. Head) could not quite understand.

Mr. Charles Cockson said with a 1in. bar only 23-horse power would be required, and therefore for a section of 2in. 92-horse power would be necessary.

Mr. R. H. Tweddale, London, said there appeared to be great difference of opinion as to the power to be applied in welding to bring the ends together. He had seen in a paper read in America a statement that a 2in. bar required 75-horse power through 95 seconds, whilst Mr. Dobson gave 88-horse power through 250 seconds, and Sir Frederick Bramwell gave 50-horse power through 55 seconds.

Mr. Aspinall said the identical machines described by Mr. Dobson had for three or four months been tried at his own works, and his experience agreed with that of Mr. Dobson, in thinking that when starting they would require only 30-horse power, whereas they needed 80; but, in his case, after going into the matter carefully, and doing a considerable amount of work both with solid bars and tubes, they had to give it up, as they found it impossible to do any "commercial" work with it. It was more expensive than doing the work by hand. One peculiarity about the machine was that it was only adapted for holding straight work; for irregularly-shaped pieces the machine was practically useless, and he was surprised the people interested in the machine did not attempt to make it adapted for general work, instead of leaving it in its original form. He had once noticed, at a Birmingham Show, an American machine, which had admirable appliances for holding work of all kinds.

The further discussion of the paper was then adjourned until the following day, and during the afternoon visits were made by the members to various works in the immediate neighbourhood of Manchester, the chief centres of interest being the corporation electric light station.

### EXCURSIONS.

Following upon Dr. John Hopkinson's paper on the "New Electric Lighting Works, Manchester," the visit to the central station in the afternoon was very largely attended, about 220 members being conducted over the premises in batches, under the guidance of Mr. C. H. Wordingham, Ass. Inst. E.E., the resident engineer, and Alderman Higginbottom. The route traversed by the members commenced with the boiler-house, thence to the coal store, then over the top of the boilers to enable the duplicate system of steam-piping to be inspected, next to the economisers, and, finally, to the engine and dynamo room. Much interest was evinced in the coaling stage, where the fuel, consisting of washed slack, was being raised from barges lying in the Rochdale Canal—which skirts one side of the building—by means of an electric traveller, the gantry for which runs along the range of hoppers for feeding the Vicars' mechanical stokers. This traveller works quietly and smoothly, and the speed, both of traversing and lifting, can be regulated at will by means of a resistance. There were two boilers at work supplying steam at 125 lb. pressure to three vertical compound tandem engines capable of indicating 100-horse power each, and driving three dynamos for supplying the all-day circuit. One boiler was under steam ready to serve as a "stand by" in case of emergency. Although these works have been in existence only a comparatively short period, there are at present on the mains 39,268 incandescent lamps of 8-candle power, 256 arc lamps, and ten motors, the average charge for current up to the end of March last being about 5½d. per unit. An additional boiler is being fixed, and the foundations are prepared for two additional 400-indicated horse power engines and dynamos, while the mains are being extended in all directions.

From the electric power station the members were conducted by omnibuses to the largest of the Manchester Corporation gas works, situated in Bradford-road, over which they were conducted by Mr. William Rodger, manager, Alderman Higginbottom and Mr. Charles Nickson, superintendent, while Mr. West was in attendance to explain the action of his retort charging and drawing apparatus, which was seen at work. The inspection was commenced at the retort house containing 952 retorts, the order from thence being by way of the washers and scrubber washers, coolers, engine and exhauster house, purifying shed, new gasholder tank, and finally to the station meter and governor house. The area covered by these works is nearly fifty-two acres. There are two retort houses capable of carbonising 850 tons of coal and cannel daily, producing 8,500,000 cubic feet of gas. The retort settings are constructed on the regenerator principle. No. 1 house, with 488 mouthpieces, is worked with West's charging and drawing machinery, comprising air compressor, air receivers, air pipes and drums, coal breakers, elevators, and coal hoppers. No. 2 house, with 474 mouthpieces, is at present worked by hand, but arrangements are being carried out for the use of stoking machinery. There are four gasholders with three lifts, constructed on the telescopic principle, with a total capacity of 6,800,000 cubic feet. A new gasholder tank is being constructed by Mr. James Nuttall, of Manchester, for a holder capable of containing 7,000,000 cubic feet of gas. The holder itself is being built by Messrs. Ashmore, Benson, Pease and Co., of Stockton-on-Tees; the outer lift will be 250ft. diameter by 50ft. deep, the middle lift 247ft. diameter by 50ft., the inner lift 244ft. diameter by 50ft. The total cost will be about £250,000. The number of men employed varies from 675 to 353. These works have good sidings for railway wagons, and are in direct communication with the Lancashire and Yorkshire Railway; and the Ashton and Oldham Canal runs by them.

The capacity of these works will be gathered from the following table:—

| RETORT HOUSES. | | | | | | STORAGE. | | | | | | | | | Station meters | | Purifiers. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | No. of beds of retorts. | No. of mouthpieces. | System of charging. | Carbonising power. | Producing power. | Gasholders. | | | | | | Cannel. | Coke. | Tar and ammoniacal water. | No. | Hourly capacity. | No. | Hourly capacity. |
| | | | | | | No. | Dia. of outer lift. | No. of lifts. | D'pth of each lift. | | Capacity. | | | | | | | |
| | | | | Tons. | Cubic feet. | | ft. | | ft. | in. | Cubic feet. | Tons | Tons. | Gallons. | | Cub. feet. | | Cub. feet. |
| 1 | 28 | 334<br>154 | M'chine<br>Hand | 410 | 4,100,000 | 1 | 150 | 3 | 33 | 4 | 1,700,000 | 30,000 | 30,000<br>(say) | 1,940,000 | 1 | 150,000 | 8 | 150,000 |
| 2 | 28 | 464 | Hand | 400 | 4,000,000 | 2 | 150 | 3 | 33 | 4 | 1,700,000 | | | | 2 | 150,000 | 8 | 150,000 |
| | | | | | | 3 | 150 | 3 | 33 | 4 | 1,700,000 | | | | 3 | 150,000 | | |
| | | | | | | 4 | 150 | 3 | 33 | 4 | 1,700,000 | | | | | | | |
| 2 | 56 | 952 | — | 810 | 8,100,000 | 4 | — | — | — | | 6,800,000 | 30,000 | 30,000 | 1,940,000 | 3 | 450,000 | 16 | 300,000 |

The price of gas in the city of Manchester is 2s. 6d. per 1000ft., and the standard illuminating power equal to twenty candles, to obtain which the fuel employed consists of cannel and ordinary coals in the proportion of about two to one. Alternative visits were arranged to Messrs. Thomas Hoyle and Sons' calico printing works, Buxton-street, London-road; Messrs. S. and J. Watts and Co.'s warehouse, and to the printing works of the *Manchester Guardian* and *Evening News*. In the evening the members attended a conversazione in the Town Hall, on the invitation of the Lord Mayor.

The discussion was resumed on Wednesday, when there was again a full attendance of members. The President, Professor Kennedy, occupied the chair.

Professor Watkinson, referring to the payment of royalty, the cost of horse-power, and the depreciation, which, on electric apparatus, was heavy, and which were amongst the items of expense mentioned by Mr. Dobson, said he believed it possible to arrange a plant that should be enormously cheaper than the one described, free from royalty, and the depreciation practically *nil*. The cost of Mr. Dobson's plant was about £700, neglecting the cost of the engine. The cost of a welding plant might, he thought, be reduced to about £100; the cost in horse-power by about 70 to 80 per cent., and the depreciation almost reduced to nothing. He, like Mr. Head, thought electric "welding" was really electric fusion. Dr. Joule had read the first paper on the subject, Lord Kelvin being the first to make actual experiments; and Dr. Joule had, as they learned from the paper on the subject, used very much the same metals as those welded by Mr. Dobson. So long as they could rely upon the pressure of the metals being welded, which could be readily applied, there was nothing to prevent the adoption by anyone of the electric welding or fusion process. In welding by the incandescent method, a very large current was required at a low pressure, depending upon the metals to be welded and their sectional area. In Mr. Dobson's plant, the large current was generated in an alternator at a high pressure, and then transformed to the necessary pressure by a transformer, and the plant was altogether a very complicated one, and liable to get out of order, to say nothing of the cost. If, instead, they had a dynamo to give them a large current direct, and put the welding table on the dynamo, they would then get over all the difficulties, so long as they only required one or two welding tables, which would be quite sufficient for ordinary works. In ninety-nine cases out of a hundred they would avoid the difficulty of taking the 20, 30, or 40 thousand ampères to where it was required. In the arrangement he suggested they would have a small dynamo to give a large current at low-pressure, and arrange it to be belt driven, using a very high-speed fly-wheel, and then with a wheel 5¼ tons in weight and 6ft. in diameter, it would be possible to store about 100-horse power for a minute, with a decrease in speed of only 10 per cent. He would recommend the dynamo designed by Professor Forbes for large currents.

Dr. John Hopkinson said with regard to the increase of resistance of iron and other metals with rise of temperature, the behaviour of iron was somewhat peculiar. Most metals increased in resistance with a considerable degree of uniformity, but not so with iron. To a certain temperature it behaved much as copper and other pure metals; but as the temperature rose the rate of increase of resistance became greater, and then, at a very high temperature, it began to decrease. With regard to the increase of resistance of conductors with an alternating current, he might mention that, with a large alternating current and a large conductor, they did not get the current uniform throughout the section of the conductor. The current was to a large extent confined to the outer portions of the conductor, owing to magnetic effects, into which he would not enter. The method of electric welding had been called a "luxury," but they must remember that the luxuries of to-day are the necessities of to-morrow.

Mr. Parker said electricians could very much help mechanical engineers in developing electric welding; but at present the method was very cumbersome. He was sorry to hear of the failures at Crewe, and the unsatisfactory results from a commercial standpoint experienced by Mr. Aspinall. He remembered that Sir Wm. Siemens had in 1881 done work similar to that mentioned by the author in welding and fusing steel, platinum, &c., almost in the manner described in the paper.

Mr. Dobson, in replying upon the discussion, said with regard to Mr. Saxon's remarks, that gentleman had somewhat misunderstood him. When he had spoken of bars only up to 2¼in. being welded, he had only referred to the power of one particular machine. They could as easily make a weld on a 12in. shaft as a 2in. shaft. With regard to the unsatisfactory experience at Crewe, he thought the necessity of swaging had been overlooked. In a metal like iron there must be a certain amount of swaging, or the weld would be imperfect. Other metals did not require it, but in the case of iron and some of the lower qualities of steel it was an absolute necessity. Mr. Aspinall, who had had the machines under his control before they came to his own firm, had been less fortunate in his experience than he had. Mr. Hopkinson had asked whether in hard steels the temper was affected by welding. In such cases, after the welding was done, the temper was of course destroyed, but the operation of welding did not appear to put the slightest difficulty in the way of re-tempering, this was done quite as easily all through a built-up bar as it was originally. He did not find that there was any minimum point where the resistance was least, except that, as the current was gradually increased, the resistance at first was least. The President said he had in the winter 1888-90 spent some weeks in the States examining the process Mr. Dobson had carried out successfully in England.

A vote of thanks was then passed to Mr. Dobson for his paper.

The Secretary next read a paper by Mr. Henry Barcroft, of Newry, in which a description was given of specially-designed screw propellers with adjustable immersion, which had been fitted to canal boats. This was followed by a lengthy discussion, and then by a paper by Mr. Thomas Olive on the Manchester Main Drainage Works.

To these papers, and the discussions upon them, we must return in our next impression.

The President announced that this closed the proceedings, so far as the meetings for the reading and discussion of papers were concerned. He might, however, mention that at a subsequent meeting in London, two papers which had been prepared for that meeting would be read, one by Mr. Samuel Dixon, of Manchester, on "Drilling Machines for Cylindrical Boiler Shells," one of which machines the members saw who visited Mr. Joseph Adamson's works at Hyde. The other paper would be by Mr. Charles J. Hewitt, of Prescot, on the "Manufacture of Standard Screws for Machine-made Watches," the interest of which would no doubt be considerably increased by the visit some of the members were paying to the Lancashire Watch Factory at Prescot on Friday. Mr. C. Woodall had also promised a paper on "The Hydraulic Supply Station of the Manchester Corporation;" but this he had not been able to get quite ready, and it would be read at a subsequent meeting.

In conclusion, the President proposed the following votes of thanks, which were heartily endorsed by the members:—To the Council of the Owen's College for their kindness in inviting the Institution to meet there, and the facilities they had offered to the meeting throughout; to the Executive Committee, particularly the Lord Mayor as chairman, the Mayor of Salford as vice-chairman, and Mr. Charles Hopkinson as hon. secretary, for the admirable arrangements they had made for the visit, which would always be a pleasant recollection; to the Lord Mayor—Sir A. Marshall—for his handsome reception at the conversazione in the Town Hall; to the proprietors of the various engineering and other establishments which were open for inspection, and to the several hosts who had so hospitably arranged for the entertainment of the members on the occasion of their visit; to the directors of the London and North-Western and Lancashire and Yorkshire Railway Companies for their kindness in offering special facilities for the excursions over their lines.

The proceedings then terminated.

The Institution Dinner was held at the Grand Hotel, Manchester, on Wednesday evening, and about 300 members sat down. The chair was occupied by the President—Professor Kennedy—and amongst those present were Sir Anthony Marshall, the Lord Mayor of Manchester; Sir William H. Bailey, Mayor of Salford; Wm. Mather, M.P., Alderman Sir Bosdin T. Leech, Mr. John Ramsbottom, first President of the Association; Alderman John Hopkinson, President of the Owen's College; Sir E. Leader Williams, Engineer-in-chief to the Manchester Ship Canal; and Mr. J. K. Bythell, Chairman of the Manchester Ship Canal Company.

The visits arranged for Wednesday comprised the Manchester Ship Canal, the Corporation Hydraulic Power Supply Station, the Manchester Packing Warehouse, and the chief Fire Brigade station in Jackson's-row. Of these, that which received by far the largest patronage was the Canal, the members being conducted from Owen's College to the Pomona Docks on omnibuses, and here they embarked upon the Manchester Ship Canal's Passenger Steamship Company's steamer Eagle, on board of which were also Sir Edward Leader Williams, engineer of the undertaking, and Mr. S. Platt. From the Pomona Docks the vessel steamed up the canal as far as Irlam Locks, passing on her way through the Mode Wheel and Barton Locks. The members were thus enabled to witness the turning of the Trafford-road swing bridge, the Barton aqueduct, which serves to carry the Bridgewater Canal over the principal waterway, and the Barton-road bridge. The otherwise pleasant and interesting trip was somewhat marred by the unpleasant odour which arose from the water, and which seems to have become much more perceptible than when we visited the canal some few months ago. Although this obnoxious smell is no doubt due in a large measure to the pollution of the upper parts of the river Irwell by the numerous and varied factories, chemical and otherwise, which are situated on its banks, yet the delay in the completion of the sewage works of Manchester and Salford is certainly responsible for a large portion of the pollution, since the canal itself acts in large measure as a huge settling tank, in which decomposition takes place. With the completion of the abovementioned sewage schemes, and when the Rivers Pollution Act can be more rigidly enforced, a corresponding improvement will take place in the condition of the water. At Twenty Steps Bridge, near Latchford, a turbine and pump, which we may illustrate in a future number, are being fixed by Mr. C. L. Hett for use in making a subway under the culvert. On the day of the visit there appeared a fair amount of shipping, and some nine or ten steamships were berthed in the docks at the Manchester end. The Pontoons and Dry Docks Company, Limited, whose premises are situate on the bank of the canal at Mode Wheel, received very extensive damage on Tuesday night, owing to a fire, by which a wooden structure serving as an oil and paint shed was entirely destroyed.

Of the other works of interest inspected on Wednesday, the pumping station of the Manchester Corporation Hydraulic Power Supply commands chief notice. The buildings forming this station are in two blocks, divided by a roadway giving access to the yard and to the Rochdale Canal. The main building consists of an engine house, boiler house, accumulator tower, and coal store. The office block has a show room for hydraulic appliances on the ground floor, with offices above approached by a staircase with a hydraulic balance-lift working in the well-hole; behind the office is a residence for the foreman, with workshop and stores. The engines are at present four in number; but two additional engine foundations are prepared, and it is possible that within a year the station will be completely furnished with pumping plant. The type adopted is the inverted triple - expansion surface - condensing pumping-engine, each engine upon trial indicating rather over 200-horse power; the specified duty is the delivery of 230 gallons of water per minute against an accumulator pressure of 1120 lb. per square inch, with 120 lb. per square inch steam pressure, the piston speed not exceeding 240ft. per minute. The steam at 120 lb. pressure is supplied by five steel Lancashire boilers, each 30ft. long by 7ft. 6in. diameter; they are furnished with Vicars' mechanical stokers, and have two Green's economisers of 360 pipes together. The coal is brought from the coal store to the stoker hoppers by means of a ladder elevator discharging into a worm conveyor trough, which is carried along the wall of the boiler-house; this in turn feeds the conveyor extending over the boiler fronts. Coal is delivered to the station either by barge or by road, and is handled by a 30 cwt. hydraulic travelling crane. Three-cylinder Brotherhood hydraulic engines are provided for actuating the conveyors, stokers, and economiser-scrapers in the boiler-house, and also for working the lathe and drill in the fitters' shop. The two accumulators have rams 18in. diameter and 23ft. stroke, and are loaded to give a minimum pressure of 1000 lb. per square inch at the consumers' machinery. The station having been opened in the present year is not yet working to its full capacity. The number of machines already connected, and others for which contracts are pending, is so large, however, that in a few months the four engines already installed will be barely sufficient for the work to be done. The works are in charge of Mr. F. M. Evanson, resident engineer, but were designed by Mr. Corbet Woodall, who has promised to read a paper upon them before this Institution.

## THE IRON TRADES EMPLOYERS' ASSOCIATION.

THE annual general meeting of the members of the above Association was held at the Grand Hotel, Manchester, on Monday, and, being practically at the same time as the summer meeting of the Institution of Mechanical Engineers, also being held in Manchester during the week, there was a good attendance of representatives from the various industrial centres over which the organisation of the Employers' Society extends. The chair was occupied by Mr. B. A. Dobson, the president. The twenty-second annual report of the General Committee of Management, which was presented to the meeting, dealt briefly with various matters of importrnce which had come before the Association during the past year. Commenting, in the first place, on the state of trade, the Committee expressed their regret that they could report no general improvement in the shipbuilding and engineering industries. At the beginning of the current year, a slight spurt took place on the North-East Coast, but since then trade had been on the decline, and was now bad. In nearly all the other districts where the Association had organisations, trade was reported as dull or bad, with little signs of improvement. Some firms had secured a fair amount of work, and were still tolerably busy, but this was confined more particularly to makers of specialities, or machinery where foreign competition was not so much in evidence as in the general engineering trade. The reports of the various trade societies also showed a considerable decrease in their funds, and a considerable increase in the number of unemployed members on their books.

With regard to labour and wages questions, the principal disputes that had occurred to disturb the relations between employers and employed during the year had been on account of wages. On the North-East Coast the Amalgamated Society of Engineers and the Machine Workers applied for advances; the notices were afterwards withdrawn. The moulders and patternmakers, however, went out on strike for an advance of 3s. 6d. time wages, and 10 per cent. piece rates, on the 20th March and 7th April respectively. These demands were afterwards reduced to 2s. and 5 per cent., but no advance of any kind had been granted by the employers, and the men were still out on strike, with little prospect of a settlement, the employers feeling that if they conceded the moulders' and patternmakers' demands, they could not consistently refuse an all-round advance of wages to other workmen, which would result in disaster to the whole trade. After detailing the steps which had been taken to assist their members on the North-East Coast in resisting the demands of the workmen and obtaining a supply of castings from other quarters, the report refers to the action taken in several districts by the leading trades societies who had set their face against overtime, and had made attempts to limit it, at any rate as much as possible, "but, unfortunately," the report somewhat sarcastically adds, "there has been little necessity to work any overtime whatever on account of the state of trade."

Next turning to the eight hours' question, the report goes on to state that there had, during the past year, been a move towards a reduction of working hours to forty-eight per week by several firms unconnected with the Association; and one in particular, Messrs. Mather and Platt, of Salford, had adopted the system. The Government had now followed suit, not only in the various arsenals and workshops connected with the War Department, but since then in the various Admiralty dockyards. The Employers' Association Committee feeling keenly that the hands of employers of labour all over the country might be forced by the recent developments, had done what they could to place the effects of a general movement in this direction before the trade and the public, and with, it was hoped, some beneficial effect. Messrs. Mather and Platt had issued at the end of their trial year a lengthy report, showing the working of the system, and stating that the firm had sustained no loss by the reduction of hours. The committee of the Iron Trades Employers' Association had, however, replied to that on several occasions, and had adduced many forcible arguments which had not yet been traversed by the persons who defended the system of forty-eight hours, and more especially in a pamphlet which was issued to the members and other employers of labour all over the country, as they felt that whatever the effect on an individual firm during a short period in a limited area, once the movement became general it would result in a very large increase in the cost of production, and therefore mean ruin to many firms.

The agreement reached last December between the Iron Trades Employers' Association and the Boilermakers and Iron Shipbuilders' Society for the better regulation of apprentices was also referred to, and the Committee expressed their trust that this agreement would have a good effect upon the relations between employers and their workmen in the above industries in the future. In conclusion, the Committee expressed their regret that Exemption of Machinery from Rating Bill had not yet been passed into law; the amended Employers' Liability Bill had, however, been thrown out by the House of Lords, and the old Act was still in operation.

The President, in moving the adoption of the report, referred to the increasingly antagonistic attitude that was being taken up by trades unionism towards employer generally, and in the engineering trades especially, which had become a serious element in the outlook for the future.

The report having been unanimously adopted, a discussion took place with reference to the moulders' strike on the North-East Coast dealt with in the report, and it was decided that the situation, so far as the employers were concerned, should remain unchanged until September, when the matter would again come under the consideration of the executive.

The usual committees having been appointed, and votes of thanks passed to the retiring officials, Mr. B. A. Dobson—Messrs. Dobson and Barlow, Bolton—was unanimously re-elected president for the ensuing year. The proceedings were then brought to a close with the annual dinner, the President occupying the chair.

## ELECTRIC WELDING.*

*Experience in electric welding.*—Practical every-day working for nearly three years of the process of welding by electric force enables the author to give certain indications of the method considered as a practical workshop operation. During this period his firm has had two machines in operation, worked from the same generating dynamo, and employed on different classes of work: one is specially arranged for piecing bar iron and steel; and the other and smaller machine for special classes of work of a more delicate description, such as brazing and the piecing of clean-finished work, where the fire heat would have destroyed the quality of the work on the adjacent material.

*Mechanical power.*—The statement made with regard to the requisite mechanical power placed great difficulties in the way at first, as it was found that this power had been much understated. Having something like 35 indicated horse-power to spare on a certain engine, and understanding that 30-horse power would be the utmost wanted in order to piece a 2in. round bar, the author determined to drive the dynamo from this engine, particularly as it was in close proximity to the smithy and stretching shed, where this piecing was previously effected by means of the ordinary smith's hearth. By this practical test it was found that not 30-horse power, but as much as 80-horse power seemed to be required for the larger sizes; and until this was understood, the engine was frequently stopped for want of steam, occasioning great loss and inconvenience. The company having control of the welding machine suggested that they should supply a semi-portable engine and boiler; and that this should be tried, with the option of purchase after a certain length of time, if approved. This was agreed to, and a portable engine by Messrs. Marshall, of Gainsborough, capable of working up to 100 indicated horse-power with 80 lb. pressure, was supplied and placed at a distance of about 45 yards from the welding machine. This got over the difficulty of power, but was of course more expensive on the score of separate attendance and other cost. But even with this engine it was found that, when piecing the larger diameters—and as yet nothing over 2¼in. has been pieced—if the work was to be done within a reasonable time, the engine was seriously checked in speed. It was therefore with a view to be certain as to the basis of calculation for the necessary expenditure on driving power that the experiments which follow were conducted.

After some months' working with the portable engine, it was proved satisfactorily that the process was a practical one, and, so far as the results to the author's firm were concerned, a success. As considerable enlargements were about to be made to the establishment, a portion of a large dynamo-room for electric lighting purposes was set apart for the welding dynamo and exciter; the distance of the leads from the dynamo to the welding machine was approximately 100 yards. Having a quick-running vertical engine of the kind made by Messrs. Fleming and Ferguson, making 140 revolutions per minute, with an extra heavy fly-wheel and abundance of surplus power, the author has been able to work the larger diameters without affecting the steadiness of the arc lamps driven off the same engine; and as the load will vary 80-horse power in the tenth of a second, this result speaks well for the arrangement of the engine and for its governing powers. The greatest variation in voltage of the lighting dynamos has been two volts.

*Dynamo.*—The Thomson-Houston welding dynamo is an alternating current machine. Its speed is 1000 revolutions per minute, and it gives at full load a current of 200 ampères at 300 volts, having a frequency of 100 complete alternations per second. The machine is excited from a continuous-current dynamo giving 40 ampères at a pressure of 110 volts. The large welder is capable of piecing iron or steel bars up to 2in. diameter.

*Transformer.*—The primary coil consists of forty-one turns of 0·452in. copper wire. These are coiled round an iron core formed of thin sheet iron plates bolted together. The secondary circuit consists of a single massive copper tube 1¾in. diameter inside and 3¾in. outside, passing through the centre of the core, and connected at the two ends with massive castings 6¼in. broad by 3in. thick, which support the welding clamps; one clamp is kept stationary during the welding, and the other is movable. The pressure is obtained by a screw and hand-wheel, forcing the movable clamp towards the fixed clamp.

*Good and bad welds.*—It must not be imagined that a good weld can always be made by pressure alone. No doubt if the material were perfect in character and thoroughly homogeneous, this might be the case. The iron and steel of commerce are not perfectly pure; and in order to make certain that the work may be subsequently depended upon, it is advisable that the burr formed by the pressure should be reduced by hammering in swages.

The ordinary surfaces of bars, whether cut by shears or broken with the chisel and hammer, are found sufficiently uniform to permit of welding, without further preparation. Should there be dirt or rust upon the surfaces, it is easily expelled when the metal is sufficiently soft to allow of the end pressure of the screw necessary to form union, and the dirt, scale, or oxide makes its way to the exterior.

*Work done.*—In common practice at the author's works the following materials have been heated, and the undermentioned work has been performed. Welding of steel of every quality, iron of every description, from crown to best roller iron and charcoal iron, steel and iron together, wrought iron, and cast iron; different diameters of the same and different materials. Riveting in many varieties; work which previously had to be riveted cold, and which consequently left the strength of the parts uncertain, is now done easily and certainly with the requisite heat. The piecing of counter-shafts and lathe spindles, where the question of exactness of length is of the utmost importance; screwing taps, rollers, and spindles broken in the neck bearings, and brazing of all descriptions have all been successfully treated.

*Power required for electric welding.*—These tests have been confined to the welds required in everyday work, and have varied from ¼in. steel and iron to 2in. as shown in Table 1. The measurement of the alternating-current power supplied to the welding transformers is attended with some little difficulty, owing to the short space of time during which the current and electromotive force are practically steady. As also every piece of iron varies in resistance, though cut from the same bar, the power registered is continually varying in the welding of bars of the same diameter. Another cause, accounting to some extent for the different powers obtained with the same size of shafting, is that the rheostat is not always worked from the same segment of the coils through the adding or deducting of the resistance, and consequently causes a greater or less excitation of the field of the alternator, thereby producing a greater or less electromotive force. A Siemens electro-dynamometer was connected in series with the thick-wire coil of a Siemens watt-meter, the latter being in series with the primary coil of the electric welder. Connected across the terminals of the welder was the thin-wire coil of the watt-meter, in series with a non-inductive high resistance. A Siemens voltmeter for the measurement of alternating volts was also connected across the terminals of the welder. By this means the virtual volts and the virtual ampères were estimated with sufficient accuracy; and at the same moment a reading was taken from the watt-meter, giving the true watts absorbed in the transformer. At the time of taking the instrument readings, indicator diagrams were taken from the engine, which afford a considerable check on the results obtained from the watt-meter. In order to estimate accurately the power taken for each weld, it is necessary to add the power required to excite the alternator, and the power lost in transmission. For this purpose the resistance was measured of the mains supplying the current to the primary coil of the welder, and also the resistance of the mains carrying the exciting current; the former was 0·2 ohm, and the latter 2·6 ohms. The electrical horse-power given in the table is obtained from the true watts shown by the watt-meter, divided by 746, and the loss in the mains and in the exciting current is got by calculation; the loss in friction is the amount of power required to work engine, alternator, and exciter, at no load.

*Conclusion.*—The practical experiments made in the author's works show that in bending cold the weld has rarely given way. But in explanation of this it must be borne in mind that all the piecings of plain bars are more or less swaged. It is well within the mark to state that there is not one out of five hundred welds which turns out a failure or even defective.

The question of cost, which is of course of importance to commercial engineers, has not been alluded to in detail. The author admits, however, that the payment of royalty, the cost of horse-power, and the depreciation which on electrical apparatus is heavy, together bring the cost considerably over the net cost of the ordinary smith's hearth work, while the actual payments in wages and so on are considerably less. The loss in weight of iron is about one-twentieth only. It may be taken that on straightforward welds the total cost will be between 10 and 15 per cent. more than the ordinary smith's work; whereas in delicate work and difficult operations, such as have been alluded to, the cost will probably be one-third of the smith's work. But the real advantage of the apparatus, at any rate as at present arranged, is not so much an economy as a method of securing an absolutely reliable result, and occasionally saving considerable expenditure by its special adaptability.

TABLE I.—*Power Expended in Electric Welding.*

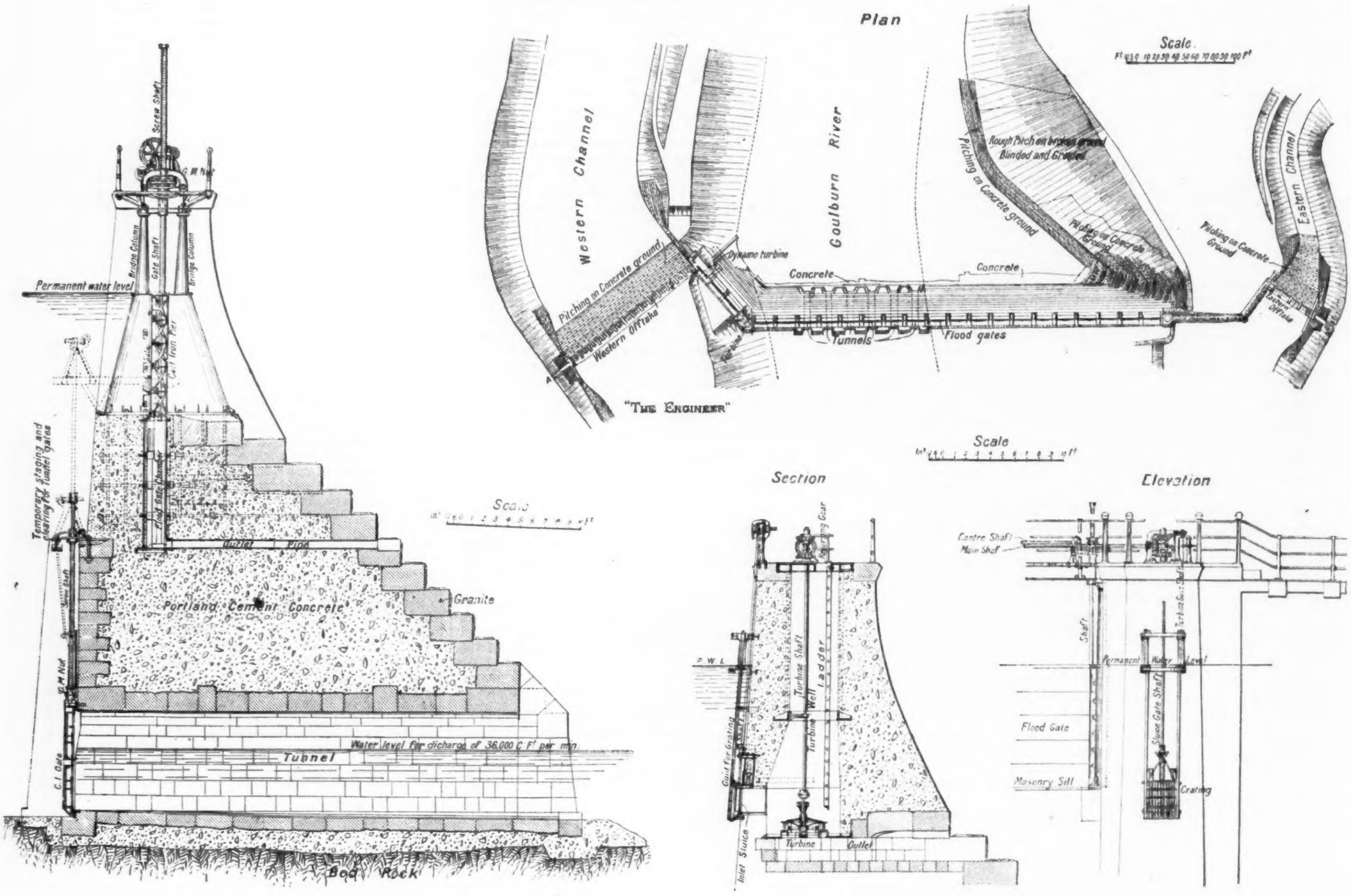
| Work welded. | 1894. | Duration of current. | Electrical horse-power. | | | | Indicated horse-power. |
|---|---|---|---|---|---|---|---|
| | | | $\frac{\text{Watts}}{746}$ | Loss in mains and in exciting. | Loss in friction. | Total. | |
| | May. | Seconds. | E H.P. | E.H.P. | E.H.P. | E.H.P. | I H.P. |
| 2in. wrought iron bar | 24 | 243 | 59 | 10·8 | 18 | 87·8 | |
| Ditto polished all over | 25 | 256 | 55 | 10 8 | 18 | 83·8 | |
| Ditto | 29 | 255 | 59 | 10·8 | 18 | 87·8 | 88 |
| 1⅝in. round iron bar— | | | | | | | |
| Average of 15 welds | 16 | 57 | 17·7 | 6·3 | 18 | 42 | 42 |
| Average of 7 welds | 25 | 50 | 21 | 6·3 | 18 | 45·3 | |
| 1in. steam pipe, wrought iron | 24 | 67 | 20·1 | 6·8 | 18 | 44·9 | |
| Ditto | 24 | 66 | 19 | 6·8 | 18 | 43·8 | |
| Ditto | 24 | 61 | 24·7 | 6 8 | 18 | 49·5 | |
| Ditto | 29 | 86 | 15 | 6·8 | 18 | 39·8 | 49 |
| Ditto | 29 | 66½ | 25·5 | 6·8 | 18 | 50·3 | 49 |
| 1in. Bessemer steel shaft | 24 | 64 | 22·3 | 8 | 18 | 48·3 | |
| Ditto | 24 | 65 | 22 | 8 | 18 | 48 | |
| Ditto | 29 | 62 | 23 | 8 | 18 | 49 | 49 |
| Ditto | 29 | 54 | 27·6 | 7 | 18 | 52·6 | 51 |
| ¾in. Bessemer steel | 24 | 37 | 15·5 | 6 | 18 | 39·5 | 36·5 |
| Ditto | 24 | 38 | 15·2 | 6 | 18 | 39·2 | 36·5 |
| Ditto | 29 | 40 | 17 | 6 | 18 | 41 | 48 |
| Ditto | 29 | 54 | 15 | 6 | 18 | 39 | 43 |
| ½in. Bessemer steel | 24 | 21 | 9·2 | 4·7 | 18 | 31·9 | |
| Ditto | 24 | 21 | 10·1 | 4·7 | 18 | 32·8 | |
| Ditto | 24 | 36 | 8 | 4·7 | 18 | 30·7 | |
| Ditto | 24 | 22 | 10·3 | 4·7 | 18 | 34 | |
| Ditto | 29 | 25 | 9·2 | 4·7 | 18 | 31·9 | |
| Ditto | 29 | 30 | 8 | 4·7 | 18 | 30·7 | 34 |

---

* Paper read before the Institution of Mechanical Engineers, at Manchester, by Mr. Benjamin Alfred Dobson, Member of Council.

# THE GOULBURN RIVER WEIR, VICTORIA

MR. STUART MURRAY, MELBOURNE, ENGINEER



## THE GOULBURN RIVER WEIR, VICTORIA.

A DESCRIPTION of this weir and its dependent system of works, with numerous illustrations, has been prepared by Mr. Stuart Murray, Chief Engineer of Water Supply, and published at the cost of the Victorian Government. Mr. Murray states in the introduction that this description has been prepared with the expectation that it will prove serviceable as well as interesting to engineers, and in order that the details of a work so important and costly may be subjected to the fullest and widest criticism.

The most serious difficulty with which Australia has to contend is the severe droughts which periodically occur, and there is no question that has attracted so much general attention throughout these colonies as that of irrigation and the storage of water. A Royal Commission, which was appointed in 1884 to investigate this subject for New South Wales, reported that on water conservation mainly depended the prosperity and development of the whole extent of the central and western divisions of that colony; that the purposes for which water conservation and storage are chiefly required are to provide fodder and grain for horses, cattle, and stud sheep; to afford a supply of water to be kept in reserve for saving stock of all kinds in bad seasons; to produce fruit, vegetables, and miscellaneous crops, and to increase generally the productive powers of the land. Following on this Commission a report was prepared by Mr. H. G. McKinney, the Government engineer, detailing the results of investigations made, and advising a scheme for storing and distributing the water of the Upper Murray river at a cost, including the distributing works, of £1,412,250. The reservoir was estimated to be capable of supplying 1800 cubic feet per second, which it was considered would be sufficient to irrigate 270,000 acres, yielding a gross revenue of £177,500 a year, and after allowing for interest on outlay, management, and maintenance, leaving a clear profit of £100,000 a year. So far, the irrigation works in New South Wales have not been carried out to any great extent, and such as exist are due principally to private owners, the supply being afforded generally by pumping. The most successful of these works are those carried out by Messrs. Chaffey at Mildura, where the water is taken from a watercourse in connection with the river Murray and raised by steam power to heights varying from 50ft. to 80ft. There are several pumping stations, the largest working four centrifugal pumps, requiring engines of 1000-horse power. The water is distributed through iron pipes, and sufficient is provided to irrigate about 30,000 acres. The crops grown on the cleared and irrigated land are maize and wheat, and a large area is planted with vines and fruit trees. Mildura has become a fair sized town, and the settlers are reported as being well satisfied with their prospects.

In Victoria works have been carried out by the Government, hereafter described, capable, when completed, of irrigating 775,000 acres of land. There are two Water Trusts which take their supply from the National Channel, and which have about 400 miles of irrigating channels. Within the area of the Rodney Trust 1000 acres have been prepared and planted with fruit trees, and 2000 acres been laid down with lucerne, maize, and various other kinds of fodder crops. The fruits include raisins, vines, wine grapes, apricots, and apples; and the price charged for water by the trust is Rs. ½ for 1000 gallons.

As the result of experience in the use of irrigated land for fruit growing in this district, there is a considerable diversity of opinion. Several of the largest fruit growers who were at one time favourable to the formation of irrigation trusts are now opposed to such a course, contending that crops of fruit can be grown as large and as of good a quality without artificial watering as with it, or, at all events, that the advantages of watering do not pay for the cost it entails, so they are entirely of the opposite opinion. Where, however, the holdings are small, the benefit from irrigation is generally admitted. The works which have been carried out by Mr. Murray for the Victorian Government are of a very extensive character.

The Goulburn river, a tributary of the Murray, is the largest and most permanent of the Victorian rivers. The area of its watershed above the newly constructed weir is 3940 square miles; the area below the weir is 2500 square miles, which consists principally of alluvial plains. The irrigation of this plain has supplied the motive for the construction of the weir and its dependent system of works.

The least volume discharged by the river during nine years when gaugings were taken was 2500 cubic feet a minute, and the greatest volume 1,923,000 cubic feet a minute. Floods do not occur suddenly, but give a fair amount of warning. The greatest rise in the level of the river at the site of the weir in twenty-four hours during the four years the works were in progress was 10ft., and the greatest fall in the same time 8ft.

The Commission reported in 1886, and soon after a Bill was obtained in Parliament authorising the construction of the weir, and declaring it to be a national work, under the provisions of the Irrigation Act. A contract was obtained in the following year, and the work commenced immediately thereafter. The weir is 695ft. long, exclusive of the space occupied by the channel regulators, which add a further 230ft. It raises the summer level 45ft., the extreme depth from the still water surface to the river bed being 50ft. The foundation rests on alternating beds of sandstone, slate, and pipeclay, standing on edge almost vertically. The body of the work is cement concrete, backed with steps of carved granite. Across the natural channel of the river six tunnels were formed beneath the site of the weir, each having a sectional area of 44 square feet. These were designed to carry away the water due to the ordinary flow of the river while the superstructure was in progress. These tunnels were provided with iron gates, which were permanently closed on the completion of the work. As these tunnels provided for the escape of the water in summer, the construction of the superstructure gave very little difficulty. On several occasions the river floods rose sufficiently high to overtop the work in progress, but did not do any material damage.

The body of the weir is not monolithic, but consists of large blocks of concrete banded together, bedded and jointed in cement mortar. This course was adopted with the object of preventing the cracks that are inevitably developed in a mass of monolithic concrete. The blocks are composed of one part of Portland cement, two parts of sand, and four and a-half of stone broken to a 2½ gauge, mixed by hand. The linings and faces of the tunnels are of granite. The down-stream part of the weir is built of granite blocks, in courses ranging from 15in. to 30in. in the tail wall, and above in steps with a uniform rise of 24in. The first eight steps from the tail wall are each 2ft. wide on the tread, while those above are respectively 2ft. 3in., 2ft. 6in., 3ft., and 3ft. 6in. The stones in each course underlie the others 18in., and are cheeked in 1in. The granite had to be carted a distance of fifteen miles over very hard roads. The face of the concrete work in the main body of the structure is rendered with a thick coating of cement mortar.

The waterway in the upper portion of the weir is occupied by twenty-one flood-gates, each having a clear opening of 20ft., and a vertical depth of 10ft. These, when required for the escape of flood-water, can be lowered into recesses in the body of the structure, and can be adjusted so as maintain the water level at the off-takes at the normal level. The frames of the gates are rolled T-iron beams, having 7in. section in the tables, with ¾in. web. They are 13in. deep at the centre, curved to 8½in. at the ends. The frames are filled in with cast iron plates; each gate weighs seven tons. They are worked by screw gearing, carried on the gangway of the bridging, and actuated by three 30½in. Leffel turbines. The turbines can be worked together or separately, and any or all of them can be brought into gear with any of the gates. The head available for working the turbines varies from 3ft. to 13ft., giving 3-horse power, with 78 revolutions per minute, to 27-horse-power, with 163 revolutions. Hand gearing to each gate is also provided in case of accident. For the purpose of working the gates in case of sudden floods coming during the night, an electric plant of five arc lamps, each of 2000 candle power, has been provided. The dynamos are worked by a 23in. turbine.

Immediately in connection with the weir are two regulators for the channel off-takes, one on the western, another on the eastern side. The western regulator has fourteen and the other four gates, each having an opening 10ft. wide and 7ft. high. These gates are of the vertical centre-pin type, of iron frames, filled in with timber sheeting. The quantity of excavation and materials used were:—

| | | |
|---|---|---|
| Excavation .. .. .. .. .. .. .. .. | 120,539 | cubic yards. |
| Granite masonry .. .. .. .. .. .. .. | 72,016 | ,, feet. |
| Cement concrete .. .. .. .. .. .. .. | 15,276 | ,, yards. |
| Pitching and rubble masonry .. .. .. | 671 | ,, ,, |
| Cast iron .. .. .. .. .. .. .. .. | 442 | tons. |
| Wrought iron and steel .. .. .. .. .. | 175 | ,, |
| Gun-metal and brass .. .. .. .. .. | 23,474 | lbs. |
| Timber .. .. .. .. .. .. .. .. .. | 1,839 | cubic feet. |

The cost has been as follows:—

| | £ |
|---|---|
| The Goulburn Weir .. .. .. .. .. .. .. .. .. | 106,262 |
| Land and compensation .. .. .. .. .. .. .. .. | 116,000 |
| Engineering and supervision .. .. .. .. .. .. .. | 7,226 |
| | 229,488 |
| Western Channel Works, including land and all other expenses .. .. .. .. .. .. .. .. .. | 217,995 |
| | 447,483 |

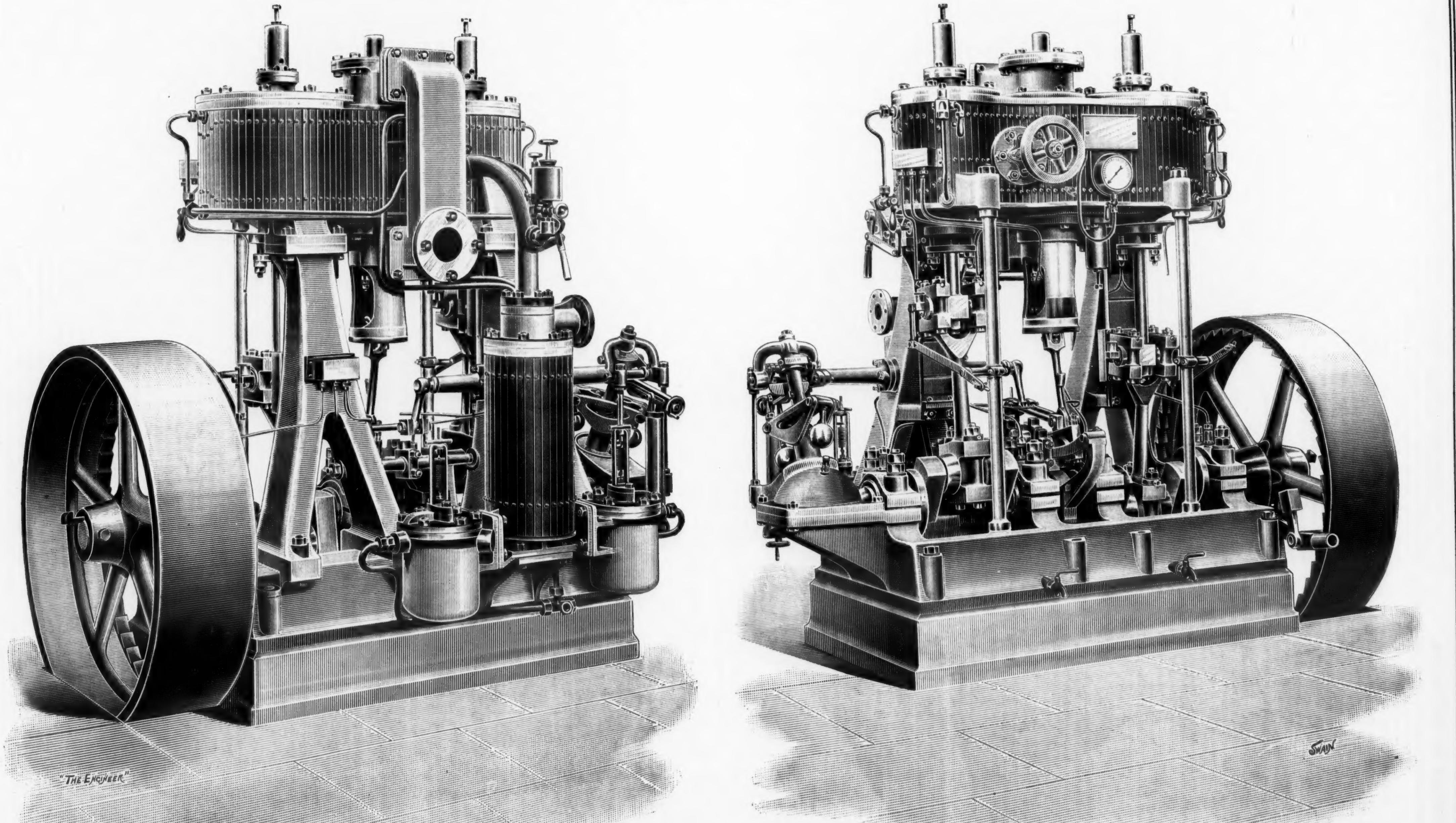
The distributing works on the western side consist of 19½ miles of channel, having a bed width of 110ft. and a depth at full supply of 7ft. The side slopes in cutting are 1½ to 1, and in embankment 2 to 1, with a berm of 5ft. at the set-off of the bank. The minimum height of the embankments is 2½ft. above full supply level, and the minimum crest width 15ft. The new grade is 6in. a mile, and the computed discharge 103,000 cubic feet per minute. The channel on the east side of the river has not yet been constructed.

The report is accompanied by twenty-seven illustrations, from which have been selected one showing—Fig. 1, an elevation of the weir; Fig. 2, plan of the weir; Fig. 3, the turbine wells and turbines; Fig. 4, the tunnel and flood-gate chambers.

HIGH-SPEED ENGINE FOR ELECTRIC LIGHTING

MESSRS. HALL-BROWN, BUTTERY AND CO, GOVAN, GLASGOW, ENGINEERS

(*For description see page* 102)


"THE ENGINEER"
SWAIN

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### MARINE BOILER PRACTICE.

Sir,—When forced draught was first introduced, I read a paper upon the subject, and pointed out the danger and defects of such a system for marine boilers. I have now brought to a conclusion a long series of experiments commenced in 1886, the object of which was to determine the best modes for accelerating the steaming of marine boilers. A few remarks and figures on the subject may be of interest to your readers.

It was necessary to try the various classes of boilers in general use in order to ascertain what was due to construction and what was due to working and management. It soon became evident that however good a boiler might be, much depended upon the system or mode of working it to secure success.

When high authorities lead the van it takes time to arrest the progress of error. Endeavours are made to work boilers upon the cupola or iron-melting system, as in foundries where concentration of heat is required. No such action is safe in marine boiler practice. The blasting process simply converts the furnace into a battery, and the tube-plate into a target to receive the full force of its fire and of the heat generated. No boiler can stand this process long. It is due to the command of good materials for boiler-making that more accidents do not occur; as it is they are frequent enough.

Naval ships are full of delicate machinery. The process employed for working the furnaces causes the decks to become covered with dust and grit, and renders the boiler-room a pandemonium. I do not hesitate to say that a third of the coal is wasted. The error of the system has called forth remedies to mitigate the evils produced. Ferrules are placed in the tubes as fenders to ward off the heat, these in turn reduce the area for draught and the power of the boiler considerably; the fans have to run at increased speed in consequence. It is considered by some that marine boilers cannot be driven at a high speed without forcing, yet we have the loco practice in evidence against this idea. The loco class of boiler is now much used for marine purposes. I have tested them severely. I know of no water-tube or other class of boiler that will equal them for efficiency if treated properly, and allowed to work loco fashion.

An ordinary marine boiler I experimented with stood the highest test possible. High rates had no evil effects upon it whatever. The draught was increased until the coals were lifted from the grate. Coals were burned as fast as they could be put on as a crucial test. A similar trial was made with a loco class of boiler, and from close observation it appeared that the greater the speed the greater the immunity from harm to tubes and tube plates. A furnace working with a partial vacuum and others working with a plenum will bear no comparison. I am unable to send all the results of the various trials, as they are too voluminous. The Admiralty experiments were simply carried out to ascertain the difference between forced and induced draught under the same conditions. The Gossamer's forward boilers were fitted with induced draught. The following tables will give the results:—

*Experiments at Portsmouth Dockyard with Boiler ex H.M.S. Polyphemus.*

| Date of trial. | Description of trial. | Duration of trial. | Average pressure of steam. | Temperature. | | Revolutions of fan. | Total coals consumed in lbs. | Total water evaporated in lbs. | Lbs of water evaporated per lb. of coal. | | Lbs. of coal consumed per sq. ft. of grate per hour. | Water evaporated per sq. foot of grate per hour. | | I.H.P. Approximate. | Lbs of ashes. | Lbs. of clinkers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Feed | Atmosphere. | | | | At actual temperature. | At 212 deg | | At actual temp're | At 212 deg. | | | |
| 1890 Aug. 5 to 9 | Induced draught | 96 hrs. | 74·2 | 62 | 69·9 | 485 | 80,600 | 777,044 | 9·64 | 11·13 | 40·4 | 389·6 | 450·37 | 423 | 3628 | 1202 |
| Oct. 28 to Nov. 1 | Forced draught | 93 hrs. | 77·3 | 51 | 49·8 | 372 | 94,500 | 759,338 | 8·03 | 9·3 | 47·3 | 381 | 444 | 395 | 3804 | 1807 |

Length of tubes between tube-plates, 8ft. 6in. Number of tubes, 258. Diameter, 1⅜in. outside. Area of fire-grates, 20·77 square feet. I.H.P. of fan engine, 1·38 per cent. of power produced.

In this case both series of experiments were conducted on the same boiler, the induced draught installation being dismantled after trial and substituted by the forced draught system.

*Experiments at Chatham with Boilers on Board H.M.S. Gossamer.*

| Date of trials. | Description of trials. | Hrs. | I.H.P. | | Boilers in use and class of fire doors. | Revolution of fans. | | I.H.P. per ft. of grate. | Grate surface | Lbs. of coal per I.H.P. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intended | Actual. | | Star'bd. | Port. | | | |
| 1893 March 6 and 7 | Induced draught | 30 | 1250 | 1288·11 | Two forward boilers of locomotive class, fitted with Martin's patent doors. | 389 | 383 | 16·3 | 79 | 1·92 |
| May 1 to 5 | Forced draught | 96 | 750 | 710·69 | Two after boilers, fitted with ordinary doors. | 219 | 214 | 8·99 | 79 | 2·32 |
| 1894 Feb. 7, 8, and 9 | Forced draught | 48 | 750 | 772·64 | Two after boilers, furnaces fitted with Martin's patent fire doors. | 310 | 304 | 9·77 | 79 | 1·87 |
| " 14, 15, & 16 | Induced draught | 48 | 750 | 825·81 | Two forward boilers, fitted with Martin's patent doors. | 258 | 268 | 10·45 | 79 | 1·68 |
| " 22 and 23 | Induced draught | 24 | 1000 | 1004·04 | Two forward boilers, fitted with Martin's patent doors. | 410 | 426 | 12·709 | 79 | 1·60 |
| " 27 | Forced draught | 6 | 1000 | | Trial abandoned on account of priming. | | | | | |

Grate surface, 143·32 square feet. Tube surface, 5722 square feet. No. of tubes, 1728. Length, 7ft. 1½in. Diameter, 1½in.

These trials were made with the ship moored in the basin for the convenience of registering results. The boilers were originally arranged for forced draught. The tube ends were reduced to allow more water against the tube-plate; this also reduced the steaming one-third, so that the maximum induced draught rates could not be developed. The test lay between the two systems of draught. A sea trial of about ten days full speed was also made on the annual manœuvres. The following is an extract from the Commander's report:—

"The stokeholds are open, in consequence of which there is a free exit for men in case of emergency, and the firemen can work more efficiently and with less discomfort and exhaustion than with closed stokeholds. From personal experience of the closed and open stokeholds, there is, in my opinion, absolutely no comparison between the two systems in this respect, for while with induced draught the stokehold is perfectly light and well ventilated, with forced draught quite the reverse is the case, and a large amount of coal dust is constantly blown about, causing great discomfort to the men. The combustion is more perfect, as evidenced by the very small amount of smoke emitted from the funnel, which also remained comparatively cool, whereas the forced draught funnel under an equal air pressure emitted large quantities of smoke and turned black from the heat, both being painted in the same manner. A sudden increase of speed can be more readily obtained, as the fans are always running and there is no necesity to close stokeholds. I have failed to discover any compensating advantage whatever attached to the forced draught system."

All the boilers were fitted with tubes with their ends reduced and ferruled, so that the area for draught was reduced to about half the ordinary tube area. The table will show that it was not possible to steam at high speed with forced draught, and the last trial had to be abandoned. The full power of the induced draught was not developed. The boilers would require re-tubing with parallel tubes before they would steam up to the ship's rated power. It was common, on the forced draught trials, for the funnel to get very hot and the flames to issue from the top—a very serious defect for war vessels. Ample means were provided for observation on the induced draught boilers on board the Gossamer. As a rule, the flames terminated with the tubes. On charging the furnaces a momentary flame might reach the fans, but the temperature would range from 450 deg. to 500 deg., showing that it is possible to absorb all the heat on the heating surfaces. There are several things requiring attention for high rates of steaming, such as the disposition of the feed-water, the arrangement of the furnaces, &c., which, as a rule, are much neglected. W. A. Martin.

Pocock-street, Blackfriars-road, London, S.E.
August 1st.

### THE EIGHT HOURS' DAY IN PORTSMOUTH DOCKYARD.

Sir,—It may interest some of your readers to know that much dissatisfaction is being expressed in the dockyard concerning the working of the eight hours' day. The men find that they really have to work all their time in the yard. Much of the idling has been stopped, and it is probable that more work is being turned out per man than ever before. This does not suit the dockyard matey at all.

Again, there is trouble because of the new examination system. Apprentices, before being admitted, have to pass an examination in arithmetic, &c. &c. This examination has hitherto been carried out by the chaplain without fee of any kind, and favour has always been shown to the sons of dockyard hands.

Some of the progressive agitators, hating the Church and its works, insisted that the chaplain examination should be abolished, and that the work should be done by the Civil Service Commissioners. The Admiralty conceded the point, and the result is that instead of about 90 per cent. of the candidates passed being the sons of dockyard hands, not 10 per cent. are such, and the promoters of the change have a very bad time in store for them.

Portsmouth, July 31st. Keppel.

### THE PATENT AGENTS' REGISTRATION BILL.

Sir,—The Patent Agents' Registration Bill as amended by the Select Committee contains provisions which will entitle certain persons to be placed on the register without undergoing examination at any time prior to 1896, and also provides that the register shall be kept in the form given in the schedule, which form contains a column in which an indication is to be given of the date of *first* registration, but does not provide for an unmistakeable indication being given of those registered persons who have been duly examined as to their knowledge of patent law and practice. This, I venture to suggest, is unfortunate for the public and for those who become entitled to registration by examination. Those who have already passed, and those who pass and are registered prior to 1896, are in an even worse position than those who are registered subsequent to that date, since, as regards the latter, the date of registration is an indication that they have passed the examination. This defect should, I suggest, be remedied by providing another column in the register in which the date of passing the examination should be given. A Successful Candidate.

August 2nd.

### LIGHT RAILWAYS IN ENGLAND.

Sir,—I read with much interest your descriptions of the Eyemouth Railway and of another local light railway in Hampshire, and wish to express my strong approval of the sentiments expressed in your closing remarks on the former line, which I quote, as follows:—"If people were half as ready to develope industries of this kind through responsible engineers, as they now are—aided by non-technical company promoters and inside and outside brokers—to float rash speculations headed by those retired from all sorts of official positions, we should hear less of total loss of fortune on the part of investors, and nothing of the distress and poverty of the outlying fishing districts in remote parts of our coasts."

I have again and again urged that there is a field for light railway development in England, if conducted on proper and economic principles, and though some years ago you severely "jumped upon" certain opinions which I had expressed in this matter, it is encouraging to read your appreciation of such a work carried into execution. Ireland probably has several places awaiting an opening-up of this kind. In this connection it is appropriate to call attention to the advantages offered by electric railways, built upon their own land like ordinary railways. The greatly reduced weight of the motor cars from that of steam locomotives enables a very much lighter type of substructure to be safely and properly adopted, and the power plant can be made available for other uses, while in many cases it is probable that water power would be available to drive the generating plant. One such railway here is three miles long, connecting a small manufacturing town with the main line railway, and carrying freight and passengers. It has two passenger cars with motors, two trail cars for passengers, and two cars for baggage and express—parcels—traffic. Coal and freight cars from the main line are hauled by a ten-ton electric locomotive, which can haul four loaded cars up a grade of 1 in 20. The power plant consists of a 150-horse power water wheel, with a steam engine in reserve.

In regard to your remarks as to the unfortunate readiness of investors "to float rash speculations," it may be noted that a company is reported as being organised here to manufacture and operate palace cars, and an English broker or promoter is reported as saying that the bonds can be floated in England if "properly promoted." It is easy to build such cars, if money is forthcoming, but quite another thing to operate them. Practically all important lines have contracts with the existing Pullman Company or Wagner Company, and these two companies have absorbed the few smaller companies, such as the Mann, Woodruff, &c. The contracts between the railway and palace car companies usually provide for the exclusive use of the latter's sleeping cars, &c., and it would be well for prospective investors, charmed by the tales of the wealth of the Pullman Company, to make some inquiries as to the probabilities of their cars, if built, being enabled to run on any railway.

New York, July 20th, E. E. Russell Tratman, C.E.

### INDIAN RAILWAYS.

Sir,—I have read with interest the letters you have published bearing upon the working of the Indian railways. Manufacturers who have been in the habit of supplying their goods to these lines of railway have felt and are feeling the keenness of competition from firms of quite indifferent standing, whose goods are freely shipped. I am quite prepared to have the question asked by the engineers whether or no competition should be limited, and I say by all means yes. Buying in the cheapest markets does not necessarily mean that the lines are kept in the highest state of efficiency. Again, a very unfair means of doing business has crept up on this side, and that is railway companies giving their orders to middlemen who are quite ignorant in many cases of the goods they supply, their object being simply to get the orders and sweat the manufacturers. By this means the quality of the goods supplied invariably suffers. In many cases the railways and engineers think they are getting a cheaper article—on paper yes, but in practice no. I would suggest the Indian Government dividing the practical monopoly which exists, *i.e.*, amongst the engineers on this side. In these democratic days one cannot expect business without competition, which I venture to think is being considerably overdone, especially in the branches of soft goods and hardware; economy by all means, but not at the expense of efficiency. I should think the India-office, in which is included the management on this side of the railways, could be worked at half the present expense and with equal efficiency. Merchant.

Glasgow, July 31st.

### THE MORALITY OF DIAMOND MAKING.

Sir,—We read in the scientific journals much about attempts to make diamonds, in relation to the work of Moissan and others, but has it occurred to anyone that a practical method may already have been discovered? In such case what would be gained by publication but severe injury to individuals and to South Africa? Patenting would be of no use, as the patent would be infringed in a wholesale manner. Working it avowedly as a secret process would not answer; the operators would be likely to disappear mysteriously. Can any of your readers throw light upon the solution of the problem "What should he do with it?" considered in its moral and material aspects. W. H. H.

## HIGH SPEED ENGINE FOR ELECTRIC LIGHT.

Our illustration (p. 101) is from photographs of front and back views of an engine constructed by Messrs. Hall-Brown, Buttery, and Co., of Helen-street Engine Works, Govan, Glasgow, from the patented design of Mr. E. Hall-Brown, for the electric light installation at the Northern Co-operative Stores, Aberdeen. The installation is under the superintendence of Professor A. B. W. Kennedy, of London. The engine, which is of the automatic expansion double-acting type, with cranks set at 180 deg., has several points of interest. The cylinders are cast in one piece, with a central casing for a piston valve, which in this case is actuated by a Finck's link gear, controlled directly by a high speed spring governor of the Wilson-Hartnell type. Although in this case Finck's link has been adopted, the makers also make an arrangement with a modified Hackworth gear, and for engines with a throttle valve governor a single excentric serves to distribute the steam to both cylinders.

The specification for this engine stipulates that the governing shall be equally perfect at the normal speed—in this case 225 revolutions—and at 20 per cent. above the normal speed.

In order to fulfil this condition the governor has been arranged with a supplementary spring acting upon an adjustable lever, the load upon the spring being also adjustable by means of a screw and hand wheel; by this means the governor can be accurately adjusted to the highest degree of sensitiveness possible without hunting. In order to have the governor acting as directly as possible upon the valve gear, it has been placed at an angle, and is connected by means of a single lever with the valve gear shaft. This arrangement can be plainly seen by comparing the front and back views of the engine. The makers usually fit balanced cranks to their high-speed engines, but in this case, as the speed of revolution was comparatively low, these were dispensed with. The cylinders rest upon wrought steel columns in front, and cast iron columns of inverted Y section at the back; this design, while being pleasing to the eye, make a very rigid engine entirely free from any motion of the cylinders. At the back of the engine the steam separator and steam traps are placed. These steam traps are one of the makers' specialities, and have, we understand, given complete satisfaction. The exhaust from the low-pressure cylinder is carried off from the ends by a separate pipe at the back of the engine, and is prevented from coming into contact with the cylinder body at any part. The crank pins are lubricated by means of centrifugal lubricators, and are supplied with oil, together with all the other joints upon the engine, from boxes placed upon the cylinder and columns. The bearing surfaces throughout are exceptionally large, and ample provision is everywhere made for efficient lubrication during long runs. Every bearing and slide upon the engine is adjustable, and all nuts are efficiently locked by means of set screws or double nuts. The governor is driven from the crank shaft by means of machine-cut bevel wheels running in a bath of oil. The barring gear consists of a ratchet-and-pawl arrangement, with which the engine is easily started from any position. Throughout the whole engine the workmanship and material are of the highest class, and on trial the engine, we understand, worked with smoothness and steadiness. The dimensions of the engine shown are:—Cylinders, 9in. and 15in. by 9in. stroke; 50 indicated horse-power at 225 revolutions, with a steam pressure of 120 lb.

## RAILWAY MATTERS.

The penny-in-the-slot system of selling tickets has been adopted by the North London Railway. The arrangement is for workmen's tickets only.

The battle of the routes still continues in Ceylon with regard to the proposed Indo-Ceylon railway scheme. The authorities favour the Karunegalu extension, although a direct seaside route appears to have advantages.

News from St. Petersburg says, according to the Vienna correspondent of the *Standard*, that the railway from the Caspian Sea *viâ* Aschabad to Samarcand is to be extended from this last place to a point as near as possible to the Indian frontier.

The railway bridge at Washburn, Wisconsin, belonging to the Omaha lines, on Monday last caught fire owing to a forest fire. Soon afterwards a freight train ran on to the bridge, which at once collapsed. The engine and sixteen cars were destroyed.

Cardiff railway station is about to be largely improved. There is to be a new down platform, on which suitable structures will be erected for the convenience of passengers; the platform itself will be covered with light glazed roofs, and connected with the opposite side by means of a subway.

Judgment has at length been delivered in the appeal of the London Street Tramways Company by the House of Lords. It confirms the decision of the Court below, and dismisses the appeal with costs. Lord Ashbourne alone expressed an opinion that the appeal should be allowed.

A new fare-registering punch has been devised by Mr. F. Bracebridge-Mills, of Hatton-garden. It is of convenient size, its most salient advantages being self-adjustment, avoidance of calculation and simplicity, there being only one thumb-lever, one ticket slot, and one perforating punch.

The Brazilian Railway branching off from Santa Maria northwards, to ultimately connect with the State of San Paulo, has so far progressed as regards the section in the State of Rio Grande do Sul, that it has been of some use to the Government for moving troops, the permanent way being completed to Villa Rica, a distance of 48½ miles.

The Chignecto Ship Railway Co. have asked the Canadian Government for an extension of time in which to complete the works in order to enable the company to earn the Dominion subsidy of a quarter of a million dollars for twenty years. Three million dollars have already been spent on the railway, which is in Nova Scotia.

A goods train conveying iron plates for H.M.S. Renown, now building at Pembroke, ran off the line on Monday at Lamphey, near Pembroke. Workmen and cranes had to be brought from Pembroke to clear the line, which was completely blocked by the large plates. Considerable difficulty was experienced in removing them, owing to their great weight. The traffic between Tenby and Whitland was seriously interfered with, as the engines were blocked at the Pembroke end of the line.

The Isle of Man Tramways and Electric Power Company has completed its tramway between Douglas and Laxey, a distance of eight miles, and on Saturday last an electric car was run through. Dr. Hopkinson, who is a director of the company, had charge of the trial, which was quite successful, the car running the whole distance without a hitch. The second journey was made entirely with power supplied from one of the accumulating stations.

The Railway between Thessalonica and Monastir, a portion of which has been in operation since 1892, is now open for traffic. The line between Monastir and Vertekop was very expensive to make, there being fifteen tunnels. The rolling stock has been chiefly supplied by the Deutz, Dusseldorf and Eszlingen Works, the Maschinenbau-Anstalt of which latter town has obtained an order for ten locomotives for the South African Railway, while the Bochumer Verein has booked 7000 tons of rails for the same line.

The railway which will connect the Port of Bizerta with Tunis by a branch from Djedeida—on the Medjerda main line railway system in Tunisia—has made considerable progress, having reached the town of Mater, about half-way between Bizerta and the new junction. The convention between the Bane-Guelma Railway Company and the Tunisian Government for the construction of the several lines connecting Kairwan, and the principal southern seaports with Tunis, is still wanting ratification by the French Parliament.

The Kurung railway bridge, on the N.W. State Railway, near Rawal Pindi, which consists of 150ft. spans, carried on stone piers 98ft. high, is remarkable, says *Indian Engineering*, both for design and method of construction. The staging used in erecting the girders consisted of four piles supporting light Warren girders, on which the platform was laid. The piles were hollow, and were constructed of twenty-four flange rails, arranged with the heads of the rails inside. These rails were bound together by flat iron bands placed 5ft. apart. The rails were arranged so as to break joint, short odd lengths being used at top and bottom. Successive lengths of rails were fished together in the ordinary way. The bracing between the piles also consisted of rails, all which have since been used on the permanent way.

Except two lines in progress, one to extend from Tsuruga by Kanagawa, into Etchin, and the other from Fuknshima on the main northern line, by Yonezawa and Akita to Awomori, there are no Government railways being made in that part of Japan east of the Biwa lake, but a fresh impulse has been given to the construction of private lines. The company owning the main line from Tokio to Awomori contemplates the construction of a line from Tokio through Mito to Sendai, and are considering the connection of Shimbashi Station, Tokio, with their terminus at Uyeno by a direct line across the city. A metropolitan line is being constructed to the centre of Tokio, near Uyeno. The connection of Nagoya with the Kansei Railway at Yokkaichi by a direct line across the Kisagawa, by the head of the Owari Gulf, which will afford an alternative and shorter route to Kioto, is being proceeded with.

The manufacturers of locomotives, carriages, and wagons suffer from the absence of new railway expenditure. At home the largest proportion of rolling stock is made in the railway workshops, whose capacity is much beyond the proper function of companies whose main duty is to carry traffic. Messrs. Matheson and Grant state in their last half-yearly Engineering and Iron Trades' Report that "In India, the Colonies, and South America, not only are much needed extensions of existing lines postponed, but the severest economy is also being practised in regard to renewals. It is scant comfort to manufacturers to know that the reaction, when it comes, will be the more active because of present abstention. The organisation and plant of engine and carriage builders cannot with advantage be applied to other engineering manufactures, and slack times in their one industry hit them hard in consequence. Locomotive builders make tramway engines, and carriage builders make tramcars, but there is not much doing in either. The makers of little locomotives have more orders and inquiries than at the beginning of the year, but factories are not yet half employed. The approaching sale of the plant used in the construction of the Manchester Ship Canal will release and render available a large number of second-hand engines of the kind used by contractors, but it is doubtful economy to purchase these for anything but a short term of working.

## NOTES AND MEMORANDA.

On July 30th the heat in New York reached 105 deg. in the shade. Before 2 o'clock thirty-three cases of sunstroke were reported.

Some twelve to seventeen tons of ice, or its equivalent in cold air or cooled water can now be produced per ton of coal by some of the ammonia and other chemical refrigerating systems.

The fact is interesting from a mechanical engineering and animal mechanics point of view, that Shorland, the cyclist, in the twenty-four hours' race on the Herne Hill track on Saturday last, rode 460 miles 1286 yards, which means an average speed of 19·2 miles per hour for the whole of the twenty-four hours.

In the Presidency of Bengal saltpetre is manufactured in the Patna and Bhagulpore divisions, and in the city of Calcutta and its suburbs. Besides this, a considerable quantity comes down from the North-West Provinces and the Punjab. The total exports in 1892-93 amounted to 438,408 cwt., valued at Rs. 43,36,588.

According to some comparative researches on the products of the combustion of lighting gas given by an Argand burner and an Auer burner, by M. N. Gréhant, the combustion products from the Auer burner yielded evidence of the presence of carbonic oxide to the extent of 1 in 2580, those from the Argand burner a trace only, estimated at 1 in 75,000.

The production of platinum is increasing in the United States. The nickel ore from Copper Cliff, near Sudbury, contains 0·20 per cent. of plantinum, and similar ores have been observed at Denison, Ontario, containing from traces to 0·53 per cent. of platinum. A recent discovery of platinum ores on the river Tulamee, in British Columbia, appears to be of even greater importance.

At a recent meeting of the Paris Academy of Sciences, M. Georges Charpy read a paper on the relation between the density of a saline solution and the molecular weight of the dissolved salt. According to *Nature*, the density of a saline solution augments proportionally to the molecular concentration if it be admitted that the molecular weight of water at 0 deg. is about 3 × 18. The densities of equally concentrated solutions of analogous salts are nearly proportional to their molecular weights.

The following method of purifying water by means of alum is employed in a number of towns in the United States. The alum forms a kind of jelly, which retains the micro-organisms existing in the water, and carries them down to the bottom of the filter. It is necessary to be very careful in using it—an excess causing the mixture to pass through unaffected—the water instead becoming strongly charged with alum. The requisite quantity of course depends on the quality of the water. It is estimated at 15 grammes to 10 litres of water.

It is stated that by a new German process steel tubes for boiler work are punched from the hot metal. A bar of steel is placed in a matrix of sufficient strength, and having a hole the exact diameter of the tube; then, without allowing time for the steel to cool, a mandrel having a rounded end is forced lengthwise into the mass. The *American Manufacturer* says tubes nearly 8in. in diameter are thus produced, the pressure required to operate the mandrel being 180 tons. The tube is finished by drawing and redrawing to the required thickness.

During the month of June the rainfall at Oxford, representing the mean fall in the Thames valley, has shown an excess of 0·58in.—the only important excess since July, 1893—in which month there was an excessive rainfall, the quantity above the twenty-five years' mean being 1·12in. The only other similar instances since then were in October, 1893, when there was a surplus of 0·09in., and in March, 1894, when the excess was 0·08in. There is this peculiarity in the rainfall of the present June: Of the 2·79in. of rain that fell, 2·56in. came down during the first half of the month—as much as 0·99in. falling on one day, the 4th; whilst only 0·23in. fell during the second half of the month.

In a recent number of the *Comptes Rendus* is a paper on "The Calorific Radiations included in the Luminous Part of the Spectrum," by M. Aymonnet. The following conclusions are deduced from a study of the spectra given by the Bourbouze and Drummond lamps and by the sun:—(1) The eye does not perceive all the radiations between the red and violet; (2) the eye is not acted on by rays intercepted by water; (3) when the medium between the radiant source and the measuring apparatus contains water, there is an imperfect concordance between the distribution of heat and that of light in the same region of the spectrum; (4) the bright lines or bands which we can observe in a spectrum are only those or a part of those which pass through water.

In Upper Silesia a borehole has been carried to a depth of 6700ft.—over a mile and a quarter—although the diameter of the tube—a Mannesmann—is fully 2in. at the bottom, and it is expected that an additional depth of nearly a quarter of a mile will yet be reached. The *South African Mining Journal* says that strata at 17ft. depth show a constant temperature of 51 deg. Fah., with an increase of 1 deg. Fah. for 55ft. of descent until something like 1800ft. is reached, when the temperature increases by 1 deg. Fah. for every further 44ft. of depth. If the increase of temperature goes on increasing at the same ratio, the temperature at the bottom of the projected boring in Silesia may be expected to be found to be very nearly 100 deg. Fah. The result of the experiment will be of interest especially to mining engineers.

The world's production of silver amounted to 2,592,000 kilos. in 1881, and remained stationary until about 1887. Since then the production of silver has increased at an enormous rate on account of the discovery of the rich deposits in the Sierra Mojada, Colorado, and Montana, and rose to 4,479,000 kilos. in 1891, and 5,935,000 kilos. in 1892. On the other hand, the production of gold, which in 1881 amounted to 158,000 kilos., remained stationary until 1888. Then it increased, through the opening of the South African goldfields to 192,000 kilos. in 1892. The *Journal* of the Society of Chemical Industry says that part of this increase is due to the extraction of gold from American silver ores. The silver output of America alone amounted to 692,000 kilos. in 1872, 1,240,000 kilos. in 1885, and 2,018,000 kilos. in 1892. The relation between the price of gold and silver was 1 : 15·56 in 1870, 1 : 18 in 1880, and 1 : 22 in 1890, and, in spite of the Sherman Bill, came to 1 : 23·73 in 1893.

At a recent meeting of the Berlin Physical Society Dr. H. du Bois spoke on the changes of resistance of a bismuth spiral in a powerful magnetic field. This change, discovered by Lord Kelvin, had been measured in the case of bismuth in a magnetic field whose maximum strength was 12,000 C.G.S., and the curve of resistance in the field, compared with that of the resistance outside the field, was found to be at first concave upwards and then straight. The resistance in the field of maximum strength was 1·7 of that in zero field. The speaker, using some very powerful electro-magnets which he had recently exhibited to the Society, and which gave an intensity of 38,000 C.G.S., had, in conjunction with Dr. Henderson, measured the resistance of spirals of pure bismuth, and found that the curve pursues a further straight line course, so that the resistance in the field of greatest intensity is three times as great as in a field of zero intensity. The measurement of the resistances in a magnetic field at different temperatures had yielded interesting results. In weak fields a rise of temperature increased the resistance; in stronger fields the effect was less, and became zero in a field of 7000 C.G.S. In still stronger fields the resistance of the warm spiral was less than that of the cold. The experiments, *Nature* says, have so far been carried on only for temperatures between 0 deg. and 25 deg., but will be pushed further up to 100 deg.

## MISCELLANEA.

The erection of the Watkin Tower has been temporarily stopped for want of funds.

The 1895 meeting and exhibition of the Bath and West and Southern Counties Society will take place at Taunton.

An electric light is to be placed in the Fire Island lighthouse, off New York, the candle-power of which is estimated to be 450,000,000 candles.

The telegraphic line from Tati to Buluwayo, a distance of 108½ miles, has been constructed in the short time of 133 days at a cost of under £3400.

Experiments are to be made at the approaching German manœuvres with a pontoon made of aluminium. It is so light that it can easily be carried by three or four men.

Six months ago the Llanelly Pottery Company consented to the adoption of the eight-hour system in its works. The workmen have found the experiment a failure, and have asked for the resumption of the old system, which will accordingly be now reverted to.

The Ealing Electric Lighting Station will be put into operation the first week in September, and the town lighting commenced. A local exhibition illustrative of electrical developments and applications for lighting power and cooking will be opened in the middle of September.

In our account last week of the visits paid by the Leeds Association of Engineers to various works at Wakefield, we omitted to mention that the machinery particularly noticed at the boiler-making establishment of Messrs. Spurr, Inman, and Co. was made by Campbells and Hunter, Dolphin Foundry, Leeds.

The trial at Chatham of the new protected cruiser Forte, 10, 4360 tons, 7000-horse power, has been successful. At forced draught the engines develope a speed of 19½ knots. The armament of the Forte consists of a couple of 6in., four 7in., and nine smaller quick-firing guns. Her engines were made in Chatham dockyard.

The condition of the Gohna Lake is still giving anxiety, as the inflow continues to gain on the percolation. According to the latest reports, the surface of the lake is now 100ft. below the top of the dam. If no fresh landslip occurs, it is just a question whether the dam will hold out till the expiration of the rainy season.

Next spring we are to have the first of a series of exhibitions, under the direction of the London Exhibitions Limited, at Earl's Court. The Empire of India is selected to be the subject of the Company's initial venture. The Albert Palace and the Paris Hippodrome buildings will be re-erected in the grounds at Earl's Court. Mr. Imre Kiralfy is concerned.

Last week the French Parliament granted a sum of £4000 at the request of the Commissioner-in-Chief of the Exhibition of 1900. The money voted is for the purpose of defraying preliminary expenses incurred in the preparation and engraving of plans and drawings, and also to provide the necessary funds for paying the costs of the competition for designs which will shortly be inaugurated.

A large set of plant for electric transmission for a colliery, consisting of a dynamo to give 250 ampères at 600 volts at 400 revolutions, to work several motors for pumping and other purposes, is being made by Messrs. J. P. Hall and Company. The largest motor is to give 70 brake horse-power at about 900 yards from the surface. This is said to be the largest plant yet put down for this purpose.

The Chief Commissioner formally inaugurated the Rangoon High-pressure Water Supply Works last week. These have been completed in less than nine months. They draw water from the lowest level of the lakes, giving thereby 500,000,000 gallons additional supply, and averting the danger of a water famine. They also pump water up to Pagoda glacis, giving a much-needed additional pressure.

The Lambeth Board of Guardians have accepted the tenders of Messrs. Galloways and Mr. W. Neil for the new work at their Renfrew-road Workhouse, the former supplying the boilers and carrying out the engineer's work, the latter undertaking the new chimney shaft and builder's work. The consulting engineer, under whose specifications the work will be carried out, is Mr. E. H. G. Brewster, of Delahay-street, Westminster. The amount of the respective tenders was £1500 and £1906, making a total of £3406.

A sale of agricultural machinery and machinist plant, including ploughing tackle, two 16-horse power single-cylinder engines, by Fowler, with 5-furrow plough; 11-tine cultivator, sleeping van, water cart, &c., several portable engines, thrashing machine, straw elevators, workshop and machine tools, and some food-preparing machinery, by Mr. David Guy, will take place on the premises, Dicker, Hellingly, Sussex, about 2½ miles from Hailsham, on Thursday, August 9th. Catalogues at the East Sussex Auction Mart, Hailsham.

The canal on the Canadian side of the Sault Ste. Marie will be opened for traffic within a few weeks. Its total length is 18,100ft., of which 3500ft. is the distance across St. Mary's Island. The lock chamber is 900ft. in length, 60ft. in width, and the depth of water on the sills is 20ft. 3in. at low-water mark. The canal itself is 152ft. wide at the water line, and 145ft. wide at the bottom. According to *Engineering News* the first contracts for the work were let in 1889, and up to December 31st, 1893, the total amount expended had been 2,243,890 dols. Up to June 30th, 1893, the Dominion of Canada had expended a total of 71,310,793 dols. on its canals and had received from them a total revenue of 9,850,579 dols.

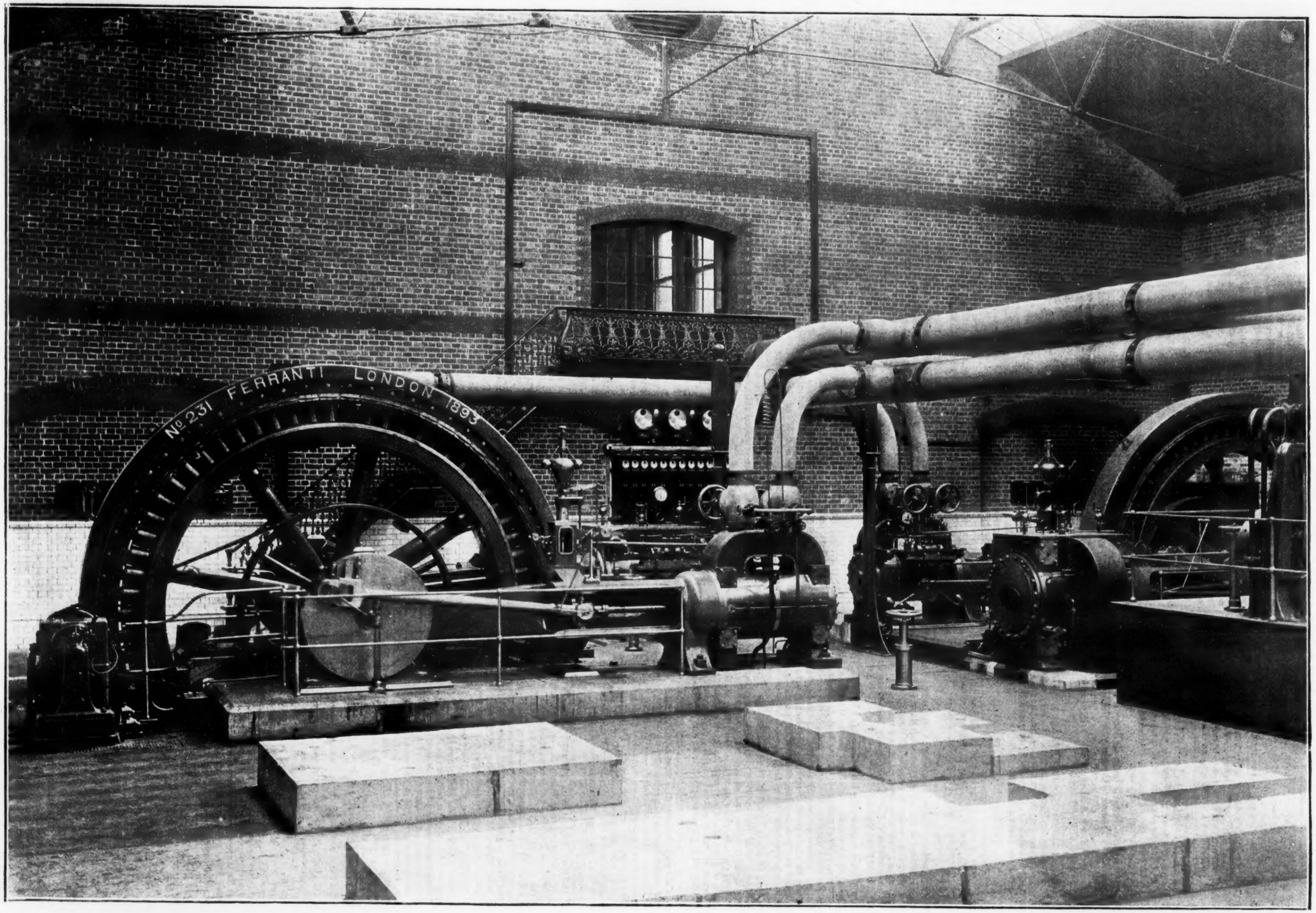
We have received the August number of the *Journal* of the National Lifeboat Institution, the principal feature of which is the wreck chart for the year 1892-3. By far the most wrecks have occurred on the East Coast—notably on the Norfolk and Suffolk Coast, and those of Northumberland and Durham, where the institution appears to have been especially busy. The localities of the various casualties, irrespective of collisions, were: East Coast of England, 547; North Coast, 367; West Coast of England and Scotland and East Coast of Ireland, 827; North Coast of Scotland, 114; East Coast of Scotland, 145; and other parts, 214; total, 2214, or 916 less than in the previous year. We may mention that the institution is in want of funds.

Matheson and Grant in their half-yearly Engineering Trades' Report say that notwithstanding the extreme cheapness of steel and the more than corresponding reduction in the prices of finished work, the leading firms are only partially employed, and in seeking profit from the manufacture they have often to undertake troublesome and risky erection *in situ* at home and abroad. According to the amount of repetition, bridges up to 200ft. span can be purchased at from £10 to £13 per ton, and roof structures at from £12 to £15 per ton. During the last half-year a considerable tonnage has been made for English railways at home; the bridges for the Manchester Ship Canal have been finished, but much further work in warehouses, wharfs, and other subsidiary structures will be needed. There has been a moderate export of bridges to India, China, and Japan. The principal railways at home are constantly extending and rebuilding their stations, and there is much strengthening and renewing of bridges.

THE PORTSMOUTH ELECTRIC SUPPLY WORKS—MACHINERY HALL

MESSRS. S. Z. DE FERRANTI AND CO., LONDON, ELECTRICAL ENGINEERS

(*For description see page* 107)


No. 231 FERRANTI LONDON 1893

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, August 3rd, 1894.

International Navigation Congress .. 95
Institution of Mechanical Engineers .. 96
The Iron Trades Employers' Association .. 99
Electric Welding .. 99
Portsmouth Electric Supply Works. (Illustrated.) .. 99
The Goulburn River Weir, Victoria. (Illustrated.) .. 100
High-speed Engines for Electric Lighting .. 101
Letters to the Editor:—Marine Boiler Practice—The Eight Hours' Day in Portsmouth Dockyard—The Patent Agents' Registration Bill—Light Railways in England—Indian Railways—The Morality of Diamond Making .. 102
Railway Matters .. 103
Miscellanea .. 103
Notes and Memoranda .. 103
The Portsmouth Electric Supply Works—Machinery Hall .. 104
Leading Articles:—China and Japan—Testing a Bridge to Destruction .. 105
Brighton Beach—Albion Colliery Explosion .. 106
The Coal Trade .. 107
Literature .. 107
Parliamentary Notes .. 107
The British Association .. 107
Combined Engine and Dynamo. (Illustrated.) .. 108
Russian Secret Process Shot .. 108
German Machinery at the Antwerp Exhibition .. 108
The Portsmouth Electric Supply Works—Engines .. 109
The Institution of Naval Architects .. 110
Recent Experiments with Cylindrical Boilers and the "Ellis and Eaves" Suction Draught. (Illustrated.) .. 111
The Design of Mail Steamers, with Special Reference to their Use for War Purposes. (Illustrated.) .. 112
American Engineering News .. 112
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. 112
Notes from Lancashire—The Sheffield District—The North of England .. 113
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. 114
American Notes .. 114
Launches and Trial Trips .. 115
Specific Heats of Gases at Constant Volume .. 115
The Patent Journal .. 115
Selected American Patents .. 116

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. W.—*Your letter is an advertisement, and as such we cannot insert it.*

G. F. B. (Westgate Bridge).—*The address of the Brownley Injector Company is 150, Broadway, New York.*

### THE HEINE BOILER.

*(To the Editor of The Engineer.)*

Sir,—We should esteem it a favour if you or any reader could tell us the name of the makers of the Heine boiler. Any information respecting same would help us. T. L.

Manchester, July 26th.

### NEW GAS FOR GAS ENGINES.

*(To the Editor of The Engineer.)*

Sir,—We are asked for a new gas engine which works with gas produced by means of acid and certain decomposable materials instead of with the ordinary or with Dowson gas. Can any reader give us the name of the maker of the engine or of the gas apparatus? F. B.

London, July 31st.

### RURAL WATER SUPPLIES.

*(To the Editor of The Engineer.)*

Sir,—I venture from my very long experience in the obtaining water and in its distribution, to inform your correspondent "Sanitary Inspector" that there is little or no difficulty in pumping water from a well 500ft. away from the well; the lift the pump alone has to do is that it is limited to 30ft., and this only under favourable circumstances. There is a little to be considered with regard to the suction pipe, not only that it should be somewhat larger than a more direct or shorter one, on account of the friction set up by the water rubbing against the surface of the pipe, but by the stopping and again starting a long and perhaps heavy column of water, and to obviate this difficulty I introduce a small air vessel as near the pump as possible, and any ordinary lift pump under the circumstances should overcome the supposed difficulty. With regard to the hardness of the water the schoolmaster must certainly have gone abroad, otherwise Clarke's process must surely have got some note by this time, as it is very nearly forty years since it was applied and used at the Plumstead Waterworks, and has been used at Canterbury, and I have applied it in many breweries and private supplies. Most will know that it is simply what is known as quick-lime dissolved in any water and put into the hard water at the rate of about half-a-pint of the saturated lime-water to twenty gallons of the hard water, and it is found that water of what is known as 20 deg. of hardness is reduced to 5 deg., so that by investing about a shilling in lime and its application, will save something approaching £20-worth of soap. Richard Allison.

Ipswich, July 31st.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* | £0 14s. 6d. |
| *Yearly (including two double numbers)* | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* | £0 18s. 0d. |
| *Yearly* | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* | £1 0s. 8d. |
| *Yearly* | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

British Association for the Advancement of Science.—Wednesday, August 8th. Address of the President, Lord Salisbury, at 8 p.m. Meetings of the sections on following days.

# THE ENGINEER.

*AUGUST* 3, 1894.

## CHINA AND JAPAN.

The war, which has evidently now commenced in earnest, and which is likely to become worse before it is ended, has aspects specially interesting to engineers. If judged by area, population, and wealth, China is as a giant to a dwarf when compared with Japan, but much of this superiority is latent only, and it is questionable if it can be brought effectively to bear. Probably most of those who are familiar with both countries would agree that the Chinese are, as a race, the more astute, that their intellectual capacity is greater, and that, given the same opportunities and training, they would excel the Japanese in most walks of life. But this potential capacity is neutralised and restrained by the absurdly antiquated systems and principles under which the country is governed. The breaking down of these barriers to progress is a condition precedent to the reforms which will open out the country to Western civilisation and to the arts of peace and war necessary to her greatness. It is not at all unlikely that the present war may be the beginning of a social and political revolution which will tend to the advantage not only of China herself, but to all in Great Britain who are interested in engineering enterprise, as well as to the manufactures allied with and arising out of such enterprise. At first sight the difference between the two countries—except in size and wealth—is not apparent, so far as we are concerned. Both have come to Europe for warships, armaments, telegraphs, and railways, but in a very different spirit. Japan has, to the full extent of her powers, adopted modern methods where they are likely to be beneficial, and has sent her young men to England, France, Germany, and America to learn how to make and manage the wonderful tools of the Western World. This policy has already borne fruit. In the technical colleges, arsenals, factories, and hospitals which Japan has established she is every year becoming less dependent on European assistance, and more able to hold her own in any contest where the maintenance and replenishment of armies, ships, machinery, and weapons are important. The Chinese, on the contrary, have only come to us when military necessity has forced her to obtain assistance from Europe, but she detests the "foreign devils," teaches her people to despise them as mere clever craftsmen of inferior race, and gets rid of them as soon as she can. The officers, engineers, foremen, and workmen who have gone from here are grudgingly received, and are utilised without any thanks or due appreciation of their skill. Electric telegraphs were opposed for all kinds of childish superstitions engendered by the governing class, and were finally adopted only as an aid to the central government in communicating with the provinces. Commercial advantage and the general good of the country were reasons which carried no weight whatever. The few railways which have been made in the North of China were permitted almost solely as a protection to Pekin, and to keep open the communication between the capital and the sea. The development of mines and trade, which has to a small extent followed, seems to produce no desire for extensions, and such desire will never arise or have effect till the spirit which underlies the government of the country is exorcised. In the island of Formosa the enlightened Viceroy, who established a railway and who attempted to open out the collieries, has been snubbed and superseded; the proposed coaling station is abandoned, and progress of all kinds arrested. It may be said that the Chinese have, at any rate, war steamers and big guns. But they are worse than the Turks in their management of them. He would be a brave man who ventured on a steamer whose boilers were under the control of Chinese engineers, and the same criticism may be applied to all branches of the public service. There is an army large enough, if judged by numbers, but, except in regard to the *corps d'élite*, most of the soldiers are still armed with bows and arrows and antiquated matchlocks, while their strategy is, to a considerable extent, dependent on omens for guidance. Ill-armed troops, which can only march four or five miles a day for want of good roads, will find their numbers of small avail when in conflict with a country like Japan, which, small as it is, can concentrate her well-armed and disciplined forces rapidly by modern methods.

China may court victory and propitiate her gods by letting off fireworks, as her doctors try to cure diseases by incantation and the burning of coloured paper, but such methods are clumsy and ineffectual. The hope for China lies in the fact that the better part of the people are not wholly adverse to European methods. The few railways which are opened are eagerly used, and if popular animosities against the foreigner were not stimulated by the governing classes who, for their own ends, encourage the superstitions of the people, reforms would be accepted. But, just as in Japan a generation ago, the ancient and now anachronous power of the nobles had to be modified, and freedom to use Western methods arose only when the Daimios, with their two-handed swords, had their power taken away, so in China the mandarins, who deem the doctrines and rules of Confucius all-sufficient, will have to be restrained before the country can be opened out, and the present war may be the beginning of it. If the Japanese can gain immediate advantage before the Chinese can crush them by mere force of numbers, defeat and military necessity—which are the only arguments appealing to the Chinese mind—may lead her to modify her present system of seclusion, and induce her to utilise the aids to peaceful progress and to real national strength, which we are willing and anxious to give her.

Korea is a mere incident of the struggle; but if Japan prevails, the opening out of the peninsula will be of great advantage to manufacturing countries like our own. A revival of trade in England is looked for; the burden of the capitalist who seeks investments for his money is becoming hard to bear, and it will be interesting if the present cloud in the East is to open out into profitable opportunities so urgently wanted, but which seem to be denied us elsewhere. It is worth noting, however, that while in Eastern and other semi-civilised countries, many obstacles and delays are encountered in the attempt to introduce British manufactures, especially those in which engineers are interested, there is, on the other hand, a freedom from restrictions of another kind which hinder progress here. Vested interests are hard to deal with in Great Britain, especially those which control the occupation or use of land and public roads. Even in England there are vast openings for the industrial investment of capital, if we could but remove some of our ancient restrictions as to traction on common roads, and as to improvement in the means of conveying passengers in busy towns.

## TESTING A BRIDGE TO DESTRUCTION.

It is known that on a few occasions the operation of testing a bridge has, probably more by accident than design, been pushed to an extreme neither judicious nor justifiable. In certain cases of testing, such as those relating to specimens and samples, which are prepared and intended for the express purpose of ascertaining their ultimate resistance to stresses of various descriptions, it is necessary to carry the experiments to the point of rupture. But in the instance alluded to, and perhaps in others, the limit of the elasticity of the material should be the standard by which to regulate the severity of the test. A stress of an excessive character injures this all-important quality, and permanently damages the object experimented upon. The testing of materials has in recent times been carried to a pitch formerly never contemplated. Most technical schools and colleges are provided with costly machines, which afford to the student and young engineer ocular proof of what in the majority of instances is a foregone conclusion. It is scarcely necessary to refer to the class of tests undertaken by skilful and competent men who possess works and machines of their own. and conduct the process as a matter of business, and by their ability and integrity, have contributed much valuable and reliable information respecting the strength of materials. Apart from official tests relating to engineering and architectural structures of a public nature, the Governmental departments, and almost every private manufacturing firm, are continually engaged in conducting trials and experiments which, while no doubt possessing special interest, have also a general value in all that pertains to the ever-advancing progress of the arts and sciences.

Another and very important class of tests comprises those undertaken by the engineers in charge of extensive professional works. While the results arrived at are added to the existing fund of combined theoretical and empirical knowledge on such subjects, the tests themselves, similarly to those quoted above, are devised for a special purpose, and conducted with a special object in view. They have a particular and specific relation to those peculiarities of design and construction which constitute the distinguishing characteristics of the work in hand. It is frequently not general information respecting the strength of any given material that is required, so much as the strength and powers of the resistance it will display under the conditions to which it will be subjected. To start *ab origine* and in corroboration of our last remark the experiments in connection with the building, breaking, repairing, and in the numerous repetitions of these latter two operations in the case of the "model tube" of the Britannia Bridge may be cited. That a very large amount of perfectly new and greatly needed information respecting the behaviour of wrought iron under stress was derived from these tests no one will deny. At the same time the great object of them, the chief object at least was to ascertain the direct proportions to be given to the bridge itself, and the manner in which the material could be distributed to the best advantage. Whether these results were as fully achieved as they might have been is now beside the question. At any rate, the Britannia Bridge still spans the Straits of Menai, notwithstanding the increase in the load it has to carry since it was erected, a cause which has led to the demolition of some of its younger brethren, and their replacement by new bridges. Although not exactly a plate girder bridge, it belongs to the continuous web type, a fact to be noticed for a reason that will shortly appear.

Among the defects—or, perhaps more correctly speaking, the deficiencies—of all mere technical tests as distinguished from genuine professional or working ones, the principal is that they are conducted on a more or less limited and imperfect scale. Indeed, the usual method of procedure more frequently than otherwise does not admit of a very liberal treatment or development of the process. A concentrated load or its lever equivalent is all that can be obtained from the expensive machines already mentioned; and the fallacy of arguing, from the effects thus produced, what will be the attendant conditions with a different disposition of the loading, has before now led to very unpleasant results. So far as the mere size of the specimen is concerned, it is well known that in several instances reasonably large specimens have been subjected to tests of a destructive character—such as cast and wrought iron girders, columns and pillars, and built-up struts and other sections of iron. But even in the ordinary working specifications for testing, the specimens of the material to be operated upon rarely exceed the somewhat insignificant length of 8in. As a test that the quality of the material as specified is secured, these proofs are indispensable and satisfactory; but whether the specimens be large or small, whole girders, columns, or component parts of bridges, the conditions attending the loads and stresses, not necessarily pushed to destruction, do not always represent those to which the material is exposed when under its actual working strain, great or small. It may be argued that for this discrepancy between what may be termed in some sense theoretical and practical testing, there is no remedy. All that can be done, which is not very much, is to assimilate the conditions as much as possible. We cannot repeat the "model tube" experiments. It would be impracticable, and also wholly unnecessary, to construct a model of the Forth or Brooklyn Bridges upon any scale that would afford reliable results, and then proceed to break it. Before either of these stupendous structures were erected, the capabilities of steel—the material used in the construction of both—were ascertained, and its employment with safety guaranteed beyond all doubt. It is clear, therefore, that there was nothing to be gained, even had it been practicable, by experimenting upon a model bridge; and as it was, the factors of safety were, we believe, with respect to the Forth Bridge, settled between the Board of Trade and the engineers for the bridge.

While admitting the difficulty, and consequently the rarity of testing to destruction a working example of a bridge, it will be conceded that when an opportunity does present itself of carrying out so valuable and unusual an experiment, it should not be neglected. Such an instance occurred recently in the case of the Wohlhusen railway bridge, which is deserving of investigation, and something more than mere casual attention. Built twenty years ago to carry the line from Berne to Lucerne on the Jura-Simplon route over the river Emme, this bridge gave last year unmistakeable signs of being no longer fit for the increased weight of the traffic, and was replaced by a new structure similarly of iron. Before demolishing the old bridge, the Swiss railway authorities decided to remove it bodily, and place it—main, cross girders, and platform, all complete—upon small abutments built for the purpose, about a couple of feet above the level of the adjoining river bank. In the columns of The Engineer we drew attention to the collapse of the bridge at Mönchestein, near Bâle, between which and that at Wohlhusen there is a general resemblance with respect to span, depth, and the disposition of the lattice web. web. The bridge thus selected for testing to destruction was on the skew at an angle of 48 deg., which caused one panel or bay of the one main girder to overlap the succeeding one in the other girder, thus obviously rendering impossible a uniform distribution of a moving load. It was situated on a curve of the line of fifteen chains radius which had a single track, with a gradient of 1 in 55, and was 140ft. in span, 19ft. in depth, a ratio of about 1 to 8, and with a length of panel equal to 14ft. The main girders are of the old Warren type, with its single triangulation of isosceles triangles in the web. Both the diagonal ties and struts are of a similar section, and built up of double tee-irons braced together and stiffened by intermediate angle-irons and plates. A trough shape was given to the booms of the main girders, which were 17ft. apart, and connected together by the counterbracing usual in the case of deep through bridges. Cross-girders and rail-bearers supported the iron platform. We do not intend to enter into all the details of the breaking test, but to describe merely such portions of them as will enable our readers to understand the grounds upon which we found our opinion respecting the ultimate failure of the bridge.

Ordinary rails and ballast, piled up in successive layers, were used for the experimental loading, which was gradually spread over the half span of the bridge, until its total amount was equal to, per foot run, nearly four times that of a heavy goods train and locomotive. During the whole trial, the greatest care was observed to note and measure accurately all differences of level, deflections of the booms, flexure of the bars of the web, on any departure or deviation to the smallest extent of any member of the truss, from the normal plane which defined the limits to which such alterations in form might safely extend. When the test or live load, to which must be added the dead weight of the superstructure itself, amounting to 78 tons, covered the half span, it was further augmented to nearly 4½ tons per foot run, a sudden cracking sound was heard, and almost immediately afterwards the whole structure gave way. Experience has confirmed this almost instantaneous collapse in other instances of the downfall of railway bridges.

During the progress of the testing, the observations showed that the effects of the load were gradually and increasingly apparent in the different members of the main girders, but not to the same extent. Comparatively the booms suffered but little deformation, and as in similar instances where the failure was not the result of design, but brought about by defects in the structure itself, the web constituted the weak part, and the bars in compression, which were inclined nearly at angles of 45 deg., the chief defaulting members. The main girders deflected at their centre to an amount measured by inches, while the vertical bars became bent likewise, and thus the booms were brought closer together in consequence of the diminished depth of the girder, and the general deformation and inevitable distortion of the whole framework ensued. Small cracks likewise made their appearance in different parts of the ironwork. A curious instance of cracks occurring in cast iron was afforded by the columns supporting an iron viaduct on one of the Moravian railways. They took the form of thin longitudinal fissures, and eventually the authorities replaced them with pillars of wrought iron. The original columns were filled with concrete, and it is possible that the unequal expansion and contraction of the two materials in a climate far more rigorous than our own, may have given rise to the splitting.

If we connect the destructive testing of the Wohlhusen Bridge with that of other bridges all of the same open web type of construction which have collapsed of their own accord, the very pertinent question presents itself whether the plate or continuous web girder is not after all better adapted to resist tests of a destructive character than when the connection between booms and web is discontinuous. This question demands some consideration, not only with regard to actual facts and existing examples of bridges, but because, as we have already pointed out in our columns, engineers both at home and abroad are showing a decided preference for very open web girders, or those in which the panels or bays are very long, the diagonals in corresponding proportions, and consequently the points of connection between the booms and the web at much greater intervals. Under these circumstances the whole boom becomes a continuous girder, although not exactly resting upon immovable intermediate supports. The economy—especially so far as the diagonal struts are concerned—of this system of construction, we have previously admitted in former articles, and see no reason for altering the opinion already expressed, but we are now regarding the subject from a different standpoint, which, whether true or false, will not affect the validity of what has been advanced on the score of economy.

In the disposition of the test load, it is obvious that it was the intention of the experimentalists to assimilate the conditions of the trial as closely as possible to those which would actually obtain in ordinary traffic. Thus the load was successively advanced from one of the abutments, panel by panel, until it had been spread over just one half of the span, and the important point to be noticed here is that the downfall of the bridge occurred when the position of the rolling or live load was such as to produce the maximum shearing stress on the web at the centre of the girders. This is exactly contrary to what occurs with regard to the stresses on the booms, which reach a maximum when the rolling load covers the whole span, which is practically equivalent to a uniform distribution of it. Neglecting the dead load or weight of the structure itself, since its shearing effect is equal to zero at the centre of the span, we shall have, if our figures are correct, the diagonal component of the shearing stress, or the actual stress upon the centre struts of the web equal to thirty tons. While it is quite possible that their net sectional area might have been sufficient to withstand a greater stress, it is evident that they did not possess the requisite degree of resistance to flexure, as they visibly doubled up towards the end of the experiment. It should be remarked that when the bridge failed the amount of the test load and the dead weight upon each girder was a little under 2½ tons per foot run, which might leave a sufficient margin over and above the working stress due to the maximum traffic loads of a single line of railway in Switzerland some twenty years ago.

We have termed the test load a live one, but it scarcely deserves the name, and should strictly be regarded in the light of a load not uniformly distributed. This assumption will not theoretically alter the calculations respecting the stresses, although there is not the slightest doubt that, practically, had the test load been endowed with the *vis viva* of an express train the structure would have collapsed long before it attained to the breaking proportions.

## BRIGHTON BEACH.

More than four years have passed since we last adverted in these columns to the above subject. When we did so we described the several precautions either then taken or in contemplation to stay the constantly increasing denudation of shingle upon the sea frontage. It may be as well, perhaps, before reviewing the results we see have followed those precautions, to recall to the minds of our readers the circumstances under which the denudation remarked upon had arisen. Following the execution of new harbour works at Shoreham, about 4½ miles to the westward, a large accumulation of beach had taken place at Aldrington, a parish contiguous to that suburb of Brighton known as Hove. This accumulation formed a projecting headland that diverted from its original course the drift of the shingle to the eastward. Hove beach thereupon soon became bare of this natural defence, and all the efforts made by Mr. Ellice Clarke, M. Inst. C.E., then engineer to the borough, failed to restore this. After several years of anxious but futile experimenting with groynes of various designs, it was deemed necessary to seek the advice of the late Sir John Coode, M. Inst. C.E. This expert decided upon the erection of a permanent sea-wall, with short groynes at its base. The construction of this gave the protection needed. But the result was the attack by the sea on the beach of the adjacent town of Brighton, and now the anxieties previously felt at Hove have been transferred to the former place.

When last we touched upon this topic, now—as we have said — more than four years ago, we stated that it was the intention of the Brighton authorities to construct a series of very long groynes in the vicinity of the West Pier. A recent visit to the town has enabled us to judge of the effect of these. While they were in contemplation only we expressed great doubt as to whether even the great length to be given them would reach the altered line of the travel of the shingle eastward. In some degree, this doubt has not been justified by results. There has been, most certainly, a degree of addition to the beach on the section dealt with by these new groynes; but it is noticeably of very light stuff. The proportion of what may be termed solid shingle is relatively small, and the absence of this must render it doubtful if, under the attack of exceptionally heavy seas from the south-west, it would remain undisturbed. We are, however, willing to give the design the benefit of this doubt, and to admit that some amount of protection has been gained; but most certainly this has only been attained by a serious sacrifice of the appearance of the beach, as well as of the pleasure uses to which it is put by the visitors to the town. It may almost be said, indeed, that at this—the principal point of resort of these pleasure seekers—there is now more of groyne than of beach. Several of the new erections are massive structures of concrete; and these, although more permanent and reliable, are undeniably not picturesque objects, such as wooden groynes after a certain time undoubtedly do become. The immediate object has, however, in a degree been gained; and probably this is all that the Town Council much cares about. But it must await the experience of many years before it will be possible to decide whether even the limited advantages at present secured may be regarded as likely to be of a permanent character.

As in all former cases of the localised treatment of the beach, the driven-back sea is taking its revenge to the eastward. Between the west station of the Volks' electric railway and the old Chain Pier, the inroad by the sea has become so great as seriously to threaten the structure of the line. This has ever been a "tender spot" in the town's maritime defence, and we fear, since the erection of the groynes before referred to, it has become far more difficult effectually to deal with. But it is when we proceed still further eastward that the effects of the western works are most to be seen. From the Chain Pier, and for the whole length of beach facing the Madeira-walk, the loss of shingle since the time we offered our last remark upon this subject has evidently been seriously great. The waves now attack the carriage road of the undercliff, and it must be merely a question of time as to the necessity for undertaking extensive work to protect this. At many points there now remain but a few yards of light sandy stuff where before the solid shingle extended for a great length seawards. The Corporation has expended, and is still expending, very large sums in making this favourite walk and drive ornamental and attractive, and it cannot afford to remain inactive and see all the work done destroyed by the encroaching sea. So averse have the local authorities shown themselves to follow the example set them by those of Hove, that we despair of their admission of the principle adopted by the latter, that the first expenditure upon a sea wall, although large, must prove in the long run to be the cheaper of the two systems. Hove having adopted it, now rests and is thankful. Brighton must for many years remain in an opposite condition to this. The time may be reached when immunity may be secured, but it can only be at the cost of increased destruction to the cliffs between the town and Rottingdean, the progress already experienced in that direction having some little time back enforced the removal of fully a mile of the coast road further inland. This same progress has, as is well known, before this seriously threatened the main drainage of the town.

This last consideration must operate for many years to come, even when, at the cost of utterly disfiguring their beach, the Corporation has recovered the ground lost by it. We are perfectly aware that this body has a strong reason to urge against a sea wall of the kind adopted at Hove. It argues that such a wall would destroy the beach for use by bathing machines and pleasure boats, and so remove one of the chief attractions of the town to visitors. We admit that this consideration is not without force; but it yet seems to us that some method might be designed to avoid the sacrifice dreaded. As matters have gone so far as they have, however, it is probably too late to retrace the steps taken at so large an expenditure. We can only now regard the past and future battle with the sea at Brighton as being one most instructive to all of our profession concerning themselves with maritime defences.

◆◆◆

## ALBION COLLIERY EXPLOSION.

The coroner's jury on the deaths arising from the Albion Colliery explosion, after an inquiry lasting over nine days, have given their verdict, which is much more to the point than verdicts are generally on colliery explosions. As a rule, juries find that there is not sufficient evidence to show how the gas was ignited. Thus, after the explosion at the Abercarne Colliery, also in the South Wales district, in 1878, when 268 men perished, the verdict was to the effect that there was no evidence to show how the accident occurred. The inquiry into the explosion at Seaham Colliery in Durham, in 1880, when 164 men were killed, the jury found that an explosion had occurred, "but as to the seat of the explosion we have not been able to determine." Yet, for the purpose of determining the cause of this explosion, Sir Frederick Abel had, under instructions from the Home Secretary, made a number of experiments on samples of coal dust collected at the Seaham Colliery, and an exhaustive report, which proved that the existence of very small quantities of inflammable gas in the air of a mine may suffice to bring about a propagation of flame with the addition of coal dust, and by that means cause an explosion. Since then the further experiments made by Mr. Henry Hall, H.M. Government Inspector of Mines, for the Royal Commission on explosions from coal dust in mines, demonstrates the danger of using gunpowder in fiery pits. The jury, in their verdict on the Albion Colliery, state that they are "unanimously of opinion that shot-firing was practised in the colliery, when the men were at work, without sufficient precautions as to their safety, and contrary to rules;" and they further state "that there is not a proper system of watering the mine." This very clearly shows that the jury attributed the explosion primarily to shot-firing in presence of coal dust. Among the recommendations made by the jury is one which certainly might well be added to the general rules of the Coal Mines Regulation Act, namely, "That a record shall be kept of the number of men in the mines at all hours." Considering the uncertainty of life in the best-managed coal mines, it appears strange that no regulation exists for registering the names of persons underground at all times. The jury also recommend more frequent inspection by H.M. Inspectors of Mines, as they consider that "the present examinations by the workmen's representatives are worthless." This opinion is not in harmony with that expressed by the Royal Commission of 1886, for at the end of the report the Commissioners state that they "attach much importance to systematic inspection by workmen, under Rule 30 of the Coal Mines Act of 1872." The careful study which has been made in late years of colliery explosions points clearly to the great danger of blasting in fiery mines, even when a small quantity of inflammable gas exists in presence of dry coal dust. The rules laid down in the Coal Mines Regulation Act are apparently not sufficient to ensure safety. There is but one possible conclusion, namely, that blasting must be altogether prohibited or rigorously restricted to the use of the so-called "high" explosives which detonate without giving off a dangerous flame. Mr. Hall's conclusions respecting dust explosions and the dust of the Albion Colliery, as embodied in his report dated August 20th, 1893, were referred to on page 11 of our impression of the 6th ult.

### THE COAL TRADE.

Both parties to the truce in the coalfield are loyally endeavouring to carry out its conditions. The joint secretaries of the Conciliation Board met in Manchester on Tuesday, when the lists of collieries in the various districts consenting to accept the arrangement were handed over. The names of these collieries have not been published, but they are understood to include the larger and more important undertakings in the whole of the districts covered by the Federation, and there are very few, if any, exceptions in the case of the collieries associated with the Coalowners' Federation. Another gratifying feature is that there are many non-associated collieries assenting. It is stated that there are other collieries, not included in the Federation, the proprietors of which are anxious to join in the agreement. As it is desirable that the new conditions shall cover as large a portion of the coalfield as possible, a circular has been issued which will enable those non-associated collieries to come within the settlement made at the meeting of the Conciliation Board on July 19th last. The proprietors of these collieries have been informed that they may be included in a supplementary list, provided they communicate their desire to Mr. T. Ratcliffe Ellis, solicitor, Wigan, on or before Monday next, August 6th. On both sides further efforts are being made to maintain selling prices. The Erewash Valley Colliery Owners' Association met last Monday. Having regard to the fact that the present quotations are now at their lowest summer level, the Association passed the following resolution :—"That this meeting unanimously resolves that the present selling prices be maintained." If this decision can be carried out, and the example thus set followed in the Midland coalfields generally, the result would undoubtedly be to steady the coal industry, and contribute to satisfactory and peaceful working for two years at least. The entire effect would be wholesome, as giving confidence in commercial circles, and affording absolute assurance that there will be no further rupture for a definite and, considering the frequent disturbances of late years, an unusually prolonged time.

## LITERATURE.

*A Handbook of Gold Milling.* By Henry Louis, F.G.S., &c. 8vo., 540 pp. London: Macmillan and Co. 1894.

Under the modern conditions of gold production, owing to the rapid exhaustion of alluvial and other easily wrought deposits, the world is becoming dependent for the maintenance of its supply of the precious metal upon mines whose ores contain an almost infinitesimal proportion of useful to waste material. Such ores—containing from four to five up to at most forty or fifty parts of gold per million of rock—must necessarily be treated upon a very large scale in order to obtain any useful return on the outlay necessary for the establishment of even a moderate sized reduction plant. It is not surprising, therefore, that the office of millman, amalgamator, or reduction officer, as the person in charge of the gold-saving works is differently styled in different parts of the world, has developed from a mere dependency of the underground works into perhaps the most responsible position on the staff of the mine. For the use of those who may be called upon to undertake such duties, Mr. Louis has in this volume brought together a large amount of valuable material, representing the accumulated experience of quartz-mill operators in all parts of the world, but principally in the Western States of North America, which have been foremost in the development of this branch of mining work. In the earlier chapters, full and complete accounts are given of the physical and chemical properties of gold, and also of those of mercury; the methods for obtaining and keeping the latter metal in a sufficiently pure state for amalgamating purposes, and the precautions necessary for checking and preventing waste in amalgamating, being treated with considerable detail. The author is inclined to believe that the property known as "rustiness" in gold, which prevents the free action of mercury upon the metal, may be due not so much to actual films of rust on the surface as to the existence of an allotropic condition of gold only soluble in mercury with considerable difficulty, as compared with the ordinary crystalline variety, which amalgamates very readily. The same slow solubility characterises the amorphous brown gold obtained by precipitation from weak solutions by ferrous sulphate or other reducing agents; and therefore the author thinks that the presence of such an amorphous metal in the ore may sometimes be the cause of loss in working rather than rust in the literal sense. Since the publication of the volume, this subject has been more fully considered by him in a paper read before the American Institution of Mining Engineers at their meeting in Montreal in February last.

The construction of the stamp mill and its accessories forms the subject of several chapters, every part being considered in detail, with the assistance of numerous carefully drawn illustrations. Much attention has been paid to demonstrating the mechanical principles involved in the design of each part, and, as a whole, this section gives a very complete idea of the points to be attended to in building stamp mills. The author, however, seems to have a very poor opinion of British pig iron, for in discussing the construction of stamp heads, which "should be of first-class quality, low in phosphorus and silicon, of close even texture throughout," he states that "No English iron should be used in the mixture."

Other crushing machines, such as the arrastra and Huntingdon mill are described, but in less detail, as foreign to the main purpose of the work, which is devoted to the construction and working of stamp mills, and for the same reason, concentrating and amalgamating plant are only described to the extent necessary for explaining their uses as accessory to bettering amalgamation. The use of chlorine and the Macarthur-Forrest process, the latter under the somewhat uncouth term of "Cyanidation," in the treatment of mill tailings and concentrates are briefly noticed, and the final chapter is devoted to a description of the methods of assaying gold ores and bullion as required in the current practice of an amalgamating mill.

Within the limits to which the author has chosen to confine himself, the work is exceedingly well done, and it cannot fail to be of value to those engaged in gold-mining work, whether as beginners or as more experienced hands, whose tenderfoot period has long been passed; and a word of commendation is certainly due to the publishers for the excellent manner in which the work is turned out.

## THE BRITISH ASSOCIATION.

The 1894 meeting of the British Association begins next Wednesday night, at Oxford, with the delivery of the address of the incoming president, Lord Salisbury, Chancellor of the University of Oxford. Lord Rosebery will be at the Association as one of the vice-presidents. The opening meeting will be held in the Sheldonian Theatre, which will only accommodate 1800 persons, so that it is possible that some among the late comers may be unable to obtain entrance. The programme of the papers to be read before Section A is still far from complete, many authors having not yet sent in either their papers or abstracts thereof. This section is usually overcrowded with papers. Especially has it been so of late years, when so large a proportion has been on the subject of electricity. A sub-section to deal with that subject seems to be necessary to give relief from its undue preponderance, and for the benefit of those members who care more for the numerous other subjects with which Section A has to deal. Professor A. W. Rücker, of South Kensington, is the president of this section. A course of lectures which he gave some years ago at the Royal Institution was recognised by those present as of exceptional ability, presenting clearly in popular form some of the most abstruse recent problems and discoveries in relation to molecular physics. Among those who usually take an active part in the proceedings of this section, and who are expected to do so at the coming British Association meeting, are Lord Rayleigh and Lord Kelvin.

Section B, Chemistry, has had its title extended to that of "Chemistry and Mineralogy," the latter science having previously been somewhat neglected at the British Association; it is also one which, like forestry, is more largely studied and taught abroad than at home. The president is Professor H. B. Dixon, who is said to intend to advocate improvements in the system of teaching chemistry at Oxford University.

The programme of the proceedings in Section G, Mechanical Science, is in a creditably forward state, and some one or two of the papers will be discussed jointly with Section A. The president of Section G is Professor A. B. W. Kennedy. About the proceedings of this section during the coming British Association meeting there is at present nothing fresh to add to a recent summary given in the *Times*, which said that Professor Kennedy will take as the subject of his presidential address, "Modern Mechanical Training, Constructive and Critical." So full is the programme that, for the first time for many years, the section will meet on Saturday, for which a paper of special interest by Sir A. Noble, on the measurement of pressure in gun-bores, will be the chief item. In this section the various days of meeting have already had their subjects allotted. On the Thursday after the President's address, Sir Frederick Bramwell will give a paper on some reminiscences of "Steam Navigation on Common Roads," which is expected to be followed by a discussion. This will be followed by a paper by Professor Fidler on the "Plastic Properties of Iron and Steel." On Friday will take place the joint discussion with Section A, first, on "Integrators," which will be opened by Professor Henrici; and, second, on "Flight," which will probably be preceded by a paper by Lord Kelvin on "Resistances Experienced by Solids Moving Through Fluids." The remainder of the day will be devoted to civil engineering papers. There will be one on "Tunnel Constructing by Shields," which has come so much to the front lately, by Mr. Fitz-Maurice; and another on "Bore Hole Wells for Town Water Supply," by Mr. H. Davey. On Saturday, besides Sir A. Noble's paper, there will be another by Mr. B. Donkin on "Steam Cylinder Temperatures," with a valuable set of experiments, while Mr. J. Kenwood will give a paper on "Modern Lighthouse Work." Monday will be devoted to electrical subjects. Mr. T. Parker will describe the Oxford electric light system. Mr. W. H. Preece will give papers on his own experiments on "Signalling without Wires," and on "Efficiency of Glow Lamps," on which he has been doing much work. Tuesday will be devoted to mechanical engineering, when Professor Unwin will give a summary of the report of the Steam Dryness Committee. Other papers will be by Professor D. S. Capper on "Calibration of Laboratory Instruments;" by Professor Beare on "Steam Losses;" and by Mr. H. F. Burstall on the "Temperature Entropy Diagram."

Sections A and B will meet in separate theatres in the Museum; Section G will meet in Keble College Hall. Of the two usual conversaziones the first will be held on Thursday, August 9th, at 8.30 p.m., at the University Museum, and the second on Tuesday, August 14th, at 8.30 p.m., at the new Examination Schools. On Friday, August 10th, at 8 30 p.m., Dr. J. W. Gregory, of the British Museum of Natural History, will lecture at the Sheldonian Theatre upon "Experiences and Prospects of African Exploration," in place of Mr. W. H. White, Chief Director of Naval Construction, on "Steam Navigation at High Speeds." Mr. White has been ordered to go abroad, so cannot deliver his lecture. On Monday, August 13th, at 8.30 p.m., Professor J. Shield Nicholson will lecture in the Sheldonian Theatre on "Historical Progress and Ideal Socialism." On Sunday, at 8.45 p.m., there will be a concert in Balliol College Hall: applications for tickets must be sent early on Friday to the Entertainment office. During the time the British Association is at Oxford a number of general and private garden parties will be given. Professor J. W. Sollas, of Trinity College, Dublin, will lecture to working men at the Clarendon Press Institute, Walton-street, Oxford, on Saturday, August 11th, at 8.0 p.m., on "Geologies and Deluges." Admission free to members of the Institute, and to working men resident in Oxford.

The British Association excursions on Saturday, August 11th, will be (A) to Blenheim and Woodstock; (B) to Nuneham, Dorchester, and Wallingford; (C) to Nuneham and Abingdon by river; (D) a geological excursion to Stonesfield; (E) to Silchester. The excursions on Thursday, August 16th, will be (A) to Windsor and Eton; (B) to Reading and Goring; (C) to Swindon Railway Works; (D) a geological excursion to Swindon; (E) Warwick and Stratford-on-Avon; (F) Edgehill, Compton Winyates, Broughton, and Wroxton.

More than one hundred foreign men of science will be present at the meeting, and upon some of them university honours will be conferred before they leave Oxford. The local secretaries at Oxford are Mr. Gilbert C. Bourne, M.A., Mr. G. C. Druce, M.A., and Dr. D. H. Nagel, M.A. We hereby express to them our respect, our condolences, and our sympathy. No man, it is said, who has occupied the position once of local secretary to the British Association has been known to accept the office again. Mr. George Griffith, M.A., of Harrow, is still back in his old post, so well occupied by him for years in the days of long ago, and it will appear unnatural hereafter to see anyone else doing the work. The reception room at the coming meeting will be the new Examination Schools, High-street, Oxford.

## PARLIAMENTARY NOTES.

*The flues of torpedo-catchers.*—A question was asked by Mr. Gourley on this subject, in answer to which Sir U. Kay-Shuttleworth said: The following information has been received from Commander Torlesse, late of the Havock and now of the Hornet, in relation to the question of my hon. friend. He says:—"I presume the Havock is meant. The Hornet has never used water for the purpose indicated, nor was she troubled with flame—from her funnels. No trouble has been experienced in the Hornet from flame—from the funnels—but in the Havock at full speed a good deal of flame has been produced at times. No special report has been made, as it was considered that more experience in stoking would reduce the flame. I have seen Commander Farquhar, of the Havock, who states that his object in having water thrown over the boat—on July 14—was to prevent cinders from the funnels from burning small holes in the canvas cover of the boat." Commander Torlesse adds:—"I had never regarded the boat as in danger of catching fire, but merely used the water as a precaution against damage." Further practice and experience will probably show whether it will be necessary to make a small alteration in the funnels of the Havock in order to prevent any undue smoke or flame. The best hand-picked Welsh coal is used. No smoke-consuming apparatus has hitherto been submitted to the Admiralty which is considered suitable for naval purposes.

*Technical workshops for soldiers.*—In every corps, and in all situations where it is practicable, the commanding officer is required by regulations to establish workshops for the employment and instruction of soldiers in various trades and handicrafts. Difficulties frequently arise through a deficiency of men of the various trades, and from other causes; and the large number of recruits in a battalion, in consequence of short service, necessarily militates against any large extension of the system, but where it can be carried out the result is considered generally satisfactory.

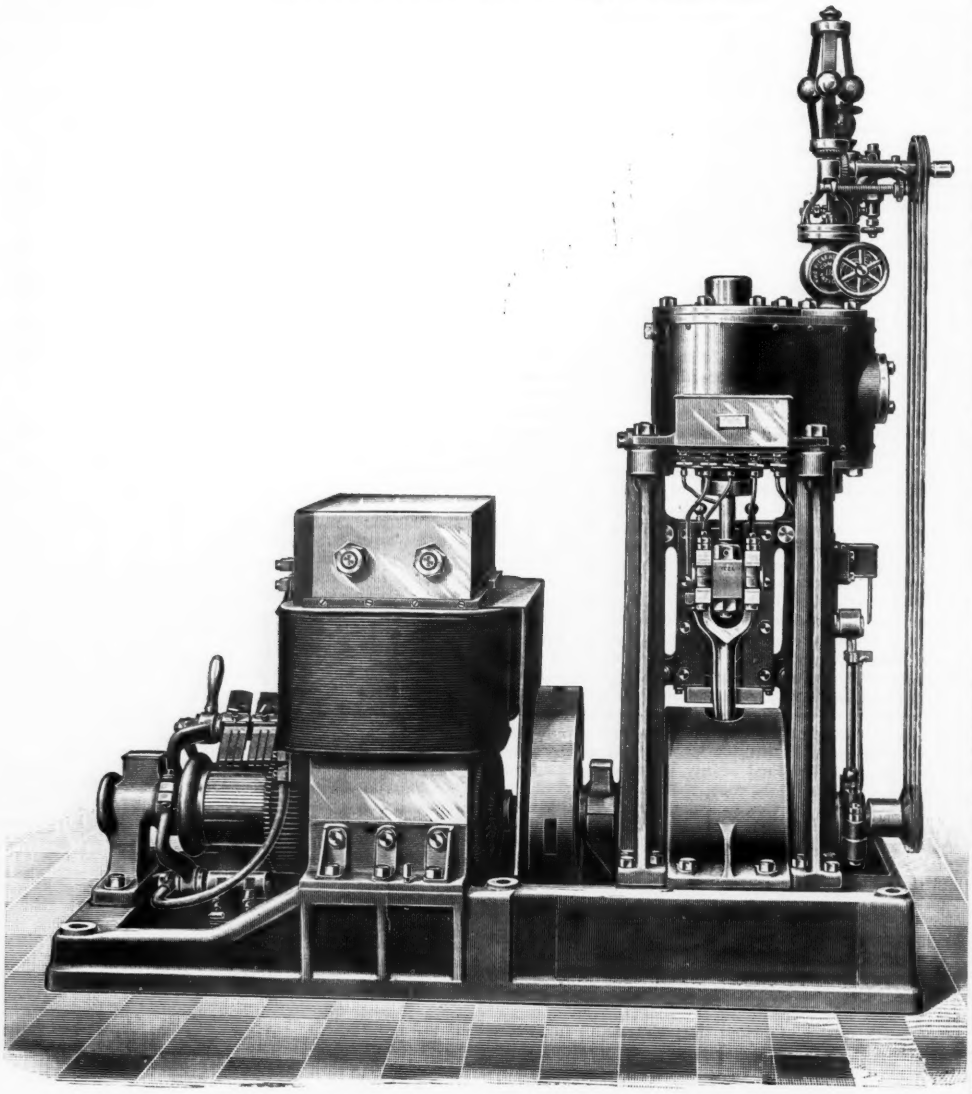
## PORTSMOUTH ELECTRIC SUPPLY WORKS.

In a recent number we referred to the inauguration of the Portsmouth Electric Supply Works, which have been carried out under Messrs. Kincaid, Waller, and Manville as consulting engineers, and Professor W. Garnett, by Messrs. S. Z. de Ferranti and Co., London, with engines constructed by Messrs. Yates and Thom, of Blackburn. On page 104 and 109 we commence the illustration of the machinery employed in these works. The engraving on page 104 is from a photograph taken in the engine and machinery hall; that on page 109 showing in some detail the construction of the engines. The dynamo, as will be seen from page 104, is of what is now known as the fly-wheel type. We shall give further illustrations and descriptions in another impression.

Death of Mr. G. O. Formby.—The death is announced at Liverpool of Mr. Geoffrey Oswald Formby, who in October, 1883, gallantly headed a party which descended the Severn Tunnel shaft to rescue fifty men suddenly imprisoned in the workings by the inrush of a tidal wave during a gale which affected nearly all parts of the country. Many of the readers of The Engineer will remember the event, and the generous account which is given of it in the book on the Severn Tunnel by the late Mr. T. A. Walker, who completed it. The water had extinguished the boiler fire of the winding engine on the bank and rendered the cage useless. Twenty-five men who at the time were engaged in a section below the shaft escaped by ascending the ladders affixed to the sides of the shaft, but the water continued to pour into the workings in such an enormous volume that their companions were unable to follow their example. As soon as the high tide began to recede a boat was lowered and launched in the tunnel by Mr. Formby, then a young engineer, and others. After considerable difficulty the workmen were rescued, only one life being lost, that being of a man who fell off the shaft ladder under the weight of descending water, which he unsuccessfully endeavoured to face. There is little doubt, the *Times* thinks, that Mr. Formby's plucky conduct on that occasion sowed the seeds of disease which, after prolonged suffering, terminated fatally at Liverpool on the 22nd ult., closing a career of credit and great promise.

# COMBINED DYNAMO AND HIGH-SPEED ENGINE

MESSRS. J. P. HALL AND CO. OLDHAM, ENGINEERS



## COMBINED ENGINE AND DYNAMO.

The following particulars are from the specification for the combined engine and dynamo which is illustrated by the accompanying engraving. The engine has high-pressure double-cylinder to give 7½ indicated horse-power, with 80 lb. steam pressure, at 500 revolutions per minute. The over-all dimensions of the engine and dynamo are 1ft. 9in. by 4ft. 10in. by 3ft. 10in. in height. The dynamo gives 40 ampères at 100 volts at 500 revolutions per minute, the magnets being shunt wound. The engine bed is of box section, with extension for carrying the dynamo, the crank pedestals are cast on, and fitted with phosphor bronze bearings. The stuffing-boxes are long, and the glands screwed on, this form being adopted so that they shall not bind on the rods through carelessness in screwing up unevenly.

The cylinders are 4¼in. diameter by 3in. stroke, lagged with planished sheet steel over non-conducting felt. The standards are of cast iron, of H section, and the pistons are of aluminium steel, fitted with hard cast iron rings and secured to the rods with cones, collars, and Delta metal nuts. The piston-rods and the crank shaft are of steel, of large diameter and great strength, working in long phosphor bronze bearings. The bearing at the armature end is made extra long, and the shaft is provided with a coupling forged out of solid, and on this the fly-wheel is keyed; this bearing is so arranged that it takes up any thrust or pull from the armature. The fly-wheel is made with slots for barring, which are so arranged that if the engine moves suddenly forward when the bar is in, it comes out automatically without risk or shock to the attendant. The connecting-rods are of steel, of the ordinary marine type, and the lubrication is effected by tubes from the main oil box. The governor is of the Pickering high-speed sensitive type, driven by a strap. The guides are of cast iron, secured to the back of the standards. The slide blocks are of steel, are lined with Magnolia metal, and lubricated by tubes from the main oil box. The piston-rods are secured by steel nuts pinned in position on each side of the slide block.

The dynamo, as above mentioned, is shunt wound and has a drum armature. The magnets are of soft charcoal iron, of the single horseshoe type—cores and pole pieces in one—machined all over. The yoke is formed of a separate piece fitting between the extended top ends of the cores and secured in position by bolts. The shunt coils are carried on sheet iron formers with brass ends, the coils being of high resistance, held in position with the brass end rings. The angle plates for carrying magnets are massive brass castings. The armature core is built up of annealed charcoal iron discs insulated from each other, and mounted on a strong steel shaft fitted with key to drive the discs. The winding consists of a sufficient number of turns of insulated copper wire of such sectional area as to give the specified output. The insulation is mica and tape throughout and coated with varnish. The driving power is transmitted to the winding by means of flat driving teeth let into the core and insulated with mica. The commutator is of large diameter, with forty bars of hard drawn copper, insulated with mica, and carried in a cast steel bush, keyed on the shaft. The depth of the bars in the direction of wear is ⅜in. The collecting gear consists of four brushes, two for the positive and two for the negative, held in holders with holding-off catches. The shaft is hard steel, with keys being sunk in, and with half-coupling forged out of the solid to couple to the engine crank shaft.

## RUSSIAN SECRET PROCESS SHOT.

Since writing on this subject in connection with the reports of the trials carried out at Ochta on June 28th and July 3rd and 6th last—see The Engineer of July 6th and 13th—we have endeavoured to learn what we could from persons present at the trials representing English manufacturing firms. We soon ascertained that the shot were kept from inspection before firing as well as after recovery. This bore out our conjecture that a false point had been added on the apex of the shot. We made a sketch, which we did not publish, but sent elsewhere, of the device which we thought was probably employed, namely, a sharp, hard steel point, such as would break into the skin of a treated plate, and probably be shivered and projected to a distance or carried through by the shot. The wood screen might be used to detect if the latter took place. To-day we have a letter from Captain Tresidder, who represented Messrs. Brown at the trial. He encloses a paper containing such data as he was allowed to note, and which are not confidential, which he is contributing to the professional papers of his old corps, the Royal Engineers. Naturally Captain Tresidder was not allowed to see the projectiles, but his impressions acquired when attending the trial and his judgment are of special value. The data as to velocity, &c., are not worth giving here, because striking velocity was not always recorded, and may be said to be fairly represented by the velocities we gave, namely, 1850 foot-seconds for the 6in. plate and 2400 for the 10in. The effects on the plates were also sufficiently given in our previous articles. We now learn, however, the interesting fact that an ordinary and secret process shot fired at a tough homogeneous 10in. steel plate gave in each case about 12in. to 13in. penetration. Seeing that the secret process shot continually perforated the treated plates, while the ordinary shot, under corresponding circumstances, broke up, it is clear that this secret process is effectual mainly in preventing the projectile from shivering against the hard skin of the treated plate. We now come to Captain Tresidder's conjecture as to the secret process projectiles. He considers, without question, that they have false points or caps fixed on their apices. They have been called magnetic shot. We did not take any notice of this word, as we regarded it as a blind. Captain Tresidder views it in much the same way, but suggests that magnetism may have been employed to hold the cap to the smooth apex of the shot, at all events in some instances. He thinks that cap is of wrought iron or very mild steel, for the reasons given by us in The Engineer of July 6th. We have thought it probable that hard steel was used. The account we had received of the effect previously produced by small projectiles on a treated plate, and the absence of recovered fragments, seemed to us to point to this conclusion. Wrought iron we hold to be out of the question, because we know that its normal behaviour is to extend into a ring and to be left in front of the face of the plate. This action might not take place always, but certainly it would occur repeatedly when so many rounds were fired; and wrought iron does not rebound, and so some distorted caps would be seen in front of the target—unless a man were sent out to pick them up, which could hardly escape observation. Captain Tresidder may, however, be correct in believing that a soft steel cap is used, and he mentions in support of his view that from the head of the secret process shot which was embedded in the tough, homogeneous plate, there was visible "a strip of soft iron or steel, as if the cap had been carried into the plate and a strip had been squeezed from it to the rear." He adds that, by an accident, "a momentary glimpse of a certain object was obtained, which was bright, of iron or steel, about 4in. or 5in. long, and pointed at one end; and there can be little doubt it was one of the caps. The point was probably to reduce resistance in flight."

Captain Tresidder suggests a sketch (see Fig. 1) which may be compared with the sketch we made, which we here reproduce in Fig. 2. It will be seen that, considering the secrecy that has been maintained, the accordance of Captain Tresidder's idea with our own is remarkable. There is, however, a distinct divergence in principle between the two. Captain Tresidder's is a pad to break the shock of the hard skin on the point; ours is a sort of temporary wedge to break the skin open instead of allowing the point proper to do so. We know that Captain Tresidder's point would, in a measure, effect the purpose intended, and the strip he saw supports his view. On the other hand, it is so very nearly the old wrought iron cap, that it hardly accounts for the sudden announcement that a new device had been discovered. The first piece of treated plate, with skin perforated or torn by small projectiles, was evidently an unexpected cause of delight. This, we think, was not shown to Captain Tresidder, and this suggests that some new feature and action had been arrived at. The difference, at all events, is small, and the surmise sufficiently promising, we think, to justify a wish that trials could be made with false points or caps, both of soft and hard steel.

FIG. 1

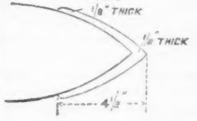
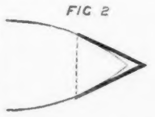


FIG 2



If further evidence as to the existence of a cap or false point is needed it is found in following the fact stated by Captain Tresidder. "After the first two rounds at the 10in. plate, the velocities were chalked on the plate, 2350 (estimated) against the capped shot and 2393 (observed) against the uncapped one. It was asked why the unobserved velocity was not estimated to agree with the observed one, the charges being the same. The reply was that the energies were alike. This meant that the weights were different, as of course would be the case if one shot carried a cap and the other did not. Now, the energy of a 90 lb. shot at 2393 foot-seconds being 3573·9 foot-tons, it is easily calculated that the same energy would require a shot weighing 93·324 lb. if the velocity were only 2350 foot-seconds. This gives about 3⅓ lb. as the weight of the cap. It agrees with the apparent weight of the object seen.

## GERMAN MACHINERY AT THE ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

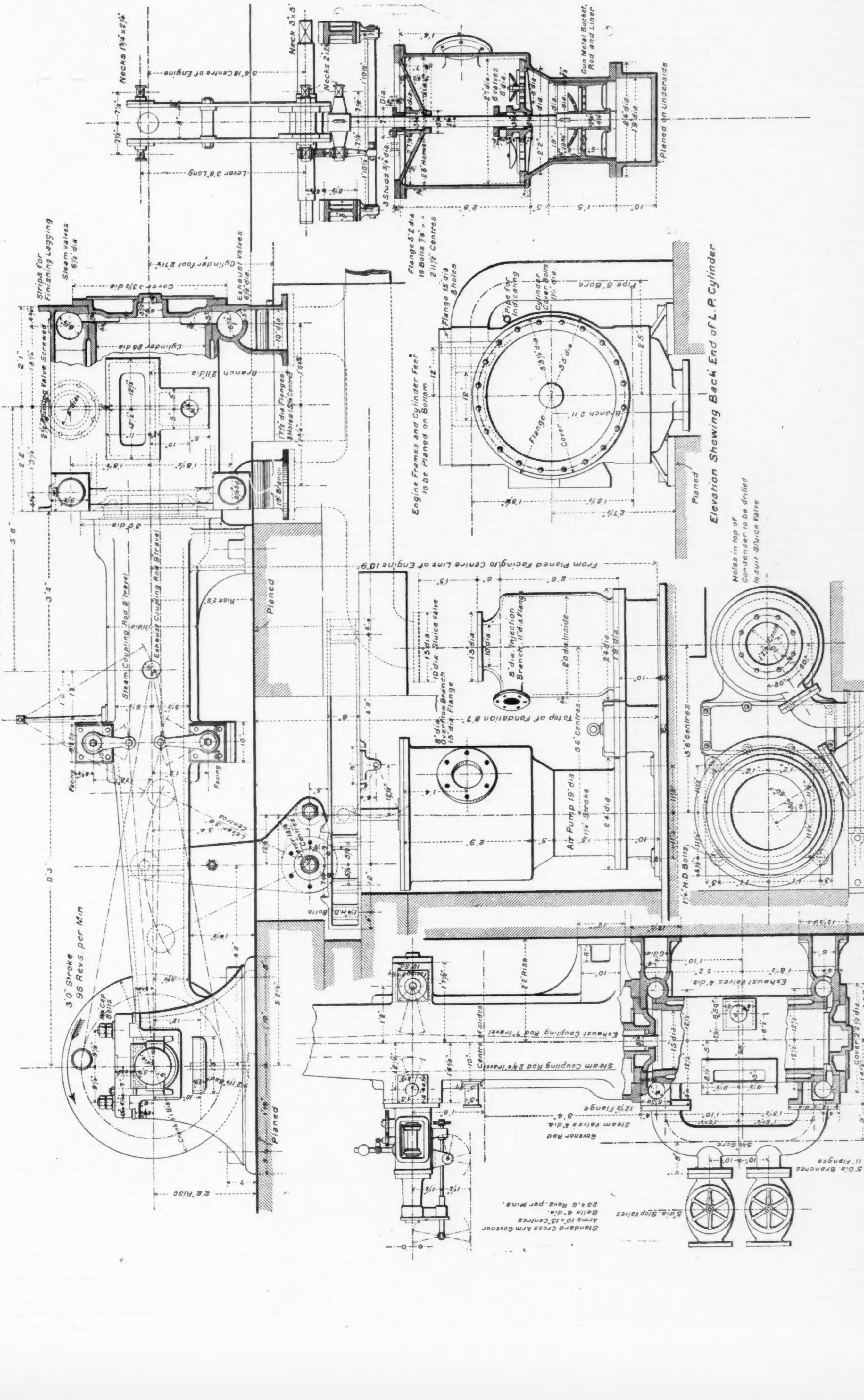
Thirty years ago, or even fifteen, the machines exhibited by German manufacturers at International Exhibitions were to a great extent copies from British types. There are still some German makers who show no originality, and are content to turn out standard lathes, drilling machines, &c., and to send them to exhibitions; but the number who think out improvements, especially in the direction of saving labour and increasing the speed of production, seems to be increasing.

One of the most ingenious novelties is the Phœnix drilling machine, exhibited by Messrs. Habersang and Zinzen, of Düsseldorf. It is a multiple drilling machine, with six drills driven by the same shaft. Three machines are exhibited, differing in detail; but in all the motion is communicated by a belt to a horizontal drum with different speeds, at the head of the machine, and thence by bevel gearing to a vertical shaft, terminating in a spur wheel. This drives six pinions, each of which turns a drill. The communication between pinion and drill is made by a short shaft, with ball-and-socket joint at top and bottom, so that the drills will work equally well, whether they are directly under the driving pinion or not. As the head of the machine is always at the same height, the drills cannot be raised or lowered; but the table travels instead, and can either be moved automatically at different speeds, or can be raised and depressed by hand. In all the machines the drills pass through a cast iron ring which supports the guides. In one machine the six drills are equidistant from the centre, and one screw serves to move them all nearer to or further from it. This machine is chiefly useful for drilling flanges, and, if desired, it can be made with five or four equidistant drills, instead of six. In another machine there is a separate screw for each drill, so that they can occupy any position with regard to one another within the limits of the guiding ring. In the third machine exhibited the guides are secured to the ring by a square-headed bolt

## THE PORTSMOUTH ELECTRIC SUPPLY WORKS—ENGINES

MESSRS. YATES AND THOM, BLACKBURN, ENGINEERS

*For description see page 107*



Necks 1¾ x 2¼
3.4.18 Centre of Engine
Neck 3 x 5
Necks 2½
Lever 3.6 Long
3 Studs ¾ dia
28 Holes
Gun Metal Bucket, Rod and Liner
Planed on Underside
Flange 3'.2 dia 18 Bolts ⅞ 2.11½ Centres
Flange 15 dia 8 holes
Strips for Finishing Lagging
Steam Valves 6½ dia
Cylinder Foot 2¼
Cover 33½ dia
Exhaust Valves 6½ dia
Cylinder 28 dia
Branch 2.11 dia
10 dia
17½ dia Flanges 8 Holes 1.3¾ Centres
Pipe for Indicating
Cylinder Cover Bolts 1⅛ dia
Pipe 8 Bore
Flange
Cover
Branch 2.11
Engine Frames and Cylinder Feet to be Planed on Bottom
Planed
Elevation Showing Back End of L.P. Cylinder
10 Branch
Steam Coupling Rod 8 Travel
Exhaust Coupling Rod 8 Travel
Rise 2.2
Planed
From Planed Facing to Centre Line of Engine 10.9
15 dia
10 dia Sluice Valve
13 dia
Injection Branch 11 dia Flange
2.0 dia Inside
Holes in top of Condenser to be drilled to suit Sluice Valve
8 dia Overflow Branch 13 dia Flange
To top of Fondation 8.7
3.6 Centres
Air Pump 19 dia 19¼ Stroke
Facing
Lever 3.6 Centres
3.6 Centres
1¼ H.D. Bolts
3.0 Stroke 95 Revs per Min
Cap Bolts
Crank 11 dia
2.2 Rise
Planed
Exhaust Coupling Rod 7 Travel
Steam Coupling Rod 2¾ Travel
Centre of Slides
Exhaust Valves 4 dia
Cover 22½ dia
2.2 Rise
15 dia
12½ Flange
Steam Valves 4 dia
Governor Rod
5 dia Branches 11 Flanges
5 dia Stop Valves
Standard Cross Arm Governor Arms 10 x 13 Centres Balls 4 dia 254.6 Revs per Mins.

"THE ENGINEER"

SWAIN ENG.

passing through a slot, so that each drill has to be set by hand, and the table is only moved by a lever, and not automatically. This serves chiefly for drilling hinges, and similar small objects in which large quantities are required to the same size.

The name "Phœnix" seems to be a favourite on the Continent. The Phœnix Company of Ghent has a large installation, which will be described with other Belgian exhibits; and exactly opposite the Phœnix drilling machines the Phœnix printing presses are exhibited. These are shown by Messrs. Schelter and Giesecke, of Leipzig, and consist mostly of presses for colour printing. Several small improvements have been introduced into these machines. For instance, in one pretty little press, which is engaged in producing Messrs. Schelter and Giesecke's artistic circulars, there is a scale by which the degree of pressure can be regulated, and four distributing rollers, which oscillate in such a manner that two give ink by the downstroke and the other two by the upstroke.

At an adjoining stand Messrs. Gilgenberg and Co., of Cologne, exhibit a new joist-cutting press, by which they can cut the ends of eighty joists per hour. The general arrangement is that of an ordinary hydraulic press; but the peculiarity consists in the shape of the cutters, and in the method of cutting. Six knives are used; one each for the top and bottom, which vary according to the section of the joist, and four for the sides, which serve for all sections. These side knives are of triangular form, so that when one edge is worn they can be turned. The top and bottom cutters can be changed in half a minute when it is desired to shear a different section of joist, and the side cutters are set to the corresponding width in the upper and lower part of the machine, so that when the pump is started the piston forces all six into the joist, which is thus cut on all sides. The largest machine exhibited will cut joists up to 18in. deep; and a small hand-power machine is also shown, which will cut up to 6in. The same machine can be used for channel, angle, and T iron; but it is doubtful whether it would for these have any advantage over ordinary shears—especially as the knives, cutting the metal on all sides, leave a sharp instead of a square edge.

Mr. Erhardt, of Wolfenbuttel, Brunswick, has a good arrangement for oil extraction, consisting of three hydraulic presses, a preparatory press, a trolley, and a hydraulic pump. Instead of bags, steel cylinders are used. Those shown are of $1\frac{3}{8}$in. metal, $17\frac{3}{4}$in. internal diameter, and 2ft. $7\frac{1}{2}$in. deep. They are drilled with 16,000 holes, $\frac{1}{16}$in. diameter at the outside, tapering to about $\frac{1}{100}$in. on the inside. The three hydraulic presses are in a row; the rails for the trolley run just in front of them. The empty cylinders are placed on the trolley, which stands under the preparatory press; they are there filled with the linseed, or other material to be treated, and the contents of the cylinder slightly pressed, to consolidate them. The trolley is then run forward, the cylinder is brought by a lever under the hydraulic press, a circular shield of sheet iron is dropped round it to catch the jets of oil which spurt out, and a pressure commencing at 450 lb. to the square inch is applied. The exhibitor states that the presses can, if necessary, work up to 4500 lb. to the square inch. The trolley will accommodate two cylinders; the one containing the pressed grain is removed, and another that has been refilled is substituted. The first one is then run back to the preparatory press, which pushes the cake of compressed grain into a receptacle in the trolley. One man is thus able to fill, empty, and keep three presses constantly at work. Fifteen tons of linseed can be treated daily in the three presses exhibited, and other materials in proportion.

One of the most compact ice-making machines I have seen is exhibited by the Hallesche Maschinenbau Austalt, formerly Messrs. Vaas and Littmann. The medium employed is liquid carbonic acid. The machine exhibited will produce 2 cwt. of ice per hour; but others have been made on this principle, with an hourly production varying from 11 lb. up to two tons. All ice-making machines may be said to consist of three essential parts, the compressing plant, the refrigerator, and the condenser. With carbonic acid a smaller pump is required than when ether, ammonia, or sulphuric acid is used; in the machine shown, the pump, which is double-action, drawing the carbonic acid gas from the refrigerator, compressing it, and forcing it into the condenser, has a piston 3in. diameter, and the length of stroke is 10in. The refrigerator, like that of most ice-making machines, consists of a tank containing brine, into which cells containing fresh water are lowered; and from which, when they are frozen, they are raised by a small overhead traveller. Wrought iron coils, filled with liquid carbonic acid, pass from the condenser to this tank, and round each a group of cells. The condenser is a wrought iron coil, made in a single piece, in which the carbonic acid, which has assumed a gaseous form in giving up its cold to the brine, is again liquefied, partly by pressure from the force pump, and partly by the surrounding cooling water. The cylinder of the compressing pump has an outer case with an air-space between, and a special patent valve for the carbonic acid is used. Of course loss in carbonic acid cannot be detected by smell, but the exhibitors say that there is practically none; and in any case it has the advantage over sulphurous acid, that it is cheap, and that if any should escape, it cannot contaminate the water, nor injure the machinery.

A new arrangement for driving centrifugals is shown by Messrs. Heine Brothers, of Viersen. A small engine, making 250 revolutions per minute, has a horizontal fly-wheel and a disc crank. The fly-wheel runs in a groove in the bed-plate, and has a flange on its lower edge. A copper pan, or "hydro-extractor," pierced with holes in the usual manner, is surrounded with an iron casing and mounted on a vertical shaft. This pan is 24in. diameter and 13in. deep, and on the shaft is a pulley 6in. diameter. A belt passes round the fly-wheel and round this pulley, so that the centrifugal is driven at 1000 revolutions a minute, with no gearing and only one belt.

Messrs. Fleck and Sons, of Berlin, exhibit band saws and various descriptions of wood-working machines, but their chief novelty is an automatic saw sharpener. This machine will serve equally well for straight or circular saws, and will cut any description of teeth. The cutter is an emery wheel, which is mounted on a guide set in a circular frame. An index on this frame shows the angle to which the wheel is set, and on the top of the frame is an arm with a balance weight, to regulate the pressure of the wheel on the saw. A guide on the tool holder runs on a plate cut to correspond with the form of tooth desired, so that when once a form of tooth has been chosen, the use of the corresponding guide or template will always ensure its exact reproduction. A small arm—which can be set to any desired length—pushes the saw forward as soon as the wheel has finished cutting a tooth, so that when the attendant has set and started the machine, he does not need to touch it again till the saw is finished. A small fan at the base of the machine is connected with an opening behind the emery wheel, so as to carry off the dust and prevent it from injuring the machinery. In its ordinary working position the centre of the emery wheel is exactly above the centre line of the saw, so that all teeth are alike; but when it is considered desirable to have teeth sharpened alternately on the right and left sides, the whole upper part of the machine can be made to travel by means of an excentric. By this means the emery wheel cuts the teeth, first on one side and then on the other. The length of stroke of this excentric can also be regulated, so that the machine is completely automatic.

Messrs. Fleck and Sons also exhibit an automatic grinder, for sharpening the cutters of planing machines. Like the saw sharpener, this consists of an emery wheel, which can be set at any angle. Another exhibit is a circular saw with movable table. The table can be set to any angle by an index below, and then clamped in position whilst the saw blade remains vertical. They also show a moulding machine for working on all four sides—in which the arrangement of the cutters is a little different to those of English make—some band saws, and a thicknessing machine. This will cut to an exact thickness boards up to 20in. wide, and they have made machines to take double this width.

The gas and petroleum engines shown are very numerous. Most of the latter are of German make, though Belgium and France are also well represented. The largest engines shown in motion are those of the Dresdener Gas Motoren Fabrik, already described as driving the Gould's pumps for the water supply of the building. Two "Capitaine" engines, as illustrated in The Engineer of July 20th, page 63, are exhibited by Mr. Ph. Swiderski, of Leipzig. The one is a 10-horse power vertical, the other a 4-horse power portable on a low frame.

Messrs. Körting Brothers, of Hanover, are running dynamos coupled direct to the engines. One of their exhibits is a 6-horse power gas engine, making from 180 to 200 revolutions per minute, and driving a dynamo giving 50 amperès, at 65 volts. Electric lights, both arc and incandescent, are connected to the dynamo, so as to show that the slow speed does not interfere with the steadiness of the light. The engine is water jacketed, the cylinder being cast separate from the jacket, and inserted in it. The water flows round the cylinder as long as the engine is working, but when it stops the jacket is self-emptying, so that there is no risk of water being left in it to freeze in winter. The governor has four balls, and is somewhat of the Buss type; it is on a horizontal shaft by the side of the machine, is cased in, and very compact. Messrs. Körting have made engines and dynamos coupled on this system up to 60-horse power with single-cylinder engines, and up to 300-horse power with two cylinders. Another exhibit is a 2-horse power petroleum engine, in which the petroleum to be used in the lamp first passes in a small iron pipe over the flame, to convert it into gas. They also show some valves, radiators and pulsometers, and a pump for boiling water, which is, however, not working.

Messrs. Grob and Co., of Leipzig, also exhibit petroleum engines, including a 6-horse power portable, which took the gold medal last May at an agricultural show at Meaux, near Paris. The most interesting part of their exhibit is a full-size model of the steam launch Princesse Clementine, shown in section. The novelty in this exhibit consists in the arrangement of the levers on the screw shaft. Of these there are two, both aft and close to the rudder. One puts a friction clutch in and out of gear, thereby disconnecting the screw from the engine; the other reverses the three blades of the screw. The exhibitors say that, by reversing the screw blades, the boat to which this engine belongs has been made to stop in her own length.

There are other interesting German exhibits, of which I must reserve an account till next week. The jury met cn the 26th ult., and commenced work on the following day.

---

City and Guilds of London Institute.—The Council of the City and Guilds of London Institute have conferred the Fellowship of the Institute upon Dr. W. E. Sumpner, who was awarded the Diploma of Associate of the Institute in 1887, and has since, by many original and valuable researches, contributed to the advancement of the electrical industry. The Council have also conferred the Diploma of Associate upon the following matriculated students who have this year successfully completed the full course of instruction at the Central Technical College. Civil and Mechanical Engineering—Messrs. N. Abbott, S. B. Aldis, C. L. Bushell, R. B. Carter, A. O. Cautley, A. C. Hall, A. Hallett, J. H. James, C. Lightfoot, H. G. Lloyd, F. Maeers, B. T. Stubbs, W. Thomas. Applied Physics and Electrical Engineering—Messrs. M. A. Abrahamson, J. R. J. Bowden, P. J. C. Day, R. A. Fullerton, A. F. Harris, H. C. Leake, A. E. Mayes, W. F. S. Mentbeth, M. J. P. O'Gorman, L. L. Robinson, J. Severs, A. K. Taylor, J. A. W. Ward, R. J. C. Wood. Applied Chemistry—Messrs. A. M. Crighton, A. Marshall, E. W. S. Schwabe.

---

## THE INSTITUTION OF NAVAL ARCHITECTS.

Our account of the proceedings at the Southampton meeting published in our last impression included those of Wednesday. The first paper read on Thursday morning was by Mr. F. Gross on "Recent Experiences with Cylindrical Boilers and the Ellis-Eaves Suction Draught." This paper we publish in full on page 112.

The discussion was opened by Mr. F. Marshall, who said that his firm had fitted two vessels, and the results obtained were very satisfactory. Mr. Gross' figures were accurate. At the Cardiff meeting he had been asked to speak; but he did not then, for lack of experience, feel free to express an opinion. Explain the matter how one might, the fact remained that induced draught was no doubt better than forced draught. The result was probably due in part to the fact that the combustion was more evenly distributed over the grate with the former. Holes did not burn in the fire; certainly the boilers gave no trouble, and the owners of the two ships referred to were so satisfied that they had ordered a third. There were, of course, drawbacks, as there always were to every change for the better. There was some difficulty to be feared about the fan engines, which had to run continuously for long periods at 320 revolutions per minute. The Perthshire had two fans, but in larger ships as many as five were required. Very close supervision was needed to keep these fan engines running for fifty or sixty days without stopping, night or day. Smaller boilers could no doubt be used, and weight saved; but against this must be placed the weight of the fans, engines, &c. The air was sent into the furnaces at temperatures varying between 220 deg. and 270 deg., which last had been got in the Berlin.

Sir Edward Harland spoke at some length, but he appeared not to have followed the paper very closely, and for a minute confused the drawings of Mr. Terry's paper on the ventilation of oil steamers, published in our last impression, with Mr. Gross' drawings. He held that while it was possible to attain very high rates of combustion with square grates in torpedo boats because water-pans could be placed beneath the bars, it would be impossible to do this in circular furnaces 3ft. 6in. diameter or thereabouts, because, in the first place, much smoke would be made; and, secondly, because the fire-bars would certainly be melted down, because a water-pan could not be used. Again, he held that seeing how slowly air took up heat, it would have been much better to use the air-heating tubes for heating the feed-water. As to induced and forced draught, he could not see that there was any difference. It came to the same thing in the end whether he pulled a man's nose or applied gentle persuasion with his foot behind. The man had to move. For his own part he preferred a closed stokehold.

Mr. Thornycroft followed. He pointed out that shipowners wanted economy in coal, and it appeared to him that just the same result would be obtained if instead of heating the air the same amount of surface had been added to the boiler. In torpedo work, very high rates of combustion were attained, but a water pan was used, and the force with which the air entered was so great that he had known the water to be licked up by it and carried on to the bars. His own experience was that forced draught gave no trouble, while the fire-rooms were really quite cool, and more easily kept cool than the engine-rooms.

Mr. Fothergill agreed generally with Sir E. Harland. If the heating surface in the air heater was added to the boiler, the result would be just the same. The ordinary cylindrical furnace was not adapted for fierce draughts. It had to be filled nearly to the top. The cool crown plate would check combustion and cause smoke. The great advantage of the water-tube boiler was that it gave a big space for combustion. But there was no cause for apprehension about fan engines. He was using engines which ran at 700 revolutions per minute, for thirty consecutive days without difficulty. Forced draught would become the rule instead of the exception.

In reply, Mr. Gross said that he was able to answer fully all the questions that had been asked. The paper which he had just read must be taken as an addition to that read last year at Cardiff by Mr. Ellis, and the drawings on the wall were those which had been used at Cardiff to illustrate the apparatus.—These drawings were reproduced on a small scale in our pages at the time.—No doubt many of the questions now asked were put because Mr. Ellis' paper had been forgotten. To begin, however, with Sir Edward Harland's questions. He might say that that gentleman was quite correct in assuming that difficulties would be encountered with fire-bars; indeed the trouble was greater than Sir Edward had supposed. On one occasion, for example, they had melted a set of fire bars in half an-hour, and yet they could now run for seventy-five days, and leave the bars quite good. The whole difficulty had been got over, as explained by Mr. Ellis, by raising the fire-bridge end of the bars 2in. higher, instead of dropping them 2in. lower than the door end. Why or how this had the required effect Mr. Gross did not stop to explain; he contented himself with stating the fact. It might be, he said, that if they exceeded a rate of combustion of 60 lb. per square foot per hour there would be trouble; but that was fast enough, and up to that rate there was no trouble of any kind. As for the fans, it was a proved truth that at any chimney temperature not exceeding 600 deg. they lasted perfectly well and gave no trouble. The boiler tubes they used were $3\frac{1}{4}$in. in diameter, with a baffler, or distributor, resting on the Serve ribs, and the result was quite satisfactory, for in each of these tubes there was 75 per cent. more effective surface than in a plain tube of the same diameter and length. As for the general arrangement, he liked one fan for each boiler or for each end of one double-ended boiler, because if a fan engine broke down there was only one end of a boiler rendered inefficient, and the others could take up the work, and it must be remembered that even if all the fans broke down the ship could still steam well with natural chimney draught. As to the weight of the air-heating tubes, they were only of 12 or 14 guage, and did not weigh anything like what an equal amount of boiler surface would weigh. Very careful experiments showed that whether the water was heated, as suggested by Sir Edward Harland, or the air was heated, the result was just the same. As for weight, the big Atlantic and other liners now carried as much as 3000 tons of coal, surely the chance of saving 300 tons on this was worth trying for. It was often said that air took up heat very slowly; that was not his experience. The velocity of the air in the heating tubes was 2000 feet per minute, and it was easy to see that the air was in contact with the hot metal for a very short time. Nevertheless, it was easily heated to 300 deg. Sir Edward Harland had asked why certain blanks in the tables had not been filled. The answer was that the information wanted could not be given because of causes which had augmented the consumption of fuel or upset the direct progress of events. Thus, in one case, a breakdown occurred, and the engines had to work compound instead of triple. In another case the propeller lost a blade. The table contained nothing but ascertained facts. The high economy realised was due to the fact that, although the boiler had nominally only 28 square feet of heating surface to one of grate, yet that really, because of the Serve tubes, there were nearly 50 square feet.

A vote of thanks was passed unanimously, and then Mr. Terry read his paper on the ventilation of oil steamers, which we published last week. The discussion which followed was very short. No one had any fault to find. A few questions were asked, and Mr. Martell called attention to the curious fact that short as was the period which had elapsed since the carriage of oil in bulk had been suggested, yet that cargo such as rice was now carried in the oil tanks, and that even tea was about to be carried. This could only be done by the aid of a method of ventilation so efficient that when the oil had been pumped out, every trace of the gas should be pumped out also.

Mr. Terry replied in a few words, and a vote of thanks was passed. This virtually concluded the business of the meeting, and the members then proceeded to the Paris, where they were sumptuously entertained by the directors the International Company. The Paris, we may add, had only got into dock at 5 a.m. the same day.

In the afternoon a garden party was given, as already stated, at Bassett, by Sir Stuart and Lady Macnaghten, and in the evening a dinner at the Royal Victoria-rooms by the South-Western Railway Company.

On Friday morning a large number of the members proceeded in a special saloon train, provided by the South-Western Railway Company, to Portsmouth Dockyard, where a dockyard train was in readiness. The members on their arrival were conducted over the several shipbuilding and engineering shops. They visited H.M.S. Majestic, first-class battleship of 14,900 tons, 10,000 indicated horse-power natural draught, 12,000 forced draught, in process of building. Also H.M.S. Sultan, third-class battleship of 9290 tons, 6500 indicated horse-power natural draught, 8000 forced draught. They then visited the main pumping station, electric shop, torpedo and gun mounting stores, and other works of interest. By special permission of the Lords of the Admiralty, they then visited H.M.S. Revenge, first-class battleship, 14,150 tons, indicated horse-power, 9000 natural draught, 13,000 forced draught, now ready for sea, and witnessed the working of her heavy guns.

On leaving the gun mounting store, the members were carried by the dockyard train to the jetty, where, a little after 1 p.m., the Jersey steamer, Frederica, took them on board. The Frederica had left Southampton at noon with a large party of ladies and a few gentlemen, who did not care to visit the docks. Luncheon was served while the ship lay alongside the pier, and about 2.30 p.m. she started in beautiful weather for a trip round the Island. She reached Southampton about 6 p.m., having run nearly 60 miles in three and a-half hours, without the slightest attempt at pressing her. Indeed, she travelled much faster than was desired by those on board.

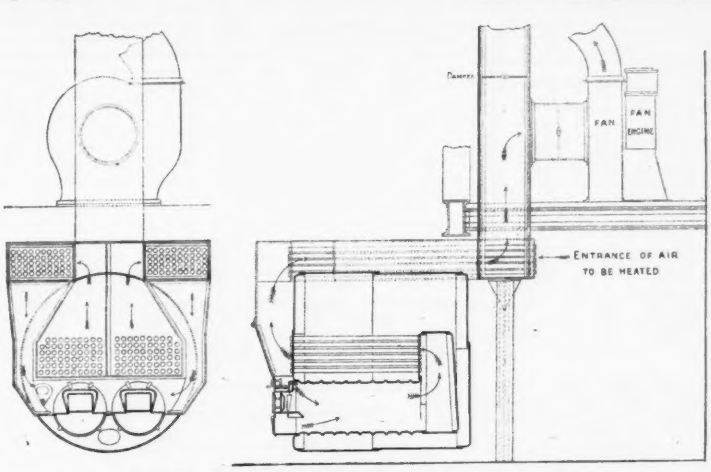
So ended a meeting in every way a success, for although the Tantallon Castle was hospitably thrown open by Sir Donald Currie, and a tender was provided to convey visitors to her, not many availed themselves of the opportunity on Saturday morning. Very great credit is due to all concerned. The hospitality extended to the Institution was in every respect cordial, ample, admirably planned and admirably carried out. Thre was no hitch from beginning to end, and Mr. G. Holmes, the secretary, left nothing that fell within his province undone to secure the great success attained.

## RECENT EXPERIENCES WITH CYLINDRICAL BOILERS AND THE "ELLIS AND EAVES" SUCTION DRAUGHT.[*]

By Mr. F. Gross.

At the last summer meeting Mr. Ellis read a paper on "Some Experiments on the Combination of Induced Draught and Hot Air Applied to Marine Boilers fitted with Serve Tubes and Retarders." So much special attention is being given to boilers for ships at the present time, that it will perhaps interest the members to be informed of the experience which has been gained to date with this system applied to marine boilers on land and at sea. The boilers which have been working longest with this combination are at the Atlas Works, Sheffield. Nos. 7 and 8 are now three years old; Nos. 9 and 10 are two years old; Nos. 11 to 16 have since been gradually added. These ten single-ended marine boilers, placed together in one shop, furnish part of the steam required by the works, and are at work day and night. Their ordinary work is to maintain a regular combustion due to 3in. vacuum at the fan inlets, corresponding to a combustion of 35 lb. to 37 lb. per square foot of grate, which is uniformly 5ft. 8in. long in all the boilers. For short periods, at certain intervals during the day, the quantity of steam required is appreciably greater than the regular quantity, when, by increasing the number of fan revolutions, the rate of combustion is immediately raised to 40 lb., 45 lb., 50 lb., or even 60 lb. per square foot of grate, and as promptly reduced when the demand for the extra steam has passed away. It will be evident that, unlike boilers with natural draught, the boiler is the constant quantity, whilst the draught is varied largely according to the requirements for the time being.

For the purpose of obtaining data on suction-draught fans, different diameters and widths are used. Moreover, some fans work one boiler only, and are placed above the boilers; others work two boilers, and are placed on the ground floor, sucking the gases downwards, and discharging them into short funnels, which just clear the roof of the building. The success of boilers Nos. 7 and 8 led to the construction of Nos. 9 and 10, and the satisfactory experience with the four, to the subsequent further six, partly for the sake of space, partly for economy and absence of smoke. The ten boilers, 10ft. 6in. by 10ft. 6in., displace three to four times as many Lancashire boilers of about 28ft. by 6ft. 6in., whilst the evaporation per pound of South Yorkshire coal is 9 lb. actual from cold feed—or 10½ lb. from and at 212 deg.—when burning at 30 lb. per square foot of grate, or 8½ lb. actual feed—or 10 lb. from and at 212 deg.—when burning at 45 lb. per square foot of grate, as against 6½ lb. actual from cold feed in the Lancashire boiler burning at 19 lb. per square foot of grate with a chimney 130ft. high. Very recent careful examination of the boilers shows that the Purves flues, tube plates, and Serve tube ends in the oldest are as good as new; and it is worthy of special note that the feed-water comes cold from the river, unfiltered, and that the draught is not shut off when the doors are opened for firing, slicing, or raking. The dampers are used only when the fires are being cleaned—every six hours. The fans likewise continue to work satisfactorily, as anticipated, because the gases when entering the fans do not exceed 450 deg. at the highest rate of combustion, the air heated by the waste gases then entering the furnaces at 320 deg. For these boilers, owing to the steam pressure being as yet unavoidably only 50 lb. per square inch, the fan engines are simple engines.



Boiler with Ellis and Eaves' Hot Air and Suction System

The International Company's steamship Berlin—better known under the old name of the Inman Company's City of Berlin—was the first steamer fitted with the draught, as conveniently as the position of the eight single-ended boilers facing the centre longitudinal line of the ship permitted. The air-heating tubes had in this case to be placed across the front instead of lengthwise of the boilers, offering consequently more obstruction, with less effective heating surface, than when placed in the usual way. She has been working hard since March 1st, 1893, with satisfactory results, and has burnt at an average rate of 26 lb. per square foot of grate, 5ft. 3in. long.

The same owners adopted this draught for the two new steamers built in this country and recently completed, viz., the steamship Southwark, by Messrs. Denny, and the steamship Kensington, by Messrs. J. and G. Thomson, Clydebank. They are twin-screw sister ships, 480ft. long by 57ft. wide by 40ft. deep. The main engines are quadruple expansion, and intended to develope 7000 indicated horse-power in each ship at trial trip. The Southwark has two double-ended main boilers, 15ft. $9\frac{3}{16}$in. mean diameter by 21ft. 8¾in. long, and one single-ended, 15ft. $9\frac{3}{16}$in. mean diameter by 11ft. 1in. long. Each of the five boiler ends has four Purves furnaces 3ft. 4in. inside diameter, grate bars 5ft. 9in. long. Total grate surface, 383 square feet. Total heat-distributing surface inside the boilers, 12,285 square feet. Working pressure, 200 lb. Each boiler-end has one exhausting fan 7ft. 6in. diameter, and separate single-acting engine by Messrs. Sturtevant, of Boston, United States, these engines being used freely in the International Company's steamers. The Serve tubes in the boilers are 3¼in. outside diameter. At the trial trip, with a displacement of 12,300 tons, she easily developed the expected power, and gave the mean speed of 16·3 knots. On her station she has been running four round voyages, Liverpool to Philadelphia, almost entirely with the two double-ended boilers only at work, with an average combustion of 27½ lb., which will gradually be increased. In the Kensington the boilers are slightly longer, the double-ended 21ft. 7in. and the single-ended 11ft. 5in. The total heat-distributing surface inside the boilers is slightly less, viz., 11,672 square feet. The number and size of Purves furnaces, the length of grate bars, and diameter of Serve tubes are the same as in the Southwark. At the trial trip, with a displacement of 12,400 tons, she gave a mean speed of 15·8 knots. She has run one voyage West so far.

*Particulars of Ships at Work with the "Ellis and Eaves" Combination Draught.*

| | S.S. Berlin. | S.S. Southwark. | S.S. Kensington. | S S. Perthshire. | S.S. Buteshire. |
|---|---|---|---|---|---|
| Length of ship | 488ft. 6in. | 480ft. | 480ft. | 435ft. | 435ft. |
| Width of ship | 44ft. 0in. | 57ft. | 57ft. | 54ft. | 54ft. |
| Depth of ship | 36ft 9in. | 40ft. | 40ft. | 32ft. | 32ft. |
| Displacement at trial trip—tons | — | 12,300 | 12,400 | 7500 | — |
| Number of boilers | 8 single-ended | 2 double-ended & 1 single-ended | 2 double-ended & 1 single-ended | 2 single-ended | 2 single-ended |
| Size of boilers | 13ft. 2½in. mean dia. × 11ft. 4½in. | 15ft. $9\frac{3}{16}$in. m. dia. × 21ft. 8¾in.<br>15ft. $9\frac{3}{16}$in. m. dia. × 11ft. 1in. | 15ft. 9in. m. dia. × 21ft. 7in.<br>15ft. 9in. m. dia × 11ft. 5in. | 15ft. 6in. m. dia. × 12ft. | 15ft. 6in. m. dia. × 12ft. |
| Number of furnaces | 24 | 20 Purves. | 20 Purves. | 6 Purves. | 6 Purves. |
| Inside diameter of furnaces | 3ft. 2in. | 3ft. 4in. | 3ft. 4in. | 3ft. 9in. | 3ft. 9in. |
| Length of grate | 5ft. 3in. | 5ft. 9in. | 5ft. 9in. | 5ft. 9in. | 5ft. 9in. |
| Total heat-distributing surface in boilers, reckoning outside surface of tubes | 14,616 sq. ft. | 12,285 sq ft. | 11,672 sq. ft. | 4770 sq. ft. | 4770 sq. ft. |
| Total grate surface | 396 sq. ft. | 383 sq. ft. | 383 sq. ft. | 127 sq. ft. | 127 sq. ft. |
| Working pressure | 150 lb. | 200 lb. | 200 lb. | 160 lb. | 160 lb. |
| Number of fans | 4 | 5 | 5 | 2 | 2 |
| Size of fans | 7ft. 6in. dia. | 7ft. 6in. dia. | 7ft. 6in. dia. | 8ft. dia. | 8ft. dia. |
| Mean speed developed at trial trip—knots | — | 16 3 | 15 8 | 11·75 | — |
| Average revolutions of fan engines | 360 | 317 | — | 320 | — |
| Number of voyages | 17 | 4 | — | 1 | — |
| Average I.H.P. of voyages | 5566 | 4446 | — | 2450 outwards | — |
| Average coal consumption per I.H.P. | — | — | — | 1·34 lb. Newcastle Sm. | — |
| Temperature of air before entering furnaces | 260° | 271° | — | 220° | — |
| Temperature of gases at fan inlet | 441° | 393° | — | 310° | — |
| Vacuum at fan inlet | 3·5in. | 2 9in. | — | 1 75in. | — |
| Vacuum over fires | 1·1in. | ·8in. | — | ·2in. | — |

Whilst the foregoing steamers are giving experience for the Atlantic service, two other large steamers are doing the same for the long voyages to and from Australia. Messrs. Turnbull, Martin, and Co., London, in the Australian dead meat trade, have this combination draught in their new sister ships, Perthshire and Buteshire, built by Messrs. Hawthorn, Leslie, and Co., Newcastle. These ships are 435ft. long over all, 54ft. wide, and 32ft. deep. Displacement when fully loaded, 12,000 tons. For the power of 3000 indicated horse-power in each ship there are two single-ended boilers, 15ft. 6in. diameter by 12ft. long, each with three Purves furnaces, 3ft. 9in. inside diameter, and grate bars 5ft. 9in. long. Total grate surface in each ship, 127 square feet. Heat-distributing surface within the boilers, 4770 square feet in each ship. Working pressure, 160 lb. The fans and triple-expansion fan engines are of Messrs. W. H. Allen and Co.'s make. Each ship has completed one round voyage to Australia and back. On the outward voyages, with an average indicated horse-power of main engines of 2450 to 2500, the coal consumption averages about 26 lb. per square foot of grate. On the home voyage, requiring considerable extra steam for the large refrigerating machinery, the Perthshire averaged a combustion of 31½ lb. over fifty-nine consecutive days, and the Buteshire 27½ lb. per square foot of grate over fifty-six consecutive days. The coal consumption of Newcastle small coal on the outward voyages averages 1·345 lb. per indicated horse-power of main engines. This includes the power required by the fan engines. With South Wales coal the consumption of main engines will therefore be under 1·3 lb. per indicated horse-power, after finding the power for the fan engines. Although the boilers of the Perthshire had been continually under steam for seventy-five days, being worked for fifty-nine days at this, for Australian voyages, unprecedented rate of combustion, the furnaces, tube plates, tube ends, and the fans were found in good order on arrival London. These owners in are fitting the draught arrangement to a third sister ship, the steamship Banffshire, now building by Messrs. Hawthorne, Leslie, and Co.

Briefly summarised, the experience to date may be considered to have established a rate of combustion on a grate 5ft. 9in. long of 30 lb. to 60 lb. in marine boilers on land, and of 26 lb. to 31½ lb. at sea, in the Atlantic and Australian services, without troubles to furnaces, tube-plates, tube ends, fans and fan engines, accompanied by an appreciable economy compared with boilers of the same size with plain tubes working with natural draught at half the rate of combustion. The main factor in the economy is, of course, the Serve tube in combination with the retarder, because the Serve tube has on an average at least 75 per cent. more heat "absorbing" surface than the same diameter of plain tube. The result is that at the highest rates of combustion, and with 3¼in. diameter tubes—permitting natural draught to be readily used—the gases, when they reach the smoke-box, do not exceed 700 deg. The heat absorbing surface of the air-heating tubes completes the economy, the gases reaching the fans cooled down to 300 deg. to 400 deg., having heated the air to from 200 deg. to 300 deg., according to the rate of combustion and amount of absorbing surface. Against closed stokehold forced draught, burning at the same rate of combustion with plain tubes, the weight of the boilers with this system will be greater, but there is a considerable net saving in weight for other than short cross Channel voyages through the economy in fuel, which is naturally greatest against closed stokehold cold air draught. At a combustion of 30 lb. per square foot of grate this economy will be at least 15 per cent. Against Mr. Howden's latest practice the loss of weight is trifling, being practically only the extra weight of the ribs in the Serve tubes and of the greater surface of the air-heating tubes, and these produce a distinct advantage in economy in fuel of at least 7½ per cent. In a number of steamers working with Mr. Howden's draught, the substitution of Serve tubes for plain tubes has at once given an economy of 10 per cent., and it will be conceded that the horizontal air-heating tubes in the suction draught will be more effective than vertical tubes. Even with natural draught, with a funnel height of 75ft. or more, the Serve tube has proved in a considerable number of vessels that it gives an economy of 10 per cent. over plain tubes in the same boilers, and the special advantage of this suction-draught combination is to give the same economy when burning at twice the rate in half the number of boilers, or to make the steam as economically as is now done with natural draught and plain tubes when burning at three times the rate in one-third the number of natural draught boilers.

Taking, therefore, boilers and coal together, this system requires in reality for moderate and long voyages the least weight of cylindrical boiler for a combustion of 25 lb. per square foot of grate and upwards; and, as the action of the suction draught is to heat the boilers more uniformly the higher the rate of combustion—therefore the opposite of forced air pressure draught—it is probable that we shall gradually see the boilers reduced more and more in size, and the rate of combustion at sea increased to 40 lb., 50 lb., and upwards per square foot of grate. Electric motors with small fans will assist in this direction, and the economy, safety, and comfort of this system in working are strong recommendations for large passenger and cargo boats, whilst for warships the power to do away entirely with smoke, and even with funnels, should not be without importance. The accompanying table gives the principal data for the five ships grouped together for handy reference.

---

[*] Paper read before the Institution of Naval Architects on the 26th July, 1894.

## THE DESIGN OF MAIL STEAMERS, WITH SPECIAL REFERENCE TO THEIR USE FOR WAR PURPOSES.*

By Professor J. H. Biles, M. Inst. Naval Architects.

The selection of a subject for a paper for the summer session at a port like Southampton naturally involves, in a greater or less degree, the consideration of mail steamers; and the contiguity of the arsenal of Portsmouth, replete as it is with naval war material of all kinds, cannot but suggest the question of how much assistance mail steamers may be to the Navy in time of war. It is evident that the ordinary mail steamer of over 5000 tons, with a sea speed of over 16 knots, has a sea-keeping power and a sea-going speed not inferior to many warships. For carrying despatches or for scouting these qualities are necessary, but this work can at the best only relieve warships from such duties. It is submitted that it is a question of national importance, and one which is deserving of consideration and discussion by this Institution, whether mail steamers may not be so designed that they may in time of necessity leave their peaceful business of carrying mails and passengers, and take a place among the fighting ships of the Navy, where they will be capable of doing work similar to what is expected of our first-class cruisers. It is with the object of raising this question, and indicating some of the points to which attention may be given in designing mail steamers with this object in view, that this paper is submitted to the Institution.

While efficiency for commerce is the first consideration for the shipowner, it need not be the only consideration, and if, in considering what is best for commercial requirements, there may be alternative methods of equal value open to the ship designer, that which is of greater use for war purposes ought to be, and probably will be preferred. As some justification for this statement, one has only to refer to the papers read by Mr. James Dunn, in 1882 and 1883, on merchant steamers and bulkheads, to see what shipowners did when some of the simplest requirements for war purposes were pointed out to them. The greater subdivision of these merchant steamers was expected to have detracted somewhat from their commercial efficiency. This expectation was probably only realised to a small extent, for at the present time vessels are successfully running with much greater subdivision than that thought desirable ten years ago. It is therefore evident that shipowners can adapt their ships so as to meet some of the requirements for war purposes without detracting unduly from commercial efficiency.

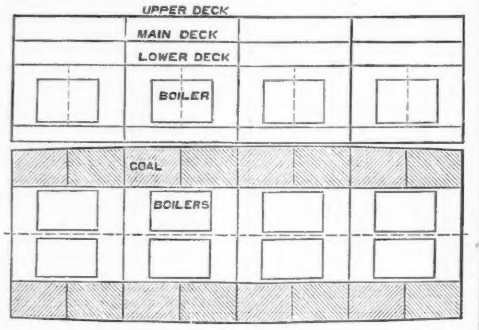


FIG. 1.

But there is obviously a limit to the amount which can be done by the shipowner for this purpose without involving him in an extra first cost, which can give no commercial return, but which may, on the contrary, be a constant cause of loss. It is, however, at first desirable to see what can be done to make a mail steamer so that she can readily be changed into a warship, and then to see what such changes in the design will involve in the commercial efficiency of the vessel, and how the losses due to such changes can be met by the country in return for the services such a vessel can render in time of need. Another way of putting the question is to ask whether it is necessary that all the warships of a country should be unremunerative in times of peace, or whether some of them may not be doing useful service, such as carrying mails and passengers. It is desirable first to consider in what respects, and in what manner, an ordinary mail steamer should be modified to make her suitable for war purposes. As far as I understand the requirements of the Admiralty for merchant ships which may be used for war purposes, they are: (1) The ship must be divided so that when one compartment is in free communication with the sea the ship will not sink; (2) that the decks shall be capable of being readily strengthened so as to carry guns.

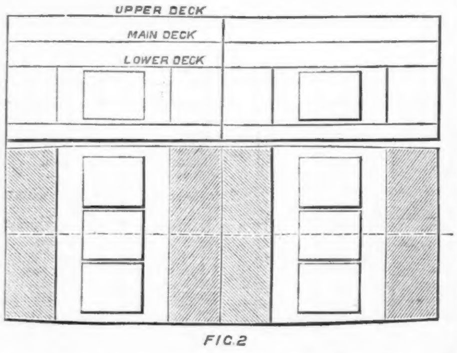


FIG. 2

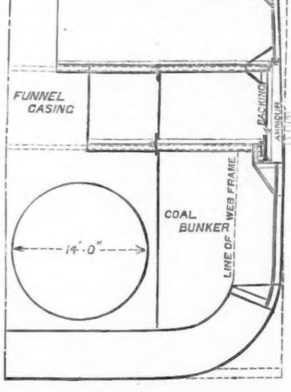
The points which may be considered in a mail steamer with reference to her suitability for war purposes may be taken broadly to be: (1) Sub-division; (2) capability of being protected by armour or coal; (3) facilities for placing and working guns; (4) speed; (5) coal endurance. First, as to sub-division, it is usual to fit large mail steamers with a double bottom throughout, though in some notable cases this has not been done. This double bottom is not, as in the large warships, carried up the side, but is usually stopped before the turn of the bilge. Hence, for any purpose of use in war time, for protection against guns or torpedoes, it need not be considered. Other longitudinal sub-divisions, such as middle-line bulkheads, fore and aft coal bunker bulkheads, may be of great use. Starting on the assumption that coal can be made use of as protection, it is obviously desirable to put the coal where it can give protection—viz., in the vicinity of the water-line, at the sides of the ship.

A very common arrangement of bunkers is to have the coal in transverse blocks, extending from side to side of the ship, the boilers extending from side to side in adjacent compartments. This arrangement is shown in Fig. 2. This method does not give a maximum of protection for a given amount of coal. To ensure the maximum of protection there should be no transverse block, except, perhaps, one at each end of the machinery space. The arrangement of bunkers which gives the best protection is that where the boilers are at the middle line, and the coal is at the sides. The longitudinal bulkheads forming the sides of the bunkers can be continuous for the length of boiler space, and in some ships this side bulkhead can be carried through the engine space also. The axis of the cylindrical boiler is almost of necessity placed fore and aft, especially if the boilers are double-ended. This arrangement admits of further subdivision if the beam of the vessel and the diameter of boilers be so chosen in relation to each other that the bunkers on each side of the ship shall contain all the coal necessary for the voyage for the boiler between them. Then each boiler end may have abreast of it all the coal that is necessary, and the bunker space abreast of the boiler may be divided by a transverse bulkhead between the ship and bunker sides, through which there need be no opening. Such an arrangement is shown on Fig. 1.

The space occupied by these two alternative methods is not very different, the superiority of one over the other depending upon the amount of coal carried. The arrangement shown in Fig. 1 avoids coal passing at sea, and admits of ready shipment of coal in port with a minimum of labour in stowage. The question of rapidity of coaling in port is dependent partly upon the number of openings through which coal can be passed, and partly upon the facility with which the coal will run, so as to fill the bunkers with as little assistance as possible from the coal heavers. Both these considerations are best fulfilled by the long side bunkers when they are of considerable size, as in Fig. 3. Even if the relation between beam of ship, diameter of boiler, and length of voyage cannot be so fixed as to allow all the coal necessary for each boiler to be carried abreast it, the arrangement in Fig. 3 is preferable, though it will be necessary to carry additional coal either on the deck above the boilers or in transverse bulkheads between the boilers. It is, however, worth very serious consideration whether the beam of the vessel and the diameter of the boilers should not be so related to each other that the capacity of the bunkers abreast of the boilers should be sufficient for all the purposes of the voyage. The material necessary to form bunker bulkheads would be placed so as to be of structural strength greater than in the other way. The bunkers would be a large cellular structure at the side of the ship, and would form a protection of the best kind against the effects of collision.

Probably this amount of subdivision of coal bunkers and boiler-rooms is the greatest that can be afforded, if commercial efficiency only is taken into account. Efficiency for war may be kept in view by placing a row of horizontal stiffeners or beams between the ship's and bunker sides at a distance of 8ft. or 10ft. below the water-line, so that in war time a flat of wood or iron could be readily laid upon these beams with a view to further subdivision and to a retention of the coal in the vicinity of the water-line. The stringer of keelson at ship's side at the line of these stiffeners could be made water-tight, either in the usual way by staple angles, or so arranged that when the flat is laid it could be readily made water-tight with cement. In the largest vessels the lowest continuous deck is not far from the water-line, and is sometimes below it. As this deck is required for passengers, the space amidships is too valuable to give to coal bunkers. Even in this case, however, efficiency for war may be kept in view, and without interfering with commercial efficiency provision for protection may be made. It is quite common to have partial bulkheads several feet in width between the decks for purposes of structural strength. Usually the line of the inside edge of these bulkheads is arbitrarily chosen, and the position of this line in each bulkhead has no relation to the adjacent one. If, however, the inside edges of these bulkheads be arranged all in one plane, say 10ft. from the ship's side, it would be very easy to run a line of plating on this plane in war time, so as to form an inside line of further longitudinal subdivision. The lower and main decks are usually plated, though not usually caulked. If, when the ship is building, the lower deck be caulked, and an angle, with its flange standing some 3in. above the wood planking be fitted, and if holes be punched in this angle, as well as in those forming the stiffeners on the inside edge of the partial bulkhead, and if similar arrangements be made on the under side of the main deck beams, there will be all the necessary means of connecting a line of plating, and thus forming this line of subdivision at a most important part of the ship. If the further precaution is taken of making the partial bulkheads themselves water-tight at the lower deck, the side of the ship in the vicinity of the water-line can be most readily subdivided into a large number of small compartments, and the ship's liability to sinking from the effects of gun fire be considerably reduced. This method of subdivision may be carried out as far as such partial bulkheads extend, and as these bulkheads add very considerably to the strength of the ship, it may not be too much to say that the arrangement for such subdivision in war time should be made for three-fourths of the whole length of the ship. It is probable that this amount of subdivision is as small as is practicable for rapid handling of coal at sea.

FIG. 3



(*To be continued.*)

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Fast cruiser for the United States navy.*—The new triple-screw cruiser Minneapolis, built at the Cramp shipyards, was given a trial trip of 88 miles on July 14th, developing an average speed of 23 knots for the entire distance, and a maximum speed of 25·42 knots. The machinery worked to perfection, the boilers carrying 150 lb. pressure and the engines making 124 to 134 revolutions per minute. The trip was made in the open sea, starting from near Boston. The outward run of forty-four miles was made in 1 hour 55 min. 18 sec., an average of 22·90 knots. The turn was made in 18 min. 34 sec., and the return trip of forty-four miles was made at the rate of 23·20 knots. The Minneapolis is a sister ship of the Columbia, whose trial trip occurred a few weeks ago—page 576 of The Engineer. She is 412ft. long, 58ft. beam, draws 22ft. 6in. of water, has 7350 registered tonnage displacement, and has cost 2,690,000 dols. She was specified to have a speed of at least 21 knots. She has three sets of triple-expansion three-cylinder engines, developing 21,000 indicated horse-power at 129 revolutions per minute. There are eight double-end main boilers in four water-tight compartments. They are constructed of steel for a working pressure of 160 lb. to the square inch, and have a heating surface of 49,248 square feet, which is 14 per cent. more than the Columbia. The motive power is transmitted through three screws, one being placed as in ordinary single-screw ships, and the others being placed on either side, supported by brackets as usual in twin-screw ships. The hull is of steel. The boilers and machinery are well protected with an armour of steel and the guns are well shielded. The main battery consists of one 8in., two 6in., and eight 4in. rapid-firing, breech-loading rifles. The secondary battery consists of twelve six-pounder and four one-pounder rapid-firing guns, four Gatling guns, and five tubes for launching torpedoes. The accommodation for the officers and crew are spacious, well ventilated, lighted by incandescent electric lights and fitted with every possible comfort and convenience. The hull is divided into small water-tight cells or compartments, and there is a double bottom with tanks and cells.

*Water-power projects.*—The utilising of natural water-power for commercial purposes has been carried out very extensively, especially in the Eastern States, where there is ample water supply throughout the year. Many large manufacturing cities, notably Lowell, have large mills and other establishments driven by water-power, and the successful work at Niagara, where one of the largest paper mills in the world is now in operation by the new power plant, has given a great impetus to new projects. Work is now approaching completion for the utilisation of 35,000-horse power of the falls of the Androscoggin River at Rumford Falls, and about 8000-horse power are already being developed by a wood pulp and paper mill turning out 120,000 lb. of paper per twenty-four hours, and by other plants. The river here makes a great loop, with three separate falls in the upper part. The head of the upper canal is above the first falls, and the head of the middle level canal is above the second falls. These canals are practically parallel, the middle level receiving the water from the raceways or weak weirs of the high level. From the middle level the water flows to the low-level canal, which has no head from the river, and this discharges into the river below the third falls. Two dams form slack water for the canal head-gates, and for storing logs for the saw mills. The fall from the high level to the middle level is 100ft., developing 25,000-horse power; from the middle level to the low level it is 50ft., with 12,000-horse power, of which 8000-horse power are already utilised; and from the low level to the river it is 30ft., with 7000-horse power.

*Asphalte deposits.*—A company has been organised to develope the asphaltum deposits in Oklahoma—formerly the Indian Territory—and both liquid asphaltum and bituminous sand will be put on the market. Several shafts have been sunk to depths of 15ft. to 40ft., and the beds are said to consist of a layer of the asphaltic sand overlying a bed of viscid bitumen, which is very sticky and difficult to extract. The chemical analysis of this bitumen is as follows:—

| | |
|---|---|
| Carbon .. .. .. .. .. .. .. .. .. .. | 55·00 per cent. |
| Hydrogen .. .. .. .. .. .. .. .. .. | 10·21 ,, |
| Oxygen .. .. .. .. .. .. .. .. .. .. | 7·14 ,, |
| Nitrogen .. .. .. .. .. .. .. .. .. .. | 2·74 ,, |
| Silicate and ashes .. .. .. .. .. .. .. | 24·91 ,, |

*Sewage irrigation.*—In a recent paper before the California Sanitary Convention, Dr. Orme pointed out the advantage in fertilisation to be obtained by using sewage instead of water only. The excreta of human beings is the most valuable, but owing to its rapid decomposition it must be applied to the soil within two or three days, and the only practicable way is by water carriage. The volume of carrying water must not exceed 50 to 60 gallons daily per capita, or the area of land near a city and available for irrigation would be inadequate. At Los Angeles it is found that the whole sewage can be disposed of in this way, but sanitary rather than financial results must be given first consideration.

*Steel sleepers.*—The use of steel railway ties or sleepers is making but slow progress in this country, and this progress is doubtless made even slower than it might have been by the rapid introduction of steel tie-plates or base-plates to distribute the load over a greater surface than the area of the rail base, and thus prevent the wear and cutting of the wood. A trouble met with on two roads using steel ties has been the necessity for insulating the rails from the ties where a track circuit is used for operating block signals; this involves considerable expense. A street railway is about to experiment with the Daniel's tie, which is a corrugated plate to which the rails are bolted.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The accountants to the Iron Trade Wages Board have this week issued their return of the selling prices of manufactured iron for May and June. The net average of bars, hoops, sheets, and plates of best and common qualities combined is declared as £5 19s. 4·98d. per ton. This compares with £6 0s. 3d. for March and April, and £6 for May and June last year. Ironworkers' wages will remain unaltered at 7s. 6d. per ton for puddling until October 6th next year.

Engineering firms engaged in the manufacture of pumping engines should be acquainted with a unique experience which has just happened to the South Staffordshire Mines Drainage Commissioners in connection with the working of their immense pumping engine plant, owing to the premature rotting of three large pitch pine main rods attached to the new powerful engine at their Moat Pumping Station. The pump came to a sudden stand, and but for the happy possibility which presented itself of starting other engines, serious flooding of the surrounding collieries must have occurred, and great damage been caused. Fortunately, however, only one colliery was flooded, and other rods being in stock it was possible to get the pumps to work again in seven days eleven hours after the accident. The breakdown is attributed to the gases and damp air from the underground levels having prematurely eaten a way into the rods on their return in the up-cast shaft, and rods which should have lasted twenty-seven or twenty-eight years proved under such conditions to have only a lifetime of eight or nine years. The engineer to the Commissioners also points out that large-sized timber is often overgrown, and the turpentine, so necessary to its vitality, is frequently extracted.

An alarming boiler explosion, for the probable cause of which no authoritative theory has yet been advanced, took place on Friday of last week, at the extensive iron and engineering works of Messrs. Cochrane and Co., Woodside, near Dudley. The scene of the occurrence was the bridge-making department, where about 250 men were employed at the time. The boiler, which was situated under an iron shed in a corner of this part of the works, was of the vertical type, being 4ft. 6in. in breadth, and 10ft. high, and was used for supplying power to an iron cutting machine in close proximity to it. The boiler, which, it is stated, was in a good state of repair, having recently been thoroughly overhauled, had only been restarted the previous day, it having been idle for several weeks, and this is the only explosion which has taken place at the works during a history of fifty-four years. Happily, only five men were injured, and the damage done to property was not very great. The boiler was lifted right out of its seating, and the top portion was carried over a high building and landed at a distance of about fifty yards away, while other portions which were mostly torn into small sections, were scattered some of them a distance of 150 yards.

---

[*] Paper read before the Institution of Naval Architects on July 26th, 1894.

With respect to the proposed amalgamation of several Coventry cycle firms, it is stated that the capital will be put down at £180,000, a large proportion of which is to be reserved by the interested firms. The main idea of the projectors of the scheme is to manufacture all the component parts of a cycle, and not send to Birmingham and Wolverhampton for them, as is the case at the present time.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—There is still a very depressing outlook all through as regards the engineering, iron, and coal trades of this district. The continued absence of new work of any weight coming forward is still the general complaint amongst engineers; only in a comparatively few isolated cases are they at all busy, and this chiefly upon special work. In the iron market business drags on much as it has done for a considerable time past, with a persistent weakening tendency in prices, except where they are directly influenced by the miners' strike in Scotland and the cessation of production in that important iron centre, and the only feature in the present position which can give any satisfaction whatever to producers and manufacturers is the fact that stocks are excessively low, so that any slight revival in trade would speedily make itself felt. The prospects in the coal trade are anything but hopeful. Coalowners are endeavouring to hold on to present rates, but the whole tendency of prices is in favour of buyers, who are consequently not anxious about covering forward requirements.

The Manchester iron market on Tuesday was not more than very moderately attended, and both for raw and manufactured material the inquiries coming forward were for the most part only of very small weight. With regard to local and district brands, there is a continued weakening tendency in prices for Lancashire pig iron, and it is scarcely possible to give anything like definite quotations, as local makers are altogether out of this market except at prices considerably under their quoted rates, and beyond occasional small special orders with some of their regular customers they are doing little or nothing. For district brands prices continue extremely low, especially as regards Lincolnshire, whilst Derbyshire tends steadily in a downward direction. For delivery equal to Manchester, Lincolnshire is quoted about 38s. for forge to 39s. for foundry, net cash, but 3d. under these figures is reported to have been taken in some cases, and where buyers have orders to place they are holding back for still lower figures before they are disposed to put through transactions. Derbyshire foundry brands vary considerably; some brands could now be readily bought at 42s. 6d. and 43s., with others quoted about 45s. net cash, delivered Manchester. A generally firm tone is maintained for outside brands offering here, Scotch iron, if anything, tending to harden, owing to the very limited quantities that are obtainable. Delivered equal to Manchester, good foundry brands of Middlesbrough are not obtainable under 43s. 10d., whilst for Scotch iron, which is mostly in merchants' hands, quotations vary according to circumstances, but 45s. 6d. may be given as about the average figure for Eglinton, and Glengarnock may be quoted about 49s. 6d. net prompt cash, delivered at the Lancashire ports.

The finished iron makers report this branch of trade without any improvement whatever. For the most part forges are scarcely going more than three to four days per week, and new business comes forward only in driblets from hand to mouth. Quotations are unchanged, but for favourable specifications makers in some instances might possibly give way a little. For bars the average basis of prices remains about £5 7s. 6d. for Lancashire, and £5 10s. for Staffordshire bars delivered here; Lancashire sheets are still quoted about £6 17s. 6d. to £7 2s. 6d.; and Staffordshire, £7 5s.; Lancashire hoops, £5 17s. 6d. for random and £6 2s. 6d. for special cut lengths, delivered in the Manchester district.

In the steel trade only a very quiet business is still reported, so far as raw material is concerned, with prices about 52s., less 2½, for foundry hematite, and £4 net cash for ordinary basic billets delivered here. Local makers of steel boiler plates have, however, been booking a fair amount of business, owing to Scotch plates being for the present out of the market, and they have been enabled to secure about £6 10s. for delivery in the Manchester district.

The work of completing the equipment of the Manchester and Salford Docks and the dredging of the Manchester Ship Canal over those portions where the full depth has not yet been obtained is being vigorously pushed forward, and it is expected that in the course of a few weeks the waterway will have a depth of 26ft. from end to end. Already vessels drawing over 22ft. are enabled to enter the docks without difficulty, and, as regards traffic, this is showing steady improvement in the weekly tonnage of vessels entering and leaving the port. The engineers in this district are now using the canal much more freely, and amongst recent consignments from the Salford Docks has been the first large Lancashire boiler, Messrs. Joseph Adamson and Co., of Hyde, having shipped one of their boilers 30ft. long by 7ft. 6in. diameter, and weighing about eighteen tons, by the Dynamic, for Belfast. Other engineering firms are also beginning to use the canal for exceptionally heavy machinery, Messrs. Kendall and Gent, amongst others, having shipped by the canal several heavy pieces during the past week, including a large special milling machine, whilst Sir Joseph Whitworth and Co. shipped the other day a steel shaft weighing fifteen tons for the White Star steamer Germanic, in the hands of Harland and Wolff, which for the first time brought the recently erected thirty-ton crane into requisition.

Although there is perhaps not quite so complete a cessation of inquiry in the coal trade as reported last week, the business doing continues only of very limited dimensions, and stocks are rapidly accumulating, with collieries only in exceptional cases working more than three to four days per week. Here and there some giving way has taken place in prices, upon last month's rates, and stocks held at the collieries are beginning to be pushed on the market at rather lower figures, but generally there is no actually quotable change on prices which have been ruling of late, and the leading Manchester colliery concerns, at a meeting held on Tuesday, to consider what action should be taken with regard to prices, decided to follow much the same policy as had been adopted by the Lancashire and Cheshire Coal Sales Association at their meeting last week. The reduction in wages which comes into operation this month has been much more than discounted by the reductions which have already been made in prices, and on these grounds they considered that buyers are in no way justified in asking for any further concession. The leading coalowners are therefore determined to make every effort to maintain present prices, and although in special cases to meet exceptional circumstances which may arise there may be some giving away, the quoted list rates in the Manchester district will remain practically unchanged, at any rate for the present. All descriptions of round coal are hanging upon the market, but the average qualities remain at 11s. to 11s. 6d. for best Wigan Arley, 10s. to 10s. 6d. for Pemberton 4ft. and seconds Arley, 8s. to 8s. 6d. for common house coal, and 7s. to 7s. 6d. for steam and forge coals, although it is exceptional where the maximum figures are being actually got. Engine classes of fuel, which have become a drug upon the market recently, especially as regards the commoner sorts, are rather easier, inferior qualities of slack being readily obtainable at 4s., with good medium qualities about 4s. 9d. to 5s. 3d., and some of the best slacks still quoted at 5s. 9d. to 6s. 3d. per ton at the pit mouth.

Business in the shipping trade is not quite so active as it has been, and for ordinary Lancashire steam coal delivered at the ports on the Mersey not more than about 9s. is now being got.

Athough the settlement arrived at by the Coal Trade Conciliation Board, which is now being practically accepted by both the miners and the coalowners throughout this district, puts an end to any further disruption on the general wage question for the next two years, there are so many extras connected with miners' wages, which vary at different collieries, and are open to modification in some way or another, representing in some cases quite as serious a reduction as the 10 per cent. that has been agreed to, that it can scarcely be said that all trouble in connection with wages questions is at at end. In view of the possibility of numerous isolated disputes arising upon these miners' wages questions, the Lancashire Federated Coalowners and the Lancashire and Cheshire Miners' Federation are endeavouring to form a local Coal Trade Conciliation Board, which can deal with these matters independently of the general Conciliation Board. This local association is in fair way of being established, and it is hoped that it may be the means of preventing any serious disputes arising in the district on isolated questions connected with wages, which might otherwise prove a considerable disturbance to the trade.

*Barrow.*—The hematite pig iron trade of the north-west of England cannot be described in any way but as lifeless, and the new business of the past week has been exceedingly small. Some makers are still engaged on old contracts, but these are being rapidly worked out, while other makers who have practically cleared their books are running iron into stock with no early prospect of realisation. Makers find that at present prices there is no remuneration left in the smelting of pig iron after all costs are paid. The present condition of things points to an early reduction in the make of iron, as it is folly of the worst type to produce more iron than is wanted at a time when prices mean a loss, and when prospects of an improved trade are so remote. Prices of warrants are quoted at 43s. 11½d. sellers, net cash; and buyers, at 43s. 9½d. Makers are still quoting Bessemer iron in mixed Nos. at 44s. 6d. to 45s. 6d. net f.o.b. Stocks have increased during the week, but only to the extent of 194 tons. There is now in stock in warrant stores 155,801 tons, being an increase since the beginning of the year of 61,178 tons.

Iron ore is still a very weak trade, and the continuance of the Scotch strike does not help to improve matters, as there is a smaller consumption of native hematite at Scotch furnaces. Ordinary sorts of iron ore are still quoted at 8s. 6d. per ton net at mines. Lower prices cannot be expected, as raisers in the majority of cases are working their mines at a loss.

Steel makers complain of the scarcity of orders for rails, and from present prospects there is not likely to be any improvement, as there are no big specifications in the market on foreign or colonial account, and this is the source of the trade which is necessary to keep British rail mills employed. There is, however, a good trade in steel plates for shipbuilding purposes, and makers are fairly well sold forward. Other branches of the steel trade are, however, quiet, and orders are held to a small extent only.

Shipbuilders and engineers ara busy, but do not report any new orders.

Coal and coke are in poor demand, and supplies are small, but prices remain unchanged.

The shipping trade is still very much depressed. The exports of pig iron and steel from North-west ports during the past week have amounted to 11,406 tons, against 16,389 tons in the corresponding week of last year, a decrease of 4983 tons. The metal shipments this year so far have been 442,161 tons, comparing with 441,217 tons in the corresponding period of last year, an increase of 954 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE South Yorkshire coal trade is in a very quiet condition. Although there is no great enthusiasm over the wages arrangement, it is regarded as about the best thing that could be done in the circumstances. It is admitted as an agreement more in the interests of the men than the masters; but the alternative was too serious to entertain. No doubt the coalowners, if they had gone before Lord Shand, would have got a 10 or maybe a 15 per cent. reduction; but there was the certainty of its being demanded back in the winter, with the prospect of a new struggle if refused. The coalowners generally were reluctant to face that risk. The men are gradually falling in with the 10 per cent. reduction; but prices are now so low, that very little profit can possibly be made out of coal this season. The supply is far in excess of the demand. Very little is going to London. Prices are as low as they can be, yet merchants appear to expect still further reductions. Silkstones are now making from 9s. 6d. to 11s. per ton; Barnsley softs, from 8s. 6d. to 10s. per ton; other qualities, from 8s. per ton. Steam coal is in steady request, local collieries, which are fairly well employed, sending large quantities to the Humber ports. Not much is reported doing in other directions, railway companies being the only large customers on account of contracts. Barnsley hards fetch from 7s. 9d. to 8s. 6d. per ton; inferior sorts, from 7s. per ton. Gas coal is at 7s. 6d. to 8s. 6d. per ton. Manufacturing fuel continues in quiet demand, good slacks fetching 4s. 6d. to 5s. 6d. per ton. Smudge and small coal from 2s. per ton; coke in fair request at 9s. to 11s. per ton.

An improvement is reported in the demand for railway wheels, tires, and axles. These are coming in chiefly from India, but there is a considerable call also from the home railway companies. This increased animation in the railway material trade is exceptionally welcome, as goods for the shipbuilding yards are in very light demand, owing to the depression in the marine carrying trade. Several wagon and carriage builders in this district, as well as in Lancashire, report that they are busier than they have been at any time this year.

Much good work is being done by the leading boiler-making firms, the tendency being to put in very large boilers in order to obtain high pressure and thus increase the power of production at a lessened cost. These orders are mainly on account of the home establishments. Rather less is reported in the engineering houses, but one or two firms have some noteworthy special work in hand. Raw material seems to be slightly firmer, not so much as to justify a change in quotations, which for hematites still remain at from 51s. to 52s. 6d. per ton. Common forge iron, 38s.; Bessemer billets, £5 7s. 6d. to £5 10s.; bar iron, £5 10s. to £5 15s.; ordinary iron sheets, £8 10s.; common wire rods, £5 5s.; rope rods, £8 8s.; high carbon rods, £8 8s.

Much local interest is still excited in the fresh development of the battle between projectiles and plates. The makers of armour are not at all doubtful of their ability to produce plates strong enough to resist the new shell, for which we are indebted to Russia. The Russian shell, it is stated, has its chief feature in being fitted with a cap of soft metal to take the first impact of the hardened surface of the opposing plate. This cap, it is said, permits it to penetrate through the armour with very little injury to itself. Local experience has suggested different ways of overcoming the difficulty, and there is no doubt that the armour-plate firms will, as hitherto, be equal to the requirements imposed upon them. The Government, as mentioned last week, have been offered by Messrs. Thomas Firth and Sons specimens for trial of shells made on the Russian principle. So far as is known at present no date has been fixed for these experiments, on which not a little depends. The Admiralty have not thought it needful to make any modification of their armour-plate contracts, which are now being actively proceeded with at the Atlas Works, the Cyclops Works, and the River Don Works. A good deal of war material is also being turned out at present in gun forgings, steel castings, and forgings for the new vessels, and on the whole the various military departments are kept pretty busy on British orders. Any increase in the way of foreign requirements would make our principal firms exceedingly well off for work. One of our large concerns has an important contract for armour for the Government of Japan, but that work is spread over a series of years. Had the military advisers of the Mikado anticipated the rupture with China, no doubt these orders would have been placed at an earlier date for immediate delivery.

There is a fair amount of orders in hand for marine castings and forgings for distant Governments.

Business is rather dull in the heavy steel trades, and were it not for our own Admiralty work many of the hands employed in the East End would be on short time. The dividends declared for the year ending June 30th, by the principal companies engaged in the steel and gannister trades, are invariably weaker than for the corresponding period of last year. Makers of gannister and similar fire-resisting appliances have been seriously affected by the double strike in the north and south. Where there is no work in the iron and steel furnaces, there is, of course, no call for fire-resisting linings, which form the chief specialities of these establishments.

Manufacturers of edge tools are still very well off for work, and most of the best houses are under considerable pressure to make deliveries. Files are again in better request, some very important lines having been received on Russian and German account. Agricultural and gardening tools, after a brief period of depression, are again being freely inquired after.

There is no improvement to note in the cutlery and electro-plating trades. It was expected that there would be an end by this time of the suspense created by the American tariff question. In the absence of anything definite from the United States, firms with an American connection report that business goes from bad to worse. It is freely reported that there never was a time when the cutlery output in Sheffield was so small. High-class goods, for presentation and similar purposes, elegantly done up in handsome cases, are still well inquired after for the States. These grades are not much affected by tariffs, as the American will have the best English goods for such purposes. There is an idea that although the passing of the Wilson Bill may give a stimulus to the Sheffield cutlery craft, it will not be of long duration. A great feature of the Sheffield trade with that market has been table knives. Of late years this has been getting less and less, and the expectation is that it will gradually decrease till it reaches very unimportant dimensions. The Americans, however, have not made so much progress in fine pocket cutlery, and our local houses anticipate an active call for that class of goods in the fall of this year. As regards silver and electro-plate, there has rarely been a time when so little work was doing; indeed, several firms have withdrawn their travellers for a time on account of their journeys having turned out so unremunerative. The price of silver seems now to have settled at about 2s. 4½d. per ounce, fluctuating now and again a little above or a little below that figure.

Ivory cutters are complaining severely of the inaction in their line, caused by the decline of the cutlery and silver trades. Many of them have a large amount of capital lying idle in their accumulated stocks of hafts. The stag horn cutters are rather better fixed, as the use of tips for umbrellas and walking sticks has now become an important factor in their business. The London ivory sales, held last week, seem to point to the conclusion that ivory will not get any lower in some qualities. Better rates were realised and a large business was done.

The Lord Provost of Edinburgh, the Right Hon. Sir James Russell, LL.D., paid a visit to the works of Messrs. Charles Cammell and Co. last week. There his lordship witnessed the rolling of an armour-plate weighing 26 tons. This is intended for the citadel of the new warship Magnificent. The plate was reduced from a thickness of 14½in. to 9in. under the huge rolls. Subsequently the Harvey process of hardening armour-plate was explained. At the works of Messrs. Thomas Firth and Sons, the Lord Provost witnessed the process of manufacturing projectiles. His visit was at an interesting period, when a fresh development of the contest between armour and shell is in progress. Sir James Russell afterwards visited the manufactory of Messrs. Mappin and Webb, where the production of silver and electro-plated goods was explained by Mr. H. Howlden, the general manager, whose guest his lordship was during his visit to the town. The Lord Provost expressed himself as much interested in the magnitude of the works carried on in the large East End establishments, and in the beauty of the process associated with the silver trade.

Messrs. Newton, Chambers, and Co., of the Thorncliffe Ironworks, were awarded a silver medal for their stable fittings at the Royal Lancashire Show, held at Bolton, where they had a representative exhibit.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE depression in trade is increasing, and in no department of the iron and allied industries are manufacturers doing even a fairly satisfactory business. Most people agree that a worse time has not been experienced since 1879, and some hold that a more trying time has never been seen during the present generation. And yet in the early part of the year there was every prospect of a revival, but unfortunately strikes have come in and killed the improvement. The strike that has had the most to do in bringing about this result has been that of the moulders, which has now lasted five months, and appears no nearer the end than it did weeks ago. Practically nothing has been done during the past week towards ending the struggle, and the already widespread distress is every day being extended as works are compelled to close, because manufacturers cannot procure the castings which they need. It will scarcely be believed that because 1500 moulders refuse to work, nearly 18,000 other workmen, engaged in iron and steel works, engineering works, shipyards, &c., have to be compulsorily retired from their labours, and many of them are practically starving, yet they have no voice in the settlement of the dispute. The engineers did come out on strike for an advance of wages similar to that demanded by the moulders, but recognising after a time that trade had fallen back, and did not justify their persisting in the demand, they withdrew their claim; but that has not availed them anything, for as long as the moulders keep out there can be no work for the engineers. It certainly is high time that in the interests of the thousands who are unwillingly thrown out of work by the strike, greater efforts should be made to bring the contending parties to an agreement. It is a most serious matter for the iron and shipbuilding industries to have to suffer from this enforced idleness. Messrs. Richardson, Duck, and Co., and Messrs. Craig, Tayler, and Co., both shipbuilders at Thornaby-on-Tees, have had to close their yards, and now out of eight yards on the Tees only one is in operation, and that is a small one. At the Hartlepools there is only one at work, and on the Tyne and Wear a large proportion of the shipyards and engine works are idle. On this account it is impossible to keep the iron and steel works in anything like full operation, and some have had to be closed altogether. Messrs. Dorman, Long, and Co. are stopping their West Marsh and Britannia Works at Middlesbrough, and Messrs. William Shaw and Co. have this week closed their Wellington Cast Steel Foundry, Middlesbrough. Messrs. Dorman, Long, and Co. have orders booked, but while the shipyards are closed cannot get the specifications; and as to their girder business, it is said that the stocks at their depôts are so large that a stoppage for a time will involve no inconvenience. The works of the Darlington Steel and Iron Company are to be closed after the orders now on the books are completed and the stock of materials used up, which will be in about three weeks. The works are to stop for an indefinite period, and 800 men will be thrown out of employment. In this case, however, it is not the moulders' strike that can be blamed for the stoppage, because the Darlington Company do not produce plates or angles, they confine their attention mainly to rails, and it is the general depression of trade that is affecting them. The chairman of the company addressing the shareholders on Monday, at the half-yearly meeting, said that such a condition of trade as the present had never been experienced since he entered commercial life, and one would have to go back sixty or seventy years to find anything as bad. He remarked that, during the twelve years since he was appointed chairman, the company had manufactured 750,000 tons of steel, for which they had received about £4,000,000, and the total amount of profit on that was £74,164, of which the shareholders got £43,000, or 3d. out of every £1 received. The ordinary shareholders got dividends in only four out of the twelve years. The loss incurred in the last financial year ending April 30th was £3571, and since then the loss had been going on, and the difficulties under which they laboured had been increased. Under the circumstances the directors thought it best to close. Darlington has not an equal chance in competing with other works nearer the seaboard for rail orders, because most of the rails now required are for export, and being an inland place and away from a navigable river, extra cost is incurred in shipping the rails.

The slackening of operations at most of the steel works, and the closing of others, has lessened the demand for hematite pig iron, and the trade in that is extremely dull, while prices are drooping, because while consumption has decreased the production has not been curtailed, and stocks are increasing, though the stock in Connal's stores last month shows a decrease of 272 tons, the quantity of hematite held at July 31st being 43,317 tons. Makers are not reducing their output, because they are not averse to augmenting their stocks, which are only small; indeed, a short time ago they had in some cases difficulty in supplying all that was required. They are now desirous of accumulating a stock to meet the autumn business, and thus none of the furnaces are put out. The quotation now for mixed nos. of East Coast hematite pig is 43s., but there have been sales this week at 42s. 9d., and even 42s. 6d. A good deal of hematite pig iron has been sent to Russia and Italy during the past month.

Cleveland pig iron is also produced in excess of requirements, for though exports have of late been good, yet much less is consumed locally. Since last report, No. 3 Cleveland G.M.B. pig has been sold at 35s. 4½d., and in a few cases at 35s. 3d., for prompt f.o.b. delivery; but sellers are again asking and realising 35s. 6d. and will not take less, as that has been the price of warrants. The stock of Cleveland pig iron in Connal's warrant stores at July 31st was 95,392 tons; decrease, 2639 tons for the month. No. 1 Cleveland pig iron is quoted 37s. 6d.; No. 4 foundry, 34s. 6d.; and grey forge, 34s. The increase in stock is mainly in the commoner qualities of pig iron.

The pig iron shipments from Middlesbrough — including Skinningrove—during July reached 88,329 tons, the exports to foreign parts being the best that have been reported since last October, but to Scotland there has been a considerable falling off. The following is a summary of the shipments as compared with the previous months named:—

| | Coastwise tons. | Foreign tons. | Total tons. |
|---|---|---|---|
| July, 1894 .. .. .. .. | 35,551 .. | 52,778 .. | 88,329 |
| June, 1894 .. .. .. .. | 43,335 .. | 46,515 .. | 89,850 |
| May, 1894 .. .. .. .. | 44,514 .. | 47,420 .. | 91,934 |
| July, 1893 .. .. .. .. | 25,294 .. | 54,957 .. | 80,251 |
| July, 1892 .. .. .. .. | 11,741 .. | 30,188 .. | 41,929 |

Germany last month received 24,000 tons of pig iron from the Tees, Russia 10,543 tons, and Italy 6195 tons, that to the last two countries being chiefly hematite iron. Altogether, 582,742 tons of pig iron have been shipped this year, against 549,732 tons in 1893, and this year's quantity is the largest ever known. Germany has had over 120,000 tons, or more than a fifth of the total shipment, and Scotland 246,791 tons, or two-fifths.

The finished iron and steel trades are extremely slack, and prospects are discouraging, but no further reductions in prices are made, because quotations are now at figures which leave no margin for profit. Mr. Waterhouse has submitted to the Board of Conciliation his statistics of the quantities of and average prices realised for manufactured iron in the North of England during May and June, 1894. The average price is practically the same as in the previous two months, viz., £4 17s. 8·30d. or 0·03d. less. In accordance with the sliding scale, wages of finished ironworkers during August and September will be at the same rates as they have been in June and July. The deliveries fell off about 2600 tons, chiefly, as might be expected, in plates.

The half-yearly meeting of the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trades of the North of England was held on Monday. This organisation is now twenty-five years old, having been founded in 1869. The president had a very good account to give of its work during the past half-year. This board has been the model for many similar institutions founded, not only in this country, but also on the Continent and in America. An effort is being made to shorten the hours of work at mills and forges, particularly on the Saturdays.

The Consett Iron Company's directors report that their profits during the last financial year reached £124,786.

Alderman Philip A. Berkley, who has for many years been connected with Palmer's Shipbuilding and Iron Co., has resigned his position, and retires into private life.

There is nothing new in the coal trade, and business on the whole is much better than might be expected, taking the stoppages of so many works into account; but the decrease in consumption locally is more than counterbalanced by extra deliveries to Scotland and also to the Continent, and very few of the collieries lose any time. The annual meeting of the North of England Institution of Mining and Mechanical Engineers will be held at Newcastle on Saturday.

In connection with the jubilee of the firm of Bell Brothers, the employers set aside £500 to be spent in entertaining the men at their different works—at Clarence Blast Furnaces on the Tees, at their collieries at Fursdale, Browney, and Page Bank, in Durham, and at their mines and quarries in Cleveland and Weardale last Saturday. The men at these places number over 10,000.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market continues very quiet, business being greatly hampered by the colliers' strike. Scotch warrants have sold in small quantities at former prices. There has been little doing in Cleveland warrants, and hematite iron is quite neglected.

The prices of makers' special brands are steady as follow:— G.M.B. f.o.b. at Glasgow No. 1 is quoted 43s. 6d. per ton; No. 3, 42s. 6d.; Monkland No. 1, 47s.; No. 3, 42s. 6d.; Carnbroe No. 1, 47s.; No. 3, 46s.; Clyde No. 1, 55s.; No. 3, 49s.; Gartsherrie No. 3, 49s.; Calder and Summerlee No. 1, 56s.; No. 3, 49s.; Coltness No. 1, 57s.; No. 3, 41s.; Glengarnock at Ardrossan No. 1, 52s. 6d.; No. 3, 49s; Eglinton No. 1, 51s.; No. 3, 46s.; Dalmellington at Ayr No. 1, 50s.; No. 3, 46s.; Shotts at Leith No. 1, 55s; No. 3, 51s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 2807, compared with 6502 in the corresponding week of last year. Of the total there was sent to South America 75 tons, India 20, Australia 360, France 35, Italy 850, Holland 40, Belgium 80, Spain and Portugal 100, China and Japan 200, other countries 265, and coastwise 782, compared with 3747 in the corresponding week.

There is no change in the number of furnaces in blast, which is 11, compared with 62 at this time last yeat. Ordinary iron is being produced at Coltness by 3 furnaces, and at Shotts by 4, while there are 4 furnaces making basic at Glengarnock.

As regards the market for finished iron and steel, the amount of business is inconsiderable; very few of the works have yet resumed, being deterred by the apprehension of dear coals. Conferences have taken place in one or two districts between employers and workmen with the object of endeavouring to arrange terms on which work could be started. A proposal has been submitted to the men to the effect that while the strike lasts they should allow one-half of the extra cost of coal to be deducted from their wages.

The iron and steel manufactured goods shipped from Glasgow embraced locomotives worth £3170, sewing machines £915, other machinery £13,128, steel goods £6153, miscellaneous iron goods £23,034.

The coal trade is almost dormant, owing to the continuance of the strike. Stocks, which were held mostly in Fifeshire, are now reported to be well exhausted. Consumers have been keeping out of the market as much as possible, so as to avoid a rise in prices. Numerous vessels, for the most part small in size, have arrived in Glasgow and other ports from England with cargoes of coal. The price at the ship's side in Glasgow harbour is so far moderate in the circumstances, being from 9s. to 10s. per ton. The exports of coal from Scottish ports during the week reached only 24,246 tons, compared with 140,864 in the corresponding week.

The strike has now lasted about five weeks, and during that time only two small distributions of money have been made to the men. Much distress is reported in the mining districts. Efforts have been made to bring about a settlement of the dispute, but these have proceeded on the assumption that the employers may possibly agree to some concessions to the men; and as there is nothing in the state of trade to warrant an increase of the cost of production, there is no chance of effecting a settlement on any such basis.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE usual and natural sequence to colliery explosions—the inquest and verdict—have taken place in respect of the Albion; and, from the Home Secretary to the colliery officials, there is subject matter for reflection in the verdict now rendered. This was as follows:—"The jury found that the deceased had lost their lives through an explosion at the Albion Colliery, on June 23rd, 1894, which explosion was accelerated and extended by coal dust; but the jury disagree as to the exact place at which the explosion had its origin, and we are unanimously of opinion that shot firing was practised in the colliery when the men were at work, without sufficient precautions as to their safety, and contrary to rules; we are also of opinion that the under-manager neglected his duty in not seeing that his subordinates in the night shifts performed their duties in accordance with rules; that the firemen were negligent in not reporting gas when found, and that there is not a proper system of watering in the mine. The jury beg to make the following recommendations:—(1) That shot-firing in timber shall be absolutely prohibited; (2) that all old workings shall be properly shored or gobbed; (3) that a record shall be kept of the number of men in the mine at all hours; (4) that thorough inspection shall be more frequently made by her Majesty's inspectors, because we consider the present examinations by the workmen's representatives worthless." With this verdict the Albion is relegated to the long list of fatalities, and in the meanwhile, before the next calamity, there is no doubt a good deal of useful work will be done in the way of prevention. There is, however, a significant hint in the fourth clause—"the examination by the men's representatives is worthless." If it be true that the very men who are more interested than any others in avoiding accidents are not to be trusted, there is little security against a recurrence in one pit or another. Steam collieries are recruited from all quarters—Cornish tin workers, North Walian lead workers, labourers from all parts. Then we have the "rush" to get out as much coal as possible, a colliery never suffered to get cool, and any day an explosion. The recommendation for more inspection is a good one. Inspections outside the coalowners' jurisdiction are needed, and, to be of practical service, they should be quadrupled at least in number.

On Saturday the Sliding Scale Committee held their audit meeting at Cardiff, when the results of the examination of coalowners' books showed the justification for a reduction of wages to the extent of 3¾ per cent. The last reduction, in April, was 2½. This now leaves wages at 23¾ per cent. above the standard. In all probability the next audit will declare an advance, as the demand for coal has been well sustained of late, and prices have been fairly high and firm. Last week again the total coal shipment from the Cardiff ports exceeded 300,000 tons, and this week's total I expect will be larger, as the monthly holiday that is looming generally incites to greater effort in the preceding week.

Some little unpleasantness has arisen again amongst the collieries. It would seem as if explosions underground must be followed by ruptures above. The question now under discussion is the objection of the coalowners' committee to take checkweighers' evidence. A good deal more is made of it than is justified, and, as usual, representatives of the Miners' General Federation are trying to widen the breach.

The coal outlook continues very satisfactory, and marked activity continues in all directions.

The last new and successful colliery undertaking, the Llanbradach, was the scene of a pleasant gathering last week. The directors and many of the largest shareholders met to see the first output of No. 2 pit, and having noted the landing of several trucks, sat down to a luncheon in celebration of the starting of, in all probability, a long and prosperous annal. Both pits are now working well, and a township is arising, which is certain to be a large and prosperous one. The strong likelihood is that in a few years, at least, a place equal in size and importance to Mountain Ash, will stand where only a few years past there was not even a cottage.

It is to be hoped that local authorities will keep pace in providing all necessary places and institutions for the new community. Not unfrequently this is omitted, and an isolated township is handicapped badly.

The coal market mid-week at Cardiff was not so active as one would wish, but there is not much reason for complaint, as prices did not show more fluctuation than about 3d. in best qualities. The latest steam coal prices are:—Best steam, 12s. to 12s. 3d.; seconds, 11s. 6d. to 11s. 9d.; dry coal from 10s. to 10s. 3d. Small steam is accumulating, and cheaper, ordinary kinds are selling at 5s. 3d. to 5s. 6d.; best, 5s. 9d., f.o.b.

In house coal there is no denial a slight weakness has begun to show itself, and appearances suggest that the usual summer quiet season is at hand. One comfort for coalowners is, that it has been so long delayed that it can only be a short one. Best household is selling rather tardily at 11s.; No. 3 Rhondda, 10s. 9d.; brush, 8s. 9d.; small, 6s. 9d.; No. 2 Rhondda, 9s. 6d. and 10s.; small, 5s.

Swansea is busy in coal exports, and last week despatched 36,670 tons; while the vigour of the patent fuel made was demonstrated by an export of 12,208 tons. The coal totals included 14,030 tons to France; San Francisco, 2500; Montreal, 2100, and the United States 1602 tons. Newport continues to display a good deal of activity. Output of the district is large and increasing, and shipments, foreign and coastwise, very satisfactory.

There is scarcely any change in the condition of the iron and steel trades. In rails, small parcels continue to be the characteristic. One went from Newport this week to Clevedon 60 tons. Good and large foreign orders are much needed. In bars an average make is recorded, but prices lack firmness, and on 'Change, Cardiff, this week, as well as Swansea, rails and bars were 2s. 6d. per ton weaker. The lowest quotations, Swansea, mid-week, were as follows:—Welsh bars, £5; sheet iron, £5 15s. to £6 10s. at works; steel sheet, £6 to £6 5s., with the usual extras for higher gauges; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens, £4 2s. 6d. to £4 5s.

In pig iron there is no change. There was an expectation that the Scotch strike would have sent prices up. This has not been the case, and the remark on 'Change was that everything in respect of Glasgow warrants was at a standstill; latest prices are 42s. cash buyers; Middlesbrough, No. 3, 35s. 5d. and 35s. 6d.; hematites, 43s. 8d. for mixed nos.; block tin is at £65 15s. to £66. Iron ore is coming in freely from Cyfarthfa, Dowlais, Blaenavon, and Ebbw Vale. A good deal has also come in to Port Talbot. Swansea prices are: Tafna, 11s.; Rubio, 11s. 3d. Cardiff prices for pit-wood, 15s. 3d.; moderate demand; coke, improving; furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; best foundry, 20s. to 21s.

Tin-plate reports are unfavourable, both in respect of the attitude of the men and the state of the market. The uncertainty still prevailing in respect of the American tariff has had a depressing influence on business, and prices are weaker.

The comment on 'Change, Swansea, this week was to the effect that prices continue below any possible profit, and every effort is being made by the men to increase the cost of production, which must in the end come upon the consumer.

There are several important works at present which may any day be declared closed. In fact, rumours have been busily in circulation this week to the effect that a decision to close had been arrived at, but until the actual stoppage I shall not give currency to the statement. The latest quotations are:—Bessemer, 10s. 3d. to 10s. 4½d.; Siemens, 10s. 4½d. to 10s. 7½d.; best charcoal, 11s. 6d. to 12s. 6d.; wasters, 6d. to 1s. less than primes. Ternes remain at 19s. to 23s.

At Briton Ferry the shipment of coal has been marked, especially by Perch and Co.

Large arrivals of iron ore have come from Spain. Briton Ferry blast furnaces are well employed, and production of bars and plates a good average. It is thought that the Earlswood Tin-plate Works will resume operations shortly.

Swansea shipment of tin-plates last week was only 47,079 boxes, receipts from works 64,580 boxes. Stocks now are 307,098 boxes.

Swansea imported last week 1614 tons pig, 205 scrap iron, 233 tin-plates, 598 tin bar, and 2000 tons iron ore.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE situation of the iron and steel trade in this country does not show much change on the week, demand being limited, and prices fluctuating. Here and there a better feeling has been noticeable lately, and makers are, as a rule, less despondent than during previous months, but there is still very much left to be desired, both as regards home and foreign demand, and the prices generally quoted leave no profit.

In Silesia the blast furnace works have been reported in somewhat better employment lately, which may be accounted for by the increasing activity in the malleable iron department, where orders have been coming in quite regularly during the past week; especially bars and sheets are meeting with a healthy demand. There is likewise much animation to be noticed at the tube mills, and prices are firm, if not rising. A very lively business continues to be done on the Austro-Hungarian iron market, all sorts of pig iron being well inquired for. Makers of manufactured iron also report themselves pretty actively engaged generally, although for some sorts rather a decrease in demand has been perceptible, which is chiefly caused by the keenness of German competition. The rail works unfortunately continue insufficiently occupied, and there is now but little hope that orders of any weight will be given out this year. In structural material there is not much doing just now, but autumn demand is likely to be fairly good. The business in hardware has, on the whole, decreased.

The condition of the French iron industry continues quiet but rather satisfactory, pig iron being in fair request at tolerably firm quotations. The greater part of the malleable iron works are regularly employed, and there has been a stiffening tendency noticed with regard to prices. For the present, merchant bars are paid with 155f., girders 165f., p.t. free Paris.

On the Belgian iron market demand and sale continue limited, but prices show a little more firmness. Hitherto the Belgian State Railways have been able to purchase their requirements at extremely low rates, because the Belgian works keenly competed with each other, but now the Belgian steel works have joined in a sort of convention for the purpose of fixing the prices and dividing the orders among the different works. The State Railway administrations have, in consequence of this, been compelled to pay considerably higher prices at a late tendering for rails and appurtenances. During the first two quarters of 1894 the production of the Belgian blast furnace works has been, in pig iron, 189,220 t., against 211,676 t. for the same period last year; foundry pig, 47,415 t., against 39,890 t.; and steel, 207,150 t., against 127,625 t.; totals being 443,785 t., against 379,115 t. last year.

There is nothing new to report concerning the state of the iron industry in Rheinland Westphalia, pig iron being in quiet but pretty regular demand. In the Siegerland there has been a specially good inquiry coming in for spiegleisen, and basic has also been briskly called for in some instances, Belgian demand for that sort having increased of late.

The general position of the finished iron trades shows no improvement, but if anything the outlook is more favourable than in former weeks, bars having met with a fairly active inquiry. Prices, too, have been rather well maintained, makers in most instances refusing to sell at the famine prices which they had been forced to accept when business was at its worst. Girders as well as all sorts of structural iron are in quiet demand, and there is much under-quoting practised; producers, however, show some little inclination to give way in their prices. In the hoop trade inquiries for the fourth quarter have increased, and the mills are vigorously engaged.

There is but an irregular activity reported at the plate and sheet mills, some being well employed, while others are scarcely kept going, but they all unite in complaints regarding the condition of prices. Drawn wire, as well as wire nails, are in poor request on home account, while export business is tolerably good; indeed, there has been a steady increase noticeable in the export of wire nails for the last years. In 1880, for instance, 164 t. were exported, while in the year following export rose on 217 t., in 1882 it was 238 t.; in 1883, 282 t.; in 1884, 386 t.; in 1885, 387 t.; in 1886, 396 t.; in 1887, 413 t.; in 1888, 487 t.; in 1889, 464 t.; in 1890, 410 t.; in 1891, 497 t.; in 1892, 502 t., and in 1893 it was 548 t. Chief consumers for German wire nails are England and Japan, having bought about one-half of the total production last year. Foundries and machine shops are tolerably well employed, and so are the wagon factories generally.

The production of pig iron in the Saar and Mosel district has been, for June, 1894: 23,379 t. forge pig, 53,969 t. basic foundry pig 12,035 t.; together, 89,383 t. Output was 1 per cent. less than during the preceding month of May, when it was 90,268 t. In June, 1893, total production amounted to 84,108 t., showing an increase of 6·3 per cent. for the same month this year. From January to June of present year 533,083 t. were produced, against 498,912 t. for the corresponding period last year. Output during the second quarter of present year was 34,171 t. or 6·8 per cent. more than during the same period in the preceding year.

## AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, July 26th, 1894.

ALL reports from the interior show continued sluggishness. The banks are unable to find borrowers, and the railway managers report traffic poor. Iron and steel makers are doing one half what they usually do, although Pittsburgh and Western Pennsylvania are favoured more than any other locality. The coke strike continues, and a good many concerns are not getting the amount of coke contracted for. In Central Pennsylania 7000 miners are still out. There is an unsettled feeling in all industrial centres, growing in part out of the railroad strike. The western railway managers are succeeding in moving considerable freight. The opinion in manufacturing circles is that the country is on the eve of a general improvement. The country never before experienced such a severe restriction and with so little inconvenience. It has been worth all it cost. Material for construction purposes is offered this week for delivering any time during 1894 on the basis of quoted prices to-day. Large consumers are now seriously considering this proposition, and large orders may soon be made out.

## LAUNCHES AND TRIAL TRIPS.

On the 17th ult., the Montrose Shipbuilding and Engineering Co., Montrose, launched two barges, the New Orleans and St. Louis, 76ft. 2in. long, with 21ft. 5in. beam, and 7ft. 6in. depth, and on the 25th and 26th ult. the barge Uranus, and a sister barge—unnamed—the latter making the fifth barge supplied for London owners.

On Wednesday afternoon there was launched from the east yard of Messrs. C. S. Swan and Hunter, shipbuilders, Wallsend, a steel screw steamer to carry about 5200 tons deadweight of the following dimensions:—Length over all, 340ft. 6in.; breadth, 43ft.; depth moulded, 28ft. 11in. The vessel will be to Lloyd's highest class, and has been built under special survey to the order of Messrs. Burrell and Son, of Glasgow; is of the spar deck type, with poop, long bridge house amidships and forecastle. She will be engined by the Wallsend Slipway and Engineering Company, the sizes of the cylinders being 24in., 40in. and 64in., by 45in. stroke.

On Wednesday morning the s.s. Leyden left the Cleveland dockyard of Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip. She is a steel screw cargo steamer of the three-decked type to Lloyds' highest class, and has been built to the order of Messrs. Robert Alexander and Co., of Liverpool, for the Stoomvaart Maatschappy Leyden, of Rotterdam, the principal dimensions being:—Length, 357ft. 6in.; beam, 43ft. 6in.; depth, moulded, 28ft. The upper and main decks are of steel, the poop, bridge, and forecastle decks of pine, and the vessel will carry about 5400 tons deadweight on a moderate draught of water. The deck machinery for loading and discharging cargoes is very complete, and includes five large steam winches, whilst the hatchways are extra wide and long for carrying boilers and large pieces of machinery, &c. Water ballast is carried in the cellular double bottom, which extends right fore and aft, and the vessel is subdivided by six transverse watertight bulkheads. The engines have been fitted by Messrs. Thomas Richardson and Sons, of Hartlepool, the cylinders being 24½in., 39in., 67in., by 45in. stroke, with two double-ended boilers working at a pressure of 180 lb. per square inch. The construction of the vessel and machinery has been carried out under the supervision of Mr. H. H. West and Mr. S. S. Goodwin respectively, of Liverpool, and Captain M. H. Foster has personally superintended the work.

## SPECIFIC HEATS OF GASES AT CONSTANT VOLUME.

At a recent meeting of the Royal Society a paper was read "On the Specific Heats of Gases at Constant Volume, Part II., Carbon Dioxide," by Dr. J. Joly, F.R.S. In the former experiments on this gas, recorded in the first part of this research,* the highest absolute density at which the specific heat was determined was 0·0378. In the present observations the determinations of specific heat have been carried to densities at which the substance was partly in the liquid state at the lower limit of temperature of the experiments. Observations dealing with true specific heat, uncomplicated by the presence of thermal effects due to the presence of liquid, are limited by the density 0·1444. At this density the mean specific heat over the range, 12 deg. C. to 100 deg. C., is 0·2035.

These observations, combined with those contained in Part I. (*loc. cit.*), afford a well-defined line, which rises slowly at the higher densities, turning away from the axis of density.

According to an empirical equation to this line, the specific heat of carbon dioxide at constant volume is given in terms of its variation with density $\rho$, as follows:—

$$Cv = 0{\cdot}1650 + 0{\cdot}2125\rho + 0{\cdot}3400\rho^2.$$

"On the Specific Heats of Gases at Constant Volume, Part III., the Specific Heat of Carbon Dioxide as a Function of Temperature," by Dr. J. Joly, F.R.S.

In order to investigate the question of the variation of the specific heat of carbon dioxide with temperature, a steam calorimeter was constructed having double walls of thin brass, between which the vapour of a liquid boiling under atmospheric pressure could be circulated. The vessels used in the experiments were hung in the closed inner chamber. Into this chamber steam could be admitted after the temperature had become stationary and the same as that of the jacketing vapour. In this way the initial temperature could be varied.

Experiments at various densities and over four intervals of temperature were carried out. The densities chosen were 0·0456, 0·0800, 0·1240, 0·1800, and 0·1973. The intervals of temperature over which the gas at each density was investigated were: Air temperature to 100 deg.; 35 deg. C., boiling point of ether, to 100 deg.; 56 deg., boiling point of acetone, to 100 deg.; and 78 deg., boiling point of ethyl alcohol, to 100 deg.

The results are plotted on five equi-density lines, in which the precipitation due to the calorific capacity of the gas between $t_1$ and 100 deg. is plotted against the initial temperature $t_1$ in each case. If the specific heat is invariable, these are right lines. This proves to be sensibly the case for the lines $\rho = 0{\cdot}0456$ and $\rho = 0{\cdot}0800$, those of lowest density.

The next line, 0·0124, is nearly rectilinear over the higher ranges, but, pursued in the direction of decreasing temperature, it rises markedly, thus indicating that the specific heat at constant volume falls in value with increasing temperature. The line $\rho = 0{\cdot}1800$, and the one close above it, $\rho = 0{\cdot}1973$, show this variation very markedly. Their variation below the critical temperature is complicated by the presence of liquid.

The following empirical equation expresses the line $\rho = 0{\cdot}124$ calculated into a line of variation of specific heat with temperature:—

$$Cv = a\,(100-t) + b\,(100-t)^2 + c\,(100-t)^3,$$

where $t$ is the initial temperature of the experiment in Centigrade degrees:—

$$a = 0{\cdot}19020000,$$
$$b = -0{\cdot}00006750,$$
$$c = 0{\cdot}00000182.$$

---

* "On the Specific Heats of Gases at Constant Volume, Part I. Phil. "Trans.," vol. clxxxii., 1891, pp. 78—117.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*18th July*, 1894.

13,843. Cycle Tire Protectors, S. Kupfer.—(*R. Landauer, Germany.*)
13,844 Umbrellas and Sunshades, L. N. Loeb.—(*A. Gruyer, jun., France*)
13,845. Valves for Hydraulic Presses, C. Downs, London.
13,846. Receptacle for Money, F. B. Shotter and P. W. Tracey, London.
13,847. Purifying Benzine, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis and Albin Haller, France*)
13,848. Apparatus for Selling Books, R. Wittman and J. L. Magyar, London.
13,849. Railway Ticket Printing Machines, J. Lewthwaite, London.
13,850. Treating Refractory Ores, E. A. Ashcroft, London.
13,851. Nickeliferous Iron Ores, W. T. Gibbs, London.
13,852. Covers for Drains, &c., J. Willoughby, jun, London.
13,853. Washing Agents, A Gross, S. Siebenbürgen, and S. Leitersdorfer, London.
13,854. Fire-extinguishing Apparatus, R. Tranquilli, London.
13,855. Ascertaining the Position of Ships at Sea, S. Carey, Dartmouth.
13,856. Articulations for Permitting the Folding of a Rod round an Axis, A. Hofbeck, London.
13,857. Vessels for Evaporating Liquids, G. Fletcher, London.
13,858. Bed Pans, W. L Chester, London.
13,859. Fire-escape, C. Manton and W. J. Busby, London.
13,860. Sash Fasteners, D. Dawson, London.
13,861. Pneumatic Tires, P. Chick, London.
13,862. Cart for Loading and Turning Hay, W. Williams, London.
13,863. Umbrella Clip, A. Gates, London.
13,864. Egg Lifter, A. E. Smith, London.
13,865. Letter Boxes, W. A. E. Crombie, London.
13,866. Tilting Casks, W. Valentine and T. A. Patrick, London.
13,867. Chimney Tops, H. H. Fletcher, London.
13,868. Extracting Gold, H. C. Barker and R. Pearson, London.
13,869. Pie Dishes, W. T. Langley-Smith, South Croydon.
13,870. Bath Valves, S. Jennings, London.
13,871. Electric Transformers, J. A. Kelman, sen.—(*J. A. Kelman, jun, United States.*)
13,872. Electric Railways, G. Vermeire, London.

*19th July*, 1894.

13,873. Copying Ink, W. M. Williams, London.
13,874. Apparatus for Drying Grain, J. Backhouse, Liverpool.
13,875. Hand Knitting Appliances, A. W. Patching, Manchester.
13,876. Presses for Baling Cotton, W. P. Thompson.—(*J. F. Elsworth, Egypt.*)
13,877. Clamps for Guy Ropes of Tents, W. Edwards, London.
13,878. Hook and Eye, M. V. Christie, Rosscarbery, Co. Cork.
13,879. Illuminated Signs for Advertising, J. E. Robinson, Liverpool.
13,880. Metal Loop for Harness Nose-bands, H. A. Ward, Birmingham.
13,881. Insecticide Distributing Apparatus, J. J. Stott, Manchester.
13,882. Reversible Seats for Tramcars, E. Horner, London.
13,883. Levelling of Billiard Tables, E. Horner, London.
13,884. Metallic Bedstead Manufacture, H. Lewis, Birmingham.
13,885. Metallic Bedstead Manufacture, H. Lewis, Birmingham.
13,886. Displaying Advertisements, S. Bunting, Birmingham.
13,887. Domestic Ovens, W. Barraclough and A. Rhodes, Glasgow.
13 888. Pipe Couplings, P. Ellis, Derby.
13,889. Simplex Door Handle, C. Lea, Silverdale, North Staffs.
13 890. Locks, C. Lea, Silverdale, North Staffs.
13,891. Roving Frame Flyer, R. Hartley and J. B. Cocks, Rochdale.
13,892. Laminated Springs, R. R. Eadon and J. Beatty, Sheffield.
13,893. Apparatus for the Automatic Supply of Fibrous Materials to Carding Machines, E. Tilston, Manchester.
13,894. Cap Spinning, H. Cockroft, Leeds.
13,895. Packing for Piston-rods, &c., J. S. Crawford, Glasgow.
13,896. Filters, J. J. Stott, Manchester.
13,897. Retaining the Tips on Billiard Cues, J. Wilday, Birmingham.
13,898. Cotton Spinning Machines, J. and J. Vaughan, Manchester.
13,899. Magazine for Photographic Dry Plates, J. B. Brooks, Birmingham.
13 900. Multiplex Telephony, A. M. Rosebrugh, Canada.
13,901. Securing Window Blinds, E. P. Cowcher, London.
13,902. Ambulances, W. and E. Allday, and A. R. Tozer, London.
13,903. Magnetic Locks, C. E. Stallybrass, Cardiff.
13,904. Incandescent Gas Lamps and Burner, E. Deen, London.
13,905. Hat or Bonnet Fastener, F. Calder, jun., London.
13,906. Tires for Velocipedes, &c, J. Solloway, London.
13,907. An Improved Toy, G. Wastell, London.
13,908. Fastenings for Corsets, &c., E. S. Collins, London.
13,909. Gaiters, R. Southcombe, London.
13,910. Cycling Boots, J. Gerard, London.
13,911. Carriage Tops, E. A. Sommerfruechte, London.
13,912. Pumps for Inflating Pneumatic Tires, H. Guest, London.
13,913. Liquid Holder for Fly Papers, C. M. Walker, London.
13,914. Roller Skates, E. Garnier and R. Baheux, London.
13,915. Voting Screens for Polling Stations, T. Wile, London.
13,916. Trucks, Trolleys, and Barrows, C. Smith, London.
13,917. Water Cycle, J. M. Gorham and R.S. Erskine, London.
13,918. Metallic Boxes, E. A. Jahncke and Jahncke, London.
13,919. Rims for Bicycle Wheels, &c, G. W. Marble, London.
13,920. Comminuting Molten Substances, J. A. Mays, London.
13,921. Spikes to Prevent Slipping, W. J. Blaxton, London.
13,922. Guiding the Fingers in Writing, E. Müller, London.
13,923. Check Straps for Weaving Looms, H. Waring, London.
13,924. Chiropodist Instrument, L. C. Darvall.—(*F. M. Garies, United States*)
13,925. Multiple Gearing, W. H. Bright, C. A. and W. A. Ware, London.
13,926. Treating Wood, J. B. Fillol, E. Hebrard, and L. Loustalot, London.
13,927. Advertising on Match-boxes, A. Gassmann, London.
13,928. Grinding and Polishing, A. and R J. Edwards, London.
13,929. Indicating the Heat of Ovens, H. H. Wood, London.
13,930. Watch Glasses, E. Mayer, London.
13,931. Nail for Securing Roof Covers, J. Bartlett, London.
13,932. Driving Chains, E. F. Sargeant, London.
13,933. Cricket Bats, W. H. Stanley, Eastbourne.
13,934. Refrigeratory, M. Pollak, Saxony.
13,935. Nail Whitening Fluid, E. G. Gubbins and G H. Brown, Weybridge.
13,936. Supports for Drawing-boards, R. Brealey, London.
13,937. Feeders for Carding Engines, C. O. Liebscher, London.
13,938. Pneumatic Tires, P. A. Craven, London.
13,939. Inlaid Colour Floor Coverings, C. Wolfendale, London.
13,940. Kitchen Cooking Apparatus, G. A. Dubeux, London.
13,941. Tin and Can Opener, W. Broad, London.
13,942. Billiard Cues, E. Beadle and A. Beadle, London.
13,943. Heating by Heating Medium, H. Piron, London.
13,944. Bottles, &c., G. F. Dièckmann, London.
13 945. Producing Circulation of Air, E. Barger, London.
13,946. Hydraulic Engine or Motor, G. R'che, London.
13,947. Cutting Tubes, S. Schreiber and W. Tulby, London.

*20th July*, 1894.

13,948. Clothes Jack for Coats, &c., M. Plessner, London.
13,949. Tobacco Pouches, J. T. Currie, London.
13,950. Sash Stop and Window Fastener, H. Swann, London.
13,951. Cutting or Stamping Press, W. H. Dorman, Stafford.
13,952. Bunch of Flowers Holder, A. J. Hall, Harrogate.
13,953. Artistic Photo Frame, A. P. Barnett, Birmingham.
13,954. Pressing and Curling Hats, G. Atherton, Manchester.
13,955. Hand Saw, G. Atherton and T. Gare, Manchester.
13,956. Tubes and Bobbins for Weaving, W. Jordaan, Manchester.
13,957. Fog Signal Firing Apparatus, R. W. Bell, Manchester.
13,958. Engine Reversing Gear, J. H. Mann and S. Charlesworth, Leeds.
13,959. Metallic Cots and Bedsteads, S. I. Whitfield, Birmingham.
13,960. Egg Tongs, D. Boarder, London.
13,961. Oil Lamps, G. N. Milward and H. H. Kirby, Birmingham.
13,962. Children's Mail-carts and Perambulators, W. Legge, London.
13,963. Hay-rake, &c., E. Scott.—(*Messrs. Chambers, Behring, Quinlaw, and Co., United States.*)
13,964. Windrow Hay Loader, E. Scott.—(*The Sandwich Manufacturing Company, United States.*)
13,965. Wafer, C. Williams, Portobello, N.B.
13,966. Horse Muzzle, J. McKenny, Dublin.
13,967. Surgical Bandages and Pads, W. Browne, jun, Tyrone.
13,968. Oars, S. Fyfe, Glasgow.
13,969. Wheels of Cars and Carriages, G. Johnston, Glasgow.
13,970. Preparing Clay for Flower-pots, W. Johnson, Leeds.
13,971. Inkstands, W. E. Kerslake, Liverpool.
13,972. Penholders, Pencils, &c., W. E. Kerslake, Liverpool.
13 973. Locking Railway Carriage Doors, C. R. Honiball, Liverpool.
13,974. Ejector Guns and Rifles, J. B. Fenby, Bromwich.
13,975. Lap Machines, W. Frost, Manchester.
13,976. Step for Railway Carriages, W. Keach, jun., Chichester.
13,977. Oil Distributor for Rough Seas, J. Davies, Swansea.
13,978. Toy Hoops, C. Lea, Birmingham.
13,979. Metal Rims, G. D. R. and A. Bunting and A. MacDonald, Sheffield.
13,980. Fastenings for Wearing Apparel, T. W. Broughton, London.
13,981. Fly Trap, W. Thomas, London.
13,982. Composition for Waterproofing, E. J. Knowlton, London.
13,983. Driving Air Propellers, &c., J. Waddington, London.
13,984. Mechanical Stoking Apparatus, J. Hodgkinson, London.
13,985. Side Saddles, W. M. Bywater, London.
13,986. Exhibiting Advertisements, W. Pilkington, London.
13,987. Means for Locking Handcuffs, W. E. Leverett, London.
13,988. Motive-power Engines, W. Fletcher, London.
13,989. Tickets for Marking Goods, G. B. Baughan, London.
13,990. Appliance for Holding Dresses, E. Harvey, London.
13,991. Window Sashes, W. Gibbin, jun., London.
13,992. Barb Button, H. J. Chatwin, Staffordshire.
13,993. Electric Light Regulator, A. H. Johnston, London.
13,994. Capstans or Winches W. Elliot and W. Garrood, London.
13,995. Electric Railways, W. P. Thompson.—(*J. F. McLaughlin, United States*)
13,996. Apparatus for Aerostation, W. P. Thompson.—(*R. de Palacios and W. Goetjes, Germany.*)
13,997. Mud-guards for Cycles, W. Bransom, London.
13,998. Collar Studs, Solitaires, &c., T. R. Thomas, London.
13,999. Apparatus for Making Ice Creams, H. Lane and J. Pullman, London.
14,000. Machinery for Colour Printing, C. A. Beeby, London.
14,001. Ensuring Safety on Single Lines, E. Tyer, London.
14,002. Gas Motor Cars, H. P. Holt, London.
14,003. Feed Troughs, J. G. Davis, London.
14,004. Decorative Window Screen, J. Barrett, London.
14,005. Washing or Mixing Apparatus, A. L. Gelinek, London.
14,006. Manufacture of Glass, G. Bamberg, London.
14,007. Ventilator for Railway Carriages, L. B. Peters, London.
14,008. Railway Chairs, C. Chenu, London.
14,009. Pedals for Cycles, L. Barrow, London.
14,010. Revolvers, L. Nagant, London.
14,011. Obtaining Infusions of Hops, E. Weymar, London.
14,012. Tanning, J. Y. Johnson.—(*F. Kornacher and the firm of Diesel and Weise, Germany.*)
14 013. Cutting or Threading Screws, H. Luckman, Birmingham.
14,014. Condensing Towers, E. J. Barbier, London.
14,015. Treatment of Potable Waters, H. J. N. Bergé, London.

*21st July*, 1894.

14,016. Hub for Wheels of Cycles, S. Johnson, London.
14,017. Working Corking Machines, E. W. Jenkins, Swansea.
14,018. Imitation Stained Glass, J. F. Russell, London.
14,019. Convertible Mail Carts, T. F. Simmons, London.
14,020. Boilers for Consuming Smoke, J. Bloor and A. Welburn, Birmingham.
14,021. Appliances for Measuring Cloth, T. Crowther, Bradford.
14,022. Receptacles for Carbonated Beverages, T. and D. Rylands, London.
14,023. Fire-extinguishers, D. Laffan, Dublin.
14,024. An Improved Candlestick, L. E. Mannings, Bristol.
14,025. Eye-glass Frames, E. Brown and S. Brown, Birmingham.
14,026. A Combined Horseshoe and Pad, J. Money, Renfrew.
14,027. Window Sash Fasteners, H. A Dawson, Lancashire.
14 028. Accelerating the Speed of Steamships, D. Doyle, Cork.
14,029. Prepayment Mechanism Application to Gas, S. Simpson, Mansfield.
14,030. Winding Yarns, C. W. Hollis and Claringburn and Co., Nottingham.
14,031. Manufacture of Socks, A. L. Woodward, Nottingham.
14,032. Hat and Cap Attachments, W. M. Harris, Birmingham.
14,033. Envelope for Book Packets, A. Guye, Surrey.
14,034. Device for Taking Personal Measurements, W. P. Thompson.—(*E. von Lange, Germany*)
14,035. Bicycle Sulkies, F. S. Stoddard and J. Nottingham, Liverpool.
14,336. Manufacture of Wool, T. Seddon and C. Long, London.
14,037. An Improved Toy, R Field, Huddersfield.
14,038. Bicycles and other Velocipedes, G. Pinnington, Chester.
14,039. Bodkins, A. W. Summers, Manchester.
14,040. Fastening for Trousers, H. Goldman, Manchester.
14,041. Storage Box for Photographic Negatives, J. B. Brooks, Birmingham.
14,042. Lamps, G. Wooliscroft and H. Garland, Cheshire.
14,043. Device for Securing Ladies' Hats, H. Sampson, Uxbridge.
14,044. Torpedoes, R. Parry, Holyhead.
14,045. Reducing the Resistance of the Water on the Hulls of Vessels, T. Blackett, Newcastle-on Tyne.
14,046. Shaft Bearings, G. V. Maxted and F. Knott, London.
14,047. Cycle Pedals, H. Lucas, London.
14,048. Boots and Shoes, W. Pulman, Manchester.
14,049. Bicycles, &c., G. Gilbert and E. Mushing, Birmingham.
14,050. Cultivator, G. L. Whiting, London.
14,051. Horse Collars, D. K. Bill, London.
14,052. Public Baths, W. Harpur, Cardiff.
14 053. Tobacco Pipe, J. J. McGhee, London.
14,054. Furnaces for Producing Cyanide of Ammonia, W. Schulte and F. A. Sapp, London.
14,055. Hand-propelled Velocipedes, M. Naletoff, London.
14,056. Manufacture of Azo-colouring Matters, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Bruning, Germany.*)
14 057. Buckle and Ring for Braces, F. Williamson, London.
14,058. Dry Seats in Wet Weather, F. Wilson, Manchester.
14,059. Attaching Blinds to Rollers, R. E. Ware, London.
14,060. Golf Clubs, A. H. Scott, London.
14,061. Tubing for Conveyance of Grain, F. E. Duckham, London.
14,062. Projectiles for Ordnance, T. Turner, London.
14,063. Reservoir Pens, W. Moyle and J. T. Aitkenhead, London.
14,064. Fuse Head for Blasting, T., W. A. and S. R. Malson, and E. Smith, London.
14,065. Fuse Head for Blasting, W. A., T. and S. R. Malson, and E. Smith, London.
14,066. Writing Slates, A. Haynes and S. Turton, London.
14,067. Apparatus for Mixing Liquids, E. J. B. P. Jodelay and M. J. E. Laurans, London.
14,068. Combustible Composition, R. Odeyn, London.
14,069. Electrical Governors for Water-wheels, C. S. English, London.
14,070. Tacheometrical Instruments, W. H. Beck.—(*J. Donnan, India*)
14,071. Steam Boilers, T. Taylor, London.
14,072. Steam Boilers, T. Taylor, London.
14 073. Steam Boilers, T. Taylor, London.
14,074. Apparatus for Removing Scale from Fire-tubes, H. Baschy, London.
14,075. Time Recorders, J. Dey, London.
14,076. Pipe Wrench, B. A. Hjorth and F. H. Getzmann, London.
14,077. Apparatus for Washing Bottles, W. Beetham, London.
14 078. Manufacture of Metal Bars, A. F. E. Dupont, London.
14,079. Matches, W. Hertz, London.
14,080. Incandescent Electric Lamps, G. F. Redfern.—(*C. Schwabe, Germany.*)
14,081. Fireproof Ceilings and Floors, F. A. P. Stolte, London.
14,082. Apparatus for Measuring Distances, H. Underdown and W. Beeston, London.

*23rd July*, 1894.

14,083. Guide for Rotary Cutters, J. W. Urquhart, Leicester.
14,084. Boxes, Packet Shapes, &c., G. Gibbons, Leicester.
14,085. Plough for Planting Potatoes, S. Watts, Frome.
14,086. Paraffin Boiler, F. W. Beck, East Grinstead.
14,087. Securing Gas and Lamp Globes, J. Allpass, Manchester.
14,088. Safety Appliance for Pit Cages, G. Archer and A. D. Mitton, Nottingham.
14,089. Buckles, J. Walker, Birmingham.
14,090. Furnace Fire Bars, T. Woodward, Nottingham.
14,091. Horse Collars, F. Cook, Glasgow.
14,092. Dyeing and Treating Yarns, F. Barraclough, Yeadon.
14,093. Carts, &c., J. Walmsley and J. Smith, Blackburn.
14,094. Interlining for Coats, &c., W. H. Sladdin, Brighouse.
14,095. Cork Extractors, L. W. Sutcliffe, Manchester.
14,096. Pick and Pick Motion for Looms, J. Sheldon, J. Murray, and W. Smith and Brothers, Limited, Manchester.
14,097. Harness Collars, C. H. Guest and J. Greenall, Leeds.
14,098. Skirt Holder or Suspender, C. H. Hart, Eastbourne.
14,099. Steam Engines, A. Burgess, Coalbrookdale.
14,100. Storage Chest, J. Hatfield and J. Marshall, Hull.
14,101. Tool for Extracting Screw-studs, W. Earl, Newcastle-on-Tyne.
14,102. Golf Putters and Cleeks, W. Lowe and T. Eddleston, Buxton.
14,103. Safety Apparatus for Ropes, H. J. Laybourne, Cardiff.
14,104. Invalids' Bed-gown, M. Byers, London.
14,105. Securing the Keys of Railway Lines, F. Drake and T. H. Aggett, Teignmouth.
14,106. Fastening for Boots and Shoes, T. Hayward, Shropshire.
14,107. Compound Automatic Machine, S. Bryan, Cardiff.
14,108. Driving Gear for Cycles, C. B. Lawson, Glasgow.
14,109. Railway Ticket, C. Stange, Glasgow.

14,110. Steam Water Outlet Appliance, A. Flachsmann, Cologne.
14.111. Dust Protector for Gas Lamps, N. Berlin, jun., Cologne.
14,112. Tires, C. Challiner, Manchester.
14,113. Electrical Energy Meter, A. G. Cooper, London.
14,114. Pumps, F. Edwards. London.
14,115. Sealed Sack and Water Mystery, J. Bracken, Oldham.
14,116. Preventing Smoke in Furnaces, S. A Johnson, London.
14,117. Mechanical Toys' Mechanism, G. F. Lutticke, London.
14,118. Supply of Mechanical Toys, G. F. Lutticke, London.
14,119. Coating the Soles of Boots, &c., E. Hitzel, London.
14,120. Brace or Suspender Fittings, A. Breese, London.
14,121. Changing Photo Films, A. C. and A. A. Smith, London.
14,122. Prepayment Gas Meters, J. Tourtel, London.
14,123. Fixing Electric Bells, W. P. Theermann and G. C. Elliott, Manchester.
14,124. Safes, Cash and Jewel Boxes, A. A. Crozier, London.
14,125. Bottles, J. H. Valentine, London.
14,126. Screw Driver, E. G. Brewer.—(*Messrs. Solomons and Benson, South Africa*.)
14,127. Rotary Engines, J. H. Adamson, London.
14,128. Apparatus for Churning Butter, S. Cheeld, London.
14,129. Churning Butter and Testing Milk, S. Cheeld, London.
14,130. Life-saving Appliance for Boats, W. von Rüdiger, London.
14,131. Gas or Oil Motors, E. T. Owen, London.
14,132. Velvets and Velveteens, G. H. Smith and B. Cooper, Manchester.
14 133. Interceptor Traps for Sewers, J. Barron, London.
14,134. 1 . 4 . 6 and 1 . 4 . 7 α-naphtholdisulphonic Acids, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
14,135. α-naphtholmonosulphonic Acids 1 . 4, O Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
14,136. Printing on Paper or Fabrics, W. Mather, London.
14,137. Colouring Matters, J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, London.
14,138. Extraction of Eucalyptol, L. R. Scammell, London.
14,139. Spring Eye-glasses, E. Edwards.—(*M. Seiffert, Germany.*)
14,140. Controlling the Admission of Persons into Houses, E. Edwards.—(*M. Hecht, Germany.*)
14,141. Brakes, E. Edwards. —(*A. Klietsch and L. Hoffmann, Germany.*)
14,142. Turning-over Leaves of Music, B. Weedon, London.
14,143. Valves for Pneumatic Tires, C. E. Hüttemeier, London.
14,144. Nozzle for Fire Buckets, C. L. Wilkin, London.
14,145. Construction of Ceilings, &c., J. F. Golding, London.
14,146. Reticulated Metal Work, J. F. Golding, London.
14,147. Construction of Partitions, J. F. Golding, London.
14,148. Cooking Appliances, F. Giles, London.
14,149. Mouldings, F. Stengel, sen., and C. Müller, London.
14,150. Steam Jet Blowers, W. H. Wheatley.—(*A. F. Carman, United States*.)
14,151. Transparent Advertising Tablet, H. S. Fearon, London.
14,152. Bagatelles, A. Brandelet, London.
14,153. Spring Fastener for Gloves, &c., E. Fisher, London.
14.154. Sulpho-cyanides, G. S. Albright and J. J. Hood, London.
14,155. Extracting Metals, J. J. Hood, London.
14,156. Electrical Wagons, O. W. Ketchum, London.
14,157. Fasteners for Sash Windows, W. A. Walpole, London.
14,158. Water Motors, C. C. Leathers, London.
14,159. Extinguishing of Lamps, H. Quaadt, London.
14,160. Clocks, J. Cohen, London.
14,161. Photographing in Colours, J. Joly, London.
14,162. Boiling Starch, J. Hibbert and E. Roberts, Manchester.
14,163. Cycle Frames, C. W. Brown, London.
14,164. Valves Suitable for Pneumatic Tires, H. Hadden, London.
14,165. Boiling Size, J. Hibbert and E. Roberts, Manchester.
14,166. Shuttle-throwing Devices, G. Schwabe, London.

*24th July*, 1894.

14,167. Fish-plates, J. Chaloner and G. Hibbert, Chapel-en-le-Frith, Derbyshire.
14,168. Angle Measuring Instrument, J. W. Shepard, Southampton.
14,169. Whisking or Churning Devices, R. Wood, Glasgow.
14,170. Connecting the Hubs of Wheels, R. Timson, Leicester.
14,171. Tripod Camera Stands, E. Greenhalgh, Manchester.
14,172. Ball Casters, H. Maudsley and F. Painter, Accrington.
14 173. Exhaust Steam-pipe Condenser, R. B. Rigby, Widnes.
14,174. Measuring Small Strains, J. A. Ewing, Cambridge.
14,175. Ring Watch Guardian, C. Alexander, Manchester.
14,176. Fluid for Lithographic Printing, W. Lunn, Birmingham.
14,177. Artificial Baits, S. Allcock, Redditch.
14,178. Flushing Cisterns, T. Atkins, Wolverhampton.
14,179. Baking Powder, G. Weddell, Newcastle-upon-Tyne.
14,180. Anti-frictional Bearings, H. P. Hoghton, Manchester.
14,181. Packing for Stuffing-boxes, W. Watson, Glasgow.
14,182. Salt-sprinkling Vessel, M. Spieldiener, Liverpool.
14,183. Self-sealing Vessels, J. Raab and F. Bingler, Manchester.
14,184. Liquid Heating Apparatus, F. Kleemann, Manchester.
14,185. Blast Furnaces, R. T. Howard and J. Collier, Bolton.
14,186. Propelling Bicycles and Tricycles, J. Hamilton, Loughborough.
14,187. Pulleys or Drums for Preventing the Slipping of Driving Belts or Ropes, J. H. Sunderland, Rochdale.
14,188. Connecting Pipes or Tubes, J. Mills, Manchester.
14,189. Cloth Measuring Indicator, J. H. Cunliffe and G. Hoyle, Rochdale.
14,190. Drawing Boards and Sketching Appliances, R. H. Bentham, Preston.
14,191. Blower for Driving Cycles, S. H. Robinson-Baker, Charleville, Co. Cork.
14.192. Separating Mixed Gases, W. P. Thompson, Liverpool.
14,193. Printing and Dyeing Calico, E. B. Manby, Manchester.
14,194. Guard for Food, E. Lightowler, Southport.
14,195. Sowing Artificial Manures, W. Davidson, Glasgow.
14,196. Coke Ovens, A. D. Shrewsbury, Glasgow.
14,197. Pads for Rupture Trusses, A. G. Wing, Weston-super-Mare.
14,198. Plating of Saddle Trees, R. Flemming, London.
14,199. Eye for Fixing Stair-rods, G. Y. Iliffe, Birmingham.
14,200. Children's Savings Banks, M. Cole, London.
14,201. Grass Mowing Machines, G. Kearsley, E. King, and W. Shepherd, Sheffield.
14,202. Signalling, H. D. Fitzpatrick.—(*The Boughton Telephotos Company, United States*.)
14,203. Letter and Bill Files, W. O. Gottwals, Ottawa.
14.204. Couplings for Vehicles, A. Fürst and J. Wellner, London.
14,205. Cigarette Holders, A. J. Boult.—(*H. Müller, Germany.*)
14,206. Covers for Typewriters, J. C. W. Stanley and W. W. Hughes, London.
14 207. Boxes, J. C. W. Stanley and W. W. Hughes, London.
14,208. Spinning Machines, C. B. Holland and J. Fraser, London.
14,209. Stocking, H. Wildt, London.
14,210. Drying Cement, W. W. Hughes, London.
14.211. Treadles for Velocipedes, G. A. Jeffery, London.
14 212. Printed and Painted Fabrics, F. Boyer, London.
14,213. Watches, J. G. Sanders, Edmonton.
14 214. Cloth Caps, E. Hope, Manchester.
14,215. Rectifying Sulphuric Acid, J. W. Scott, London.
14,216. Steam Boiler Furnaces, W. and R. Woodward, Manchester.
14,217. Coin-controlled Machines, H. H. Lake.—(*J. P. Tirrell and J. W. Willard, United States*.)
14,218. Coin-controlled Machines, H. H Lake.—(*J. P. Tirrell and J. W. Willard, United States*.)
14,219. Labelling of Bottles, G., J. G., and M. O. Rehfuss, London.
14,220. Lasting Machines, H. H. Lake.—(*C. S. Luitwieler, United States.*)
14,221. Bottles and Stoppers, L. Kalling, London.
14,222. Buffing of Boot Soles, H. H. Lake.—(*A. W. Rogers and S. W. Winslow, United States*.)
14,223. Dyeing Fibre, H. H. Lake.—(*M. E. Waldstein, A. H. Peter, and E. Spott, United States.*)
14 224. Making Photographic Negatives, B. McF. Clinedinst, jun., London.
14,225. Overhead Sewing Machines, W. Webster, London.
14,226 Fire Ranges, C. Hattersley, London.
14,227. Sausage-filling Machines, F. J. Gardner, London.
14.228. Manufacturing Carbonic Acid, &c., E. W. Enequist, London.
14,229. Photographic Apparatus, G. G. Hardy, London.
14,230. Mechanism of Sewing Machines, J. White, London.
14,231. Sewing Machine Spool-holders, J. White, London.
14,232. Deadening Noise in Motors, F. L. Serment, London.
14,233. Machine Gun and Carriage, W. H. FitzGerald, London.
14,234. Lamps for Public Lighting Purposes, A. Dessy, London.
14,235. Syphons, R. Thayer, London.
14,236 Car Brake Systems, H. A. Clark, London.
14,237. Cash Registers, A. H. Miller, London.
14,238. Apparatus for Flattening Rice, E. S. Spencer, London.
14,239. Mattresses, E. Edwards. — (*I. Abrahamsen, Denmark.*)
14,240. Waking Persons Electrically, W. Wilke, London.
14,241. Diary, E. J. Harvey, Beckenham.
14,242. Valves, &c., J. T. Marshall and R. Wigram, London.
14,243. Steam Jet Apparatus, C. F. Kierzkowski-Steuart, London.
14,244. Plumbing Seals, B. von Possanner-Ehrenthal, London.
14,245. Brake-blocks, A. Köberling and H. Höhrmann, London.
14.246. System of Electrical Distribution, C. F. Scott, London.
14,247. Portable Case of Shelves, A. S. Tomkins, London.
14,248. Controlling Sale of Tickets, J. Olsen and J. Craig, London.
14,249. Camphor, A. M. A. F. E. van Dyck, London.
14,250. Wax Thread Sewing Machines, H. F. Nason, London.
14.251. Sash Fasteners, A. J. Ball and J. de Courcy Hickton, London.
14,252. Gun-carriages, W. B. Gordon and T. R. Morgan, sen., London.

*25th July*, 1894.

14 253. Detachable Handle for Paint-pots, C. Cox, London.
14,254. Bandage, G. Palme, London.
14,255. Dust Excluder for Doors, &c., J. Hayward, Sussex.
14,256. Bell, C. J. Vincent, Truro.
14,257. Swimming Appliances, W. Snaydon, Dorchester.
14,258. Can-openers, A. Clowes, Birmingham.
14,259 Self-feeder for Chaff-cutters, J. Osborn, St. Neots.
14,260. Game, H. O. Roberts, Gloucester.
14,261. Bolsters or Holders for Spindles, E. Hitchon, Accrington.
14 262. Device for Retaining Stockings, A. J. Heys, Manchester.
14,263. Joining the Rims of Cycles, E. C. Wasdell, Birmingham.
14,264. Hair Curlers, H. H. Pearce, Birmingham.
14,265. Machines for Heading Nails, H. W. Tonks, Birmingham.
14,266. Fastening Pneumatic Tire Coverings, J. Parr, Leicester.
14,267. Self-heating Smoothing Iron, T. T. Tuttle, London.
14,268. Carving-fork Guards, J. E. Bingham and A. B. Ball, Sheffield.
14,269. Bicycle Lamp, S. G. Watson, Birmingham.
14,270. Extracting Corks from Bottles, J. F. M. Pollock and W. Leach, Leeds.
14,271. Securing Table Cutlery Handles, T. S. Fenton, Sheffield.
14,272. Rolling Wires, Bars, &c., G. Goldthorpe, Halifax.
14,273. Securing Door Knobs, J. T. Stanyon, Chertsey.
14,274. Winding Cotton, J. Haydock, jun, and J. Haydock, Glasgow.
14,275. Scouring Slivers of Fibrous Material, J. Rhodes, jun., Bradford.
14,276. Weaving Shuttles, J. Waddington, Bradford.
14,277. Shutter for Photographic Cameras, D. Morgan, Bristol.
14,278. Cinder Sifters, J. Stranaghan, Manchester.
14.279. Focussing in Optical Lanterns, W. Lawson, Manchester.
14,280. Brackets for Blinds, R. Pill and T. Pill, Manchester.
14,281. Focussing Appliance for Photographic Cameras, E. G. B. Barlow, Glasgow.
14,282. Chains, H. Schlieper, jun., London.
14,283. Holding the Cords of Venetian Blinds, J. F. Williams, Cheshire.
14,284. Distributing Oil from Ships' Sides, D. J. Jenkins and S. Carey, Dartmouth.
14,285. Strainers for Tea-pots, A. G. Hewitt, Birmingham.
14,286. Machines for Making Envelopes, J. Ball, Manchester.
14,287. Wire Weaving Power Looms, J. Telford, Manchester.
14,288. Game, A. W. Treen, London.
14,289. Device for Holding Knives while Cleaning, E. J. Hallam, London.
14 290. Electrical Lamp Holders, G. Binswanger, London.
14,291. Applying Heat to the Human Body, W. S. Hedley, Brighton.
14,292. Pneumatic Tires for Velocipedes, J. Litherland, London.
14 293. Anti-Germanite Tablet, F. G. Hargan, London.
14,294. Controlling the Consumption of Gas, A. Whittall, Birmingham.
14 295. Rustic Wood Arbours, G. Bayliss and A. Inman, Birmingham.
14,296. Filing Nails in the Heels of Boots, J. Lee, London.
14,297. Obtaining Combustion in Furnaces, W. Esplen, Liverpool.
14,298. Mudguard for Cycles, R. M. Crabbe, Liverpool.
14,299. Thick Soft Absorbent Cloth, W. Pickstone and A. Greenhalgh, Manchester.
14,300. Valves for Pneumatic Tires, W. P. Thompson.—(*A. Knuss and M. Härter, Germany*.)
14,301. Lamps, J. S. Byrne and J. T. Steele, Liverpool.
14,302. Buckles or Clasps for Braces, A. W. Patching, Manchester.
14,303. Electricity Motor Meter, C. Raab, Liverpool.
14 304. Flour Manufacture, T. T. Vernon, Liverpool.
14,305. Cases for Oil Heaters, J. Harper and Co., Ld., and C Retallack, London.
14,306. Galvanising Metal Sheets, Davies Brothers and Co., Ld., E. A. Davies, and S. T. Thomas, London.
14.307. Fancy Sealing Wax, E. G. Smith and E. A. Still, London.

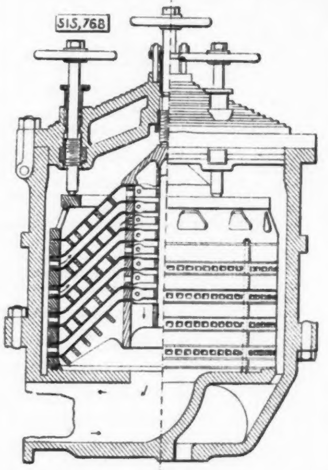
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**516,768.** Breech Mechanism for Ordnance, *O. F. Leibert, Bethlehem, Pa.—Filed November* 1st, 1893.

*Brief*—The breech plug has a curved and a straight rack upon it which are engaged by a compound operating wheel provided with teeth having worm faces and spur or pinion faces.

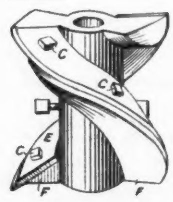
515,768



**516,776.** Wood-working Machine, *J. H. Soars, Muncy, Pa.—Filed July* 1st, 1893.

*Claim.*—In a cutter head for wood-working machines the combination of a solid lip F, having on its top or upper side placed at a suitable angle a plane or flat surface from the body of the head to its outer edge, being spiral lengthwise and radial in any plane of cross section, and milled out on the bottom or under side in a spoon shape forming a clip breaker, with an adjustable flat curved knife E spiral longitudinally and running radially to the head viewed in any particular plane of cross section and made to conform to and fit closely on the top of the lip F, beveled backwardly on its top or upper side, having slots G therein for adjusting the knife on the lip F, and fastened thereon by the use of knife bolts C, passing through the slots G into the lip F ; all substantially as described.

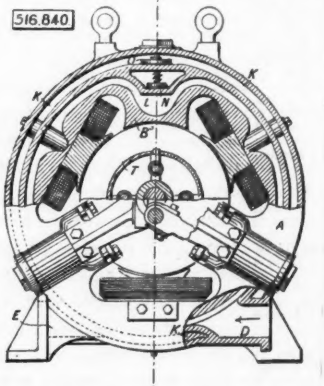
516,776.



**516,840.** Electrically-operating Pump, *C. Robinson, Lynn, Boston, Mass.—Filed October* 11*th*, 1893.

*Claim.*—(1) The combination of an electric motor driving a pumping apparatus, the casing of which forms a part of the magnetic circuit of the motor, such casing being provided with channels and valve mechanisms adapted to assist the circulation of the fluid from the pump. (2) The combination of a casing having interior and exterior channels, field magnets of an electric motor connected by such casing and having field magnet cores projecting through the channels, an armature for such motor, and pumping mechanism operated thereby ; whereby the circulation of the fluid through the casing acts to cool the field magnets of the motor and increase the efficiency. (3) The combination of a casing forming a magnetic yoke, field magnets of an electric motor connected thereby, and a rotating armature driving pumping mechanism adapted to force water or other fluid through the casing, such casing being formed with interior and exterior channels, and with consequent pole pieces, as $B^3$, between the field magnets, all as described and set out herein. (4) The combination of a casing, as A, provided with an intake, as D, an interior channel, as L, valve mechanisms, as N O, an exterior channel, as K, an exit, as E, reciprocating pistons, as F F, a revolving armature, as T, field magnets secured to the casing and having their cores projecting through the channels therein, and consequent poles, as $B^3$, formed in the casing and having one of the channels arranged to circulate the fluid through them, all arranged substantially as herein set out and described.

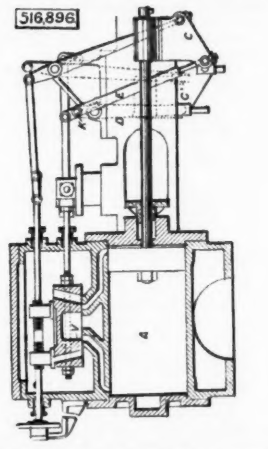
516.840



**516,896.** Valve Gear for Duplex Direct-acting Engines, *H. W. Morley, Bradford, and T. Holehouse, Chorlton-cum-Hardy, England.—Filed June* 22*nd*, 1893.

*Claim.*—(1) In a duplex direct-acting engine, the combination of oscillating levers D and E, actuated by the crossheads C and C' respectively, the lever E oscillating on a movable stud K, controlled by the lever D for the purpose of regulating and controlling the admission valve V of the cylinder A, all arranged substantially in the manner as shown and described. (2) In a duplex direct-acting engine, wherein the valve gear for regulating and controlling the valves V and V', consists of operating levers E and E', actuated by piston-rods B and B' respectively, and fulcrumed on movable studs K and K', the position of which said studs is controlled by levers D and D', respectively actuated from the contrary piston-rods B' and B, the combination therewith, of variable cut-off valves actuated from their respective piston-rods, substantially as described. (3) In a duplex direct-acting engine, the oscillating levers D and E actuated by crossheads C and C' respectively, the lever E oscillating on a movable stud K controlled by the lever D for controlling the admission valve V of the cylinder A, valves V V actuating levers therefor and means for varying the movement of said valves, substantially as described. (4) In a duplex direct-acting engine, wherein the valve gear for regulating and controlling the valves V and V', consists of operating levers E and E' actuated by piston-rods B and B' respectively, and fulcrumed on movable studs K and K', the position of which said studs is controlled by levers D and D', respectively actuated from the contrary piston-rods B' and B, the combination therewith of slotted crossheads C and C', fitted with movable blocks for the purpose of varying the ratio of the levers D and D', and E and E', all arranged substantially in the manner as shown and described. (5) In a duplex direct-acting engine, the oscillating levers D and E actuated by the cross-heads C and C' respectively, the lever E oscillating on a movable stud K controlled by the lever D the valve V and controlling lever F and a connection between the valve V and operating levers providing for a slack action, substantially as described. (6) In combination with the oscillating levers D and E actuated by the crossheads C and C' respectively, the valve rod F and valve V, and means for moving the fulcrum of lever D horizontally against spring pressure, substantially as described.

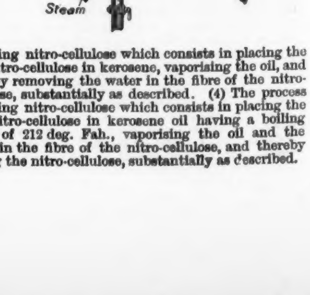
516,896



**516,924.** Process of Drying Nitro-cellulose. *F. G. Du Pont, Wilmington, Del.—Filed June* 15*th*, 1893.

*Claim.*—(1) The process of drying nitro-cellulose which consists in placing the wet nitro-cellulose in a volatile oil, vaporising the oil, and thereby removing the water in the fibre of the nitro-cellulose, substantially as described. (2) The process of drying nitro-cellulose which consists in placing the wet nitro-cellulose in a hydrocarbon oil, vaporising the oil, and thereby removing the water in the fibre of the nitro-cellulose, substantially as described. (3) The process of drying nitro-cellulose which consists in placing the wet nitro-cellulose in kerosene, vaporising the oil, and thereby removing the water in the fibre of the nitro-cellulose, substantially as described. (4) The process of drying nitro-cellulose which consists in placing the wet nitro-cellulose in kerosene oil having a boiling point of 212 deg. Fah., vaporising the oil and the water in the fibre of the nitro-cellulose, and thereby drying the nitro-cellulose, substantially as described.

516,924



## NOTES ON THE STRENGTH OF FRAMED STRUCTURES AS AFFECTED BY ELASTICITY.

By C. F. Findlay, M.A., M. Inst. C.E.

In the design of girders and other framed structures, it is customary to ignore altogether the elastic properties of the material, except in cases such as that of the continuous girder, where no solution can be obtained of the question of the distribution of stress, without considering those properties. In England and America there is also a prejudice amongst engineers against the adoption of such designs as do not admit of the direct application of statical rules without reference to elasticity. This prejudice appears to be diminishing, and the fact of its diminution may be attributed largely to the example of continental practice where metallic arches and continuous girders have been built for large spans in great numbers, their strength being calculated with perfect confidence. Experience has justified that confidence as fully in regard to those structures as in regard to simple trusses.

In point of fact, there is no such broad line to be drawn between one class of frames and the other as is supposed by those who simply design by formulæ, without inquiring how the formulæ are arrived at. The ordinary statical rules by which force applied at a point is balanced by stresses along various bars, which stresses, at the intersections with other bars, are again resolved in various directions, pre-suppose elastic properties in the various links. Just as force is an abstract conception that we have invented to assist our ideas in connection with the motion of bodies, so stress which we talk about as if it had a real existence outside our own minds, is only a conception we have formed in connection with the visible strain of bodies. The existence of stress in a body without strain is rather unthinkable than impossible.

These statements may possibly be regarded as mere truisms, but there is an important practical conclusion to be drawn from them, viz., that it may be worth while to examine the magnitude of the errors introduced by the various hypotheses made in order to simplify the calculation of the strength of frames to the point where the elastic properties need not be taken into account. We do not propose in these notes to enter into the general question of elastic theories as applied to arches, continuous girders, frames with redundant members, &c. This has already been done in many treatises—although the English language is deficient in this respect as compared with French and German. What we propose is to give an idea of some of the principal corrections that ought to be applied to calculations made by statical rules, and to show how a study of the elastic properties of frames may assist in the decision of questions relating to them, which are otherwise indeterminate. We shall give numerical calculations to illustrate the principles we may establish, so as to enable the reader to judge for himself how far the principles are of practical importance for purposes of design.

The assumptions tacitly made when the stresses in a frame are determined by statical rules may be broadly divided into three classes, as follows, viz.:—(1) That the frame consists of links united by frictionless hinges. (2) That the links are all perfectly straight and remain straight when strained, their axes* of figure meeting at one point for each joint. (3) That the external forces and reactions are known as to magnitude and direction, and are applied only at certain joints of the frame. This assumption in general implies that the frame is fixed at one point of support, that another of its points is free to move without resistance along a given line, and that otherwise the frame is free from constraint.

### Section I.—Secondary Stress.†

The stresses in framed structures with riveted joints are, in practice, calculated on the assumption that the joints are frictionless hinges. Calling the stresses so calculated the "primary stresses," the name "secondary" is usually given to the additional stresses arising from the invariability of the angles between the different members of the structure meeting at any joint, and we shall use the word in that sense. In most bridges there are stresses of the same nature, caused by the fact that the axes of figure of the various members meeting at any one joint do not intersect at one point; the stresses from this cause are so large sometimes as to be a serious danger,‡ but they are not included among the secondary stresses to be here considered. The fact that the secondary stresses—as above defined—in bridges are not as a rule calculated even in the most important structures, can only be explained by one of two reasons. Either they are supposed to be so small as to be negligible, or else to be beyond the range of calculation with ordinary skill and labour. We hope in the present articles to do something to dispel the latter impression. In regard to the former it may be sufficient to say that the secondary stress is very frequently in excess of the primary stress—in absolute amount—in some of the web members of a girder; the actual stress as compared with the primary stress being thus reversed on one edge of the member from tension to compression, or *vice versâ*, and on the other edge more than doubled in amount. In the booms the secondary stress rises to 25 per cent. of the primary stress in the case of a representative English bridge—referred to below—and may often be much more. The calculations giving these results are based on principles which are universally accepted; they are confirmed by the very valuable measurements made by M. Charles Rabut, on the bridges of the Chemins de Fer de l'Ouest in France, described in *Le Génie Civil*, vol. xxii., 1892, page 88, and of which a short summary is given in the foreign abstracts of the Proceedings of the Institution of Civil Engineers, vol. cxii., page 391. Not only are the secondary stresses of so large an amount that an approximate determination of them would be a considerable addition to our knowledge of the strength of structures; but also they vary to so great a degree from one bridge to another, according to the general and detail design adopted, that even where these stresses are not calculated a knowledge of the general laws which govern them may be a valuable aid in design.

The following two propositions embody the information necessary for determining secondary stresses in general.

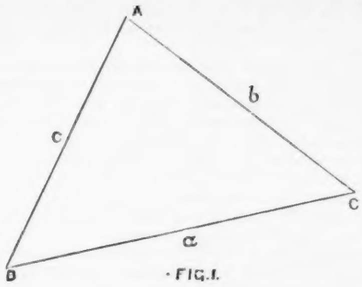


FIG. 1.

If the triangle A B C form part of a hinged framework in its unstrained state, and the angle A becomes A + Δ A by reason of the deformation of the triangle, then

$$E \times \Delta A = (t_a - t_b) \cot C + (t_a - t_c) \cot B \quad . \quad \text{(I.)}$$

where E is the modulus of elasticity (supposed uniform), and $t_a$ $t_b$ and $t_c$ are the stresses per unit of sectional area in *a b* and *c*, the area being reckoned without deduction for rivet holes. A stress is considered positive when tensional because it produces a positive increment of length in the link affected, and E is in the same units as $t_a$ $t_b$ and $t_c$ (say tons per square inch).

If any number of links whose axes of figure in the unstrained state are straight lines, O A, O B, O C, O D, &c., are united at O, so that the angles between them are invariable, and if $\theta_{12}$ be the increase which would take place in the angle A O B with frictionless hinges at all the joints, then

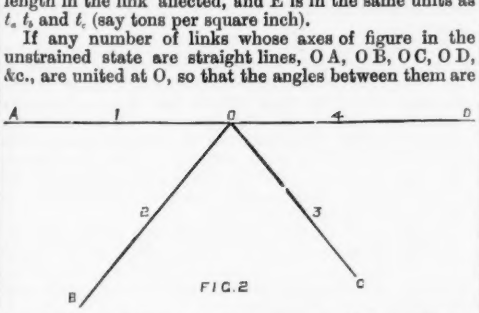


FIG. 2

$$6\,E \times \theta_{12} = \frac{l_1}{I_1}\,(2\,M^1_0 - M^1_A) - \frac{l_2}{I_2}\,(2\,M^2_0 - M^2_B) \quad \text{(II.)}$$

where $M^1_0$ denotes the bending moment at O in the link 1, and $M^1_A$ the bending moment at the other end of the same link, $l_1$ and $l_2$ the lengths of the links, $I_1$ and $I_2$ the moments of inertia of their cross-sections (supposed constant). For determining the signs of $\theta$ and M in equation (II.) rotation contrary to that of clock-hands is, as usual, considered positive. This equation ceases to be approximately true when the transverse dimensions of a link are very small compared to its length. The exception is of no practical importance, because in those cases the secondary stress is so small that we have no occasion to calculate it.

The proofs of these two propositions will be given in an appendix, and it will be seen that Equation (II.) is obtained on the assumption that $\frac{t\,l^2}{E\,\rho^2}$ is not large (say less than unity), $\rho$ being the radius of gyration of the cross-sectional area of any link whose length is $l$ and stress $t$. For instance, if $t = 4$ tons per square inch, and $E = 13{,}000$, the ratio $\frac{l}{\rho}$ should not exceed 55 to 60 in order that Equation (II.) may be applicable. Or, take the case of the American bridge referred to below. The vertical post 10 is 25ft. in length, and has $\rho =$ about 4in., so that $\frac{l}{\rho} = 75$, while $t$ is $1\frac{1}{2}$ tons per square inch, so that with wrought iron with E, about 11,000 tons, the fraction will be nearly $\frac{8}{11}$, and Equation (II.) will apply. For the eyebars in the same bridge, the values of M obtained by applying Equation (II.) although small, are very much larger than the true values.

If there are $n$ links meeting at O, we have $n - 1$ equations similar to (II.) and also the relation:

$$M^1_0 + M^2_0 + \&c. + M^n_0 = 0 \quad . \quad . \quad . \quad . \quad \text{(III.)}$$

Taking the whole frame, we have therefore as many equations as unknown quantities M. The left-hand side of Equation (II.) is given by (I.) without much labour, and $\frac{l}{I}$ can be easily calculated for each link. When this has been done the values of M could be at once written down as determinants. The evaluation of these determinants rigorously would in most cases, however, be a very formidable task, and we shall presently show how, for practical purposes, sufficiently approximate values can be obtained with no great amount of arithmetical computation. Before doing so we may call attention to a few results of importance flowing immediately from (I.) and (II.)

(1) The secondary stresses are independent of the modulus of elasticity (so long as the latter is uniform). This follows from the fact that Δ A enters into both equations in the form E × Δ A. The deformations, both linear and angular, are inversely proportional to E, but the bending moments caused by a given deformation being directly proportional to E are, when expressed in terms of the primary stresses, independent of E.

(2) The secondary stresses in any frame are a constant fraction of the primary stresses (and therefore proportional to the load), so long as the distribution of the load remains the same.

(3) The angular deformations at the joints are independent of the linear dimensions of the frame so long as the angles between the links are unaltered. Compare, for example, two parallel girders of the same span with horizontal booms and bracing at the same angles, the stresses per square inch employed being the same, but the depth of one girder being twice the depth of the other. The changes in the various angles will be the same in both girders, but the shallower girder will have a central deflection approximately double that of the deeper girder, owing to the greater number of joints. In Equation (II.) the left-hand side is the same for both girders, but on the right-hand side $l$ has for the shallower girder half the value it has for the deeper, which doubles all the values of M; and further, I will probably be greater in the shallower girder for all the boom members, because the stress is doubled, and this leads to a further increase in M. We thus see, in regard to secondary stress, the great advantage in using a deep girder. In fact, when a triangulated girder is very shallow, the ordinary calculations based on the assumption of hinged joints give an altogether false idea of the stresses in the girder, and the instinctive preference of engineers in such cases for a plate girder has thus a rational justification.

(4) The deformation to which the booms are subjected in parallel girders depends comparatively little on the nature and angles of the bracing, but mainly on the stresses in the booms and on the depth of the girder.

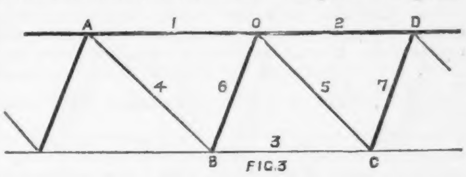


FIG. 3

Consider the girder of which A B C D represents a part. The angular deformation of the boom A O D at O is given by successively applying Equation (I.) to the three angles A O B, B O C, C O D. Now, in most cases the stresses in corresponding members of successive panels will not differ much from each other. Assume, then, that $t_1 = t_2$, $t_4 = t_5$, and $t_6 = t_7$. It will be found that $t_4 = t_5$, $t_6$ and $t_7$ disappear, and if $\theta_{12}$ be the angle between A O and O D under strain,

$$E\,\theta_{12} = (t_3 - t_1)\,(\cot\alpha + \cot\beta) = \frac{g}{p}\,(t_3 - t_1) \quad . \quad . \quad \text{(IV.)},$$

if $g$ be the length of the panel and $p$ the depth of the girder. In other words, the angular deflection of the girder per foot run of length is $\frac{t_3 - t_1}{E\,p}$. If $t_3$ and $t_1$ be constant throughout the girder, the angular deflection at the abutment of a span of length $2\,l$ is $\frac{l\,(t_3 - t_1)}{E\,p}$, and the linear deflection in the middle is approximately $\frac{l^2\,(t_3 - t_1)}{2\,E\,p}$, which is the same as the deflection obtained by the usual theory of flexure for a beam of the same span and of constant depth and flange stress, whereas for a beam of constant moment of inertia the deflection is five-sixths of the same quantity. The expression arrived at in Equation (IV.) above for the deformation of the boom does not apply to the middle of the span. The deformation of the flanges at the middle of the span will be greater than at any other point, and it may be said generally that the deformation of the flanges of any girder will be greatest at the point where the shearing stress changes sign, as, for instance, in a continuous girder at the supports.

(5) It is clear from equations (I.) and (II.) that the secondary stresses will vary very much from one member of a frame to another by reason of the great variations in the angular deformations $\theta$, and of the coefficients $\frac{l}{I}$. Considering Equation (I.), we observe that of the three quantities $t_a$, $t_b$, and $t_c$, two are always of the same sign, and the third of the contrary sign. Of the three angles A B and C—Fig. 1—that one will be in general most deformed by the strain which is included between the two links affected by stress of the same kind. Applying this to any of the triangles of the girder in Fig. 3, we see that the angles which suffer the greatest deformation are those made by the compression diagonal with the upper boom, and by the tension diagonal with the lower boom. The latter is of smaller importance, because the two links enclosing the angle being both in tension, they should be of small width, and will in that case have no large secondary stress. The former angle, being enclosed between two compression links, which must necessarily be of considerable width, gives rise to important stresses in the diagonals, and the arrangement adopted for the bracing may considerably affect these stresses. If it be desired to reduce as far as possible the deformation of the angle between the compression diagonal and the upper boom, this object will be obtained by placing the tension bars vertical, or nearly so. This may be seen by applying Equation I. to one of the triangles in Fig. 3, and making the value of $\theta$ a minimum, subject to the condition that the depth and panel length of the girder are constant, when it will be found that the minimum value is given by the relation—

$$\frac{\tan\alpha}{\tan\beta} = \frac{t_6 - t_1}{2\,t_3 - (t_6 + t_1)}$$

$t_1$ is usually greater numerically than $t_6$, and since $t_1$ and

---

* We use the term "axis of figure" for the line passing through the centres of gravity of the areas of all cross-sections of any link.

† A chapter is devoted to this subject in Winkler's "Vorträge uber Brückenbau;" but it is not dealt with in any English work with which we are acquainted. The method here given is different from Winkler's, though of course identical with it in principle.

‡ See report by Professor Ritter and Tetmajer on "The Moenchenstein Bridge Disaster"—The Engineer, December 4th and 11th, 1891.

$t_8$ are both negative, we see that tan $\beta$ is large, or that A B is nearly vertical. Other considerations, however, which are of greater importance prevent this arrangement of bracing from being adopted in practice, but in the Warren girder, consisting of equilateral triangles, it is approached. If such a girder be compared with another having vertical posts, and tension diagonals at 45 deg., the deformation of the angle between the posts and the upper boom is less in the former girder than in the latter in the ratio of 1 to 1·7, and if the sections used were the same, the secondary stress in the posts would vary in pretty much the same ratio.

(6) Where the frame is irregular, or the angles of the bracing vary from panel to panel, a graphic method of ascertaining deflections and other deformations may be preferred to arithmetical calculation, and Equation (I.) indicates a readily available graphic method, since it may be written in the form,

$$\Delta\ A = \left(\frac{\delta a}{a} - \frac{\delta b}{b}\right) \cot C + \left(\frac{\delta a}{a} - \frac{\delta c}{c}\right) \cot B,$$

where $\delta a$, $\delta b$, and $\delta c$ are the changes of length in the links. If, then, $\delta a$, $\delta b$, and $\delta c$ be magnified $m$ times, the result is to magnify $\Delta$ A $m$ times. Therefore, if, in a diagram of the frame, the lengths of all the lines be increased or diminished by quantities proportional in any constant ratio to the actual changes of length in the various members, the resulting diagram will give correctly the angular deformations multiplied by a factor depending on the scales used both for the diagram itself and for the alterations of length. The only proviso is that the proportional change in length of the lines in the diagram must be small. As $t$ is always known for each link, it is better to avoid introducing E in drawing such a diagram, and it is unnecessary because E is a common factor. Suppose, for instance, the diagram is drawn on a scale of 5ft. per inch, or $\frac{1}{60}$th, and that the scale of strains is chosen such that each line on the diagram becomes altered by $\frac{1}{200}$th part of its length for every ton per square inch of stress in the corresponding link; then $\Delta$ A$^1$, the increment of any angle A$^1$ in the diagram, is $\frac{E \times \Delta A}{200}$, where $\Delta$ A is the deformation of the actual angle in the frame. With the scales here suggested, the angular error (apart from errors of drawing) may have a maximum value of about 5 per cent. If a smaller scale were used for the strains, the errors of the method would be less, but the probable errors of drawing would increase. The diagram of deformation must be adjusted to the fixed points and fixed line of the frame, if it is desired to scale from it linear deformations (as, for instance, the central deflection). Fig. 4 is a simple case of such a diagram drawn to the scales suggested above. The truss is supposed to be fixed at A, and free to slide horizontally at B. The linear deformations of the truss can be scaled from the diagram to $\frac{E}{12{,}000}$ times their true value, where E is in tons per square inch, and the angular deformations to $\frac{E}{200}$ times their true value.

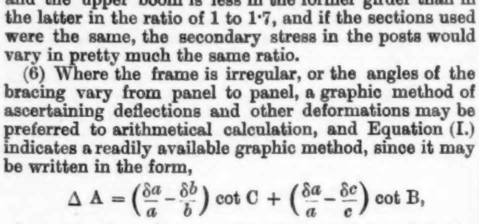


FIG. 4

(*To be continued.*)

## INSTITUTION OF MECHANICAL ENGINEERS.

In our report of the meeting at Manchester, published in our last impression, we gave an account of the proceedings down to Wednesday afternoon, but the two papers referred to as read on that day, with the discussions, we had to defer until to-day. The first of these papers was by Mr. Henry Barcroft, entitled, "Description of Twin Screw Propellers with Adjustable Immersion fitted on Canal Boats."

During the discussion on Mr. Barcroft's paper,

Captain Longridge said with regard to driving by gear wheels, it was objectionable where they ran at high speeds.

Mr. Robinson said he would like to know what led Mr. Barcroft to adopt the method of keeping the propeller only partially immersed. He thought the propellers were much too large for the work they had to do, and if they were put lower down greater efficiency would be obtained. Then with regard to the blades, why had the writer made them so broad, and was the pitch uniform or varying? There was also the question of "wash." It appeared to him that with a propeller working out of the water they would have more wash than when it worked under the water, and he could not see that the propellers situated as described would be less likely to get clogged with weeds. As to the application of electricity, he thought the number of transformations which would have to be gone through, from the dynamo to the motor, from the motor to all the gearing, would prevent the proper working of such a method.

Mr. Aspinall thought there should be an arrangement for taking up the thrust of the propellers.

Mr. Parker did not think the suggestion of the author as to electricity was a very good one.

Mr. Platt thought the method described in the paper was a very good one for applying to existing barges built in the ordinary way.

Dr. Edward Hopkinson was of opinion that the dynamo and motor suggested by the author might be successfully applied. A good way would be to apply, instead of the boiler and engine, a small motor with an overhead system of wires.

Mr. Head considered skew wheels quite unobjectionable when used in ordinary gearing, but when used to convey the whole power of the engine, they worked very unsatisfactorily.

Mr. Chas. Proctor said the injury done to the banks of the canals might be avoided in future by walling them in, so that no "wash" would do any harm. It might interest them to know that he and the late Mr. H. J. Martin had been engaged in trying to facilitate the traffic through the Midlands to the various ports, by having an engine which could easily be transferred from one boat to another.

Mr. B. A. Dobson said he had always taken a great interest in canal boats, and anything that tended to reduce the cost of haulage must be a great advantage. Mr. Barcroft had evidently tried to make the simplest arrangement that could be applied to existing canal boats, and he thought he had pretty well succeeded. As to the gearing which had been adversely criticised, he had found as a matter of practice that if they would keep worm gearing properly oiled it was about as good as anything they could possibly get to do the work. With regard to the propellers, it seemed to him that the slow surface speed at which they were run was admirably calculated for canal work; the wash would not be so great, and there would not be the objection to taking down the air as with an ordinary propeller. The question of the wash on the sides of the canal was most important, and he might mention a device he saw recently on a canal boat in France, by which the wash was entirely avoided. A shield was fixed just outside the propeller, and threw the water aft, so that it lost its speed before touching the banks.

Mr. Tweddale remarked that he had seen a similar shield in this country thirty-two years ago, which, in addition, was utilised for steering the boat; it worked very successfully at the trial, but he never heard of it afterwards.

Mr. Paul thought the fact stated in the paper, that the propeller, had little or no influence upon the steering of the vessel, necessarily involved the inefficiency of the propeller. Further than this, it had been universally found that when the top of the propeller approached even near the surface of the water its efficiency was materially decreased, and that if it actually broke the surface, there was a loss of 25 per cent. of efficiency, and he did not see how all this experience could be reversed by the system adopted by Mr. Barcroft.

Mr. Richards said it always appeared to him that the great desideratum was as far as possible to use a very fine pitch propeller, the result being that the flow of the water was directed aft, and this prevented the side wash which was so objectionable.

Mr. Stern referred to a system of propulsion on the Erie Canal in which a shield was placed round the propeller to break the wash.

Mr. Corley said the conditions for narrow canals were quite different from those met with on boats in open water. Canal engineers appeared to be very divergent in their views as to the best conditions of working.

Mr. Richmond referred to the delay in closing lock gates, which might cause damage to such a propeller as proposed.

Mr. Rogers said he had been making some propellers for electric launches on the Thames with very small pitch, and it had been found to answer admirably, there being little or no wash on the banks of the river. The principal advantages of the method he had adopted were the quick speed and very small pitch.

In replying upon the discussion,

Mr. Barcroft said the skew wheels used were very convenient, and the loss of power was not material. The total mileage run up to the present was 6000 miles, and 300 in waterways in Ireland. In passing through the locks there had been no accidents, and with regard to the waste of time in locking, he had once taken the time in going through the Grand Canal, and found it to be about 1½ minutes, so that the loss of time would not be very serious. The slip became greater in proportion to the narrowness of the canal, varying from 4 per cent. in one, to 68 per cent. in another, the waterway being in the latter case only very little larger than the section of the boat.

The President said he was doubtful whether the critics had quite realised the whole of the difficulties Mr. Barcroft had to encounter. It was one thing to design a marine engine for a ship, and another to design engines that should drive propellers for a barge, and only those specially engaged in the latter work could understand the difficulties lying in the way.

The Secretary next read a paper by Mr. Wm. Thos. Olive, describing the Manchester Main Drainage Works, in connection with which he is the resident engineer.

The reading of the paper was followed by a short discussion, during which

Mr. Charles Hopkinson said the author had forgotten to mention that the attention of the Manchester Corporation was called to the flood question in the fifties, and by 1872 a large amount of money had been spent in building substantial river walls along the banks of the river Medlock. The most serious flood on the rivers in Manchester was that of 1866, on the Irwell, and it was this flood that stimulated—more than any other—the action which had since been taken. He wondered why, with an indefinite quantity of condensing water, the engines described in the paper had not been made condensing, and they ought surely to get more than 70 per cent. of efficiency out of their accumulators, when there were numerous makers who would guarantee more than that.

Mr. Elliott, in the course of some interesting remarks with reference to the sludge presses, said those erected at Davyhulme, although not perhaps quite new in design, were new as regards carrying out the arrangement on any large scale. One feature to be noticed was the closing of the presses, and keeping them closed by hydraulic power. In the ordinary press, as generally used, the closing of the press in order to resist the internal pressure of the sludge forced into it, had usually been effected by means of nuts, and inasmuch as the pressure to be resisted was very great, there had been very considerable manual power required to close the press and make it tight. This work was now being done at Urmston by hydraulic cylinders, which not only closed the presses, but kept them closed. It might interest them to know that the actual work each of the presses was capable of turning out, with the sludge found at Urmston, was about one ton per hour. With regard to the quantity of lime used, this varied at different seasons with the districts from which sewage was coming, and the area from which sludge came to the works had varied to some extent, but the actual quantity of lime used per million gallons of flow appeared to have been about 12 cwt.—which would compare very favourably with the use of lime in many other places where sludge was treated. The arrangements for keeping the hydraulic pressure upon the presses were made to control the supply of sludge to them, so that if by the bursting of a leather of the accumulator it should quickly come down before the people in the press-house were aware, the supply of sludge would be cut off automatically by the falling of the accumulator.

Mr. Olive, in replying upon the discussion, said with regard to the sludge that was dealt with, the farmers in the neighbourhood had so far been only too glad to take it away almost as fast as they made it. They had now, however, an old river course in which they could deposit the surplus sludge; the sewage varied enormously in character, some of it being very difficult to deal with in the presses.

The proceedings in connection with the summer visit of the Institution of Mechanical Engineers to Manchester were on Thursday and Friday devoted entirely to visiting various works in the immediate vicinity of Manchester, and to excursions to several of the important engineering centres in the neighbourhood.

One of the largest parties, numbering upwards of two hundred, was conveyed on Thursday by special train to Oldham, where the morning was spent in a visit to the Lion Spinning Mill at Royton, which is one of the best examples of a modern Lancashire cotton mill. The mill, which is 355ft. long and 129ft. broad, contains 107,000 mule spindles, with the necessary carding and other preparation machinery, which has all been supplied by Messrs. Platt Bros. and Co., Oldham. The driving engines are of the high-speed compound horizontal type, 2000 indicated horse-power. The high-pressure cylinders are 27in. diameter, and low-pressure 46in. diameter, all 5ft. 6in. stroke, making 75 revolutions per minute. The fly-wheel, which is 22ft. diameter, is grooved for forty cotton ropes of 1⅝in. diameter, giving a rope speed of 5175ft. per minute, and the driving is direct from the fly-wheel to the line shafts; those in the mule-rooms making 300 revolutions per minute. The whole of this work, with pipe connections to the boilers, was made by Messrs. Pollitt and Wigzell, Sowerby Bridge. The boilers, six in number, made by the Oldham Boiler Company, are 8ft. diameter by 30ft. long, with 110 lb. working pressure, and four of them, fitted with McPhail and Simpson's dry steam generators, are placed in a house alongside the engine house, with a Green's economiser, containing 480 pipes.

From the cotton mills the party proceeded to the Oldham Corporation Electric Light Works, which, designed by Professor Alex. B. W. Kennedy, were commenced in 1892, completed and inaugurated on 15th March, 1894, and are now in charge of the resident engineer, Mr. S. Wilmot Newington. The streets provided with the electric light are the principal business thoroughfares of the town, and the plant is sufficient for the simultaneous lighting of about 2500 incandescent lamps of eight candle-power each, ample reserve being provided in case of any machines requiring repair.

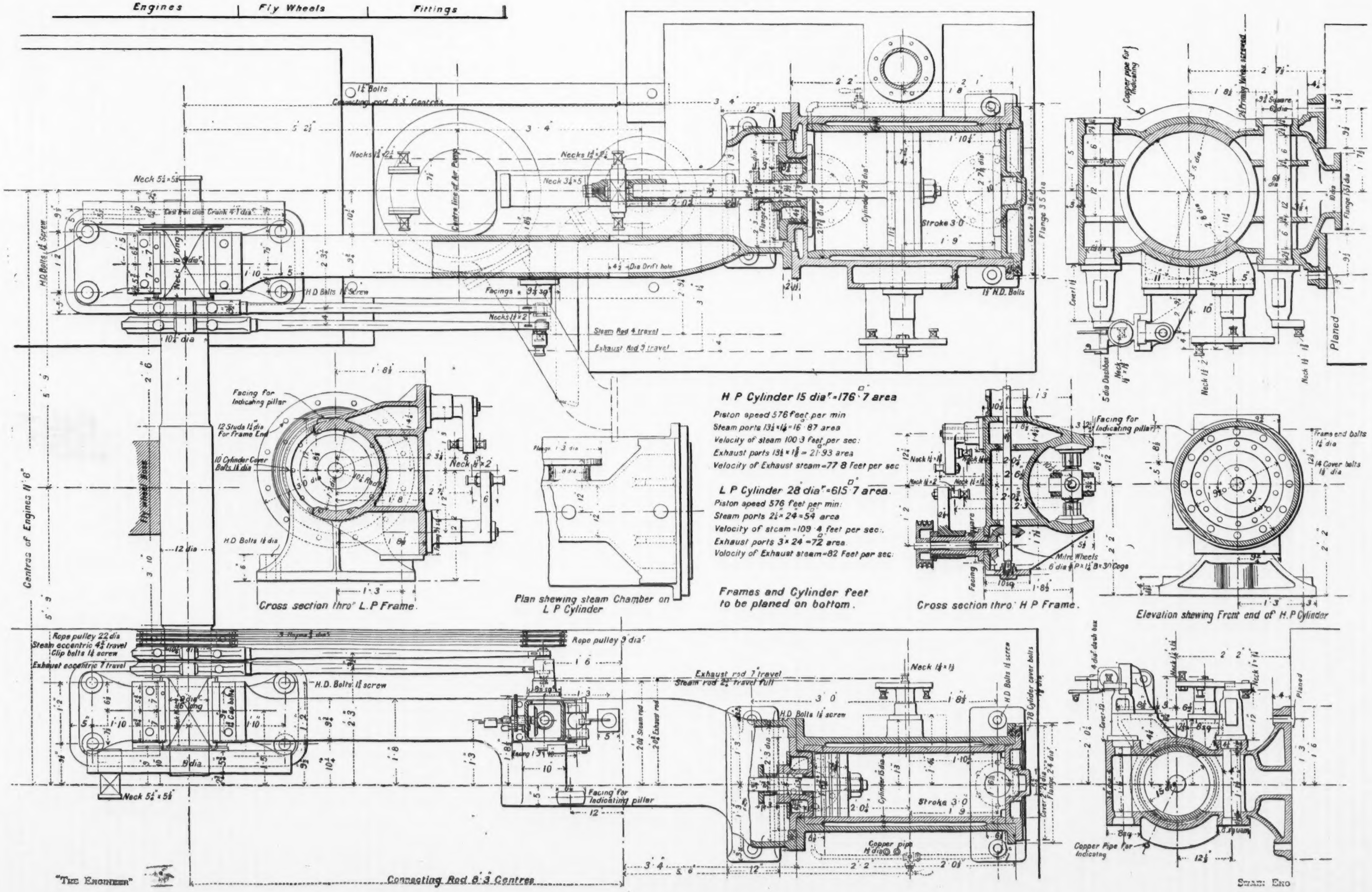
As the area to be supplied is small, and there are many hours during which the amount of lighting required is very limited, a low-tension system of the simplest possible kind has been adopted—namely, a two-wire system, in which the current is distributed at 105 volts. The mains are bare copper, carried upon stoneware insulators in concrete troughs, or conduits under the footpaths. Where roadways are crossed, or where there is not room for a concrete conduit, the mains are laid as insulated cable, carried in cast iron pipes or casings. The conduits are so arranged that fresh copper can be pulled into them without opening up the roads or footways beyond lifting the covers of the manholes. The system of supply is arranged throughout so that it is possible at any future time to change it into a three-wire system with a minimum of alteration, and without pulling up the footpaths or roadways. The batteries are provided partly for a reserve, but mainly for the purpose of supplying current during the period of minimum demand, which in Oldham is often long. They are charged by the dynamos during the hours when the latter have no work for supplying current to the circuit. By allowing them afterwards to discharge, the whole station can be shut down at night, and often in the morning also, so as to economise expenditure in wages and fuel. It is also intended that the waste gases from the Corporation destructor on adjoining ground shall be utilised under one of the two boilers, thereby saving a certain amount of fuel.

The next visit was to the Hartford ironworks of Messrs. Platt Brothers and Co., the party receiving a very considerable accession by a number of members who came on during the afternoon by train from Manchester. These works, which were founded in 1821 by Mr. Henry Platt, have now attained a magnitude far above that of any other textile machine works in the world, and their inspection was looked forward to with no little interest. Before, however, going through the works, the party

# THE PORTSMOUTH ELECTRIC SUPPLY WORKS—ENGINES

MESSRS. YATES AND THOM, BLACKBURN, ENGINEERS

(*For description see page* 122)


Engines
Fly Wheels
Fittings
Cross section thro' L P Frame.
Plan shewing steam Chamber on L P Cylinder
H P Cylinder 15 dia$^r$ = 176$\overset{\square''}{}$ 7 area
Piston speed 576 feet per min
Steam ports 13½ × 1¼ = 16 87 area
Velocity of steam 100 3 feet per sec:
Exhaust ports 13½ × 1⅝ = 21·93 area
Velocity of Exhaust steam = 77 8 feet per sec
L P Cylinder 28 dia$^r$ = 615 7 area.
Piston speed 576 feet per min:
Steam ports 2¼ × 24 = 54 area
Velocity of steam = 109 4 feet per sec:.
Exhaust ports 3 × 24 = 72 area
Velocity of Exhaust steam = 82 Feet per sec:
Frames and Cylinder feet to be planed on bottom.
Cross section thro' H P Frame.
Elevation shewing Front end of H.P Cylinder
Centres of Engines 11' 6"
Connecting Rod 8' 3" Centres
Rope pulley 22 dia
Steam eccentric 4¾ travel
Clip bolts 1¼ screw
Exhaust eccentric 7 travel
Rope pulley 9 dia$^r$
Exhaust rod 7 travel
Steam rod 2¾ travel full
Steam Rod 4 travel
Exhaust Rod 3 travel
Stroke 3' 0"
Cylinder 28 dia
Cylinder 15 dia
Copper pipe for Indicating
Facing for Indicating pillar
Mitre Wheels
Planed
Fly wheel Boss
"The Engineer"
Swain Eng

were invited by Messrs. Platt Brothers to luncheon in the new dining-rooms adjoining, which have only just been completed for the accommodation of the workmen and boys who live out of town—the visit of the Institution of Mechanical Engineers being, in fact, seized as a suitable opportunity for inaugurating the opening. This new dining-room is 200ft. long by 60ft. wide, and provides accommodation for upwards of 1000 hands, whilst it will seat comfortably about 1200 people. It is lofty, excellently lighted and amply provided with lavatories, &c. After luncheon, Professor Kennedy, the President of the Institution, briefly proposed the health of their host, Mr. S. Platt, who, in responding, said he was pleased to see the members of the Institution of Mechanical Engineers present that day, and to show them the whole of the works, which were open for their inspection. Referring to the aspects of industrial operations such as their own, there were, he said, certainly times in which they were only carried out under great difficulty, and it was for them to be constantly on the watch as to how to meet these difficulties, and to battle with the ever increasing competition of the world. The new dining-room in which they were assembled, and the opening of which the members of that Institution were practically inaugurating, was, as they had already been informed, erected for the special accommodation of their workmen, and he hoped they were at the same time also inaugurating new relations between themselves and their workpeople.

Of course the time at the disposal of the members only enabled them to make a very partial inspection of one portion of these extensive works. They are fifty-five acres in extent, exclusive of the collieries, and comprise the old works, the new works, the Werneth spindle works, wood sawing mill, and forge and brick works, which are united by lines of railway connected with the Lancashire and Yorkshire Railway. Several locomotives are kept constantly at work during the whole day conveying the trucks of raw material between the stations and the various parts of the works, and also taking out the trains of finished machinery. The old works are situated about two miles from the new works, and are quite independent in their operations, having iron foundry, smiths' shops, special tool-making and millwrights' departments, turning, planing, fitting, and erecting rooms, &c., where all the machines for ginning, and for opening and carding cotton, wool, and worsted, are made and packed for conveyance to the station. The new works, which were gone through by the party, are the largest of all, and have also their own steel, iron and brass foundries, smiths' shops, turning, planing, fitting, and erecting rooms, as well as special tool-making and millwrights' shops, where machines for combing, drawing, preparing, spinning both by mules and ring frames, warping, sizing, and weaving cotton, woollen, worsted and silk waste are constructed, and delivered on trucks to the railway. The Werneth spindle mills are in close proximity to the new works, and all the spindles and flyers for spinning frames, as well as the spindles for ring-spinning frames, and for self-acting mules, twiners, and doubling frames, are made here, together with tin rollers and copper cylinders for the various machines. File-cutting is also an important branch of this establishment. The sawmill, capable of turning out 350,000 cubic feet of timber per annum, and timber yard cover a space of eight acres, and are amply provided with lines of rails and travelling cranes for the quick conveyance of timber baulks to the sawmill and elsewhere. There are numerous vertical and circular saws at work reducing the largest logs of wood to planks of various widths and thicknesses. The machines, which are nearly all of the firm's own make, are driven by a compound horizontal steam engine of 400-indicated horse power. In connection with the sawmill there are rooms in which all the operations of wood turning, planing and joinering are carried on by means of the most improved appliances. There are also steam drying stoves, built upon the fire-proof system, where the timber is dried before using, as well as large steers for seasoning the timber planks. The sawmill and timber yard are lighted by electricity by means of sixteen Brush electric lamps of 2000 candle power each. Adjoining the saw mill is a building devoted to the manufacture of the fluted iron rollers required in textile machinery. This building is in shed form, about 315ft. long by 100ft. wide, with a cellar under a portion of it. In the cellar the rollers are cut into the required lengths, and thence are taken into the shed above, where they are turned and fluted by means of lathes and fluting machines. In the brick works, which have been built to utilise the clay found on the site of the place, an automatic brick-making machine, capable of turning out about thirty-four bricks a minute, by what is known as the "semi-dry" process, which produces the smoothest and best surface bricks made by the trade, attracted considerable attention. The clay is passed through air-drying tubes, breakers, pulverisers, and disintegrators, from which it issues in fine dust, and is then pressed into semi-dried bricks ready for placing in the kilns, of which there are six, each capable of holding about 70,000 bricks. Fire-bricks are also made here from material procured from the firm's own mines. It may be added that extensive collieries have been acquired with a view to secure an ample supply of coal and coke of undoubted quality, for the requirements of the works. These include the Moston colliery, situated about half-way between Oldham and Manchester, the seams yielding excellent house-fire coal as well as furnace coal; the Tunshill and Butterworth Hall collieries at Milnrow, and the Jubilee colliery at Crompton, about four miles from Oldham, which raise the mountain mine coal of very pure quality, and smithy coal, coke, and foundry coke are here produced, containing a minimum of sulphur. The plant includes coal-washing apparatus, 108 coke ovens, and coal crushing machinery, making coal dust for foundry purposes. Situate also at Crompton are the Brushes, Clough Sand, and Fireclay Works, which supply the forge and foundries with sand of various kinds, especially ganister, obtained of excellent quality. About 1000 men in all are employed at the collieries, and the total number of hands employed by the firm exceeds 10,000.

The alternative excursion to Bury and Rochdale on Thursday, the 2nd inst., was well patronised and greatly enjoyed by the members. At Bury the party was met by Mr. Henry Webb, and conducted over the Peel Mills. These mills are among the best examples of modern mills for spinning American cotton. The machinery, which is of the latest and most improved kind, was supplied by Messrs. Platt Brothers, of Oldham, and the blowing-rooms were fitted by Messrs. Lord Brothers, of Todmorden. They have their own railway sidings, and are fireproof throughout, fitted with automatic sprinklers, and lighted by electricity, which is generated by "Castle" dynamos made by Messrs. J. H. Holmes and Co. The dynamos are in a separate house, and are driven by two compound high-speed non-condensing engines, each 90-horse power, working at 200 lb. pressure. In these engines slide-bars are dispensed with; the upper ends of the links coupling the pistons to the triangular connecting-rods are provided with ball joints, and these are adjustable from outside the cylinders; they permit the pistons to revolve, so that all grooving of the cylinders, pistons, and trunks is avoided. No. 2 mill has a quadruple-expansion vertical engine of 1600-horse power, provided with Corliss valves throughout. The steam pressure is 200 lb. per square inch, generated in four Lancashire boilers, 28ft. long and 8ft. diameter, made of steel and tested to 360 lb. pressure. The cylinders are arranged in pairs on each side of the fly-wheel or rope drum, the high-pressure and first intermediate cylinders on one side, and the second intermediate and low-pressure on the other. The crossheads of each pair are connected by a pair of links and a Fleming and Ferguson triangular connecting-rod to a single crank; the two cranks of the engine are opposite to each other, so that the weights of the two sets of reciprocating parts are balanced. The action of this form of connecting-rod is such that there is no dead centre. The cylinders are 18in., 26in., 37in., and 54in. diameter, with 4½ft. stroke, and the engines make eighty revolutions a minute. There are two air pumps, 26in. diameter and 15in. stroke. The rope drum is 21ft. diameter, with 36 grooves, the diameter of the ropes being 1⅜in., and their velocity 5280ft. a minute. No. 1 mill has a side-by-side compound engine of 1300-horse power, working at 95 lb. pressure per square inch. The cylinders are 32in. and 56in. diameter by 6ft. stroke. The air pump is 39in. diameter by 31in. stroke. The rope pulley is 32ft. diameter, weighs 75 tons, and is grooved for thirty 1⅜in. ropes. The high-pressure cylinder is fitted with Corliss valves, and the low-pressure with slide-valves. Both engines were made by Messrs. John Musgrave and Sons, of Bolton. Through the courtesy of Mr. Webb we are enabled to give the result of a week's working on both of the mill engines, the compound horizontal engine indicating 1160-horse power, driving 67,000 spindles, half twist and half weft, on a fuel consumption of 69¾ tons, equivalent to 2·3 lb. of coal per horse-power per hour. In the same period the quadruple engines consumed 69½ tons of coal to drive 100,000 spindles, half twist and half weft, indicating 1400-horse power, giving a coal consumption equal to rather less than 2 lb. of coal per horse-power per hour. It should be stated that hand firing is employed exclusively at these mills.

From the Peel Mills the party divided into two sections, one visiting Messrs. Adam Ashworth and Sons, and the other Messrs. Lucas and Co.'s felt hat works, where the routine production of felt hats was shown. The two sections then united again and took train for Rochdale, where after being hospitably entertained at luncheon by Messrs. Thomas Robinson and Son, the party was split up and conducted over the works.

These works are situated close to the Lancashire and Yorkshire Railway, and cover an area of about seven acres, employing about 1200 men. Lying nearest to the railway are the saw mill and joinery works, where almost every kind of woodwork is produced direct from the log. The timber in the log is first sawn on a large horizontal double-saw frame, with two saws having a horizontal reciprocating motion; they are driven at a high speed from a double-throw crank, whose centres are opposite, so that the motion of the one saw balances that of the other. The saws cut in both directions of their stroke, so that the feed of timber is continuous. Alongside is a vertical log saw frame, arranged to work with a number of saws at once for sawing up small logs and deals. There are also various kinds of self-feeding circular saws; also planing machines, mortising and tenoning machines, &c. In addition to joinery, this department is largely devoted to the manufacture of flour-milling machinery, principally dressing, such as semolina purifiers, sieves, bran dusters, &c., which follow the work of the roller mills in the conversion of grain into flour.

The works are so arranged that the raw material enters by the main line, and is discharged from the wagons direct at the foundry and smithy, from which during the course of manufacture it passes in direct circulation to the fitting shops and packing department. The iron-foundry is a large building 317ft. long by 94ft. wide, built in two bays. A line of columns passes down the centre, supporting the roof and crane road. Three overhead steam travelling cranes traverse the whole length of the building, each capable of lifting a load of 10 tons. A number of machines are at work here for moulding pulleys and wheels and from plate patterns. The smithy is a similar building to the foundry, being lofty and spacious. It is 150ft. long by 45ft. wide, containing fifteen fires, and is fitted with steam hammers, forging machines, and tools for special work in cutter making. The lower end of the fitting shop is devoted to the construction of wood-working machinery, and the upper end to roller mills for flour milling and to steam engines. The total length of the fitting shop is 537ft., and its width 103ft. In addition to many special turning, grooving, and milling machines, there is a balancing apparatus, by means of which pulleys and cutter blocks are accurately balanced for the speed they are intended to run at. An overhead travelling crane driven by ropes works over the engine fitting shop, and is capable of lifting 15 tons. The machinery in this department is driven by a horizontal compound tandem engine of 40-horse power, having an ordinary slide valve with an arrangement whereby the cut-off is regulated by the governor according to the load.

Amongst the most interesting plant which was inspected in process of construction, we may mention a fine machine for planing, mortising and boring huge balks of greenheart timber for making lock gates. This machine is capable of taking material 60ft. long, and is being made for the Mersey Docks and Harbour Board. We hope to place an illustrated description of it before our readers in an early issue.

On Friday one of the principal excursions was to the Lancashire Watch Works, at Prescot, which practically occupied a numerous party the whole day. They were accompanied by Professor Kennedy, the President of the Institution. We have previously given some description of these works in connection with their formal opening about a couple of years back. The entire scheme for the factory has not yet been carried out, but when completed it will occupy a rectangular plot of ground of about 11½ acres. The front building will be 440ft. long by 28ft. wide, and four storeys high, the central portion forming the administrative department. Behind the whole length of this building, and separated from it by areas for light, will be the main works corridor 20ft. wide, from which the different workshops will be entered. The latter will be placed with their lengths at right angles to the corridor, and are intended to be seven in number, the outer being three storeys and the inner one storey high. The rear of all the workshops is intended to be connected together by a rope-race, for the transmission of power by cotton ropes, the areas between the workshops being approached by archways. The steam engines, boilers, and electric lighting plant are intended to be in the centre of this rope-race. The buildings already completed consist of one of the three-storey outer workshops and two of the one-storey inner shops, occupying a space of 300ft. by 260ft., and with a total floor area of 59,325 square feet. The dimensions of the three-storey workshop are 300ft. in length and 28ft. in width, and the large one-storey warehouse, a portion of which is temporarily divided off for the present engine and boiler and other purposes, is 336ft. long by 100ft. wide, whilst the smaller one-storey workshop is 256ft. long and 45ft. wide. The present offices are contained in what will ultimately be the main works corridor. The three storeys give space for the employment of 700 workmen, whilst the factory as it at present stands provides accommodation for at least 1500 workpeople, and turns out a minimum of 500 complete watches a day. It would be impossible to enter into anything like a detail of the different departments of the works, and the infinite variety of tools, mostly of special design, which are employed in the numerous operations of watchmaking by machinery. The members were occupied close upon four hours in going through the various departments, starting at the drawing-office where they were shown how a watch is designed, then through the tool room, blacksmith's shop, pattern shop, clerical department—where they were shown the system of taking prime cost and material keeping—the engine house, on to the press room, the pinion shop, through the balance rooms, stores, framing shop, gilding room, case room, escapement, jewelling, and motioning room, on to the erecting, dial, and examining rooms, where the trueing and poising of the balances of the completed watches is performed, and the mechanism is finally fitted in the cases and timed. As a general description of the works, it may be stated that the side walls of the shops are constructed of cast iron stanchions, filled in to a height of 3ft. above each floor with brick-work, and over this with glass in wood frames, so that continuous windows are formed the whole length of each side. The ground floors are solid, formed with a layer of ballasting and a layer of Portland cement concrete. The upper floors are fire-proof, with steel girders supported on cast iron columns. The three-storey workshop has an ordinary slated roof, but the one-storey workshops have saw tooth shed roofs with large skylights facing the north. For ventilation Blackman air-propellers are employed, the outlet ventilators being on the induced current principle, preventing down draught, and the steam generated in a boiler 30ft. by 8ft. is used for heating the buildings throughout. The motive power is provided by a locomotive type boiler, working at 140 lb. pressure, and supplying steam to a Marshall compound engine capable of developing 80-horse power, from which the various shafts are driven by cotton ropes working in iron-grooved pulleys. The shafting is of steel throughout, and the belt pulleys, which are made in halves, will fit on it anywhere. The work benches have wood tops, 2½ft. wide, carried on cast iron standards, which are secured to the floor boards and joists, the total area of bench tops being 14,480 square feet. In the smaller one-storey shop, which is used for making tools, there are a joiners' shop and a smithy partitioned off at one end, and there is accommodation for about one hundred mechanics, whilst the larger one-storey shop is employed in the making of watch movements, there being accommodation for about six hundred workpeople. In the three-storey workshop the first-floor contains the flat steel and stem-winding departments; the second floor is used for jewellery, gilding, escapement, and balance making; and the third floor for assembling room, dial, and band making.

The inspection of the works having been completed the party were entertained at the King's Arms Hotel by Mr. T. P. Hewitt, managing director of the company, and before separating,

Professor Kennedy said, as one of the oldest members of the Institution of Mechanical Engineers, he desired, on behalf of his fellow visitors, to say that to all of them that visit had been the most pleasurable and instructive they had ever had. At various times they had visited many engineering and mechanical works, but during all their excursions they had never met with so high a development of mechanics, nor seen a factory where there was so splendid an organisation, or where the employés worked under more favourable conditions of good light, atmosphere, and sanitation, as at the Prescot Watch Factory, where he thought these arrangements were pretty nearly perfect. He also desired to thank Messrs. Hewitt for the kind and hospitable manner in which he and his fellow members had been treated.

Mr. T. P. Hewitt, in responding, said that when their secretary—Mr. Bache—wrote that so distinguished a body as the Institution of Mechanical Engineers were coming into the neighbourhood, and more especially as his brother was to read a paper on screw-making before them, he ventured to think it would please the members to come and see what was being done by mechanical aid at the watch factory. He was therefore extremely pleased to hear that they had been able to teach them something new, and certainly, to his mind, the operations required for making machine-made watches was one of the highest forms of mechanics. Many of the visitors had expressed to him the pleasure they had experienced, but the greatest source of gratification to him was to hear them admit that they had learnt something which might be of use to them hereafter.

The members who chose the alternative excursion to Bolton and Horwich on Friday were divided into two parties. Party "A," which was limited to ninety, paid a visit, first to the fine spinning cotton mills of the North End Spinning Company, under the guidance of Mr. Herbert Mather and Mr. H. S. Forrest, and next to the works of Messrs. Dobson and Barlow, under the guidance of Mr. Benjamin A. Dobson.

These works occupy over twelve acres, and although large additions have been made to the original buildings, by great care the modern requirements have been maintained, and, with the exception of the style of buildings, no disadvantage exists. In a preparing and spinning-machine manufactory the variety of trades is enormous. Those under direct supervision in this establishment number no fewer than thirty-two. The foundries are extensive; the heavy work is served by power cranes, the lighter by metal trams. There are five cupolas, capable of melting from 90 to 100 tons of castings per day. Two of the cupolas, on account of their proximity to the wood sheds, have the uptake turned over into a downtake, which is conveyed to the chimney by a flue, thus avoiding the dispersion of sparks in the air. The heated air in passing raises the temperature of the blast supplied to the cupolas, as the blast-pipe passes through the hot-air flue. The cupolas are charged by power hoists. The chimney is 366½ft. high, and was for long the largest stack in the world; even now it has only two or three competitors. It was constructed for a chemical works formerly upon the ground, which has been absorbed by the machine works. There is a small steel foundry; also a brass foundry, and softening, annealing, and hardening furnaces. The machinery made in this establishment is principally for cotton spinning and doubling, although silk, wool, and other fibres are also dealt with. Thus the machines may be divided into those for ginning, scutching, carding, combing, drawing and preparing, ring and mule spinning, ring and mule doubling, winding frames, gassing frames, and bundling presses; in fact, all the requirements of a cotton mill. The fitting-rooms are arranged to suit this category, and there is one general preparation in the way of planing, milling, polishing, and turning. Many of the milling and turning machines are made to serve a special purpose, and not a few of them show great ingenuity.

Bolt and nut turning, automatic screw-making, automatic wheel-cutting machines, multiple milling machines, are of various kinds and considerable in number. Subdivision of labour is the secret of the existence of the machine trade; without it competition with foreign makers would be impossible. Therefore it is that the machine tools in the works have all been designed with a view to economy of production. The work required is of the most exact character; in several cases pieces of 50in. diameter of thin cast iron have to be turned to the 1000th part of an inch. The wood-working department is also extensive. Here, again, the object sought for has been to reduce the cost of labour. The multiplicity of pieces in a business of this description is almost incredible, the number of articles dealt with amounting to hundreds of thousands per week. The packing department for the large foreign trade is of great importance. Each framing and article of any weight is securely fastened by stays, which in turn are nailed to the case. About 1000 cases of machinery per week are despatched to all parts of the world.

The boilers employed are of the Lancashire type, supplied with Galloway tubes, and furnished with mechanical stokers on the spreading system. Some of the engines are old; but there are three or four new ones, including two high-speed engines, one running at 240 revolutions and the other at 140. The bevel and spur wheels in connection with the driving gear have been abolished by degrees in favour of ropes or straps. A large portion of the works is lighted by the inverted arc lamp reflected from a whitewashed ceiling—"Proceedings," 1893, page 396. In the dynamo-room are different kinds of dynamo and switch arrangements. Electric welding is also a special feature in these works. In the third storey of the building facing the principal entrance gates is an experimental room, where are samples in working order of the principal types of cotton spinning machinery constructed. This room affords extremely interesting explanations of the principles of such machinery.

The members of party "B" first made their way to Messrs. Hick, Hargreaves, and Co.'s works. The Soho Works were erected in 1832 as a general engineering establishment, the earlier products being stationary steam engines, boilers, mill gearing, hydraulic machinery, water wheels, marine engines, and locomotives; of the last a large number were made here for the Liverpool and Manchester and other early railways. This firm was the first to introduce the Corliss engine into this country about 1865, and they have been closely identified with it ever since. Over 1100 of these engines have been built of all sizes from 40 to 10,000 indicated horse-power, simple, compound, and triple-expansion, adapted for all pressures up to 200 lb. per square inch. Steel boilers were first made at the Soho Works in 1863; and their present capacity, including the Phœnix Works, is about 150 boilers a year. The boilers are mostly of the Lancashire type, but upwards of 200 torpedo-boat boilers of the locomotive type have been made; some of the most recent of these have each 2400 square feet of heating surface, and whilst weighing only 16 tons have given 1750 indicated horse-power on the trial trip. Mill gearing in all its branches is also a speciality; some large fly-wheels for rope driving have been made, a recent example being 32ft. diameter, grooved for 56 ropes weighing 128 tons, and to transmit 3000 indicated horse-power. Turbines and hydraulic machinery are also largely manufactured. The works have been extended from time to time to suit the growing requirements of the business, and they now cover seven acres, and give employment to about 1000 workmen. They are divided into nine departments, namely two pattern shops, brass foundry, three moulding shops, smiths' shop, heavy machine shop, light machine shop, with fitting and erecting shop, millwrights' turning shop, and millwrights' erecting shop. The tools are modern, many being of a special character to suit the work, and there are ten rope-power travelling cranes from 15 to 40 tons capacity. The motive power consists of five Lancashire boilers, 7ft. diameter by 30ft. long, working at a pressure of 70 lb. per square inch; and six engines, giving altogether about 450 indicated horse-power. The works are advantageously situated, being traversed by sidings from the London and North-Western Railway. The Phœnix Boiler Works were purchased in 1891, the boiler department at the Soho Works having become inadequate to meet the demands upon it. It is contemplated to remove all the boiler-making plant to these works, and to utilise for other purposes the space now occupied by the old boiler shop at the Soho Works.

From Messrs. Hick, Hargreaves' works the party next proceeded to Messrs. John Musgrave and Sons, Globe Iron Works. This firm of engineers, boiler makers, and millwrights was established in 1839 by John Musgrave, and has been worked and carried on by his sons and grandsons up to the present time. At first the works employed only about fifteen men; but the growth of the business has necessitated continual alterations and additions until the works now occupy over eight acres, almost entirely covered by buildings, including three foundries, with complete accessories of pattern shops, dressing shed, store rooms, &c. There are four shops devoted to engine work, and four others for mill-gearing, besides large engine-erecting shops, and extensive boiler-works, smiths' shops, and all the numerous adjuncts, providing employment for about 1000 men. The special work produced comprises quadruple, triple, and compound engines, with triangular connecting-rods, and having no dead centres; also quick-speed engines on this principle, designed especially for electric machinery; Musgrave's barring engine and Corliss valve-gear, Crompton's metallic packings for piston-rod glands, Buckley's piston-rod support, Tabor indicator, &c. The engines are constructed with a special view to high-class finish, steady turning, and economical running; they are driving a large number of the most successful cotton-spinning and weaving mills in this country, India, Russia, Germany, and Japan; and examples of the work here produced have gone into nearly every part of the world.

The two parties afterwards united to visit the Lancashire and Yorkshire Railway Locomotive works at Horwich.

These works, of which the building was commenced in 1886, are situated between the Chorley New Road, Horwich, and Red Moss, and are about one mile distant in an easterly direction from Blackrod Station upon the main line between Manchester and Fleetwood. The land enclosed for the works comprises 85 acres, and lies north-west and south-east. The covered area of workshops is 15 acres. They comprise offices, general stores with gallery, boiler shops, smithy, forge, foundries, tin and copper shops, machine shops, erecting and repairing shops, &c. The boiler shop is fitted with the necessary cranes, portable and fixed riveting machines, multiple drilling machines, pneumatic fullering tools, quadruple stay-tapping, and plate-edge planing machines. The boiler shop and smithy contain hydraulic flanging press; and in the forge are a plate-straightening machine, rolling, tire, and merchant mill engines, tire and merchant mills, and a 30-ton Ramsbottom duplex hammer. In the steel foundry are melters, core-drying furnaces, and a wagon-wheel moulding-machine, &c.; and the iron-foundry is adapted for light and heavy castings. The steel dressing shop contains annealing furnaces, and is used for dressing steel castings. The wagon-wheel shop comprises lathes for boring and turning wagon wheels; one set of lathes rough the work, and the remainder finish it. Bolt machines, drop stamps, and nail-making machines are in the bolt shop of the smithy. The erecting and repairing shop is provided with 30-ton cranes, portable hydraulic riveters, flexible shaft-drilling machine, and the necessary complement of tools. Steel castings are largely used in the manufacture of the locomotives. The tender shop is for the making and fitting up of tenders; and the paint shop contains the necessary paint-grinding and mixing machinery and stores. In the chain-making and testing shop is a 100-ton chain-testing machine, together with the necessary chain makers' fires, &c. To facilitate the carriage of material from the stores, and of work to the various shops, a system of 18in. gauge tramway is laid to the extent of 7¼ miles, the haulage being performed by small locomotives. The shops and offices are fitted with both arc and incandescent electric lights. The fitting shop is lighted with inverted arc lamps, and each department of the works is also in telephonic communication with the offices. Owing to want of time the members were unable to make a complete survey of the works.

## GOODS ENGINE—MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILWAY.

In The Engineer for April 13th and 16th we illustrated and described certain express engines, described by Mr. J. Parker before he resigned his position as locomotive superintendent on the Manchester, Sheffield, and Lincolnshire Railway. We now illustrate one of several powerful tank engines, which have been at work for some time in conducting the goods traffic of the line. The following table gives all the principal dimensions:—

| | | | |
|---|---|---|---|
| Cylinders—diameter | 1ft. 6½in. | | |
| ,, stroke | 2ft. 2in. | | |
| Steam ports | 1⅝in. × 1ft. 2½in. | | |
| Exhaust ports | 3¼in. × 1ft. 2½in. | | |
| Lap of valves—outside | 1in. | | |
| ,, inside | 1/16in. | | |
| Maximum travel of valves | 4 7/16in. | | |
| Lead in full gear | 7/32in. | | |
| ,, in mid gear | ¼in. | | |
| Throw of excentrics | 5¾in. | | |
| Diameter of sheaves | 1ft. 5in. | | |
| ,, piston-rods | 3in. | | |
| Centre to centre of cylinders | 2ft. | | |
| ,, valve spindles | 2ft. | | |
| ,, expansion links | 5¼in. | | |
| Crank pins, connecting-rod—diameter | 8½in. × 4in. | | |
| Coupling-rod pins—leading and trailing, diameter | 3½in. × 4¾in. | | |
| ,, ,, driving—diameter | 4in. × 4¾in. | | |
| Wheels (cast steel centres):— | | | |
| Coupled—diameter | 5ft. 1in. | | |
| Radial ,, | 3ft. 6in. | | |
| Tires | 5½in. wide × 3in. | | |
| Axles (steel):— | | | |
| Coupled: Wheel seat—diameter | 8¾in. × 7 3/16in. | | |
| Journals ,, | 8in. × 9in. | | |
| Centre to centre of journals | 3ft. 9½in. | | |
| Radial: Wheel seat—diameter | 8¼in. × 6⅞in. | | |
| Journals ,, | 7in. × 11in. | | |
| Centre to centre of journals | 3ft. 7½in. | | |
| Frames (steel):— | | | |
| Thickness | 1 1/16in. | | |
| Distance between, front end | 4ft. 2in. | | |
| ,, ,, hind end | 3ft. 10in. | | |
| From back of buffer plate to centre of leading axle | 5ft. 5⅜in. | | |
| From centre of leading axle to centre of driving axle | 7ft. 11in. | | |
| ,, ,, driving ,, ,, trailing ,, | 8ft. 7in. | | |
| ,, ,, trailing ,, ,, radial ,, | 6ft. | | |
| ,, ,, radial ,, hind buffer plate | 5ft. 3in. | | |
| Total length of frame plate | 33ft. 2⅜in. | | |
| Boiler (steel):— | | | |
| Mean diameter of barrel outside | 4ft. 3in. | | |
| Length of barrel | 10ft. 8in. | | |
| Height of centre line from rail | 7ft. 4¼in. | | |
| Barrel plates | ½in. | | |
| Smoke-box tube plate | 1in. thick. | | |
| Fire-box shell, "Belpaire" form (steel)—width at bottom outside | 4ft. 1in. | | |
| Fire-box shell—length at bottom outside | 6ft. | | |
| Steam pressure | 160 lb. per sq. in. | | |
| 233 tubes, copper, 1¾in. outside diameter, 11 and 13 | B.W.G. | | |
| Length between tube plates | 11ft. ⅝in. | | |
| Saddle plate | ⅝in. | | |
| Back plate | 17/32in. | | |
| Crown and side plate | ½in. | | |
| Fire-box (copper)—Length at bottom inside | 5ft. 4⅝in. | | |
| Width | 3ft. 6in. | | |
| Mean depth | 5ft. 3½in. | | |
| Top of box to inside of shell | 1ft. 5⅞in. | | |
| Tube plate | 1in. thick. | | |
| Below tubes | ⅝in. | | |
| Back plate | ⅝in. | | |
| Crown and side | ½in. | | |
| Heating surface:— | | | |
| Tubes | 1179 sq. ft. | | |
| Fire-box | 99 ,, | | |
| Total | 1278 ,, | | |
| Grate area | 18·85 sq. ft. | | |
| Ratio of grate area to heating surface | 1 : 67·798 | | |
| Smallest diameter of chimney | 1ft. 2in. | | |
| Diameter of blast pipe nozzle | 5in. | | |
| Weights in working order:— | Tons | cwt. | qr. |
| Leading | 15 | 4 | 0 |
| Driving | 16 | 3 | 3 |
| Trailing | 14 | 18 | 0 |
| Radial | 13 | 13 | 0 |
| | 59 | 18 | 3 |
| Capacity of water tanks | 1400 gallons. | | |

## THE NEW UNITED STATES CRUISER MINNEAPOLIS.

The steam trials of the new United States cruiser Minneapolis (see p. 131), which came off on the 14th ult., have given great satisfaction to our American cousins, and have earned Messrs. Cramp, of Philadelphia, her builders, a bonus of 400,000 dols., in addition to her contract price, which was 1,690,000 dols., as she attained a speed of 23·05 knots. She is, therefore, one of the very fastest war vessels afloat, and a worthy addition to the fine fleet that is being created on the other side of the Atlantic. The Minneapolis is one of the few cruisers that are provided with triple screw propellers, among the others being the Columbia, the French Dupuy de Lôme, and the German Kaiserin Augusta.

She was launched on August 12th, 1893, and is 412ft. long, with 58ft. beam, and has a displacement of 7350 tons and a horse-power of 21,000, and is known as a "commerce destroyer," or "pirate." She is not, therefore, provided with an armament suitable for engaging even the large cruisers of other nations, her heavy armament consisting only of one 8in. gun and two 6in. and eight 4in. quick-firers. She has in addition a dozen 6-pounders, four 1-pounders, and four Gatling guns, as well as five torpedo-ejectors; but to anything at all powerful in the way of fighting vessels she is intended to show a clean pair of heels. She is protected by a sloping armoured deck 4in. thick at the sides, and has a double bottom minutely subdivided into water-tight compartments. The engines and machinery will be further protected by patent fuel, which will be packed around them to the thickness of 5ft.

With her centre screw only revolving, the Minneapolis can get along at the respectable speed of 10 knots with a very economical expenditure of coal. Of this she is said to carry no less than 2400 tons, and is able to steam 15,000 miles without re-coaling, so that the mischief she would be enabled to inflict on the mercantile marine of an enemy before she was likely to be caught would be almost incalculable. Still, as the French found in the old war with this country, a *guerre de course*, however successful, has never yet to any appreciable extent influenced the issue of a naval campaign.

# THE ELECTRIC LIGHTING OF PORTSMOUTH AND SOUTHSEA.

DURING the last few years the growth of electricity as the illuminant of provincial towns has made rapid strides; indeed, so much has been done by the country municipalities in this direction, that the metropolis would seem to lag behind. It is, however, so much easier to make a brave show in a small town, and to have it talked of far and wide, than in a great city, that the latter, in so far as words and advertisements go, seems to suffer in the comparison. The enthusiasm with which mayors, and aldermen, and town councillors go into the matter in the country is wanting in the City, and the dinners, at which everyone concerned compliments every colleague, are missing where competition is the rule, and mutual admiration most certainly the exception. And yet, though one must incline to smile at the compliments which are passed round—for their very extravagance robs them of sincerity—one must be amused at the presentations which are made with the lively sense of favours to come, and one may enjoy the dinners, these should all be recognised as parts of the scheme, the main purpose of which is to attract the attention of the local householder, and induce him to get his premises wired and become a customer.

As a rule, the local body contemplating the establishment of an electricity supply station sends a committee on a tour of inspection, chiefly to London, when all available stations are examined, and a vast quantity of information is collected, which bears fruit some time later in the complete and unoriginal scheme which is submitted to the council of the town for its approval; oftentimes the worst points of many systems being taken, while the best remain behind.

The Electric Lighting Committee of the Corporation of Portsmouth, unlike all others, has made great departures into original fields; and, though it went far and wide to study what had been done, it did not in the end follow in any previously dug groove, but laid the foundation of its station upon fresh ground, and has distinctly advanced in its own independent way along the road of progress. Like others, it at first followed in well-worn tracks, but unlike others, it had at an early stage the good luck to learn better things, the courage and the power to make a change, and it is thought that the borough will find in the years to come the advantages of the system it has adopted and carried out.

The employment of the high-tension alternating current transformer system was a necessity for the lighting of a borough which includes, with Portsmouth, Southsea, Portsea, and Landport, and which extends over a great mileage. The necessity for this was pointed out by the engineers who were finally employed by the Portsmouth authorities, and through whom the Provisional Order was obtained. The dynamo builders chosen to carry out this part of the work, namely, the Ferranti Company, possess special experience in high-tension work. But to obtain information as to dynamos in the future, one of Mr. Parson's turbo alternators has been put down for comparison, and for special work, beside the Ferranti machines; and in order that the arc lighting along the sea front should be as perfect as possible, the Ferranti Company has further installed rectifiers at the station, for the purposes of commutating the alternations of the current into simple interruptions, and so gain all the advantages of the continuous current system, without its several drawbacks.

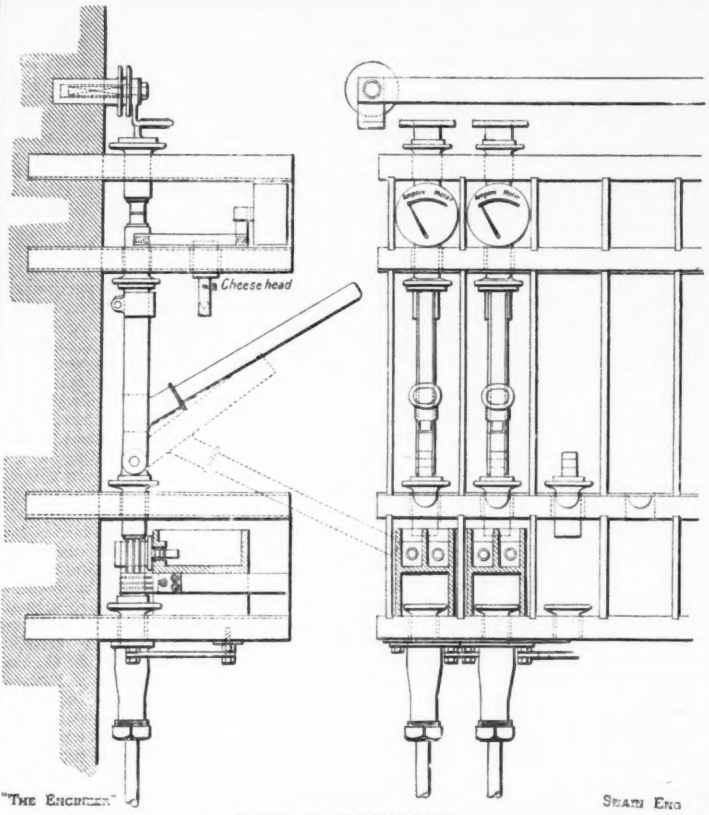
The result is that the arc lighting is remarkable for steadiness, and promises to be so in economy; and it is not surprising to hear that the use of the Ferranti rectifiers is being largely extended in other parts of the country, that the City of London Company has already begun a large installation of these machines for its arc lamps, that the Islington Vestry has ordered them, and that the London Electric Company is also contemplating a departure in the same direction.

The chief points which claim attention in the adoption of the system used at Portsmouth are:—(1) Direct-driven fly-wheel dynamos supplying alternating current at 2000 volts for all purposes. (2) The transformation by means of converters in chambers in the streets, and low-tension distribution from each such chamber, there being no transformers in consumers' houses. (3) The rectification of the alternating current for the arc lamp supply. But though these be the main points in which novelty and progress have been illustrated, a multitude of most important points of detail go to make up the whole.

The generating plant supplied by Messrs. C. A. Parsons and Co., Heaton Works, Newcastle-on-Tyne, at present consists of a Parsons' condensing steam turbine alternator for an output of 150 units. The compound steam turbine is arranged for multiple expansion from the 160 lb. per square inch boiler pressure down to a condenser pressure of ½ lb. absolute, or a range of about 300-fold expansion. The turbine revolves at 3000 revolutions per minute and is coupled direct to a two-pole alternator, giving 75 ampères at 2000 volts, with a periodicity of 50 complete periods per second. To the spindle is coupled the exciter, so that the whole plant is complete in itself and entirely self-contained. It stands on rubber blocks which rest on a concrete foundation without any holding-down bolts whatever. An automatic variable cut-off valve gear and governor, electrically controlled, maintains a constant electro-motive force, and enables the full range of expansion to be maintained at light loads, thus securing exceptional economy of steam on the all-day load. One of these machines, when tested by Professor Alex. B. W. Kennedy, showed a steam consumption of slightly less than 20 lb. per electrical horse-power at full load; at three-quarter load it was only 21 lb., at half load 23 lb., and at quarter load 29 lb. per electrical horse-power. The condenser is of the jet description, but differs somewhat from the usual type.

A separate water pump is placed below the condenser, no injection water proper being admitted to the air pump, which is placed above and is compound. By this arrangement the vacuum obtained is better than is usual with jet condensers, and at the same time the power required to work the pumps is considerably reduced. The pumps are worked from the crossheads of a small tandem compound auxiliary vertical engine, with cylinders 4in. and 7in. diameter and 12in. stroke, supported on girders so as to stand on the footplate of the engine-room above. The exhaust from this engine can be sent either into the chimney or into the condenser. Valves are arranged so that both the steam turbine alternator and the condenser engine can take their steam from either range of steam pipes, and so that the steam turbine alternator can be run high-pressure in case of the injection water failing, or other cause. It has been found that the steam turbine alternator can run satisfactorily in parallel with the other and slow-speed alternators, thus showing the interesting fact of an alternator at 3000 revolutions per minute running in parallel with one at ninety-five revolutions.

In the dynamo room—see page 104—there are two horizontal side-by-side compound condensing steam engines, made by Messrs. Yates and Thom, the fly-wheels, which are utilised as the field magnets of the dynamos, being placed in the middle of the crank-shaft between the two cranks. Each engine will give 320 indicated horse-power, with a boiler pressure of 160 lb. per square inch when running ninety-six revolutions per minute. We have published details of these engines in our last impression. The high-pressure cylinders are 15in. diameter, and the low-pressure cylinders 28in. diameter and 3ft. stroke. All the cylinders are steam-jacketed in the bodies, lagged with planished steel, and fitted with Corliss valves and gear. The high-pressure cylinders are provided with Dobson's patent automatic expansion Corliss valve gear, controlled by the governor, of which Messrs. Yates and Thom are the sole makers for this country, and the low-pressure cylinders with Corliss valve gear with variable expansion adjustable by hand while the engines are running; the steam valves in each case being worked independently of the exhaust valves. The piston-rods are steel 3¼in. diameter, the crank-shaft also, with main journals 9in. diameter and 16in. long, swelled up in the middle to 12in. diameter. The crank-shaft pedestals are cast with the foundation frames, and are fitted with gun-metal steps in four parts, with side wedges and screws for horizontal adjustment. The fly-wheels of both engines are 12ft. 9in. diameter and 1ft. 9½in. wide, made in halves, and prepared round the rim for sixty-four poles, each wheel weighing with bolts, hoops, &c., but exclusive of poles and wiring, about ten tons. The air pump of each engine, which is vertical and single-acting, is placed in a chamber between the cylinders, and is driven by means of a rocking lever attached to the engine crosshead. It is 19in. diameter and 11¼in. stroke, the working barrel being lined with gun-metal and fitted with a gun-metal bucket and rod.



DETAIL OF SWITCH-BOARD

The bucket and delivery valves are of india-rubber on the multiple principle.

The condensing water is supplied to the jet from the Camber, which is a sort of tidal basin or offshoot of Portsmouth Harbour, and which is distant some 250 yards from the condenser. The injection pipe is 14in. in diameter, and the mean level of the water is 18ft. below the condenser; but notwithstanding such severe conditions, a highly efficient vacuum can be maintained. The discharge pipe from the condensers runs along beside the injection pipe and returns the condensing water and condensed steam to the Camber; while, at the same time suitable atmospheric exhaust pipes have been provided for the engines in case of failure of any part of the condensing plant. It is not clear why the engineers have selected jet condensers, as the supply of water is at all times sufficient for surface condensers; and, had the latter been adopted, many advantages would obviously have followed, and all the complication involved in the use of Stanhope, or any other kind of water softeners, would have been rendered unnecessary.

Both engines are massively built, and are provided throughout with indicating gear and efficient means of lubrication, also with brass-mounted oil drippers, neatly polished handrails and pillars round the working parts of the engines, and all other necessary fittings for the proper and satisfactory working of engines of the very highest class.

Special attention may be called to Messrs. Yates and Thom's improved isochronous motion for maintaining the engines at one uniform rate of speed. It is a simple and effective device, and consists of friction-wheels running up and down on a hollow governor spindle as the governor balls rise and fall, with suitable gear for causing the fulcrum supporting the governing lever attached to the lower end of the counterpoise of the governor to rise or fall at the same time, for effecting the necessary compensation for maintaining the governor balls at a constant vertical height.

The steam and exhaust ports of the cylinders have been made of large area, so that the full boiler pressure, as nearly as possible, can be got on to the high-pressure pistons, and also to afford a free and open passage for the exhaust steam. The Corliss valves and gear have been specially designed for giving a quick cut-off, and for obtaining as perfect expansion curves as it is possible to get, with provision for running the steam pressure down in the boilers—the range of cut-off being with this gear from 0 to ¾ of the stroke. Messrs. Yates and Thom have, we understand, fitted this Corliss valve motion to a very large number of engines.

There are five steel Lancashire boilers, each 30ft. long and 7ft. 6in. diameter, with furnace tubes 3ft. diameter, and sufficiently strong for a daily working pressure of 160 lb. per square inch—this type having been selected in preference to that of the water-tube because of its manifest superiority as to simplicity and cost of maintenance and its excellent evaporative powers. The shell plates are $\frac{23}{32}$in. thick, the furnace plates $\frac{17}{32}$in. thick, the end plates $\frac{11}{16}$in. thick, and the cover plates $\frac{23}{32}$in. thick. The shell of each boiler is made in eight parallel rings of plates, the longitudinal seams in the shell being treble riveted, and made with double cover straps having six lines of rivets, the ring seams as well as the end plates being double riveted. The furnace tubes are each made in twelve rings of plates, with eleven flange seam expansion joints. The end plates both at front and back are solid, rolled in one piece, not welded. The front end plates are attached to the cylindrical shell by external steel angle rings 5½in. by 5in. by $\frac{11}{16}$in., and the back end plates to the shell by a flange formed on it by the hydraulic press. Each end plate is stayed to the shell by five gusset stays above the furnace and tubes, and two below at front, and three below at the back, and in addition two strong longitudinal stay bolts from end to end of each boiler. All the rivet holes throughout each boiler are drilled and countersunk on both sides, and the whole of the shell plates, as well as the cover straps, are planed on their four edges. All the end plates, angles, and flue tubes are turned on their edges, and the end plates bored out for furnace and flue tubes. The steel used throughout the boilers is of mild ductile quality, and by the Siemens-Martin process. Each boiler is fitted with a full complement of mountings, with two 6in. junction valves for duplicate ranges of steam pipes. The mountings are made to the Manchester Steam Users' Association's standard, and both boilers and mountings have been made under the Manchester Steam Users' Association's inspection. Each boiler is fitted with Vicars' patent mechanical stokers and smokeless furnaces of the latest improved type, and is fed by one of Vicars' patent fuel conveyors and elevators, with all the necessary dampers, tightening screws, &c., complete; also with the requisite shafting and two small auxiliary engines for driving mechanical stokers and the coal conveyor and elevator, either together or separately.

The fuel economiser is of the Green type, and consists of 288 cast iron heating pipes in three sections of 96 pipes each, the scraper gear being worked by a small electrical motor.

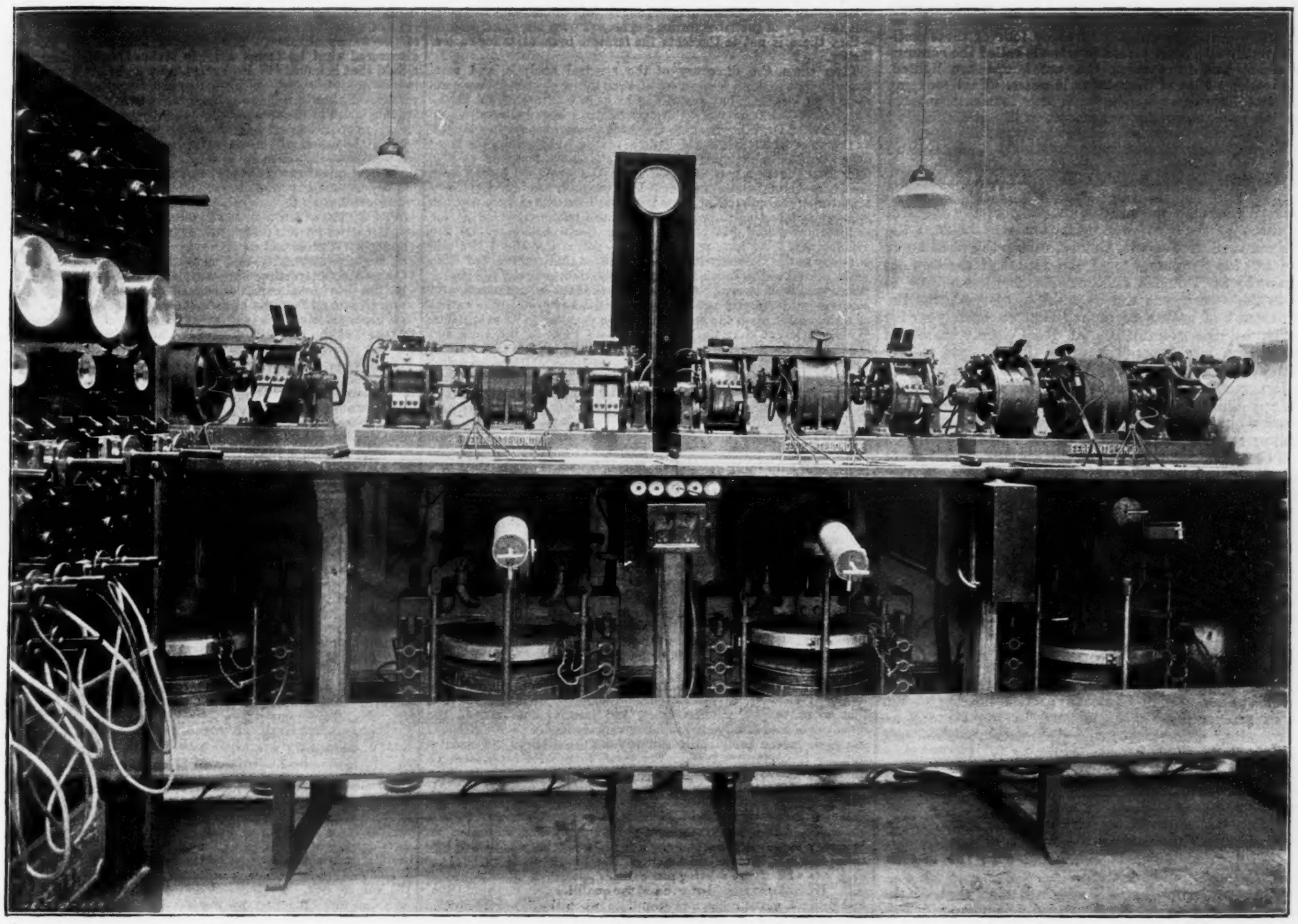
In the pump house are fixed three vertical three-throw single-acting pumps for feeding the boilers, each being capable of delivering 1600 gallons per hour to the boiler, against a pressure of 160 lb. per square inch. The steam cylinder of each pump is 4½in. diameter, 8in. stroke, the crank shaft being connected to the three-throw pump shaft by cast iron double helical spur wheels. The three rams of each pump are of brass, 3½in. diameter and 4½in. stroke, and make about sixty double strokes per minute. The water used in the boilers can be obtained from either of two sources, *i.e.*, the town supply or from a large storage tank erected in the building, and every precaution against breakdown or failure in this direction has been adopted in the way of the duplication of suction, feed, and steam pipes.

One Stanhope water purifier is provided for softening and treating 2000 gallons of exceptionally hard water per hour, with lime mixing, lime settling, mixing tower, softening and clarifying and soda tanks, &c., complete. A cast iron water storage tank is also provided, 28ft. 9in. long, 11ft. wide, and 10ft. deep.

There are two separate main ranges of steam pipes connecting boilers and engines, both being 10in. diameter, and made of lap-welded mild steel with cast steel flanges riveted on the pipes, with the elbows and tee pieces also of cast iron; all the flanges of each main steam range have shallow spigot and faucet joints, with drilled bolt holes, and are bolted together with turned steel bolts ⅞in. diameter pitched about 4in. from centre to centre. Each range of steam pipes is also provided with a mild steel water catcher, of ample size, with internal diaphragm complete, and also drain pipes and an efficient steam trap for effectually draining each range of steam pipes, in addition to which water catchers, with drain pipes and steam traps at the end of each main range are also provided. One of Messrs. Yates and Thom's eight-ton overhead hand power travelling cranes is fixed over the engines and dynamos, the span being 64ft. 9in. from centre to centre of the rails.

Looking at the fly-wheel of the engine, it is at first a little difficult to realise that one is looking at a powerful dynamo, so simple is it in its parts. The magnets of the field are, as we have said, fixed upon the periphery of the wheel. They are each formed of an iron core 9½in. long by 5in. in diameter, the pole pieces or extremities being about 5in. broad, and of the full length of the width of the armature, 17in., and each of these cores, of which there are sixty-four on the fly-wheel, is wound with copper strip, previously prepared in a special machine designed by Mr. Ferranti, the strip being ⅛in. thick and $1\frac{5}{16}$in. wide. It is insulated from the iron core of the magnet by means of vulcanised fibre, and each turn of the copper strip is insulated from its neighbour by fibre or shellaced paper, while the top and bottom of the coil are protected by rings of ebonite or fibre.

# PORTSMOUTH ELECTRIC LIGHT WORKS—FERRANTI RECTIFIERS



The armature frame is round the fly-wheel, and contains the various sections, which are formed of laminated iron, the copper winding of the bobbins, if they may be so-called, being threaded through slot holes through the plates—the necessary insulation being provided by lining tubes of mica having been previously inserted in the slot holes; and the ends of the bobbin coils are protected by gun-metal boxes, which are run up with insulating oil, and make a perfectly tight covering over the bobbins, which are thus protected against any possible mechanical injury. It will be seen from this that as the whole of the high tension part of the machine is therefore entirely covered, and that no part of the framework of the armature is in any way electrically charged when running, the chances of accident to the machine are remote to the last degree, the effects of deterioration of insulation due to atmospheric causes cannot exist, and consequently the life of the dynamo should be long and distinguished.

It makes a very simple machine, and as simplicity in design naturally means ease of overhaul when necessary, such a point will render this type, we are sure, much sought after in the future by the central station engineer. But besides the great advantage of the capability of ready overhaul, he will also possess, when he gets one of these alternators, a machine which, as it has all its vulnerable parts securely covered beyond the reach of dust or damp, of steam leakages or water from a defective roof, or of accident from any falling body, should reduce his anxieties to vanishing point. There is very little really trustworthy data as to the cost in power of rope transmission, though we happen to know that important experiments have recently been carried out by Mr. D'Alton, at Deptford, for the purpose of arriving at the truth, but we are of opinion that these losses have been clearly underestimated in the past, and that, therefore, the gain to Portsmouth in having its dynamos driven directly upon the engine shafts will be shown in the gain in efficiency as between the engine cylinders and the terminals of the dynamos, to be very considerable. The machines already at work in the station are of about 225 unit size, though it is anticipated that when they are required to produce a larger output both engines and dynamos will be found capable of easily carrying a load of 300 units. Provision is made in the station for a considerable increase in number of units of power, and already the foundations have been built for two more machines, which will doubtless be required for the rapidly increasing load of the near future, and the date, we venture to think, is not far distant when the Corporation will be called upon to complete the equipment of the entire station, which will then, it is understood, consist of ten large dynamos, with all necessary engines, boilers, and auxiliaries. The supply commenced with a connection of about 5000 incandescent lamps, of 16-candle power each, and of 100 arc lamps in the public streets; but so rapidly has the demand grown, that the Corporation finds itself quite unable to keep pace with the requirements of the townspeople, and some thousands of lamps are "waiting" for connection, with little prospect of being lighted for many months to come.

The system of transformation suggested by Mr. Ferranti and adopted by the engineers to the Corporation, is by means of street transformers, so placed that each one can be utilised for the supply of all consumers within a radius of 200 yards to 300 yards, the secondary sides of the converters feeding into a low-tension network at 100 volts or a little more, which network starts from each pit and supplies the consumers in the neighbourhood. Each transformer is fitted with suitable switches for the purpose of the alteration of its connections, and such alterations can be made at the will of the engineer in charge, which will alter the point of highest efficiency of the transformer, from full down to any particular point of the load. Thus in winter it might be desirable to work the transformers to give greatest efficiency at three-quarters to full load, while in the summer the best results would no doubt be obtained at, say, quarter load; or, again, it would probably pay the engineer to work them during the day time at such a point that their highest efficiency should be at a very light load, while he could alter his connections at night to a heavier output for best efficiency. Indeed, the changes which an engineer could ring upon these transformers as a whole are many, for it should be borne in mind that the demands of different districts vary greatly—the shopping neighbourhood would require to have its transformers treated in one way, the residential district in another, and those in which public-houses abound differently to others where churches most do flourish. It is proposed to make each transformer alter itself automatically in the future, but for the present the best automatic machine has been found to be a man with a suitable key.

S Z DE FERRANTI LIMTD

SWITCH BOARD

The arc lighting of the public streets and of the sea front was probably the most difficult problem which Messrs. Kincaid, Waller, and Manville, the engineers, and Professor Garnett were called upon to solve, and they can be congratulated upon no point more heartily than upon their success in this. The total number of arc lamp standards erected is just over the hundred, all of which are fitted with arc lamps of the double carbon type, made under the Brockie-Pell patents, and a large number of the standards are further provided each with a pair of 32-candle power incandescent lamps, which serve to provide sufficient lighting during the hours between midnight, when the arc lamps are switched out, and dawn, when the incandescents are in turn put out by an attendant. The incandescent lamps are, of course, provided with the necessary current from the nearest street transformer, the arc lamps having a distinct set of mains of their own from the commutator room of the central station. When the question of the arc lighting was being considered by the engineers, Mr. Ferranti had just completed some highly satisfactory work with his newly-designed motor commutator, or, as he prefers to call it, rectifier, at Faraday House; and when he showed it to the engineers they saw its great advantages, and after a lengthy investigation, adopted it for use at Portsmouth. It obviated the necessity of putting down a separate engine and dynamo for the arc lighting, gave them all the gain of additional steady long hour load upon the main dynamos, and great efficiency in plant use, for the dynamo and rectifier together, as against a separate arc light dynamo with its separate engine, steam pipes, &c., could not fail to show a high degree of economy in capital outlay, in space, and in steam, oil, and other stores, as well as in up-keep and attention, all of which means money. The rectifier consists of a motor, which is synchronous and self-starting, affixed to the middle of a short length of shaft, at either end of which is a commutator, the alternate sections of which are joined together in parallel, and each of these two groups of sections are joined in series to the similar sections of the commutator at the other end of the shaft. Three or four of these rectifiers have already been placed in what is called the commutator room, and from them the arc lamps are lighted, generally about forty of them being in series. Each arc lamp circuit has its own switch, and the little commutator room has all the appearance of a central station in miniature.

## THE BRITISH ASSOCIATION AT OXFORD.

Last Wednesday morning a meeting of the General Committee of the British Association was held in the new Examination Schools, Oxford, under the presidency of Dr. Burdon Sanderson, and the report of the Council was read by Sir Douglas Galton. Among the points set forth in the report was the desirability of rendering the total amount of grants of money allotted each year for research by the committees of the Association more uniform, and less dependent upon the receipts at any particular meeting of the Association. The Council therefore recommended "that it is not advisable to lay down any definite rules as to the amount to be expended in grants, but that, as far as circumstances permit, the following regulations should be adhered to:—(1) That £1000 be at present regarded as the normal annual grant in aid of research. (2) That this sum be annually granted, unless the estimated floating balance in the hands of the treasurer at the end of the current financial year is less than £500 or greater than £1000. (3) If the estimated balance falls short of £500, it is desirable that the grant should be reduced; if it exceeds £1000, the excess may be regarded as available for increasing the grant above £1000. (4) In the case of a sudden increase of the floating balance above £1000, due to an exceptionally large meeting, it is not desirable that the whole of the surplus should be spent at one meeting.

The report also contained a proposal to create three new sections, namely:—Section D, Zoology; Section I, Physiology; and Section K, Botany. The following foreign men of science have been elected by the Council as corresponding members of the Association:—Professor Christian Bohr, Copenhagen; Professor W. C. Brögger, Christiania; Professor W. Einthoven, Leyden; Professor Heger, Brussels; Dr. R. Hertwig, Munich; Dr. Hildebrand, Stockholm; and M. Henry Moissan, Paris. The Association has received an invitation to meet in Liverpool in 1896. The rest of the report of the Council dealt chiefly with subjects connected with the interior organisation of the Association.

The foregoing report was adopted, also that of the treasurer, Professor A. W. Rücker. The General Committee then voted a presentation of £100 to the assistant general secretary, Mr. George Griffith, for his arduous work in drawing up an index to the volumes of the British Association from 1861 to 1890. This most useful index is now in print. Mr. Eli Towerbutts, of Manchester, complained that before Tuesday afternoon all the tickets for seats in the body of the hall to hear Lord Salisbury's opening address had been taken, and that there was strong feeling in consequence among those who came later. One of the local secretaries said that he and his colleagues could not help it. On Monday, after the doors of the reception room were opened, a crowd of applicants for tickets burst down all barriers, and were supplied in the order of application. They unfortunately had not, at that time, a more suitable building in Oxford for the holding of the meeting of Wednesday night. The hall was two centuries old, and had never before been artificially lighted, but electric lighting had been introduced into it for the occasion.

### PRESIDENT'S ADDRESS.

The following lines are an abstract of Lord Salisbury's address, delivered on Wednesday night. Having glanced at the history of the connection of Oxford with the British Association, he went on:—

A study of the addresses of my learned predecessors in this office shows me that the main duty which it falls to a President to perform in his introductory address, is to remind you of the salient points in the annals of science since last the Association visited the town in which he is speaking. Instead, therefore, of recounting to you what has been done, or trying to forecast the discoveries of the future, I would rather draw your attention to the condition in which we stand towards three or four of the most important physical questions which it has been the effort of the last century to solve.

Of the scientific enigmas which still, at the end of the nineteenth century, defy solution, the nature and origin of what was called the elements is the most notable. It is not, perhaps, easy to give a precise logical reason for the feeling that the existence of our sixty-five elements is a strange anomaly and conceals some much simpler state of facts. But the conviction is irrestible. We cannot conceive, on any possible doctrine of cosmogony, how these sixty-five elements came into existence. A third of them form the substance of this planet. Another third are useful, but somewhat rare. The remaining third are curiosities scattered haphazard, but very scantily, over the globe, with no other apparent function but to provide occupation for the collector and the chemist. Some of them are so like each other that only a chemist can tell them apart—others differ immeasurably from each other in every conceivable particular. In cohesion, in weight, in conductivity, in melting point, in chemical proclivities they vary in every degree. They seem to have as much relation to each other as the pebbles on a sea beach, or the contents of an ancient lumber room. Whether you believe that Creation was the work of design or of inconscient law, it is equally difficult to imagine how this random collection of dissimilar materials came together. Many have been the attempts to solve this enigma; but up till now they have left it more impenetrable than before. A conviction that here was something to discover lay beneath the persistent belief in the possibility of the transmutation of other metals into gold, which brought the alchemy of the Middle Ages into being. When the immortal discovery of Dalton established that the atoms of each of these elements have a special weight of their own, and that consequently they combine in fixed ponderable proportions from which they never depart, it renewed the hope that some common origin of the elements was in sight. The theory was advanced that all these weights were multiples of the weight of hydrogen—in other words, that each elementary atom was only a greater or a smaller number of hydrogen atoms compacted by some strange machinery into one. The most elaborate analyses, conducted by chemists of the highest eminence—conspicuously by the illustrious Stas—were directed to the question whether there was any trace in fact of the theoretic idea that the atoms of each element consist of so many atoms, or even of so many half-atoms of hydrogen. But the reply of the laboratories has always been clear and certain—that there is not in the facts the faintest foundation for such a theory.

Then came the discovery of the spectral analysis, and men thought that with an instrument of such inconceivable delicacy we should at last find out something as to the nature of the atom. The result has been wholly disappointing. Spectral analysis in the hands of Dr. Huggins and Mr. Lockyer and others has taught us things of which the world little expected to be told. We have been enabled to measure the speed with which clouds of blazing hydrogen course across the surface of the sun: we have learnt the pace—the fabulous pace—at which the most familiar stars have been for ages approaching to or receding from our planet, without apparently affecting the proportions of the patterns which as far as historical record goes back they have always delineated on the evening sky. We have received some information about the elementary atoms themselves. We have learnt that each sort of atom when heated strikes upon the ether a vibration, or set of vibrations, whose rate is all its own; and that no one atom or combination of atoms in producing its own spectrum encroaches even to the extent of a single line upon the spectrum that is peculiar to its neighbour. We have learnt that the elements which exist in the stars and specially in the sun are mainly those with which we are familiar upon earth. There are a few lines in excess to which we can give no terrestrial name; and there are some still more puzzling gaps in our list. It is a great aggravation of the mystery which besets the question of the elements, that among the lines which are absent from the spectrum of the sun, those of nitrogen and oxygen stand first. Oxygen constitutes the largest portion of the solid and liquid substance of our planet, so far as we know it; and nitrogen is very far the predominant constituent of our atmosphere. If the earth is a detached bit whirled off the mass of the sun, as cosmogonists love to tell us, how comes it that in leaving the sun we cleaned him out so completely of his nitrogen and oxygen that not a trace of these gases remains behind to be discovered even by the sensitive vision of the spectroscope?

All these things the discovery of spectrum analysis has added to our knowledge; but it has left us as ignorant as ever as to the nature of the capricious differences which separate the atoms from each other, or the cause to which those differences are due.

In the last few years the same enigma has been approached from another point of view by Professor Mendeléeff. The periodic law which he has discovered reflects on him all the honour that can be earned by ingenious, laborious, and successful research. He has shown that this perplexing list of elements can be divided into families of about seven, speaking very roughly; that those families all resemble each other in this, that as to weight, volume, heat, and laws of combination the members of each family are ranked among themselves in obedience to the same rule. Each family differs from the others, but each internally is constructed upon the same plan. It was a strange discovery—strangest of all in its manifest defects. For in the plan of his families there were blanks left; places not filled up because the properly constituted elements required according to his theory had not been found to fill them. For the moment their absence seemed a weakness in the Professor's idea, and gave an arbitrary aspect to his scheme. But the weakness was turned into strength when, to the astonishment of the scientific world, three of the elements which were missing made their appearance in answer to his call. He had described beforehand the qualities they ought to have; and gallium, germanium, and scandium, when they were discovered shortly after the publication of his theory, were found to be duly clothed with the qualities he required in each. This remarkable confirmation has left Mendeléeff's periodic law in an unassailable position. But it has rather thickened than dissipated the mystery which hangs over the elements. The discovery of these co-ordinate families dimly points to some identical origin, without suggesting the method of their genesis or the nature of their common parentage. If they were organic beings all our difficulties would be solved by muttering the comfortable word "evolution"—one of those indefinite words from time to time vouchsafed to humanity, which have the gift of alleviating so many perplexities and masking so many gaps in our knowledge. But the families of elementary atoms do not breed; and we cannot therefore ascribe their ordered difference to accidental variations perpetuated by heredity under the influence of natural selection. The rarity of iodine, and the abundance of its sister chlorine, cannot be attributed to the survival of the fittest in the struggle for existence. We cannot account for the minute difference which persistently distinguishes nickel from cobalt, by ascribing it to the recent inheritance by one of them of an advantageous variation from the parent stock.

The upshot is that all these successive triumphs of research, Dalton's, Kirchhoff's, Mendeléeff's, greatly as they have added to our store of knowledge, have gone but little way to solve the problem which the elementary atoms have for centuries presented to mankind. What the atom of each element is, whether it is a movement, or a thing, or a vortex, or a point having inertia, whether there is any limit to its divisibility, and, if so, how that limit is imposed, whether the long list of elements is final, or whether any of them have any common origin, all these questions remain surrounded by a darkness as profound as ever. The dream which lured the alchemists to their tedious labours, and which may be said to have called chemistry into being, has assuredly not been realised, but it has not yet been refuted. The boundary of our knowledge in this direction remains where it was many centuries ago.

The next discussion to which I should look in order to find unsolved riddles which have hitherto defied the scrutiny of science, would be the question of what is called the ether. The ether occupies a highly anomalous position in the world of science. It may be described as a half-discovered entity. I dare not use any less pedantic word than entity to designate it, for it would be a great exaggeration of our knowledge if I were to speak of it as a body or even as a substance. When nearly a century ago Young and Fresnel discovered that the motions of an incandescent particle were conveyed to our eyes by undulation, it followed that between our eyes and the particle there must be something to undulate. In order to furnish that something, the notion of the ether was conceived, and for more than two generations the main, if not the only, function of the word ether has been to furnish a nominative case to the verb "to undulate." Lately, our conception of this entity has received a notable extension. One of the most brilliant of the services which Professor Maxwell has rendered to science has been the discovery that the figure which expressed the velocity of light, also expressed the multiplier required to change the measure of static or passive electricity into that of dynamic or active electricity. The interpretation reasonably affixed to this discovery is that, as light and the electric impulse move approximately at the same rate through space, it is probable that the undulations which convey them are undulations of the same medium. And as induced electricity penetrates through everything, or nearly everything, it follows that the ether through which its undulations are propagated must pervade all space, whether empty or full, whether occupied by opaque matter or transparent matter, or by no matter at all. The attractive experiments by which the late Professor Herz illustrated the electric vibrations of the ether will only be alluded to by me, in order that I may express the regret deeply and generally felt that death should have terminated prematurely the scientific career which had begun with such brilliant promise and such fruitful achievements. But the mystery of the ether, though it has been made more fascinating by these discoveries, remains even more inscrutable than before. Of this all-pervading entity we know absolutely nothing except this one fact, that it can be made to undulate. Whether, outside the influence of matter on the motion of its waves, ether has any effect on matter or matter upon it, is absolutely unknown. And even its solitary function of undulating ether performs in an abnormal fashion which has caused infinite perplexity. All fluids that we know transmit any blow they have received by waves which undulate backwards and forwards in the path of their own advance. The ether undulates athwart the path of the wave's advance. The genius of Lord Kelvin has recently discovered what he terms a labile state of equilibrium, in which a fluid that is infinite in its extent may exist, and may undulate in this eccentric fashion without outraging the laws of mathematics. I am no mathematician, and I cannot judge whether this reconciliation of the action of the ether with mechanical law is to be looked upon as a permanent solution of the question, or is only what diplomatists call a *modus vivendi*. In any case it leaves our knowledge of the ether in a very rudimentary condition. It has no known qualities except one, and that quality is in the highest degree anomalous and inscrutable. The extended conception which enables us to recognise ethereal waves in the vibrations of electricity has added infinite attraction to the study of those waves, but it carries its own difficulties with it. It is not easy to fit in the theory of electrical ether waves with the phenomena of positive and negative electricity, and as to the true significance and cause of those counteracting and complementary forces, to which we give the provisional names of negative and positive, we know about as much now as Franklin knew a century and a-half ago.

I have selected the elementary atoms and the ether as two instances of the obscurity that still hangs over problems which the highest scientific intellects have been investigating for several generations. A more striking but more obvious instance still is Life—animal and vegetable Life—the action of an unknown force on ordinary matter. What is the mysterious impulse which is able to strike across the ordinary laws of matter, and twist them for a moment from their path? Some people demur to the use of the term "vital force" to designate this impulse. In their view the existence of such a force is negatived by the fact that chemists have been able by cunning substitutions to produce artificially the peculiar compounds which in nature are only found in organisms that are or have been living. These compounds are produced by some living organism in the performance of the ordered series of functions proper to its brief career. To counterfeit them—as has been done in numerous cases—does not enable us to do what the vital force alone can effect—to bring the organism itself into existence, and to cause it to run its appointed course of change. This is the unknown force which continues to defy not only our imitation but our scrutiny. Biology has been exceptionally active and successful during the last half century. Its triumphs have been brilliant, and they have been rich enough not only in immediate result, but in the promise of future advance. Yet they give at present no hope of penetrating the great central mystery.

Lord Salisbury then proceeded to consider the relations of the geologist and the mathematician with the biologists, showing that their claims were contradictory, the latter assuming an antiquity for the earth which the others refused to admit, and then went on:—

Of course, if the mathematicians are right, the biologists cannot have what they demand. If, for the purpose of their theory, organic life must have existed on the globe more than a hundred million years ago, it must, under the temperature then prevailing, have existed in a state of vapour. The jelly-fish would have been dissipated in steam long before he had had a chance of displaying the advantageous variation which was to make him the ancestor of the human race. The gravest objection to the doctrine of natural selection was expressed by Weismann in a paper published a few months ago, not as agreeing to the objection, but as resisting it; and, therefore, his language may be taken as an impartial statement of the difficulty. 'We accept natural selection,' he says, 'not because we are able to demonstrate the process in detail, not even because we can with more or less ease imagine it, but simply because we must—because it is the only possible explanation that we can conceive. We must assume natural selection to be the principle of the explanation of the metamorphoses, because all other apparent principles of explanation fail us, and it is inconceivable that there could yet be another capable of explaining the adaptation of organisms without assuming the help of a principle of design."

There is the difficulty. We cannot demonstrate the process of natural selection in detail; we cannot even, with more or less ease, imagine it. It is purely hypothetical. No man, so far as we know, has ever seen it at work. An accidental variation may have been perpetuated by inheritance, and in the struggle for existence the bearer of it may have replaced, by virtue of the survival of the fittest, his less improved competitors; but as far as we know no man or succession of men have ever observed the whole process in any single case, and certainly no man has recorded the observation. Variation by artificial selection, of course, we know very well; but the intervention of the cattle breeder and the pigeon fancier is the essence of artificial selection. It is effected by their action in crossing, by their skill in bringing the right mates together to produce the progeniture they want. But in natural selection who is to supply the breeder's place? Unless the crossing is properly arranged, the new breed will never come into being. What is to secure that two individuals of opposite sexes in the primeval forest, who have been both accidentally blessed with the same advantageous variation, shall meet, and transmit by inheritance that variation to their successors? Unless this step is made good, the modification will never get a start; and yet there is nothing to ensure that step, except pure chance. The law of chances takes the place of the cattle breeder and the pigeon fancier. The biologists do well to ask for an immeasurable expanse of time, if the occasional meetings of advantageously varied couples from age to age are to provide the pedigree of modifications which unite us to our ancestor the jelly-fish. Of course the struggle for existence, and the survival of the fittest, would in the long run secure the predominance of the stronger breed over the weaker. But it would be of no use in setting the improved breed going. There would not be time. No possible variation which is known to our experience, in the short time that elapses in a single life between the moment of maturity and the age of reproduction, could enable the varied individual to clear the field of all competitors, either by slaughtering or starving them out. But unless the struggle for existence took this summary and internecine character, there would be nothing but mere chance to secure that the advantageously varied bridegroom at one end of the wood should meet the bride, who by a happy contingency had been advantageously varied in the same direction at the same time at the other end of the wood. It would be a mere chance if they knew of each other's existence—a still more unlikely chance that they should resist on both sides all temptations to a less advantageous alliance. But unless they did so, the new breed would never even begin, let alone the question of its perpetuation after it had begun. I think Professor Weismann is justified in saying that we cannot, either with more or less ease, imagine the process of natural selection.

It seems strange that a philosopher of Professor Weismann's penetration should accept as established a hypothetical process the truth of which he admits that he cannot demonstrate in detail, and the operation of which he cannot even imagine. The reason that he gives seems to me instructive of the great danger scientific research is running at the present time—the acceptance of mere conjecture in the name and place of, knowledge, in preference to making frankly the admission that no certain knowledge can be attained. "We accept natural selection," he says, "because we must—because it is the only possible explanation that we can conceive." As a politician, I know that argument very well. In political controversy it is sometimes said of a disputed proposal that it "holds the field," that it must be accepted because no possible alternative has been suggested. In politics there is occasionally a certain validity in the argument, for it sometimes happens that some definite course must be taken, even though no course is free from objection. But such a line of reasoning is utterly out of place in science. We are under no obligation to find a theory, if the facts will not provide a sound one. To the riddles which nature propounds to us the profession of ignorance must constantly be our only reasonable answer. The cloud of impenetrable mystery hangs over the development and still more over the origin of life. If we strain our eyes to pierce it, with the foregone conclusion that some solution is and must be attainable, we shall only mistake for discoveries the figments of our own imagination. Professor Weismann adds another reason for his belief in natural selection which is certainly characteristic of the time in which we live. "It is inconceivable," he says, "that there should be another principle capable of explaining the adaptation of organisms without assuming the help of a principle of design." The whirligig of time assuredly brings its revenges. Time was, not very long ago, when the belief in creative design was supreme. Even those who were sapping its authority were wont to pay it a formal homage, fearing to shock the public conscience by denying it. Now the revolution is so complete that a great philosopher uses it as a *reductio ad absurdum*, and prefers to believe that which can neither be demonstrated in detail, nor imagined, rather than run the slightest risk of such a heresy.

I quite accept the Professor's dictum that, if natural selection is rejected, we have no resource but to fall back on the mediate or immediate agency of a principle of design. In Oxford, at least, he will not find that argument is conclusive; nor, I believe, among scientific men in this country generally, however imposing the names of some whom he may claim for that belief. I would rather lean to the conviction that the multiplying difficulties of the mechanical theory are weakening the influence it once had acquired. I prefer to shelter myself in this matter behind the judgment of the greatest living master of natural science among us, Lord Kelvin, and to quote as my own concluding words, the striking language with which he closed his address from this chair, more than twenty years ago: "I have always felt," he said, "that the hypothesis of natural selection does not contain the true theory of evolution, if evolution there has been in biology. . . . I feel profoundly convinced that the argument of design has been greatly too much lost sight of in recent zoological speculations. Overpoweringly strong proofs of intelligent and benevolent design lie around us, and if ever perplexities, whether metaphysical or scientific, turn us away from them for a time, they come back upon us with irresistible force; showing to us through nature the influence of a free will, and teaching us that all living things depend on one everlasting Creator and Ruler."

The section which represents mechanical science, and chiefly applied mechanics from the engineer's point of view, meets in Keble College Hall, a hall which is usually devoted to much more festive occupation. Tables are turned aside to make room for seats and diagrams, and gastronomics will give place to discussions on subjects which provide the means for its study. An unusually large number of papers has been sent in before the commencement of the meeting, and a programme occupying the whole of the available time of the first five days of the meeting has been arranged. The following is the programme which will probably be followed:—

*Thursday, August 9th.*

Address by President, Professor A. B. W. Kennedy, LL.D., F.R.S.

Sir F. J. Bramwell, F.R.S., "Some Reminiscences of Steam Locomotion on Common Roads."

H. Davey, M. Inst. C.E., "Borehole Wells for Town Water Supply."

*Friday, August 10th.*

Joint meeting with Section A:—(*a*) Professor O. Henrici, F.R.S., "On Integrators, Harmonic Analysers and Integraphs, and their Application to Physical and Engineering Problems." (*b*) Discussion on flight. Joint discussion with Section A.

Lord Kelvin, President Royal Society, "On the Resistance Experienced by Solids moving through Fluids."

Professor T. Claxton Fuller, M. Inst. C.E., "The Strength and Plastic Extensibility of Iron and Steel."

M. Fitzmaurice, M. Inst. C.E., "Tunnel Construction by means of Shield and Compressed Air, with Special Reference to the Tunnel under the Thames at Blackwall."

*Saturday, August 11th.*

Sir A. Noble, C.B., F.R.S., "On the Measurement of the Pressures developed in the Bores of Guns."

B. Donkin, M. Inst. C.E., "The most Economical Temperature for Steam Engine Cylinders."

J. Kenward, F.S.A., "Lighthouse Apparatus, and Lighthouse Administration in 1894."

*Monday, August 13th.*

T. Parker, F.R.S.E., M. Inst. C.E., M. Inst. M.E., "Continuous Current Distribution of Electricity at High Voltage, being a description of the Lighting of the City of Oxford."

W. H. Preece, F.R.S., "Signalling through Space."

Professor S. P. Thompson, F.R.S., "Some Advantages of Alternate Currents."

H. Lea, M. Inst. C.E., "A Special Chronograph."

G. M. Clark, "A Direct-reading Platinum Pyrometer."

*Tuesday, August 14th.*

Professor W. C. Unwin, F.R.S., "Report of Committee on Dryness of Steam."

H. F. Burstall, M.A., A.M.I.C.E., "The Temperature Entropy Diagram."

J. Swinburne, "The Hunting of Governed Engines."

Professor D. S. Capper. M.A., M. Inst. C.E., "Engineering Laboratory Instruments and their Calibration."

Professor T. Hudson Beare, B.Sc., M. Inst. C.E., "Experiments on the effect of Piston Speed on Steam Economy."

Professor Everitt, "Spring Spokes for Bicycles."

Mr. E. G. Coker on "Torsional Strength of Solid and Hollow Shafts."

From this it will be seen that the programme is varied, and promises to afford the section plenty of interesting occupation.

The paper by Sir Frederick Bramwell is just now of peculiar interest, as showing how far mechanical engineers of from one to two generations ago were in advance of those of the present day in the conveyance of passengers by steam on common roads. They had arrived experimentally at results which it is not too much to say could not be surpassed even to-day with all the advantages of constructive facility which we now possess. These facilities we have not been able to employ to our advantage in consequence of legal restrictions which exist in no other country. The result is that while we were leading in steam conveyance on common roads from thirty to forty years ago, we are now very far behind those of some other countries, as has been abundantly proved in the recent competitive trials of road carriages in France, as reported in our columns. These trials have recalled attention to this subject, and few have in recent times so greatly interested mechanical engineers. The necessity for some change in our laws as affecting steam on common roads has for a long time been impressed on those who use agricultural locomotives, and the possibility now proved of using light vehicles for daily use is bringing the subject more prominently forward. We shall publish Sir Frederick Bramwell's paper in another impression.

## SIXTH INTERNATIONAL CONGRESS ON INLAND NAVIGATION.

(*By our Special Commissioner.*)

The numbers of members attending the Congress increased from day to day. At the first meeting on the Monday about 300 had notified their arrival, and during the week this number was nearly doubled. The subjects which provoked most discussion were the question of tolls and the training of rivers.

On the 27th ult. a large party left by special train for Amsterdam, where steamers were in readiness to take the visitors to the entrance works of the new canal for connecting the port with the Rhine *viâ* the Mermede. The sewage of Amsterdam is syphoned under this canal into the Zuyder Zee. The entrance locks built two years ago to accommodate the large Rhine barges were passed. The steamers then turned back.

The Canal du Rhin enters the port at its easterly limit, and the steamers proceeded along the front of the quays and wharves for a distance of nearly six miles, to the newly constructed petroleum harbour, three-quarters of a mile west of Hoathaven. Several miles of quays were passed provided with warehouses, sheds, and lines of railway, all ready to deal with a large traffic, and statistics show that the tonnage by the Amsterdam Ship Canal has grown from 3,965,192 tons in 1877, the year in which the Canal was opened, to 10,485,138 tons in 1892. During the same period, the register tonnage of all vessels using the port has increased from 2,431,715 tons to 4,512,347 tons. The number of vessels remains almost exactly the same, although the tonnage has increased 86 per cent. Plans have been prepared for extending the quays and accommodation generally whenever the conditions of the trade of the port render this desirable.

Having returned to the landing stage near the centre of the port the company disembarked and partook of the hospitality of the city of Amsterdam, an excellent luncheon being provided in two large rooms at the railway station. After doing justice to this, a move was made to Ymuiden by special train, where the new lock under construction was visited. The foundations are laid on fine sand, no piles are employed, but the walls and chamber, as well as the gate platforms, rest on concrete. The walls are almost entirely of brick. The gate sills, hollow quoins, square quoins, and coping, are of limestone; lime, mortar mixed with sand, is employed in building the walls. The dimensions of the lock are 740ft. long, 82ft. wide, depth below the level of canal 31ft. 6in. The Government have specified these dimensions to enable the largest ships of war to enter and use the canal when necessary. The largest lock of the existing entrance is small in comparison, being no more than 393ft. 6in. long, 59ft. wide, and 24ft. 6in. below canal level. The new lock is to be connected with the existing ship canal and harbour by a cutting $1\frac{2}{3}$ miles in length, having a bottom width of 105ft. 6in., a depth of 26ft. 10in. below canal level, and slopes below water of about 5 to 1. It will be observed that the depth of the lock sills will allow of considerable deepening of this canal. The estimated cost of the works is £550,000, and they are expected to be completed in 1896.

Steamers were again provided to take the members to look at the piers and the outer harbour of Ymuiden. This was a very enjoyable part of the day's proceedings. Three dredgers were at work, and these are required to remove about 800,000 cubic yards of sand and silt per annum to keep open the channel from the dock to the North Sea.

The final meeting of the Congress was held in the Great Hall of the Academy on Saturday, July 28th. During the earlier proceedings this had been occupied by No. I. section, in which papers were read on canal construction. Section II. dealt more particularly with the difficulties encountered in breaking up ice and clearing navigations of this obstruction, as described in our last impression. Drawings of steamers especially built for the purpose were exhibited.

Section III. was devoted to the consideration of the toll question, and Section IV. with the training of rivers. All the sections held their meetings in the same building, which was a great convenience. Unfortunately, many of the papers had not been translated into English or French, and the discussions were not as full as they would otherwise have been.

A very important question was submitted to the final meeting, viz., whether the International Congresses on inland navigation and on maritime works, viz., docks and harbours, should continue to be held separately or be united. After considerable discussion, in which the representatives of England, France, and most other countries—Germany alone dissenting—spoke in favour of amalgamation, it was voted that the two should henceforward be fused under the title of the "Congress on Navigation." It was further determined that the invitation of the representatives of Italy to hold the next Congress in that country should be accepted.

After a hearty expression of thanks to our Dutch hosts for the very kind manner in which they had received the members, and for the great and successful exertions made for their entertainment, both mental and physical, the Congress separated.

In the evening the Comte and Comtesse de Bylandt held a reception, to which members of the Congress were invited, and they will long remember the noble and generous manner in which they were entertained.

On the 30th the excursion was to Haarlem, and the great pumps for draining Haarlemeer were visited. Eight pumps 6ft. in diameter, with a stroke 9ft. 10in., are placed at Linden, and lift the water a height of 16ft. 5in. Seven of these were at work and one in reserve. This machine, with another of eleven pumps 5ft. 3in. diameter, with a similar stroke and lift, are employed to pump an area of 18,100 hectares, or 44,700 acres.

At Haarlem the party embarked on a steamer which proceeded to the Amsterdam Ship Canal and along the canal for several miles to Zaandam, noted for its numerous windmills, and as having been the residence of Peter the Great when he betook himself to learning the art of shipbuilding.

It was noticed what an effective protection was afforded to the slopes of the canal by the reeds growing along its edge. These are self-sown on the Herm. A railway bridge was opened for the passage of the steamer, and as this line has been made since the Ship Canal was constructed, it shows that the Dutch are not afraid of swing bridges. At first the Vetser Bridge was the only crossing.

## LEGAL INTELLIGENCE.

### NISI PRIUS COURT, MANCHESTER.

(*Before* Mr. Justice Collins *and a Special Jury.*)

REDDAWAY *v.* BANHAM.

The hearing of this case, which was commenced on Wednesday, July 18th, was resumed on the 21st. Mr. Gully, Q.C., M.P., Mr. Byrne, and Mr. J. C. Graham, were for the plaintiffs, Mr. F. Reddaway and Messrs. F. Reddaway and Co., belt manufacturers; while Mr. Bigham, Q.C., Mr. M'Call, Q.C., and Mr. Sutton, were for the defendants, Mr. George Banham and Messrs. G. Banham and Co., also belt manufacturers. The action was brought to obtain an injunction restraining the defendants from continuing to use the word "camel" in such a manner as to deceive purchasers into the belief that they were getting goods manufactured by the plaintiffs, and also to recover damages. It was stated that Mr. Reddaway had used the term "camel hair belting" since 1879, and has spent about £18,000 in advertising it. He had adopted the figure of a camel as a trade mark. It was now, he stated, well known throughout the world, particularly in India, and it was part of the plaintiffs' case that camel hair belting had become synonymous with Reddaway's belting. In 1891 Mr. Reddaway found that a number of other firms had taken the name. In one case he took legal proceedings and obtained an injunction, and in all the other cases, except one, his competitors ceased to use the name camel hair belting, the exception being the present defendants.

When the hearing of the case was resumed on the 21st the Judge, in reply to Mr. Bigham, said the question at issue must go to the jury.

Mr. Bigham urged that there was no case to go before the jury, inasmuch as no injunction could restrain a man from correctly describing his goods as being made of a certain material.

The Judge said he would take a note of the objection.

Mr. Bigham, in opening the case for the defendants, pointed out that the action was not brought to restrain them from infringing a patent. Mr. Reddaway did not object to Mr. Banham making a belting exactly similar to his own in every respect, but what he did object to was that Mr. Banham should call it camel-hair belting. Counsel denied Mr. Reddaway's right to raise this objection, and contended that any man might describe his goods as being of a certain material, or as being made in a certain way, and so long as the description was true nobody could interfere with him. As a matter of law he was entitled to say of his goods what was the truth. He proposed to show the jury by abundant proof that the material used by Mr. Banham, like that used by Mr. Reddaway, was camel-hair yarn; and if he could satisfy them on that point he should ask the Judge to tell them that the defendants were entitled so to describe their goods, and so to stamp, invoice, and sell them. It appeared to him therefore that the whole question upon which the case turned was, aye or no, was this camel-hair belting truly described?

Evidence was given by expert witnesses to show that the defendants' belting was made of camels' hair.

Mr. George Banham, in cross-examination by Mr. Gully, said there might or might not be a written agreement between George Banham and Co. and Julius Rolla, of Frankfort, granting the sole agency for the sale of Banham's manufactures in Germany to the latter person. Subsequently he admitted that there was such an agreement, but explained that he did not know whether the agreement was "ratified" or not. He had got counsel's opinion to the effect that the agreement was not valid. A circular issued by Rolla advertising Banham's camel-hair belting was a little different from a similar circular of Reddaway's, but not much. He never saw the circular till July, 1893, when he wrote to tell Rolla to discontinue using it. He was not aware that Rolla was still using the circular.

The Judge, in summing up, told the jury that the one question that lay at the root of the whole matter was whether the name "camel-hair belting" was so closely identified with the plaintiffs' manufacture that in the market and among people who dealt in the material the term was understood to mean Reddaway's belting. The plaintiffs' case depended upon their being able to prove that condition, and should they fail to establish it they had no case at all. His Lordship pointed out that even although the defendants' description of their belting was a true description, yet that would not be a conclusive argument in their favour if the jury were of opinion that the term "camel-hair belting" had acquired on the market, *prima facie*, the meaning "Reddaway's belting." In conclusion the Judge handed the jury a list of four questions which he desired them to answer, yes or no.

The jury returned twice, each time professing their inability to answer the questions, but at the same time stating that they had arrived at a "plain verdict." His Lordship urged them on each occasion to reconsider the matter. In mercy to the parties, he remarked, they ought to come to a conclusiom on each and all of the questions. Eventually the jury agreed, replying to the different questions as follows:—

(1) Does camel-hair belting mean belting made by the plaintiffs as distinguished from belting made by other manufacturers?—Yes.

(2) Or does it mean belting of a particular kind without reference to any particular maker?—No.

(3) Do the defendants so describe their belting as to be likely to mislead purchasers and to lead them to buy the defendants' belting as and for the belting of the plaintiffs?—Yes.

(4) Did the defendants endeavour to pass off their goods as and for the goods of the plaintiffs so as to be likely to deceive purchasers?—Yes.

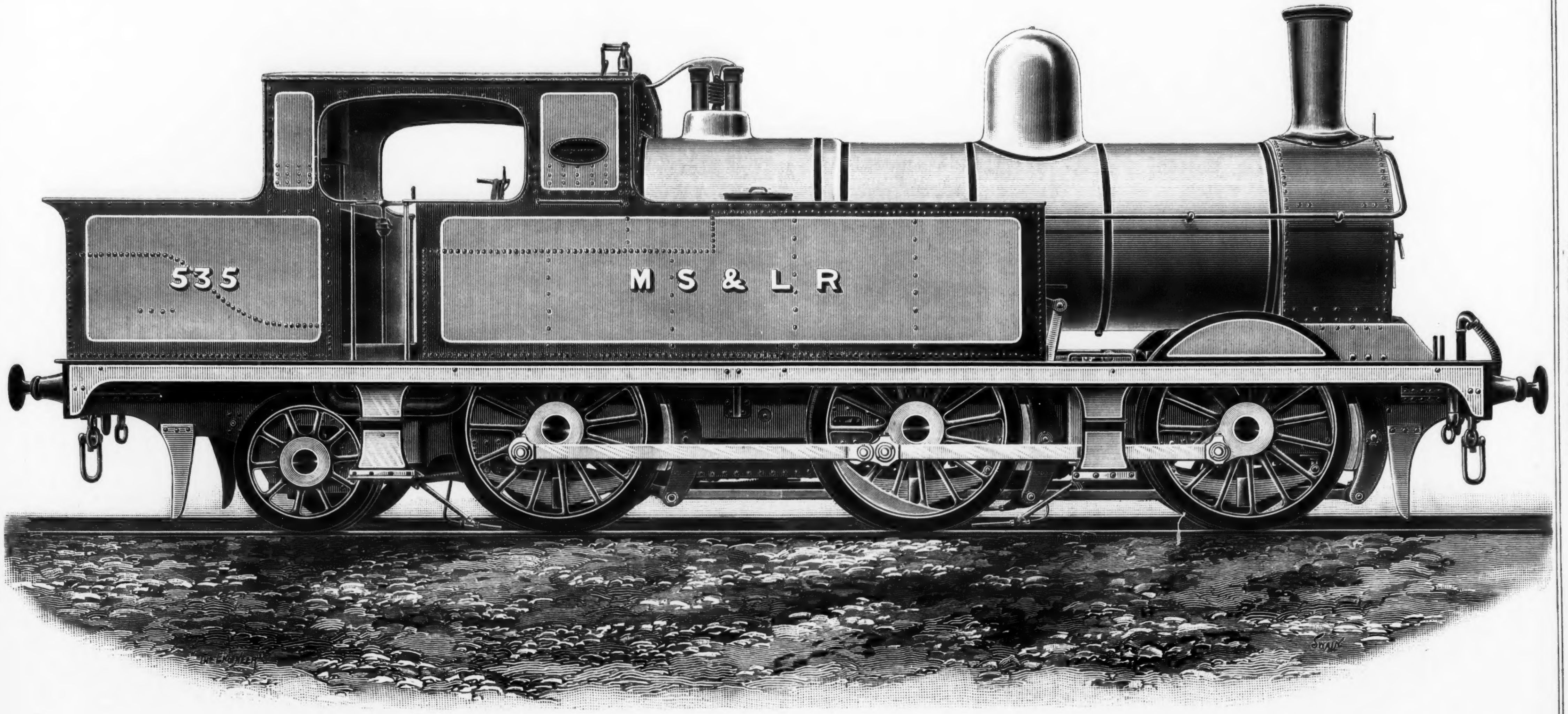
In accordance with this verdict his Lordship gave judgment for the plaintiffs with costs on the higher scale.—*Manchester Guardian.*

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineers: Frederick G. Whittaker, to the Conquest; C. E. Stewart to the Vivid, additional, as engineer overseer of her Majesty's ships Dido and Isis. Staff engineers: John W. Hole, to the Talbot; William S. Stribling, to the Hecate; Charles Dawe, to the Majestic. Chief engineer: John M. Downer, to the Seahorse, to date July 1st. Engineers: R. D. Donohue, to the Traveller, to date July 18th; John W. Pleming and J. H. Barry to the Dryad, to date July 20th. Acting engineer: William H. Beckett to the Royal Arthur.

# GOODS ENGINE, MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILWAY

MR. J. PARKER, GORTON, ENGINEER

(*For description see page* 121)



## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

## CONTENTS.

THE ENGINEER, August 10th, 1894.

NOTES ON THE STRENGTH OF FRAMED STRUCTURES AS AFFECTED BY ELASTICITY. (Illustrated.) .. .. .. 117
INSTITUTION OF MECHANICAL ENGINEERS .. .. .. 118
GOODS ENGINE, MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILWAY. (Illustrated.) .. .. .. 121
THE NEW UNITED STATES CRUISER MINNEAPOLIS. (Illustrated.) .. 121
THE ELECTRIC LIGHTING OF PORTSMOUTH AND SOUTHSEA. (Illus.) .. 122
THE BRITISH ASSOCIATION .. .. .. 124
SIXTH INTERNATIONAL CONGRESS ON INLAND NAVIGATION .. .. 125
LEGAL INTELLIGENCE .. .. .. 125
LEADING ARTICLES—The Marine Boiler of the Future—American Armour .. .. .. 127
Glasgow Corporation Tramways—The Coalfield under the Settlement—The New Standedge Railway Tunnel .. .. .. 128
GERMAN MACHINERY AT THE ANTWERP EXHIBITION .. .. .. 128
THE DESIGN OF MAIL STEAMERS, WITH SPECIAL REFERENCE TO THEIR USE FOR WAR PURPOSES. (Illustrated.) .. .. .. 129
MAXIM'S FLYING MACHINE. (Illustrated.) .. .. .. 130
LETTERS TO THE EDITOR—Carnot and Modern Heat—Entropy—Heat and the Steam Engine—The Daring and the Hornet .. .. .. 132
RAILWAY MATTERS .. .. .. 133
MISCELLANEA .. .. .. 133
NOTES AND MEMORANDA .. .. .. 133
DESCRIPTION OF TWIN-SCREW PROPELLERS WITH ADJUSTABLE IMMERSION FITTED ON CANAL BOATS .. .. .. 134
BRITISH SOCIETY OF MINING STUDENTS .. .. .. 134
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. .. 134
Notes from Lancashire—The Sheffield District—The North of England .. .. .. 135
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. 136
IRON AND STEEL INSTITUTE—BRUSSELS MEETING .. .. .. 136
AMERICAN NOTES .. .. .. 137
LAUNCHES AND TRIAL TRIPS .. .. .. 137
ON SULPHUR IN CAST IRON .. .. .. 137
THE PATENT JOURNAL .. .. .. 137
SELECTED AMERICAN PATENTS .. .. .. 138

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

C. W. V.—*(1) We believe that the pumping engine business has been closed, but the mining machinery business is carried on as heretofore. (2) From four to five years ago. We cannot answer the second part of this question.*

B. A. T.—*Many rotary meters have been patented. Yours is but a modification. None of them are positive. They all pass more water than the theoretical quantity, because of leakage past the vanes. Consequently they have each to be calibrated and its coefficient ascertained. But this coefficient only holds good for a stated pressure and rate of revolution. As a rule the percentage of leakage increases very rapidly as the quantity of water passed diminishes. Your scheme does not get over this objection.*

J. D. (Brighton).—*The American yacht Vigilant is not in the least like the old style of cutter yachts. She has sloping spoon-shaped bows. She has the equivalent of a great fixed centre board, at the bottom of which is a large mass of lead ballast shaped as a parabolic spindle of least resistance. There is next to no dead wood at the bow or stern, and no keel in the usual sense of the term. She is more like a gigantic "half rater" perhaps, than anything else, and the absence of dead wood enables her, like a half rater, to turn almost in her own length. She is painted light French grey, nearly white. The Britannia is painted black.*

### SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

THIN PAPER COPIES—
*Half-yearly* .. .. .. £0 18s. 0d.
*Yearly* .. .. .. £1 16s. 0d.
THICK PAPER COPIES—
*Half-yearly* .. .. .. £1 0s. 3d.
*Yearly* .. .. .. £2 0s. 6d.

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

### MEETINGS NEXT WEEK.

THE JUNIOR ENGINEERING SOCIETY.—August 18th to 25th. Summer excursion to Cardiff and District. Saturday morning, August 18th, leave Paddington—G.W. Railway—for Weston-super-Mare. Monday, Cardiff, Bute Docks, Cardiff Iron and Steel Works of the Dowlais Iron Company, and the Cardiff and Tin Stamping and Enamel Works. Tuesday, new coal pits of the Dowlais Iron Company, and Cyfarthfa Ironworks in the morning; Tin-plate Works and Llandaff Cathedral in the afternoon. Wednesday, Barry Docks, Cardiff Electric Light Station. Thursday, Newport, Mon., steamer from Cardiff for trip up the Bristol Channel and River Usk, St. Julian's Brickworks, Newport Ropery Works, Alexandra Docks, Isca Foundry, Spittle's Foundry, and Mordey, Carney, and Company's Dry Docks. Friday, visit Taff Vale Railway Locomotive Shops, Lloyd's Bute Proving House, Works of the South Wales Glass Manufacturing Company, and a Railway Carriage and Wagon Works. Saturday morning, August 25th, Tintern, Wye Valley, Tintern Abbey, Portskewett Pumping Station of the Severn Tunnel, London *viâ* Severn Tunnel.

# THE ENGINEER.

*AUGUST* 10, 1894.

### THE MARINE BOILER OF THE FUTURE.

THE papers read before the Institution of Naval Architects at the last three meetings of this body held respectively in Cardiff, London, and Southampton, and the discussions which followed, supply ample evidence that an important change in marine boiler construction is imminent. It has, of course, been long known in a general way that various forms of boilers, more or less unlike the Scotch boiler, were finding favour with the Admiralty and with shipowners. But the proceedings of the Institution of Naval Architects have given form and substance to various more or less vague statements. Indeed, it is one of the special functions of such associations to collect facts and to aggregate them; and to substitute definite and precise information for vague rumours. In spite of very free denials, it is now indisputable that shipowners are beginning to look with favour on the water-tube generator. Matters are now indeed in very much the same condition as they were twenty-five years ago.

The compound engine was then being tried with caution and hesitation. Setting aside such vessels as the Thetis and Propontis, which worked at fairly high pressures, numerous ships could be named in which pressures of 30 lb. and 35 lb. were used with compound engines and surface condensers. The success attained was such that engineers took heart of grace and ventured to make boilers carrying 60 lb. No harm followed. These boilers did not blow up or burn out, and they gave the compound engine a chance. Then came thick steel plates and corrugated flues; and so pressures crept up, and the triple-expansion engine was among us almost unawares. Improvement after improvement was made in the engine, but the type of boiler remained the same. From first to last the advance was made with difficulty. There were unceasing disputes with the Board of Trade, which very vigorously opposed the effort to carry high pressures in the Scotch, or indeed in any other kind of boiler. When pressures of 160 lb. had been reached a lull ensued, and for about ten years very little has been done in the way of change. Various causes have, nevertheless, been silently at work; among these may be mentioned the extreme lowness of freights, which has rendered economy of fuel imperative. The demand for high speeds; the adoption of forced or assisted draught; the failure of Admiralty boilers; all these things have operated to stimulate invention—and what is more to the purpose, to induce engineers and shipowners to consider inventions however audacious, instead of putting them aside almost without a thought.

Thus, then, we find ourselves now in the midst of a change in marine boiler engineering; and it is well that engineers and shipowners should consider in what direction they are drifting. The man who maintains that things as they are are good enough for him, will find himself out of the race in a very brief period. It is a quite familiar fact that none of the older class of steamers can be made to pay. We doubt if there is now running any screw steamer, of fair size, with compound engines. Mr. Asplin's engines in Messrs. Leyland's steamers are, it is true, compound; but they are really, if we may say so, triple-expansion engines with the intermediate cylinder suppressed, working with high ratios of expansion and high pressures. Just as the compound engine and 80 lb. steam cannot compete with the triple-expansion engine and 160 lb. steam, so it will be found that these last cannot compete with engines working with 200 lb. steam, generated in boilers differing more or less from the Scotch boiler. This pressure is not in extended use yet, but it will be in a very short time—possibly by the end of the year. The question is, what will the new steam generator be? At the present moment every marine engine building firm of importance throughout the kingdom is either patenting, experimenting with, or building water-tube boilers of some kind. It remains, of course, to be seen which of all these will survive the test of a life at sea. Possibly the water-tube boiler of the future has yet to be invented or discovered. On the other hand, those who perused Mr. Ellis' paper read last year at Cardiff, and Mr. Gross' paper read this year at Southampton, cannot fail to see that Sir J. Brown and Co. are determined that the Scotch type of boiler shall not be superseded without a struggle. The results obtained with the Serve tube and induced draught have been so far, remarkable and satisfactory in the highest degree, and we specially commend Mr. Gross' paper, as published in our last impression, to the attention of our shipowning readers. Mr. Gross' reply to the criticisms passed on this paper was extremely impressive—much more impressive than can be gathered from any report of the discussion. It must be understood that what he had read was read in the presence of men highly competent to dispute the accuracy of his statements or the soundness of his reasoning. The impressiveness of his reply was due to the way in which he explained the scrupulous care that had been taken to eliminate every doubtful statement. He himself, or the other representatives of Sir John Brown and Co., might be quite certain of a given truth, but unless the evidence was not only sufficient to give them certainty, but to be absolutely irrefragable in the widest sense as well, Mr. Gross said nothing about it in his paper. It is to be remembered that the efficiency of the Serve tube is a thing on the whole opposed to the results of the researches of such men as Peclet. Then, again, that air heating tubes should take up heat as they do is contrary to the experience of inventors of hot air engines; but there are the facts, and if they do not agree with theory, so much the worse for the theory.

But it is not the Serve tube alone that commands success. Mr. Gross consumes heroic quantities of coal in comparatively small furnaces, and neither burns his grate nor his boiler. Mr. Martin has for years advocated induced draught, and got well laughed at for his pains. But there is an old adage which says that "he laughs best who laughs last," and we fancy that Mr. Martin will laugh last in this case. No doubt it does seem absurd that if air is drawn through a fire by a fan at the root of the chimney the boiler will not be injured; whereas if the same fan forced air through the fire, leakage would be set up at the tube ends. But it only seems absurd because we are so ignorant of what really takes place in a boiler and a furnace. There is, again, no tangible reason why raising the inner ends of the grate bars 3in. or 4in. should prevent them from being melted. Neither Mr. Ellis nor Mr. Gross has suggested any explanation of the fact, but there it is. Bars, which, when set in the ordinary way, are melted in half-an-hour, will endure a month's incessant steaming with little injury when set as Mr. Gross has described. With his facts and his figures before him, we are not surprised to find that Mr. Gross thinks that as much may be done with the Scotch boiler as with any water-tube boiler in the market. Then we have Mr. Howden. He prejudices his own case by injudicious statements; but solid facts remain, and prove that he has certainly effected improvements of great value. No doubt all these changes in construction represent augmented first cost; but the shipowner cares next to nothing for this if only he can see his way to an adequate return for his money. The inventor need not be deterred by the cost of his invention; but he must be prepared to prove that the outlay will pay.

It may be asked what is the benefit to be derived from the use of tubulous boilers, or Howden's system, or the Serve tube, or any other device of the kind, seeing that none of them claim to effect any enormous augmentation of economical efficiency. The reply is that at sea a saving in weight and space is often of quite as much value as a considerable saving in coal. Thus, for example, if a boiler-room can be shortened 2ft. or 3ft., that usually means an addition to the cargo space of the entire cross-section of the ship 2ft. or 3ft. long. A saving in coal again means not only the saving in the cost of fuel, but a reduction in bunker space. Again, increased boiler efficiency, weight for weight, means, other things being equal, an increase in power and speed, which may be matters of very great, or in warships of the last, importance. But beyond all these things there is a curious and most influential element in the whole matter, the effect of which must not be overlooked. This is fashion. It is certain that mankind is imitative in every phase of life. If one shipowner adopts an improvement, somebody else is certain to follow suit. Thus we sincerely believe that if water-tube boilers became the fashion it would be next to impossible to get an order for any other type of generator. It is not to be supposed that this follow-my-neighbour system is adopted blindly or without due reason, at all events at first; on the contrary, it is usually the result of a sincere conviction that what is done by majority is right. But be this as it may, we have the fact that at the present moment the unmodified Scotch boiler is going out of fashion, and something else is coming in. What that will be remains to be seen. If Sir John Brown and Co. can get such results in the future, and on an extended scale, as are set forth in Mr. Gross' paper, it would be rash to assert that the tubulous boiler is going to have it all its own way.

### AMERICAN ARMOUR.

WE fear that our readers must have had too much of armour lately. It is therefore desirable to deal with certain recent matters very briefly, although there are some points of interest and considerable importance. We have received further accounts of the Government investigation of the Carnegie plates on which fines were exacted. There is, however, in all these nothing that we can see to shake the view that we endeavoured to put before our readers. The armour-plates we think were very likely quite up to the standard of those that are accepted generally and used on the sides of the finest ships afloat. We think that the United States Government used the condition laid down as to manufacture in a way that pressed very hardly, if not unfairly, on makers. At the same time, all this refers to degrees of excellence to be attained; now the main point at issue was the tampering with plates after selection. Mr. Frick says he knew nothing of it; but he surely does not need to be told that the head of a great establishment is responsible for what takes place, and if he employs men who throw dust in his eyes the consequences must in all fairness fall on him, not on the Government, especially as by some means they discovered for themselves what he ought to have discovered. The matter does not really call for further remark.

To pass on to other questions. Two contradictory reports appear in the *Times* of August 2nd and August 7th of an important trial of a Harvey 17in. or 18in. plate made at Carnegie's according to the former account, and at Bethlehem according to the latter. It was attacked by 12in. projectiles weighing 850 lb. The first shot struck with a velocity of either 1410 or 1465 foot-seconds. The second with 1858, or else with 1926 foot-seconds, according to which account is correct. We give the figures of the report of August 2nd in each case first. The discrepancy in the accounts of the results obtained are much greater than in the above figures. According to the account of August 2nd, the first shot, a Carpenter projectile, "burrowed" 13·6in. into the plate, and rebounded practically intact. The second, a Wheeler Stirling shot—the first of this kind yet tried—went through the plate, through 42in. of oak backing and 3ft. of support, then through 15ft. of earth, and "out over the hill and through the woods 300ft. beyond." Its original point had been fused and bruised away, as had that of the first shot, while several spiral cracks on the surface reached half way down the body. The shot hole made by the first round had a "halo" of fine cracks, 4in. wide. That of the second had a bulge 26in. in diameter, and 1·4in. high, with "only twenty-seven radial cracks about 5in. or 6in. long." The plate appeared rather harder and flaked more at the second point of impact. In the *Times* of August 7th, Mr. Fox, writing as the agent to the Harvey Steel Company, tells us that the plate had structural defects and was unfit for test. It was 18in. thick, not 17in. It was from Bethlehem, not from Carnegie's. The first shot only penetrated 8in. and broke into small pieces, leaving the plate uninjured practically, "not a single crack being developed." The second shot only penetrated 1in. deeper, and broke into many pieces as before. "The plate was accepted by the Government as exceeding the official requirements, and carried with it the acceptance of the entire lot of which it was the sample, namely, 660 tons."

The differences between these two accounts are indeed startling, so much so as to shake faith in the reports of American trials, we fear. We need hardly point out that the writers are obviously interested on opposite sides. He of August 2nd writes as an eye-witness, but he is reckless in his figures. His calculated energies are 1410 and 2370 foot-tons. Mr. Fox makes them 12,660 and 21,880 foot-tons. We make them 12,650 and 21,860, practically agreeing with Mr. Fox. Then the eye-witness evidently rejoiced to see one shot "burrow" into the plate, and the other bounding into the woods, after riddling everything. Very naturally Harvey's agents are much shocked at the character, to say nothing of the tone, of this report. Evidently the contradiction—for correction is too mild a word—which they have now given us is the result of inquiry. We cannot, however, say that the case is disposed of. We cannot conceive that the "lie circumstantial," as Shakespeare calls it, can be told with the vigour here displayed. We think it is necessary to suspend judgment for a time, and wait for further explanation. The sense of wrong has, we think, made Mr. Fox protest too much. The plate, according to him, started by being so defective that it was unfit for test. Nevertheless it was tested, and behaved so triumphantly, that 660 tons, "*of which it was the sample*," were accepted. Is not this a little like the woman who was sued for breaking a pot, when she pleaded "it was cracked when I got it, it was whole when I returned it, and besides, I never had it at all?" We calculate the first round as a very mild test on either set of figures. The second was a severe one; but with an inch difference in reported thickness of plate, and results all in hopeless contradiction, it is idle to proceed further.

Finally, we would suggest some curious conclusions that follow from comparing recent American with Russian and other continental trials of treated plates. At Texel, in 1893, projectiles entered more deeply into a treated than into an untreated plate until the velocity exceeded 1600ft., when they broke against the treated faces. At Gavre in April, 1893, a projectile broke against a 10·54in. Harveyised plate, at 1901ft. velocity, with only 6·6in. penetration; but when the velocity reached 2132 foot-seconds, the shot perforated without fracture, passing on 200 yards; and again, at 2296 foot-seconds it again perforated, and ricochetted about 2000 yards beyond the target unbroken.

So far as these experiments go, they suggest that the treated face has power to break the projectile, and so destroy its effect, between 1600 and perhaps 2000 foot-seconds velocity, but fails both below and above that range of velocities; and in each case there was more than one example. On the other hand, Russian recent trials show that by means of some device—probably a steel false point—the sudden action of fracture of the treated surface of the plate may be prevented, and perforation obtained. All this looks bad for Harvey; nevertheless, we should not take it too seriously. The results of other experiments do not agree with these. The range of velocity at which the hard face acts includes nearly all the serious velocities on service; and the Russian secret shot have yet to be shown to be a device available for service conditions. We do not know enough of them yet to say much. Certainly it must be, under most conditions, a very great advantage to give a plate a very hard face, unless we greatly injure its mass by so doing. All that we should argue from the above is that there is sufficient ground for making certain trials with treated plates, especially with a view to service conditions. It is probable that the direct attack to which they have nearly always been subjected does not really show the full powers that they possess.

◆◆◆

### GLASGOW CORPORATION TRAMWAYS.

The most recent and also one of the most important of Glasgow's municipal undertakings, the acquisition of the city tramways, has now been fairly ended, and after fully a month's working it is pretty clear that from a passengers' point of view the new order of things, allowing for some inevitable shortcomings, is an improvement on the old. When some few years ago it was decided to make the working of the tramways a Corporation department on the expiry of the old company's lease at the end of June, 1894, the citizens were promised great things in the way of mechanical traction. The tramway committee discussed electric, steam, gas, cable, and other systems of haulage enthusiastically, and visited almost every city in the world where anything bearing on the question could be seen and reported upon. Ultimately, however, the committee found it impossible to decide upon any mechanical scheme of traction, and moreover if such had been fixed on there were very considerable difficulties in the way of putting it into practice until the Corporation obtained possession of the lines. Accordingly negotiations were opened with the tramway company for the purchase of existing depôts, stables, and the stud of horses. The negotiations failed, and the Corporation found itself face to face with the necessity of providing within a comparatively limited period, buildings, cars, horses, and working staff—in short, everything necessary for the system except the street rails. Under the circumstances it is creditable to all concerned that before the first day of last month nine large depôts had been erected in different parts of the city, and some 3000 horses bought and partially trained for their trying work. Over a hundred cars of improved pattern, out of a total requirement of about 250, had also been obtained, and a complete staff of servants organised. These preparations involved a direct expenditure of over £300,000. Mechanical haulage, though shelved for the time by the necessities of the situation, has not been forgotten, and in several of the depôts the construction arrangements have been carried out with a view to the future accommodation of winding machinery for cable traction. Probably the first experiment will be made on the great east and west thoroughfare formed of Gallowgate, Irongate, Argyll-street, and Dumbarton-road, with a total length of some seven miles. Recently, when the roadway in Argyll-street was relaid after the operations of the Central Railway Company, boxes for the accommodation of cables and pulleys were placed in position. It has been tentatively arranged that the motive power for this route will be located at Kelvinhaugh, where a large depôt has been built. A slow-running cable will be carried to the eastern extremity of the city, and westward from the power station there will be a fast-running cable carried to Whiteinch, the vehicular traffic on the latter section being much less dense than to the east of Kelvinhaugh. Meanwhile the number of horse cars is being gradually increased; but they have by no means the monopoly of the passenger traffic enjoyed by their predecessors, the old tramway company keeping up a formidable rivalry by a large service of well-appointed omnibuses.

### THE COALFIELD UNDER THE SETTLEMENT.

Opinions differ very much with regard to the probable working of the coal settlement. On one point there is pretty general agreement. It is this:—That the arrangement will "hit" the old collieries—that is, the pits which are much worked out—very hard, but that it will suit those collieries which are only partially worked, or being opened out. The coal trade cannot possibly be brisk until business is good enough to overtake something like the full output. On the other hand, the colliers cannot have full employment for that and another reason, the other reason being that there are more miners than mines. The tendency in the country districts is for the farm labourers, and all dependent upon agriculture, to abandon their callings and go down the pits, or compete in the crowded centres for such occupation as is to be had. All this, of course, is bad for the country, and bad for the town. It depopulates the rural hamlets, and adds to the hosts of unemployed in the large towns. Farm labourers leave the land for which they are fitted, to scramble with their brethren in the town, where they are not wanted. It is in the coal industry where their presence is most keenly felt. That is one of the great difficulties of the miners' leaders. These gentlemen have tried various ways of getting rid of what they called "the unskilled labour." One drastic remedy, compelling them to come into the Union, has proved powerless. The labourer has got his foot down the pit, and he keeps it there. He resisted for a time all efforts to coerce him into the Miners' Union, but finding that if he did not join the ranks life in the colliery villages would be intolerable, in consequence of the merciless boycott operated against him, he made up his mind to join the Union, and to-day the whole of the Yorkshire, Derbyshire, and Central England colliers may be set down as Unionists. That result, however, while it has given Mr. Pickard and others a formidable organisation with which to work, has left the congested labour market where it was. In fact, it has made the difficulty more deep-rooted, for the recent accessions to the mining ranks from the farm lands are now formally recognised as miners. It is calculated that there are at this moment 200,000 more miners than are required. This of necessity diminishes employment all round. There is no mystery in the cause why the country worker sought a living in the colliery. The great wages agitation, which gave the miners 40 per cent. advances, proved too much for friend Hodge. He was human enough to prefer making, in a couple of days, sufficient to keep him comfortably for the week, rather than by labouring six days for the beggarly allowance the farmer could afford him. Mr. Pickard, in his successful advance of wages, has thus succeeded over much. As he cannot get rid of his surplus labour, his only resource is to try to reduce the hours of working, to spread it more equally over the whole of the mining community. Hence the compulsory Eight Hours-a-day Bill. The coalowners admit that this will largely diminish the output of individual colliers, and necessitate the employment of more men in the pits; but at the same time, it will increase the cost of production, and thus it will tell against the revival of trade, upon which the future of the industry chiefly depends. In this way the eight hours policy will practically take away with the left hand what it gives with the right. It is bound to furnish another evidence of the folly of those who seek to govern the conditions of working, as one of them put it in Derbyshire a short time ago, "altogether irrespective of the law of supply and demand." There is no over-riding these natural laws. Still there are some people who think it can be done, yet all attempts at experimental legislation, such as this contribution to the doctrine of idleness, are foredoomed to failure.

### THE NEW STANDEDGE RAILWAY TUNNEL.

No greater contrast was in all probability ever presented with regard to civil engineering old and new than that furnished by the opening of the new double railway tunnel through the Standedge Hills, which has been used for the first time during the present week. Four tunnels now pierce the well-known Standedge Hills, which are met with on the London and North-Western Railway route from Liverpool and Manchester to Huddersfield. It may not be generally known that it is one hundred years since the canal tunnel was commenced, viz., in 1794. The tunnel, which is 3 miles and 17½ yards in length, took seventeen years to construct, whilst the second railway tunnel was finished in two years, and the double-line tunnel just opened has been constructed in four years. The extent of the whole of the undertakings is very great. The cost of constructing the canal tunnel, which was opened in 1811, was about £56,000. The tunnel is about 656ft. above the level of the sea. It is 8ft. wide and 16ft. high, one half being under water. During its progress there was serious loss of life. The first of the railway tunnels, which is 3 miles and 60 yards long, was commenced on the 1st November, 1846, and was completed on the 1st November, 1848. The gunpowder used for blasting and other purposes cost £5131, fuses £698, and candles £3618. No fewer than 1953 men were employed on the work at one time. There were nine fatal accidents during the progress of the work, which entailed an outlay of £201,608 12s. 3d. Mr. Nicholson, who constructed the well-known Woodhead tunnel, was the contractor. The second railway tunnel was commenced in the middle of April, 1868, and was completed in the middle of October, 1870, about six months earlier than was expected. Its exact length is 5435 yards, or one yard shorter than its twin tunnel. The total quantity of brickwork built was 52,156 cubic yards, the total bricks used being 16,831,149, the weight of which amounted to 68,000 tons. The total cost of the tunnel was stated at time to be £120,000. The last tunnel was commenced on the 5th of August, 1890, when the first sod was cut, and so far has the work progressed, that Major Yorke, Government Inspector of Railways, has already inspected the undertaking, and has given his certificate for the opening of the tunnel and works. The material required and the engineering skill have been provided by the company, and it carried out the work entirely, excepting since February, 1893, as regards labour, which was provided by Messrs. Williams, Lee, and Thomas, who up to that date had been foremen in the different departments of the work.

## GERMAN MACHINERY AT THE ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

Several small machines for special purposes are exhibited by Messrs. Goebel and Co., of Darmstadt. One of these is an automatic railway ticket printer. The tickets are in a shaft to the right of the machine, from which they are automatically pushed forward by a tiny lever, printed on one side, and then by the same lever pushed on till they enter a slot in a brass wheel. As soon as this wheel has made half a turn, a catch on the opposite side withdraws the ticket, and brings it under the press by which it is printed on the other side. It is then stamped at each end with a consecutive number, and falls into a shaft on the left. The machine is driven by hand; the inking cylinders for the three printings work at right angles to the travel of the tickets. The whole apparatus is well made and is very compact.

A larger printing press shown by the same firm is driven by steam. This is intended for printing in three colours, numbering, perforating, and cutting. In this machine the paper is continuous, and, in the one shown at the Exhibition, is 9in. wide. If numbering is not required, it can be printed in four colours, of which all can be on the same side, or three on one side and one on the other. The paper is on a roll near the bottom of the machine, and the strip is brought over guide rolls in such a manner that whilst one press in the lower part is printing the first colour, the second and third are being done on the continuation of the strip by other presses above. It depends on the arrangement of the paper on the guide rolls whether the first impression is made on the front or back. The second and third, also the fourth or numbering, must be on the front. The paper when required is then perforated longitudinally, and either cut off to any desired length or perforated transversely and rolled on a drum at the opposite end of the machine.

The exhibitors also show a machine which they have just brought out for cutting paper into strips for receiving telegraph messages on a Morse instrument. It takes a roll of paper 14in. wide, out of which forty strips or "tapes" are cut by circular knives. These are all coiled on the same roll, until the required lengths have been cut; but when removed from the machine they fall apart. Thus the effect is the same as if the solid roll had been cut through, though in that case the strips would naturally not be so neatly or accurately cut as by the present method. A few machines for ticket-dating, &c., also form part of the exhibit.

Messrs. Preusse and Co., of Leipzig, show a number of different descriptions of bookbinding machines at work, and also the various machines necessary for the manufacture of wire-sewn cardboard boxes. Commencing with the smallest size for stitching pamphlets, they go on to the double pamphlet stitcher, with two adjustable heads, which can be set from 3in. to 6in. apart, and then to the regular octavo and quarto bookbinders, stitching on cloth or tapes, with four or more heads. In one machine shown the work is continuous. The sheets to be sewn are placed across an oscillating ledge, which takes them to the needles. Books of any thickness can be sewn, and it is not necessary to cut each away directly it is finished. A wooden distance piece about ¾in. thick is inserted, and then the stitching of the next book is commenced. A carrier at the back moves the finished books to a slide, so that they can be cut apart when desired, and there is no occasion to stop the machine until the supply of cloth or wire is exhausted.

The largest make of machine is called the "Imperial." It has nine heads, and is intended for account books. It will take books up to 26in. in height by 6in. thick. All these machines use wire, but Messrs. Preusse also show a thread sewing machine, intended for *editions de luxe* and other high-class work, for which cotton is considered to be preferable. It will take any size of book up to 13½in. by 10¼in., will make from one to five band stitches on the backs, and works continuously.

Instead of pasting the corners of boxes together with strips of cloth, the exhibitors maintain that it is cheaper, as well as stronger, to stitch them with wire, and they have several sizes of machines for this purpose, according to the thickness of the cardboard and the depth of the box. In all of them there is a continuous roll of wire, usually flat; and the machine cuts this into lengths, forces the staples in from the outside, and then clinches them and drives the points in from the inside. Another variety of the machine, which may be used for circular or any shaped boxes, as well as for pamphlets, sews flat along the side of the box. It is also used for strengthening the corners by stitching wooden strips into them. A machine which attains the same object of stiffening cardboard boxes, though in a different manner, is the tin-plate cornering machine. In this, ornamental indented strips of coloured tin-plate are fastened by pressure along the edges of boxes, which are thus stiffened considerably without any great addition to their weight.

They also exhibit a series of machines for the manufacture of folding and parcel's-post boxes. Each set consists of three machines, one to bend and cut; another to stamp out, or "blank;" and a third to sew. These are all made in various sizes: in the first, the largest machine will take cardboard up to 4ft. 9in. wide, of which it will cut 10in., and crease the remainder ready for folding. The blanker cuts out the flaps and holes, and is so constructed that the waste produced by its operation is automatically removed whilst working. Finally, the box is stitched flat along the sides with round wire. For small-sized boxes a special form of blanking press is used, which will also groove, so that a bender is not required.

Finally, Messrs. Preusse show two descriptions of folding machines, one for books and the other for newspapers. Being furnished with self-acting sheet straighteners and angle-guides, they fold the sheet into 4, 8, 16 or 32 as neatly as can be done by hand, and deliver the folded sheets into a till at the bottom. All that the attendant has to do is to place the sheet on the machine. The newspaper folder first folds the paper in four or eight, and then doubles it twice in the same direction, to make it in a suitable form for posting.

Similar newspaper folding machines are exhibited by Messrs. Molitor and Co., of Heidelberg. There is a little difference in the construction, but they work equally well. They also exhibit the Lightning Press, intended chiefly for wrappers, of which it can print 5000 per hour.

Very little German brewery plant is shown. The principal exhibitor in this branch is Mr. P. Kyll, of Cologne, who exhibits an apparatus intended to supersede the ordinary cooling-back, or the refrigerating machinery which is usually preferred by German brewers to the open back. In this apparatus, an air pump, which is cooled by water, forces air through a double filter, containing first permanganate of potash, and afterwards, cotton wool soaked in salicylic acid. This air, thus disinfected and cooled, is forced into a long oval covered vessel containing wort. In this there is an outlet at the end for the escape of steam, and water sprays over the whole of the exterior surface. The wort is allowed to remain from four to eight hours in this receptacle, and it is found that 500 gallons of cooling water at 59 deg. Fah. will lower the temperature of 400 gallons of wort from 212 deg. Fah. to 122 deg. Fah.

Another exhibit by the same firm is a steam boiling pan for maize, sweet potatoes, &c., intended for distilling. It is heated by steam at a pressure of 45 lb., from a separate boiler, which also supplies steam to an engine; and the peculiarity of the arrangement is that this engine is carried by the under-frame of the pan, whilst three pumps for water, wort, and residue are on the opposite side, so that, with the exception of the steam supply, the whole apparatus is carried on the same frame.

Next to the gas and petroleum engines, and the electric motors, the visitor will probably be struck by the number of milling machines. Those exhibited by Messrs. Smith and Coventry have already been described, and in a subsequent letter I shall have to mention machines of French and Belgian make. Amongst German tool makers a large stock of milling machines is shown by Messrs. Reinecker and Co., of Chemnitz. These are horizontal and vertical, with the usual automatic movements, but a more interesting part of the exhibit consists of tools for forming the cutters of these machines, as well as for making taps, rimers, &c. Amongst these I observed a special lathe for making spiral milling-cutters, the section across the cutters being in the shape of a ratchet-wheel. In this the cut gradually deepens, and when the tool gets to the end of the cut, it is lifted out by a spring, and comes into position for the top of the next tooth. Another lathe turns the piece which is being made alternately forward and backward, with a slow forward movement that may be varied, and a quick return. Besides tools with cutters, there are several with emery wheels, chiefly used for finishing. But the chief novelty shown by Messrs. Reinecker is a measuring machine. The exhibitors claim that this instrument will, in comparatively unskilled hands, show to the naked eye differences of 1-10,000th of a millimetre, or 1-250,000th part of an inch. Gauges of guaranteed accuracy, which have been tested at 57 deg. Fah., are supplied with the machine. These gauges vary from $\frac{3}{16}$in. up to 4in., and the measuring consists in comparing the length of the object to be tested with one of these standard gauges, and noting the difference. The apparatus resembles a small lathe, but without driving gear or tool holder. A carriage on the bed-plate supports the piece to be tested. The back centre protrudes from a metal disc, which presses against a diaphragm, whilst the front centre can be moved forward by turning with a thumb screw a large brass wheel, divided on the rim into thousandths, and fitted with a vernier, so that it will register one ten-thousandth of a revolution. This diaphragm forms the front of a vessel containing coloured spirit, from the top of which rises a fine glass tube. The standard piece is first placed in the machine, and the wheel turned till the disc, pressing against the diaphragm, causes the spirit to rise in the tube. The height to which this rises is noticed, and the position of the wheel is read off on the scale. The piece to be tested is then inserted, the wheel turned till the spirit rises to the same level as before, and the scale on the wheel again noted. The apparatus is so sensitive that if the hand be placed for a few seconds on the object which is being tested, it causes the spirit to rise in the tube. A large collection of taps, wrenches, dies, spiral drills, gauges, and milling cutters form part of this exhibit.

Mr. F. Flinsch, of Offenbach, exhibits a series of machines for the preparation of tobacco. The first, styled the "torrefactor," is a revolving iron drum, into which the tobacco is placed, and a current of hot air passed through. There is also a small fireplace underneath. As soon as the tobacco has been properly dried it is passed to a second revolving drum, lined with sieves. Cold air is forced through this, and at the same time the dust falls into the space between the sieves and the outer casing. It is next passed through a cutter, an apparatus similar to a guillotine for paper, but with rollers to press it forwards. A fourth machine makes up the tobacco into packets. In this a pillar with four arms stands in the middle of a table. Under each arm is a receptacle, the breadth and width of a packet, and these four boxes revolve round the central pillar. The first arm presses the tobacco into the packet, the second folds the paper and closes, the third compresses a second time, whilst the fourth seals the packet, which is automatically ejected by a piston under the box. The size of the packets can be regulated as desired, and the machine will turn out 600 per hour.

A similar set of appliances is exhibited by Mr. W. Quester, of Cologne, who guarantees his cutting machine to shred the tobacco to the fineness of $\frac{1}{175}$ of an inch. A peculiarity of this machine is the automatic arrangement for preventing choking: when the feed is too quick, the mouthpiece, which is movable, lifts, and cuts off the supply. Mr. Quester also shows a press for tobacco stalks, which renders them as fine as the thinnest leaves.

Though electric motors for machinery can no longer be considered as novelties, the manner in which they are applied by the Deutsche Electrizitäts Werke, of Aix-la-Chapelle, seems to be new. They show lathes, drilling machines, &c., each with a small motor fitted into a box in its base. Each of these motors will exert about one-half-horse power, as they give 4 amperès and 100 volts. The advantage of a separate motor for each tool in small workshops is obvious, and these are so compactly arranged that the dynamo takes up no extra space.

Messrs. Burberg Brothers, of Mettmann, are exhibiting a disintegrator, which is not shown at work, though it appears to be a serviceable machine. It is 3ft. 5in. diameter by 8in. wide, and has eight beaters. The sides and ends of the casing are lined with narrow strips, set like louvres. Some of these have smooth edges, others are studded with small points, according to the nature of the material to be treated. Messrs. Burberg say that this machine is capable of grinding two tons of wood or bones per hour. A competition between this and some of the disintegrators already described would be interesting.

Another exhibit which looks good, but cannot be seen at work, is a steam jet cupola, exhibited by Mr. F. A. Herbertz, of Cologne. Whether the use of the steam jet in furnaces is advantageous is a matter of opinion, but the arrangement of the hearth on wheels, so that it can be easily withdrawn for repairs, would be very useful both for copper matte and for lead. There are several other exhibits which, like this furnace, are put up and then left, without anyone to describe their advantages, and which, for this reason, may possibly not attract the attention they deserve; but I think that the machines to which I have called your attention this week and last are sufficient to show that the problem of rapid and economical production is being seriously considered by German manufacturers. I propose next week to describe some Belgian exhibits, which are not less interesting than the German.

---

## THE DESIGN OF MAIL STEAMERS, WITH SPECIAL REFERENCE TO THEIR USE FOR WAR PURPOSES.*

By Professor J. H. BILES, M. Inst. Naval Architects.

(*Continued from page* 112.)

IN considering the subdivision of a vessel for war purposes by longitudinal bulkheads, it may be objected that when one side of a ship is damaged by collision or gun-fire, the vessel may receive a very inconvenient and possibly dangerous heel. This may be obviated by placing similar compartments on opposite sides of the ship in communication with each other, either by pipes of large size, or, if the compartments be immediately above the double bottom, by setting off one frame space in the double bottom through which water may flow freely from one side of the ship to the other. This is a simple method of automatically maintaining an upright position in a warship which is liable to penetration near the water-line by gun-fire or other means, as the water which enters one compartment on one side of the ship and tends to cause the heel will find its way freely to the other side and prevent the heel. Naturally more water enters the ship, but it is submitted that it is better to have a little more immersion than an inconvenient and possibly alarming heel. This method of maintaining the upright may be worth adopting from the first in a mail steamer, as far as the lower bunkers are concerned, because it can be simply applied, and is a precaution against excessive heeling in the case of collision; but the provision for its adoption in the case of the further subdivision of compartments above the lower deck in war time would be a more serious matter, as the number of compartments is greater, and the communicating pipes would have to go through the lower bunkers. These pipes might either be put in permanently when the ship is building, or be treated as war-time fittings, which would be removed from the ship after they had been first fitted and placed in store. The part in the double bottom must be fitted when the ship is building. These communicating pipes should have no valves upon them, but should extend from side to side, and should always be open, and, therefore, always ready to serve their intended purpose.

With reference to the main transverse bulkheads of a ship, so much attention has been given to their construction and spacing by the Bulkhead Committee that there is no necessity to take up time with this matter. Ships have been built with bulkheads placed so as to fulfil the condition of being able to float with any two adjoining compartments in communication with the sea, and no large ship which it is intended shall be used for war purposes should be without such subdivision. For war purposes the chances are that, other things being equal, the greater the number of transverse bulkheads the longer will a ship remain afloat under gun fire, provided that the bulkheads are free from openings and strong enough to resist water-pressure. For carrying passengers there is a limit to the smallness of the compartments, especially when there are no openings in the bulkheads. Each compartment so separated from the others must have its own stairway, and the loss of space due to a large number of stairways would become serious. Probably 32ft. to 35ft. is the minimum distance which is permissible between main transverse bulkheads, thus dividing a ship, say, 500ft. long, into fourteen to sixteen compartments.

The question of subdivision for war or mercantile purposes cannot be considered at the present time without dealing with the question of openings in the bulkheads. In a mail steamer it has been demonstrated to be practicable to have bulkheads without doors in all the passenger and cargo compartments, and doors only in the machinery space well above the water-line. The safety and simplicity of such an arrangement is obvious. If a vessel so divided goes into action, or into fleet manœuvres, one considerable cause of anxiety is absent. The vessel, as far as transverse bulkheads is concerned, is always ready for action, and cannot be put in danger by the unauthorised opening of water-tight doors. The disadvantage of such an arrangement for a warship or a mail steamer used for war purposes is, that passage between compartments can only be had above the water-line, and consequently in an exposed position. Those who will have to fight warships can say which is the preferable risk to take. With the unpierced bulkheads the ship is more secure, and in vessels of the cruiser type, amongst which the mail steamer fitted for war purposes must be classed, subdivision is its chief defence. It seems, therefore, desirable to endeavour to retain the bulkheads intact. There are, however, other things to provide for besides openings for men to pass through. Even in those vessels which have bulkheads unpierced for doors, there are pipes passing through below the water-line. The method of pumping and draining the ship usually adopted is to have one or more central stations in the machinery space, from which pipes are led into the different compartments, so as to pump any water from them. These pipes pass through the bottoms of the bulkheads. Any damage to a pipe occurring in a flooded compartment will cause the water to flow through the pipe to the compartment intended to be pumped out by the pipe, and it is quite conceivable that a central station may be damaged when the compartment in which it is is flooded, and all the compartments drained by the pipes connecting with the central station might be soon flooded. This can be obviated by putting a pump in each compartment, and as it is impossible for any pump to cope with a very serious leak, it is only possible to use such pumps for draining a compartment, or for coping with a small leak, such as would be likely to occur from a small injury to an adjacent bulkhead.

In a mail steamer divided into main compartments 32ft. to 35ft. long, it would be quite practicable to have such an arrangement, but in a warship divided more minutely than this, and still further subdivided by horizontal flats, it would be quite impracticable to have such an arrangement for every compartment. One method of carrying this out for the main compartments of the ship is to have at each main transverse bulkhead a small compartment large enough to hold a steam pump. This compartment should be water-tight, and accessible directly from a deck above the water-line by means of a trunk. On the side of the compartment at the bottom there should be a sluice valve, worked from a deck above the water-line. The water in the main compartment could be drained into the pump compartment through the sluice valve, from which it could be discharged by the pump. The steam connection to the pump could pass through the bulkhead above the water-line, so that the main compartment could be efficiently drained, and the bulkheads need have no holes in them below the water-line. The sluice valve and pump suctions would in all ordinary times be accessible from the deck for examination. This is a matter of importance in cargo holds, where pump suctions and sluice valves are usually quite inaccessible.

A method of carrying out this idea, and at the same time assisting the structural strength of a bulkhead, is to make all the bulkheads dividing main compartments double instead of single. The space between the two bulkheads is available for the trunk purpose named above. It can hold the pump, and will serve the further purpose of a well to the double bottom, with the important advantage that if a double-bottomed vessel runs over something which opens to the sea the outer skin beneath the double bottom, the water cannot flow into the vessel's holds through the supposed non-return valves in the tops of the wells, as is the case with the present arrangements, but is confined to the space between the bulkheads, and may rise to any height it can without flooding a compartment. Such a double bulkhead, with lattice girder work between, would be very strong to resist water pressure in the event of a compartment being flooded. Figs. 4 and 5 show such an arrangement. The bottom strake of plating is 25 per cent. more than the thickness required by Lloyd's. This increase has been made to provide for the greater corrosion which will take place at the bottom of the bulkhead. The remainder is $\frac{6}{20}$ths thick, being carried double to main deck. From main to upper it is also $\frac{6}{20}$ths thick, but single. This is considered thick enough. The weight of this arrangement in a midship bulkhead of a ship of 57ft. beam and 40ft. deep is not more than the single bulkhead constructed in accordance with Lloyd's rules. The double bulkhead need not be carried further above the water-line than to the main deck. It will be sufficient to carry a trunk from the main to the upper deck immediately over the pump, so that, to overhaul the pump, it may be lifted up bodily. For structural purposes this arrangement seems to be stronger than the ordinary one. For resisting water-pressure it is at least as strong, and, even if any leakage should occur from strain, the water can only get into the well or space between the bulkheads, in which space it can be dealt with by the pump without affecting cargo in the next compartment, and if not too great for the pump to cope with the leak, can be got at readily and stopped.

FIG. 4

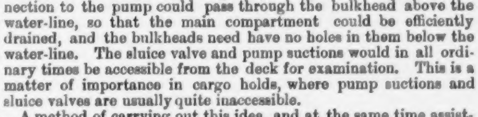
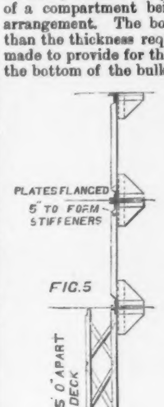


FIG. 5



Other holes are made in bulkheads, though not at such a low position as for bilge or drainage pipes. Electric light wires, voice pipes, steam and other pressure pipes, all have to go through bulkheads. Of these, the steam pipes make the largest hole in a bulkhead; but in both war and large merchant ships they are usually high up, but not generally above the water-line. It would not be difficult to put steel trunks round the steam pipes, which could be made water-tight, and would tend to prevent water which got into a compartment from getting into an adjacent one through the hole made through the bulkhead for the steam pipes. Inside this trunk voice pipes and electric wires could pass. It would make the steam pipe as safe as a boiler from damage by gun-fire if this trunk were made about the same thickness as the boiler shell; and if the mountings not in this trunk were made of the same thickness and of tough metal, they would be equally capable of resisting the effect of gun-fire. This resistance, either in the case of the boiler or the horizontal trunk, would be considerable against splinters. Steam pipes have to be carried at a considerable height in large mail steamers, on account of the length of stroke of the main engines. Hence it is of importance for war purposes to keep the stroke as short as possible, and to keep the engines as low as possible in the ship. The smaller stroke of engine is accompanied by a smaller breadth of base, which allows the engines to be placed lower in the ship. The tandem type of engine is not a desirable one, and should be avoided in a steamer required for war purposes. Probably from a marine engineer's standpoint there may be advantages in this type of engine, but the disadvantages for war purposes are so great that the tandem type ought not to be allowed in mail steamers which are likely to be taken up in war time. On the contrary, some sacrifice of efficiency should be made, if it is necessary, by adopting shorter stroke and the non-tandem type. Engines of great power have been run for six days continuously at ninety revolutions per minute, and there seems to be no valid reason why this number of revolutions should not be considerably increased, and the stroke proportionately reduced.

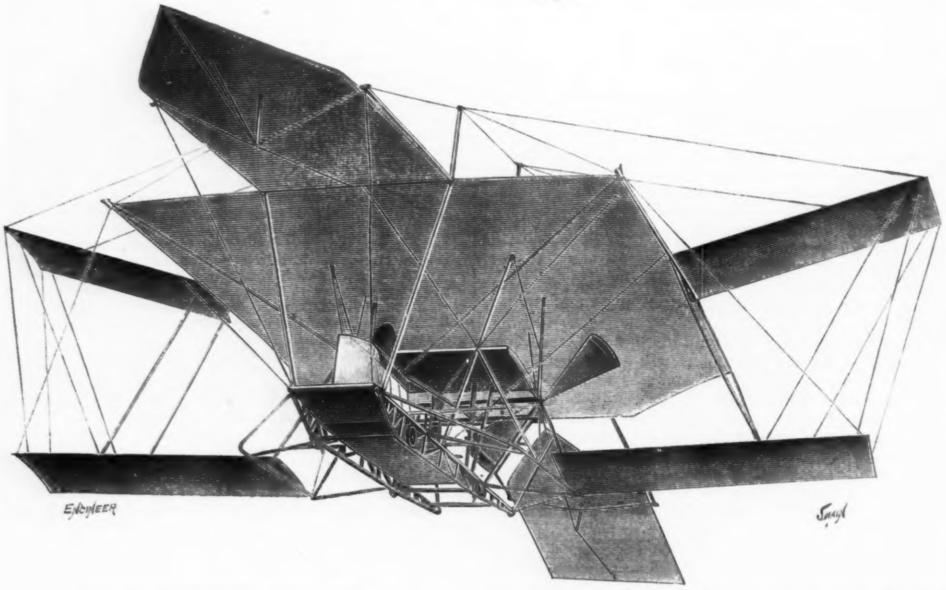
(*To be continued.*)

---

* Paper read before the Institution of Naval Architects on July 26th, 1894.

# MAXIM'S FLYING MACHINE—DETAILS

Fig. 2



## MAXIM'S FLYING MACHINE.

We are able this week to give some particulars and illustrations of Mr. Maxim's latest wonder. The success which recently attended Mr. Maxim's endeavours to propel a machine through the air is so marked that we think a description of this most remarkable contrivance will not just at present be out of place. It is not to be supposed for a moment that this machine approaches anything like perfection, but there can be no doubt that its performances considerably eclipse all previous efforts. Through the courtesy of Mr. Maxim we are enabled to here reproduce two views—one of the machine in flight, the other of the water-tube boiler used, with its casing removed—also a table showing the lifting efforts. The remaining diagrams are our own, and illustrate the principles of various devices which we shall proceed to describe; but before doing so we shall briefly glance over the occurrences of the 31st ultimo, on which occasion the soaring tendency of the machine became so great as to overcome all the obstacles which were designed to retain it near the ground, and Mr. Maxim found himself in a somewhat similar position to that of Frankenstein when overpowered by the monster which he himself had fabricated and endowed with life. This is what happened:—The machine had travelled some 1000ft., the latter 550ft. of which it had flown, a fact which is clearly proved by the impressions made on the inverted guard rails. It appears that suddenly the lifting effort became so great that the framework carrying the after-retaining wheels became distorted to such a degree that the wheels ceased to perform their office, and the after-part of the machine became free—the fore-part, however, continuing to hold the machine down, but not for long, as the wobbling which ensued rendered steering impossible, and the machine got out of line with the track. The left-hand front wheel also got free, and the machine charged against one of the timber supports carrying the right-hand guard rail, tore up the rail, which is simply a 9in. by 3in plank, and did very great damage to its own framework. The ride was in this way brought to a sudden stop, and it will be several months before it can be renewed. The total weight of the machine, including 600 lb. of water, 200 lb. of naphtha, and three men, was about 8000 lb.

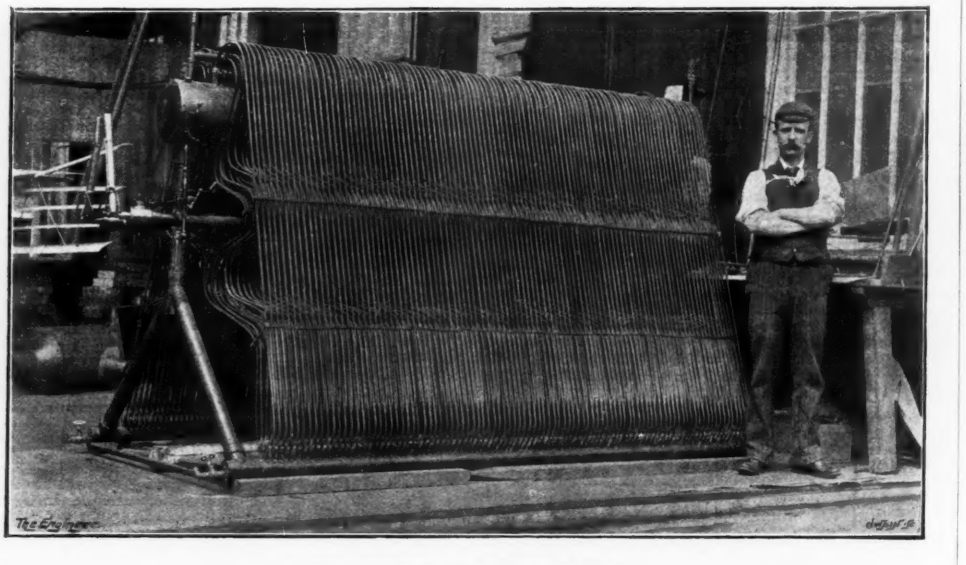
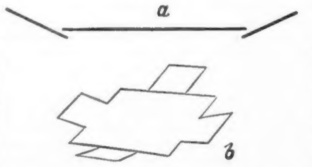


Fig. 4—MAXIM'S WATER-TUBE BOILER

Fig. 1 shows the deck plan of the machine. P P are the two propellers mounted on the shafts S S, to each of which motion is given by a compound steam engine. B is the main boiler, delivering steam through the pipes MM. G is the gasoline boiler, which is kept charged with about 40 lb. of naphtha by a pump, $p^1$, automatically regulated, the supply being contained in the tank $T^1$, while the larger tank, T, contains the feed-water, which is fed into the boiler by the feed pumps *p*. W W W W are the wheels which run on the track before the machine has commenced to soar, and *w w w w* are those which were supposed to retain the machine by reason of the inverted rail above them. This they failed to do, owing to the too slender construction of the framing in their vicinity.

Above all this there is the great central aëroplane, with a surface of some 1400 square feet. This, with the side wings and the steering planes fore and aft, all taken together, have a total area of 5400 square feet. At the time of the trial the area was 4000 square feet, as six of the side planes were found unnecessary. Our view—Fig. 2—shows the machine as it was at the trial. The total width is 104ft., and the length 125ft. The angle of the steering planes, which is about 7·25 degrees, or 1 in 8, is controlled by a steering windlass, which when soaring turns them, very slightly, opposite ways, as *a* in Fig. 3, when the machine would soar whichever way it was being propelled. The total lift of the planes amount to 10,000 lb.

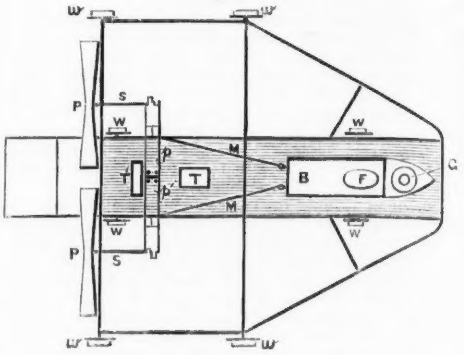
Fig. 3



Another valuable property of these fore-and-aft aëroplanes is their tendency to preserve the equilibrium of the machine in descent. To understand this, let the reader take a sheet of paper, hold it some 6ft. off the ground, and observe how it dives to the ground on being released. Now let him take the same piece of paper and cut away the four corners and bend up the sides, so as to resemble *b* in Fig. 3, and let it fall. He will see that it is quite another matter.

The boiler, Fig. 4, is a fascinating contrivance, replete as it is with so many novel features. It is a little like Thornycroft's, and a little like Yarrow's, but the tubes are necessarily much lighter and thinner than in either. Their shape is shown in Fig. 5. The water boxes at the bottom are $2\frac{1}{2}$in. diameter, [and $1\frac{1}{2}$ mm. thick. The water tubes are of copper, and about $\frac{1}{2}$in. thick. The total heating surface is about 800 square feet, the flame surface being 30 square feet. The Y downtake is 3in. in diameter. There is a forced circulation maintained by an injector in the upper leg of the inverted Y. This may be briefly explained as follows:—Water is pumped into the boiler at 330 lb. to the square inch. This escapes into the boiler through an injector nozzle, and as the steam pressure usually required is 300 lb., it follows that there are 30 lb. devoted to this circulation. The cold water coming in combines with the hot water, increasing the gravity of the water in the downtake, and down it goes, so that the water coming in is immediately taken to the hot tubes. The nozzle is provided with a spring which always maintains the 30 lb. difference in pressure. A very convenient apparatus is attached to the feed pipe, by which it is possible to see at a glance exactly how many pounds of water per hour are entering the boiler.

Fig. 1



A novel way of observing the height of water in the boiler is a thermostatic gauge, the principle of which we endeavour to show in Fig. 6. A gauge communicates with the interior of a bent tube, which is a boiler in itself. Its lower half is exposed to the flame of the furnace, the upper half lying in the drum below the water-level, and as long as this half is immersed the water within it will be at the same temperature as that in the drum, and therefore at the same pressure. But if it is exposed the pressure rises enormously, and consequently the needle also, and it is known that the water is low. There are no glass water gauges on the boiler, as this device supplies all that is wanted.

Fig. 6

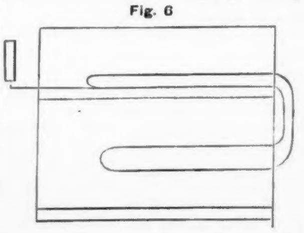
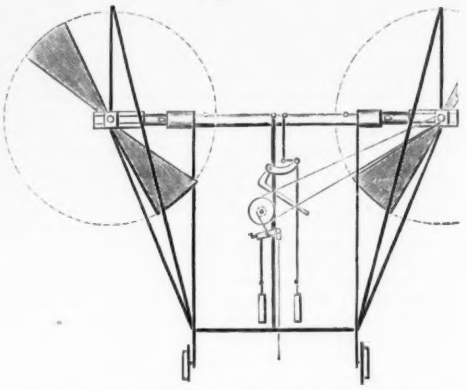


Fig 9



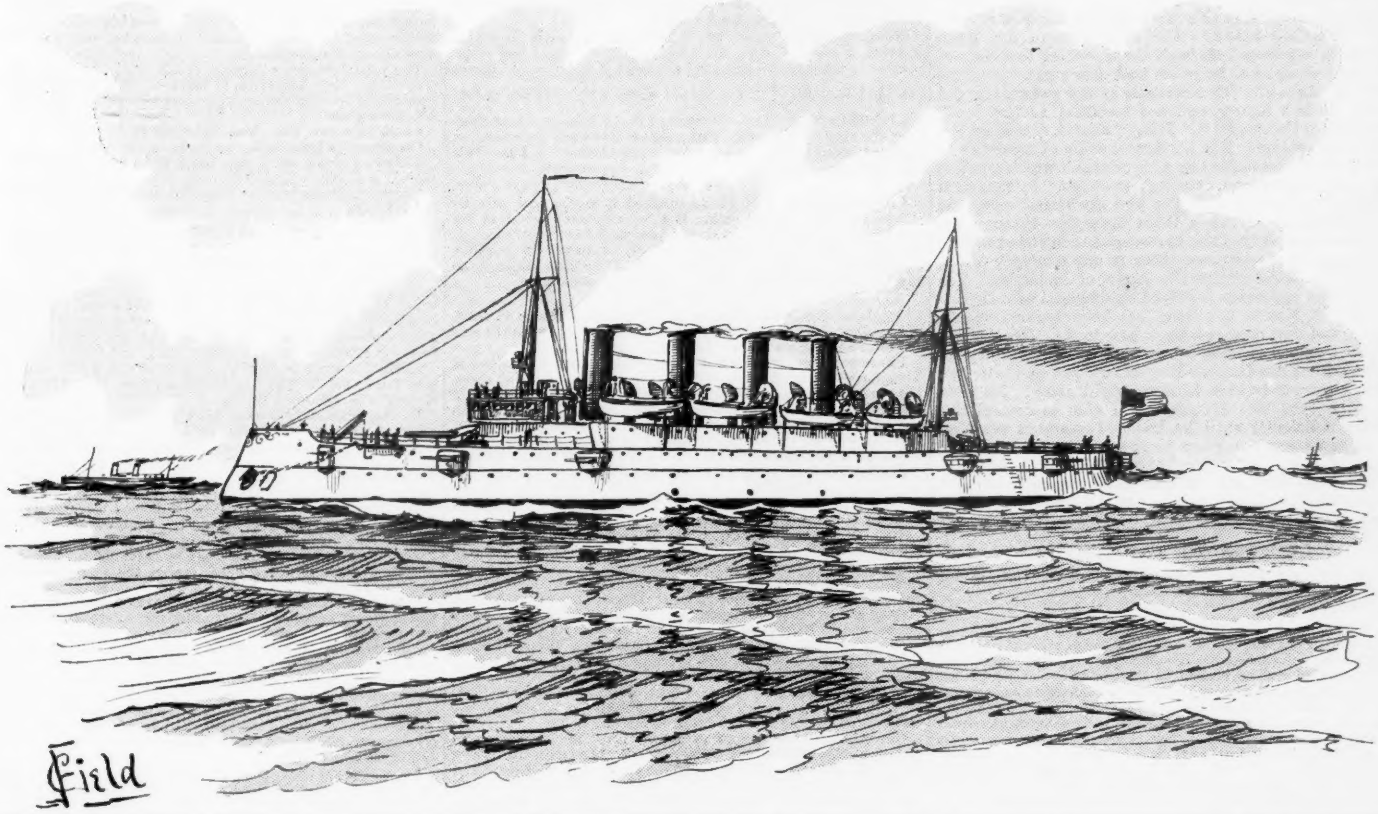
Over the upper part of the boiler there is a second system of smaller tubes, also of copper, $\frac{3}{16}$in. diameter and $\frac{1}{50}$in. thick, constituting the feed-water heater, which raises the temperature of the water to 250 deg. Fah. In this way the products of combustion having passed between the boiler tubes are brought into contact with the incoming water before escaping.

The boiler will and does make more steam than can be used. Its weight with its feed-water heater, casing, uptake, furnace, and water, is 1200 lb., 200 lb. being that of the water itself. The fuel employed is naphtha of 72 deg. Beaumé. This is heated in the gasoline boiler by a part of its own contents. and delivered to 7650 jets at a pressure of 50 lb. per square inch. The average contents of this boiler is about 40 lb. Figs. 7 and 8 show the devices by which an automatic regulation of its supply is obtained, which is found perfect.

It will be seen that the gasoline boiler is supported on one arm of a bell-crank lever, which is balanced with spiral springs, so regulated as to keep it floating when containing 40 lb. of naphtha. The entire generator and contents weigh 100 lb. If the boiler becomes overcharged, the increase in its weight sets in motion a system of rods and levers terminating at rod R in Fig. 8. P is here the gasoline pump rod, actuated by one arm of the rocking lever which derives its motion through the connecting-rod C from a crank-shaft driven by belt and pulleys off the port propelling engine. The rod R in actuating the bell-crank lever—one arm of which is shaped like a T—throws in or out of gear either one or the other of the fixed pawls which engage with the

## THE U.S. CRUISER MINNEAPOLIS

MESSRS. CRAMP AND SON, PHILADELPHIA, BUILDERS AND ENGINEERS



ratchet wheel, which in its turn, by means of bevel gearing, increases or decreases the radius of the arm to which the gasoline pump is linked, according to the direction of the ratchet feed.

The gas, when generated, passes through the furnace and then out at the other end of the steam boiler. It then enters the burner through an injector, and the fall in pressure from 50 lb. per square inch to 1 lb. per square inch is made to do work in sucking in air. A damper-shaped valve may be turned about so as to vary the air at will—full on blows the gas out, while with it closed, a great cloud of black smoke is given off at the smoke stack. With a proper adjustment the flame is a purple white, and about 22in. high.

Fig. 5

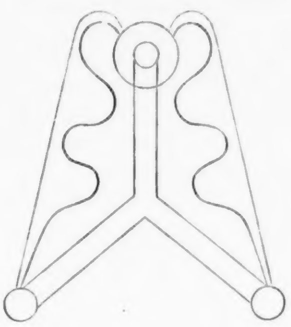


Fig. 8

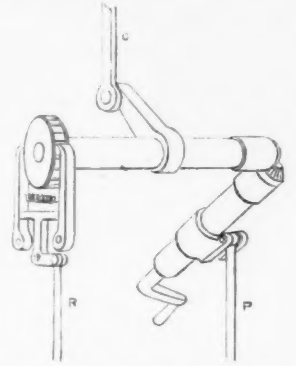
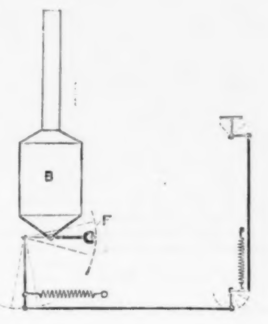


Fig. 7



The engines are 363·63-horse power, and drive the screws—which are 17ft. 10in. diameter, each having two blades 62in. wide, with a 16ft. pitch, at a speed of 375 revolutions per minute, driving the machine at 40 miles an hour. Mr. Maxim estimates that 150-horse power is wasted in slip, 133·33 expended in actual lift on the angle of the aëroplanes, and 80·30 in driving the machine, its frame and wires, through the air. The screw thrust before starting has been found to be 2100 lb.—while running, 2000 lb.

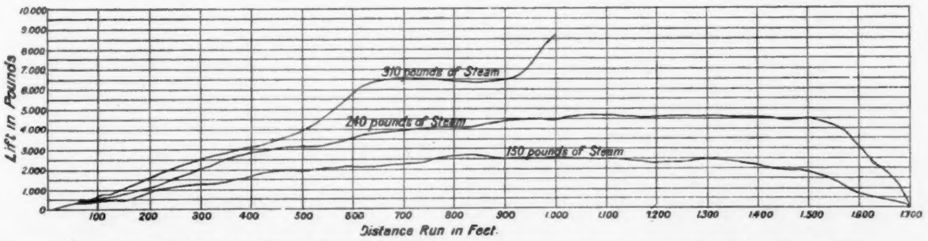


Fig. 11—Diagram showing Lifting Efforts of Maxim's Flying Machine during Three Runs made July 31st, 1894

The engines are beautifully constructed; their position, with relation to the platform of the machine, can be seen by referring to Fig 9, which shows the methods adopted in working the pumps. The feed-pumps are driven from the low-pressure cylinder tail rods by means of bell-crank levers, the gasoline pump by means of a pulley mounted on a second crank shaft, which we have already mentioned. The feed-pumps work very fast, and pounding is prevented by a rubber bag on the suction very near the pump and spring pistons in the discharge. The quantity of discharge is regulated by varying the stroke by means of the hand lever shown. An indicating check valve shows exactly how much water is entering the boiler, the marking being in pounds per hour.

The engines weigh 600 lb., so that Mr. Maxim obtains more than 1-horse power for every 2 lb. of weight—which is in itself an achievement. The pumps weigh 100 lb.; the high-pressure pistons are 5·05in. in diameter; the low-pressure 8in. in diameter by 1ft. stroke. The high-pressure cut off is at ·75 of the stroke, that of the low-pressure being at ·625. The relatively high-pressure in the low-pressure cylinder is due to its earlier cut off, and to a large clearance in the high-pressure cylinder which is allowed in order to protect the cylinder from injury by water in case the machine should pitch. The ports and steam passages are unusually large. Piston valves are used with 3in. travel. The engines move with very little friction, owing to their exceeding lightness. The piston speed is estimated at 750ft. per minute.

An instance of the great care and forethought with which the engines have been planned lies in the construction of the big ends of the connecting-rods. The bolts which secure the brasses are hinged on the end of the rod in such a way as to allow of any slight bending, in the event of the strain on the framework of the machine bringing the crank out of line with the cylinder. It must be remembered that the engine, cylinders, frame, and rods, are entirely made from sheet metal, so that there is every possibility of there being necessity for some such safeguard as this. By-pass valves are provided, so as to allow live steam to pass directly to the low-pressure cylinders—thus if the steam pressure in the boiler should mount too high, it will blow past the high-pressure cylinders, instead of blowing off into the air, and the fall in pressure is made to do work in the exhaust from the high-pressure cylinders, drawing the steam from the high-pressure and driving it into the low-pressure, thus causing more direct pressure on the low-pressure than back pressure on the high-pressure. In this way the engines may be made to develope fully 400-horse power. The steam supply is controlled by two regulators shown in Fig. 10. These levers are also the steering handles for side steering. When going straight ahead they are both vertical. If it is desired to turn to port, the port handle is turned outwards, which slightly checks the steam supply to the port engine, and the machine necessarily turns. If the machine is to be stopped, both handles are thrown over simultaneously to the extreme positions, as shown by the dotted lines. So simple an arrangement as this admits of instinctive action, entailing absolutely no brain effort, and therefore gives the driver more time to think of other things.

Fig. 10

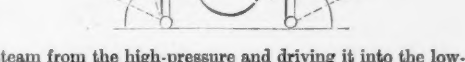
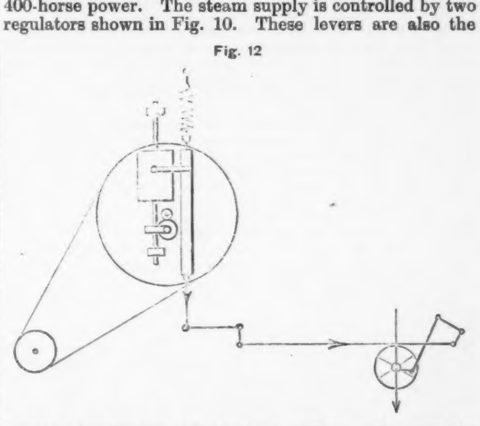


Fig. 12



The diagram given in Fig. 11 shows what occurred on the day of the disaster. The ordinates show the lifting effort in pounds, the abscissæ the distance in feet travelled. It will be seen that the dynograph ceased to record after a distance of 1000ft. had been covered. In other words—

this was the point when the crash came. Fig. 12 shows how the lifting effort is registered on the revolving drum of the dynograph, turning once round in 1800ft. The pencil traces a line on the paper, which indicates the pressure on one of the axletrees, both of which are fitted with dynographs.

All the framework of this extraordinary machine is composed of hollow tubes. The exhaust from the main engines is conducted through them out at the back of the main aëroplane, in order that the steam may not injure the canvas. The condenser is not yet a perfected detail. It is a luxury, and not essential to the flying properties of the machine. It is, of course, receiving Mr. Maxim's attention. The horizontal angle of incidence in flight is to be maintained by a "gyrostat," which consists of a gyroscopic wheel, rotating, suspended by universal joints, and connected with the two horizontal aëroplane rudders, so as to act upon them instantly—through the well known property of the gyroscope to continue rotating in the same plane—in case there is any tendency of the machine to deviate from the angle of incidence. The whole of the apparatus is stayed by diagonal wire ties.

What Mr. Maxim has done has been to, so to speak, make a bird that does not know how to fly. We believe that the safe use of such a machine will always depend on the skill of the driver. Because we put on skates, we do not expect to be able to skate right away. No more can we expect Mr. Maxim to be able to control this machine efficiently until he has had years of practice. In the same way there are birds who fly well and birds who fly badly. This bird has only just been hatched. Let us hope that Mr. Maxim will not come to grief, "Icarus like," before he is fully fledged.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### CARNOT AND MODERN HEAT.

Sir,—In your issue of July 13th Dr. Lodge attempts to take up my challenge, but does not submit to the condition I laid down, that he was to confine himself to the use of ordinary logic and mathematics, and not employ his favourite mode of demonstration, namely, "oracular demonstration." He begins by saying that "a thing with constant specific heat has its intrinsic energy a linear function of its temperature." This is a dark saying, as oracular sayings usually are, and does not seem to me to have much to do with the question at issue. He then, incidentally, defines the absolute scale of temperature as "a scale on which heat and temperature are proportional." I am afraid that Lord Kelvin would not acknowledge this as a definition of his absolute scale.

Dr. Lodge then finishes his demonstration thus:—"Hence, allowing that a gas has no intrinsic energy at absolute zero, the statement is justified." What statement? Is it the statement that the scale of a constant-volume-perfect-gas thermometer agrees with the absolute scale? If so, the demonstration is to me unconvincing. What it does prove, if it proves anything, is that the intrinsic energy of a perfect gas is proportional to its absolute temperature.

Dr. Lodge then goes on to talk about some formulæ, none of which were used by me, and proposes to subdivide a term expressing work of expansion into internal and external work of expansion, which I, as a disciple of Lord Kelvin, object to, because, as Lord Kelvin says, we know nothing about internal work.

In the second last paragraph of his letter Dr. Lodge goes on to say that "Professor Alexander chooses to say *now* that his N was the specific heat at constant volume, the same as my *c*." What the force of the "now" is I do not see, as I am not aware that I ever called N aught else than "specific heat at constant volume."

Dr. Lodge then says that if my N means this, my appeal to Regnault's experiments was meaningless. A mistake it might be, but it was surely not meaningless. I admit that Regnault's experiments were made on the specific heat of air under constant pressure, not under constant volume. But to me it appears that if the specific heat under constant pressure is constant, that under constant volume is likely to be constant also, and has been proved to be so in different ways.

In his last paragraph Dr. Lodge returns to the charge again thus:—"Given a perfect gas, its temperature scale is the same as the absolute scale, and there is no difficulty." Difficulty about what? I made no references to a perfect gas.

At the beginning of his letter Dr. Lodge speaks vaguely about my having "curious ideas concerning the value of time." What he means by this I do not know, but would remark that he seems to place a higher value on time than on courtesy. Dr. Lodge seems aggrieved by some remarks I made in my last letter, but he has himself to blame for them. I never descend to personalities unless when provoked, when I give the offender a "Roland for his Oliver." Had he not made an unprovoked attempt to heap ridicule on my book I would never have mentioned his lack of civility in not acknowledging the receipt of a complimentary copy from the author.

I would remark that one who uses such a word as "extrapolate," which belongs to no language on earth, has little call to reproach others for using long words.

I apologise to Mr. Donaldson for insinuating that he had said that he did not lay claim to much knowledge of mathematics. I do not know how I came to think that he had said so. However, what I said was intended for praise rather than depreciation.

In reply to Mr. Donaldson's letter in your issue of July 20th, I may say that there are now no points at issue between Dr. Lodge and myself. My second letter was merely a castigation of Dr. Lodge for his reply to my first, and an acknowledgement of my failure to prove that the scales of the air thermometer, both constant pressure and constant volume, are the same as Thomson's absolute scale.

Mr. Donaldson asks me if I mean to say that 2lb. of cherries are numerically equal to 2lb. of beef. I reply, Yes. He says my illustration "is infelicitous, because all the members of the equations cited are of the same dimensions." What he means by this I do not quite understand. If, by the members of an equation, he means the two expressions equated, I admit that the two terms of the—single—equation I cited are of the same dimensions, but I do not see the objection to that, as it is always so in dynamical equations. In fact, this is often used as a check on the correctness of equations in dynamics and physics.

Mr. Donaldson says that "neither Professor Rankine nor Professor Alexander has made a mistake in first obtaining general expressions for the laws, and then deducing particular forms. The mistake they have made lies in the fact that they have not arrived at true general expressions for the laws." He then proceeds to say that he, in his work on "Water Wheels," has proved this statement with regard to one general formula of Rankine's. I cannot tell whether or not this is true, but even if it be, this does not prove that all Professor Rankine's general formulæ are untrue. Moreover, he does not prove that any of my general formulæ are untrue.

Mr. Donaldson next makes some remarks on the definitions of Thomson's symbol, M, given by Mr. Mansell, "Student," and myself. He then gives the value of M for a gas which he deduces from my definition: to wit,

$$M = p\,v \log \frac{v+1}{v},$$

and remarks on it that "not only is, therefore, M, but also its differential coefficient with respect to *t*, equal to a number of foot-pounds." Mr. Donaldson will at once see, when I direct his attention to it, that he has either mistaken the meaning of my definition of M, or that he has made a mistake in his deduction of its value for a gas, given above. The definition I gave was M = heat absorbed per unit increase of volume by a unit mass of air, whose temperature remains constant when it is expanding.

Now, Mr. Donaldson will admit that the expression "per unit increase of volume" does not mean during an actual unit of increase of volume, as he seems to have taken it to mean, but means the limit to which $\frac{\delta H}{\delta v}$ approaches when $\delta v + \delta H$ are indefinitely diminished. Here, of course, $\delta H$ denotes the quantity of heat absorbed by the body—unit mass of air—while expanding at constant temperature $t$ from volume $v$ to volume $v + \delta v$. With this hint he will find that

$$M = p.$$

In my definition of M I have confined it to air, as air was the substance I was dealing with. But for a general definition the word "air" in my definition should be replaced by "a substance." It ought to be observed that here the unit of heat is the quantity equivalent to a unit of work. But if Mr. Donaldson has access to my book he will find that there it is proved that for a gas

$$J\,M = p,$$

where J denotes Joule's dynamical equivalent of a unit of heat. Most scientists seem to think it most convenient to choose the unit of heat, so that J may = 1, as we have done above.

I have not seen Mr. Donaldson's expoundings of his opinions of Thomson's writings on heat derived from a slight study of them, but my own experience is quite the reverse, namely, the more I study Thomson's writings the more I am convinced of their truth and of the great genius and wisdom of the writer. I am not a blind admirer of Thomson, but when I do venture to differ from him I do so with bated breath.

Peter Alexander.

Sea Bank Cottage, Cairnryan, Stanraer,
August 6th.

### ENTROPY.

Sir,—Of the many letters on this subject which have appeared in your columns, perhaps the most sensible is that of Mr. Henry Cherry in your last number. He remarks very truly that the thermal condition of a body is completely determined by its volume, pressure, and temperature. I would be disposed to go further, and say that the thermal condition of a body is completely determined by its volume and pressure, and that its temperature, entropy, intrinsic energy, &c., are all functions of these. That is to say, given the volume and pressure of a body, we can from these determine its temperature, entropy, intrinsic energy, &c., provided we can properly define temperature, entropy, intrinsic energy, &c., and possess certain experimentally determined coefficients connecting the latter with the former.

Unfortunately the definitions usually given of "temperature" are not at all satisfactory. These are—(1) "The temperature of a body is its state or condition with respect to sensible heat;" and (2) "the temperature of a body is its tendency to communicate heat to other bodies." These definitions are quite as useless for scientific purposes as the definitions given by geometers of "a straight line." That is, they are of no use whatever. Whoever manufactures a satisfactory scientific definition of temperature will cover himself with glory. The definition which is implicitly used in the manufacture of thermometers is, "the temperature of a body is a thermal property of the body, which changes proportionally with the volume of a standard body, called a thermometer, of which the pressure is constant, the two bodies being in contact." This definition labours under two objections—(1) It does not say what temperature is, but merely says how its variations are measured; (2) the scale of variations is not absolute, but depends on the special properties of the thermometric body made use of.

Thomson's definition of absolute temperature labours under the first of these defects, but not the second. Some one may remark that the popular definition is always understood though not expressed, namely, "temperature is warmness." This, of course, is the original meaning of temperature. But how are we sure that the variations of the so-called temperature of a body indicated on any scale of temperatures correspond to, or are proportional to, the variations of warmness of the body? It will thus be seen that we cannot say what temperature is any more than we can say what entropy is. All that we can say in both cases is, how the variations of each are measured by the variations of the pressure and volume of the thermometric body in contact with the body whose temperature and entropy are in question. Perhaps the simplest definition of entropy is, "The entropy of a body is a thermal property of the body whose numerical value does not change unless heat is received or given out by the body, but at a given constant temperature of the body, increases proportionally to the quantity of heat the body receives, and diminishes proportionally to the quantity of heat the body gives out." From this definition it follows that if a body kept at absolute temperature T, receive or give out H units of heat, its entropy will increase or decrease by a quantity proportional to $\frac{H}{T}$, and if the units be properly chosen, the increase or decrease will be equal to $\frac{H}{T}$.

Mr. W. Oldknow very rightly, I think, objects to the use of the word property in connection with entropy, as it is not a property of matter, but is merely a mathematical convention. There are many such conventions, very useful in their way, which are so much used, that it is convenient to have names for them, such as "potential," "momentum," &c., and which, to save much circumlocution, are conveniently though improperly called properties of matter. No more has that which is commonly measured by expansion, and called temperature, any right to be called a property of matter; but as it is intimately connected with that property of matter called warmth or hotness, it is convenient to identify it with that property. I hope, therefore, that Mr. Oldknow will forgive me for my loose use of the term property.

Cairnryan, Stranraer, Peter Alexander.
August 3rd.

P.S.—I intend to say more about entropy on a future occasion.

### HEAT AND THE STEAM ENGINE.

Sir,—I respectfully ask your space for the purpose of presenting some views of my own regarding the heat and mechanical action of steam in an engine, which I have never seen in print.

The "total heat" of Regnault H = 1081·94 + ·305 T deg. is only the formula which he obtained by condensing steam of different temperatures. It is made up of the heat in the water, plus the heat which disappears during evaporation, leaving no trace except 5 or 10 per cent. in dynamic effect, according to the pressure under which it is evaporated. In the steam tables this dynamic effect should be credited to the latent heat, instead of to the total as we now have it.

The real heat units of the steam are equal to the heat units of the water from which it was raised. Thus provided with heat, the steam is able to expand itself, and do work according to the mechanical equivalent, under favourable circumstances, in a non-conducting cylinder without any condensation. The fact that the live heat in steam increases as fast or faster than the temperature, while the total heat only increases ·305 T deg., is a reason for the better economy in the use of the high steam and expansion, in comparison with the old low-pressure system.

After the steam is cut off in the high-pressure cylinder, the passage through ports, pipes, and receivers, and larger cylinders, and in the condenser, until it hits the tubes, is an act of expansion consuming heat. If we are lucky enough to have moving pistons in front of it, we get its value in work, if, as in the receiver to be noticed, we lose our pressure and heat and get nothing.

The following are some calculations which I have been making upon the results obtained by Professor Kennedy in his trial of the engines of the steamer Iona, in July, 1890, having before me the report published by your Institution of Mechanical Engineers.

The report says:—"The actual weight of feed-water used per revolution was 2·35 lb." This I find was obtained by dividing the weight of all the water put into the boiler by the number of revolutions during the test, and is quite misleading, as I shall proceed to show—noting first my approval of the detail work which enables us to correct the results.

The total feed-water is given as 136,820 lb., but it is subject to reductions. Supplementary, or make up, 8302 lb.; this was a consequence of leaks in boiler, or pipes, or feed-pump, and never went into the engine.

Steam pipe and valve chest drains 800 lb.

Condensation from high-pressure jacket 5600 lb.

Collecting these out, I get 8302 + 800 + 5600 = 14,702 lb., and 136,820 − 14,702 = 122,218 lb.

Priming 2·28 per cent. = 3504·7866 and 122,218 − 3504·7866 = 118,613 2134.

Revolutions for the trip 58,651 and $\frac{3504 \cdot 7866}{58{,}651} = 2 \cdot 0222$ lb. weight of steam per revolution used in cylinder.

On the high-pressure diagram, Plate 3, on the 110 lb. line, I get measurements from the steam curves to the compression curves which together make 2·88in.; length of diagram, 3·50in.; stroke of piston, 3·25ft.; volume of steam per revolution = 2·21ft. × 2·528 square feet piston area = 5·587 cubic feet; weight per cubic foot at 125 lb. total pressure, ·28422, and 5 587 × ·28422 = 1·587937 lb., which is 78·525 per cent. of the 2·0222 which went into the cylinder. The condensation, then, is 21·475 per cent., instead of 36·6 given in the report.

On the expansion curves of this high-pressure diagram the mean effective pressure is 33·2 lb. per square inch; piston area, 366 square inches; distance moved by expanding steam by piston per revolution, measuring from the intersection of the 110 lb. line with the expansion curves, 3·974ft. Then 33·2 × 366 × 3·974 = 48,288 88 foot-pounds work done in high-pressure cylinder by expanding steam.

For the work done in the second cylinder I take the mean pressure marked on the diagram 19 97. Piston area 899·17, piston travel 6·5ft., which give 116,716·75 foot-pounds.

From the low-pressure diagram I take the mean 7·175, and add the back pressure, 2 lb., which makes the total mean pressure above zero 9·175.

Piston area 2537·5 square inches, travel 6·5ft. The work done by expanding steam in this cylinder per revolution is 151,330·07 foot-pounds.

The receiver diagrams—Plate 5—show work done which costs heat but does not assist in turning the crank shaft. The first receiver I estimate at ·9 the capacity of the high-pressure cylinder, or 7·3 cubic feet; the mean effective pressure I find on Fig. 10 is 2·7 Then 2·7 × 144 × 7·3 = 2837·24 foot-pounds.

The second receiver I estimate at 18·3 cubic feet. Mean pressure on diagram Fig. 12, ·85 lb. per square inch, and ·85 × 144 × 18·3 = 2239·92 foot-pounds.

I now have for the total work done by expanding steam:—High-pressure cylinder, 48,288·88; first receiver, 2837·24; intermediate pressure cylinder, 116,716 75; second receiver, 2239·92; low-pressure cylinder, 151,330 07; foot-pounds, 321,412·86.

The heat necessary for doing this work I take from the Regnault table, 125 lb. pressure at cut-off. Heat in 1 lb. of water, 316 0433 units; terminal pressure, 5 lb.; heat in water, 130·8913 units; difference, 185·152 units; then as 2 0222 lb. went into the high-pressure cylinder, there are available for doing work by expansion 374·414 units. It may very properly be objected here that as 21·5 per cent. of the steam has been condensed at the time the steam valve is closed, I have no right to reckon its heat as available.

My answer is that all the condensation inside the cylinder is upon the cylinder walls, and that the heat units put into those walls during the first part of the stroke by condensation are exactly equal to the heat units sent out of them by evaporation later on, otherwise the cylinder would become hotter.

The jacket water I regard as condensed half only on the walls next the bore of the cylinder, consequently it gets only the heat due to the condensation of $\frac{5600}{2} = 2800$ lb. for the whole experiment. The heat of condensation for 150 lb. pressure is 860·5 units per pound weight, and $\frac{2800 \times 860 \cdot 5}{58{,}651} = 41 \cdot 3$ units per revolution. The available heat is 374·414 + 41 3 = 415·714 units. The work done by expansion is 321,412·86-foot pounds, and $\frac{321{,}412 \cdot 86}{415 \cdot 714}$ = 773·16-foot pounds work done per heat unit.

If my method of calculating should prove to be correct, it would follow that we can estimate from indicator cards the weight of steam going into the cylinder.

The report of the trial of the Meteor engine has no corrections which I can apply. Taking the diagrams as they are, and using the 6·93 lb. feed-water per revolution, as given, a similar calculation gives $\frac{862{,}701}{1118 \cdot 8}$ = 771-foot pounds per heat unit expended. This result should please Mr. Mansel.

The figures taken from a test made twenty years ago on a Leavitt compound pumping engine at Lynn, in this State, give total work 257,219·92 foot-pounds per revolution by expansion, and the heat used 323·76 units, which gives 794·44 foot-pounds per heat unit—and this should please Mr. Donaldson.

This fine little engine has both cylinders jacketed, with steam at boiler pressure 70 lb. It expands twelve times. Cylinders 17½in. and 36in. × 7ft. stroke, working on opposite ends of a beam. The indicated horse-power was 168·08, and the feed, including jacket water, was 14·783 lb. per hour per indicated horse-power.

William H. Harrison.

Braintree, Massachusetts, U.S.A., July 23rd.

### THE DARING AND THE HORNET.

Sir,—In my recent address to the Naval Architects at Southampton I stated that the speed of the torpedo-destroyer Daring was 29 368 and that of the Hornet 27·628 knots. In justice to the builders of the latter vessel, I desire to explain that the speed claimed for her was the mean speed obtained during a continuous run of three hours, whereas the speed of the Daring was the maximum speed of one mile with the tide.

May I ask you to allow me to call attention to this point in your columns? Brassey.

4, Gt. George-st., Westminster, S.W., Aug. 4th.

---

Sir,—Referring to the statement which has been widely circulated in the press, and repeated by Lord Brassey in his able address at the recent meeting of the Institute of Naval Architects, that the speed of the Daring was over 29 knots, we would point out that the speed referred to was that obtained on one run over the measured mile.

As we attach no importance to speeds on isolated miles, we make a practice of only putting forward as the speed of a vessel that obtained on a continuous trial of three hours on Admiralty conditions, and we would submit this as a fair basis upon which speeds should be placed before the public. On this basis we believe the speed of the Daring was $\frac{78}{1000}$ of a knot per hour greater—obtained, we understand, by about 300-horse power more—than that of the Hornet; and we are sure the builders of the Daring would not wish a comparison to be made in such a manner that the performance of their vessel should be placed in a more favourable light than the facts justify.

Yarrow and Co.

Isle of Dogs, Poplar, London, E., August 8th.

## RAILWAY MATTERS.

The West Highland Railway was opened for traffic on Tuesday.

The Barry Railway Company have just acquired land for extension of Barry Docks.

About forty-five miles of the Bareilly-Soron Railway project have been completed. This line will be a connecting link between the metric gauge systems north and south of the Ganges.

The estimated expenditure of 123½ lakhs of rupees on the northern section of the Mu Valley Railway in Upper Burmah from Choungzon to Mogaung, about 140 miles in length, has been granted by the Secretary of State.

A Great Northern goods train from Grantham to Leicester was wrecked at Leicester station on Monday last. The train dashed into the dead-end, smashing it to pieces. Three loaded wagons and vans were thrown on the top of the tender. One wagon containing eight cattle was thrown over the top of the tender, and six of the beasts were so badly injured that they had to be slaughtered as soon as they could be liberated. The guard, fireman, and driver were badly shaken. The cause of the accident is not explained.

Owing to the girders of one of the spans of the Anas Bridge being badly damaged during erection, the opening of the Godhra Rutlam Railway will probably be deferred till August. *Indian Engineering* says that the damage was caused by the timber part of the staging on which the span was resting catching fire, with the result that the girders dropped and were buckled out of shape. This accident must be very discouraging to the engineers engaged on this difficult structure, where the work has been vigorously pushed under very trying circumstances.

The breaching of the Begari Bund and the bunds on the Indus, between Sukkur and Sita road, is causing grave anxiety to the North-Western Railway officials. It is feared, and with good reason, that the railway line between Ruk and Jacobabad and the line between Sukkur and Ruk are seriously threatened. If Jacobabad, which is situated 40ft. below the level of the river, should be swept by the floods, the consequences will be most serious. The bridge over the Rohi Nullah, recently damaged by the floods, has been converted into a girder bridge and through communication restored.

The trains on the Great Western Railway were recently seriously delayed in consequence of a singular circumstance. As the corridor train to Kingswear was nearing Wooton Basset it was noticed, the *Railway World* says, that one of the lines had become bent and twisted owing to the extreme heat, so that it was unsafe for trains to pass over it. The authorities were communicated with, and in a short time the rails had been sufficiently repaired to allow of traffic being resumed; but had the circumstance not been noted before the passage of the train, it is probable that it would have given rise to a serious accident.

A memorial has been addressed to the Government by the British and Foreign Anti-slavery Society upon the question of giving a Government guarantee upon the capital required for the construction of a railway connecting the province of Uganda with the East Coast. Until this railway is made it is contended that any plan for the improvement of those countries must be of the nature of a makeshift. In addition to the merely commercial benefit to Equatorial Africa that would result from a railway to the coast, the committee would urge that its completion would greatly diminish the slave trade in Central Africa. It would also do away with the necessity for the employment of thousands of porters at present engaged in the transport of goods from the coast to the lakes.

The railway traffic on the London and North-Western Company's section from Manchester to Leeds was on Sunday last for the first time passed through the new tunnel under Standedge, a lofty portion of the Pennine chain between Diggle and Marsden, in Yorkshire. The new tunnel is three miles and seventy yards long, and has been constructed from the plans and under the direction of Mr. F. Stevenson, chief engineer to the company. It has been driven through gritstone rock and hard shale, and has been lined with hard bricks of Brindle make, of which over 25,000,000 have been used. Double lines have been laid in the tunnel at a dead level. The old pair of narrow tunnels carrying each a single line under Standedge will be closed for a time for inspection and repairs, and then all four lines will be constantly used.

In an article in the *St. James's Gazette* on "Progress in the Far East," we gather some useful information on railways in China:—"The Imperial Northern Railway of China has not been constructed for purposes of pleasure, it is essentially a strategic line. His Excellency Li Hung Chang, who had been mainly instrumental in developing the Kai-ping Collieries, saw the necessity of constructing a railway from Kai-ping to Tientsin. He lost no time in commencing work; and, being ably backed up by Tong-king-Sing and Claude W. Kinder, C.E., and others, the construction of the railway from Kai-ping was pushed on rapidly, and in 1886 the first section of the line—twenty-eight miles—was opened for traffic to Lu-tai, the extension to Tientsin—the maritime port for Peking, sixty-two miles—was completed in 1888, and the first special train from Kai-ping to Tientsin was run through by Mr. Kinder on July 25th, 1888. The following year the line was extended to Tong-ku, a mile from the Taku forts, at the mouth of the river Peiho. Early this year the line was opened for traffic to Shan-hai-kwan, 180 miles from Tientsin, the station at the former place being within 1000 yards of the Great Wall of China, through an opening in which the railway is being constructed towards Kin-chow, at the northern extremity of the Gulf of Liau-tung."

In an interesting article on "The Electrical Welding of Street Railway Tracks," contributed to *Electricity* by Mr. N. W. Perry, we abstract the following description of a process which has proved particularly successful:—"In making the standard weld, four blocks of iron are taken about 2in. square in section and shaped to fit the rail section. Let us assume that the welder is in position over the joint to be welded. The lower pair of chocks, as these iron blocks are called, are placed in position, the hydraulic jacks are worked and the clamps brought into position against the chocks and the proper pressure applied. The current is now turned on—30,000 ampères—and the chocks gradually heat up. The operation is watched very carefully, and the pressure increased or decreased as the requirements demand, until the required temperature, little short of that of fusion, is attained. The jack is now rapidly worked, bringing the necessary pressure on the chocks to complete the weld, and then the release valve is opened, and the clamps are withdrawn. The upper pair of chocks are next put in place and the operation repeated. The welder is now swung to one side, the clamp removed, and the face of the rail slightly hammered to smooth down any irregularities, and the operation is complete. Under favourable conditions the welding proper of a joint can be done in seven minutes, but it usually takes double this time. The machine is next swung over to the other rail, and the joint there welded. This being complete, the two cars—the dynamo and welding cars—move on to a second pair of joints, which are welded in like manner. They then move along the track, skipping the third joint, the one which, in laying the track, was left open, and proceed to the fourth. Thus, during the daytime every third joint is skipped, this being done to allow room for the expansion due to the welding heat. At night, when everything has cooled down, and the temperature is at its lowest, the welding machine goes over the track again, and completes the work omitted during the day."

## NOTES AND MEMORANDA.

In Liverpool there are 114 people to the acre; in Manchester 39 9; in Birmingham 38; Huddersfield having only 8. These differences are appealed to for explanation of the apparently high death-rate of Liverpool.

A new form of phonograph of a particularly simple construction has been described before the Electro-chemical Society of Berlin, by Herr A. Kœltzow. In this instrument, which in consideration of its low price appears suited to many purposes, at any rate in those countries where patent rights will not prevent its introduction, the cylinder on which the record is made is composed of a hard kind of soap. Each cylinder admits of being used for recording 250,000 words, since an arrangement allows of the removal of a very thin layer from the surface when this has been covered. Thus the cost of the cylinders for registering any number of words is not more than the cost of the paper which would be required if they were written down.

In a paper read before the Royal Society on "The Absolute Specific Resistance of Pure Electrolytic Copper," the authors, Mr. J. W. Swan and J. Rhodin, compared a large number of different specimens of electrolytic copper. Several of the specimens were at first roughly examined, and the best chosen for further investigation. The best of these were then electrolytically refined. This, without previous fusion, was drawn through sapphire dies to the requisite diameter, and the resulting wire subjected to careful measurements. The first specimen, "A," was measured both when hard and also after annealing at a red heat in an atmosphere of carbon dioxide gas; the second sample, "B," was only examined after annealing. The authors took extreme care in finding the dimensions of the wires and the temperatures at which they were measured. The values of the two specimens in C.G.S. units were as follows, the density being 8 9587 at 15 deg. C:—

| | | Absolute specific resistance. C.G.S. units. | Temp. coefficient. $\Delta t$. |
|---|---|---|---|
| Sample A. | Hard, as drawn | 1603 | 0·00408 |
| „ A. | Soft, as annealed | 1566 | 0·00418 |
| „ B. | Soft, as annealed | 1559 | 0·00415 |

Mr. Charles Baskerville writes as follows in the *Journal* of the American Chemical Society:—"In the recent literature which I have been able to consult, the separation of titanium from iron by means of sulphurous acid has been confined to the sulphates of these two metals. This process is long and tedious and often unsatisfactory. If a neutralised solution of titanium and iron chlorides of not too great dilution be boiled with an excess of sulphurous acid, the iron becomes deoxidised at once, and a white flocculent precipitate of titanium settles out. By this means the titanium is obtained free from iron and requires no re-solution and second precipitation, as is frequently necessary for purification when precipitated from the sulphate. If the sulphate be changed into a chloride by precipitation with ammonium hydroxide and dissolving again in dilute hydrochloric acid and neutralising the excess of acid with ammonium hydroxide, the separation is easily effected. The accuracy of the method is shown by the two following analyses: $TiO_2$, found, 0·0322; used, 0·0308. $TiO_2$, found, 0·0317; used, 0·0314. The tedious boiling with sulphurous acid is avoided. A clean precipitate, which settles well and does not cling tenaciously to the sides and bottom of the beaker, filters rapidly and easily washed with hot water, is obtained. Salts of aluminum remain in solution."

M. Roland, who has given much attention to utilising the artesian waters of the Oued-Rir Valley, has conceived the idea of investigating the law as to the increase of temperature with depth in the region of the Algerian Sahara, and with this object he has turned to account a series of thermic observations made during the sinking of numerous wells in the Oued-Rir Valley. He found that the water is at a level of about 75 metres = 41 fathoms, and that its temperature is 25·6 deg. C. = 78 deg. Fah., while at a depth of about 20 metres a stratum was encountered the temperature of which remains between 22 deg. and 23 deg. C. = mean 72 deg. Fah.; so that the temperature increases 3 deg. C. = 5·4 deg. Fah. for an increased depth of 55 metres = 30 fathoms, or, for an increase of 1 deg. C. = 1·8 deg. Fah., the variation of depth is 18 metres = 10 fathoms. He also found the same result in Ouargia, and remarks that it differs widely from that met with in Europe. This communication, observes M. Bresson, in connection with Professor Berthelot's project for a 4000-metre shaft, proves that a useful effect as regards the central heat would be much more rapidly arrived at in the Sahara than in the old continent. At a depth of 4000 metres, with an increase of 1 deg. C. for every 18 metres, and the probable progression of temperature in depth, one would soon arrive at a heat of from 300 deg. to 400 deg. C.

At a meeting of the Vienna Academy of Sciences, Dr. J. Hann submitted an investigation on the daily period of wind velocity on the summit of the Sonnblick—3100 metres—based on a careful and laborious calculation and discussion of anemometrical observations for six years, and also on the range on mountain limits generally. The minimum of wind force takes place on the Sonnblick very early, about 8 h. or 9 h. a.m., and the maximum occurs about 8 h. p.m. On the Säntis—2500 metres—the minimum also takes place relatively early between 10 h. and 11 h. a.m. But from the accepted theories of the cause of the daily period of wind force on mountain summits it might be supposed that the minimum would occur in the afternoon. He therefore examined the records for several other stations, and found that in the summer, for altitudes ranging from 1400 to 4300 metres, the mean time of the minimum occurred at noon. He then investigated these facts to see how they fitted in with the assumed causes of the daily range, and as he could not reconcile them, he suggests that the possible explanation of the daily range on mountain peaks may be that the surface of the mountain being much more warmed than free air during the day affects the anemometers. It is assumed, however, *Nature* says, that the chief effect is only active for a few hundred metres below the summit, in the morning, and that later it would be interrupted by the wind coming from the valley. If the minimum were due to the great ascending current, it would occur during the afternoon.

In a paper on the "Weathering Properties of Sandstones," by Mr. W. Bolton—*Dingl. Polyt.*—it is pointed out that the usual criteria for the quality of building stones, such as their strength in compression, their absorptive power for water, and their behaviour when tested for weathering properties in the conventional manner, are not always conclusive. In particular, the compressive strength of the stone is seldom of much value in judging quality, as even inferior stones possess a crushing strength much above anything to which they are likely to be exposed in practice. Attempts to rank building stones according to their specific gravity have proved quite illusory, as no connection can be traced between this property and their mechanical value. A similar negative result has attended endeavours to find a relation between the tensile strength of the stone, its capacity for absorbing water and the force of expansion of the latter which is exerted in freezing. Methods directed to the determination of the capability of stones to resist those influences known collectively as "weathering," comprise the examination of the porosity of the stone as indicated by the quantity of water that it will absorb under standard conditions, the attack of its soluble constituents by hydrochloric acid, and the observation of its behaviour when a liquid is caused to crystallise in its pores. The author bases his judgment on the analysis of the stone, especial attention being directed to the nature of the substances serving as binding material to the particles composing the bulk of the stone. Some practical experience and observation would perhaps be the most valuable.

## MISCELLANEA.

A complete installation of electrical apparatus for all kinds of cooking has been fitted and is employed in the Imperial Restaurant, Queen Victoria-street, this being the first in Europe.

A seam of bituminous coal, 5ft. 11in. in thickness, has been struck by Mr. Donald Munro, at Dungannon, Ireland. The depth at which the seam was discovered is 188 yards from the surface.

An extensive system of wharves is about to be constructed on the water front of the city of Everett, adjoining Boston, Massachusetts. The land necessary for this purpose embraces upwards of 250 acres.

A scheme is on foot for the erection of a steel rope suspension bridge across the River Wye at Sellach, Herefordshire. The plans show a suspension bridge with a clear span of 180ft., and necessary approaches to same.

The competition for plans for the new museum of Egyptian antiquities at Cairo is an open one. The plans must be handed in before March, 1895. The best plan will receive £E600, and the four next best £E100 each.

The Chadderton Ironworks Company announce that they have granted to Messrs. W. B. Haigh and Co., Ld., Oldham, the sole and exclusive licence to manufacture and sell the McDougall's steam saving appliances.

The thirty-mile canal, with the additional seven-mile tunnel driven through the western mountain range, by which a proper sewerage for the city of Mexico is at last to be obtained, and danger of inundations removed, has been formally opened.

The Mersey Docks and Harbour Board have decided to extend in a westerly direction the existing double line of rails on the quay at Birkenhead. They are also considering plans of the laying down of additional hydraulic supply pipes at Birkenhead.

Tenders are invited for laying a cable from Canada to Australia by seven different routes, in order that, in accordance with the wishes of the Intercolonial Conference, the fullest possible information may be obtained as to the cost of laying and maintaining a cable.

The proposed Wallasey embankment is intended to prevent the flooding of the low-lying ground inland. It is feared that if something is not done the sea will break through the sandbanks and flood the district of Hoylake and Wallasey, besides submerging the Wirral Railway.

At a meeting of the City Commission of Sewers, held on Tuesday last at Guildhall, Mr. Alderman Bell presiding, it was decided to make an improvement in Ludgate-hill, near the Old Bailey, and to sell for £500 a small isolated piece of ground in Widegate-street to the Jewish Board of Guardians, contiguous to their property.

The Government of India decline to sanction the extra staff applied for by the Burma Administration for forest work. Owing to the large areas of forest now being reserved, it is considered in Burma that a larger staff should be maintained, otherwise supervision cannot be satisfactorily carried out, and the results must necessarily suffer.

In connection with the autumn meeting of the Iron and Steel Institute at Brussels, the King of the Belgians has invited the members to a reception at the palace in Brussels on the evening of Wednesday, August 22nd. Upon the occasion of the visit to Liége on Thursday, the 23rd, the members are invited to a luncheon at the Jardin d'Acclimatisation of Liége by the Liége and Mons Societies of Engineers.

The death is announced of Mr. Charles Arthur Redl, at Chateau d'Oex, in Switzerland, on August 3rd, in the 81st year of his age, who deserves to be remembered as the original inventor some forty years ago of the dual system of signalling which led, after various developments, to that which is now in general use both in the army and navy. The value of the system was recognised by a special committee at the time, and Mr. Redl received from Government a considerable grant for his services in introducing it and instructing several young naval officers in its use.

Western Australia has an eye to the many improvements which engineering skill offers. Among the works about to be undertaken are the extension of the railway system from Southern Cross to Coolgardie, from Geraldton to the Murchison Goldfield, and from Donnybrook to the Collie Coalfields, the continuation of the harbour works at Fremantle, the conserving of and boring for water, the surveying and opening of roads, the extension of the telegraph system, and the improvement of harbours, jetties, and lighthouses on the coast.

The death is announced of Dr. C. R. Alder Wright, Professor of Chemistry at St. Mary's Hospital. Dr. Wright was known for the wide extent of his chemical researches and experiments. In 1878 he published his work on "Metals and their Industrial Application," and among his other efforts in metallurgy he assisted Sir I. Lowthian Bell in his researches on the chemistry of the blast furnace. More recently he made abstruse investigations in the field of organic chemistry, with special reference to the opium alkaloids and alkaloids of aconite. He also gave much attention to chemical dynamics, and was regarded as one of the ablest physical chemists of the day.

Two powerful steamers, which have been built for the Russian Government in connection with the Trans-Siberian Railway, now in course of construction, are intended to navigate rivers wherein there are rapids of such force that the ordinary paddle machinery would not be sufficient to overcome the force of the current. To get over this difficulty chain gearing is used. At each end of the vessel there are swinging arms and horizontal and vertical rollers to guide the chain from the time it enters at the bow until it is dropped over the stern after passing the hauling gear. The vessels will shortly leave for the Yenisei river. They are named the Pervoi and Vtoroi.

It is satisfactory to learn that the Forest Department in Burma are striving to effect an opening for Pyinkado timber for street paving, and with this view a note has been prepared on the properties of this wood, and copies and specimens sent to the Antwerp Exhibition. Scientifically Pyinkado is known as *Xylia dolaborisormis*, a large tree belonging to the order *Leguminosa*. *Indian Engineering* says the tree is very common in Burma and the supply of timber is only limited for use as railway sleepers. The breaking weight of one square inch in section and 30in. long is 318 lb., as compared with 208 lb. for teak and 209 lb. for oak. The crushing strain per square inch is stated to be 5208 tons, as compared with 3411 tons for oak and 2838 tons for teak.

A Newfoundland clergyman, the Rev. Patrick O'Brien, has invented an improvement in the hulls of ships, which, it is claimed, affords the maximum of speed and safety, and in a great measure avoids drifting to the leeward. The inventor, *Transport* says, curves the bottom of the vessel in convex form from stem to stern, and gives it a concave face from the keel to the sharp-edged bilge, while from the bilge to the top of the hull the sides are curved, presenting an outer convexed surface at the stern. In every case where a cross section is taken through the bilge, the sides and the bottom of the hull meet at an obtuse angle, and the outward inclination of the sides preferably increases from the ends of the hull. The steering qualities of vessels built after this plan are said to be greatly improved, especially in high winds which throw the hull over upon its side, as the bilge sections then serve as a side keel to hold the vessel to its course.

## DESCRIPTION OF TWIN-SCREW PROPELLERS WITH ADJUSTABLE IMMERSION FITTED ON CANAL BOATS.*

By Mr. Henry Barcroft.

*Canal boat propulsion.*—It is pretty generally known among those acquainted with canal traffic that until lately it has been impossible satisfactorily to navigate canal boats on the ordinary canals of the country by direct steam power; and boat hauling, except under favourable circumstances, is still carried on by means of horses. A canal barge is usually made as full in every dimension as possible, the limit being the size of the canal locks to be passed through, so that there is no space at the sides or stern for paddle or stern wheels, nor is there a space forward of the stern post available for a screw. Even if space were reserved here, it would admit of only a small propeller, too small in area to be effective at slow speed, and liable to get entangled in weeds. Nor would there be what is termed a "run aft," to allow a flow of water to supply the place of the water driven astern by the thrust of the screw. If a boat were well proportioned for carrying a large and paying load, the action of a common propeller would be in proportion prejudiced; and, instead of the massive boat going forward, the power would be wasted in driving a small current of water astern at a more or less considerable velocity.

*Conditions essential.*—In endeavouring to solve this problem in navigation, the writer regarded certain conditions as essential to success, which may be thus enumerated. First, that any mechanical means employed should be applicable to almost every existing boat, if possible without any structural alteration. Secondly, that any propeller when applied should not interfere with the passage as at present through locks and under existing bridges. Thirdly, that no cargo or crew space should be sacrificed. Fourthly, that the weight of the machinery should not seriously affect the carrying power of the boat. Fifthly, that the action of the propeller should not be prejudicially affected by weeds. Sixthly, that no wash should be originated, sufficient to affect injuriously the banks of a canal. For the purpose of attaching any kind of propelling machinery, these considerations exclude every part of a boat otherwise available, except the space at each side of the rudder; and the question then arose how best to utilise this space by the employment of propellers of sufficient area to cause the boat to go forward satisfactorily. The effort of every propeller expends itself in two directions, driving the water astern and the boat forward; and the definition of excellence given by Rankine is to the effect that, other things being equal, the best propeller is that which drives the greatest volume of water astern at the slowest speed. After many experiments, extending over two or three years, upon a 60-ton lighter purchased for this special purpose, the arrangement was evolved which is the subject of this paper, and which is found by experience to comply with all the foregoing stipulations.

*Newry.*—The last boat fitted, the Newry, is 62ft. long by 11½ft. broad, with 5½ft. draught fully laden, when, inclusive of machinery, she would have about 65 tons on board. Her machinery, weighing in all about three tons, consists of one locomotive boiler having 87 square feet of heating surface and weighing 23 cwt.; one horizontal engine with two cylinders, 4½in. diameter by 8in. stroke, placed on the deck immediately forward of the stern post. On each side, coupled to the crank shaft, are skew wheels 12in. diameter, driving wheels of the same diameter and of double the number of teeth on upright shafts, which are set in upright frames securely clamped to the foundation framing, and the foundation framing is secured firmly to the deck and deck beams of the barge. At the lower part of the upright frames are axles bolted or welded on at right angles, and upon these axles revolve the twin screw propellers, to which motion is conveyed by means of bevel wheels, one on the lower end of the upright shaft, and the other on the propeller boss. The interior of the boss is similar in design to what are called "patent axles" of road carriages, but suitably proportioned for the strains and work. The thrust is taken by a collar, on each face of which is a leather ring, the whole working constantly in oil, as is the case with all carriages. By this arrangement a saving is effected as compared with an ordinary screw working through a stern tube, which is necessarily subject to great friction. The diameter of the axle is 2¼in. and of the collar 4½in., giving an area of 12 square inches to take the thrust. The leather rings are each about $\frac{3}{16}$in. thick. The skew wheels used in this instance for gearing the engine crank shaft to the upright shafts are really worm gearing; the worm on the horizontal driving shaft has 16 threads of coarse pitch, having an inclination of 27 deg., while the worm wheel on the top of the upright driven shaft has 32 teeth inclined at the same angle to its axis or at an angle of 63 deg. to its face; hence the upright shafts and the propellers are driven at half the speed of the engine.

*Screw propellers.*—The twin propellers are 4ft. 10in. diameter, and have each three blades, and each blade has an area of four square feet; thus the total blade area is 24 square feet. The blades, made of thin steel, are riveted to arms, which in turn are screwed into or against the boss. The dimensions have been arrived at after numerous experiments, the great aim being to attain, subject to certain limitations, the utmost possible progress of the boat in proportion to the amount of coal consumed. The pitch of the blades is equal to 1000 revolutions per mile, and at full speed the propellers make 100 revolutions per minute. It is not asserted that the diameter or area or pitch of the screws is absolutely the best; but from experiments with various diameters, areas and pitches, the writer is unable to suggest any decided improvement, so long as the power and piston speed, &c., remain constant. Every change in these last would naturally involve a reconsideration of the proportions throughout.

*Crew.*—The crew consists only of a man and a boy, who have had no difficulty in handling the boat and machinery under all the varying circumstances in which they have from time to time been placed.

*Ulster.*—The Ulster, built a year ago, and similar in many respects, has now accomplished 3000 miles. Sometimes in Lough Neagh she has encountered considerable seas. On the Ulster Canal she has navigated up to Clones, eighty-one miles from Newry, through sections of 91 square feet, or only half as large again as her own immersed section; and in the Newry Canal she has passed through weeds so thick as to meet across the water; altogether the navigation from Newry to Clones is as difficult as any to be met with. These boats are very efficient as tugs. The Ulster towed a lighter laden with coal from Newry on the coast to Benburb on the Ulster Canal, a distance of 46 miles. The united cargoes of the tug and the lighter amounted to 107 tons. In this trip a length of 13½ miles in the Bann River and Lough Neagh was done in 4½ hours; the revolutions of the propellers were approximately 14,580 each, the revolutions due to the distance being 13,000; the coal consumed was 2¼ cwt. The leathers in the nave of the propellers had not been examined up to the end of May, although the tug had run 2350 miles; on examining them in June the author could see no wear on them, and the propellers are at work again without any change having been made. One cause which may tend to diminish their wear the writer is inclined to think may be that the pressure on the teeth of the lower mitre wheels transfers part of the thrust to the footstep of the upright shaft, thereby relieving the leather rings to that extent.

*Immersion of propellers.*—The propellers, which have never been wholly submerged, are readily raised and lowered, so as to regulate the immersion and thus secure the utmost efficiency. If they are too low, the engine is held by the increased resistance of the water, and the revolutions are restricted; while if they are too high, the engine runs away owing to diminished resistance, and a loss arises from excess of slip. The boatmen soon get to know the level that gives the best results, which for a full boat with 5½ft. draught is about 3ft. 3in. to 3ft. 6in. from the surface of the water down to the bottom of the propeller. The two propellers are adjusted independently of each other. A portable crane is dropped in a socket cast in the bed-plate at each side, and a long screw is hooked to a ring on the propeller frame; on slacking the clamping eyebolts the frame is suspended from the crane, and is then raised or lowered by the screw. Other methods have been used, but this plan has been selected as convenient and inexpensive, as well as being light and portable. It is a peculiarity of these partially submerged propellers that they have little or no influence upon the steering of the vessel; that is to say, if one propeller were going ahead and the other astern, they would stop the way of the boat, and not tend to turn her round. For going ahead the propellers in all cases turn towards the stern post in the upper half of their revolution. In place of twin propellers, a single propeller has been used with good results, though working on one side of the stern instead of centrally. Two, three, and four blades have been tried; all are effective, but two cause an undesirable vibration; three are most efficient, while with four blades the vibration ceases, but the efficiency is somewhat lessened, owing probably to what is called churning the water. If desired the whole propelling apparatus can be made portable, and readily moved from one boat to another. The only alteration that is needed for an existing boat is an extension of the stern post, so as to set the rudder farther back; a space of from 15in. to 21in. is needed between the stern sheeting and the rudder when put square across: and most boats can pass the locks with this addition.

*Performance.*—In April last the Grand Canal Company, Dublin, fitted their No. 34 lighter with machinery similar to that above described. The first voyage was from Dublin to the Shannon and back, having another boat No. 35 in tow. The distance there and back is 158 miles, with 78 locks. The second trip was over the same distance, and the time occupied about six days. In this trip the coal consumed in the double journey was altogether three tons at 14s. 6d. per ton, or at the rate of less than 1¼d. per boat per mile. On the Grand Canal it is usual to work night and day with relays of horses and men, and the time required out and back is five 24-hour days; the regular charge for hauling of 1s. per boat per Irish mile would be equivalent to nearly 9½d. per English mile. So that, without working at night, the steam tug was only one day behind the horse boats in a week, notwithstanding that about fifteen hours were lost by the steamer in waiting for the locks to be filled after she had passed through and for the subsequent passage through of her consort.

*Machinery.*—The propeller bosses and arms have from the first been manufactured by Messrs. Grice and Harrison, axle makers, of Birmingham. The blades and all the rest of the machinery for the Newry and for No. 34 lighter were constructed by Messrs. Robey and Co., of Lincoln, who have kindly supplied the accompanying drawings.

*Driving by petroleum engine.*—The new propellers seem admirably adapted for almost any method of driving. (The author described an arrangement by which power is derived from a petroleum engine.) Here the engine is represented on deck, 12ft. forward of the rudder; it rises only 2ft. 8in. from the deck, thus enabling a light boat—that is, one without cargo—to pass under low bridges. If, however, the nature of the navigation should make it desirable to put the engine below, this can be readily done.

*Hilda.*—A very suitable arrangement has been adopted by the Portadown Carrying Co. for their steam lighter the Hilda, 80 tons burden, which navigates Lough Neagh, the largest lake in the United Kingdom, being twenty-four and twelve miles in extreme length and breadth. Also the Lagan Canal to Belfast, where bridges are met with so low that the arch is but 2ft. 4in. above the deck of a lighter when empty. No option remained but for the boiler, made by Messrs. Victor Coates and Son, to be put below. On deck, close to the upright shafts, are the engines, one for each propeller, which were supplied by Messrs. Vosper and Co., of Portsmouth.

*Electricity.*—A desirable combination would be to introduce electricity for conveying power from an oil engine, placed in any suitable part of the vessel, to the propellers. The engine could drive a generating dynamo, which in turn could set in motion a motor wound on the cross horizontal shaft. By means of resistance frames, various speeds could be obtained and reversing be accomplished, as on an electric railway.

---

[*] Paper read before the Institute of Mechanical Engineers at Manchester on Wednesday, 1st August.

## BRITISH SOCIETY OF MINING STUDENTS.

### MEETING AT CARDIFF.

This Society, which is a stepping-stone to the Mining Institute, and has been in existence about seventeen years, held its annual meeting on August 1st and 2nd at Cardiff. The gathering was not a large one, but was thoroughly representative of all the coalfields in the kingdom, throughout which and the Colonies the 229 members of the Society are scattered. The business meeting took place on Wednesday morning in the lecture hall of the South Wales Institute of Engineers, the chair being taken by the President—Mr. Frank Brain, M.E., Assoc. Inst. C.E., of Gloucester. In his address he dealt at length with the report of the Royal Commission upon coal dust in mines. As to the recommendation that high-class explosives should be used in preference to gunpowder, he said that experiments made went to prove the improbability that dangerous explosions of coal dust alone could ever be produced by contact with an ordinary flame; and high-class explosives had failed to cause explosions of coal dust. Taking into account the cost of the electric fuse, the cost of high-class explosives was somewhat higher than gunpowder, but as the result of increased consumption, these he believed could be produced to compare favourably with gunpowder even from an economic standpoint. There was no doubt that electricity was the coming power in mines. In the colliery he was connected with they had three electric pumps working underground, and he could speak with confidence of their utility. His company was also putting down a system of underground haulage, worked by electricity, and scarcely a week passed in which they did not hear of some new electric plant in mines. It was their duty to apply themselves to the discovery of means to the prevention of accidents in mines. Last year there were over 1000 lives lost by mining accidents, and although this compared favourably with years gone by, there was still room for improvement, and they must minimise mining dangers by putting into practice what they learned. The president was re-elected, and also the secretary and treasurer, Mr. H. F. Bulman, Newcastle-on-Tyne. The following were appointed vice-presidents:—Mr. Hy. Palmer, Newcastle; Mr. H. W. Hughes, Staffordshire; Mr. C. H. Cobbold, Yorkshire; and Mr. R. B. Mawson, Lancashire. The remainder of the day was spent in visiting Cardiff Castle and Barry Docks.

Thursday was occupied in visits to the Llanbradach and Great Western Collieries. Llanbradach, which is about ten miles to the north of Cardiff, was reached by brake, and the visitors were conducted over the colliery by Professor W. Galloway, consulting engineer, and Mr. Bradford, manager. This colliery is the newest in South Wales, and is at present producing 500 tons a-day, work on the steam coal having just commenced at a depth of over 500 yards. There are two shafts, one 572 yards, and the other 584 yards deep. The roads are lighted by electricity, and natural ventilation is maintained, small fans being in use to complete the circulation of air in the extreme of one or two headings. One of the first mechanisms inspected by the visitors was a rubbish tipping apparatus actuated by compressed air, by means of which trams containing from two to three tons are, by means of a revolving frame, simply and easily turned upside down, and their contents deposited on the slopes of the rubbish tip. The screens were next examined. These divide the coal into five different classes suitable for various markets, and allow the rubbish to be picked out by hand on picking boards and a revolving table. Descending into the house coal seam, 264 yards deep, the party saw in operation a triple expansion duplex steam pump, raising 30,000 gallons per hour to the surface continually, and Jeffery's coal heading machine and rotary rock drill, both employed at the face of one of the headings, which is being driven 6ft. high by 14ft. wide, at the average rate of about 18 yards per week. Staus' skeps and Fisher's catches were shown on both shafts, a tandem compound winding engine on No. 2 pit, and the boilers, hauling engines, &c., were also examined with interest.

A long but pleasant drive brought the party through Cilfynydd—the scene of the Albion Colliery disaster—to the Rhondda valley, where the Great Western Colliery is situated. Here they were warmly welcomed and hospitably entertained by the management, represented by Mr. Hugh Bramwell, agent; Mr. John Vaillant, chief surveyor; Mr. F. Bell, assistant surveyor, and Mr. Forster Brown, jun. There was not time remaining to make a complete inspection of these extensive collieries, from which over 2000 tons of coal per day is the average output. This is raised from four pits, viz., the Hetty, No. 2, Tymawr, and Maritime. The latter, which has a Waddle fan 25ft. in diameter, is situated across the Rhondda river, and owing to the lateness of the day was left out of the programme of inspection. The visitors were conducted through the above ground works of the other pits, which are in close proximity to each other. Amongst other interesting items examined was a newly arranged chain creeper at the Tymawr pit. By means of this, full trams are conveyed from the pit tops to the screens, a distance of 100 yards, and are returned empty on the other side, thus effecting an immense saving of labour. The creeper is driven by an engine on a lower level. A very fine new winding engine by Fowler, of Leeds, was also seen at the pit; it is compound horizontal, having high-pressure cylinder 32in., low-pressure cylinder 48in., with 5ft. stroke, and automatic expansion gear worked by a governor. The steam pressure is about 150 lb. per square inch. This engine has a cylindrical drum of 18ft. diameter, and the depth of the pit is 500 yards, this being the deepest of the four pits belonging to the Great Western Colliery Company. The air compressors were also seen in operation. There are two pairs of tandem compound engines in one house, each pair having two high-pressure cylinders 22in. diameter, and two low-pressure cylinders 40in. diameter; stroke, 5ft. The air cylinders, 34in. diameter, are placed behind each low-pressure cylinder. Each high-pressure cylinder has variable expansion apparatus, which can be adjusted while the engines are working. There is an independent condensing apparatus, consisting of a pair of engines having 10in. cylinders, 20in. air pipes, and 2ft. 6in. stroke, so arranged that they can be worked together or as single engines and condensers. The mine is ventilated by about 270,000 cubic feet of air per minute with a Schiele fan of 15ft. 6in. diameter, driven by a compound condensing engine, and there is a separate condenser with 3in. water gauge at bank. Returning to the offices, the system of working the mine was explained by Mr. H. Bramwell. The long wall system is in operation. The general principle is to drive main or water levels to the pit bottom, and from these levels headings are driven to the roads, from which the stall roads are turned and the entire seam is taken out, except the pit pillars. The visitors expressed thanks to the colliery officials and returned by rail to Cardiff, and thence to their several destinations.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The South Staffordshire Coal Trade Wages Board have taken steps to put themselves in shape with the reduction in colliers' wages which the National Federation have agreed to. A meeting of the Board has been held at Dudley since my last, and the coalowners announced that with the view to a revision in wages they must require that the net average selling prices of coal and slack over the last three months—May, June, and July—should be "taken out" by the accountants to the Board. It is anticipated that this return will show that the employers are entitled to a reduction of between 5 and 10 per cent., and under the sliding scale the men will have to submit to it. The miners' representatives have given their consent to the average being ascertained, but complain that the masters are not better organised amongst themselves so as to prevent the underselling that the men assert is going on. The reply of the masters to this, as urged at the meeting by Sir Benjamin Hingley, M.P., the chairman of the South Staffordshire Ironmasters' Association and one of the leading coalowners of the district, is that the Midlands have to contend with Scotland, the North of England, North Staffordshire, Lancashire, and the South Wales districts, and as in these districts wages and coal prices are being reduced, it is idle for Staffordshire to remain single. To do so would be to lose its trade both in coal and iron. Not one-tenth of the ironmasters were making a profit now, and the furnaces in Shropshire were losing upon every ton of iron. Other iron-making districts of England had far greater natural advantages than Staffordshire, and it was necessary to do everything possible to meet the severe competition from those quarters.

In North Staffordshire and Warwickshire the colliers are showing a good deal of dissatisfaction over accepting the 10 per cent. reduction decreed by the National Federation. At the collieries of the Shelton Iron, Steel, and Coal Company, North Staffordshire, the men and boys, to the number of nearly 2000, at first struck work, and it was only after a long explanation and considerable persuasion on the part of the local agent that they consented to go down the pits. At the Northwood Colliery a similar thing occurred, and at the Park Hill Colliery, Longton, and the Ford Green Colliery, the pits were also rendered idle. This week, however, the men are exhibiting a more reasonable spirit, and the holidays seem to have had a pacifying effect. In Warwickshire the men openly expressed themselves against accepting any reduction, and, had the local agent wavered for an instant in his commands to them to obey the Federation settlement, they would certainly have struck. As it is, however, the agent's advice is fortunately being accepted.

The great Federation coal strike in the autumn of last year against the attempt to reduce the 40 per cent. wages advance, which affected all the other central districts of England, but left South Staffordshire, which works under the Wages Board, untouched, proved a good thing for many of the dividend-earning collieries hereabouts. The affairs of the great Sandwell Park Colliery Company, West Bromwich, is a conspicuous example. At the annual meeting a few days ago the directors congratulated the shareholders on an exceptionally prosperous year. The colliery was very busy, and there was an advance in prices. As a result a 10 per cent. dividend, with a bonus of 5 per cent., had been earned, besides adding to the reserve fund and carrying forward a substantial balance.

The best—thin—sheet iron and tin-plate making concern of Messrs. Knight and Crowther, Kidderminster, announces a trading profit on last year of £10,743, out of which a 6 per cent. dividend is recommended on ordinary shares, £2000 is placed to reserve, and £2154 carried on. The total reserve fund now stands at £9000.

Several of the local railway wagon and carriage companies have just issued their annual reports. Messrs. Brown, Marshalls and Co. report a profit on the year of £9573, to which has to be added £5164 available from last year. A dividend of 10 per cent. on the ordinary capital is recommended, with £2000 to go forward. The Metropolitan Railway Carriage and Wagon Company recommend a similar division out of an available total of £22,979. Of this amount £14,294 is profit on the year, and £8684 the amount brought forward. This year £8000 is carried on after paying the dividend. The Midland Railway Carriage and Wagon Company pays a 7 per cent. dividend on the ordinary stock and 6 per cent. on the preference, besides which it places £5000 to the reserve, and carries forward £2000. The year's gross profits of this concern was £27,539, but after deducting £5500 for depreciation on wagons on line, the net profit comes out at £23,602.

## NOTES FROM LANCASHIRE.

*(From our own Correspondent.)*

*Manchester.*—Throughout both the iron and coal trades of this district the outlook continues about as unsatisfactory as it could well be. Only in exceptional cases do engineers report new work of any weight coming forward, and except that some of the heavy branches are fairly well off for orders, the position remains one generally of but very moderate employment, with really no indication that any material improvement can be expected in the near future. In the iron trade business still drags on slowly from hand-to-mouth, and a remarkable indication of the present extreme depression of trade is the fact that notwithstanding the almost entire suspension of production in Scotland, prices are scarcely appreciably affected even for north country brands of pig iron, whilst local and district brands have been gradually easing down, and continue weak. In the coal trade much the same condition prevails; the Scotch strike has been the means of taking away some of the surplus supplies from this district, but it has not enabled any materially better prices to be obtained, and so far as the local demand is concerned there is a more or less general giving way to meet the keen competition in the market to get hold of any business stirring.

The Manchester Iron Exchange on Tuesday was moderately attended, but an almost complete absence of inquiry was again the general report. With regard to raw material, users, as a rule, buy only in the smallest possible quantities for immediate requirements, and although makers' quotations are unchanged, prices for the most part still show a want of firmness. For local brands of pig iron it is scarcely possible to give any really definite quotations, as Lancashire makers are so altogether cut out of this market by the much cheaper district brands, that where any transactions are put through—and these are mostly very small lots for special customers—prices are a matter of arrangement rather than of list quotations. District brands remain much as last reported, Lincolnshire being still quoted at about 38s. for forge to 39s. for foundry, and Derbyshire about 43s. up to 45s. for foundry, net cash, delivered Manchester, but these figures can scarcely be said to represent the minimum that has been taken in some instances to secure business. Outside brands offering in this market are about stationary at recent quoted rates, good foundry Middlesbrough averaging about 43s. 10d., with some makers still quoting 44s. 4d. net cash, delivered Manchester, whilst for Scotch iron there is so little offering, that it is difficult to get quotations at all, but Eglinton remains nominally at about 46s. 6d., net prompt cash delivered at the Lancashire ports.

Here and there manufactured ironmakers report rather more business stirring in bars, some of them being now fairly off for orders, but no improvement in prices can be reported except that buyers who have here and there been endeavouring to place their orders at £5 5s. have been unsuccessful, although for specially favourable specifications a trifle under £5 7s. 6d. would no doubt in some instances be accepted. The actual quoted prices, which most makers are holding to, remain at £5 7s. 6d. for Lancashire, and about £5 10s. for North Staffordshire bars, delivered in this district. In other descriptions of finished iron business continues extremely slow. In sheets there is little or nothing doing, and prices if anything are easier, local makes being obtainable about £6 17s. 6d. to £7, and Staffordshire sheets are offered at as low as £7 2s. 6d. to £7 5s., delivered here. Hoopmakers' report an almost complete absence of business, but they still hold to the association list rates of £5 17s. 6d. for random and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

In the steel trade the position remains much as reported recently, all descriptions of raw material meeting with a very slow inquiry, with prices weak, ordinary foundry hematite being obtainable at 52s. to 52s. 6d., less 2½, and basic steel billets at £4 net cash, or a trifle less for delivery here. Local makers of steel boiler plates report a cessation of inquiry, and although Scotch makers are necessarily just now out of the market, £6 10s. represents the full figure that could be got for delivery in this district, with here and there sellers at £6 7s. 6d. per ton.

Amongst the engineering representatives attending the Manchester Royal Exchange on Tuesday, the chief matter of discussion was the visit of the Institution of Mechanical Engineers during the previous week, and the opinion generally expressed was that the whole proceedings had passed over very satisfactorily. In not a few quarters there was, of course, considerable regret that the members of the Institution would not see Lancashire under very favourable circumstances, as regards activity in the large engineering establishments that were thrown open for inspection, but this in no manner stood in the way of their hospitable entertainment wherever they went, and the full opportunities afforded of seeing all that was to be seen, in the shape of modern engineering and mechanical progress, throughout the district. Apart from excursions and visits to works, perhaps one of the events which will be most pleasantly remembered in connection with the Institution summer meeting was the special performance at the Theatre Royal; where the whole of the boxes, dress circle, and stalls had been reserved by the local committee for the members. The theatre was very tastefully decorated for the occasion; sumptuous arrangements for refreshment were provided, and the entire evening's entertainment was evidently thoroghly appreciated by a very full house.

An extremely quiet tone continues to be reported throughout the coal trade, and there is a gradual easing down in prices, although it is exceptional where any actually quoted reduction on list rates is officially announced. The leading colliery concerns in the Manchester district have found it necessary to give way upon their list rates, to meet outside competition, whilst there is some easing down in other Lancashire mining centres, and stocks here and there are being pushed upon the market at rather lower figures, whilst competition from Yorkshire and other neighbouring colliery districts continues excessively keen. For all descriptions of round coal there is only the most limited demand, so far as inland requirements are concerned, and where pits are working more than three days per week a considerable portion of the output is going into stock. Quotations nominally are unchanged from last week, but it is exceptional where more than 11s. is now being got for best Wigan Arley, 10s. for Pemberton 4ft. and seconds Arley, 8s. for common housefire coals, and 7s. for steam and forge coals at the pit mouth. Engine classes of fuel also continue plentiful, and are obtainable at very low figures, common slack being in some instances as low as 3s. 6d. to 4s., with good medium sorts about 4s. 9d. to 5s. 3d., and some of the best descriptions still quoted at 5s. 9d. to 6s. 3d. per ton at the pit.

A fair amount of business is still reported in the shipping trade, so far as cargoes for Scotland are concerned, both in round coal and engine fuel. For ordinary descriptions of common round coal prices remain at about 9s. per ton, but for slack rather better prices have been got, 5s. 6d. to 6s. being now about the average figures for delivery at the Garston Docks, or the High Level, Liverpool.

*Barrow.*—There is still a quiet tone in the hematite pig iron trade, and the holiday season has tended to make business quieter than ever. The effect of bad trade is showing itself in the stoppage of the Solway Works. Only thirty-five furnaces are now in blast, and the make of the district, as shown by the fact that 2532 tons of pig iron have gone into warrant stocks this week, is too large by the yield of four furnaces. Stocks have now accumulated to 158,333 tons, being an increase of 63,710 tons since the beginning of the year. Practically nothing is doing in the forge and foundry iron trades, and the business in Bessemer qualities would be small were it not for local consumption. Prices are easy at 43s. 8d. net cash warrant sellers, and 43s. 7d. buyers. Makers quote 44s. to 45s. for mixed Bessemer numbers, net f.o.b., but they report a very small trade.

Iron ore is very quiet, and orders show no improvement either on home or general account. Ordinary sorts are as low as they can get in price at 8s. 6d. per ton net at mines.

The steel trade is very indifferently employed. The only department in which there is any activity is that of steel plates, which are in fair demand, and orders for which makers are holding to a satisfactory extent. Steel rails are in poor demand. There is practically no home demand, and the foreign and colonial inquiries are very small. Other branches of the steel trade are quiet, and there are no inquiries of moment for any of the specialities of production in this district.

Shipbuilders are still very busy, as also are marine engineers. In the course of a few weeks the torpedo boat Destroyer Sturgeon, built at Barrow for the Admiralty, the first launched of three, will be ready for her trials. As these steamers are being fitted with Mr. Blechynden's patent boiler, some interest attaches to the speed trials. No new orders are reported for ships or engines.

Coal and coke are a quiet trade, and late prices rule.

The Furness Railway Company has declared a dividend of 1 per cent. for the half-year, compared with 1½ in the previous half, and 1 per cent. in the corresponding half of last year.

The Naval Construction and Armaments Company has declared a dividend of 1½ per cent. on the past half-year, making, with the interim dividend paid January 1st of 2½ per cent., a dividend for the year of 2 per cent. The directors report bad trade, but say they are now well off for orders.

Shipping is quiet in every sense. The exports of pig iron and steel from West Coast ports during the past week have been 20,514 tons, compared with 17,718 tons in the corresponding week of last year, an increase of 2796 tons. The shipments to date this year have totalled up to 462,676 tons, against 458,935 tons in the corresponding period of last year, an increase of 3741 tons.

## THE SHEFFIELD DISTRICT.

*(From our own Correspondent.)*

Little change calling for record has taken place in the South Yorkshire coal industry this week. The trade done at Barnsley was very discouraging, although a fair number of agents were present. This being the first week of the trial of the maximum and minimum wages settlement arrived at by the Conciliation Board, it will be regarded with interest by both sides. It is to be regretted that no material effect has been produced by this settlement. Buyers will not purchase until they see an alteration in the present tone of business, and they are no doubt holding their hands in hope of a further reduction in rates, but it is generally understood that this will not take place. Prices are now at the low-water mark, and reduction on the present rates would place coalowners in as bad a position as they were before the settlement was arranged. A little obstruction has been met with at some of the pits, but it is hoped that as soon as these grievances are amicably arranged there will be better trade all round, and contracts, which are at present being negotiated for, will be placed. This is the view held by manufacturers, and it is hoped that it will be realised, and put the South Yorkshire coal industry on a sounder basis than it has been for the last year or two. The quotations are as follows:—Yorkshire, best, 9s. 6d. to 10s. per ton; Silkstones, 9s. 6d. to 11s.; Barnsley house, 8s. 6d. to 10s. 3d.; Flockton, 8s. 9d. to 9s. 6d. per ton; other qualities from 1s. to 1s. 6d. lower. Steam coal is in fairly good request, and the tonnage forwarded to Hull and the other Humber ports is well maintained. The railway companies are also taking increased quantities. Barnsley hards make from 7s. 9d. to 8s. 6d. per ton; inferior qualities from 1s. less. Gas coal is quiet and lower rates are looked for. Plentiful supplies of manufacturing fuel can be had at low rates, and the trade for that class of coal is dull generally. Good slacks command from 4s. to 5s. per ton. Coke in better demand at 9s. to 11s. per ton. Stocks at several local collieries are very heavy, and customers are urging a light demand as a reason for pressing reductions. The gas companies have not, in all instances, fallen in with the idea to maintain prices. The owners of the gas coal pits at first contemplated an advance of 1s. 6d. per ton on the old rates. This they modified to 1s. and subsequently to 6d. per ton; even the lower reduction has, in some instances, to be abandoned, and at least one large company has placed a considerable portion of its contracts at the old rates. There is no other reason to be given for this except that coalowners, in their anxiety to get work, have been underselling each other.

The colliery owners of Derbyshire, Nottinghamshire, and Leicestershire met at the Midland Hotel, Derby, last Monday, to hear from their local representatives on the Conciliation Board a full explanation of the terms of the settlement of the 19th of July as to miners' wages. Mr. Alfred Barnes, of Chesterfield, presided, and after Mr. Salmond and Mr. Deacon, two of the local representatives on the Conciliation Board, had made their statements, it was resolved: "That one-fourth of the advances given since 1888 should be taken off all classes of labour, above ground and under ground." This resolution is in effect carrying out the terms of the agreement which stipulated first that a reduction of 10 per cent. should be taken off the 40 per cent. advances obtained in 1888.

Some activity is shown in the Sheffield railway trade departments, particularly in regard to rolling stock. The most recent orders placed in the Sheffield district are with Messrs. Craven Brothers, Darnall, who have booked as follow:—The Metropolitan Railway Company, fifteen goods wagons and cattle trucks; South-Eastern Railway Company, fifty-two third-class carriages, third-class brakes, and composite carriages; the Cheshire Lines, forty-seven third-class carriages, third-class "picnics," third-class brakes, and goods brakes.

There are some slight symptoms of movement in the heavy trades. Manufacturers here are believed to be better off than in the northern and southern districts, where depression is reported as more acute every month. Crucible steel is being sent to the Continent in larger quantities, one or two of our Sheffield houses being busy on that account. Prices of hematite, Bessemer billets, and Siemens-Martin steel remain as last quoted. Makers expect to resist the attempts of buyers to lower quotations. With the improvement in railway material already noted, some additional inquiries have been received from shipbuilding firms. Bessemer billets and special carbons used in the Sheffield trades make from £5 7s. 6d. to £5 10s. per ton; bar iron, £5 10s. to £5 15s., both at makers' works; hematites, delivered in Sheffield, 51s. to 52s. 6d.; ordinary iron sheets, £8 10s.; ordinary wire rods, £5 5s.; rope rods and high carbon rods, £8 8s.

The war between China and Japan, if it does not have such an abrupt termination as it had commencement, is expected to cause a demand for military material. Considerable orders were recently received from Japan for both rails and armour plates, but the latter were spread over a considerable period. Some years ago a number of officials of high rank from China witnessed, at one of our large works, the operations of the Maxim gun. On the strength of these trials the Chinese Government had several Maxim guns of unusual size manufactured for them. These have not yet been heard of in the present conflict. It is understood that the Japanese have also been able to obtain similar ordnance, and they have certainly had their ships fitted with machine guns, which were used in their recent engagements, but so far nothing has been heard of the Maxim or the Nordenfelt guns in the land struggles.

The lighter industries are, if anything, duller than last reported. It must be remembered, however, that this is the "off" season, and there is not likely to be any improvement until the autumnal demand sets in from the metropolitan and kindred markets. There has been a good season in agricultural implements, mining and navvies' shovels, spades, &c. A speciality in shovels are those made from Mr. R. A. Hadfield's special manganese steel, which are manufactured by Messrs. John Bedford and Sons, Mowbray-street. These shovels are said to have shown exceptional powers of endurance. Tools manufactured six months ago have shown very little perceptible wear, and give every satisfaction to the users. There has been very little business done in the light edge-tool trades. Austria Germany, and Hungary are ordering more freely in razor and file steel. A change for the better is further reported in the rolling mills. The South American States are showing remarkable recuperation, considering the revolutionary and financial troubles which have prevailed so long. The Australian market does not recover so rapidly as was expected.

The increased dock dues put in force by the Manchester, Sheffield, and Lincolnshire Railway at Grimsby, are being opposed by the fishing-smack owners, and the Grimsby Smackowners' Association is agitating against them. A deputation met the directors of the railway company at Sheffield on Tuesday, and, after hearing the views of the Grimsby people, the directors promised to lay the whole matter before the Board on Friday —to-day.

The annual meeting of the Cutlers' Company, Sheffield, was held on Monday last, the Master Cutler, Mr. George Howson, presided. Mr. Charles Henry Bingham, of the firm of Messrs. Walker and Hall, Electro Works, Howard, was elected master, with Mr. H. Herbert Andrew as senior warden, and Mr. Maurice George Rodgers as junior warden. The only alterations made in the constitution of the company were the election of Mr. John Bedford, of Mowbray-street, in the place of Mr. Henry Harrison, J.P., deceased, and the election of Mr. Sydney Jessop Robinson, managing director of Messrs. William Jessop and Sons, in the place of Mr. William Jessop, who retires. The Master Cutler elect will be installed on the first Thursday in September, and the Cutlers' Feast will follow at a later date in October or November.

## THE NORTH OF ENGLAND.

*(From our own Correspondent.)*

No improvement can yet be reported in the iron and allied trades of this district, because labour difficulties still paralyse business. If the moulders' strike could be settled there might be some chance of a better demand. It seems anything but satisfactory that the strike of such a comparatively few men should throw so many others out of employment. There are not more than about 1500 moulders and pattern makers actually engaged in the strike, but their action has thrown out of work not far short of 20,000 other men in the district. The joiners in the shipyards in the North of England, after having been on strike for about ten weeks for a considerable advance on wages, and after driving away to the Continent much work which would have fallen to their share, have abandoned their claim and gone back to work at the old rate of wages where the masters can find employment for them. The moulders, however, are more obstinate; they have been idle since March—over twenty-one weeks—and while they at first claimed an advance of 3s. 6d. per week, they subsequently reduced their claim to 2s., and to that they still adhere, notwithstanding that there can be no doubt that whatever revival there was in the early part of the year it has disappeared now, and the action of these moulders has done much to kill the improvement. Instead of getting an advance the moulders ought now rather to submit to a reduction. It can hardly be doubted that the prices of castings are far too low to admit of increased wages being paid, and while work was certainly more plentiful when the strike began than it had been for a long time, yet realised prices had not moved up. The moulders have been told by other trades unionists that their action was too hasty, and that more work was not synonymous with increased profits. Some efforts have been made this week to bring about a settlement of this regrettable dispute, the masters having met the representatives of the men to discuss the situation; but even if the matter were settled at once, it would be some weeks before that would have an influence on the iron, steel, and shipbuilding industries, because their work on the contracts now in hand is much in advance of the moulders. With the exception of the Durham miners' strike of 1892, there has not for very many years been a dispute which has been more injurious to the trade of the North of England than the present strike of moulders. These moulders have done their best to prevent the importation of castings from other districts, but within the last few days some have been brought from Scotland, and even the Continent, which has enabled some firms to go on with pressing work.

The pig iron demand in the North of England is very dull for this time of the year, and the production continues in excess of the requirements, as it was in June and last month. It is likely to continue so during this month, as August is usually a quiet period, and more is it likely to be so this year, when the strikes have intervened to reduce the local consumption. On Tees-side there are the race holidays to interfere with the deliveries, and as the production is maintained, there being more blast furnaces in operation than at any time this year, it can readily be judged that the stocks will increase. That is most unsatisfactory at a season of the year when we look for decreases instead of increases. Last month, with good shipments and no holidays to reduce the local consumption there was an increase of 9745 tons in Cleveland iron stocks, and in June the increase was nearly as much. This month local consumption is less than it was last month, as more of the finished ironworks and foundries are closed, some altogether, and others will be so only for the race holidays. The position, to say the least, is not encouraging, but it is worse for the makers of hematite iron than it is for the producers of Cleveland iron. There is less chance of their making a profit, because their prices have fallen much more heavily than those of Cleveland iron. Thus a short time ago makers of East Coast hematite were able to get 45s. 9d. per ton for M. Nos., now they can barely realise 42s. 9d., a decrease of 3s. per ton, while Cleveland No. 3 has only fallen from 36s. to 35s. 6d., or 6d.; and what makes matters worse is that the cost of production has not fallen in proportion to the decline in prices. Coke is as dear as when the higher rates ruled, and Rubio ore has only dropped 6d. to 9d., the present price being 12s. per ton delivered Tees. Nevertheless, the output of hematite pig iron appears to be increasing, two furnaces having been set on last month, one a furnace which has just been re-lighted by the Normanby Ironworks Company at Middlesbrough.

Most of the makers of Cleveland No. 3 pig iron continue to quote 35s. 6d. per ton for prompt f.o.b. deliveries, a figure which they have kept unchanged for more than a month, and special brands cannot be had under that, but there are makers and merchants who will accept 35s. 4½d. No. 1 pig is about 37s. 6d., and is scarce. Cleveland ordinary warrants have changed very little in value for several weeks, and since our last report have not varied above 2d. per ton, a condition of affairs which does not tend to induce speculation in them. The stock of Cleveland iron in Connal's stores on Wednesday night was 96,061 tons, or 669 tons increase this month. Consumers do not care about buying when they can get makers' iron just as cheap. No. 4 foundry pigs are at 34s. 6d., and grey forge are at 34s.

A third firm of pig iron makers in the North of England has this month adopted the three-shift system at their works, viz., Messrs. Cochrane and Co., Ormesby Ironworks, Middlesbrough. This is the only firm in Cleveland as yet to introduce the system, the other two firms being located in South Durham. The Cleveland Ironmasters' Association disapproves of the concession, and Messrs. Cochrane severed their connection with that organisation, in order that they might be free to act as they desired. They have had to increase the number of shiftmen by one-fifth, viz., from 143 to 175, but they will pay nothing extra to the men for the shifts worked on the Sundays, and each blast furnaceman will have one Sunday in three quite clear of work.

The men's demonstration to agitate for the eight hours' day is fixed for Saturday, and work will be suspended at the furnaces from 6 a.m. Saturday to 6 a.m. Sunday. The demonstration is to take place at Middlesbrough, and the procession is to start opposite the Municipal Buildings at 1 p.m. Work is not to be suspended at those furnaces where the eight hours has been granted.

The Cleveland ironmasters' return for last month proved to be even more unsatisfactory than had been predicted. It is not usual at this time of the year to have increases in stock reported, yet last month there was an increase of 9745 tons, and in June one of 9178 tons. The cause, however, does not lie in increased make or diminished exports, because there is a decreased production of Cleveland iron and increased shipments, especially to the Continent. The increased stock is due to the smaller local consumption, which is one of the results of the moulders' strike. The stock was raised to 173,411 tons, of which makers held unsold 76,789 tons—12,504 tons increase on June—while in makers' stores 1215 tons were held—120 tons decrease—and in Connal's stores 95,392 tons—2639 tons decrease. At July 31st there were 94 furnaces in operation, 1 more than at June 30th, and 1 more than on the corresponding date last year. Of these 51 were producing Cleveland pig iron—1 less than at June 30th—and 43 hematite, &c.—2 more. The production of Cleveland pig iron was 123,114 tons—619 tons less than in June—and of hematite, &c., 129,517 tons—2024 tons increase—the total production of pig iron being 252,631 tons, or 1405 tons increase. The return shows that pig iron shipments from Middlesbrough were 4516 tons better than in June and 11,428 tons greater than in July last year.

Nothing new can be stated as to the condition of the finished iron and steel trades, and the engineering industries continue to be injuriously affected by the strike of moulders. The engineers have abandoned their claim, but they cannot get back to work as long as the moulders keep out. In order, if possible, to obviate the necessity for the closing of the Darlington Steel Works, the men were asked whether, if orders were obtainable, they would be prepared to work at lower rates of wages, but such a course is not permissible according to the rules of their union, and thus they could not give an answer in the affirmative. At the Eston Steel Works the wages sliding scale, which has been in existence for some years, has been renewed until June 30th, 1896. Mr. William Jenkins, who for twenty-five years has been the general manager of one of the most successful of our British industrial concerns—the Consett Iron and Steel Works—has resigned his position through ill-health, and the shareholders have made him one of the directors. Mr. David Dale, the chairman of the company, is to have £1000 a year as remuneration for his services, in addition to his share of the sum annually voted by the shareholders for division among the directors.

The coal trade shows much better features than the iron trade, for most of the collieries are fully employed, and deliveries are heavy, both on inland and export account. Coke for blast furnace purposes is in better demand than supply, even though only a small quantity is being sent to the Scotch works, and 12s. 6d. per ton delivered on Tees-side is as little as will be taken for a good coke.

Messrs. John Abbot and Co., Park Works, Gateshead, are taking advantage of the lull in business caused by the moulders' strike to effect certain improvements in their engineering department. They will almost completely reconstruct their large fitting shop, and will put in additional machinery and appliances. It is intended to increase the output of the tube and chain making departments.

At the Southwick Engineworks, Sunderland, a new pattern shop is being erected, and at the Palmers Hill Engineworks the boiler-making department is being extended. It is reported that the Weardale Iron and Coal Company has purchased the engineering and wagon works carried on at Darlington by Major Davison, who is retiring.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE is no improvement in the iron trade, and none can be expected until there is a settlement of the dispute with the miners. The strike has now lasted for six weeks, and it has had the effect of completely paralysing not only the coal industry, but also the iron and steel trades, while almost every other branch of trade has suffered more or less. The Lord Provost of Glasgow having been appealed to, has been endeavouring this week to bring masters and men together with a view to a settlement. The Associated Masters have declined to meet the representatives of the men, as they are fully determined to continue their resistance to the advance of 1s. per day, for which the strike took place. Several coalmasters who were outside the Association have conferred with the leaders of the men, and a proposal has been made to the latter that the miners should resume work at the old rate of wages, the masters giving them a guarantee that no further reduction of wages shall be made during the next twelve months. While these efforts are being made towards an arrangement, great distress prevails throughout the mining districts, especially in the more populous localities of Lanarkshire.

The pig iron market was closed on Monday owing to the holiday. It might, indeed, be shut one half the week just now for all the business that is being done. A few transactions have taken place in Scotch warrants at about 42s. per ton and in Cleveland at 35s. 4½d.; the hematite market is extremely dull.

The prices of makers' iron are as follow:—G.M.B. f.o.b. at Glasgow No. 1 43s. 6d. per ton; No. 3, 42s.; Monkland No. 1, 47s.; No. 3, 42s. 6d.; Carnbroe No. 1, 47s.; No. 3, 46s.; Clyde No. 1, 50s.; Gartsherrie No. 3, 50s.; Calder and Summerlee Nos. 1, 56s.; No. 3, 50s.; Coltness No. 1, 57s.; No. 3, 52s.; Glengarnock at Ardrossan No. 1, 52s. 6d.; No. 3, 48s.; Eglinton No. 1, 51s.; No. 3, 46s.; Dalmellington at Ayr No. 1, 50s.; No. 3, 46s.; Shotts at Leith, No. 1, 55s; No. 3, 51s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to only 2564 tons, compared with 5688 in the corresponding week last year. Of the total, the United States took 6 tons; South America, 50; India, 20; Australia, 375; Italy, 260; Germany, 20; Holland, 30; Belgium, 200; Spain and Portugal, 111; China and Japan, 280; other countries, 60; the coastwise shipments being 1152, compared with 2379 in the corresponding week.

The inland consumption of pig iron is greatly curtailed in consequence of the strike. It is confined pretty much to foundries, which in the main prefer Cleveland pig iron to Scotch, owing to its relative cheapness. The imports of Cleveland iron into Scotland in the past week were 3545 tons, compared with 4711 in the corresponding week, a decrease of 1166 tons, but there is a total increase in these imports for the year to date of about 27,000 tons.

The output of pig iron has been further reduced by the blowing out of four furnaces that were making basic pig at Glengarnock, there are only seven blowing in Scotland, against 11 last week, and 67 in the corresponding week of last year. The seven furnaces in operation are all making ordinary iron, three at Coltness and four at Shotts.

There is nothing to report with reference to manfactured iron and steel, except that the works continue closed, and one or two additional firms are discharging their clerical staffs. The market for finished iron and steel is practically closed for the present. The export trade in finished iron and steel has declined to very small proportions, the shipments of the past week comprising machinery worth £1100, steel goods £3860, and iron goods £3436.

The coal trade is in a very unsatisfactory state owing to the strike, the exports from Scottish ports during the week amounting in the aggregate to only 23,970 tons, compared with 170,680 in the corresponding week. A large number of vessels arrived in the Clyde bringing cargoes of coal from different parts of England, and these are being sold at prices which are considered moderate in the circumstances.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Two more bodies have been brought up from the Albion, making a total of 290. The colliery is now in full work again. Few places have been more visited by the tourist, pedestrian, or bicyclist, than this colliery since the explosion, and even now interest has not flagged, and it is being suggested that in aid of the widows and orphans a collecting box by the wayside shall be placed. One outcome of the disaster is a stimulus to the inventive. Various ingenious arrangements in connection with colliers' lamps are being devised. That of Mr. D. Evans, of Merthyr, now patented, takes a prominent place, in totally preventing a lock being opened by an addition to the plug method. Another, by Mr. Hawkins, aims to further secure the lock with melted lead, which can only be removed by passing an electric current over it. In addition to these there is the watering tram for wetting coal dust, invented by Messrs. H. W. Lewis and H. Kirkhouse. The latter gentleman is also inventor of the "Harbour of Refuge," which has only, I believe, been put into practical working at Tyler's Town. The idea of the inventor was to make the lamp station of collieries a harbour, into which—on the occasion of an explosion—all could make their way, and with appliances provided for escape from the after-damp. I have heard the plan spoken of favourably by leading authorities. The objection is, in one quarter, that it might be wrecked by an explosion, and in another the expense and trouble.

In this column I, many years ago, referred to the invention of a working collier, who devised a helmet with a receptacle for water and a covering for the mouth. At one of the Gethin accidents a man escaped by wetting his cap with cold tea and holding this to his mouth, breathing through the wet cloth. This was the idea worked upon by the designer of the helmet. One of the sufferers at the Albion tried the same preventive, but it failed, as he was found dying with blood over his mouth and nostrils and the wet cap in his hand.

The holiday influences over the week have been unmistakeable, works half employed, collieries in part idle, offices at the docks closed for half the week. Such have been the prominent features, though no one doubts a fair resumption of business by next week at collieries and docks. In respect to the ironworks the slackness prevailing in the tin-plate district is reacting badly upon the iron and steel works, and the falling off in steel bar requirements is very noticeable in the matter of rails. The only two cargoes sent away this week have been small ones for Highbridge and Bristol. Small parcels continue to be the rule, and with it a blending of "small goods." In pig the stocks held are large, and still a considerable import continues from the North of England. Last week large quantities of pig and steel bar came to Swansea by sea.

Coal prices are tolerably firm. On 'Change and amongst leading shippers it is fully expected that an upward tendency will be shown after the holidays. The latest quotations, Cardiff, for best steam, are 11s. 9d. to 12s.; seconds, 11s. to 11s. 6d.; best Monmouthshire, 10s. to 10s. 6d.; seconds, 9s. 6d. to 9s. 9d.; good dry coal, 10s. to 10s. 3d.; small, 5s. 3d. to 5s. 6d.

House coal has kept up well, in part owing to the unseasonable summer. Latest Cardiff prices are:—Best, 12s. to 13s.; seconds, 10s. 9d. to 11s.; No. 3 Rhondda, 10s. 6d. to 10s. 9d.; brush, 8s. 9d.; small, 6s. 9d. to 7s.; No. 2 Rhondda, 9s. 6d. to 10s.; through, 7s. to 7s. 3d.; small, 5s. Coke prices are maintained: furnace, at 15s. to 16s. 6d.; foundry, 17s. to 17s. 6d., and special foundry, 20s. to 20s. 6d. In the matter of house coal the opinion on 'Change, Cardiff, is that a brisk autumn season is certain. Bookings forward are becoming larger, and the tendency to book freely when prices are moderately low is generally taken to be significant of large autumnal contracts. This hint to buyers is very clear. The output in Glamorgan and Monmouthshire of excellent house coals is unquestionable. I see that a good old house coal, the Lantwit, is being again worked, and the area of No. 3 Rhondda and of the Mynydislwyn is yet large. Troubles continue to beset the Dowlais-Cardiff colliery in the shape of water, but I hear that coal has been struck in one of the pits.

Shipments of coal from Cardiff, Swansea, and Newport last week were large. Swansea total was 44,000 tons; Newport was considerable, both for foreign shipment and coastwise. In patent fuel Swansea maintained a brisk export, Russia taking 3000 tons, Italy 3000, and France 3120 tons.

Iron ore prices are unaltered, demand slackening. Iron and steel quotations unchanged.

In the tin-plate trade the outlook is not so gloomy as last week, and on 'Change, Swansea, mid-week, it was stated that a compromise between the two parties in America having been arrived at, the Tariff Bill is certain to pass. This has given substantial hopes in the coming of better times, if the turbulence of workmen can be modified. Arrangements, I am happy to learn, have been brought about in some quarters, and, apparently, binding arrangements formed. It is remarkable that a sliding scale, similar in excellence to that of the Coalowners' Association, cannot be fashioned, and the tendency to strike amongst tin-platers be checked by leading and intelligent representatives from amongst themselves. In their best interests this should be done.

Last week there was a larger shipment than ordinary of plates from Swansea; 68,356 boxes; quantity received from works, 63,177. Prices the same, but immediately on favourable news from America, which is expected to come in the form of a boom, prices must go up. Britain Ferry Works continue well employed. Sixteen mills are now in action, and the output of steel bars and pig is a good average.

The Swansea and Ilfracombe Steamship Alexandra Company has been registered, with a capital of £10,000 in £5 shares.

Shipping news at Cardiff is unsatisfactory, freights being so low. The freights from Cardiff to Alexandria are about 4s. 3d., and Genoa only 4s. 9d. to 5s., which is 1s. 6d. to 2s. less than prices ruling a few months ago. Shipowners are complaining bitterly that it is impossible to make any margin of profit, and cases of even serious loss have occurred, rendering it less expensive to lay steamers up than to run them. One great failure is announced.

The half-yearly meeting of the Taff Vale Railway shareholders has been held at Bristol under the presidency of Mr. Arthur Guest, and at the close of a long and interesting report, which gave an excellent insight into the company's doings and prospects, a dividend of 3½ per cent. was declared, equal to 8½ per cent. on the old ordinary stock.

A highly complimentary reference was made to the general manager, whose efforts in all ways have been able and energetic, and the suggestion was cheered that pitwood should be imported *viâ* Penarth Dock, and the railway income be increased thereby.

Unrest amongst some sections of the working men continues. This week it is the boilermakers at Barry Dock. Messrs. R. Stevenson and Co., of Newcastle-on-Tyne, are the contractors for the erection of the gates at the deep lock works, Barry Dock, and it is amongst these that a ferment has arisen, the union men refusing to go to work until the contractor gives an undertaking not to employ non-society men.

A Newport inventor has constructed a water cycle, which is to be tried forthwith on the Bristol Channel.

The attainment of majority by the heir of Lord Wimborne has led to the fullest demonstration in the district, and local newspapers have teemed with the annals of the Guest family, the usual humble uprise, and their magnificent achievements. These are all more or less summaries, or quotations from "The Guest Annals," which appeared twenty years ago in the "History of Merthyr," and are to form a feature of the "History of the Iron Trade of Wales," now in compilation and dedicated, I am pleased to hear, by special permission to Lord Wimborne.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

ONLY a moderate amount of business has been done in the different branches of the iron industry this week, but as producers are generally fairly well situated for contracts, they have been able to firmly maintain their prices, and the tone of the market may be described as satisfactory.

There is little or no change noticeable in the Silesian iron trade since previous letters; orders for pig iron are few, as well on home as on foreign account, and the tendency of prices is, naturally, rather weak. Manufactured iron makers, as a rule, report this branch of trade as in a fairly good condition, a number of small orders having come in lately, so that, for the present, the mills are generally pretty well off for work. Quotations do not show any appreciable change upon the week.

In Austria-Hungary makers, as well as dealers, report themselves fairly well content with the present state of the iron market, though pig iron is rather weak in tone and consumption remains but limited. But there is quite an active business done in most sorts of manufactured iron, girders, for instance, and general structural material being briskly called for, while the demand coming in for bars and plates, though a fairly regular one, is not very lively at the present moment, autumn business having not yet commenced. Shipbuilders and engineers are very busy, several good repair jobs having come to hand, which will engage attention for some time to come, and there are more orders for bridges, &c., holding out, so that a vigorous activity is likely to be maintained in that department.

All through last week a quiet sort of business has been done on the French iron market, only in the Department Nord the demand for bars and plates has shown increasing animation. The forges are, as a rule, satisfactorily occupied, and prices have hitherto been firmly maintained. In the steel trade not much has been doing lately, and some establishments complain of being but very insufficiently employed.

On the Belgian iron market only a very small amount of business is still being put through. Pig iron continues weak in demand generally; owing to unceasing efforts on the part of the blast furnace works, foreign trade in crude iron has been a trifle more animated of late. The business in manufactured iron is very quiet all round, the general demand not only on home but also on foreign account remaining exceedingly dull. Heavy plates are the only article that has been rather well inquired for upon the week. The condition of prices is pretty firm.

The Rhenish-Westphalian iron market has, on the whole, maintained the appearance of former weeks, most sorts of pig iron being in good demand, while the different articles of finished iron also meet with a regular though not very brisk inquiry, and prices are all the more firmly maintained because a fair autumn business is generally anticipated. With the exception that perhaps here and there a temporary relaxation in the pressure of demand has been noticeable, the position of the iron ore trade continues very much as previously reported. Quotations are, for spathose iron ore, M. 7·40 to 7·90 p.t., roasted ditto being paid with M. 11 to 11·50 p.t. net at mines. For inferior sorts M. 9·80 to 10 per cent. is given. Minette of Lorraine has well maintained the old price of M. 2·50 to 3·20 p.t. at mines. In the pig iron business demand has been just a trifle more quiet this week than last, but prices are very fairly maintained. Spiegeleisen, which continues to be quoted M. 52 p.t. is in fair request on foreign account, but home demand has been comparatively poor. Forge pig No. 1 costs M. 46 p.t.; No. 3, M. 40 p.t.; Siegerland good forge quality, M. 44 p.t.; hematite, M. 63 p.t.; foundry No. 1, M. 63 p.t.; No. 2, M. 54 p.t.; basic, M. 45 p.t.; German Bessemer, M. 49 to 50 p.t. Luxemburg forge pig continues to be quoted 48f. p.t., free Luxemburg. The tone of the malleable iron market may be termed a satisfactory one, considering the time of the year, and there have even been symptoms of an improvement in demand since last week. The bar trade is, all things considered, in a fairly good condition, the mills being tolerably well engaged on inland and foreign orders, and there is a pretty firm tendency maintained in quotations. The South German bar mills have even ventured to raise their prices M. 3 p.t. In girders a moderate business is done, while hoops present no change whatever since former reports, being in fair request at moderate prices. A satisfactory employment is maintained at the plate and sheet mills, and orders, as well as inquiries, come in quite regularly, so that makers might be fairly content with the present state of affairs, if prices were a trifle less unremunerative. The demand for drawn wire continues regular, foreign inquiry having been really good, especially that from North America. Rivets meet with an increasing request, but prices continue low, the cutting competition of foreign houses leaving but little chance for an improvement in quotations. The wagon factories are likely to be in brisk employment for some time to come, having secured orders for 1000 covered and 1000 open cars, 1300 coke wagons, 450 small cars and appurtenances, which have recently been given out by the Government railways.

Latest list prices per ton at works are as under:—Good merchant bars, M. 110; angles, M. 120; girders, M. 90 to 95; hoops, M. 113 to 118; billets in basic and Bessemer, M. 81; heavy plates for boilermaking purposes, M. 150; tank ditto, M. 130 to 135; steel plates, M. 125; tank ditto, M. 115 to 120; sheets, M. 140; Siegen thin sheets, M. 130; iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivets, M. 150 to 155; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

The Chinese Government is reported to have ordered four torpedo boats from German houses.

## IRON AND STEEL INSTITUTE—BRUSSELS MEETING.

THE autumn meeting of the Iron and Steel Institute will be held at Brussels, and will commence on Monday, August 20th. The following papers have been offered for reading:—

"On the Use of Caustic Lime in the Blast Furnace." By Sir Lowthian Bell, Bart, F.R.S., past-president.

"On the History of Crucible Steel." By R. A. Hadfield, member of Council.

"On the Coal-mining Industry of Belgium." By A. Briart, President of the Society of Engineers of Hainaut.

"On the Iron and Steel Industries of Belgium." By A. Gillon, President of the Society of Engineers of Liége.

"On the Influence of Aluminium upon the Carbon in Ferro-carbon Alloys." By T. W. Hogg—Newburn Steel Works.

"On some Properties of Boron Steel." By H. C. Jenkins—Royal School of Mines.

"On Colour-gauges for Carbon Determination." By W. G. McMillan—Mason College.

"On Electrical Power in Belgian Ironworks." By D. Selby-Bigge.

"On the Manufacture of Coke." By the late R. de Soldenhoff.

The following outline programme has just been published:—

Monday, August 20th: The Secretaries' office will be open from 2 p.m to 6 p.m. in the Bourse, Brussels, for the registration of addresses, issue of programmes, &c. Members' correspondence may, conveniently, be addressed Poste Restante, Brussels, as the post-office is situated in the Place de la Monnaie, close to the Bourse. 5.35 p.m.—Arrival of the train from Ostend. 8.30 p.m.—Conversazione and reception in the Hotel de Ville—Town Hall—by the Civic Authorities—evening dress.

Tuesday, August 21st: 9 a.m.—Secretaries' office open in the Bourse. Meeting of Council. 10 a.m.—Reception of the President, Council, and Members of the Institute, by Mr. A. Gillon, the chairman, Mr. A. Briart, the vice-chairman, and the members of the reception committee. Reading and discussion of papers. The afternoon will be devoted to visiting the Antwerp International Exhibition.

Wednesday, August 22nd: The morning will be devoted to the reading and discussion of papers, and the afternoon to visiting places of interest in Brussels.

Thursday, August 23rd: The members will leave Brussels by special train to visit the Mariemont Collieries and the Couillet Steel Works at Charleroi, returning to Brussels in the evening.

Friday, August 24th: The members will leave Brussels by special train to visit the works of the Cockerill Company at Seraing and the Angleur Steel Works at Liége, returning to Brussels in the evening.

## AMERICAN NOTES.

*(From our own Correspondent.)*

New York, August 3rd.

The abundance of money in the banks of Eastern cities and at Chicago shows the extent of abnormal conditions in trade and manufacturing. No improvement except in retail circles is felt. Inquiries are increasing for rails and all kinds of crude and finished iron. An increased activity is promised in locomotive, car, and bridge works. Several merchant iron mills started last Monday. Steel billets are in very active demand, and, if makers could promise deliveries, works could be filled up at once for two months. The coke strike is no nearer settlement. No. 1 foundry is offered at 12 dols., mill irons at 10·50 dols., steel rails 24 dols. New work is in sight. Coal mining is interrupted by strikes at various points. Western Pennsylvania controls the cream of the iron trade. Ohio mills are awaiting promised fuel. The financial outlook is not assuring, and another issue of Government bonds is looked for in banking circles, because of the declining revenues. Gold mining is steadily increasing, and there is some improvement in silver production.

## LAUNCHES AND TRIAL TRIPS.

The s.s. Bangor went down the Clyde for official trial, and on the measured mile attained a speed of 12 knots. The principal dimensions are:—145 by 24 by 11 moulded; engines, 20in. and 40in. by 27in., 100-horse power. Built by Messrs. Scott and Sons, Bowling; engined by Messrs. Ross and Duncan, Govan. Steamer is specially designed to carry slates from Bangor, North Wales, to Aberdeen, has a deadweight capacity of 400 tons, and a net register of 91 tons. Fitted with steam direct windlass, self-stowing anchors, steam steering gear, and patent warping winches, and every modern improvement for quick loading and discharging in this special trade. MacColl's patent stern-tube is fitted, which appears to solve the difficulty of corroded propeller shafts, and avoids the expense and delay of re-wooding stern bush. The owners' representative, Mr. O. T. Jones, expressed pleasure at the fine finish and general utility of space. Vessel and machinery were constructed under the superintendence of Mr. James Maxton, of Belfast.

## ON SULPHUR IN CAST IRON.*

By W. J. Keep.

The author has for six years been trying to verify the received belief that sulphur is in every way injurious to cast iron, and has made numerous experiments with artificially sulphurised cast iron up to 2 per cent. of sulphur, both grey and white, the results of which are recorded in the paper. The conclusion finally reached is that the proportion of sulphur retained by grey cast iron cannot materially injure the iron except by increase in shrinkage, which in the extreme ends seems to be from 0·168in. to 0·194in. per foot. The general testimony is that most of the sulphur present in pig iron is lost in re-melting, and that it is impossible that it can be re-absorbed to any damaging extent from the fuel. The influence of sulphur is diminished by increase of carbon or silicon. In wrought iron, which is practically free from these elements, a small amount of sulphur is said to do great harm, and such iron will take up sulphur in considerable quantity. In steel containing less than 1 per cent. of carbon and practically no silicon a few hundredths per cent. of sulphur cause decided injury. With carbon increases to saturation as in white cast iron, not more than 0·50 per cent. of sulphur can be retained, and as silicon increases, producing graphitic carbon, it is still more difficult to find sulphur in the metal, as it will not absorb it from the outside.

The influence of sulphur on all cast iron is to drive out carbon and silicon, to increase shrinkage, and in general to reduce strength, but in practice sulphur will not enter the iron in the foundry to a sufficient extent to realise these defects. When, as happens sometimes, iron which was grey when put into the cupola comes out white with increased shrinkage and chill, and often with decreased strength, the change is due to loss of silicon, and can be remedied by remelting with an appropriate addition of ferro-silicon or other highly silicised metal.

That highly sulphurised iron cannot be produced in practice is evident from the fact that ores are used—in America—containing over 3 per cent. of sulphur with fuel containing nearly 1 per cent. of the same element; but all smelters are agreed that not more than 0·75 per cent. of sulphur can be found in white iron, 0·25 per cent. in mottled, and not more than a few hundredths in grey foundry iron. The experiments show that 0·50 per cent. of sulphur will not exert any appreciable deleterious influence, and even that may be at once corrected by a slight increase in silicon.

Remembering that the only noticeable effects would be to slightly increase the shrinkage, the above conclusion seems to be proved by the fact that, in a foundry working with a substantially uniform mixture, returning from 25 to 40 per cent. of its metal to the cupola to be re-melted over and over again each day, the castings will almost invariably have a less shrinkage than the average of the pig iron used, and yet they will probably contain more sulphur and less silicon than the pig iron originally did.

The depth of chill does not seem to be influenced by these small proportions of sulphur, neither is there any evidence to show a relation between sulphur contents and strength either in pig iron or ordinary castings. The author hopes at a future time to explain why inferior castings are from time to time produced from a uniform mixture of pig iron.

Health Exhibition at Boulogne.—An International Health Exhibition, under the patronage of the Minister of the Interior, has been opened at Boulogne. There is an interesting and extensive collection of sanitary and hygienic appliances of all kinds.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*25th July*, 1894.

14,308. Plastic Building Materials, A. E. Carey, London.
14,309. Golf Clubs, J. D. Dunn, Mitcham.
14,310. Bolt or Fastening for Windows, R. Waugh, London.
14,311. Spittoons, A. J. Boult.—(*W. Hubner and B. Kruger, Germany.*)
14,312. Electrical Switch Devices, J. T. Ashton, London.
14,313. Propulsion of Steam Vessels, T. Schooling, London.
14,314. Feed-water Purifying Apparatus, J. Bruun, London.
14,315. Boilers, J. Prégardien, Germany.
14,316. Adjustable Bands for Dresses, H. Pratt, London.
14,317. Anglers' Hook-book, J. R. Richardson, London.
14,318. Window Fasteners, J. C. Haste, London.
14,319. Cycles, G. L. B. Killick, London.
14,320. Dynamos and Electro-motors, J. A. Kingdon, London.
14,321. Roll Paper Holders and Cutters, C. H. Wright, London.
14,322. Tool for Use in Domestic Washing, B. Greve, London.
14,323. Tunnelling, C. F. Findlay, London.
14,324. Apparatus for Moulding Corsets, S. Royle, London.
14,325. Preventing Robberies from Pillar-boxes, G. Roberts, London.
14,326. Pianofortes, E. E. Kaps, London.
14,327. Manufacture of Aluminium, A. F. B. Gomess, London.

*26th July*, 1894.

14,328. Safety Receptacles, W. B. Wilberforce, London.
14,329. Anchors, A. E. Muirhead, Glasgow.
14,330. Steam Heaters, E. Binns and Hartley and Sugden, Halifax.
14,331. Fishing-rods, E. Jordan, Manchester.
14,332. Process of Preserving Food, E. Howarth, London.
14,333. Tires, W. Fraser, Birmingham.
14,334. Dyeing Machines, M. Cockroft and S. J. Pegg, Leicester.
14,335. Collars for Horses, &c., F. J. Burrell, Manchester.
14,336. Tubes, F. Huggins, London.
14,337. Lamps, A. Timpe, Manchester.
14,338. Razors, J. Lister, Bradford.
14,339. Looms for Weaving, E. Burton and J. Garforth, Bradford.
14,340. Electro-massage Roller, H. C. R. Sharman, Merton.
14,341. Measuring Stoppers for Bottles, W. G. Mann, Sheffield.
14,342. Bricks for Paving, &c., F. H. Brooke, Sheffield.
14,343. Rolling Railway Axles, L. Jones and F. Horsfield, Sheffield.
14,344. Steam Packing Rings, C. H. Benton, Leeds.
14,345. Washing Machine, J. I. Baxter and J. Brook, Halifax.
14,346. Waterproof Garments, M. Silverstone and B. Dagutski, Manchester.
14,347. Truck, H. C. Slingsby, Bradford.
14,348. Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
14,349. Connecting Boiler and Pipe Ends, J. Mills, Manchester.
14,350. Means for Opening Envelopes, R. Sinclair, Glasgow.
14,351. Brazing Solders, J. Clarke, Birmingham.
14,352. Tree for Boots and Shoes, R. Granfield, Birmingham.
14,353. Cycle Bottom Brackets, W. F. Taylor and G. J. Philpott, London.
14,354. Taps for Drawing-off Liquids, J. Burnett, Kilmarnock.
14,355. Shipping Coals, &c., at Sea, J. Thompson, Glasgow.
14,356. Cheques for Prevention of Fraud, A. Bell, London.
14,357. Hydraulic and other Packing, G. B. Sharples, Manchester.
14,358. Refractory Fuel for Stoves, C. J. Saunders, Birmingham.
14,359. Links for Wristbands or Cuffs, F. R. Hudson, London.
14,360. Windows of Vehicles, R. D. M. Lawson, London.
14,361. Valve Seats of Pumps, E. J. Lane, London.
14,362. Preserving Food in Tins, H. Thompson, London.
14,363. Retting Flax, &c., H. S. Close and W. O. Roff, London.
14,364. Pneumatic Tires, D. Doig, London.
14,365. Apparatus for Cutting Fruit, R. Machin, London.
14,366. Gloves Used in Football, &c., F. Bryan, London.
14,367. Oil Stoves, S. Falk, London.
14,368. Book Slides, G. Sims, London.
14,369. Storing and Packing Opium, A. Castenholz, London.
14,370. Golf Balls, H. B. Sleeman.—(*R. N. Coghlan, India.*)
14,371. Fire-alarm Telegraphs, G. R. Neilson and A. C. Brown, London.
14,372. Elliptical Driving Gear, A. J. Boult.—(*E. Barabraham, France.*)
14,373. Metallic Packing for Piston-rods, E. Cunningham, Liverpool.
14,374. Bleaching Textile Fabrics, B. Walsh, Manchester.
14,375. Vulcanising Water-proof Garments, I. Frankenburg, Manchester.
14,376. Photographic Printing Frames, C. A. McEvoy, London.
14,377. Holding Devices, H. W. Poole and H. M. Knight, London.
14,378. Tethering Apparatus for Horses, A. J. Instone, Surrey.
14,379. Movable Reading Stand for Fixing to Tables, A. E. Smith, London.
14,380. Mechanical Musical Instrument, F. A. Richter, London.
14,381. Water Purifier, A. Golinski and H. Lambion, London.
14,382. Centrifugal Pump Delivery Tubes, P. Hövig, London.
14,383. Weft Forks, E. Birley and T. Duxbury, London.
14,384. Manufacture of Parchment, H. O. Band, London.
14,385. Gas Engines, J. A. McMullen, London.
14,386. Textile Fabrics, M. Schwartz, London.
14,387. Laundry Iron, F. W. Dover, London.
14,388. Tobacco Pipes, J. Notton, London.
14,389. Armour Plates, H. H. Lake.—(*Harvey Steel Company, United States.*)
14,390. Storing Petroleum, T. G. B. de Ferrari, London.
14,391. Preventing Incrustations on Boiler Plates, La Société Chaligny et Cie., London.
14,392. Engine Stopping Apparatus, L. C. E. Meyer, London.
14,393. Candlesticks, O. C. Uber and C. G. Uber, London.
14,394. Induction Coil Apparatus, H. J. Dale, London.
14,395. Lamp Wicks or Burners, A. J. Aitkens.—(*G. Aitkens, New Zealand.*)
14,396. Letter-boxes, A. C. Turner, London.
14,397. Coal-dust Feeder for Furnaces, A. Friedberg, London.
14,398. Envelopes, S. Whybrew, Philadelphia, U.S.A.
14,399. Rail Straightening Implement, A. Meuser, Philadelphia, U.S.A.
14,400. Heaters and Tables, E. M. Burchard, Philadelphia, U.S.A.
14,401. Calculating Machines, J. A. Sewell, Philadelphia, U.S.A.
14,402. Flexible Belt Fender, R. B. Chambers, Philadelphia, U.S.A.
14,403. Journal Bearings, W. J. and J. J. Carter, Philadelphia, U.S.A.
14,404. Cloth Measuring Machine, I. E. V. Duzer and H. Vanderburgh, Canada.

*27th July*, 1894.

14,405. Fishing Rods, W. H. Foster, Derbyshire.
14,406. Buttons, T. R. Wing, London.
14,407. Varnishes, D. Marcus, London.
14,408. School Desks, F. H. Fisher, Birmingham.
14,409. Cycle Bells, J. Harrison, Birmingham.
14,410. Globe Holders, H. Halliday and G. H. Barnes, Birmingham.
14,411. Circular and Letter Forms, D. H. Irwin, Cheshire.
14,412. Cycle Gear, C. W. Holmes and S. Beech, London.
14,413. Coal-saving Devices, E. W. Banner, Liverpool.
14,414. Holder for Painting Golf Balls, D. D. Macpherson, Manchester.
14,415. Lubricating Piston-rods, T. Mudd and J. Airey, Liverpool.
14,416. Railway Gates, E. Currier, London.
14,417. Guard for Carving Forks, J. Wigfall, Sheffield.
14,418. Garment Retainers, W. M. Harris, Birmingham.
14,419. Traps and Syphons, J. Merrill, Sheffield.
14,420. Adjustable Rails, W. Whiting and H. B. Tucker, Bath.
14,421. Pickers for Looms, J. Muir and A. Muir, Glasgow.
14,422. Bobbin Wheel Protectors for Slubbing Frames, J. W. Stubbs, Manchester.
14,423. Air Compressing, &c., Engines, J. Wild, Manchester.
14,424. Holding Labels to the Sides of Vehicles, T. Mills, Halifax.
14,425. Gas Engine, C. R. Roberts, Dorset.
14,426. Manufacture of Knurs, W. Sykes, Yorkshire.
14,427. Preventing Children Falling into Dolly Tubs, W. Needham, London.
14,428. Controlling Loom Shuttle Boxes, A. Lockwood, Keighley.
14,429. Valve Gear of Combustion Engines, W. H. Pasley, Dorset.
14,430. Valves for Air Regenerators, W. W. Pilkington, Liverpool.
14,431. Gas Generators, &c., W. W. Pilkington, Liverpool.
14,432. Compound Locomotives, F. W. Webb, Crewe.
14,433. Manufacturing a Compote from Jelly, P. A. Noll, Berlin.
14,434. Instrument for Piercing the Human Ear, D. Willman, Dublin.
14,435. Pencils for Writing, &c., W. A. Thornton, Leeds.
14,436. Incombustible Burners for Liquid Fuel, C. Westphal, Liverpool.
14,437. Apparatus for Collecting Household Refuse, S. L. Kinsbruner, Liverpool.
14,438. Sewing Machine Shuttles, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
14,439. Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
14,440. Spring Driving Mechanism, P. Lochmann, London.
14,441. Brake and Foot Rest for Cycles, C. H. Flint, Birmingham.
14,442. Grass Border Protectors, J. N. Lester, Wolverhampton.
14,443. Wire for Lawn Tennis Racket, C. Burrows, Cumberland.
14,444. Preparing Wheat, J. T. O'Callaghan, London.
14,445. Electric Railways, J. Y. Johnson.—(*Malone Wheless, United.*)
14,446. Apparatus for Enlarging and Reducing Photographic Negatives, C. S. Jones, Essex.
14,447. Preventing Waste of Beer, G. S. Trafford, London.
14,448. Surgical Drainage Tube, A. Essinger.—(*Paul Hartmann, Germany.*)
14,449. Navigable Balloons, &c., J. B. Scammell, London.
14,450. Wick and Case, G. Aitkens and J. A. Pike, Birmingham.
14,451. Cocoa-pot and Agitator, &c., C. M. Blagdon, London.
14,452. Cameras, G. Dixon, Edinburgh.
14,453. Arithmetical Instrument, G. Thomson, Edinburgh.
14,454. Trace Springs, H. R. Kirschbaum.—(*W. Kirschbaum and Co., Germany.*)
14,455. Lightship Connections, E. Templeton and H. P. Schisckar, London.
14,456. Solitaires, T. Morton, Birmingham.
14,457. Vapour Burners and Torches, C. Thompson, London.
14,458. Holders for the Bottles of Milk-testing Machines, S. Cheeld, London.
14,459. Printing Machinery, M. M. Spear, London.
14,460. Surveying by Photography, J. B. Lee, London.
14,461. Chemical Dyes, G. W. Johnson.—(*Kalle and Co., Germany.*)
14,462. Detachable Gear for Boats, F. A. Rodewald, London.
14,463. Boats' Tillers, F. A. Rodewald, London.
14,464. Safety Locking Bars for Points, C. Hodgson, London.
14,465. Dresses, Bodices, and Jackets, T. Jones, Manchester.
14,466. Gearing for Bicycles and Vehicles, T. Ellis, London.
14,467. Quoins or Wedges for Mining, A. François, London.
14,468. Mountings for Quick-fire Guns, A. H. Bogle, London.
14,469. Portable and other Cranes, H. Sadler, London.
14,470. Raising and Drawing Liquids, A. Bonnoront, London.
14,471. Tobacco Pipes, G. G. Kerr and J. L. Kerr, London.
14,472. Photographic Hand Cameras, S. C. Rudman, London.
14,473. Sliver Cans and Driving Mechanism, G. Meyer, London.
14,474. Loom Shedding, E. B. Redmayne and R. Pickles, London.
14,475. Safety Device for Workmen, J. Marawske, London.
14,476. Vapour or Gas Motor Engine, C. H. Bryant, London.
14,477. Device for Holding Umbrellas, A. Stone, London.
14,478. Camp Stool and Walking-stick, N. and J. Bouvet, London.
14,479. Ranges, &c., J. Slater and C. E. Hauvette, London.
14,480. Transmitters for Sewing Machines, J. White, London.
14,481. Tungsten Articles and Apparatus, A. Meig, London.
14,482. Attaching and Fixing Balusters, A. S. Cripps, London.
14,483. Wire Tray for Biscuit Bakers, J. Hillman, London.
14,484. Case for Thermometers, C. M. Page, London.
14,485. Harrows, J. Gerth and A. Schwarzenberg, London.
14,486. Support for Water Bottles, B. S. Phillips, London.
14,487. Gas Engines, D. Clerk, London.
14,488. Electric Arc Lamps, J. Jeffryes and J. Lea, London.

*28th July*, 1894.

14,489. Aprons, P. R. J. Willis, London.
14,490. Pneumatic Tyres, W. L'Estrange, Manchester.
14,491. Teaching Model Drawing, F. D. King, Bradford.
14,492. Reflector for Photographers' Lamps, A. G. Adamson, Glasgow.
14,493. Electric Light for Photographers' Lamps, A. G. Adamson, Glasgow.
14,494. Slag for the Manufacture of Cement, W. Thomlinson, Stockton-on Tees.
14,495. Means for Roasting Grain, A. Perry, London.
14,496. Manufacture of Iron, C. J. Sandahl, Liverpool.
14,497. Penholders, W. J. Thornhill, Manchester.
14,498. Preventing the Bagging of Trousers, W. Cooke, Liverpool.
14,499. Safety-valves for Hot-water Boilers, J. Edge and T. P. Richards, Liverpool.
14,500. Wheels for Vehicles, J. Jordan, London.
14,501. Emery Wheels and Grindstones, A. A. Tattersall, Glasgow.
14,502. Metallic Alloy, J. W. Dixon and W. Skinner, Sheffield.
14,503. Recovering Hydro-cyanic Acid from Mixtures, G. T. Beilby, Slateford, N.B.
14,504. Valves for Steam Engines, J. Cochrane and W. Cameron, Barrhead, N.B.
14,505. Feeding Printing Machines, J. J. Allen, Halifax.
14,506. Spindles, S. Williams, Halifax.
14,507. Rods for Spring Blind Rollers, J. Robertshaw, Manchester.
14,508. Sash Pulleys, P. Daw, Birmingham.
14,509. Electric Current Regulators, H. V. Keeson, London.
14,510. Hinge Lock and Sash Fastener, D. Griffin, Birmingham.
14,511. Drawing Frames, R. Hartley and J. B. Cocks, Rochdale.
14,512. Hammocks, Lounges, and the like, N. Voice, Sussex.
14,513. Refrigerator Separator, C. Johnson, Scarborough.
14,514. Damping Seams, D. Römhildt, Germany.
14,515. Bowls of Tobacco Pipes, R. Heyd, Germany.
14,516. Clocks, A. J. Treadaway and W. Collins, Birmingham.
14,517. Children's Mail-carts, H. I. Humphry, Birmingham.
14,518. Telephone Switchboard Apparatus, A. Whalley, Warrington.
14,519. Machine for Sorting Cereals, F. H. Schule, Glasgow.
14,520. Producing Nitric Acid Free of Halogen and Nitrose, W. B. Maxfield.—(*W. Dieterle and L. Rohrmann, Germany.*)
14,521. Buttons, C. Heaton and Co. and H. Heaton, London.
14,522. Removable Coverings for Tramcars, F. Brangwin, London.
14,523. Mechanical Toy Bells or Gongs, O. Hanks, London.
14,524. Castors for Furniture, E. Pratt, London.
14,525. Setting Types and Signs for Photos, E. Porsolt, London.
14,526. Sewing Machines, I. Nasch and W. Nasch, London.
14,527. Gates, W. J. Slack, London.
14,528. Ironing Board for Tables, &c., H. S. Grant, London.
14,529. Governors or Steam Motors, C. G. P. de Laval, London.
14,530. Apparatus for Emptying Cesspools, J. Watts, London.
14,531. Regulating Feed-water Supply to Boilers, J. E. L. Ogden, H. B. Watson, and J. S. Watson, London.
14,532. Projectiles for Ordnance, &c., T. Turner, London.
14,533. Transforming Electric Currents, J. Fleming, London.
14,534. Carcase Stretcher, A. J. Boult.—(*J. E. Perl, United States.*)
14,535. Lead Seals, C. Herfort, Liverpool.
14,536. Electric Welding, C. F. Parkinson and W. Gatwood, Manchester.
14,537. Pockets for Painters' Jackets, W. W. Peck, Liverpool.
14,538. Fastening Device for Window Sashes, H. Hook, Liverpool.
14,539. Combs, L. Auerbach, London.
14,540. Braces, &c., T. Roghmanns and C. Richter, London.
14,541. Closets, W. Krebs, London.
14,542. Filter, S. Stroh, London.
14,543. Cooking Cage, E. M. Seed, London.
14,544. Utilising Exhaust from Engines, F. W. Golby.—(*J. M. Salaud, France.*)
14,545. Electromotors, T. Parker, Ld., and T. Parker, London.
14,546. Electric Contact by Weight, S. David, London.
14,547. Treating Gold and Silver Ores, E. L. Mayer, London.
14,548. Checking and Indicating Money, T. S. Howie, London.
14,549. Wrenches and Pipe Cutters, J. Manning, London.
14,550. Steam Engines, H. Grafton, London.
14,551. Transmission of Signals, D. Young.—(*J. M. McMahan, United States.*)
14,552. Bottle, R. S. Trueman and J. C. Trueman, London.
14,553. Refractory Retorts, N. Teissier and G. L. A. Nègre, London.
14,554. Heating and Cooling Liquids, A. Lawrence and Bennett, Sons, and Shears, Ld., London.
14,555. Preserving Perishable Goods, W. S. Simpson, London.
14,556. Forging Metals, H. H. Lake.—(*A. B. Ibbotson, Italy.*)
14,557. Ball Bearings, R. F. Hall, London.
14,558. Appliance for Use in Massage Treatment, W. T. Cormick, London.
14,559. Horseshoes, W. Q. Botten and H. Morel, London.
14,560. Locking Devices for Velocipedes, H. H. Lake.—(*O. Schröder, Denmark.*)
14,561. Ventilators, E. J. How and H. King, London.
14,562. Billiard Checkers, F. W. Heaton, Manchester.

*30th July*, 1894.

14,563. Pumps for Pneumatic Tires, J. P. Titterton, London.
14,564. Drawing Instrument, G. R. Postlethwaite, Birmingham.
14,565. Dyeing Hat Bodies, J. Booth and L. Thornley, Manchester.
14,566. Reversing the Pitch of Propellers, A. V. Coster, Hull.
14,567. Hearths for Boilermakers, &c., J. A. Riley, Halifax.
14,568. Hardening Wire, J. H. Roberts and J. Cooper, jun., Bradford.
14,569. Tubulous Steam Generators, B. H. Thwaite, London.
14,570. Automatic Electric Contact, G. Hussey, Clitheroe.
14,571. Buckle for Fastening Belts, C. C. Walker, Walsall.

---

* "Proceedings" Institution Civil Engineers, vol. cxv., 1893 94.

14,572. Metallic or Tubular Wheels, A. R. Bonnick, Coventry.
14,573. Steam Engines, J. H. Dales, Leeds.
14,574. Foot Grip for Boots, &c., G. B. Thornton, Glasgow.
14,575. Constructing, &c., Bottles, A. Dickinson, Darlaston.
14,576. Cap - spinning Machinery, W. Atkinson, Keighley.
14,577. Thimbles, E. A. Bramwell, London.
14 578. Feed-water Heaters, J. J., T. F., and J. W. Meldrum, Liverpool.
14,579. Warp Beams, H. Liebert, Manchester.
14,580. Electric Brakes for Trains, A. Young, Edinburgh.
14,581. Step-ladders, R. Ramage, Glasgow.
14,582. Cone for Bicycles, &c., J. F. Dixon, Birmingham.
14,583. Taps, J. Wilks, Thornaby-on-Tees.
14,584. Speed for Bicycles and Tricycles, J. Scott, Belfast.
14,585. Fruit Gatherer, R. H. Jones, London.
14,586. Handle Baskets for Flowers, W. Langbein, London.
14,587. Car-couplings, C. Moradelli, London.
14,588. Rotary Engines or Pumps, J. Roberts, Liverpool.
14,589. Machines for Drying Wheat, J. Higginbottom, Liverpool.
14,590. Stud Protector, E. Palmer and M. Ruddell, London.
14,591. Handle for Carrying Parcels, E. J. Preston, London.
14,592 Letters and Signs for Advertising, E. Böhm, London.
14 593. Tobacco Pipes, E. Böhm, London.
14,594. Christmas and Birthday Cards, H. C. Hall, London.
14,595. Devices for Ingot Turning, &c., W. Wass, London.
14,596. Trouser Clips for Cyclists, T. Hooper and S. G. Moore, London.
14,597. Stopper for Blacking Bottles, W. Nye, London.
14 598. Chalk, R. J. Mostyn and F. Strickland, London.
14,599. Preservation of Wood, E. Groebe, London.
14,600 Methylglyoxalidine $C_4HN_2$, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
14,601. Production of Azo-colours, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
14,602. Controlling Electro-motors, J. B. G. A. Canet and A. Hillairet, London.
14,603. Rotary Presses, F. L. H. Sims, London.
14,604. Ship's Berth, J. P. A. Claireau, London.
14,605. Automatic Sash Fastener, A. G. Ewens, London.
14,606. Apparatus for Making Syrups, R. H. Hunstock, London.
14,607. Cable Traction Apparatus, R. Lamb, London.
14,608. Preventing Uncoupling of Vehicles, F. Robinson, London.
14,609. Strainers, D. B. Gotham, London.
14,610. Making Rings from Metal, M. D. Marcy, London.
14,611. Pulverising Apparatus, H. H. Lake.—(*E. Joliçard, France*)
14,612. Disinfecting Urinals, &c., J. M. B. Baker, London.
14,613. Tent, J. W. Mackenzie.—(*F. G. Hamilton, Australia*)
14,614. Electric - magnetic Motors, A. H. Beard, London.
14,615. Car Fenders, G. H. Modemann, London.
14,616. Systems of Lubrication, P. S. Whiting, London.
14 617. Packet for Automatic Machines, G. Brandt, London.

31*st July*, 1894.

14,618. Button for Pneumatic Tires, J. L. Wiles, Tonbridge
14,619. Cushions for Billiard Tables, D. Doyle and T. Farrell, Youghal.
14,620. Securing apparatus to Sunken Ships, W. E. Syer, Manchester.
14,621. Music Recorders, &c., J. L. Cantelo, Liverpool.
14,622. Machinery for Grinding, &c., F. C. Askham, Sheffield.
14,623. Spindle Bobbins, The Todmorden and Cornholme Bobbin Manufacturing and Commercial Company, Ld., and J. Greenwood, Halifax.
14.624. Fuel Economisers, &c., T. Wrigley, Manchester.
14,625. Steam Generators, G. Greaves and J. Crowther. Manchester.
14,626. Driving Chain for Cycles, A. L. Goodall, Derby.
14,627. Minimising Effects of Collisions, H. Kitcher, Southampton.
14,628. Pneumatic Saddles for Cycles, T. R. Sparks, Booterstown.
14,629. Tobacco Pipe, Cleaner, and Case, F. O. Ferguson, Ilfracombe.
14,630. Books for Memoranda, M. L. Macauley, Glasgow.
14,631. Inflatable Tires, G. H. Chinnock, Manchester.
14,632. Automatic Sprinkler Installations, T. Witter, Manchester.
14,633. Supplying Cotton to Scutchers, H. A. Corrigan, Manchester.
14,634. Galvanic Battery, C. E. Buell, Glasgow
14,635. Pneumatic Tires, W. E. Heys.—(*P. Koechlin, France.*)
14,636 Dust Shields for Axle Boxes, H. E. Lord, Sheffield.
14,637. Shuttle Guard for Looms, B. and G. W. Smith, Bingley.
14,638. Vacuum Regulating Apparatus, A. Shiels, Glasgow.
14,639. New Form of Sea-going Vessel, B. Russell, London.
14,640. Horseshoes, C. I. C. Bailey, London.
14,641. Cleaning Windows, A. E. H. Payne, London.
14,642. Electrical Battery. V. I. Feeny.—(*F. Dubero and P. Mohrdieck, United States.*)
14.643. Closing Watertight Doors, J. O. Pelton, London.
14,644. Stocks of Whips, J. W. Field, Birmingham.
14,645. Lasting Machines, A. J. Boult.—(*The Consolidated Hand Method Lasting Machine Company, United States*)
14,646. Type-writing Machines, G. C. Dymond.—(*H. L. Wagner, United States*)
14,647. Screens for Flues, H. G. Westharne, Liverpool.
14,648. Locks, C. W. Brown, London.
14,649. Manufacture of Aluminium, E. Tarin, Liverpool.
14,650. Tires, C. H. Gray, London.
14,651. Electrical Heating Devices, G. C. Dymond. —(*J. A. G. Trudeau, Canada*)
14,652. Lasting of Boots, C. H. Gray, London.
14,653. Water-closets, C. Foulger, Liverpool.
14,654. Signalling Apparatus, G. C. Dymond.—(*A. K. Moore and J. Lohmeyer, Australia.*)
14,655. Bottles, H. A. Bierley and C. E. Armstrong, London
14,656. Wrenches, J. K. Starley, London.
14,657. Displaying of Advertisements, W. S. Cook, London.
14,658. Hydraulic Presses, G. Kynoch and Co. and D. Clerk, London.
14,659. Heating Apparatus, &c., F. S. Rippingille, London.
14,660. Spring Clip, G. Whitehouse and J. Woodcock, London.
14,661. Portable Optical Lanterns, S. J. Levi and A. J. Jones, London
14,662. Tightening Driving Belts, H. Prince, London.
14,663. Dental Forceps, B. and A. Neumann, Germany.
14,664. Presses for Embossed Printing, J. Y. Johnston, London.
14 665. Hooks and Eyes, H. S. Wedmore, London.
14,666 Tobacco Pipes, J. H. Ward, London.
14,667. Adjustable Awnings, J. and R. H. McHardy, London.
14,668. Billiards with Mechanical Players, J. McHardy, London.
14,669. Self-stirring Pots, J. McHardy, London.
14,670. Body Belts, J. McHardy, London.
14,671. Hob-nail Boot Protectors, J. McHardy, London.
14,672. Diving Apparatus, J. Buchanan and A. Gordon, London.
14,673. Bicycles, S. M. Arnold, London.
14,674. Preparing Moulds for Castings, C D. Abel.—(*H. Köttgen and Co., Germany*)
14.675. Apparatus for Condensing, &c., Milk, B. F. McIntyre, London.
14,676. Slotting Machine, F. Knights, London.
14,677. Machine for Cutting Almonds, J. L. Collier, London.
14,678. Centrifugal Blowers, W. H. Harrison, London.
14,679. Wire Fabrics, M. B. Lloyd, London.
14,680. Dredging Apparatus, &c, E. Chaquette, London.
14,681. Dredging Apparatus, &c., E. Chaquette, London.
14,682. Lawn Tennis Apparatus, W. B. Hopkins, London.
14,683. Flying Machines, A. Liwentaal, London.
14,684. Moving Suspended Bodies, P. E. Pownall, London.
14,685. Imitation of the Serpentine Dance by an Animal, C. Doré, London.
14,686. Folding Hat and Parcels Rack, B. S. Phillips, London.
14 687. Vermin Traps, W. L. Garrett, Kent.
14,688. Clearing of Congested Drains, J. and A. W. Binks. London.
14 689. Secondary Batteries, F. and F. W. Tallack and L. Héndlé, London.
14,690. Centrifugal Governors, H. H. Lake.—(*Cie de l'Industrie Electrique, Switzerland*)
14,691. Governing Devices for Motors. H. H. Lake —(*Cie. de l'Industrie Electrique, Switzerland.*)
14,692. Preventing the Spread of Cracks in Packing Cases. F. J. Ludington, London.
14,693. Manfacturing Bottles, H. H. Lake.—(*P. B. Maussiee, France*)
14,694 Portable Organs, P. P. Bilhorn, London.
14 695. Type-setting Apparatus, S. E. Gunyon.—(*L. K. Johnson and A. A. Low, United States*)
14,696 Apparatus for Advertising, J. Silbermann, London.
14 697. Substitute for Whalebone, &c., F. Hartmann, London.
14,698. Driving Gear, J. Y. Johnson.—(*C. A. de Dion, France*)
14,699. Fireproof and Waterproof Ceilings, W. Whittaker, London.
14,700. Jugs, &c., G. Collins, London.
14.701. Window-sash Fasteners, R. Davidson, London.
14,702. Tires for Cycles, W. H. Crossman, London.
14,703. Collars for Horses, F. G. G. and H. J. Sewell, London.
14,704. Furnaces for Treating Complex Ores, W. W. Fyfe, London.
14,705. Dividing, &c , "Mineral Pulp," W. W. Fyfe, London.
14,706. Treating Crushed Complex Ores, W. W. Fyfe, London.
14,707. Mechanism, Bürkle and Söhne, Germany.

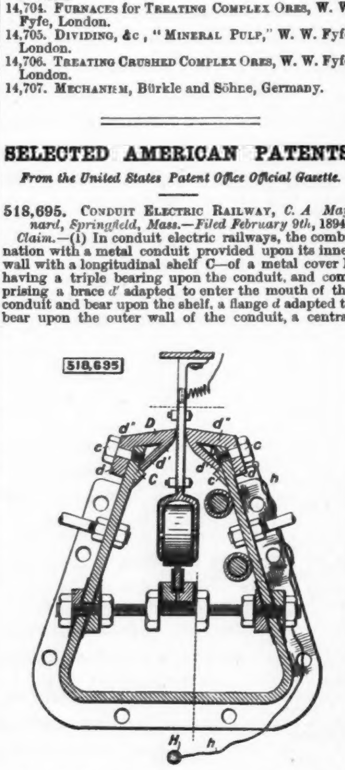
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**518,695.** Conduit Electric Railway, *C. A. Maynard, Springfield, Mass.—Filed February 9th*, 1894.

*Claim.*—(1) In conduit electric railways, the combination with a metal conduit provided upon its inner wall with a longitudinal shelf C—of a metal cover D having a triple bearing upon the conduit, and comprising a brace *d'* adapted to enter the mouth of the conduit and bear upon the shelf, a flange *d* adapted to bear upon the outer wall of the conduit, a central portion *d''* integral with the brace and flange and adapted to be seated upon a top rim of the conduit, and screw bolts *c* through flange *d* and the wall of the conduit, as and for the purpose set forth. (2) In conduit electric railways, the combination with a return wire H removed from the conduit, and with removable covers D D, of auxiliary wires *h* arranged to connect the two, as and for the purpose set forth.

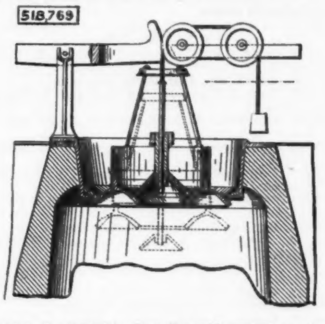
518,695



**518,769.** Charging Apparatus for Filling Blast Furnaces, *T. F. Witherbee, Port Henry, N.Y.—Filed June 27th*, 1893.

*Claim*—(1) A charging apparatus for blast furnaces, which comprises an annular movable bell having a central aperture, the spreading bell, I, which is of less diameter than said aperture and thereby adapted to pass through it so as to occupy a position either above or below the annular bell, and means for raising and lowering the said spreading bell, as shown and described. (2) A charging apparatus for filling blast furnaces, comprising a movable bell having a central aperture, and a spreading bell adapted to pass through the said central aperture below the said movable bell and centrally thereof, and a fixed bell adapted to close the said central aperture of the movable bell and also adapted to receive the said spreading bell, substantially as shown and described. (3) A charging apparatus for blast furnaces, which comprises an annular bell arranged within a hopper, and having a vertical, circular extension, E, constituting a supplemental inner hopper, a bell for closing such inner hopper, and means for raising and lowering the annular bell and its hopper, as and for the purpose specified. (4) A charging apparatus for filling blast furnaces, comprising a hopper secured to the stack of the blast furnace, an annular movable bell adapted to be seated on the contracted end of the said hopper, the said movable bell having a central aperture, a second hopper secured on the crest of the said movable bell, a fixed bell adapted to close the said central aperture of the movable bell, and a spreading bell adapted to be seated within the said fixed bell and adapted to pass through the said central aperture of the movable bell, substantially as shown and described.

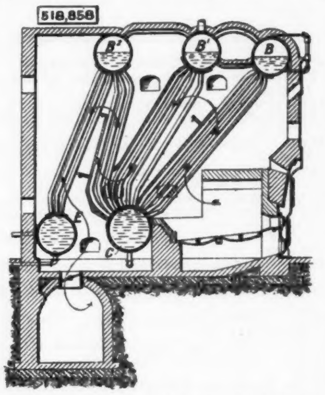
518,769



**518,858.** Steam Boiler. *H. S. Pell, Akron, Ohio.—Filed December 22nd*, 1893.

*Claim*—(1) In a water-tube boiler, the combination of elevated drums having steam and water communication with each other, a lower mud drum, tubes connecting the elevated drums with the lower mud drum, a lower feed drum, tubes connecting the lower feed drum with one of the elevated drums, and means for supplying water to the lower feed drum, substantially as described. (2) In a water-tube boiler, the combination of three elevated steam and water drums, B and $B^1$ and $B^2$, a lower drum C, series of tubes connecting the lower drum with each of the elevated drums, pipes affording steam and water communication between the drums B and $B^1$ and steam communication between the drums $B^1$ and $B^2$, a lower feed-water drum E, a series of tubes connecting the lower feed-water drum E with the elevated steam and water drum $B^2$, and means for supplying water to the lower feed-water drum, substantially as described.

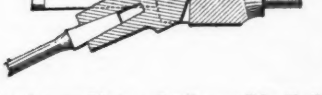
518,858



**518,938.** Bit-stock, *F. J. Colvin, Hamden, Conn.—Filed October 14th*, 1893.

*Claim.*—In a bit-stock, the combination with a head portion, of a block pivoted thereto, and having a socket to receive the head of the bit, and resilient jaws constructed to engage the shank portion of the bit, and expansible in a direction parallel with the axis of the pivot of the block, or in other words, in a direction at right angles to the direction in which the block swings.

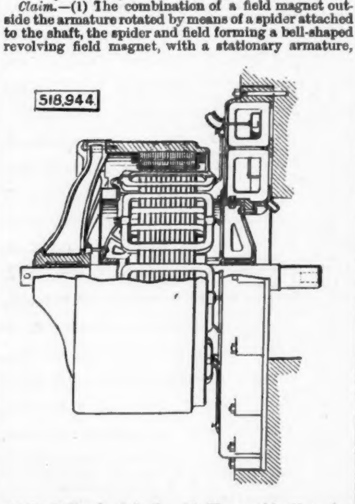
518,938



**518,944.** Dynamo-electric Machine, *G. Forbes, Niagara Falls, N.Y.—Filed August 17th*, 1893.

*Claim.*—(1) The combination of a field magnet outside the armature rotated by means of a spider attached to the shaft, the spider and field forming a bell-shaped revolving field magnet, with a stationary armature, substantially as set forth. (2) The combination of a shaft supported centrally within a stationary armature by brackets attached to the frame of the armature, with a spider and external revolving field, substantially as described.

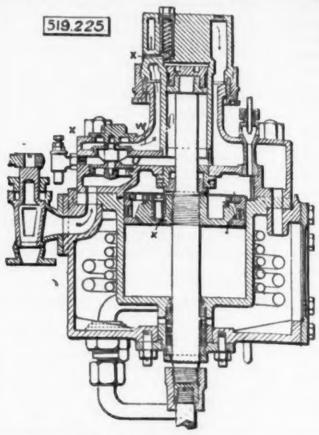
518,944



**519,225.** Pump for Compressing Air or Gases, *G. E. Belliss and A. Morcom, Birmingham, England.—Filed August 1st*, 1893.

*Claim.*—(1) In a gas or air compressor, the low and high-pressure cylinders A G, the pistons B H therein, the air conduit leading directly from one end only of the low-pressure cylinder to the high-pressure cylinder, whereby the air will be forced from the cylinder at one stroke, the cooling tank and passages and the inlet for the water connecting with one of the cylinders, whereby the water will be forced through the cooling passage and tank, subtantially as described. (2) In combination, the low and high-pressure cylinders, the pistons therein, the air conduit from the low to the high-pressure cylinders, the water chamber W around the high-pressure cylinder, the inlet channel U for the water leading to the high-pressure chamber, the valve X opening from the inlet conduit into the chamber W and the water chamber about the low-pressure cylinder connected with the water chamber W, substantially as described.

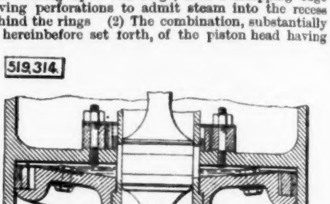
519,225



**519,314.** Metallic Packing, *W. D. Baldwin, Washington, D.C.—Filed June 8th*, 1893.

*Claim.*—(1) The combination, substantially as hereinbefore set forth, of a piston having a groove or recess in its periphery, a series of spring rings mounted in the groove or recess and adapted to press against the working surface of the cylinder, a spring plate secured directly to the piston and having a yielding spring edge overlapping the groove or recess in the piston and bearing upon the rings, said overlapping edge having perforations to admit steam into the recess behind the rings (2) The combination, substantially as hereinbefore set forth, of the piston head having an annular groove or recess in its periphery, the separate overlapping spring rings mounted in the recess and by their own elasticity pressing against the sides of the cylinder, the spring disc or plate secured directly to the piston head and having an outer edge overlapping the recess and bearing directly on the rings, said overlapping edge having perforations communicating with the space in the recess in rear of the rings, the organisation being such that the spring plate is exposed to steam pressure to supplement its elasticity in bearing upon the rings to hold them in place, and the steam pressure admitted through the perforations of the plate supplements the elasticity of the rings to cause them to pack the joint.

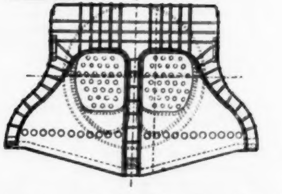
519,314



**519,315.** Locomotive Boiler, *D. L. Barnes, Chicago, Ill.—Filed March 9th*, 1894.

*Claim.*—The combination, in a locomotive boiler, of a laterally extended fire-box, a combustion chamber located within the waist of the boiler at its rear end, a transverse water wall sheet having forwardly-extending flanges at its top, sides, and bottom, and riveted through said flanges to the adjacent sheets of the combustion chamber, and also having rearwardly extending flanges on its top, sides, and at a level above its bottom, a longitudinal water wall forming two separate furnaces in the fire-box, and communicating with the rear water space thereof, front furnace sheets, each having forwardly-extending flanges riveted to the rearward flanges of the transverse water wall sheet, and rearwardly-extending flanges riveted to the side sheets of the longitudinal water wall, and furnace crown and side sheets riveted to rearwardly-extending flanges on the front furnace sheets, substantially as set forth.

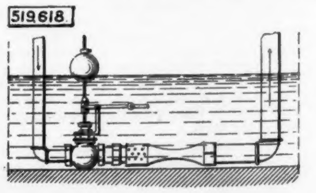
519,315



**519,618.** Fluid Ejector, *N. Power, New York, N.Y.—Filed March 15th*, 1894.

*Claim.*—In an apparatus for draining cellars, the combination, with a pressure pipe, a discharge pipe, and an intermediate ejector, of a balance valve located in the pressure pipe, the valve discs of which are mounted upon a stem, the said stem being connected with a float operating the valve discs, and a counterweight connected with the valve stem, whereby the stem, the parts connected therewith, and the valve discs are counterbalanced, substantially as shown and described.

519,618



## THE BRITISH ASSOCIATION AT OXFORD.

### PRESIDENTIAL ADDRESS—SECTION A.

ON Thursday, August 9th, Professor A. W. Rücker, F.R.S., opened the proceedings at Section A—Mathematical and Physical Science—by delivering his presidential address. He began by speaking of the spread of scientific education in these times, and contrasted it with the position occupied by science in this country in 1860, when the authorities of the Owens College, Manchester, debated whether it was desirable to create a Professorship of Natural Philosophy in addition to, and independent of, the Chair of Mathematics. It was thought necessary to obtain external support for the opinions of those who advocated this step. An appeal was made to Professors de Morgan and Stokes. The former reported that a "course of experimental physics is in itself desirable;" the latter, that "there would be work enough in a large institution for a mathematician and a physicist." In the end, the Chair of Natural Philosophy was established. He also said that the Clarendon Laboratory, in which they were assembled, though erected barely a quarter of a century ago, was the first laboratory in this country which was specially built and designed for the study of experimental physics. It has served as a type. Clerk Maxwell visited it while planning the Cavendish Laboratory, and traces of Professor Clifton's designs can be detected in several of our University Colleges.

After speaking of private munificence as an aid to the advancement of learning, and quoting the example of Sir Henry Thompson, who has offered £5000 to provide Greenwich Observatory with a telescope of 26in. aperture and 22ft. 6in. focal length, also the example of Mr. Ludwig Mond in presenting new research laboratories to the Royal Institution, Professor Rücker said:—"The growth in the number of scientific workers makes it increasingly difficult to find the funds which are necessary for the publication of their work. Up to the present the author of a paper has had to submit it to criticism, but when it has been approved by competent judges, it has been published without ado and without expense to himself. This is as it should be. It is right that due care should be exercised to prune away all unneccessary matter, to reduce as far as may be the necessary cost. It will, however, be a great misfortune if judgment as to what curtailment is necessary is in future passed, not with the object of removing what is really superfluous, but in obedience to the iron rule of poverty. Apart from all other disadvantages, such a course would add to the barriers which are dividing the students of different sciences. A few lines and a rough diagram may suffice to show to experts what has been attempted and what achieved, but there is no paper so difficult to master as that which assumes that the reader starts from the point of vantage which months or years of study have enabled the author to attain. Undue pruning will not make the tree of knowledge more fruitful, and will certainly make it harder to climb. Connected also with the vast increase of scientific literature is a growing necessity for the publication of volumes of abstracts, in which the main results of recent investigations are presented in a concentrated form. English chemists have long been supplied with these by the Chemical Society. The Physical Society, though far less wealthy than its elder sister, has determined to undertake a similar task. We are compelled to begin cautiously, but in January next the first number of a monthly pamphlet will be issued containing abstracts of all the papers which appear in the principal foreign journals of Physics. In this venture the Society will incur grave responsibilities, and I avail myself of this opportunity to appeal to all British physicists to support us in a work, the scope of which will be rapidly extended if our first efforts succeed."

When speaking of the ten years' work of himself and Dr. Thorpe over a minute magnetic survey of the United Kingdom, he made the following remarks about the errors present in certain instruments used in different scientific observatories:—"In the first place, there is little doubt that the instruments at present used for measuring declination and horizontal force are affected with errors far greater than the error of observation. We employed four magnetometers by Elliott Brothers, which were frequently compared with the standard instrument at Kew. These measurements proved that the instrumental differences which affect the accuracy of the declination and horizontal force measurements are from five to ten times as great as the error of a single field observation. The dip circle, which two generations ago was so untrustworthy, is, in our experience, the most satisfactory of the absolute instruments. In most cases these comparisons extended over several days; but the Astronomer Royal has described, in his recent report, observations made at Greenwich, for two years and a-half, with two horizontal force instruments. These differ between themselves, and the discrepancy is of the same order of magnitude as those we have detected. If such differences exist between instruments of the Kew pattern, it is probable that they will be still greater when the magnetometers under investigation are of different types. This point has been investigated by Dr. Van Rijckevorsel, who five years ago visited Kew, Parc St. Maur, Wilhelmshaven, and Utrecht, and using his own instruments at each place, compared the values of the magnetic elements determined by himself with those deduced from the self-registering apparatus of the observatory. The discrepancies between the so-called standards, which were thus brought to light, were quite startling, and prove the necessity for an investigation as to their causes."

He concluded, therefore, that it is necessary that a full primary comparison should be made between the standard magnetic instruments in our different observatories, and that the question would afterwards arise whether it should be repeated at regular intervals.

Much of the rest of the address went deeply into the subject of terrestrial magnetism and its phenomena, and we close this notice by quoting what Professor Rücker said about abnormal magnetic conditions in and around Moscow: "Observations made about thirty years ago by a former director of the Astronomical Observatory in Moscow led to the conclusion that throughout two large districts to the north and south of that city the plumb-line is deviated in opposite directions. The deflections from the vertical are very considerable, and indicate a relative defect in the attraction exerted by the rocks in the neighbourhood of Moscow itself, and the suggestion has been made that there is either a huge cavity—a bubble in the earth-crust—under the town, or that the matter beneath it is less dense than that which underlies the surface strata on either side at a distance of ten or twelve miles. As long ago as 1853, Captain Meyen made magnetic observations in order to determine whether the same district is also the seat of any magnetic irregularity. His stations were hardly sufficiently numerous to lead to decisive results, but the magnetic elements have recently been measured by Dr. Fritsche at thirty-one places within fifty miles of Moscow. The experiments were all made within eleven days, so that no correction for secular change is required. They indicate a locus of magnetic attraction running through Moscow itself. South of the town the disturbance again changes in direction so as to show either that repulsive forces are in play, or that there is another magnetic ridge line still further to the south. Dr. Fritsche thinks that these observations explain the gravitational anomalies without recourse to the somewhat forced hypothesis of a vast subterranean cave. He assumes that there is a concealed mass of iron, which approaches near to the surface at Moscow, and also along two loci to the south and north of the city. He attributes the magnetic irregularities to the attraction of the central iron hill, the deflections of the plumb-line to the flanking masses. It is perhaps not inconceivable that such results might follow in a special case, but without the support of calculation it certainly appears that the magnetic experiments point to the existence of the principal attracting mass under the town. This is in fact the arrangement shown in the figure with which Dr. Fritsche illustrates his hypothesis. If this is so, the theory would *primâ facie* seem to require that the bob of a plumb-line should be attracted towards and not—as is actually the case—away from the centre of the magnetic disturbance. On the whole, then, though the coexistence of large magnetic and gravitational disturbances in the same place is suggestive, I do not think that they have as yet been proved to be hidden effects of the same hidden mass of magnetic matter."

### ELECTRIFICATION OF AIR BY SUBTRACTION OF WATER.

At the close of the delivery of the presidential address, Lord Kelvin gave a summary of a paper written by himself, Mr. Magnus Maclean, and Mr. A. Galt, entitled, "Preliminary Experiments, Proving the Electrification of Air by the Subtraction of Water from it." In his preliminary remarks Lord Kelvin set forth that—many years ago—Armstrong discovered that spherules of water driven by steam against a hard block would produce much electricity; he was led to this in the first instance by noticing that a locomotive on iron rails, resting on cinders and blowing off steam, would give electrical sparks. Later on Professor J. J. Thomson discovered that water falling on a plate produces electricity. Electrification is probably produced by falling rain. It had always occurred to him—Lord Kelvin—that the motes in air blowing against a mountain side, and clouds forming there, would produce electricity. He then gave the following abstract describing the experiments recently tried by Mr. Maclean, Mr. Galt, and himself:—"The experiments were commenced by one of us in December, 1868, but before any decisive result had been obtained circumstances rendered a postponement of the investigation necessary. A glass U-tube with vertical branches, each 18in. long and about 1in. bore, with the upper 8in. of one of the branches carefully coated outside and inside with clean shellac varnish, was held fixed by an uninsulated support attached to the upper end of this branch. The other branch was filled with little fragments of pumice soaked in strong pure sulphuric acid or in pure water; and a fine platinum wire, with one end touching the pumice, connected it to the insulated electrode of a quadrant electrometer. A metal cylinder, large enough to surround both branches of the U-tube without touching either, was placed so as to guard the tube from electric influences of surrounding bodies—of which the most disturbing is liable to be the woollen cloth sleeves of the experimenters or observers moving in the neighbourhood. This metal tube was kept in metallic connection with the outside metal case of the quadrant electrometer. The length of the exposed platinum wire between the U-tube and the electrometer was so short that it did not need a metal screen to guard it against irregular influences. An india-rubber tube—metal metallically connected with the guard cylinder would have been better—from an ordinary blow-pipe bellows was connected to the uninsulated end of the U-tube. Air was blown through it steadily for nearly an hour. With the sulphuric pumice in the other branch the electrometer rose in the course of three-quarters of an hour to about nine volts positive. When the pumice was moistened with water instead of sulphuric acid, no such effect was observed. This result proves decisively that the passage of the air through the U-tube gave positive electricity to the sulphuric acid, and therefore sent away the dried air with negative electricity. A corresponding experiment with fragments of chloride of calcium instead of sulphuric pumice gave a similar result. In repetition of the experiments, however, it has been noticed that the strong positive electrification of the U-tube seemed to commence somewhat suddenly when a gurgling sound, due to the bubbling of air through free liquid—whether sulphuric acid or chloride of calcium solution—in the bend of the U-tube began to be heard. We intend to repeat the experiments with arrangements to prevent any bubbling of the air through liquid. We have repeated our original experiment with pumice moistened with water in the insulated U-tube, and with an uninsulated U-tube filled with sulphuric pumice between the bellows and the insulated tube, so that the air entering it is artificially dried. With this arrangement the insulated U-tube was negatively electrified by the blowing of the air through it; but this electrification may have been due to the negative electrification of the dry entering air to be expected from the result of our first experiment. We intend to repeat the experiment with artificially dried and dis-electrified air blown through the U-tube containing pumice moistened with water."

He drew upon the black-board the accompanying diagram, Fig. 1, of the apparatus described. He added that he is now experimenting with Professor Tait to try whether, by suddenly exhausting air from a receiver so as to produce a cloud, and then sweeping the cloud out, electrification will be obtained; if the thing is possible; the vessel used must be much larger than any which they had tried hitherto.

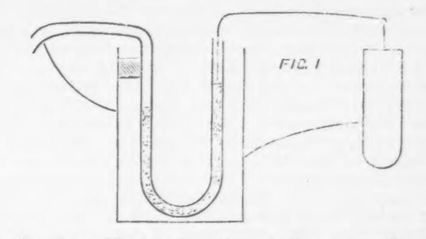


FIG. 1

Dr. Oliver Lodge, in the course of the discussion of the paper, said that if he had obtained the same results under the same conditions, he should have ascribed those results to friction. Lord Kelvin then combatted this conclusion.

### PHOTO-ELECTRIC LEAKAGE.

Dr. Oliver Lodge then brought the above subject under the notice of the Section, and called attention to the reseaches of Messrs. Elster and Geisted on the influence of the action of the extreme ultra violet rays of the spectrum upon electric leakage. One of their experiments substantially can be explained by Fig. 2. in which A B D is a Leyden jar, and E H a discharging channel. When the conditions are so evenly balanced that the jar tends to discharge itself without decided preference, either by E or by H, an ultra-violet light is then thrown upon either E A or H B, the light tends to prevent the production of the spark between the knobs on which it falls.

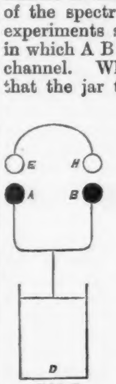


FIG. 2

Dr. Lodge also described an experiment of his own in which an insulated pewter pot—Fig. 3—was connected with an electroscope, and a beam of ultra-violet light directed into its inside, as indicated by the dotted lines. The pot was charged with electricity of high potential. When the beam went wholly inside the pot there was no leakage of electricity at all, but when any of the rays fell upon the rim or outside of the pot, electrical leakage proceeded apace.

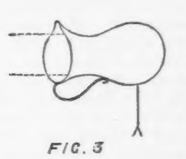


FIG. 3

Three papers upon thermo-dynamical questions by Mr. G. H. Bryan were then read, after which the proceedings of Section A closed for the day.

### STEAM CARRIAGES ON COMMON ROADS.

The work of Section G, the Mechanical Science Section, commenced with the delivery by Professor A. B. W. Kennedy, F.R.S., of his address as President. The address was warmly and deservedly praised, and contains some new points, and new ways of describing the work of the engineer. It will be found on another page.

The paper by Sir Frederick Bramwell, to which we referred last week, was the first paper read in this section. It will be found on another page. The discussion upon the paper did not add to it in any material degree. Its value was recognised as directing renewed attention to the work done by Hancock and Gurney, and to the important features of the water-tube boilers of several men of the same time, including the upwardly inclined fire-bar tubes of Gurney's boiler. It was thought that a careful study of these early examples of road carriages and boilers would have placed any practical engineer in possession of much that is essential to success. The rise and rapid extension of the railways was probably the chief cause of the failure to pursue the advantages reached by Hancock. The explosion of Gurney's boiler did much harm, but it was thought that with the encouraging report of the Royal Commission, this accident would not have had a lasting effect if public favour had not been so completely monopolised by the then new railroads.

### BORE WELLS FOR TOWN WATER SUPPLY.

After this discussion, Mr. Henry Davey read a paper on "Bore Wells for Town Water Supply," which we shall print in another impression. In the discussion upon it, Mr. G. F. Deacon referred to possible difficulties in carrying out Mr. Davey's system when sand was met with. When wells were constructed in the ordinary way and with headings, the sand could deposit and not affect the pump valves. Sir Frederick Bramwell thought there need not be any lasting trouble with bore wells for large supplies. He had obtained several supplies in this way. Mr. Davey said that sand caused no lasting trouble. The valve seats were, during sinking, faced with gutta-percha, and after the work was completed the ordinary metallic seats were put in. This completed the work of the first day of the Section.

On Friday morning Section A joined Section G for a joint discussion on four papers:—(*a*) on "Integrators and Analysers," by Professor O. Henrici; (*b*) on the "Behaviour of a Rotating Cylinder in a Steady Current," by Arnulph Mallock; (*c*) on the "Resistance experienced by Solids moving through Fluids," by Lord Kelvin; and (*d*) on the "Evolution of a Flying Machine," by Hiram S. Maxim. We dealt with Mr. Maxim's machine last week. Professor Arthur W. Rücker, F.R.S., took the chair. Lord Salisbury, the President of the Association, was present.

### EVOLUTION OF A FLYING MACHINE.

At the close of the reading of his paper, Mr. Maxim made some supplementary remarks to the effect that his finished engines originally weighed 300 lb. each, and that subsequent alterations brought their weight up to 322 lb.; by the various improvements he is able to make the pressure mount from to 200 lb. to 300 lb. in less than a minute; he thought that the engines would actually deliver 400-horse power on the screw. From experiments he had tried, he had come to the conclusion that there is practically no skin friction on a screw running in air.

Lord Rayleigh spoke of the skill, ingenuity, and perseverance which Mr. Maxim had displayed, and stated that he had had a ride on Mr. Maxim's machine; he reckoned that ride quite one of the sensations of his life, for to approach a wood at the speed of 36 or 37 miles an hour, with no visible means of stopping, is decidedly sensational. A few years ago, when lecturing at the Royal Institution, he touched upon this question of flying machines, and had to begin by defining one. Is a balloon a flying machine? He thought that the general answer would be "No." A cannon ball is not a flying machine because it cannot develope fresh energy. A rocket developes or produces fresh energy, but cannot be classed as a flying machine, which term he took to mean a machine capable of carrying a man through the air in any desired direction, and of descending with him in safety. The problem of the action of single aëroplanes was attacked and solved many years ago by a Frenchman, M. Penaud, as set forth in the *Journal* of the Aëronautical Society; he dealt with the question, at what angle to the horizon aëroplanes should be placed, without taking skin friction into account. Assuming the presence of no friction, a plane of any size can be made into a flying machine, provided only that it be driven fast enough. Penaud's results were substantially the same as those which he—Lord Rayleigh—had worked out afterwards, without knowing at the time what Penaud had done. He thought that it would be found eventually that skin friction will have to be practically taken into account in relation to flying machines. Mr. Maxim, he thought, had solved three out of, say, five of the problems of flight.

Professor S. P. Langley, of Washington, said that the making of a machine which will support itself in air, which he congratulated Mr. Maxim upon having accomplished, is not the greatest difficulty to be overcome in making a flying machine. Supposing his machine not to be guided by rails, but to begin to travel freely in the air, what is to keep it travelling in a horizontal direction? For instance, if he tried to throw the card in his hand across the room, it would require great power and skill to cause it to travel in a horizontal direction after it left his hand. In some experiments he had tried with speeds of fifty or sixty miles per hour, he had found skin resistance to be an almost negligible quantity. He had not tried to make a flying machine, nor had he ridden upon that made by Mr. Maxim; he thought that before the close of this century flying machines would have a real existence, but whether they would be commercially successful or navigable without great risk, he would not predict.

Lord Kelvin had unbounded admiration for the beauty and ingenuity of the engineering work connected with Mr. Maxim's flying machine, one part of which, however, he must attack, and that part was the aëroplane. Why was it used at all? Why not mount the screws on a vertical axis? About twenty years ago his brother, Professor James Thomson, made a little flying machine consisting of a pair of screws on vertical shafts. It would fly up to the ceiling and come gently down again. He was not sure that any description of it was published at the time, but it might have been brought before one of the Glasgow scientific societies. His brother, however, did not see the possibility of making this device into a machine which would lift a man. It was commonly assumed to be proved that the resistance to propulsion would increase nearly in proportion to the square of the velocity, but it is now found by experiment that it is not so; and it was also found that this was pointed out by Sir John Robinson, and Lord Kelvin said that if his brother had read Sir John Robinson's book, he probably would not have taken such a despairing view; besides, he had not anticipated the possibility of constructing such beautiful machinery as that produced by Mr. Maxim. Why did not the latter use four vertical screws, one at each corner of the machine? It would come down all right, and even if there were a strongish wind blowing, an adjustable aëroplane could be fixed below it by which it could be kept in a horizontal position. He thought that many inventors of flying machines had been misled by the eagle in the back yard which cannot get into the air, for such heavy birds must take a long run along the ground first. The machine of Mr. Maxim is an uncomfortable one in the matter of coming to rest after a flight, but his unprecedentedly light and powerful engines might be applied to a machine with vertical screws, in which he—Lord Kelvin—would be happy to have a fly.

Professor Osborne Reynolds stated that it was not usually noticed that there is an absolute limit to the weight which can be raised by any flying machine, namely, that weight of the materials used increased as the square of the increase of the size of the machine. The weight thus increases faster than it is possible to increase the strength. This law, he said, limits the possibilities of flight, but we may remark that this law may act asymptotically, and the absolute limit be a long way off. Birds are limited in size by this law; he thought the weight of the largest flying bird to be about 60 lb. or 70 lb. Mr. Maxim had been successful in getting power enough on a machine to lift 8000 lb. The wings of birds vary in dimensions according to their weight, and to the distances over which they habitually fly. The French partridge cannot fly slowly, its wings being so small in proportion to its size; birds which fly long distances have long wings. He thought that for actual flying by machinery the speed would have to be more like 200 miles an hour, than the speeds with which Mr. Maxim had been dealing, and that at high velocities the amount of skin friction would be serious.

Mr. Maxim, in reply, stated that he thought that a machine could be made with four vertical screws, but that these screws would have to be widely separated from the body of the machine, so as not to blow down upon the machine itself. He had found that an aëroplane shaped as in Fig. 1, would always lift as much as could be lifted by the power used to push it, showing that there is no skin friction practically. He had made a thing of the shape shown in Fig. 2, and nearly everyone would say that it is impossible that it should rise when pushed through the air in the direction indicated by the arrow. Yet it does rise, because it encounters stationary air at B, and at A leaves air going down, consequently it takes an upward flight.

FIG 1

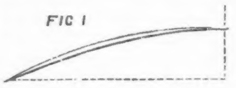


FIG 2

To some of the Friday's papers and proceedings we must refer in another impression.

### NEW SPECTRUM DISCOVERIES.

On Saturday, August 11th, the theatre in the Clarendon Laboratory at Oxford was crowded to hear Professor S. P. Langley, of Washington, give a description to Section A of the British Association of the work he has recently been performing in the ultra-red end of the spectrum. Mr. R. T. Glazebrook, F.R.S., occupied the chair. As mention was made by the speaker of the work of the early Herschel's in the same domain, it may be mentioned that Professor Alexander Herschel was among those present.

Professor Langley stated that in early times Sir William Herschel, when testing the heating power of different portions of the spectrum, found, by thermometers, the heat of the visible spectrum to be greatest at the red end, and that in the invisible region outside the red the heat was still greater. Twenty-five or thirty years later, his son, Sir John Herschel, took some paper soaked in alcohol and rubbed over with lampblack, so that when one part dried before another, the resulting difference was optically perceptible, and he found the heat in the invisible ultra-red end of the spectrum to be unevenly distributed; three white spots appeared in that region with the spectrum which he used; he employed a round hole in the apparatus in place of a slit. Later still, a scientific man at St. Petersburg, working in the same region, used a thermo-pile to indicate the amount of heating power, and observed irregularities of temperature in the ultra-red of the spectrum. Some years ago he—the speaker—used his bolometer for the purpose—an instrument in which the amount of heating of an exceedingly fine flattened platinum wire is indicated by electrical means—to search for lines of the spectrum in this invisible region; it was groping and tedious work; he was two years in fixing the positions of less than twenty lines, and he came to the conclusion that life was too short for that method of work, for in mapping those few lines between 1000 and 2000 bolometer readings had been taken.

About five years ago he resumed the investigation, having obtained official aid from the Government of the United States. New and more delicate apparatus was constructed. In working, he had a spectrum moving over the bolometer wire, and a photographic plate moving synchronously with it, in order to get the true position of each of the lines. The clockwork had to be of the most perfect nature; and in the optical part of the apparatus rock salt had to be used in place of glass, the latter being in a great degree opaque to the ultra-red radiations. A rock-salt prism is mounted upon an azimuth circle, to which a most accurate motion is given by clockwork—as accurate, indeed, as that used to drive astronomical telescopes. The electrical changes are indicated by means of a reflecting mirror in the usual way, and he was much indebted to Mr. Boys for the accuracy ensured by the use of his quartz fibres. The whole apparatus is so sensitive and exact that at present it is quite capable of measuring one-millionth of a degree. When the feeblest spectrum line falls on the wire, a sharp and marked deflection immediately follows, and by this method he had already obtained about 2000 deflections in this hitherto unknown region. There was a time when he could not trace any heat in the double D-line, but he was at that moment able to show them bolometer indications of heat, not alone in each of the D-lines, but in the fine nickel line between them. The representation of this which he was showing them in curves upon paper was not a drawing, it was an automatic representation obtained by optical means and by photography, and was untouched by hand. By another optical method he had formed the curves just mentioned into a linear representation of that part of the spectrum, and they could see that the ordinary double D-line, with the nickel line between, had been the pictorial result. He exhibited also some composite photographs, in which several different images of the lines in the ultra-red end of the spectrum had been superposed by Mr. Francis Galton's method.

In this unexplored region of the spectrum it is believed that meteorological influences have much effect; they all knew that alterations in the weather had an influence upon the rainband in the upper spectrum, and that several parts of the spectrum are influenced by telluric action. He hoped, therefore, that the study of these invisible lines in the ultra-red part of the spectrum would ultimately give the power of predicting the weather, and that the American Government would feel that it had been justified in supporting these researches, for it had done so upon purely utilitarian grounds.

A member asked Professor Langley what optical method he used to turn his curved lines into a linear representation of the D part of the visible spectrum.

Professor Langley asked whether the questioner remembered those curious optical toys with which you look into a cylindrical mirror, and see an apparently distorted diagram turned into a figure of proper proportions. He employed the same principle with another optical arrangement superposed; there was no time at that meeting to enter into the full details, but if the optical constants were correct, the reproduction would be correct; the lines are drawn out by means of a system of ordinary and cylindrical lenses. There was a time when good rock salt for optical purposes was difficult to obtain, and difficult to work; rock salt prisms can now be admirably worked, and he thought that with the one he was using he could see five or six lines between the two D lines; at will he could run through the whole spectrum up a photographic plate, in a period varying from fifteen minutes to four hours. He then projected some photographic diagrams upon the screen, showing different parts of his apparatus in use in Washington, including a siderostat made by Sir Howard Grubb. He also projected an image of the ultra-red spectrum, and pointed out what a small length of it had hitherto been mapped by direct photographic means.

Mr. Norman Lockyer remarked that it was difficult to find words in which to express due admiration for the wonderful piece of work which had just been brought under their notice; it amounted, in fact, to a revelation, and he hoped that in time Professor Langley would be able to give them the spectrum of any particular part of the sun's disc which might be desired. He considered one of the advantages of British Association meetings to be the conflict of wits which they bring about, and the suggestion of new ideas.

Dr. J. H. Gladstone stated that Brewster was able to see with the eye some lines below A of the spectrum; he—Dr. Gladstone—could not do so, but was able to resolve lines at the other end of the spectrum which were invisible to most people. Water in the atmosphere gave all the telluric effects in the spectrum, and Professor Langley's work was likely to be useful in the direction which he had indicated.

Professor G. J. Stoney said that in some of his spectrum work, he used a transparent screen coloured with picric acid, which had the peculiar power of absorbing all the violet rays down to the line G, and being, so far as he could see, perfectly transparent to all the rest of the spectrum. Could Professor Langley get indications of the temperature inside the dark lines?

Lord Kelvin had never expected to see the D lines separated by bolometric means, and still less to see it indicate the nickel line between them; the fact was almost inconceivable. The circumstance that practically the same bolometric curves of the lines in the ultra-red part of the spectrum had been obtained three times in succession in one day, was proof of the trustworthiness of the results obtained.

Professor Langley thought that hereafter the spectra of different parts of the sun's disc might be obtained, also that the bolometer would give some rough idea of the temperature inside the lines of the spectrum. He felt like a man starting a museum, who had a great store of specimens piled upon shelves, for future classification and examination; only one part of the work had been done.

The chairman considered Professor Langley's work to be the most important that had been, or that would be brought under the notice of Section A at that meeting of the British Association at Oxford.

### A NEW CHEMICAL DISCOVERY.

Last Monday, at the meeting of Section A, Lord Rayleigh and Professor W. Ramsay announced that they had discovered a new gas in common air—one more inert than nitrogen—in consequence of noticing that nitrogen obtained from common air differed in density by about ½ per cent. from nitrogen obtained from other sources. They obtained the new gas by subjecting some common air to electric sparks, absorbed the nitrous fumes so produced with potash, and the excess of oxygen with pyrogallol and caustic potash, after which they found the residue to be neither oxygen nor nitrogen, although it contained a little of the latter gas. Its density was at least 19·09; they had obtained about a quarter of a pint of it. The gas gave a blue line in the spectrum, in the place of the blue line of nitrogen, but more accentuated.

The gas has also been isolated from nitrogen obtained from air, by causing that nitrogen to be absorbed by magnesium, and then the density of the residue gradually rises. The new substance constitutes 1 per cent. of the nitrogen of the air. One speaker remarked that there is room for three spaces, with an atomic weight of between nineteen and twenty-three in Mendeléef's table; but Lord Rayleigh would not express any opinion as to the gas being a new chemical element—he confined himself to stating facts. Another speaker suggested that the milkiness obtained by Professor Dewar in liquefying common air might be due to the substance under notice. The announcement of the discovery was made to the section briefly and informally, and not communicated in a paper.

On the same day, at a meeting of the General Committee of the Association, Sir Frederick Bramwell occupied the chair. The meeting was reminded that next year the Association will meet in Ipswich, after which an invitation from the Mayor of Liverpool was read inviting the Association to meet in Liverpool in 1896, and the invitation was supported by the principal of University College, Liverpool, and Dr. Oliver Lodge; the latter remarked that nearly all the accommodation required would be found in University College, which, however, is not in the best part of the town, so that they had better be prepared for that; there is a workhouse over the way. The invitation was accepted. An invitation to visit Toronto in 1897 was then given by the Canadian Institute of Toronto through its president, Professor Wright, supported by three or four other speakers from that place. The chairman explained that they had no power to fix a place of meeting so long in advance; a resolution was then passed expressing the hope that the invitation would be renewed at the Ipswich meeting next year.

Sir Douglas Galton, who for twenty-three years has been one of the most hard-working officers of the Association, and is an authority on sanitary science, was then elected president of the Association for next year. The opening meeting of the Association at Ipswich was fixed for Wednesday, September 11th, 1895.

On Wednesday, at another meeting of the General Committee, Sir Frederick Bramwell again occupied the chair. Professor A. W. Rücker, the treasurer, stated that the number of members at the Oxford meeting was 2321, and the amount received £2175. He added that the Association did not desire to accumulate more capital, and had made arrangements to equalise its expenditure more year by year, after which Sir Douglas Galton read the list of grants, which we publish on another page, to British Association Committees for scientific work during the coming year.

A separate section for Botany was then established, and a resolution passed—on the motion of Mr. Vernon Harcourt—that the word "Mineralogy" should be left out of the title of the Chemical Section, some of the papers on that subject being better suited for Section A. The Council was authorised by the meeting to draw the attention of the Government to the desirability of sending a scientific expedition to the Antarctic regions; after which the meeting was adjourned until September 11th, 1895, at Ipswich.

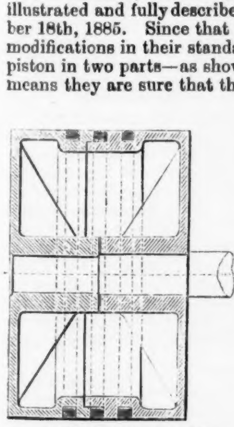
The concluding meeting of the Association at Oxford was held last Wednesday afternoon, with Sir Henry Acland in the chair; and, on the motion of Sir John Evans, it passed a vote of thanks to the Mayor, Sheriff, and Local Executive Committee of the City of Oxford, for the warm welcome which they had given to the British Association, and in which they had been so well seconded by the members of the University. The Mayor expressed pleasure at the grateful recognition of the work of the Corporation and of his brother citizens, and one of the local secretaries responded to the same effect. In responding to a vote of thanks to various Oxford University authorities, Dr. Boyd stated that when they heard that the British Association was coming to Oxford, the University authorities resolved to help in making the reception a good one, which action he hoped that the Corporation would receive in the same spirit in which it had been offered, and put it down on the credit side of the running account between them. Among the votes of thanks was one to Sir Henry Acland, Vice-Chancellor of the University, who said that his first work in connection with the Association was in 1834.

From all the opinions we have been able to gather, the members of the Association have been greatly pleased at the way in which they have been received in Oxford. At the general meetings of the committee of the Association the same content seemed to prevail, all the steps recommended by the Council having been adopted without amendment or discussion.

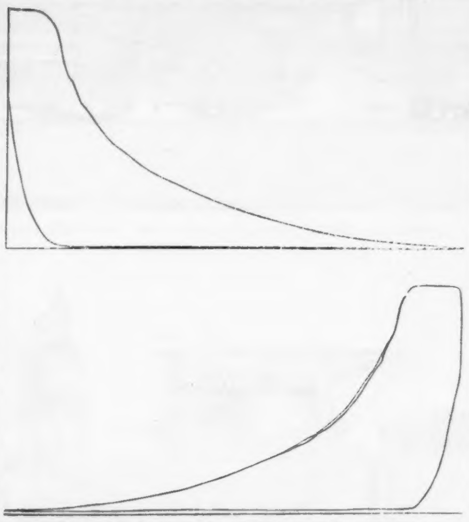
## BELGIAN MACHINERY AT ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

The engines exhibited by Messrs. H. Bollinckx and Co., of Brussels, at the Antwerp Exhibition of 1885, were illustrated and fully described in The Engineer of December 18th, 1885. Since that time they have made several modifications in their standard type. They now cast the piston in two parts—as shown in the diagram. By this means they are sure that the sides are of equal thickness all round, and the pieces are more easily cast and cleaned than when the whole piston is in one piece. In turning the surfaces C and D, a slight difference is left in their diameter, and the two parts are then forced together by a hydraulic press, thus ensuring a steam-tight joint. Another modification is in the method of joining the connecting-rod to the crosshead. As mentioned in the previous description no keys are used for the fly-wheels, which are simply turned to a tight fit, and held together by four bolts. Messrs. Bollinckx have now adopted a similar plan for the connecting-rod ends. The end of the connecting-rod is bored to a diameter slightly less than that of the pin, and instead of being made round in the usual manner, it is split at the ends, which are lengthened, so that the split parts may be pressed together by a bolt. The pin is separate, instead of forming part of the crosshead, so that by slackening the bolt it can be slightly turned occasionally. Finally, they now use two excentrics, one for the steam admission and one for the exhaust, instead of having only one. They do not claim this as a novelty, as they say that twenty years ago they always employed two excentrics. Subsequently they thought it would simplify the machine to suppress one; but they have recently come to the conclusion that by using a separate excentric for the admission the engine works with greater elasticity, under varying conditions, such as a fall in the steam pressure of the boiler, or when it is used for the motive power of electric tramways.


BOLLINCKX PISTON

Messrs. Bollinckx have two engines at work. The larger one, a Corliss of 16in. diameter and 32in. stroke, is driving one of the dynamos of the Compagnie Internationale d'Electricité. The annexed indicator diagrams were taken from this engine whilst in the Exhibition. It is running very steadily at sixty-six revolutions per minute, and has been greatly admired by English visitors for the regularity of its movement. The other engine shown by this firm is a Rider, of 11¼in. diameter. 18in. stroke, making 100 revolutions a minute, but not driving any machinery.


DIAGRAMS FROM BOLLINCKX CORLISS ENGINE

It is often difficult to determine under what nationality an exhibit should be described. Many firms have factories in two countries, or occasionally the same object is made by two firms, which seem to join in exhibiting it. This is the case with a pair of very interesting water-tube boilers invented by Mr. Dürr, of the Düsseldorf-Ratinger boiler factory. They are not working at Antwerp, but were in use throughout the Chicago Exhibition, in the pavilion of Messrs. Krupp, where they supplied steam for erecting, working, and dismounting the cannon exhibited, and also for an ice-making machine. They might thus be classed as a German exhibit, but they are shown by the Ateliers de Construction et de Chaudronnerie d'Arvans, of Bierset Arvans, near Liège, who state that they were made in their works. The general arrangement of the tubes is like that of the Babcock and Wilcox, De Naeyer, or Belleville boilers, but they differ from all of these in having inner tubes which reach nearly to the bottom of the outer ones. Thus the Dürr may be described as a sort of modification of the Field boiler. The upper part of the boiler is formed by a horizontal tube. 5ft. diameter, surmounted by a steam dome. Below this are the rows of small tubes which slightly incline towards the back, and are held by plates, back and front. The front plate forms one side of a flat receptacle connecting these tubes with the large one above; and in the middle of this receptacle is a third plate, which carries the front end of the inner tubes. In some of these boilers there are two upper reservoirs; in the one shown only one, which is divided longitudinally by a central partition. The feed-water enters this to the right, and after passing to the end, and back on the other side, it goes down to the receptacle in front, and enters the inner tubes. The plate which holds these in position separates the water which is about to pass down the inner tubes from the steam which has been formed in the narrow space between the inner and outer, thus greatly increasing the circulation. By an arrangement of baffle plates, the flame passes four times among the tubes before it enters the flue leading to the chimney. The exhibitors say that this boiler was sent from Chicago to Antwerp without being cleaned, and the tubes still look like new. They also show a small working model in copper and brass, with glass let in, to allow the formation of steam and the circulation to be seen.

The exhibits of Messrs. John Cockerill, of Seraing, and of Messrs. De Naeyer and Co., of Willebroeck, which are by far the largest in the Machinery Hall, were noticed in The Engineer of June 8th, and those of several other Belgian firms on the 22nd. Steam engines are shown by several other firms, whose work is well known to your readers. The Phénix Co., of Ghent, has a 125 actual horse-power horizontal engine, of 22in. piston diameter, and 40in. stroke, driving a dynamo of 110 volts and 1200 ampères, It has also a 85-horse power, of 13in. diameter, and 18in. stroke, driving a loom and some Root's blowers. Both these engines are of the Hertay type, and are similar to those exhibited at Brussels, and described in The Engineer of February 22nd, 1889. They have also one gas engine in the Machinery Hall, and another 50-horse power works a continuous wire rope for drawing up the boats at Captain Boyton's "Water Show." In the main building are photographs of the pumps, &c., for heavy drainage work, which they have recently erected in Holland.

An engine shown by M. Jules Joly, of Saint Ghislain, is certainly the most extraordinary in the Exhibition. It is the invention of a M. Pierrez, who has made several machines of this type, which are now working in France. It is a single-cylinder horizontal engine; but the cylinder, instead of being fixed to the bed-plate, slides on it. The inventor claims that by adopting this system the strain on the foundations is completely abolished; but it seems evident that the strain has merely been transferred, and that whilst it is taken away from the holding-down bolts, which in an ordinary engine would keep the cylinder and front of the bed-plate in position, it has simply been added to the strain on the bolts holding the crank shaft plummer blocks. This is not necessarily a disadvantage, but neither is it a clear gain. The engine exhibited is 35-horse power; the cylinder is 12in. diameter; the stroke 19¾in.; the revolutions 100 per minute. There are three elbows on the crank shaft, the middle one being set at 180 deg. to the two others. The centre bend of the crank is joined to the piston by a short connecting-rod, and there are longer connecting-rods on either side from the other bends to brackets on either side of the back piston cover. Besides the belt wheel, the engine has two heavy fly-wheels. As the steam valve, governor, &c., must necessarily be fixed, whilst the valve chest is obliged to move backwards and forwards with the cylinder, the pipe connecting the steam valve with the valve chest has an expanding joint, sliding into a sort of sleeve at every stroke. This must entail not only extra friction, but loss of heat. The excentrics are on one of the same side cranks which serve for the connecting-rods of the cylinder. The engine is running regularly and smoothly, but is not doing any work. However, the exhibitors show a certificate from the Director of the Loos Penitentiary that one has been at work there for five years, without costing anything for repairs. Without conceding the wisdom of departing from the established custom of a fixed cylinder, the exhibit must be admitted to be interesting, and it would be still more so if, with equal boiler pressure, this engine could be tried against an ordinary horizontal stationary engine of the same diameter and stroke. There are several of these dimensions in the Exhibition, but it is not proposed to have any friction-brake trials.

Messrs. Van den Kerchove and Co., of Ghent, who were such important exhibitors in 1885, have only sent two engines to the Antwerp Exhibition this year. They are vertical compound engines, made from drawings supplied by Messrs. Willans and Robinson. One of them is driving a "Pieper" dynamo, making 460 revolutions a minute, and giving 100-horse power, for the Compagnie Internationale d'Electricité; the other works the "Farcot" ventilator, at the entrance of the British machinery section, illustrated on April 20th, page 326. Though to an English engineer a Willans engine is not a novelty, the workmanship is worthy of notice, whilst to some foreign visitors the design of these seems to be also new.

Though many of the coal-mining companies exhibit in the main building briquettes produced from their coal, there is only one firm in the Machinery Hall which exhibits briquette-making machines. It is the Société des Forges, Usines, et Fonderies, of Gilly. These machines are of two descriptions. The larger one, which can turn out fifteen tons per hour, is formed like a continuous brick-making machine, except that each briquette, which is 10in. by 6¾in., is automatically cut off by the machine at the thickness of 4in. This thickness can be varied at will, as can also the other dimensions, by inserting different moulds. Briquettes of this description are mostly used for the navy, and the exhibitors have recently supplied several of these machines for use in Cardiff. The other make of machine produces ovaloid briquettes, intended chiefly for household purposes. Two pairs of rolls, each with ninety-six cavities on the rim, are carried on a heavy joist frame, and driven by mill-gearing, the material being fed into them from a hopper on the top, fitted with a slide by which the rate of feed can be varied. In the machine shown, the briquettes are 3¼in. by 2½in. by 2in., but the exhibitors make others of larger as well as smaller dimensions. At 2½ revolutions per minute the output of this machine is five tons per hour.

Messrs. J. Leveque and Co., of Herstal, exhibit some compressed air riveters. Although, as a general rule, water is probably safer than air as a medium for conveying pressure, there are frequently positions to which it cannot conveniently be conveyed. In these cases, as well as during severe frosts, Messrs. Leveque's riveters can be used, when hydraulic power would not be available. In its simplest form this tool resembles a hydraulic riveter, with an elastic tube conveying air, instead of water, from the source of supply at a distance. Another type has the air pump on the same frame as the riveter, so that it is self-contained; and it is suspended through its centre of gravity in both directions, so that it will work in any position. A further development of this apparatus is a travelling riveting machine running on rails. On the same platform are a small steam engine, a boiler, air pump, air reservoir, forge with blower, and a crane which can turn in any direction. This crane, which has a movable jib, stands in front of the machine, and from it the riveter is suspended. A large steering wheel at the side has a small tooth wheel on the same shaft. A chain passing round this turns a larger tooth wheel on one of the axles of the wheels which run on the rails; and with this one man can easily move the machine backwards or forwards. The same firm show a double-flue boiler with cross tubes, and some other examples of the riveting which has been done with their machine.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineers: W. H. Davis to the Royal Sovereign, and G. Rigler to the Benbow. Staff engineer: J. R. D. Johnson to the Sultan. Engineers: R. K. Herbert to the Malabar, C. H. Hill to the Boadicea, and R. S. Jennings to the Bonaventure. Assistant engineer: W. H. Glasspole to the Magdala. Probationary assistant engineers: J. J. Shirvell and Alfred Murray to the Malabar.

# AMERICAN LOCOMOTIVES

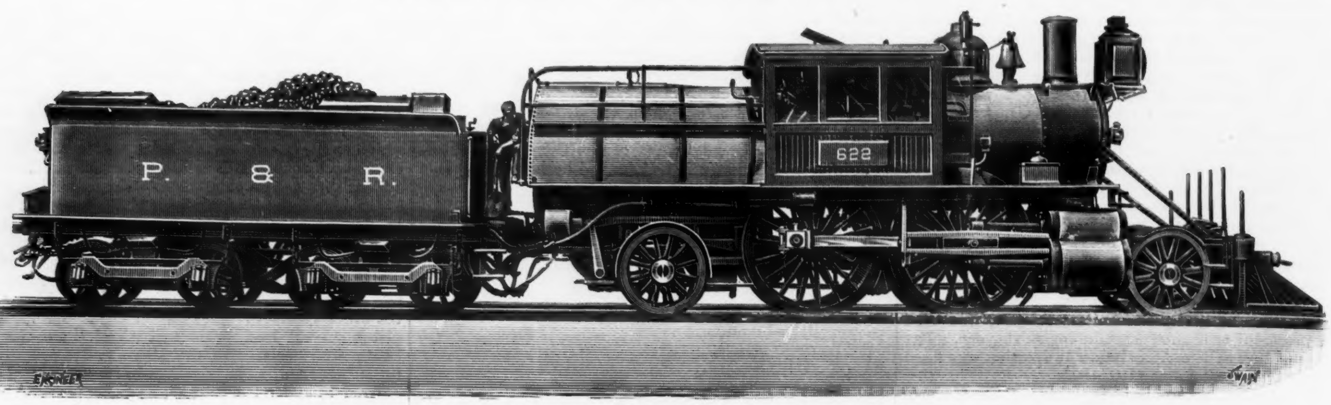


Fig. 1—COMPOUND ENGINE, PHILADELPHIA AND READING RAILWAY.

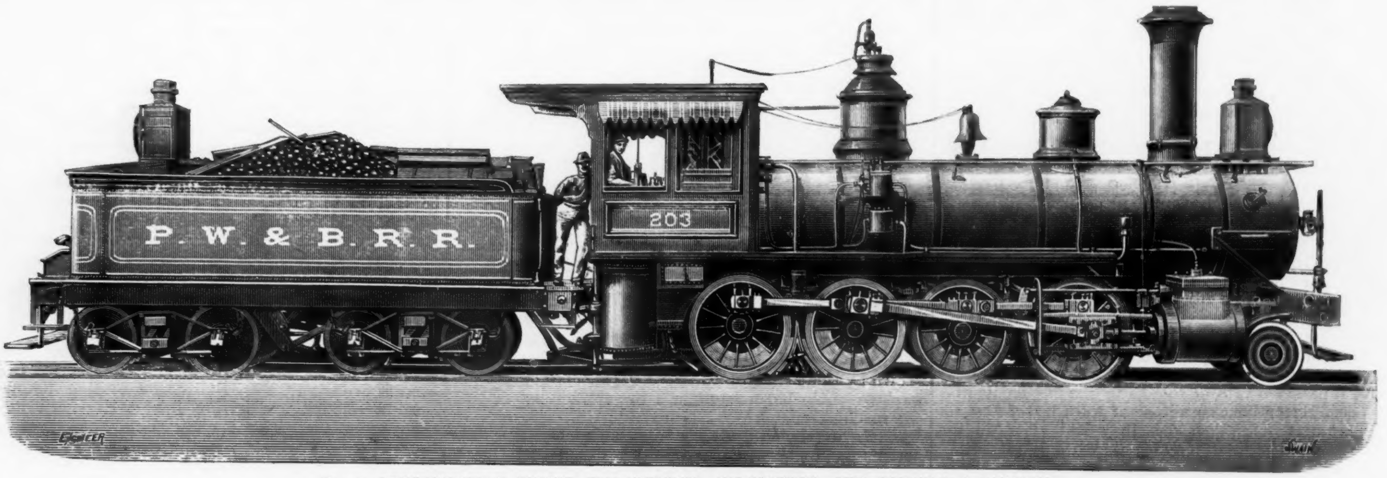


Fig. 3—CONSOLIDATION ENGINE, PHILADELPHIA, WILMINGTON, AND BALTIMORE RAILWAY.

## RAILROADING IN AMERICA.

By an English Railway Engineer.

### LOCOMOTIVES.

Probably no subject has during recent years received more attention in the technical Press than that of American railways and locomotives, and the author of the present articles is well aware of the fact that it will be somewhat difficult to treat the subject without re-covering already well-trodden ground; but, after a prolonged visit to the United States during the past autumn, when every facility was given to him for obtaining information regarding the working of and the plant employed on the numerous great railway systems, he hopes to be able to place before the readers of this journal—particularly those more directly interested in this branch of engineering—some interesting facts which have not hitherto received the attention which they deserve. The present article will deal only with locomotives, some of the leading types of which will be illustrated by reproductions of photographs specially taken; but in later articles the rolling stock, permanent way, signalling, &c., will be discussed. And here it may be stated that the author does not intend to dwell upon the theoretical principles involved so much as to point some of the leading features of American practice. Regarding the performances by American engines—of which much has been heard in this country of late — it need only be remarked that these could be easily accomplished by English engineers if similar services demanded them.

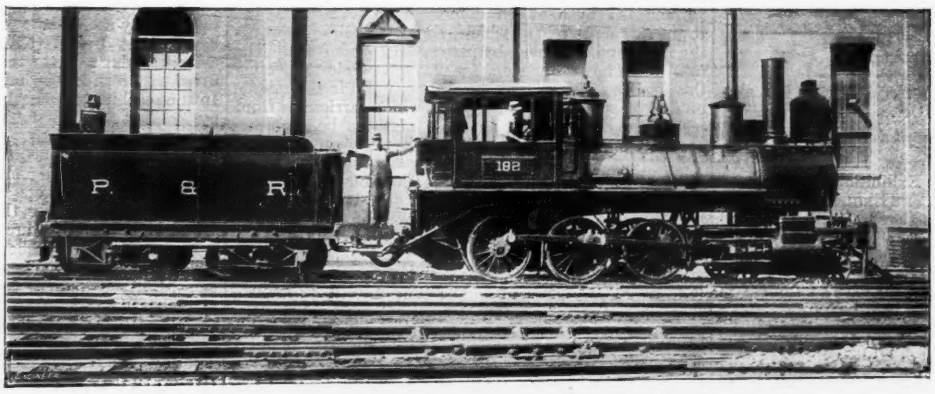


Fig. 2—FREIGHT ENGINE, PHILADELPHIA AND READING RAILWAY.

The total length of the world's railways is estimated at 375,000 miles, a distance sufficient to girdle the earth about fifteen times; and of this aggregate the United States provide 175,000 miles, or nearly one-half. This enormous system must of necessity involve many new departures in permanent way, equipment, and working, and the long journeys of the through trains, the variety of roads, their conditions, and the different climates passed through, all tend to lend interest to the subject.

At first sight a person accustomed to English trains is liable to imagine that those of the States are heavy and clumsy. Standing over 15ft. to the top of the chimney, with cylinders invariably outside the frames, the boiler pitched high, and a large cab often situated on top of the boiler, the locomotive seems even larger than it is, whilst the long cars, always observed from about the level of the rails, and measuring seldom less than 14ft. to the top of the deck-light, tend to corroborate the idea of hugeness; but when once the eye becomes accustomed to the size and arrangement of the engines, and when an opportunity has been afforded of a trip in the cars, one must admit that the train, as a whole, is well adapted to the requirements; and few could be instanced on this side of the Atlantic which will compare with them for convenience and comfort.

It is not intended here to compare the American and English locomotives, as that has often been done in the Press, and frequently, it would seem, by writers who have not had the opportunity of seeing both types at work. Each has its particular duty, and perhaps where the American engine is successful the English one might fail, and *vice versâ*; but the author is convinced that the Yankee locomotives are well adapted for their work, and in many cases an English engine would render only a moderate account of itself when put to similar tests. As already suggested, American engines as a rule are more powerful than ours, boilers, cylinders, &c., much larger, while the fire-box is often enormous, even comparatively. Steam pressures, too, are higher than in this country, 180 lb. to 200 lb. per square inch being those most generally adopted. We some time back illustrated one of the fine express engines of the New York Central Railroad, with drivers 6ft. 6in. diameter, cylinders 19in. by 24in., grate area 27·3 square feet, and constructed for a working pressure of 190 lb. per square inch. The total weight of this engine in working order is 56½ tons. The tender, weighing 17 tons when empty, has a water capacity of 3500 gallons and a coal capacity of 6¾ tons. Locomotives of this type were employed on the New York Central Railroad for part of the journey of the "Exposition Flier," viz., from New York to Chicago, a distance of 980 miles being covered in 20 hours actual time. The various stages of the journey with their respective times are shown in the annexed Table A.

When the weight of this train, comprising five cars weighing about 40 tons each, is considered, this is a very creditable performance.

Although the New York Central Company boasts of engines to beat this class in speed and power in the famous "No. 999" engine with its record of 100 miles per hour, these engines are typical of the modern American express, and the four-wheels coupled engine with a leading bogie has been the favourite type of American designers for years. A few roads are, however, trying a new arrangement—shown in Fig. 1. This represents a fine compound for the Philadelphia and Reading Railroad, and has the four-coupled drivers placed between a single pair of leading and trailing weeels. The chief dimensions are as follows:—Cylinders—Vauclain—13in. and 22in. by 24in. stroke; drivers, 6ft. 6in.; truck wheels and trailers, 4ft.; and the total weight in working order of the engine is only 58 tons. It will be noticed that the truck wheels in this engine are much larger than usually put under American engines, 3ft. being rarely exceeded.

Freight trains in the States are very heavy—often 2000 to 2500 tons — and are usually hauled at low speeds. The engines for this service are consequently very powerful, but not capable of developing high speeds. Two examples of goods engines are given herewith. Fig. 2 shows a six-wheeled coupled freight engine with cylinders 19in by 26in., and drivers 4ft. diameter; and Fig. 3 represents a "Consolidation" engine of the eight-wheels coupled type, with cylinders 20in. by 24in. and drivers 50in. in diameter, as employed for goods traffic on the Philadelphia, Wilmington and Baltimore Railroad. These are not, however, the most powerful engines built in the States, as it may be remembered that the Baldwin Company exhibited at the late Chicago Exhibition a compound "Decapod" ten-wheels coupled engine with cylinders 16in. and 27in. by 28in., drivers 4ft. 2in., and weighing nearly 90 tons in working order. The boiler is 6ft. 2in. inside diameter, and the barrel 12ft. long, made of steel plates ¾in. thick. The working pressure is 180 lb.

Table A.

| Miles. | | | Eastern time. |
|---|---|---|---|
| 0 | Leave | New York City | 3.00 p.m. |
| 143 | ,, | Albany | 5.50 ,, |
| 238 | ,, | Utica | 7.40 ,, |
| 291 | ,, | Syracuse | 8.50 ,, |
| 371 | ,, | Rochester | 10.17 ,, |
| | | | Central time. |
| 528 | Arrive | Erie | 12.36 a.m. |
| 623 | ,, | Cleveland | 2.37 ,, |
| 736 | ,, | Toledo | 4.54 ,, |
| 869 | ,, | Elkhart | 7.42 ,, |
| 980 | ,, | Chicago | 10.00 ,, |

per square inch. This engine was intended for service on the New York, Lake Erie, and Western Railroad.

Tank engines are used on most suburban lines for short "runs;" but "switching"—or, as it is termed in this country, "shunting"—is apparently almost entirely performed by tender engines, the tender being specially constructed with a sloping tank, to give the "engineer," or driver, an unobstructed view of the trainmen when coupling, &c. Fig. 4 shows a switching engine as used on the Canadian Pacific Railroad. It has cylinders 19in. by 26in., and drivers 4ft. 4in. diameter.

On the Elevated roads some very small and neat engines are employed. On the Chicago South Side Railroad all compounds of the Vauclain type are used, and have cylinders 9in. and 15in. by 16in., drivers 3ft. 6in., and four wheels coupled with a trailing bogie; total weight, 25 tons. These haul five passenger cars weighing 100 tons full, and make excellent time. They start quickly, and pull up extraordinarily sharp with the quick-acting air brakes. The tank engine shown in Fig. 5 represents one built by the Grand Trunk Railway of Canada, and used for Montreal suburban traffic. The wheels are 5ft. 6in. diameter, and the cylinders 18in. diameter by 24in. stroke. Fig. 6 shows an exceptionally heavy engine of the Canadian Pacific Railway, having cylinders 19in. by 24in., and drivers 5ft. 4in. diameter. This engine is carried on fourteen wheels.

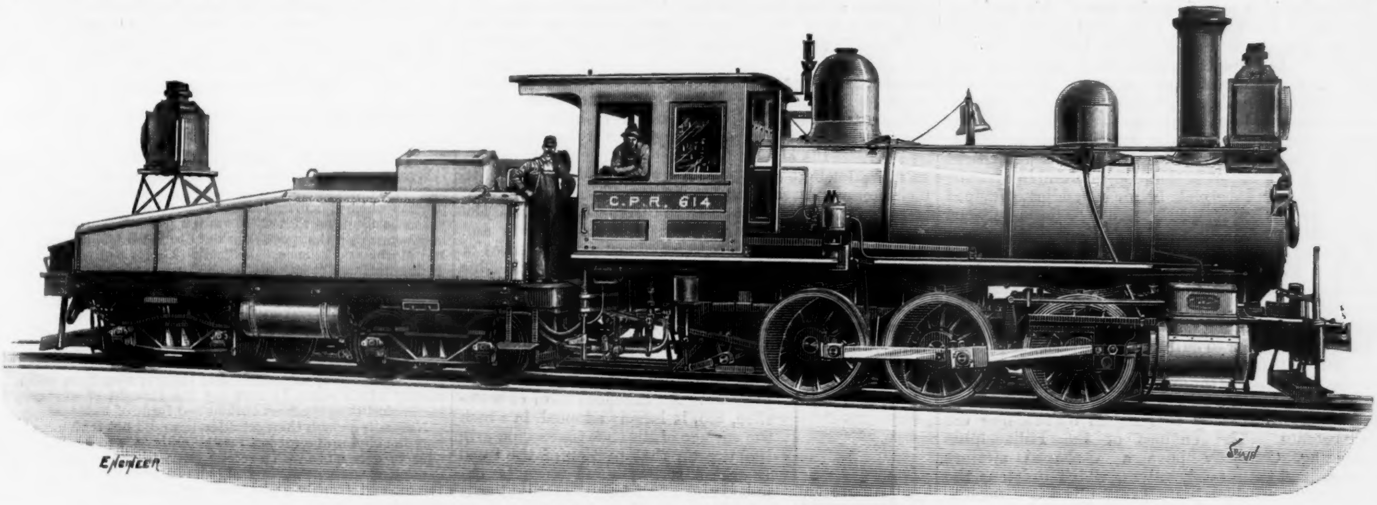


Fig. 4—SWITCHING ENGINE, CANADIAN PACIFIC RAILWAY

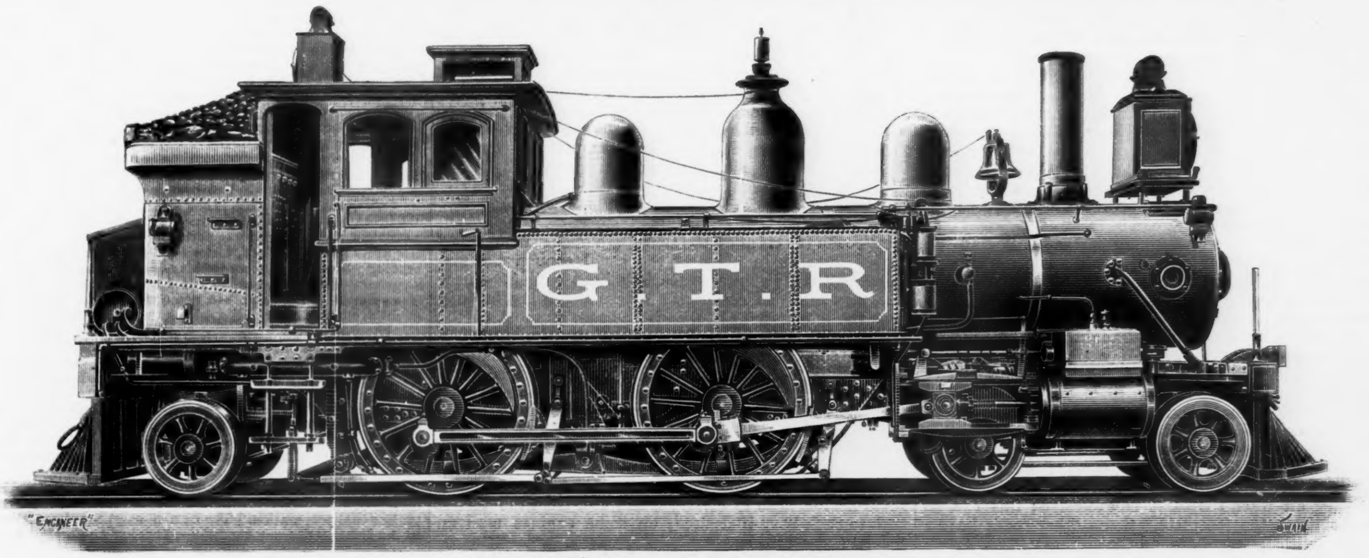


Fig. 5—TANK ENGINE, GRAND TRUNK RAILWAY

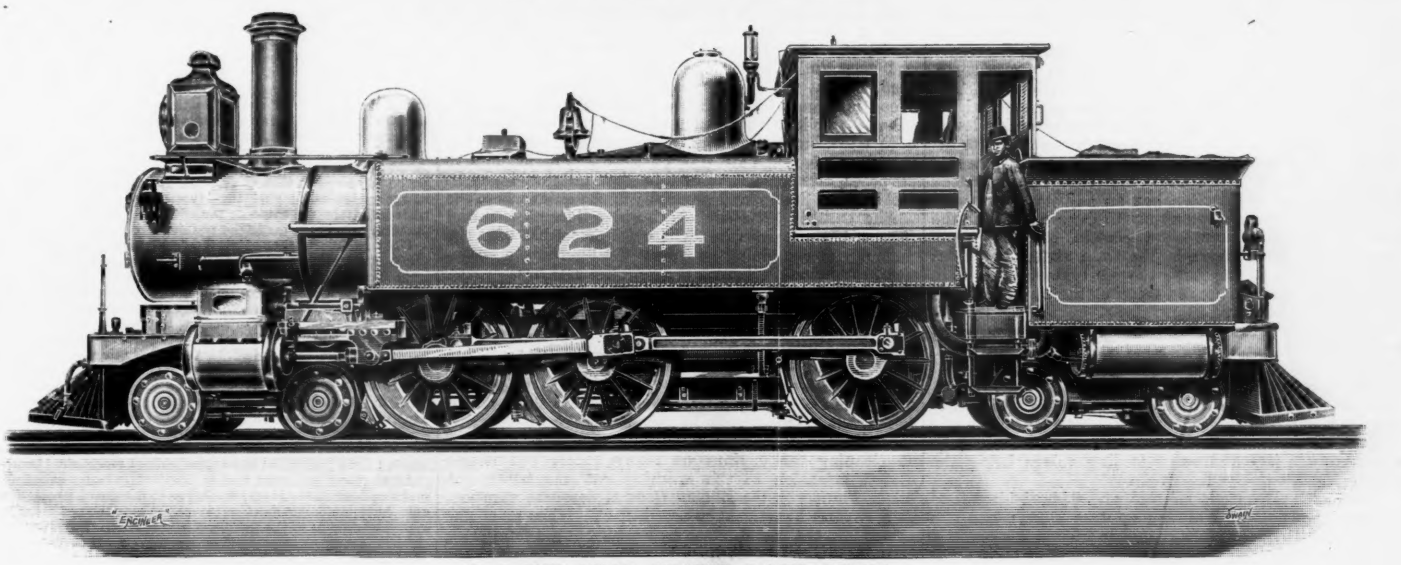


Fig. 6—TANK ENGINE, CANADIAN PACIFIC RAILWAY

Referring to some of the constructional details of American engines, wrought iron driving wheels are used on some roads. Cast steel appears to be rapidly coming to the front for this purpose, but cast iron claims the majority. Wheels of this material are cast hollow, and usually with the rim cut into segments, to allow the wheel centre to contract without straining the spokes and rim. The spaces between the segments are filled in with white metal blocks before the tires are shrunk on. The method of securing the tires varies; many roads, however, adopt the Mansell ring, or a modification thereof. The axle-boxes are frequently of cast iron having brass steps let in; while cast iron, paper, and wood are all largely used for truck wheels. Balanced slide valves, it would seem, have proved successful in the States, judging from the number of engines so fitted. Fig. 7 shows a section of an arrangement which is largely adopted. This is known as the Richardson balanced valve. It is very simple. Round the back of the valve a groove A is cut, in which four cast iron strips B—if a rectangular valve — are placed on edge, dovetailed at the corners to make steam-tight joints, and an adjustable wearing plate C is provided for these strips to work against. The compound systems are growing in favour, but the Vauclain type appears to be that chiefly used, and is already too well known in this country to require more than a passing allusion in this article. Metallic packing for piston-rod glands and valve rods is used to a large extent. A make much patronised is the United States packing, of which a sketch is given in Fig. 8. The con-

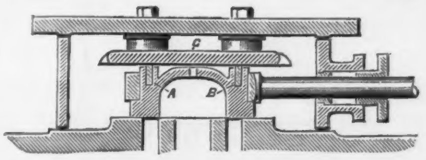


Fig. 7

struction of this will be easily followed, the metal packing rings being compressed by the spring shown;

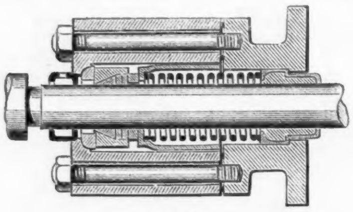


Fig. 8

over 300 roads, it is stated, make use of this packing. Steel fire-boxes are general; mild steel plates $\frac{5}{16}$in. to $\frac{3}{8}$in. for the side sheets, and $\frac{1}{2}$in. thick for the tube plate being used. Tubes are comparatively large, being 2in. diameter, and usually of charcoal iron. For renewal these are pieced by welding on fresh lengths at the fire-box end about 1ft. long, and often tubes may be seen ready for re-insertion in the boiler entirely made up of these short lengths welded together. To secure a water-tight fit, it is customary to put a thin copper thimble over the tube at the fire-box tube plate before expanding. Instead of making the fire-box long and narrow to fit in between the bar frames, many of the railway companies are now adopting wide and shallow fire-boxes placed above and slung to the frames by links pinned to cast iron shoes placed on the frame; rubbing guides are also provided. As an example of this system, see the illustration of the Philadelphia and Reading engine—Fig. 2.

Safety valves appear to be universally of the "pop" pattern, giving an instant relief for excessive steam pressure, and closing immediately the excessive steam has "popped" away. These valves are very noisy in operation, and some roads attempt to remedy this defect by muffling the escaping steam. The engines of the Philadelphia and Reading Company have a U-shaped strainer arranged around their safety valves, which quietens the discharge very considerably. Blast pipes are usually made very small, being only 3in. diameter for 18in. cylinders, and 3¼in. for cylinders 19in. diameter, these being common dimensions; while an independent blast nozzle is fitted for each cylinder. The excessive wear and tear of the fire-box, tubes, &c., due to the use of these small pipes, has led many builders to make their pipes so that nozzles of varying sizes can be bolted on, to change the orifice for different work. Most of the engines exhibited at the late Chicago Exhibition were thus provided, three nozzles of 3in., 3¼in., and 3½in. diameter being fitted with 19in. cylinders. This arrangement, however, is obviously not so convenient as a variable blast pipe operated from the footplate, as on our Great Eastern system, in which arrangement a hinged cap of suitable size for heavy work can be instantly brought into service, whilst by removing this cap and enlarging the outlet, a reduced blast can be produced for favourable parts of the road, thereby reducing the consumption of fuel and the back-pressure in the cylinders. No doubt the large grate area and the extended smoke-box add to the necessity for a powerful draught; but to hear an American freight train ascending the steep gradients of the Alleghanies, is an event not likely to be easily forgotten by an English railway man.

The extended smoke-box mentioned above has practically replaced the old-fashioned "diamond" smoke stack, and is evidently much favoured. On the Philadelphia and Reading Railroad the front of the smoke-box or door forms a "register," or circular ventilator for admitting air when the blast is excessive; this can be operated from the footplate. Some other roads have a similar device arranged around the chimney base.

Cabs are very large and commodious, wood as a rule being used in their construction; but some are made of sheet iron, lined with wood, notably on the Canadian Pacific Railroad. The outlook from an American cab is novel, and a fine view of the track is obtained, especially when the cab is placed at about the middle of the length of the boiler, as on the engine shown in Fig. 1. The driver is accommodated with a padded seat at the right-hand back corner, and all the handles, reversing lever, throttle, brake valve, &c., are placed conveniently to his hand. An elaborate array of fittings usually presents itself on stepping up into the cab, even a clock being provided. This often has an adjustable red hand which can be set by a thumb-nut to denote the time the train is appointed to reach a certain stopping place. Another excellent device is the train signal apparatus working in connection with the air brakes. This is in constant use for starting and stopping the trains, and will be referred to later on in this article.

Sight-feed lubricators are provided, and are usually a combination for oiling the valves and cylinders and also the brake pump, as well as cups communicating by pipes to the driving boxes, &c., from the cab. The bell, common to all American engines, is on some roads caused to ring by steam or compressed air, and mechanical sanding devices are in use, but are not so general as might be expected, air jets and screw-feeding valves being the chief systems employed.

The boiler clothing is effected with "blued" iron, and is decidedly neat and always appears clean; and one wonders how it is that it has not been tried in this country. It always preserves its blue colour, and dirt does not adhere to it as it does to the paint and varnish used here. The number of the engine, too, can always be detected at night, a side glass being provided in the headlight with the figures plainly painted thereon. On some roads an electric headlight is being used, a small motor and dynamo being placed immediately behind the lamp for generating the electric energy required. The finish generally of the engines is neat, although several working parts are left quite "in the rough." Side rods, for instance, are seldom machined the whole length as in this country, but are simply left black and painted between the coupling pins.

Air pressure brakes are in use on all passenger trains, and many freight trains. The New York and Brooklyn elevated railroads, however, have a vacuum brake. The Westinghouse quick-acting brake appears to have a formidable rival in the New York air brake; the exact advantages of the rival systems, however, seem hard to understand, both being apparently so similar in construction and working. On the pump, however, the New York Air Brake Company claim a distinct improvement, and judging from the number in use, it probably is entitled to its claim. The duplex air pump has four cylinders, two for steam and two for air. The action is smooth, and is said to give a higher efficiency than the ordinary single-acting pump. The steam cylinders are underneath the air cylinders, which allows natural drainage and ensures the compression of clean dry air, as impurities and the condensation from the steam cylinders cannot leak into the air chambers. The action of the pump in compressing air is similar to that of using steam in a compound engine. In the No. 1 pump—small size—both steam cylinders and the high-pressure air cylinder are 5in. diameter, the low-pressure air cylinder is 7in. diameter, and is twice the capacity of the steam cylinder driving it. In operation both air cylinders are filled with free air; the high-pressure piston remains quiet until the air from the large cylinder is compressed into the small one; then the high-pressure cylinder completes the compression and forces the air into the reservoir. Thus two measures of steam are made to compress three measures of air. This duplex arrangement of pump allows the valve gear to be made very simple. Ingenious valves are used to regulate the action of steam brakes on the engines, that is, to remedy the "leaking on" of the brake to its full power by the wire-drawn steam passing the engineer's valve and gradually attaining maximum pressure. An excellent form of brake shoe, too, is largely adopted, in which the surface of the shoe that would grip the tire on that portion of the tread D where it has most wear is cut away, and the friction of braking is taken on the edge of the flange and the extreme edge E of the tire, thus assisting to retain the original section to which the tire was turned. This is shown in the accompanying sketch — Fig. 9.

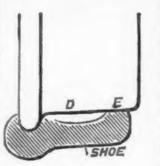


Fig. 9

Tenders are usually large, with a capacity of from 3000 to 4500 gallons of water, and some six to eight tons of coal, they are usually carried on two four-wheeled trucks; the tanks being of the "horseshoe" pattern, with coal space in the centre. The framing is of wood—white oak—but iron and steel are being adopted on new tenders on some roads. The wooden ones are, however, stated to be preferred, as they withstand the shocks due to rough hard roads better in winter, and if damaged by mishap they are cheaper and easier to repair. On some roads the sides of the tanks are made with a top curved inwards in place of the usual coping, the fuel being kept in its central space by a light railing. These look very neat and compact. Where the firing is done from the tender footplate, as is the case on most of the Philadelphia and Reading Railroad engines, a second cab is sometimes provided to cover the fireman, in addition to that for the engineer on the boiler. The connection between the two is made by steps to a raised running board or platform provided with handrailing. For lubricating purposes petroleum or petroleum compositions are used to the exclusion of all others for locomotives and cars. To prevent heating of the tender boxes on fast runs, the writer noticed the provision of a small flexible hose to convey cold water from the tender tank to each box, if desired, on some engines used on special fast services.

As regards fuel, on the Philadelphia and Reading and several Eastern roads, anthracite is used, the fire-boxes being specially made and unusually large. Bituminous coal is commonly used on other Eastern and Western roads, but on the "crack" trains of the Pennsylvania and New York Central and other roads furnace coke is used, so that the engines may be absolutely smokeless. Wood is largely burnt on the Southern roads, and gives off vile smoke with showers of sparks. Petroleum has been tried, but the systems experimented with do not appear to have been altogether satisfactory for locomotive purposes, otherwise it is certain that oil would pay as fuel in some States, and especially in the cities where the smoke emitted from engines burning bituminous coal proves very disagreeable. The chief defect has been the difficulty of combining an effective oil-burning arrangement interchangeable with the ordinary coal fire.

Locomotives in the States generally make a greater mileage in a given time than in this country, with a consequent shorter life. The system in vogue for working the locomotives is as follows. When an engine arrives in the "round-house," and as soon as the tubes have been cleaned by steam jets, fresh fuel and water taken on, and the engine oiled up, a fresh engineer and fireman will take it out. This system has one drawback; it prevents much cleaning being done—in fact, no pretence is made at cleaning the engines on many roads, but it also directs attention to the washing out the boiler. A method in use on the Illinois Central deserves mention, as it appeared particularly expeditious. When an engine comes into the round-house for washing out, a connection is made by a flexible hose to a pipe running round the shed roof, and the steam in the boiler is led away by it to "heat up" the water in a large storage tank. When the pressure has thus been reduced to about that of the atmosphere, the hot water is run out through pipes, also leading through and to storage tanks. The boiler, being then empty, is washed out as follows. Two mud plugs are provided on each engine; one is a connection to a curved nozzle, permanently secured inside the barrel of the boiler, next the smoke-box, and directed along the bottom of the boiler shell; and the second admits of a cross pipe being inserted above the top row of tubes immediately behind the fire-box. This cross tube has a blank end and perforations so placed that they come opposite the passages between the fire-box roof stays. Hot water at a pressure of 100 lb. is then forced into the boiler through these two connections, scouring the bottom of the boiler barrel and cleaning the dirt from the fire-box roof. After these operations have been completed, the boiler is refilled after washing out from the storage tank previously referred to, the fire lighted, and the engine is then ready for the road. This procedure is highly spoken of, and has the decided advantage of preventing unequal expansion and contraction of the boiler plates due to the great changes of temperature which accompany the system in vogue in this country for instance.

In another system a semicircular pipe is placed in the boiler shell at the smoke-box end, having several nozzles directed along the boiler barrel, and through which hot water is forced as in the previously mentioned system.

## THE CRITICAL SIDE OF MECHANICAL TRAINING.*

By Prof. A. B. W. Kennedy, LL.D., F.R.S., M. Inst. C.E.

While there is no place in the kingdom more suitable for a meeting of the British Association than Oxford, and certainly no place in which it is more delightful for the members to meet, it is yet to be admitted that there are few places which have much less in common with the special work of Section G. Nominally devoted to "Mechanical Science," the Section has for many years especially dealt with those branches of applied mechanical science which constitute the business of the engineer—to quote the well-known words of the Royal Charter, "the art of directing the great sources of power in nature for the use and convenience of man." The association of this ancient and learned city with boilers and chimneys, with the noise and racket of ordinary mechanical work, seems an incongruity. Even the harmless necessary railway station is kept as far away as possible, and the very river flows with a quiet dignity which seems to shut out the thought of anything more mechanical than the most ancient and futile of water-wheels.

Naturally enough these considerations did not tend to make more easy the choice of a subject for this address, and I have come very near to agreement with a recent critic in the opinion that presidential addresses are, in fact, almost immoral in the nature of things, and fit only to be abolished. Finally, I decided upon taking up my present subject, as being one in which the academic rather than the technical side of our work comes to the front, while at the same time it does not lead me out of lines in which I have been able, in past years, to work myself. It is now twenty years since I first took any active part in the scientific training of engineers, and five since I ceased to do so. I have often wished that I may have been at all as successful in teaching others at University College as I was, at the same time, in teaching myself. And since I have ceased to teach I seem to have been spending my time in finding out how much better I could do now than was possible when I was actually engaged in it. This may be pure imagination on my part; there is nothing more easy, as we all know, than to suppose that we know best how to do the things that other people do, and not the things we have to do ourselves. Indeed, I understand that this is the recognised attitude of the really superior critic. If, however, in anything which I have to say, it should seem that I am finding fault with what is now being done, I may at least point out that most of all I am finding fault with myself for not having done right when I had the opportunity—an opportunity which can now never recur. Indeed, instead of the decorous and unobtrusive heading which I have given to this address, I might have indicated its general lines almost as truly if I had entitled it "The Regrets of an Emeritus Professor"—a name which, on a suitable binding, might even have secured it a sale at the railway bookstalls.

I know well—too well—that in the present congested state of the engineering profession there are many of us who do not like to hear the word "training" mentioned at all. It seems to mean merely the preparation of more lads to struggle for a share of work that is even now insufficient to go round. There is no doubt much to be said for this point of view. But against it one must remember that all other professions are equally full, and that, after all, lads must do something. The fault is surely that there are too many lads! If our population is really to go on increasing as rapidly as at present—the benefits of which Sections D, E, and F might have a joint meeting to discuss, if not to discover—it is inevitable that demands should come for more and more complete professional preparation. The man of exceptional parts will come to the front under any conditions, training or no training, in the future as in the past. But for ordinary men—that is for 99 per cent. of us—it is essential that no advantage should be given to a rival in the fierce competition of life, and for them therefore it is of an importance hardly to be exaggerated to obtain the most complete and perfect training possible. At the same time, and on purely general grounds, it can hardly be denied that to raise the standard of our profession is indirectly to confer a benefit on the whole community. I hope therefore that in making certain suggestions about the training of engineers, it will not be thought that I am desirous of increasing their number, which is really an end as far as possible from my own wishes. Whether the number increases or stands still, or falls off, it is of importance from every point of view that those who come forward should be as well prepared as possible. And even the most conservative of us are compelled to recognise that the standard required in engineers' offices now is enormously higher than it was thirty years ago. This may truly be either the cause or the effects of improved training, but in either case it has made the training itself a necessity.

The particular aspect of mechanical training of which I wish to speak is its critical side. I do not know how a man should be trained to be an inventor. I would not tell anyone if I did. To be a creator in mechanical matters—which, however, is a quite different thing—is a faculty given only to a very few, and with them it is "born, not made." Many of us, however, without being either inventors or creators, have sufficient natural aptitude or inclination towards things mechanical to form a basis for the trainer or educator to work on, with some hope that he may be of service. About the sciences which should be taught to such men, or the methods of teaching them, about the extent and nature of their experience in shops or on works, I do not intend to speak. I shall confine myself to one aspect of the training only, an aspect which is perhaps not always sufficiently clearly kept in view—the aspect which I have just called the critical side of mechanical training.

An engineer is a man who is continually being called upon to make up his mind. It may be only as to the size of a bolt; it may be as to the type of a Forth Bridge; it may be as to the method of lighting a city, or only as to the details of a fire-grate. But whatever it is, once it is settled it is decided irrevocably—it is translated into steel and iron and copper, and cannot be revoked by an Act passed in another session. The time given him in which to decide may be a day, or a month, or a year, but in any and every case—so far as my own experience goes—it is about one-tenth part of the time which he would like to have. It is only in rare cases that the decision is obvious—most often there are more courses open than even the most facile politician ever dreamt of. The matters are too complex to be dealt with mathematically or even physically; even if they were not, there are few engineers who would have the special capacity to handle them. Moreover, their solutions are seldom "unique." From this point of view, the whole use of college training, of workshop practice, of practical experience, is to provide the engineer later on with the means of critically examining each question as it comes up, of reviewing systematically the *pros* and *cons* of each method of dealing with it, of coming finally, rapidly, and positively, to some defensible decision, which may then be irrevocably carried out.

---

* Address to the Mechanical Science Section of the British Association, by the President of the Section, at Oxford, 9th August, 1894.

In the case of a problem in pure mathematics or physics, where only one right solution can exist, that solution is arrived at by the help of a thorough knowledge of the science in question—there is little room for the critical faculty except as to method—the result is either right or wrong. With our work, on the other hand, solutions of all problems, except the very simplest—in other words, decisions on all points which present themselves—can be arrived at only by a process of criticism applied to the problems, to their statement, to their condition, to all their many possible solutions. The development of the necessary critical faculty should be one of the chief aims of every teacher and every student. A scientific training cannot make a man an engineer. Perhaps it is impossible for anything to make a man an engineer unless he has grown that way from the beginning! But a scientific training may make him, or at least give him the possibility of making himself, a critic.

In the vigorous attempts which have been made to specialise the education of engineers very early, I am afraid that the idea of teaching subjects is sometimes too prominent, to the neglect of matters less obviously useful. It is, of course, one thing to know a subject from the examination point of view, and quite another to be able to think about it, and still another to be able to write about it. In particular, I have often regretted to find how little attention has been given to a matter which perhaps may be called literary rather than scientific, but which is all-important in criticism, I mean to the power of expression. It is not easy to overrate the importance to the engineer, as to other folk, of the power of saying clearly what he means, and of saying just what he means. I do not mean only of doing this for its own sake, but because if a man cannot say or write clearly what he means it is impossible that he can think clearly. By the power of expression I do not mean, of course, the mere power of speaking fluently in public, a thing which appears physically impossible to some people; I mean rather the power of expression in writing, which carries with it clearness and consecutiveness of thought. It is difficult to know how this matter can be taught, but at least it can be insisted upon probably to a much greater extent than is commonly the case. A man requires to see clearly not only the exact thing which he wants to say, but the whole environment of that thing as it appears to him. Not only this, but he must see the whole environment of the same thing as it appears to the persons for whom he is writing, or to whom he is speaking. He has to see what they know about the matter, what they think, and what they think they know, and if he wishes to be really understood has got to do much more than merely write the thing he means. He has carefully to unwrite, if I may use the expression, the various things that other people will be certain to think that he means. For after all, the great majority of people are very careless listeners and readers, and it is not for the small minority who are really exact in these matters that one has to write. Moreover, it is a great help to clearness of thought and expression to keep before one always an ideal audience of people who will certainly misunderstand every single sentence about which any misunderstanding is in any way possible, and some others as well.

In attempting to think out or to discuss any question, whether it be technical or non-technical, in fact, as long only as it is non-political, the first necessity is probably a knowledge of the question itself; and not only this, but also a proper understanding of its whole environment. This knowledge must be of such a kind as to distinguish what parts of it are important, what parts of it are unimportant, what parts can be described in two sentences, and what others may require as many paragraphs; what parts affect the result but little, however large they seem; and which ones must be considered vital, although their very existence is difficult to discover. The faculty which enables a man to handle his knowledge in this fashion may be summed up in the single expression, "sense of proportion." Moreover the knowledge, to be of real value, must be as totally free from prejudices and prepossessions as in the most rigorous branch of pure science, and as thoroughly imbued with a healthy spirit of scepticism.

One is accustomed to think of engineering work as mainly constructive. But after all, it is quite as much critical. In almost every department of mechanical work there are half-a-dozen ways of solving any particular problem. In some fashion or other the engineer must be able to judge between these various methods, methods which are often very much alike, but each of which may possess certain particular advantages and certain particular drawbacks. The arithmetical criticism which merely counts the advantages and the drawbacks, and puts an equal number of the one against an equal number of the other, is common enough, but obviously useless. The very first necessity to the critic is that he should have what I have just called the sense of proportion, a sense which will enable him to distinguish mere academical objections from serious practical difficulties, which shall enable him to balance twenty advantages which can be enumerated on paper by one serious drawback which will exist in fact, which will enable him in fact to place molehills of experience against mountains of talk. It is perhaps a doubtful point how far this sense of proportion can be taught at all. No doubt it can only be built up upon some natural basis. I am sure that in engineering we all know men whose judgment as to whether it was advisable to take a particular course we would accept implicitly, because we know that it is based on large general criticism, in spite of the most elaborate and specious arguments against it set down on paper. Any third-year student—not to go still farther back—can criticise perfectly along certain very narrow lines, just as anyone can learn the rules of harmony and can write something in accordance with them which purports to be music. But after all the music may be music only in name, and the criticism may not be worth the paper it is written upon, however formal it may appear to be, unless the writer is thoroughly imbued with a sense of the proportionate value of the different points which he makes. To take the commonest possible case, I dare say we have all of us heard certain methods, mechanical, chemical, or other, stigmatised as totally wrong and absolutely useless because they contain certain easily provable errors. I am sure, too, that most of us could give illustrations of cases in which this has been said with the very greatest dogmatism when the errors of the impugned method are not one-tenth part as great as the equally unavoidable errors of observation in the most perfect method.

Probably the best special education in proportion which a man can have is a course of quantitative experimental work. I say quantitative with emphasis, as meaning something much more than mere qualitative work. Here, I think, comes in the usefulness of the engineering laboratory. We require that the training should be not only in absolute measurement, but in relative measurement, the latter being quite as important as the former. Many kinds of measurements stand more or less upon a level as a training of the faculties of observation in themselves, but no single kind of measurement is sufficient as a training in proportion. A year spent in calibrating thermometers or galvanometers might make an exceedingly accurate observer in a particular line, but it would not give the observer a knowledge of what even constituted accuracy in other directions; for accuracy is a relative and not an absolute term. In most engineering matters the conditions are, unfortunately, of a most complex kind; so complex that our problems are incapable of any solution sufficiently exact to satisfy the mathematician or physicist. The temptation to treat these problems as the mathematician treats those with which he deals—namely, to alter the assumed conditions, in order to get an exact solution—is a very strong one. I am afraid it is most strong often in those engineers who are the best mathematicians. It is a temptation, however, steadily to be resisted. We must assume our conditions to be what they actually are, and not what we should like them to be; and if we cannot obtain an exact solution of our problem with its actual conditions, so much the worse for us, not so much the worse for the conditions. Our first duty is generally to find out the conditions; if they are disadvantageous—in fact I mean, and not merely in the problem—to alter them if they can be altered, but not to ignore them because they are inconvenient. We have, then, to find out the extent to which the known conditions permit any exactness of solution at all; and, finally, we have to keep this in view as a measurement of the highest accuracy which is attainable. To work out certain branches of the problem with such minuteness as to give us apparently very much greater accuracy than this is not only useless, but is apt to be positively misleading, as giving an impression of an accuracy which has no real existence.

The relative value of accuracy in different sets of observations is in itself a matter in which a sense of proportion is wanted, and often very badly wanted. Where one has to measure half-a-dozen things of which two are very easily measured and the remaining four are only measurable with great difficulty, it is only human nature that we should spend our energies on getting extremely accurate results with the first two and roughly do our best with the others. It is very difficult under such circumstances to remember that the accuracy of the whole is not the accuracy of the best part of our work, but of the worst.

The extraordinary effect of a want of sense of proportion is nowhere better shown than in the absurd statements which are constantly made as to technical matters in public prospectuses, and the still more absurd statements made in those very numerous documents of a similar kind of which some of us see a great many, but which do not finally emerge into public view. Fortunes are apparently to be made by inventions which, although doubtless ingenious, yet only concern one way of doing a thing which could be done equally well in half-a-dozen other ways. Every one is expected to run after a piece of apparatus which is to save 50 per cent. of something, the total cost of that something, however, being so very small that nobody cares to save it at all. I need hardly mention the all too common case where a contemplated saving of 10 per cent. in the cost of a material works out yearly to an amount much more than equal to the whole cost of the original article.

I believe that experimental work in an engineering laboratory can educate this critical sense of proportion very admirably in a number of ways. In the first place it directs quantitative work into very varied channels, and not along one particular line. Secondly, it compels the observer to combine a number of measurements in such a way that the relative importance of accuracy in each can be seen. In the case of an engine trial, for instance, the combined results are affected by the accuracy of measurements of the dimensions of the machine, by the apparatus and the methods used for measuring the water, by the indicator, and by its springs, by the speed counter, by the thermometers, and so on. An error of 1 per cent. in counting the revolutions is just as important as an error of 1 per cent. in measuring the water, or in measuring the mean pressure. I am afraid that one could point to a good-many cases in which this has been more or less forgotten. Then, by making a series of measurements all in absolute quantities, the relative importance of each quantity to the desired total result can be seen. Thus it will be found that changes in certain quantities affect the total result to a very small extent, while changes in others affect it very largely, so that not only is the accuracy with which different quantities can be determined very different, but also the same degree of accuracy is of very different importance according to the particular quantity to which it refers. Once it is found that a final result is exceedingly little affected by a particular set of changes, it ceases to be of importance to measure or observe those changes in any extremely minute way, and of course the reverse holds equally good. Finally, and this perhaps is the most important matter of all, measurements in such a laboratory are made to a great extent under the complicated conditions under which the actual final result has to be obtained in practical work. They are not made under the conditions which ensure the greatest individual accuracy of each result.

It will be seen that throughout, but particularly in the two last points which I have mentioned, the work of an engineering laboratory is in intention and in essence different from that of a physical laboratory. The aim of the latter is to make its problems as simple as possible, to eliminate all disturbing elements or influences, and to obtain finally a result which possesses the highest degree of absolute accuracy. In most physical investigations the result aimed at is one in which practically absolute accuracy is attainable, although attainable only if infinite pains be taken to get it. It is the business of the physicist to control and modify his conditions, and to use only those which permit of the desired degree of accuracy being reached. In such investigations it sometimes becomes almost immoral to think of one condition as less important than another. Every disturbing condition must be either eliminated or completely allowed for. That method of making the experiment is the best which ensures the greatest possible accuracy in every part of the result. The business of the engineer, on the other hand, is to deal with physical problems under conditions which he can only very partially control, and the conditions are a part of his problem. He does not, for instance, experiment with a steam engine so made that it can work with a Carnot cycle. It is in the nature of the case that he must experiment with a much less perfect machine. In burning fuel he does not use apparatus specially made to absorb the whole heat of combustion, but in the nature of the case has to investigate the behaviour of apparatus in which a very large part of that heat is unavoidably wasted. So one might go on through an immense number of instances. Perhaps the whole matter may best be summed up by saying that in a physical laboratory the conditions of each experiment are under the control of the experimenter, and are subservient to the experiment itself. In an engineering laboratory the conditions form part of the experiment. However much more difficult or complicated they render it, they still unavoidably form part of it—an experiment under any other conditions, or with those conditions removed, would *ipso facto* be irrelevant.

A critical training in matters mechanical is, however, only too similar to the celebrated training of the Mississippi pilot which so nearly broke the heart of Mr. Mark Twain. Whenever the whole matter seems to be completely mastered from one point of view, it is only to find, with a little more experience, that from another point of view everything looks different, and the whole critique has to be started afresh. Machines cannot be finally criticised—that is to say, they cannot be pronounced good or bad—simply from results measurable in a laboratory. One wishes to use steam plant, for instance, by which as little coal shall be burnt as possible. But clearly it would be worth while to waste a certain amount of coal if a less economical machine would allow a larger saving in the cost of repairs. Or it might be worth while to use a machine in which a certain amount of extra power was obviously employed, if only by means of such a machine the cost of attendance could be measurably reduced. In fact, what may be summed up in the phrase the "worth-whileness" of economies, is in itself a matter on which a whole paper might be written. Unfortunately, the latter points which I have mentioned are just such as cannot easily be measured in laboratory work, or, indeed, in any other way whatever, except by actually using the apparatus in question. All that can be said is that a careful training in the critical measurement of comparatively simple points fits a man more than anything else to gauge accurately the importance of such other matters as I have mentioned. No doubt there are many men in whom the critical faculty is insufficiently developed to allow them ever to be of use in these matters, but to those who are intellectually capable of the "higher criticism" it must be, I think, of inestimable benefit to have had a systematic training in the lower.

Is there, then, any general standpoint from which mechanical criticism can be directed? Certain points are obvious, but probably the whole matter cannot easily be generalised. A city has to be supplied with water; there are three requisites—that the water should be of proper quality, of sufficient quantity, and that it should be brought in at a reasonable cost. But in such a case the first two are so enormously more important than the third, that the ideal is comparatively simple—of course, this is quite a different thing from being simply reached. A city has to be supplied with electric light: the essential conditions are similar. But in this case there are so many qualities which are equally proper, and there are so many different ways of bringing it in in sufficient quantity, that the third point — namely, the cost — becomes especially important. A factory has to be driven by steam power; the amount of power that is wanted can be produced by so many different types of engine and boiler—all capable of approximately equal economy, and all claiming equal freedom from breakdowns—that the choice is a peculiarly difficult one from the critical point of view.

It seems almost impossible that a criticism on any one basis could meet all the three cases which I have supposed, unless that basis were that the thing supplied should be the absolutely fittest, having regard to all the conditions of each case and the relative importance of each condition. Possibly in all cases we could get at some generalisation which would show us which was the absolutely fittest, if only the necessary data were in any way complete, which they very seldom are. Perhaps in one sentence we may say that that scheme, or system, or machine, will be the absolutely best in any particular case which will the longest survive and maintain its place in its particular environment. I cannot doubt that this development of Darwinian ideas in the world of the inorganic is a legitimate one. Of course the problem would be comparatively easy in each particular case if only the environment would stand still. It would even be comparatively easy if we knew how the environment was going to alter, but this we are unable to do. We only know that it certainly will change, and will go on changing, and that therefore the things which we make now have not got to survive in the conditions in which we make them, but have got to survive through some new sets of conditions of which we know nothing. I do not think the difficulty is in any way met by the popular method of guessing at what will be wanted fifty years hence, which generally means simply guessing at something very big. It is of no use making our ships or our engines of a type which we choose to imagine will be that of fifty years hence. If we do they will be of no use to-day, and for that very reason they will not even be in existence, useful or other, at the end of the fifty years. Sufficiently sad illustrations of this will occur to every one in very different directions. I hope I shall not be considered churlish in saying that I do not think that the men who have worked on this principle have really been far-seeing, or have really brought us much forward. They have been men often of genius, often of great personal fascination, always of immense imagination. But they have proceeded by methods essentially opposed to anything like the gradual evolution which must occur in technical as it does in natural matters, and in too many cases the results of their labours have not even been giants, but only monsters.

As to what causes one thing to survive rather than another we can only speak very generally. Mere survival may come about by the accident of a peculiarly tough constitution. A few engines built in the time of James Watt are still to be found at work in our own day, but can no more be taken as the fittest type than some solitary megatherium would be who, having outlived all his contemporaries, was able in after ages to look down upon his pigmy and short-lived successors. Mere length of life in such a case may be a mere accident, and is not itself a proof of fitness. We have it thrown at us every now and then that our engines now-a-days do not last like the old ones, as if the mere existence of a very old machine were a proof of its virtues. It is certainly a proof of the excellence of its construction—or, as one may say, of its constitution—and perhaps also of the very small amount of work it has done in proportion to its life and its dimensions.

It is sometimes, I am afraid, rather humiliating to have to remember that, to a very great extent, the question of the fittest, so far as it affects us, is a financial one. In manufacturing processes efficiency and economy tend to survival because they lead to decreased cost of production. In structures or other large permanent works those types tend to perpetuate themselves which require the least material—that is, in which the material used is disposed to the best advantage—and in which the outlay on labour is also smallest, assuming, of course, equal fitness in other respects. There is, no doubt, at present a tendency to dispute this altogether, and to treat all reductions in cost of labour as disadvantages, unless, indeed, the labour be very highly skilled, in which case its remuneration must necessarily be brought down for the sake of equality. I imagine this tendency will last exactly as long as the faithful can get some other people to pay the increased cost, and will thereafter determine itself somewhat suddenly. It can no more stand in the way of natural progress in engineering matters than could the somewhat similar outcry against the introduction of machinery into manufactures two generations ago. It would be as wise to paint a generation of cats green, in the hope of compelling natural selection to work along new lines.

I think we may fairly assume, therefore, that efficiency and economy are both legitimate criteria as to ultimate fitness, and will remain so. Moreover, they are both matters in which measurements can be made, and as to which judgment can be guided by such measurements. But there are other characteristics, not directly measurable, by which we can in some degree form an opinion as to the ultimate fitness of things or processes.

One set of considerations which has great critical importance is summed up in the word simplicity. This does not mean fewness of parts. Reuleaux showed long ago that with machines there was in every case a practical minimum number of parts, any reduction below which was accompanied by serious practical drawbacks. Nor is real simplicity incompatible with considerable apparent complexity. The purpose of machines is becoming continually more complex, and simplicity must not be looked at as absolute, but only in its relation to a particular purpose. There are many very complex-looking pieces of apparatus in existence which work actually so directly along each of their many branch lines as to be in reality simple. I believe it almost always happens that the first attempt to carry out by a machine a new purpose is a very complicated one. It is only by the closest possible examination of the problem, the getting at its very essence, that the machine can be simplified, and this is a late and not an early stage of design. If a mechanical problem is really only soluble by exceedingly complicated apparatus, it generally becomes a question whether the solution is worth having. There is no impossibility in making a machine that will do anything. But the very simplest possible form of apparatus which would wash our hands for us in a suitable manner is probably so very complicated that for many years to come at least that operation will be performed by manual labour.

Very closely allied to simplicity is what I may call directness. In nearly all mechanical processes certain transformations are unavoidable. In many mechanical processes, as I have recently had occasion to mention, a very large number of transformations is at present practically unavoidable. I myself cannot help thinking that probably one of the most distinct signs of fitness is a reduced number of transformations, the bringing of the final and the initial stages as close together as possible, and cutting out altogether the apparently worthless middle processes. But any generalisation of this kind must be very cautiously handled; these apparently useless processes are no doubt in certain cases as indispensable as is the much-abused middle-man in matters economic.

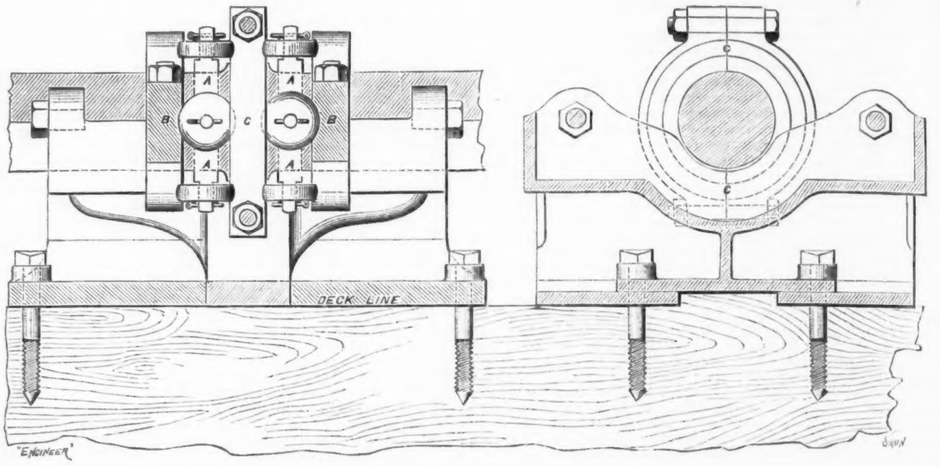
In a critical view of any case where similar results are aimed at by hand work and by mechanical means, it is important to recognise that the similarity of result should very seldom become identity. In the first machine to do anything mechanically which has before been done by hand, the error is often made of trying to imitate the hand-work rigorously. The first sewing machines were, I believe, made to stitch in the same way as a seamstress. It was not until a form of stitch suitable for a machine, although unsuitable for hand, was devised that the sewing machine proved successful as a practical matter. In another but analogous line too, you may remember that the first railway carriages were practically stage coaches put upon trucks, from which the present carriages have only very slowly been evolved.

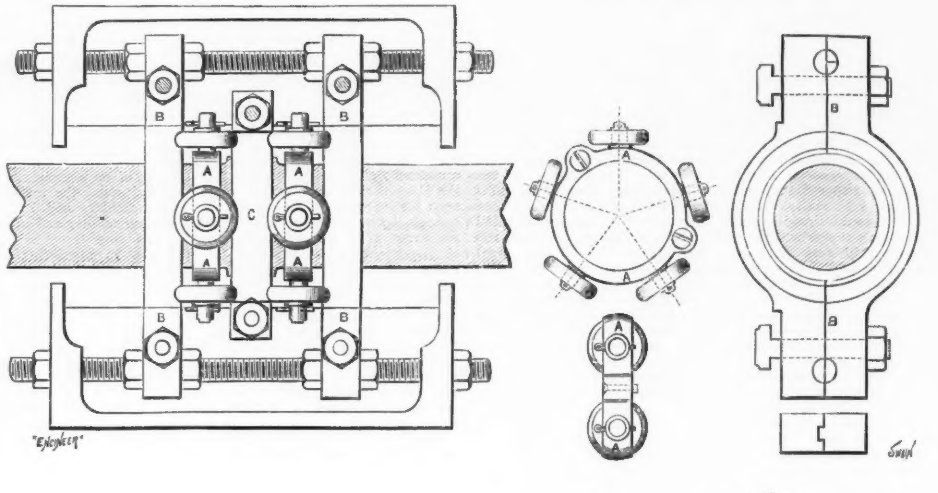
The critic has also to remember that very often the attainment of some very unimportant point, or point of which the importance has been greatly exaggerated, is made the reason mechanically for very great complication. The question of proportion comes in here again, and it has to be considered in any particular case whether the academically perfect machine, which is also extremely complicated, is not inferior to the almost equally good machine which has been constructed in a practicable shape—it almost always is so.

I have endeavoured in my remarks to indicate what appears to me to be the attitude of the engineer towards a very large portion of the work which comes into his hands. In order to deal with the work it is necessary for him first of all to have a certain definite knowledge of "things," that is to say, both of the various subjects which form part of the curricula of all technical schools, and of the further matters which form, as it were, his professional alphabet. These last he learns not from books or lectures as a student, but by example and attempt, as does an artist. Of this part of his training I have said nothing; it has been perhaps sufficiently talked about of late years, and there is little to say which I could have made interesting to a general gathering like this. I cannot leave it altogether, however, without dealing with one matter. Exceptional men are all-round mathematicians or physicists, still more exceptional men are both; but for ordinary folk the study of one side of mathematics or of a single branch of physics is the work of a lifetime. The engineer is bound to know his own profession, by hypothesis, and it is in itself no small matter. Yet in addition he must know some mathematics, some physics, some chemistry, even also some geology, if he is to take any high rank in it. It is, therefore, surely in the very nature of things impossible that he should be a great mathematician or a great physicist, or should devote as much study to those most fascinating sciences as if they themselves were the work of his life. Therefore I beseech my friends of Section A to do what they can to modify their natural attitude of superiority—even of contempt—towards us, especially when we are students. The young engineer—I speak as a member of the great majority of the ordinary kind—would probably never have chosen his profession if he had had special aptitude for mathematical work. Having chosen it, he has to look at mathematics simply as a tool, a means to an end, not an end in itself. I cannot myself see that this point of view is one disrespectful to the parent of all the sciences, and I am confirmed by the knowledge that one or two of the greatest mathematicians in the country are of the same opinion and have the courage to act on it—with infinitely beneficial results to the young men they have to deal with. But I know that to mathematicians in general—the physicists are not so bad—the very name of engineering student is odious, indicating only a man who wilfully refuses to make mathematics his first subject, and who, therefore, deserves neither consideration nor quarter, to whom it is privilege sufficient that he should be allowed to pick up such crumbs as he can digest from a table prepared for his betters. I humbly protest that we deserve better treatment. It is no doubt a great misfortune to us that we cannot afford to spend our training time preparing for examinations, and that we have been compelled to choose for our future a career in which mathematics plays only a secondary part. It is our further misfortune that we have to solve twenty real live problems, each demanding a real live answer, for every single one which otherwise we would have worked out on paper. Perhaps it is also our misfortune—or it may be only our thick-headedness—to believe that in consequence of this we are quite able to judge for ourselves what units it is most convenient for us to work in, what nomenclature satisfies our requirements, and that we are as capable of getting our "*g*'s" in their right places as even some of our distinguished critics. But this is the end of the nineteenth century: philanthropy fills our breasts. May not our misfortunes call out some pity, and not alone contempt? In spite of solemn warnings—which I have lately received in the Press—against the monstrous idea that a presidential address should contain any individual opinions, I venture to repeat here what I had lately an opportunity of saying before a Royal Commission, that in cases where a University or University College takes in hand the preparation of engineers—and I hope that such cases will grow in number—they should provide for them special training in mathematics, and probably also in physics, distinct from the general training in these subjects most suitable for Degrees. I say this with the full knowledge that I may be accused of wishing to degrade the purity of scientific work, and at the same time with the full knowledge that I have no such wish. On the contrary, this special training is the only means by which the rank and file of us will ever know any mathematics at all. And I can say from my own knowledge that if only we can be made what I may call mathematically articulate beings, we shall be able to repay the kindness by placing before the man of pure science problem after problem of transcendent difficulty, of immense interest, and having no single drawback whatever except that its solution may really be "useful," and, after all, this need not be brought too prominently under his notice.

This digression has turned out a long one. I have only further to say that my main object in this address has been to indicate, as well as I could, the general attitude which the engineer must of necessity take up towards much of his work—the point of view from which he must look at it. I shall be extremely glad if anything which I have said should cause this attitude—this point of view to be more clearly kept in mind in the period of training than probably has been hitherto the case.

# WILKES AND EDWARDS' THRUST BEARING





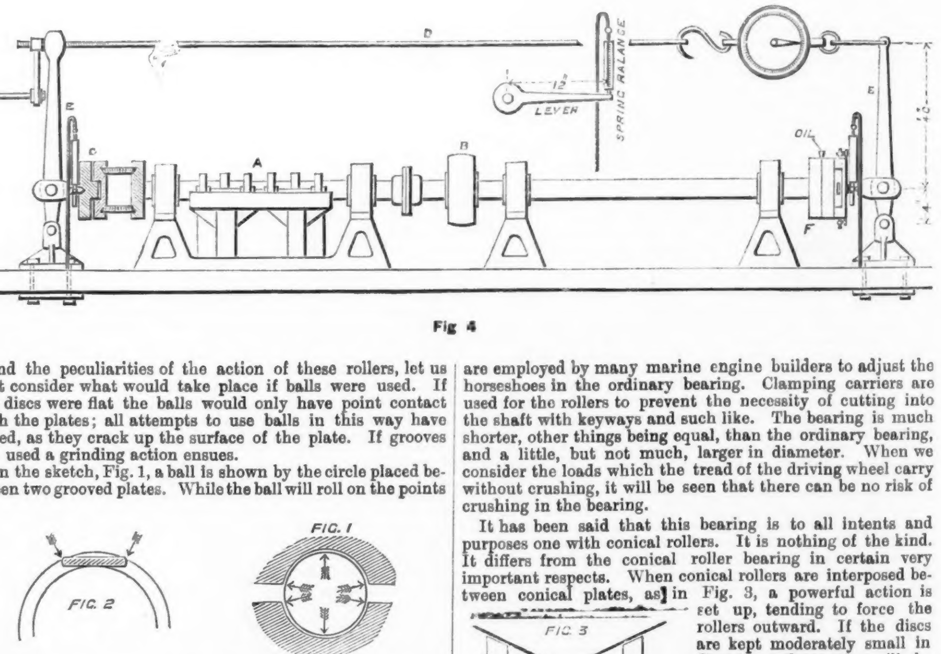


Fig 4

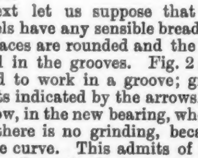
## WILKES AND EDWARDS' THRUST BEARING.

During the recent meeting of the Institution of Naval Architects, the thrust bearing illustrated above was shown at a small local marine exhibition held in the town. The bearing attracted some attention, but not nearly as much as it deserves.

All our readers are no doubt aware that in the early days of screw propulsion much trouble was experienced—and many devices invented and patented to get over the trouble—with the thrust blocks or bearings of screw shafts. Finally, the modern horseshoe system was evolved, and is now universally used, not because it is the best in the abstract, but because it lends itself best to the working conditions. It need scarcely be added that friction rollers placed between discs were tried, and balls revolving in grooves. Any one glancing at the engravings we give will say that we have merely illustrated one of these old devices. That the scheme was very old was our own conclusion when we first saw the model. Careful examination soon proved, however, that the bearing is entirely novel in essentials. It is mainly the invention of Mr. Wilkes, an American engineer, but certain additions have been added by Captain Edwards, R.N., Gloucester Lodge, Portswood, Southampton, and the English patents have been secured in the names of both.

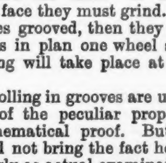
Essentially, the arrangement consists of a series of grooved discs C, secured on the shaft; of similar discs B, secured to the bearing or plummer block, and of certain very peculiarly shaped rollers interposed between the two. Unfortunately, it is has been beyond the power of the engraver to show on a small scale the curves to which the periphery of each roller is turned. There are two curves, each of which is a Schiele's tractrix, or rather a portion of one. The shallow grooves cut in the discs fit the rollers. In order to understand the peculiarities of the action of these rollers, let us first consider what would take place if balls were used. If the discs were flat the balls would only have point contact with the plates; all attempts to use balls in this way have failed, as they crack up the surface of the plate. If grooves are used a grinding action ensues.

In the sketch, Fig. 1, a ball is shown by the circle placed between two grooved plates. While the ball will roll on the points represented by the solid arrows, it is evident that it must grind at the points marked by the dotted arrows. It cannot possibly be in rolling contact with every portion of the groove.



FIC. 2

FIC. 1



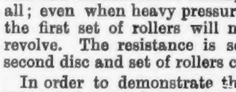
Next let us suppose that wheels are used. If these wheels have any sensible breadth of face they must grind. If the faces are rounded and the plates grooved, then they will grind in the grooves. Fig. 2 shows in plan one wheel supposed to work in a groove; grinding will take place at the points indicated by the arrows.

Now, in the new bearing, wheels rolling in grooves are used, but there is no grinding, because of the peculiar property of the curve. This admits of mathematical proof. But all the mathematics in the world would not bring the fact home to the mind of the engineer as clearly as actual examination of the bearing. Our drawings have been prepared from a bearing which has been at work for nine months in a Southampton tug boat. The discs and rollers we have examined, and we can vouch for the fact that there is not the least symptom of wear, the tool marks being still apparent. The surfaces are ordinary steel, and soft enough to admit of being easily turned or bored.

The drawings are so clear that we do not think any special description is needed. In order to moderate the pressures on the surfaces, two sets of discs and two sets of rollers are employed, the screws at the sides of the bearing being employed to distribute the load equally; just in the same way these screws are employed by many marine engine builders to adjust the horseshoes in the ordinary bearing. Clamping carriers are used for the rollers to prevent the necessity of cutting into the shaft with keyways and such like. The bearing is much shorter, other things being equal, than the ordinary bearing, and a little, but not much, larger in diameter. When we consider the loads which the tread of the driving wheel carry without crushing, it will be seen that there can be no risk of crushing in the bearing.

It has been said that this bearing is to all intents and purposes one with conical rollers. It is nothing of the kind. It differs from the conical roller bearing in certain very important respects. When conical rollers are interposed between conical plates, as in Fig. 3, a powerful action is set up, tending to force the rollers outward. If the discs are kept moderately small in diameter, the angle will be very sharp unless the rollers are also very small. The effect is that a heavy stress is put on the axes holding the rollers in, and much friction is set up at the points A A between the roller and the nut which retains it in place. In the Wilkes and Edwards' gear there is absolutely nothing of this kind, the resistance offered by the whole thrust block to rotation being exceedingly small. We have ourselves seen one disc laid flat on a table, then a set of rollers, then another disc and another set of rollers, and a third disc placed over all; even when heavy pressure is placed on the top disc only the first set of rollers will move, if the disc be caused to revolve. The resistance is so small that the inertia of the second disc and set of rollers cannot be overcome.

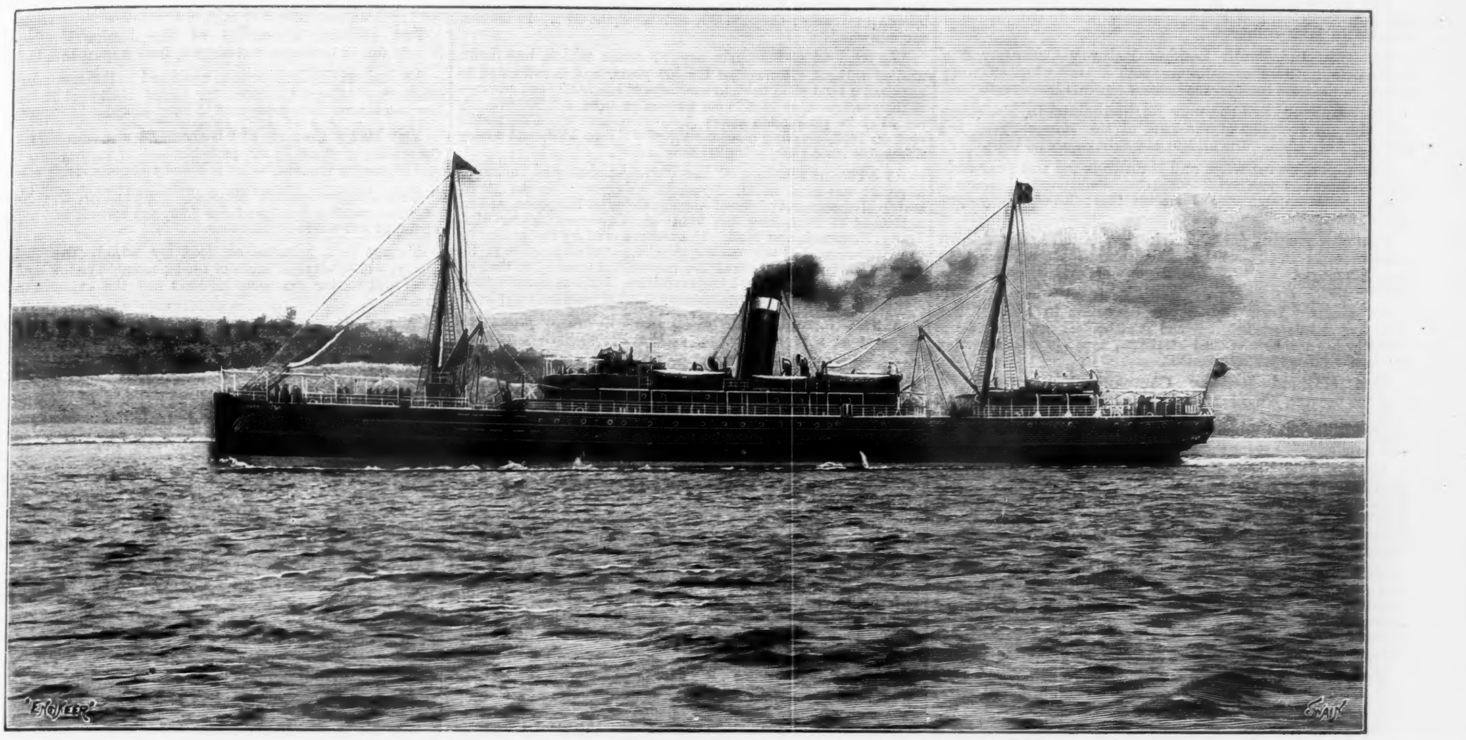
FIC. 3



In order to demonstrate the absence of friction, Captain Edwards has fitted up an ingenious arrangement. A piece of horizontal shafting A, Fig. 4, working in bearings is driven by a belt from an electric motor at any speed from 400 to 800 revolutions per minute. One end of the shaft is fitted with a brass disc F, which bears against another of the same size. The faces have been very carefully finished, and lubrication is perfect. Besides this, the discs are provided with a water jacket to keep them cool. The second disc is also mounted on a short length of shaft. When the two are pressed together the first tends to turn the second with an energy which is measured by the pressure and the coefficient of friction. The

# TWIN-SCREW STEAMSHIP DUKE OF YORK

MESSRS. DENNY BROTHERS, DUMBARTON, BUILDERS AND ENGINEERS



revolution of the second disc is prevented by an iron arm about a foot long, to the end of which is hooked a Salter's spring balance, as shown in the detail side elevation; we have thus the equivalent of a prony brake. At the other end of the first-mentioned shaft is fitted a Wilkes and Edwards' thrust bearing A, with two sets of rollers. This tends to cause the revolution of a short piece of shafting, which is in its turn restrained by a spring balance. A pair of vertical levers, E E, with lathe centres, can be caused to set up a compressive stress through the whole system. With a load of 1000 lb. on the lathe centres, a velocity of 800 revolutions can be kept up for about one minute, the pull on the brass disc spring balance, amounting to about 20 lb., the variations lying between 19 lb. and 21 lb. during the experiment we made. If the run exceeds a minute or so the bearing becomes overheated, in spite of the lubrication and the water. But at the other end C, where the roller thrust is, there is no heating, and the resistance never exceeded ½ lb., or $\frac{1}{40}$th of that of brass disc thrust.

We first examined the invention, certain that there was nothing in it; the facts have made us alter our opinion, and we are persuaded that the bearing could be used with very great advantage in torpedo boats and fast craft of all kinds of moderate dimensions. Whether or not constructive difficulties may limit its application to comparatively small sizes we are not prepared to say, because we have not considered the question. For shafts up to, say, 6in. in diameter, and speeds of 400 to 500 revolutions per minute, we have no doubt at all that the invention is eminently suitable.

## THE STEAMSHIP DUKE OF YORK.

AT various times and in various ways we have directed attention to the efforts made by railway companies to improve the means of communication between England and Ireland. More has been done as regards Dublin than other cities. However, the growing importance of Belfast, which has a greater number of houses than Dublin, and is of very much greater importance as a manufacturing centre, has stimulated effort. Until comparatively a recent period the Belfast merchant travelling to London, Liverpool, or Manchester found it better on the whole to proceed by rail to Dublin, and thence take either one of the London and North-Western Company's fast boats, such as the Violet or the Banshee, or go on to Kingstown and cross by the mail. The extension of the Lancashire and Yorkshire Railway to Fleetwood, and the construction of proper piers and landing stages and a suitable railway terminus, worked a change for the better, and so for several years a fairly satisfactory steamship service has been carried on between Belfast and Fleetwood—a distance of about 110 knots. Recently, however, it was resolved to improve this service, and Mr. Aspinall, chief mechanical engineer of the Lancashire and Yorkshire Railway, proposed a scheme, which has been worked out by Messrs. Laird with the Duke of Clarence, and by Messers. Denny Brothers, of Dumbarton, in the sense that they have designed and built the fine steamship and her machinery which we illustrate this week.

The Duke of York is a twin-screw fast steamer—19 knots. She is owned as regards two-thirds by the Lancashire and Yorkshire Railway Company, and as regards one-third by the London and North-Western Company. She is a sister ship to the Duke of Clarence, built by Messrs. Laird.

State room accommodation is provided for 230 first-class passengers, and steerage apartments for a proportionate number of third-class passengers, together with drovers' room, and complete equipment for officers, firemen, and seamen. The state rooms are of a very superior type; there is plenty of space in them, spring mattresses, and excellent ventilation. The principal saloon is a very handsome apartment, fitted with light woods, much in the same way that the saloon of the Scot has been treated. Wood carving has been used in profusion, and this has all been made in Messrs. Denny's own works. It is of an unusually artistic type, and is somewhat remarkable for the method of production. The design is first drawn on the wood by the artist, and all the rough work is executed by electrically-driven "routers." The wood next passes to the skilled artistic carver, and is by him finished. The cost is reduced in this way, while the objectionable stiffness of machine work is entirely avoided. All the work in the ship is from first to last "thorough."

The propelling machinery consists of two sets of triple expansion engines. The high-pressure cylinders are 23in. diameter, the intermediate 35½in., and the low-pressure cylinders 53in. The stroke is 33in. The engines drive four bladed propellers, 10ft. diameter, at 155 revolutions per minute. The boiler pressure is 160 lb. Steam is provided by two double-ended boilers. Fans are provided, sufficiently powerful to give ¾in. water pressure in the stokeholds, but less than this suffices to keep the pressure. The dimensions of the boilers are given in the table.

The whole of the machinery is a very excellent piece of work, utilised to the best advantage by the chief engineer of the ship, Mr. David Hayes. The frames are of carefully selected cast iron, not steel. The position of the condensers is peculiar. They are, as will be seen from our drawings, carried high up in the wings on brackets. The shaft tunnels are very roomy. The ship is lighted throughout by electricity, the engines and dynamos being carried on the middle platform, extended under the deck aft for the purpose.

The steering gear is Browne Brothers' patent, being similar to that in the Scot. The engine is carried on the end of the tiller, and traverses by the aid of a steel-toothed quadrant bolted to the deck. No covering has been provided, the whole of the working gear being enclosed in water-tight casings. Instead of a deck-house, there is a rail or fence all round.

We recently made the trip from Fleetwood to Belfast and back, and hasten to bear testimony to the courtesy of Captain Cook, in command of the ship, a gentleman whose experience of the Irish Channel extends over thirty years. The trip across was made at a very high speed without event. Coming alongside the wharf in Belfast, the port screw unfortunately caught a very flexible fine strand wire rope used as a warp, and wound up about thirty turns on the boss. A diver was at work all day, but could not get it clear. The rope did not foul the propeller in a way to prevent it from rotating, the rope being cut by the diver. It was feared, however, that if the port engine was used the rope might wear off the Muntz metal nuts of the stern gland, and so, after consultation, it was resolved to make the return trip to Fleetwood with the starboard engine only. This was vexatious, because the boat started at 9.30 p.m. on the night of the 11th of July, and was crowded with passengers availing themselves of the holiday which commences on the 12th July in Belfast, and appears to last a week. On a previous occasion the trip had been made with one screw for experimental purposes, but the screw was allowed to revolve, and an average speed of 15 knots was attained. In the present case, if the screw was allowed to turn, it might just as well be used to drive the ship. Its revolution was prevented by putting the port engines in back gear. The ship had then to drag a four-bladed screw through the water, and carry a port helm to keep her head straight. Yet, with all this drawback, she made nearly 13·5 knots. The screw was cleared next day at Fleetwood by a diver. In all respects she is a very splendid ship, and remarkably free from vibration. In fact, she is a most comfortable boat. Passengers can now leave London at 5.30 p.m., and Manchester at 9.50 p.m., arriving at Belfast about 6 a.m. the following morning, whilst under the old conditions of train and steamboat services, the times of departure from London were 2.10 p.m., and Manchester 7 p.m., arriving at Belfast at the same hour. Practically an equivalent saving has been effected on the return journey. The Lancashire and Yorkshire Railway Company, as the larger owners, work the service of trains in connection with these steamers over the Preston and Wyre line between Preston and Fleetwood. The railway companies' Belfast steamers at Fleetwood depart and arrive alongside the railway station, from which a covered gangway, with hydraulic lifts for luggage, is provided, no charge being made for porterage to or from the steamers. The sailings from Fleetwood and Belfast are 11.50 p.m. and 9.30 p.m. respectively, so that the sea passages are effected wholly in the night time.

The principal dimensions of the ship and her engines are given in the accompanying table:—

| | |
|---|---|
| Length between perpendiculars | 310ft. |
| Breadth of beam, moulded | 37ft. |
| Depth, moulded | 17ft. |
| Height between main and lower decks | 8ft. |
| Height between upper deck and poop bridge and forecastle decks | 8ft. |
| Indicated horse-power | 4000 |
| Speed | 19 knots |
| Boiler length | 21ft. 1½in. |
| Boiler diameter, mean | 14ft. 6in. |
| Grate surface for two boilers | 270 sq. ft. |
| Heating surface, tubes | 7653 sq. ft. |
| Heating surface, flues | 1530 sq. ft. |
| Total | 9183 sq. ft. |
| Ratio of heating surface to firegrate | 34 to 1 |
| Ratio of firegrate to area through tubes | 5·29 to 1 |
| Total number of common tubes | 956 |
| Total number of stay tubes | 388 |
| Total | 1344 |

## THE UNITED STATES TARIFF BILL.

IT is very difficult for an Englishman to understand the details of the dispute between the United States Senate, corresponding to our House of Lords, and the House of Representatives. It appears, however, that a Tariff Bill will actually be passed and come into operation at once. The following is a statement showing the reductions made by the Senate Bill in the average *ad valorem* duties, as compared with the duties at present imposed under the M'Kinley Law:—

The duties on painted china are reduced from 60 per cent. to 35 per cent.; on plain china, 55 per cent. to 30 per cent.; on manufactures of glass, 60 per cent. to 35 per cent.; pig iron, which paid from 26 per cent. to 41 per cent., will pay from 15 per cent. to 21 per cent.; the duties on iron ore are reduced from 33 per cent. to 23 per cent.; on scrap iron, 48 per cent. to 28 per cent.; on scrap steel, 43 per cent. to 26 per cent.; bar iron, which pays from 25 per cent. to 33 per cent., will pay from 16 per cent. to 32 per cent.; the duties on steel rails are reduced from 58 per cent. to 34 per cent.; on bars of rolled iron, from 62 per cent. to 45 per cent.; on boiler or other plate iron or steel, 54 per cent. to 25 per cent.; sheets of iron or steel—common or black—which pay from 25 per cent. to 70 per cent., will pay from 20 per cent. to 55 per cent.; the duties on tin-plates are reduced from 78 per cent. to 42 per cent.; on tin manufactures, from 55 per cent. to 35 per cent.; the duties on cylinder glass, polished and unsilvered—now 20 per cent. to 64 per cent.—will be from 13 per cent. to 48 per cent.; on plate glass, fluted, &c.—now 49 per cent. to 64 per cent.—37 per cent. to 43 per cent.; on plate glass, unsilvered, cast, &c.—now 98 per cent. to 174 per cent.—88 per cent. to 122 per cent.; the duties on plate glass, cast and silvered, and above 24in. by 60in., are reduced from 49 per cent. to 31 per cent. on cylinder and crown glass, silvered from 44 per cent. to 28 per cent.; steel ingots, &c.—now paying from 29 per cent. to 50 per cent.—will pay from 20 per cent. to 40 per cent.; nails—now 23 per cent. to 45 per cent.—26 per cent. to 30 per cent.; the duty on railway fish-plates is reduced from 72 per cent. to 25 per cent.; screws—now paying 47 per cent. to 111 per cent.—will pay from 33 per cent. to 67 per cent.; the duty on lead sheets is reduced from 37 per cent. to 18 per cent.; on nickel from 23 per cent. to 14 per cent.; on manufactures of metal from 45 per cent. to 35 per cent.; on cotton cloth, not over a hundred threads and not bleached, from 35·17 per cent. to 35·05 per cent.; ditto bleached, from 38 per cent. to 26 per cent.; ditto, dyed, coloured, &c., from 41 per cent. to 30 per cent.; on cotton cloth, exceeding a hundred threads, unbleached, from 42 per cent. to 32 per cent.; ditto, bleached, from 43 per cent. to 38 per cent.; ditto, dyed, coloured, &c., from 44 per cent. to 38 per cent.; on woollen yarn from 278 per cent. to 30 per cent.; and on woollen shawls not about forty cents a pound, from 136 per cent. to 35 per cent.; the duty on blankets—now 80 per cent. to 104 per cent.—is fixed at 35 per cent.; on woollen hats—now 86 per cent.—25 per cent.; on flannels not over fifty cents a pound—now paying 85 per cent. to 104 per cent.—25 per cent. to 35 per cent.; and the duty on silk, partially manufactured, is reduced from 60 per cent. to 20 per cent. Plates of copper, not rolled—now paying 11 per cent.—will be duty free; binding twine—now paying 6 per cent.—will be duty free, as will also oil and water colour paintings and statuary, which are at present liable to a duty of 15 per cent.

## RAILWAY MATTERS.

The Tiumen-Omsk section of the Siberian Railway will be formally opened about the 1st September.

The Great Western Railway Company has decided to begin the construction of a line connecting the Severn Tunnel to Avonmouth Dock at Bristol.

The City and South London Railway Company has decided to institute experiments with a view to substituting motors on the train itself for the present separate locomotive.

The earthworks of the new Bechuanaland to Mafeking line, with the exception of the bank at the Molopo River, are practically complete. The bridges and culverts are all built.

The report on railways and tramways fcr the year ending 30th June last, just issued by the Commissioners for Railways in New South Wales, states that there are 2560 miles of railway open in that colony.

The new graving dock at Grimsby, which has just been constructed by the Manchester, Sheffield, and Lincolnshire Railway Company, at a cost of £60,000, was brought into use on the 1st instant.

An electric tramway, about 3½ miles in length, has been opened between Belgrade and Topscheider. Another electric tramway has also been opened at Baden, near Vienna, connecting the former place with Helenenthal.

The Midland Railway Company has opened its new line between Wincoband and Chapeltown for mineral traffic. The *Contract Journal* says this is part of a more extensive scheme, which will provide a new line between Chapeltown and Barnsley, and give improved communication with Wakefield.

It has now been decided to operate the West Side Elevated Railway at Chicago by electric power. This line connects the western part of Chicago with the main city transit systems. It will be a four-track line for a greater part of the way, so as to allow of an express service. The power is to be obtained from four dynamos.

The City Commission of Sewers have resolved that, in the event of the railway company carrying out such repairs as should render Moorgate-street Station free from danger to the satisfaction of the district surveyor, further proceedings by the solicitor to the Commission be deferred pending the rebuilding of the station.

The work in connection with the Waterloo and City Underground Railway is proceeding on the south side of the river near Blackfriars Bridge. Pile driving has been commenced at this spot, where it is also intended to sink caissons, and eventually construct two tunnels, one going to the Mansion House and the other to Waterloo Station.

Complaints have been made at the Blackpool Town Council of attempts to interfere with the electric light supply and the running of the electric tramway. Conductors had been arranged to run the tramway current to earth, the interference necessitating the appointment of a special watch in order, if possible, to detect the culprits.

An underground railway is fast nearing completion in Paris. The interesting feature of the work, from an engineering point of view, is the manner in which the tunnel was built, a masonry arch being used for nearly the entire length. The line follows the streets, one-half the street being closed in short sections at a time. It will be the first section of a metropolitan system in Paris.

The North British Railway Company has just entered on the work of opening up part of the tunnel at Charing Cross Station, Glasgow, in order to satisfy the public demands, and in consequence of the rejection by the city authorities of proposals for effecting the same object by a series of ventilating shafts. A number of residences on the north side of Elmbank Crescent are being demolished to make way for the extension, which is estimated to cost about £40,000.

The Dortmund, Gronau, and Ensched Railway in Germany has fitted the electric light in its carriages. The supply is obtained from secondary batteries. The cars are fitted with low voltage lamps of 16-candle power in the first-class carriages, and 10-candle power in the other compartments. It is estimated that each lamp-hour costs 2·6d., disregarding the maintenance of the accumulators. The batteries are conveyed to and from the charging station at Dortmund in trucks, running on a narrow-gauge line. Each battery weighs about 460 lb.

According to the report for the half-year ended 31st December, 1893, of the directors of the East Indian Railway, and which was to have been presented to the annuity holders at the general meeting held on 27th June, 1894, the total length of the railway proper remains 1611 miles, of which 474 miles are double and 1137 miles are single. In addition to the above, the Tarkessur Railway 22 miles, and the Delhi-Umballa-Kalka Railway 161 miles, were worked by the company during the half-year, making the total length worked 1794 miles. The mean length worked during the half-year was 1819 miles, the same as in the corresponding period of 1892.

With regard to the probable cause of the recent accident to the Scotch express at St. Pancras, a correspondent states that No. 7 platform, where the express was run in, is one of a series which are not ordinarily used for the main line trains. Before the arrival of the Scotch express on Sunday a long fish train had been standing at the platform mentioned, and the correspondent suggests that the drippings from the trucks had fallen upon the rails and rendered them so greasy that when the brakes were applied the wheels skidded round. George Liddle, the guard in charge of the front portion of the express, stated that the train was not running at a higher speed than from four to five miles an hour when it entered the station. He leaped from his van, as he was afraid there was something wrong, and immediately he had done so the engine collided with the buffer stops and the van which he had just left became a wreck.

In our issue of July 20th we published a letter signed "Scriber." It described some important observations made under considerable inconvenience by a feline member of a dynamical research committee. The experimental observations were, as some of our readers will have observed, made with somewhat incomplete or at all events antiquated apparatus, but nearly everyone will admit that the experiment would have been impossible before the days of railways, and except by the particular combination of muscle, horn, and axle described, could not have been made even now. The line of argument which probably led to the inquiry is not, we see by the remarks in the columns of a contemporary, quite understood or appreciated, although the writer of the remarks has discussed the observed results with all the gravity and seriousness which the records of so great a feat deserve. It is proposed that the technical education committee of the County Councils of the districts in which these daring and original experiments were made should be approached with the object of obtaining a grant of money with which the use of the train for an indefinite period shall be secured and placed at the disposal of the experimenter already referred to. When this has been done such further facts as may elucidate the points not now understood by our contemporaries will no doubt be forthcoming. It may, however, be in the meantime remarked that the further experiments are not likely to alter the method of determination of the stresses per unit of leading claw section.

## NOTES AND MEMORANDA.

The deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 17·6 per 1000 of their aggregate population, which is estimated at 10,458,442 persons in the middle of this year. The highest and lowest rates were: Croydon 9·8, and Liverpool 29·2. In London the rate was 17·4.

We read of a Swedish copper mine which has been worked without interruption for 800 years, and is estimated to have had a total yield in eight centuries of 1,200,000 tons, worth—at the average value of £28 per ton—more than £32,000,000. A record of its production shows that the output was 1336 metric tons in 1633, reaching a maximum of 3445 in 1650, and slowly decreasing since 1690, being 271 tons in 1891.

At a recent meeting of the Paris Academy of Sciences a report was read on M. Bigourdan's memoir "On the Micrometric Measurement of Small Angular Celestial Distances, and on a Method of Perfecting this kind of Measurement," by MM. Lœwy, Tisserand, and Wolf. The method used by the author for the measurement of micrometric angular distances consists in the use of glass points in place of the micrometer threads, so that the image is never blotted out by superposition. It allows of much easier work, and is at least as accurate as any method previously employed.

A new formula for friction head in water pipes was proposed at a recent meeting of the Boston Society of Civil Engineers. It is $I = C' Q^{\frac{11}{10}}$, where I is the friction head in feet per foot, C′ is a coefficient varying with the roughness and the diameter, and Q is the discharge in cubic feet per second. This formula has been deduced from that used by Professor Unwin and M. Flamant by determining from a large number of experiments the proper coefficients for use with both new cast iron and riveted sheet iron pipes. A paper describing the use of this formula, with a number of tables to facilitate its application, will be found in the *Journal* of the Association of Engineering Societies for June of the current year.

A communication made to the Academie des Sciences, by M. Henri Moissan, contains some new and interesting researches respecting the metal chromium. By availing himself of the intense heat produced by the electrical current, the experimentalist succeeded in preparing cast chrome in a very small quantity, which may be fairly represented by the formula C Cr. When treated with lime or the double oxide of calcium and chrome, the metal produced under these conditions is more infusible than platinum, and takes a very fine polish. It is moreover not attacked by atmospheric agents, not to any great extent by acids, and resists the action of aqua regia and of alkalies in fusion. This preparation of chrome leads to some very important results in connection with the alloys of the metal. Alloyed either with alumimium or copper, it possesses some remarkable qualities. When pure copper, for instance, is alloyed with 0·5 of chrome it becomes endowed with a double power of resistance, is susceptible of a high polish, and undergoes less change when exposed to atmospheric influences than when in a condition of purity.

A law recently passed in America provides that no river steamer shall have an externally-fired boiler with shell plates of iron or steel exceeding an average thickness of $\frac{30}{100}$ of an inch, No boiler of this type on such vessels shall have less than 3in. space between its shell and any of its internal flues, and not less than 3in. space between such flues when any such flues are more than 5in. in diameter; and every such externally-fired boiler employed on any such steam vessel shall be provided with a manhole, in the lower part of the front head thereof, of such dimensions as may be prescribed by the Board of Supervising Inspectors, in all cases where the distance between its internal flues is less than 3in. Externally-fired boilers having shells constructed of iron or steel plates not exceeding an average thickness of 0·50in., may, in the discretion of the Secretary of the Treasury, be authorised and employed on steam vessels navigating the Atlantic and Pacific Oceans, or salt water bays or sounds, or the great lakes, or any of them, and water flowing to and from the same, or any of them; provided that in inspection, no plate that is by this Act limited to a thickness of 0·30in., and no plate that is by this Act limited to a thickness of 0·50in. shall be rejected for use if found to exceed these dimensions respectively, if the average thickness thereof does not exceed the limits therein specified, and the amount of steam pressure that will be permitted to be carried in boilers constructed in accordance with the requirements of this Act shall be determined from measurement showing the least thickness of the plates.

A large number of cities obtain their water supply from subterranean water-bearing strata reached by tube wells consisting of iron tubes driven low, and having the upper ends connected to the suction main of the pumping engine. At the city of Lowell the contracting company sank seventeen test wells before locating the permanent plant, and the formation was so irregular that one well might be good, and the next so poor as to require pulling up the pipe. The wells vary in depth from 47ft. to 67ft., the average being 52ft., and all being 6in. diameter. Before the wells were connected and pumped by steam the elevation of the water in each was 9in. above that in the brook, and rose and fell with the latter, the water from the wells always flowing into the brook. The yield from forty-four wells when pumped singly being at the rate of 7,000,000 gallons per day, a test of the wells collectively was ordered, and the supply was found to be 2,000,000 gallons. It was evident that the wells were too near together, and experiments were made to determine which could be cut out without affecting the quality of the water obtained. Finally, twelve wells were removed, leaving thirty-two, from which 2,333,000 gallons have been pumped in twenty-four hours. After adding eighteen wells, 3,000,000 gallons per day were pumped for some time, then alterations were made in the pumping machinery and twenty-two 4in. wells added, making seventy-two in all, from which 3,300,000 gallons per day are now being pumped, with a vacuum of 23in. to 23½in. The water in the outside test wells now shows conclusively that the supply is greater than the draught. In the method of sinking these wells, the pipe is put down by the use of a sand bucket nearly as large as the interior of the pipe and about 6ft. long. The bucket is raised and lowered by wooden rods connected together at the ends, so that when in the well they act as one rod, and make the bucket very efficient in its work. This bucket removes all the material from the inside of the pipe, and when it is sunk in gravel, stones 5½in. diameter have been removed with it. While the earth is being removed, the pipe is gently turned or rocked, and goes down by its own weight. This is a very rapid manner of getting pipe down through quicksand. In very hard gravel the pipe is sometimes driven a little with a heavy wooden weight. If stones too large to come up through the pipe are encountered, they are broken with a large drill, or, if this is impossible, the pipe is pulled up and the location changed. Two "push wells" were also put down. They were constructed by building a strong dam to press against and using a very strong clamp on the pipe. The pipe is pushed into the ground by the use of four jack screws. This is a very slow and expensive way, but allows a very long screen to be placed in a narrow stratum of water-bearing material, and has worked very well at other places, but here the material is not uniform enough to warrant the outlay. They are both good wells, but not enough better than the others to pay the difference in the cost. All the wells are made with the Cook patent strainer, varying in length from 8ft. to 17ft., according to the depth of the water-bearing stratum. The screens in the push wells are one 24ft. and the other 42ft. in length. After the screens are swedged into the well pipe and the well thoroughly pumped and washed by steam, the water is perfectly clear and no sand comes up through the screen. The screens are made from a drawn brass tube.

## MISCELLANEA.

It is stated that the Burma Government has decided to open an Engineering School.

The total number of spindles now used in the cotton mills throughout Japan is said to be about 720,000.

The summer excursion of the Junior Engineering Society will be to Cardiff and district, from August 18th to 25th.

An Industrial Exhibition, confined to the manufactured products of Alsace-Lorraine, the Grand Duchy of Baden, and Rhenish Bavaria is to be opened in May, 1895.

The Town Council has instructed the Southend Pier Committee to report on the probable cost of further lengthening and improving the pier, which is already 1¼ miles long.

The Anglo-Spanish shipbuilding yard on the Nervian at Bilbao receives iron ore at one door, and turns it out as a fully-equipped war vessel at the other.

There is a scheme on foot by which the Colombo sewage will be emptied south of the harbour. The low level of the town will render the work difficult and the expenditure very great.

A large quantity of india-rubber has been exported from Rangoon during the past official year. It is obtained from the forests in the Tanaih Chung districts in Northern Kachin Hills of the Upper Irrawaddy.

The repairing of the old aqueducts of Solomon in Jerusalem will entail the building of a tunnel 3750 metres long, to cost £80,000. The aqueducts will bring the water to Jerusalem from the fountains of Arroul.

A special commission has been nominated in Paris for experimenting with smoke-consuming apparatus. The meeting will be opened by papers from inventors, and a total sum of £380 will be awarded among the best apparatus.

On Thursday evening an explosion occurred at the Rowley-hall Colliery, Staffordshire, owing to men going into a portion of the mine where some gas and damp had previously been tapped. A pitman was suffocated and another man was severely burnt.

M. Janssen has exhibited at the Academy of Sciences the clockwork of the registration apparatus at the Mont Blanc Observatory. It requires winding up only once in eight months, and it is lubricated with a peculiar kind of oil, which only congeals at 80 deg. below freezing point.

There is a rumour afloat that Mr. Maxim's experiments with his flying machine are abandoned. We are desired by Mr. Maxim to state that this is by no means the case, as he is at present looking out for a suitable locality where there is more room than there is at Bexley for the completion of his experiments.

The official trials of the Vizcaya belted cruiser, built for the Spanish Government, were completed last week with satisfactory results. The Government decided to dispense with forced draught on the occasion, in consequence of the excess of speed attained by the sister vessel, the Infanta Maria Teresa. The natural draught speed was 18·6 knots.

Her Majesty's cruiser Blanche has gone into harbour to make good defects to her starboard boiler, which have necessitated her return to England. She has a crack on the inside of her boiler no less than 10ft. in length, the result being that steam could only be raised in it with safety to about 60 lb., whereas the boiler should stand a test of 250 lb. to the square inch.

The Admiralty have decided to strengthen the defences of the river Medway by constructing a boom to bar the passage of the river in case of an emergency. The boom is estimated to cost £6000. The boom, when ready, will be fitted across the river to test its efficacy, and will afterwards be stored in sections for use should an emergency arise. The work has been recommended by the Harbour Defence Committee. The gunboats Banterer and Grappler are to be utilised as portions of the boom.

The Gohna Lake rose 24ft. 6in. last week, and on the 12th inst. was within 57ft. of the top of the dam. Its full length is now 4½ miles, the average width being half a mile. The greatest depth is 720ft. The *Times* says the percolation is very heavy. This, combined with heavy rain, has washed away a large portion of the lower part of the dam, leaving an almost perpendicular drop of 400ft. The section thus displayed shows a layer of boulders on the top, below which is pulverised rock. The lake is expected to overflow within fifteen days.

The authorities at Chatham Dockyard have in preparation a scheme for still further developing the extension works by constructing another basin. Plans are also to be prepared for three new docks, one of which is to be of immense size, and capable of accommodating the largest vessel likely to be built in the future. The need for larger docks is apparent, seeing that at Chatham there is not one of sufficient size to hold the cruisers Powerful and Terrible, provided for in this year's estimates. It is estimated that the total cost of the proposed works will be about £1,500,000.

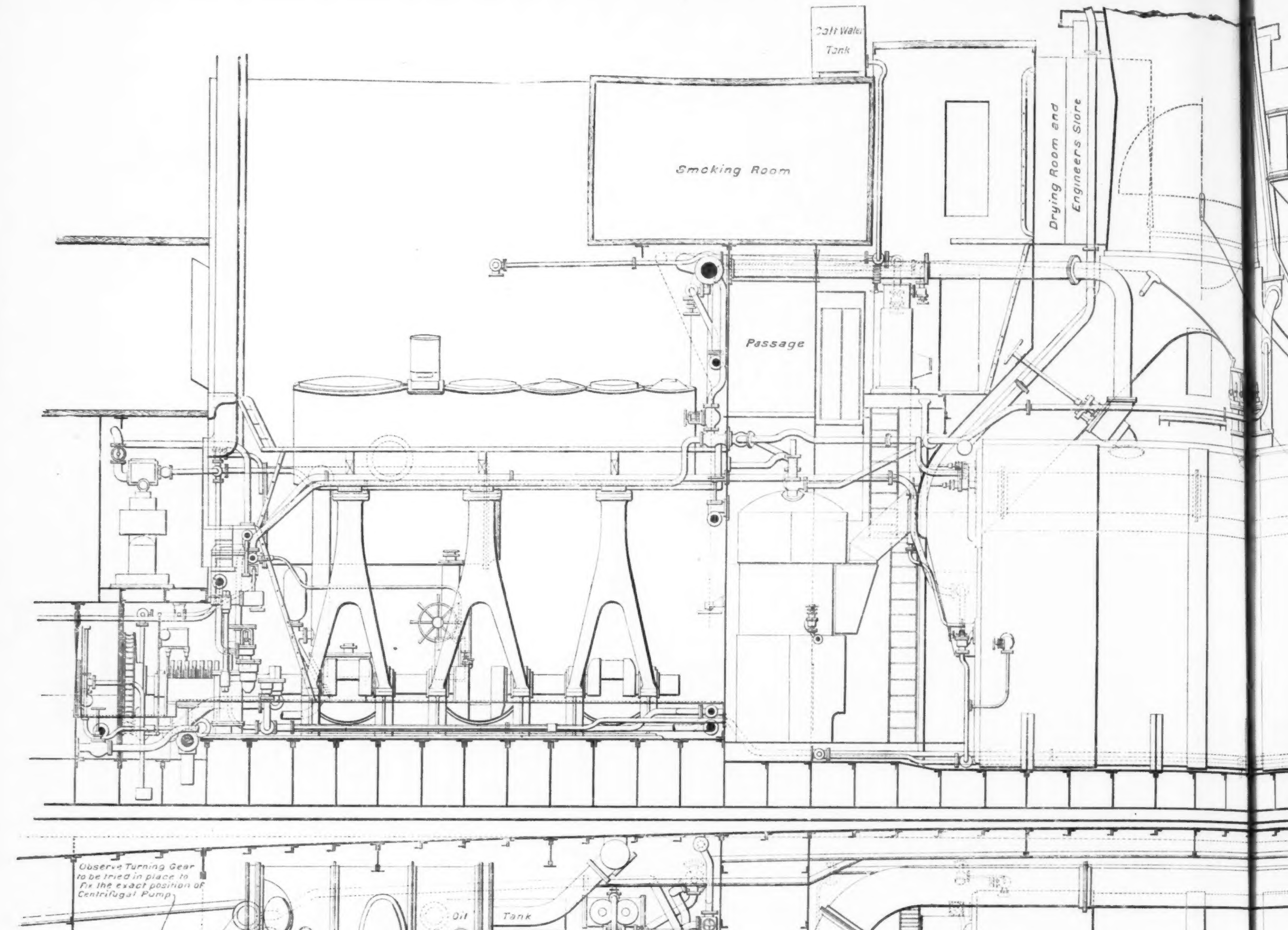
An Egyptian paper says that out of seventy-four thousand tons of coal landed at Port Said during September, only twenty-four thousand tons came from Wales, the balance being supplied from Marseilles, Antwerp, Glasgow, Newcastle, Dunkirk, Hamburg, Rotterdam and Bremerhaven. It is said that some of the foreign coal has taken such a hold on the market, that it will be some time before the Welsh trade can resume its old position in the Suez Canal. Hitherto the coal stock of Port Said has consisted, as a rule, of about 95 per cent. of Welsh coal. The falling off is the result of the recent coal strikes.

It is not at all certain, the *Times* says, that the Commission of Inventions, as stated by a news agency, "will have nothing whatever to do with M. Turpin's invention." It is true that he has received back his documents, but this, as he told the Commission, was simply in order that he might continue his studies and prepare the specifications for the patent which he was asked to take out. The Commission made M. Turpin two proposals—either to undertake trial experiments itself on its own responsibility, M. Turpin being invited to furnish a definite scheme of experiment, or that he should conduct experiments at his own expense, and invite the Commission to witness them. He has not yet decided as to these proposals.

Owing to the refusal of the pit lads at the collieries in North Staffordshire to accept their share in the 10 per cent. reduction of wages lately agreed to in the Federation districts throughout England, a similar trouble has arisen to that which has developed itself in South Yorkshire. As the pits are unable to go on without the boys' services, many of the collieries have been brought wholly to a stand, and there is this week a general disorganisation of colliery labour throughout the district. The local agents of the Federation are doing their best to bring the boys into a more amenable state of mind, but at present without success. Among the adult miners, too, a great deal of dissatisfaction exists at certain of the pits, owing to the allegation that, at some collieries, more than 10 per cent. is being taken off, and that at others the reduction is being made applicable to engine men and other classes of labour apart from the miners proper.

# TWIN-SCREW STEAMSHIP DUKE F Y

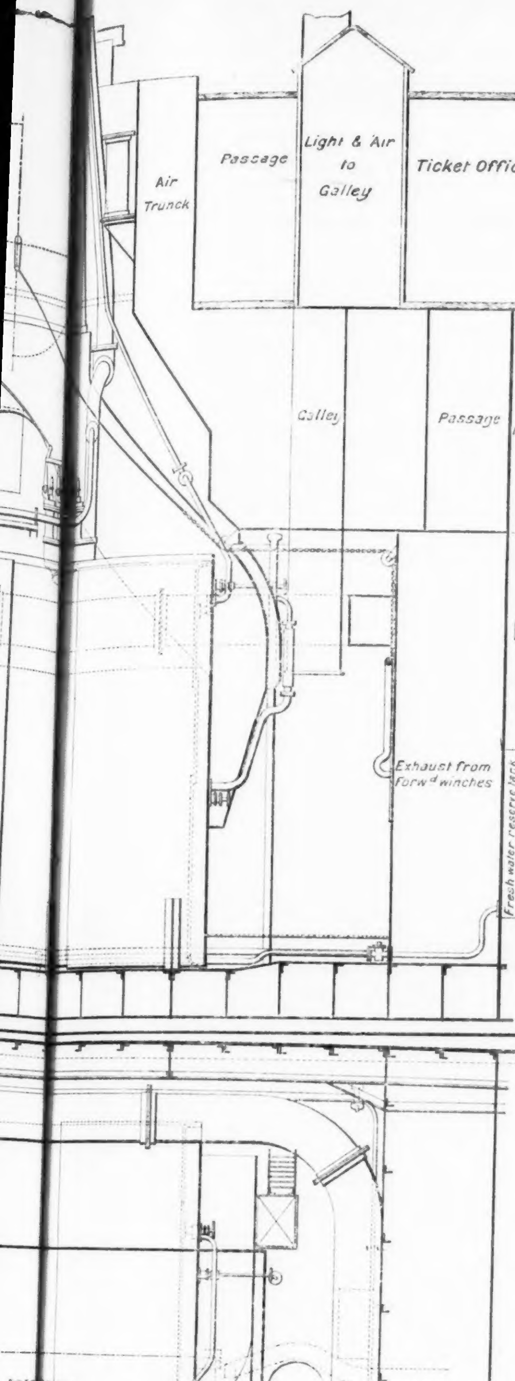
MESSRS. DENNY BROTHERS, DU TON, B

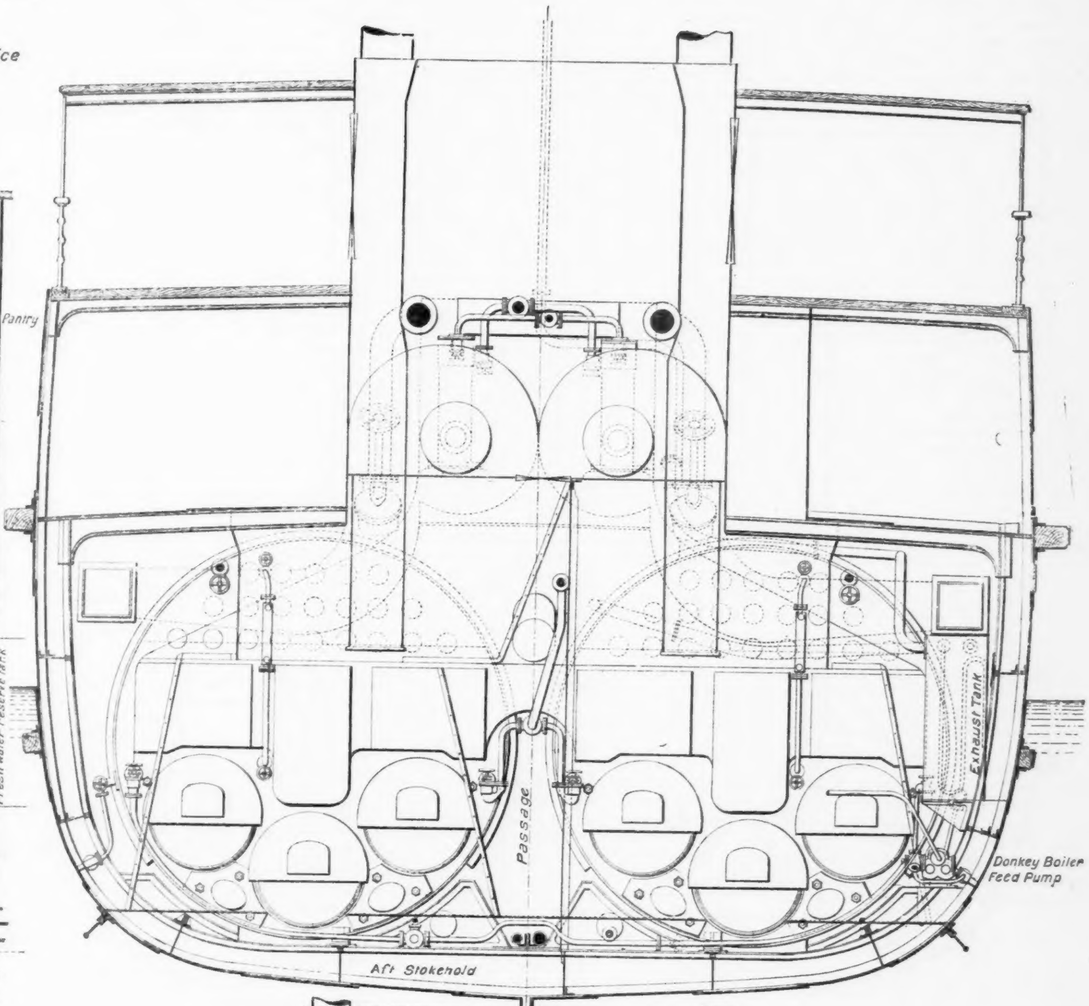

Salt Water Tank
Smoking Room
Drying Room and Engineers Store
Passage
Observe Turning Gear to be tried in place to fix the exact position of Centrifugal Pump
Oil Tank
Bunker
Air Lock
Weir's Tank
Heating Exht
Bunker

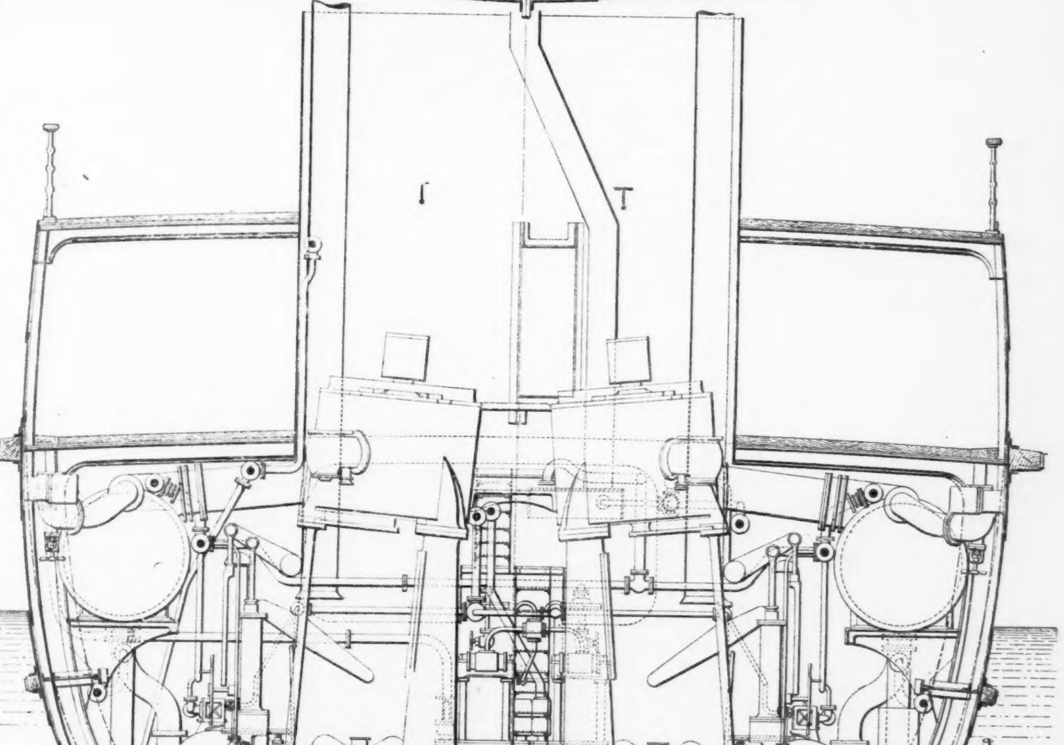
"THE ENGINEER"

# KE F YORK—ENGINES AND BOILERS

ERS, DUM TON, BUILDERS AND ENGINEERS


Air Trunck
Passage
Light & Air to Galley
Ticket Office
Galley
Passage
Pantry
Exhaust from Forw^d winches
Fresh water reserve tank
Bunker


Exhaust Tank
Passage
Donkey Boiler Feed Pump
Aft Stokehold


Frame 50
Frame 50
Frame 54 Looking Aft

SWAIN ENG.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two-page Engraving of the Twin-screw Steamship Duke of York, Engines and Boilers. Every copy as issued by the Pnblisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it. Price 6d.*

## CONTENTS.

The Engineer, August 17th, 1894. Page

The British Association at Oxford.. .. .. .. .. .. .. .. .. 139
Belgian Machinery at the Antwerp Exhibition .. .. .. .. .. 141
Railroading in America. (Illustrated.) .. .. .. .. .. .. .. 142
The Critical Side of Mechanical Training.. .. .. .. .. .. .. 144
Wilkes and Edwards' Thrust Bearing. (Illustrated.) .. .. .. 146
The Steamship Duke of York. (Illustrated.) .. .. .. .. .. .. 147
The United States Tariff Bill .. .. .. .. .. .. .. .. .. .. 147
Railway Matters—Notes and Memoranda—Miscellanea .. .. 148
Leading Articles—Engineers and the Admiralty—Lord Salisbury's Address.. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 149
Sheffield and the American Tariff Bill—Japan as a Machinery Market—Harvey Armour Trials .. .. .. .. .. .. .. .. .. 150
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 150
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. .. 150
The L. and N.W. Railway Company's s.s. Banshee .. .. .. .. 150
Some Reminiscences of Steam Locomotion on Common Roads (Ill.) 152
Weldless Rolled Chains—The Klatte Process .. .. .. .. .. 154
Commercial Dishonesty and Sanitary Neglect .. .. .. .. .. 154
Letters to the Editor—The Chicago Strike—Patent Specifications Department, South Kensington Museum—Engineers and Architects—Brighton Beach—The Eight Hours' Day in Portsmouth Dockyard .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 155
The Great Northern Route—Tenders .. .. .. .. .. .. .. .. 155
The Design of Mail Steamers—The British Association .. .. 156
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire—The Sheffield District—The North of England 157
Notes from Scotland—Wales and Adjoining Counties—Germany.. 158
American Notes—Launches and Trial Trips .. .. .. .. .. .. 159
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. .. 159
Selected American Patents .. .. .. .. .. .. .. .. .. .. .. 159
Two-page Supplement — Twin-screw Steamship Duke of York, Engines and Boilers.

## TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER, LONDON."

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

W. J. G.—*It is quite impossible to publish everything at once. We have not forgotten your request.*

J. C.—*Our drawing of the Minneapolis illustrates her as designed. The difference between that and the ship as she is consists principally in the funnels. It was intended that she should have four funnels, like the Columbia. In Brassey's "Naval Annual" she is shown with three funnels.*

J. T. H.—*The bulb A in your sketch of a maximum and minimum thermometer is filled with spirit. The space above A ought to be a vacuum, but very commonly it is not. The small amount of expansion and contraction of the thread of mercury due to change of temperature is negligible. It is, of course, possible to make a thermometer of the kind with an air bulb A, but we have never seen one.*

### SUBSCRIPTIONS.

The Engineer *can be had, oy order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)*.. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* .. .. .. .. .. .. .. .. .. | £0 18s. 0d. |
| *Yearly* .. .. .. .. .. .. .. .. .. | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* .. .. .. .. .. .. .. .. .. | £1 0s. 3d. |
| *Yearly* .. .. .. .. .. .. .. .. .. | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

Iron and Steel Institute.—Meeting at Brussels, commencing on Monday, the 20th, and concluding on the 24th inst.

Liverpool Engineering Society.—Saturday, August 25th. Excursion to the Wirral Railway Works and Dee Bridge, by the kind permission of the respective engineers, Sir Douglas Fox, M. Inst. C.E., and Mr. Alexander Ross, M. Inst. C.E.

Junior Engineering Society.—August 18th to 20th. Summer meeting at Cardiff.

# THE ENGINEER.

*AUGUST* 17, 1894.

## ENGINEERS AND THE ADMIRALTY.

In the House of Commons on Tuesday night a question was put and a statement was made, the importance and purport of both of which may very readily be overlooked or misunderstood. Mr. Clough asked the Secretary to the Admiralty whether the Admiralty were satisfied with the two first of the forty-two torpedo-boat Destroyers recently ordered; and whether they were taking care to utilise their experience as to details of the Havock and Hornet in the construction of other vessels of the same class. Sir U. Kay-Shuttleworth said in reply:—"The Admiralty are glad to recognise that Messrs. Yarrow have been the contractors who have first constructed and completed with rapidity for the British Navy vessels of the high speed of the Havock and Hornet. On behalf of the Admiralty I am happy to express our satisfaction with the manner in which the contract has been carried out. We are also ready to acknowledge the value which we attach to the designs of Messrs. Yarrow for the machinery of these vessels. Practical proof has been given of this favourable opinion by our use of certain parts of these designs as a guide to contractors for some of the other torpedo-boat Destroyers since ordered." Certain parts are no doubt included in the whole, and so far Sir U. Kay-Shuttleworth's reply is accurate. It is the truth—but not nearly the entire truth. For "certain parts" it is necessary to substitute the words "the whole," in order to arrive at the facts. "Certain parts" may mean all the machinery designs, and if the report which has been much discussed among engineers for now several months is true, all Messrs. Yarrow's working drawings have been freely handed about. This fact we have heard from numerous sources, and is far beyond dispnte. To many, if not to the greater number, of our readers the question and the reply may seem to concern only the firm in question. To those, however, who have watched the progress of events they will present a different aspect. They involve a principle of the very highest importance, and they give utterance to the complaints which have been made hitherto almost in private concerning the dealings of the Admiralty with the engineers of Great Britain. Let us consider what the facts are in the particular case cited. Mr. Yarrow has done at least as much as any other man living to develope the high-speed torpedo boat and the torpedo boat destroyer. Only those who are behind the scenes can form any adequate idea of the labour and money and genius that have been expended to produce such a boat as the Hornet; she is really the result of the arduous labours of many years. The success attained has not been reached by the assistance of professors, or the learning set forth in text-books. It has been obtained step by step by direct, costly, dangerous, and tedious experiment. The knowledge needed to design and construct such a craft is specialised to the last degree; and it is of course embodied in the voluminous working drawings. The Admiralty wanted torpedo catchers of the highest speed, as other nations were fast advancing in this direction. Certain stipulations were laid down as to speed, &c., and Messrs. Yarrow tendered for them. In accordance with the rules of the Admiralty, Messrs. Yarrow sent in during construction a complete set of working drawings for approval. The drawings, be it understood, never became the property of the Admiralty. They belonged to the contractors. They were approved, and the Hornet and the Havock were constructed. The results obtained were, as we have already informed our readers, satisfactory in the highest degree. The Admiralty desired to augment the number of such boats. This was commendable. The method adopted of obtaining them was in the highest degree reprehensible. Messrs. Yarrow's drawings were sent to the North to several firms to show them what was wanted, and to help them to design efficient machinery.

It is not necessary, we think, to dwell on the fact that these drawings contained information which was entrusted to the Admiralty while remaining the property of Messrs. Yarrow and Co. We have already referred to the theft of drawings of torpedo boats, and Messrs. Yarrow offered a reward of £200 for the detection of the thief. We mention the fact now only to emphasise further that this class of drawings, representing special information, is of the utmost value to the owners. It is certain that few of the northern firms could unaided build such a vessel as the Hornet with any hope of complete success unless they carried out for themselves an elaborate and tedious series of experiments. We are sure that the general reader of these pages will be unable to realise fully how enormous are the difficulties to be overcome in getting the last knot out of such little craft. Success or failure turns on apparent trifles—a small mistake in the pitch, diameter, or area of the screw, for instance, may mean disaster. But we believe that we are right in saying that every firm to whom Messrs. Yarrow's drawings were sent fully realised the importance—nay, the absolute necessity—of having them. Thus, then, the Admiralty supplied those who were asked to compete in price with the Poplar and Chiswick firms with all the information that has been acquired with so much expense, trouble, and risk. Commercially it is impossible to imagine anything much more unfair. The defence set up is at once plausible, but unjust. It is simply this: the Admiralty are extremely pleased with the performance of the Havock and Hornet; in the interests of the taxpayer they desire to reduce the cost, and obtain more craft of the same kind at a less price. They ask northern firms who have had no experience in this class of work to tender. Those asked say very naturally that unless they know more it is impossible for them to undertake the work. Thereupon the Admiralty send Messrs. Yarrow's drawings to guide them. Now, it may be said here at once that the Admiralty have a right to utilise for the good of the nation the information they have obtained. That is quite true—under conditions. The French Government pursue the proper course. They specially stipulate in their contracts that they shall have a right to utilise the drawings or other information supplied by contractors; and the contractors go into the matter with their eyes open. But the matter does not end here. If, for example, M. Normand designs engines, a boiler, or a boat, and M. Normand's drawings are supplied to another firm which works to these, then M. Normand is paid a royalty, or percentage on the cost. This has nothing to do with patents. The success or failure of a torpedo boat or torpedo catcher turns on matters of proportion more than anything else. It is quite understood that everything about a torpedo boat is worked, so to speak, within an inch of its life. The smallest error in proportion may cause a breakdown, and this not only because the parts may be made too small, but because they may be made too large, and the last is just the error that a man lacking experience is most liable to make. We could cite more than one case of disaster brought about in this way. But it is quite out of the question to attempt to patent proportions; they none the less represent the maximum amount of technical value in such cases as we are considering, and the contractor has to pay for it to M. Normand, for example. Why does not our own Admiralty adopt a similar system, which would serve to secure to the country what is needed and would be fair to all concerned.

Nothing can be more shortsighted than the policy which we are criticising. What is true of Messrs. Yarrow's drawings is to a less extent true of the drawings of other firms. If the special designs of all the leading firms in any branch of engineering are to be sent to other houses, the result will be that the leading firms in each department will lose interest in carrying out Admiralty orders. Thus, if the Admiralty take the drawings of gun gear of all kinds constructed by Sir W. Armstrong and Co., and send them about the country, we have no doubt that firms will be found quite ready to work to these drawings although no member of the firm perhaps ever saw a big gun fired in his life. Can it be doubted that a pennywise policy of this kind must end in disaster?

It must not be supposed that in writing as we do we wish to hold up to reprobation any individual or set of individuals. We feel, indeed, quite certain that no one at the Admiralty, from the First Lord down, would countenance an act of injustice for a moment. Those concerned fail to see what they have done in its true light. The fault is the fault, not of individuals, but of a system, and of the way in which the system is carried out. The Admiralty should remember that they are not dealing in this case with foreign engineers, but with Englishmen. Any Government worth the name will regard those whom the nation employs, and who are paid out of the national purse, with friendly feelings. The Admiralty, however, appears to regard the engineers and shipbuilders of this country as enemies rather than friends. Throughout the length and breadth of the country we hear complaints, now of one thing, now of another. The relations of engineers and the Admiralty have long been strained. Let us hope that the episode which culminated on Tuesday night will bring about more satisfactory relations between those who ought to work together in very great harmony and concord.

## LORD SALISBURY'S ADDRESS.

Lord Salisbury's address as President of the British Association is the embodiment of the views of large numbers of earnest thinkers. It is a timely protest against the dogmatism and tyranny of science. It is often said that science is not dogmatic, that it is opposed to tyranny, and that the apparent exceptions, the existence of which are admitted, are to be traced not to science but to the idiosyncracies and prejudices of men. We refuse to accept this explanation. Modern science has no existence apart from the men who teach it. Knowledge has been specialised to the last degree, and it may be safely said that to go beyond the utterances of certain individuals is impossible. It is true that an interchange of knowledge and of ideas takes place; but, on the other hand, we have distinct schools or groups who regard themselves as the depositories of all existing information on particular subjects, and who maintain not unnaturally that their verdict on such subjects is final. In matters religious there is but one Pope. In matters scientific there are a hundred, each claiming in his own way to be infallible. Each always admits that he is open to conviction; but his attitude is that of the judge who, refusing to hear evidence for the defence in a certain case, asserted that it would be waste of time to call witnesses, because his mind was already made up. "But," said counsel, "surely, my Lord, you are open to conviction!" "Certainly," replied the judge; "but I should like to see the man who could convince me!" The general public may be divided into three classes: Those, by far the most numerous, who accept without question any statement made in the name of science, and go on their way without further regard for it; secondly, those who weigh what they are told, accept it with enthusiasm, are full of faith, and ready to go to the stake for the cause; and lastly, those who maintain that the man of science knows very little indeed concerning the tremendous problems which present themselves on every side to the thinker, and flatly refuse to accept any scientific dogma as true only because it is advanced by a man enjoying a fine reputation. This latter class may be said to be made up of intelligent heretics, and they are mostly regarded with despair and contempt by the man of science.

Lord Salisbury has played the part of the intelligent heretic to good purpose at Oxford. His weighty utterances will leave their mark. No one is better fitted to express an opinion than is Lord Salisbury. He is very far indeed from being ignorant of science. He is a competent electrician, for example. Few men living have had a wider experience of the operation of the human mind; its self-deceptions, its vanities, its mode of working. Few men have had greater opportunities for estimating the value of evidence—evidence, not of the minute and detailed kind to be found in our law courts, but of that larger and wider kind selected from the contentions of nations, the world of diplomacy, and the strife of party. His knowledge of science while sufficient to prevent him from falling into error has left him free from the prejudices of the scientific schoolman. When a biologist has spent his best years in proving to his own satisfaction that he has descended from a jelly fish, it is unlikely that he can properly appreciate arguments showing that he is wrong. But Lord Salisbury is in a different position; he can estimate at their proper value the arguments for and against. The result of his labours is that he takes the book of science and he writes on almost every page the words, "Not proven," and there is none that can answer him, or demonstrate that he is mistaken. Of the foundations of Nature we know nothing, nor are we likely to know anything, and so we find Lord Salisbury, like Clerk-Maxwell and Lord Kelvin, referring not the origin of things alone but their conduct to a Great First Cause, and telling us, "That all living things depend on one everlasting Creator and Ruler."

But dogmatic as science is, we find that its dogmatism is not general but particular. It is not the dogmatism of one Catholic creed, but that of a hundred creeds. It is next to impossible to find union, harmony, or charity in the ranks of science. It has been happily remarked that the brain does not discriminate what it is thinking about, and the expenditure of mental energy is just as great in settling what we shall have for dinner as in solving a mathematical problem; in composing a speech to be delivered before the vestry of Little Peddlington, as in preparing one to be delivered in the House of Commons on the Navy Estimates, or the relations of this country with the Boers. In the same way the clash of scientific opinions; the display of warlike energy; the outpouring of the spirit of contention, is in scientific matters in no way different from all that obtains in affairs political or national. Lord Salisbury told his hearers that the views of the biologist were quite incompatible with those of the geologist; but we know very well that neither will give way. The outsider, judging between them, will arrive at the conclusion that neither possesses any sufficient evidence to enable him to arrive at the most remote approach to certainty. Nor is this incompatibility of theory and statement confined to class against class. The war is civil. Contention pervades every camp. Take, for example, the discussion which has recently gone on in our pages. It is very probable that Dr. Lodge is as eminent an authority on thermodynamics as it is possible to get. He is a professor, and a teacher of large numbers of students. To him comes Mr. Peter Alexander, who, following the example set by Mr. Branson in our railway stations, does not call a spade an agricultural implement, and very plainly asserts that Dr. Lodge does not know what he is writing about. But Mr. Peter Alexander is a professor just like Dr. Lodge, and he, too, teaches numbers of students. Our text books dogmatise and repeat each other. The only point on which men like Dr. Lodge and Professor Alexander agree is in denouncing the text books. Is it wonderful that the school which Lord Salisbury represents, a school of able, thoughtful, mostly silent men, regard the disputants with amusement, and refuse to accept their statements as absolutely true? In a word, Lord Salisbury is a scientific agnostic, holding that while our knowledge of nature and nature's operations has progressed rapidly, and may yet progress still more rapidly, little is known with such certainty that it is safe to assert that knowledge is final. Until the other day, the man who would assert that anything remained to be discussed about the composition of the atmosphere would be regarded as grossly ignorant of the results of chemical research. Lord Rayleigh has just fluttered the scientific world by announcing the discovery of a new gas. For years the world has been content to accept as a proved fact that 460 Fah. is absolute zero. Mr. Donaldson says it is not demonstrable that this is true, and no one has attempted with any approach to success to refute him. Indeed, we understand Professor Alexander to admit the general validity of his arguments. The theory of the action of steam in an engine is quite unsettled, notwithstanding the most dogmatic assertions on the subject. In great things and in small, nothing is more obvious than the absolute ignorance of mankind. It behoves the scientific man to be the most modest of animals. Lord Salisbury has put this truth into admirable phrase and sentence. We can scarcely doubt that he will do good. We have heard it seriously urged that such an address must do harm, in that it will unsettle young men's minds, and lead them to doubt the infallibility of their teachers. By all means let it be so. Empirical science is being ladled into the younger generation as Mrs. Squeers supplied brimstone-and-treacle to the wretched population of Dotheboys Hall. The modern teacher has yet to learn how to say "I believe," instead of "I know." Lord Salisbury's address may smooth the way for the change of words.

◆

### SHEFFIELD AND THE AMERICAN TARIFF BILL.

Apart from the textile towns, no place in England is more closely affected by the United States tariff than the capital of the cutlery trades. At one time America was the key to the whole Sheffield business. That situation no longer exists, and it is still the case that a good business is done with American markets, and much more would be done if the duties were not practically prohibitive. The great expectations formed when the Wilson Tariff Bill was originally submitted have of late been greatly modified, and the strife of parties has recently made England despair of a settlement. Now, however, there seems a clear course to an arrangement. The House of Representatives, evidently believing that the Senate wished to postpone indefinitely the whole tariff question, have adoped the prudent course of taking half a loaf rather than have no bread. In other words, they have abandoned their own Bill and accepted that of the Senate. At Sheffield the reduction of the duties on steel is expected to bring about a substantial accession of business. A large quantity of the steel used by the German, French, Spanish, Swedish, and Russian manufacturers is made in Sheffield, and if the continental makers beat the home manufacturers, further trade will be done from Sheffield with the markets named. In cutlery, the reduction in the new tariff represents a relief of about 25 per cent. as compared with the McKinley Act. In cutlery, as in steel, the very best productions continue to be largely Sheffield monopolies. Lower grades of steel and cheaper qualities of knives can be produced on the Continent and in the States; but the Americans have made singularly little progress in the direction of superior cutlery. This is largely due to the habits the Americans have of "riving" their meat asunder, instead of cutting it cleanly with a sharp knife. In the large hotels and restaurants the men who carve the meat require a tool; hence the great business done in carvers with the States. The number of carvers sent to the Americans is out of all proportion to the table cutlery exported to that market. English carvers are still the rule, and no good hotel hand will have anything else. The intention of tariff reformers in the States is to keep in the country the trade the country can do. Hence the relief in the secondary grades of goods. The future trade of Sheffield with America will mainly be in the best steels, the finest classes of table cutlery, carving knives, pen and pocket knives, hollow-ground razors, and what are known as "case goods"—presentation cabinets of highly-finished articles.

### JAPAN AS A MACHINERY MARKET.

Machinery engineers in this country engaged in the manufacture of cotton spinning plant have of late been doing a large trade with Japan, China, and Russia, and there are evidences that this trade may continue and extend. But it appears that engineers should be cautious with regard to machinery sent to Japan. English machinists must, it is stated, not lose sight of the fact that foreign patents are not protected in Japan. When one machine, patented elsewhere, is obtained, and is fairly easy to imitate, the imitation is at once begun by native labour. A machine capable of doing the same work is then turned out at possibly half the price of the imported plant. In short, it is said that English makers should be very careful about supplying information regarding machinery, "as they cannot tell to what use such information may be applied." This warning has come none too soon. The Japanese have always been noted for their remarkable ingenuity in mechanical matters, and although deficient in the gift of invention, they can alter or copy an original with surprising ability. The enterprise which they are showing in the cotton spinning industry is noteworthy. At present Japan is within measurable distance of the active employment of 700,000 spindles, and it is understood to be the intention of the capitalists promoting this enterprise to increase the spindles shortly to 1,000,000. While, therefore, there is every reason for anticipating a continued large demand of spinning machinery, Lancashire engineers should not give themselves away more than they can help.

### HARVEY ARMOUR TRIALS.

We have received a letter from Mr. Fox, the representative of the Harvey Company in England, pointing out that the two reports of plates tried, dealt with in The Engineer of August 10th, referred to two different plates, as we see now in reading Mr. Fox's letter again. It is satisfactory from every point of view that this should be the explanation of the apparent discrepancies in the accounts. As the matter now stands, a thick Carnegie-Harveyed plate behaved badly, and a thick Bethlehem-Harvey plate behaved very well. That one plate should be a failure is nothing very extraordinary, but no doubt was a serious disappointment. The report of the first trial was reckless in its figures for energy, as we pointed out, but surely the plate was intended as a test plate as reported. Mr. Fox tells us that the plate was not a fair representative plate, and had structural defects. The question then arises whether this was known before the trial, or only then discovered, because if the latter, as we presume, it argues an element of uncertainty which, as we have had occasion to point out, has before now been found in treated plates. This may be got over by experience, and we are right, we believe, in saying that Bethlehem has had more experience than Messrs. Carnegie in treated plates. Certainly if one plate argues possible disappointment, the other argues possible success in really thick Harveyed plates.

## LITERATURE.

*Mining: An Elementary Treatise on the getting of Minerals*, By Arnold Lupton. 8vo., 519 pp. London: Longmans. Green, and Co. 1893.

This treatise, which in the words of the preface "is prepared exclusively for the use of those who wish to teach beginners, or as a handy reference book for busy men whose excess of knowledge and experience causes them sometimes to forget their early lessons," is the work of a busy man who, in addition to an active professional practice, finds time to perform the duties of the two Professorships of Mining at Leeds and Derby, besides acting as Examiner to the City and Guilds Institute of London. The order of arrangement followed in the text, which is generally similar to that usually adopted in elementary books, commences with an introductory chapter on general geology, containing much that is not to be commended, and is followed in regular order by others on exploration, boring, mining, sinking, winding, ventilation, pumping, and all the numerous operations required to bring the produce of the mine into a marketable form. The author's long practical experience has in most of these sections been largely utilised, and the descriptions of actual mining works are very fully given. Among these, one of the most interesting notices is that of the difficult sinking through river alluvium and boulder clay of the large shaft at the Bettisfield Colliery near Bagilt, in North Wales, which was carried out by the author under the direction of the late Mr. J. T. Woodhouse, and is the only instance in which compressed air has been applied to pit sinking in this country. The development and utilisation of power in winding, air-compressing, and other engines used in mines, is treated more in detail than is generally the case in elementary books, the subject being further elucidated by the discussion of diagrams taken from several large winding engines at work in the North of England and Midland coalfields. There is also a useful appendix, giving a series of examples of the methods of working out the leading dimensions of colliery engines as a preliminary to the preparation of detailed designs, the latter subject, of course, being beyond the province of the book. The text is profusely illustrated by sketches, many of which are apparently reduced from lecture diagrams, and are simple and effective, except where the reduction has been pushed almost to the point of invisibility, as, for instance, the scroll drum winding engine, Fig. 513, which covers a space scarcely larger than a postage stamp. Taken as a whole, the chapters devoted to colliery engineering—and these form the principal part of the book—are excellent, but unfortunately as much cannot be said of the author's treatment of metalliferous mining. He has, however, introduced a decided novelty in this part of the subject—on page 19—namely, a list of minerals known to miners, which are said to be fifty-eight in number—rather a startling reduction upon the 600 or 800 species known to mineralogists. As, however, this limited and reduced mineralogy is obtained by allowing one mineral—and one only—as an ore to each metal, the result can scarcely be of much value either to teachers, beginners, or busy men. In the chapter on mining tools, it is said that "the pick is commonly made of cast steel, and sometimes of shear steel. When made of shear steel, the body of the pick is made of iron, and the steel welded on; when made of cast steel, the whole is cast in one piece." This would seem to imply that mining picks are cast to pattern in steel. Surely this is not a general practice? We have also been puzzled by a statement on page 448, that Jordan's water-pressure engines at Clausthal were quite new when seen by the writer in 1883. Judging from the illustration—given in Fig. 568—these appear to be the same engines that were set to work in December, 1876, and would have been between six and seven years old at the date mentioned by the author. Were they actually new engines that he saw? Because if so, those put down at first must have worn out very rapidly.

## *BOOKS RECEIVED.*

*Three Periods of English Architecture.* By Thomas Harris, F.R.I.B.A., F. San. I. London: B. T. Batsford. 1894.

*Society of Engineers' Transactions for* 1893 *and General Index*, 1860 *to* 1893. Edited by G. A. Pryce Cuxson, Secretary. London: E. and F. N. Spon. 1894.

*Dynamo Attendants and their Dynamos.* A practical book for practical men. By Alfred H. Gibbings, A.I E.E. London: Sidney Rentell, 29, Ludgate-hill.

*Minutes of Proceedings of the Institution of Civil Engineers.* Vol. cxvi. Edited by James Forrest, Assoc. Inst. C.E., Secretary. London: The Institution. 1894.

*Rylands' Hardware (including Jewellery, Pottery, and Saddlery.)* A complete directory of Midland manufacturers, 1894. Birmingham: Published by the proprietors of the *Iron Trade Circular* (Rylands') at their offices, 46, Union-passage.

## THE L. AND N.W. RAILWAY COMPANY'S S.S. BANSHEE.

The London and North-Western Railway Company express paddle steamer Banshee has recently been fitted by Messrs. Laird Brothers with new machinery on the tri-compound system, after the pattern of that made by the same firm for her sister ships Lily and Violet, about three years ago, and fully illustrated in our issues for April 17th, May 1st, and August 7th, 1891. The official trials were made last week between Dublin and Holyhead.

On the 30th July she left Holyhead for Dublin, and made the passage from the Breakwater to Poolbeg Light in 2 hours 46½ min., the fastest on record; to the Kish Light her speed was over 21 knots.

The return run was made on Wednesday, the 1st August, in 3 hours 3½ min. During the first half a speed well over 21 knots was recorded, but the latter part was spoilt by a slight derangement of condenser tubes, coupled with adverse ebb tide and considerable roll of sea.

On Tuesday, the 7th inst., she completed her trials by a run from Holyhead round the Kish Light and back to Holyhead—a distance of 96 knots—the machinery working admirably, and the speed attained being fully half a knot in excess of that promised by the contractors. The run to the Kish Light occupied 2 hours 21 min., the engines making thirty-six revolutions with 4750-horse power. The return run against the tide with a rough beam sea and southerly breeze occupied exactly the same time, with thirty-eight revolutions and 5150 indicated horse-power, the speed for the whole time being 20·42 knots. There is remarkably little vibration, and the vessel is extremely handy.

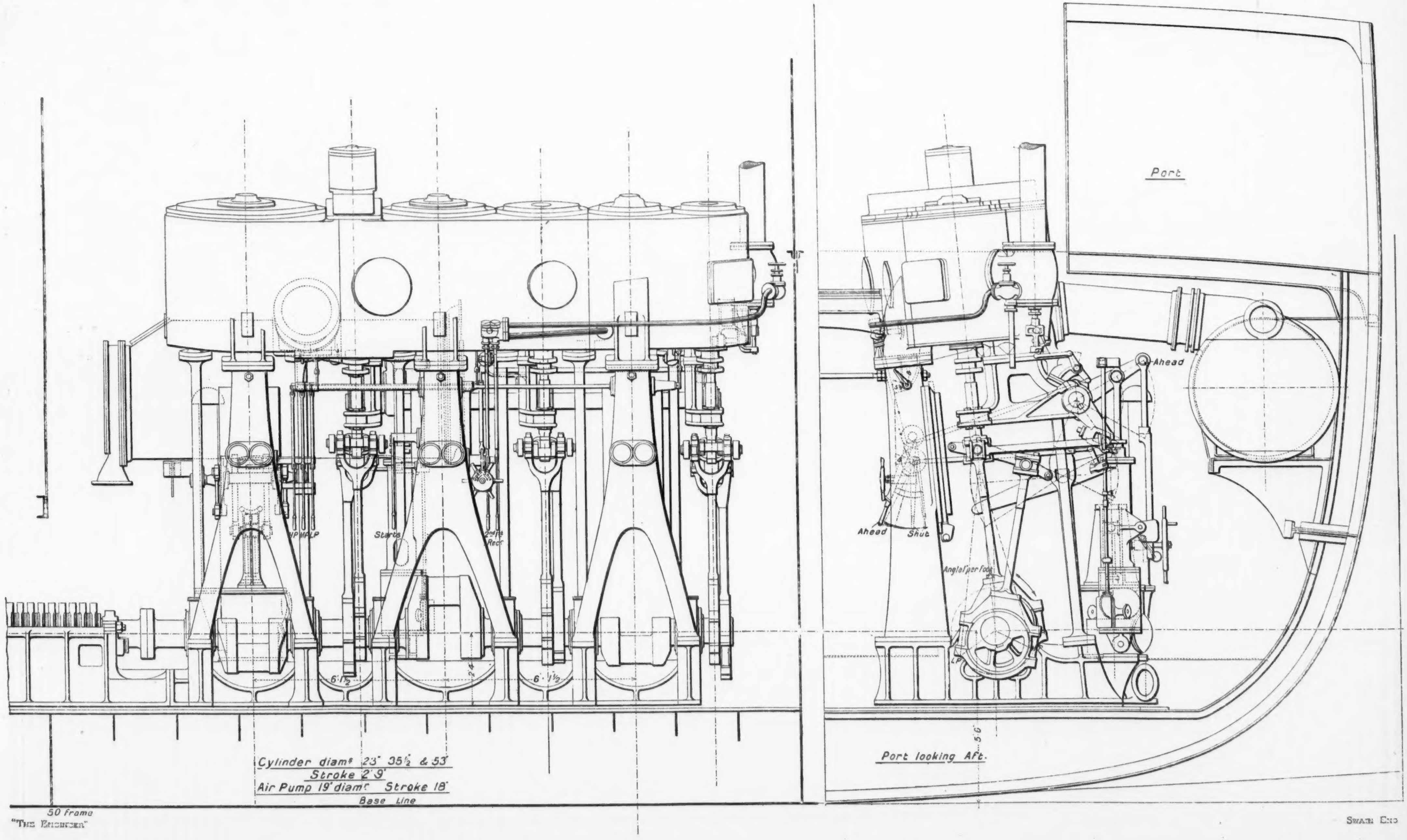
The hull has been thoroughly overhauled, the cabins redecorated, and new furniture, and a complete installation of electric lighting provided. The engines consist of a set of triple-expansion steeple engines. The cylinders are bolted without the intervention of any bed-plate to the engine-room keelsons by ordinary holding-down bolts, and secured to the entablature above by wrought iron columns. The cylinders are placed in line athwartships, the low-pressure being in the middle, the high-pressure on the port side, and the medium-pressure on the starboard side. The pistons and piston-rods, the bowstring crosshead pieces, and the connecting-rods, as well as other parts, are of steel. Owing to the small athwartship space in which it was necessary to place the three cranks, the valve chests are placed on the aft side, and excentric motion dispensed with. The type of valve gear adopted is Joy's, which is well known as possessing the good point of occupying little room. Piston valves are used for the high-pressure and medium-pressure engines, and a balanced D-slide for the low-pressure engine. The reversing gear is attached to the upper framing which supports the guides, and is worked by a steam and hydraulic engine. The crank pins, crank shafting, and paddle shafting are of hollow steel. All the bearings have a very large wearing surface. The condenser is placed in the fore part of the engine-room. The circulating water is supplied to it by a 16½in. centrifugal pump, driven by a compound engine. The air pumps are of special design. There is a vertical triple-expansion engine placed immediately over the three air pump cylinders, each steam cylinder and pump cylinder being in line, the crank shaft being placed between. The main feed pump is separate, and there are also auxiliary steam feed pumps, bilge, and fire pumps.

Steam is generated in six boilers of the locomotive marine type, at a pressure of 155 lb. on the square inch. They are placed in two groups of three each, in two closed stokeholds. Air is supplied to the furnaces by two large fans situated on the upper deck, driven by two sets of compound vertical engines. The air pressure is three-quarters of an inch of water. A winch boiler is fitted in the after stokehold for use in port. The paddle-wheels are fitted with curved steel floats of special design.

# TWIN-SCREW ENGINES—S.S. DUKE OF YORK

MESSRS. DENNY BROTHERS, DUMBARTON, ENGINEERS

(*For description see page* 147


Cylinder diamrs 23" 35½ & 53"
Stroke 2' 9"
Air Pump 19" diamr Stroke 18"
Base Line
50 Frame
"The Engineer"
HP MP LP
Starts
2nd 1st Recr
6' 1½
24
6' 1½
Port
Ahead
Ahead
Shut
Angle per foot
LP
5.6
Port looking Aft.
Swain Eng

# SOME REMINISCENCES OF STEAM LOCOMOTION ON COMMON ROADS.*

By Sir FREDERICK BRAMWELL, Bart., F.R.S., M. Inst. C.E.

IT has occurred to me that this paper may have some interest for Section G on two grounds:—(1) That it deals with a branch of mechanical engineering of which the present generation knows practically but little; and (2) that it involves, very largely, the subject of water-tube boilers or their equivalents.

I do not propose, in this paper, to give the whole history of steam locomotion on common roads, beginning with Cugnot's carriage—which it is reported really did move in Paris at some three miles an hour, as long as the steam kept up—as far back as 1769, nor to mention the propositions of the ingenious American, Oliver Evans, in 1772, whose plans, so far as regards common road carriages, it appears were never carried out; nor do I propose, in this paper, to occupy any time about steam traction engines or road rollers, nor about steam motors on tramways; but I mean to confine myself to a description of some of the steam coaches, which carried passengers generally on the same carriage as that on which the engine and boilers were mounted—a construction which, so far as I am about to deal with the subject, it will be found was departed from only in the case of Sir Charles Dance's engine, hereinafter mentioned. As indicated by the title of my paper, I intend to confine myself to *some* reminiscences on this subject, embraced, so far as my own knowledge goes, between, say, six or seven years in the thirties or forties of this century.

I think I am right in saying that by about 1825 our turnpike roads, and the stage coaches which ran upon them, had attained to the highest degree of excellence. At this time passenger railways were practically "in the air," omnibuses were running in London, and cabs were superseding the old hackney coaches; and there was a general feeling that on our magnificent turnpike roads increase of speed and economy could be attained by the employment of the steam engine, and it was also felt that such a mode of propulsion would compete successfully with the omnibuses. The natural result was that very many men, more or less ingenious, and more or less practical, devoted their attention to the subject of steam locomotion on common roads. I propose to describe, briefly, some few among the whole number of those inventions which really resulted in carriages that did practical running on common roads. Certainly the most enduring and successful of these men was Walter Hancock. He took great notice of me, then an apprentice, and, after his day's run in London, frequently took me down on the coach to his factory at Stratford. I became very much interested in this subject, and took occasion to see all that was to be seen, and to hear all that there was to be heard. Another coach that did good service was that of Summers and Ogle. Summers was son-in-law to the engineer Hague, to whom I was apprenticed. I was thus, as it were, in a steam-locomotion-on-common-roads-atmosphere.

In 1830, as you all know, the Manchester and Liverpool Railway, which I think I may fairly call the first real passenger railway, was put to work. Nevertheless, in 1831, a Parliamentary Committee of the House of Commons was constituted, which Committee reported in 1833, and I think it only fair to the enterprise of steam carriages on common roads, to give the summary of their report. It is as follows:—"(1) That carriages can be propelled by steam on common roads at an average rate of ten miles per hour. (2) That at this rate they have conveyed upwards of fourteen passengers. (3) That their weight, including engine, fuel, water and attendants, may be under three tons. (4) That they can ascend and descend hills of considerable inclination with facility and safety. (5) That they are perfectly safe for passengers. (6) That they are not—or need not be if properly constructed—nuisances to the public. (7) That they will become a speedier and cheaper mode of conveyance than carriages drawn by horses. (8) That, as they admit of greater breadth of tire than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses. (9) That rates of toll have been imposed on steam carriages which would prohibit their being used on several lines of road, were such charges permitted to remain unaltered." You will see that by Section 9, they refer to the excessive tolls, and state that such tolls would be prohibitory, if they were to remain unaltered. With respect to these tolls, the Committee give the following illustrations:—"On the Liverpool and Prescot-road, Mr. Gurney's carriage would be charged £2 8s., while a loaded stage coach would pay only 4s." "On the Bathgate-road, the same carriage would be charged £1 7s. 1d., while a coach drawn by four horses would pay 5s." "On the Ashburnham and Totness-road, Mr. Gurney would have to pay £2, while a coach drawn by four horses would be charged only 3s."

But not only did the opponents of steam carriages on common roads oppose them by obtaining heavy tolls to be laid on, but they used actual physical obstruction, as appears by the following:—In a letter of the 3rd February, 1832, from Sir Charles Dance to Mr. Gurney, it is stated that on the 22nd June, 1831, "It was reported to me by my engineer—Mr. Stone—that large heaps of stones were laid across the road about four miles from Gloucester, 18in. deep, which the engine had passed over twice—in going to and returning from Cheltenham—with considerable difficulty, and that it was so unusual a mode of repairing a road—which was in excellent order and required no repairs—that it must be a serious obstruction to all descriptions of carriages." Mr. Stone's letter of the 22nd June, 1831, accompanies Sir Charles Dance's letter. It is as follows:—"Yesterday morning we found the road filled up with loose stones for a considerable way near the four-mile stone. The carriage with difficulty went through them, and also returned through them again, without any mischief, but the third time the strain broke the axle between the throws. The horse coaches have been stopped in the stones. The clerk at the Branch Bank of England says that he came across by the mail this morning, and that it was also stopped. Mr. Todd, of Cheltenham, says he was obliged to get down from the coach he came to town by, and that the horses could not get it through. The Champion, from London, a fine four-horsed coach, was brought up, and, in whipping to get through, broke the harness to pieces. Wagons are obliged to get extra horses, in fact the proceedings are most unaccountable. It is some relief, however, to know that the steamer has gone through, where the horses have been brought up, and I hope soon to get the axle mended."

But I do not think that either excessive tolls or road obstructions were the real cause of the cessation of the steam carriage enterprise upon common roads. Year by year railways were increasing, and the public lost interest in the common road steam carriage, which was merely to develope a speed of some fifteen miles an hour, which required a large expenditure of power for the weight moved; and they turned, and wisely turned, towards the iron way. Among the six or seven names with which I am most familiar, it is difficult to assign any definite order of sequence of invention, inasmuch as, in some cases, the same inventor took out patents at varying dates. Hancock had a patent in 1827; so had Gurney; Summers and Ogle, in 1830; Church, in 1832; Maceroni, 1833; Dance, 1833; and Hancock, another patent as late as 1839. Hancock, and most of those who worked on the subject, dealt very wisely in one most important respect, with their carriages to be used on common roads; that is to say, the vehicles themselves were very commonly like a large stage coach, or—as I shall have to say with respect to Hancock—were of the omnibus form, or deviated from this, by the adoption of the char-à-banc construction. With the exception of the driving wheels, there was no moving part of the machinery visible. There was no noise from the exhaust—in the best of them—nor any visible indication of fire or steam, that is to say, neither smoke, nor a white cloud. Their appearance, therefore, was not such as to be, of necessity, alarming to horses. No doubt it was true that during, say, the first week of the running of a steamer upon a regular journey, such as the Bank to Paddington, horses would pay some attention to it, but at the end of a week the horses habitually using the road were absolutely indifferent, and, in fact, horses generally were very little disquieted. But for years after Hancock steam locomotion on common roads remained in abeyance, and when it was taken up again, it was with the totally different object of traction engines, travelling ploughing engines, and road rollers. These were carried out by some of the best of our mechanical engineers, and, as machines, were excellent; but with respect to the horse difficulty, were about as bad as they well could be. All the moving machinery was visible; there was the "barking noise" due to the steam blast; they occasionally emitted fire; and their general forms must have been an abhorrence to any horse possessed of the slightest particle of good taste. The result, as we know, has been legislation, confining the use of these vehicles to night, or, if worked in the day, to be preceded by a man with a red flag and the various paraphernalia.

I will now give a few particulars of the steam carriages to which I have already alluded, and I will commence with that of Hancock. In his case I propose to give a longitudinal section of one of his char-à-banc coaches, such as the "Infant," one of the earliest, or the "Automaton," the latest of those he built; but, generally, I shall confine myself to illustrations of the boilers, as probably these are more interesting in the present day than are the details of carriage and engine construction. Fig. 1 is a longitudinal sectional elevation of one of Hancock's carriages of the char-à-banc construction, with a sheltering roof. I may as well here give a list of Hancock's coaches:—The "Infant," of the form shown on the diagram. The "Era," which became converted into the "Erin" when it went to Ireland; this had an ordinary stage-coach body. The "Enterprise;" this had an omnibus body. The "Autopsy;" I cannot remember what was the nature of the body of this carriage, although I remember the name. The last carriage of all, the "Automaton," was a covered char-à-banc construction, as shown on the diagram. In all cases the passengers and the engine and boiler were carried on one and the same structure; except when, to show the power of the engine, an ordinary omnibus body was towed behind the steam carriage.

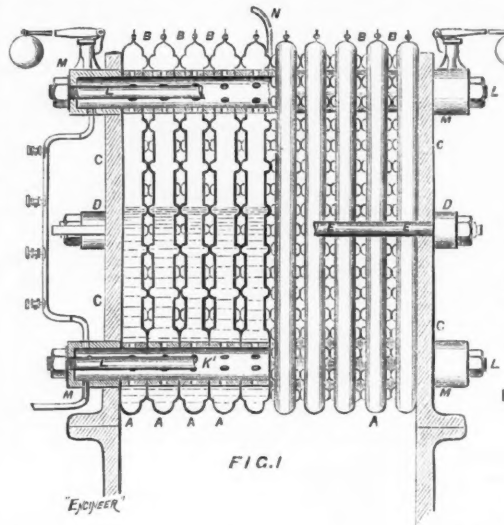


FIG.1

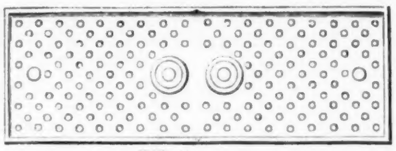


FIG.4

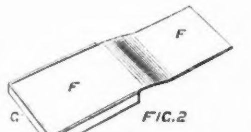


FIG.2

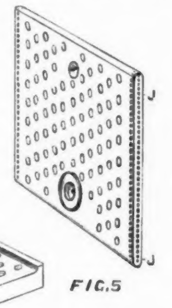


FIG.5

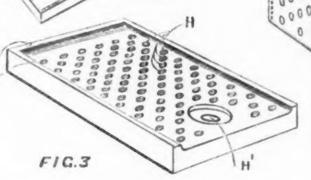


FIG.3

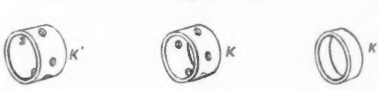


FIG.6

Whatever may have been the nature of Hancock's earlier experiments, he settled down into a construction of boiler consisting of a number of flat chambers placed side by side, with spaces for the ascent of the products of combustion in between the chambers containing the water. Time will not admit of entering into the details of the steps by which the construction of boiler eventually employed in his steam coaches was reached, and I will content myself, therefore, by dealing with the perfected boiler as I knew it. The boiler was an equivalent for a water-tube boiler, in that, as in water-tube boilers, the fire was outside the water, and not inside. This boiler combined lightness, strength, and large heating surface. Fig. 1 is an end elevation, one-half in section. It shows a number of narrow chambers, *a*—10 are drawn—placed side by side like books on a shelf, with this important difference, however, that between each chamber *a* there was left a space *b*, through which spaces the products of combustion passed. At the outsides of the outside chambers—Nos. 1 and 10—were very stout wrought iron plates *c*. Beyond these were girders *d*, *d*, &c., longer than the width of the plates, so that the ends of the girders projected clear beyond the width of the chambers. Through holes in the ends passed tie-rods *e*, *e*, &c., across the whole length of the boiler, by which rods the various chambers of the boiler were held together. But it will at once be seen that, as there were spaces *b* between the chambers *a*, these tie-rods *d* could not be effectively tightened up, because there was an absence of any proper abutment for them to pull against. This abutment was provided for in a manner which I will mention in the description I am about to give of the mode of manufacturing the chambers.

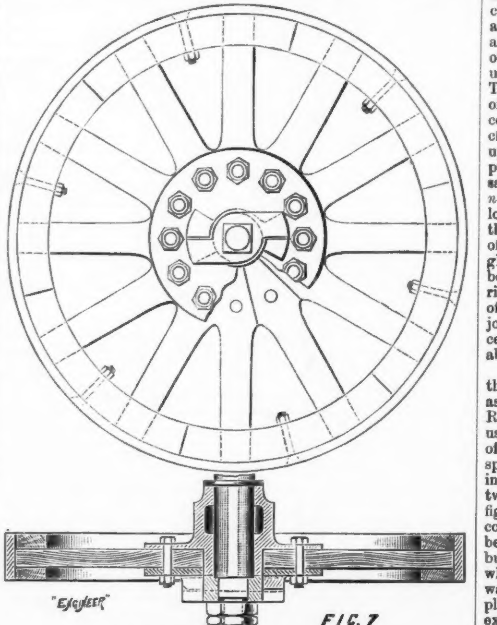


FIG. 7

Fig. 2 shows a flat plate *f* of copper or of soft iron, laid upon a cast iron slab *g*—which slab is shown separately in Fig. 3—provided with indentations having the shape of segments of spheres—practically hemispherical—*h*, *h*, *h*, &c., and a larger flat indentation *h*. The slab *g* was also provided, around three sides of its margin, with a raised rim *i*. About one-half of the plate *f* is laid over *g*, and by means of hammering, is caused to pass into and to take the forms of the depressions *h*, *h*, *h*, in the slab *g*. The other half—about—of the plate *f* is treated in the same manner, giving the result shown in Fig. 4. The plate *f* is now bent up into the form shown in the general elevation. It will be seen that there has been made out of the metallic plate *f* a flat chamber, in the form and of the construction of a "biscuit bag;" as in this bag there is no joint at the bottom, so that there are no rivets exposed to the direct action of the fire, but the riveting is confined to the two sides and to the top. It may be well to say here that there was an alternative mode of construction, which consisted in the making of a channel iron *j*, which was put in between the sides of the flat plate *f*, so that those sides needed not to be "set in," as was previously mentioned. This gave a double line of rivets. The construction is shown isometrically in Fig. 5.

Passing away from this alternative mode of joint-making and reverting to the chamber, I will call attention to the circular holes—according to my recollection, of about 3in. or 4in. in diameter—which were made through the walls of the chamber at the upper and lower parts, in the large flat circular projections provided for this purpose at the lower part, and in the plain wall of the chamber at the upper part. Before the chambers were riveted up, there was put into each of them two gun-metal rings *k*, *k*—see Fig. 6—the top rings *k* being narrower than the bottom rings, *k*. The internal holes in these rings were of the same diameter as the holes in the sides of the chambers. The radial holes were to make connection between the body of the chamber and the internal holes in the ring. When the chambers were put together, the rings were brought to be concentric with the holes in their sides, and intermediate rings. *k* 2 without radial holes, being put at the upper parts between the chambers, there was passed through the whole number of chambers at top and bottom strong tie-bolts *l*, leaving, however, an annular space between the exterior of the tie-bolts and the interior of the rings. On the outside chambers hollow sockets were placed, upon the close ends of which bore the nuts of the tie-bolts *l*. These sockets are indicated by the letter *m* in the general view of the boiler A. By this simple arrangement there was formed a complete connection for the water at the lower part of all the chambers, and another similar connection for the steam at the upper part of the chambers. Into one of the lower sockets was pumped the feed-water, and on the upper sockets were placed the safety valves. The steam to the engine was taken off by the pipe *n* from the central intermediate ring *k* 2. The upper and lower sockets were also connected by a vertical pipe, external to the fire-casing, in which were placed, at frequent intervals, a series of—not gauge *cocks*, but—gauge *valves*, to serve the purpose of a glass water-gauge. It should have been stated that the joints between the various chambers were made by a simple copper wire ring, somewhat flattened out by the pressure produced by the nuts of the tie-bolts. For years past such or similar modes of making joints tight have been well known, but Hancock was the first, or certainly among the first, to dispense with red lead and other abominations, and to make metal-to-metal tight joints.

In connection with Hancock's boiler, it may be mentioned that the same principle of using a series of flat chambers, so disposed as to cause them to support each other, was adopted by a Mr. Redmund, a malleable iron manufacturer in the City-road, who used corrugated plates for the sides of his chambers—the summits of the corrugations impinging the one upon the other—in the flue space. He made his two vertical seams of each chamber by riveting the plates together, and formed the top and bottom joints by two malleable iron castings, having the requisite corrugated configuration at their edges, which castings were inserted between the corrugated plates, the rivets going through all. I do not remember how he made his steam and water connections. I am not sure, but I believe that this boiler was put into a steam carriage, which, however, was a failure. Hancock's collection of chambers was placed a short distance above the fire, or in the last patent was placed not directly over the fire, but at the side. There was an external casing which contained the boiler, the fire chamber, and the ash pan. This pan was closed and the draught was excited by a fan driven off the main engine. The waste steam was blown into the ashpit and passed up through the fire, with the result that, except upon a very damp morning, at first starting there was not, as I have already said, any visibility of the waste steam, neither was there any sound. The safety valve, also, when it blew off, delivered the escaping steam into a silencing box. Fig. A shows that the engines were of the inverted vertical type, working on to a crank shaft, carrying a pitched pulley for a chain. This pulley could be uncoupled from the shaft by a clutch, and then the engines could be worked to drive the fan to get up steam, or to feed the boiler. I need hardly say this was long before the days of injectors, and was also long before any common use of donkey engines. On the axle of the hind wheels was a corresponding pitched pulley, either of equal diameter with that on the crank shaft or, I am inclined to think, of somewhat greater diameter. The wheels were of wood, having very strong spokes, enclosed in a cast iron nave with covering plate. They were loose upon the ends of their shaft, and had on the outsides of the nave two driving projections—Fig. 7. On the ends of the shaft were two drivers, which could be drawn out of gear with the wheels by screws. In ordinary running both drivers were in gear, but it will be seen there was left a very large amount, probably 100 degrees or more, of that which may be called "back-lash." Supposing that, in steering through the streets, it became necessary to make a slight curve, the result was that the wheel on the inner side of the curve did the driving, while the wheel on the outer side over-ran the driver. It thus became possible to follow a sinuous track with great ease, so long as the curves were inconsiderable in length. When it became necessary to make a very sharp curve, as, for example, to turn the coach completely round in a very small yard, in Wenlock-place, City-road, provided with only a single entrance, the clutch of the inner wheel of the intended circle was drawn completely out of gear, leaving the turning to be done by the outer wheel. In this way, the coach was got round practically in its own length, the fore carriage being competent to lock to such an extent as to put the centre of the circle but a small distance away from the inner wheel. This elaborate preparation to accommodate the driving wheels to the conditions needed when making a curved track, would, in these days, be, of course, wholly unnecessary, on account of the employment of the "Jack-in-the-box" arrangement, to attain the desired end, and to do so in a much better way. "Jack-in-the-box" has long been employed in traction engines, and, indeed, in the Exhibition of 1862, a passenger carriage, built by Messrs. Garrett and Marshall, of Leeds, for Mr. George Salt, of Saltaire, was fitted with this apparatus.

---

* Paper read before Section G of the British Association at Oxford, 9th August, 1894.

FIG. 8

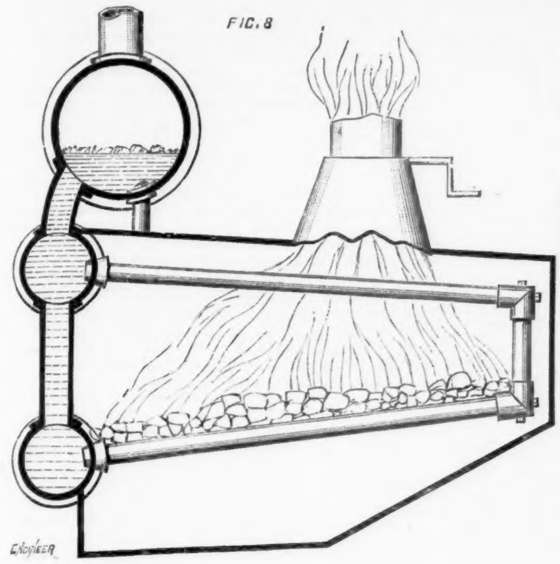
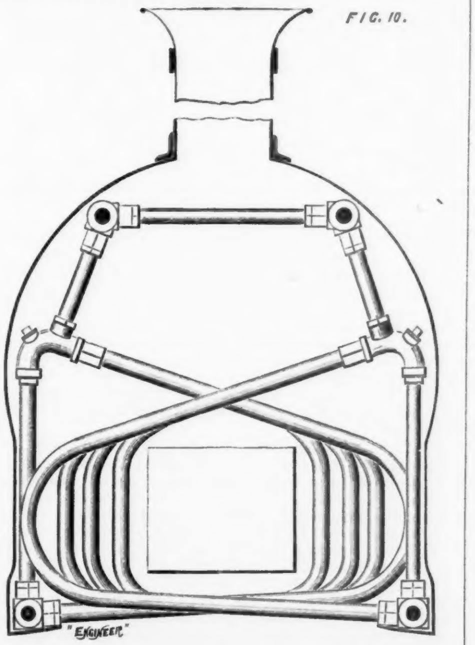


FIG. 10.



In the latest of Hancock's coaches, the "Automaton," provision was made for partially condensing the exhaust steam by passing it through condensers of somewhat the same construction as that of the boilers, and placed in the water tanks which were under the floor of the char-à-banc. I am under the impression, however, that these were never a success. In fact, Hancock thought of every detail tending to the efficient working of his coaches. For example, he met a considerable difficulty that arose from the clinkering of the fire bars, by two methods. The first was to put the bars into a sliding frame, so arranged that while the clean bars were at work supporting the fire, the dirty bars were altogether outside the fire casing, so that they could be cooled down, and then the clinker could be readily removed. When this had been accomplished, the outside set of bars were fit to be slidden under the fire, while the bars which had been in use were, in their turn, brought to the outside. An alternative plan was, to make the fire-bars circular, lying in supports, and having projecting ends, made to take a winch handle. In this way the bars could be turned in succession, breaking them away from the clinker, which was then readily removable. Another, and a great precaution to prevent "priming," since then, no doubt, very largely used, was, I believe, Hancock's idea, namely, the taking away the steam from the boiler through a very restricted orifice. My recollection is, but I do not speak with perfect certainty, that the pair of 10in. cylinders—or they might have been 12in.—in the "Automaton" were supplied by a $1\frac{1}{4}$in. steam pipe. This pipe had a coil bend in its passage from the boiler to the engine to admit of any variation, owing to the straining of the framing between the boiler and the engines, and thus to obviate the chance of fracture of the pipe.

In these days—as I have said—injectors were not, and considerable difficulty had from time to time been experienced by the sticking up of the valves of the feed pumps. To guard against this, Hancock used two suction valves in succession, and two delivery valves in succession. The steering was done by means of an ordinary fore-carriage fixed upon a central vertical pin, carrying a pitched chain wheel geared up to a wheel of the same kind, keyed on to a vertical steering spindle, on which was a hand wheel. It was found in the outset, especially when going over pavement, that the blows inflicted by the pavement on the fore-wheels were communicated to the arms of the steersman with a very distressing effect. This was entirely got over by the simple expedient of a foot-brake. These coaches worked for a period of over twelve years. They, or some of them, made long journeys with great success; but their most interesting use, as showing the ability of steam-driven coaches to cope with the needs of the traffic of a great city, of many road materials, and of gradients exceeding that of any hill on the road from London to Holyhead, was their lengthened employment for ordinary omnibus traffic between the Bank and Paddington, and, morning and evening, between the Bank and Stratford. The journeys were made regularly from Paddington to the Bank, backwards and forwards, involving, on the homeward journey, the ascent of Pentonville Hill. Not only did his various carriages surmount this ascent without difficulty, but on more than one occasion did they accomplish it even when towing an ordinary omnibus full of passengers behind them. The New-road, and Pentonville-road, were macadam; the City streets were then of granite pitching, and the Stratford-road was of gravel. Over the whole of these different formations the coaches worked perfectly. The weights of these coaches varied in working order from $3\frac{1}{2}$ tons to $4\frac{1}{2}$ tons.

FIG. 9

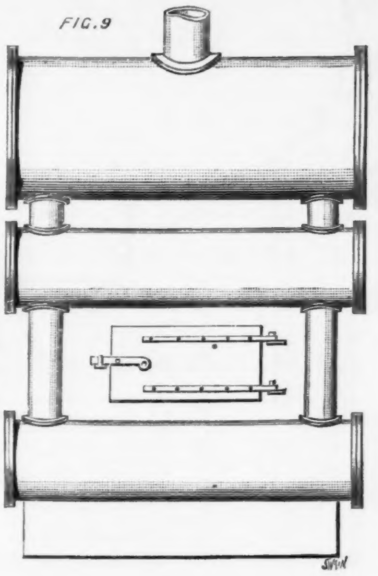
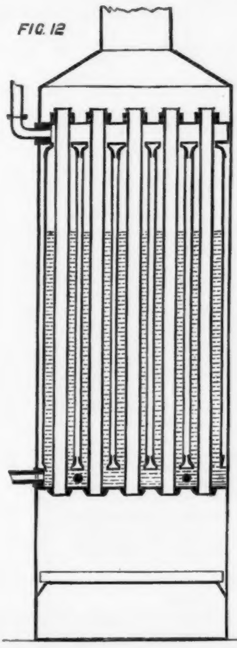


FIG. 12

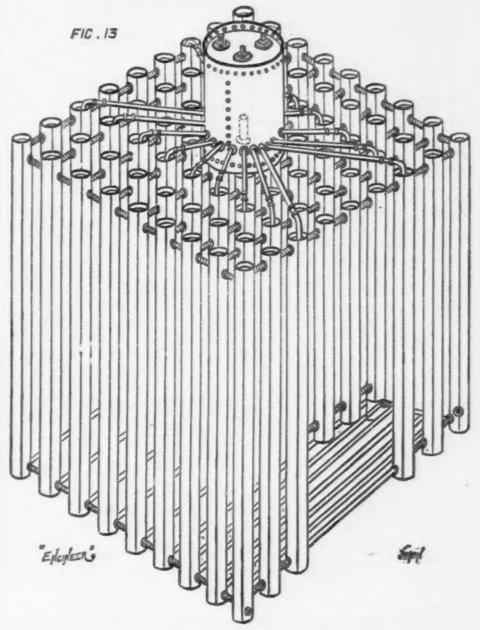


I am aware that I have spent much time over Hancock, more than I can afford to any other of the steam coaches, but I think Hancock is entitled to this extent of notice, because he persevered more than any other person who devoted himself to the subject, because I believe he understood its practical working better, and because he attained a far greater measure of success.

The next carriage with which I will deal is that of Goldsworthy Gurney. Fig. 8 is a longitudinal section of the boiler and of outside view. This, it will be seen, was essentially a water-tube boiler, and consisted of two main tubes—cast iron I believe they were—placed horizontally parallel the one above the other; from the lower end of these main tubes there issued a series of wrought iron tubes slanting upwards for some distance, and then bending, continuing on, over and to the top main tube. This carriage—or rather these carriages—made various experimental runs with more or less success, notably one from London to Bath, and worked for a considerable time between Cheltenham and Gloucester, but was eventually abandoned. I never saw it running, nor did I ever see it together as a whole; my personal knowledge was confined to the boiler, and was of the character of that of the converted cannibal who, being asked what he thought of the late bishop, said he knew he was a very nice man for he had eaten a bit of him. The very first day of my apprenticeship was occupied in holding the chisel rod for a labourer who was cutting up the boiler into scrap. The boiler drawing speaks for itself.

The next carriage I will mention was that of Sir Charles Dance. This was a steam traction engine, and had no seats for passengers, but towed an omnibus behind it. The engine was built by Messrs. Maudslay and Field. Fig. 10 gives a transverse section of the boiler, and Fig. 11 an enlarged detail. This boiler, it will be observed, is a strictly water-tube boiler, and, in cross section, somewhat like a capital letter X. Smaller tubes, started from horizontal tubes, at an angle of 45 deg. or thereabouts, interspaced so as to pass each other at the centre of the X, and going upwards until they reached the special arrangements—Fig. 11—by which the steam was separated from the water. The pipes continued upwards, and were united by cross tubes from which the steam was taken. This carriage worked extremely well, and went at a very considerable pace; for instance, I remember travelling by it from London to Reading—a distance of about forty-five miles—which on the down journey was performed, from Hyde Park Corner, in $3\frac{1}{4}$ hours, towing a full omnibus behind it. I remember we put up in the inn yard of a coaching house—the name of which I have forgotten—but we had to select this yard because it had gates at each end, and therefore we could get out without having to turn round in the yard. I presume Messrs. Maudslay simply followed directions; but, however this may be, the driving wheels of the traction engine were both of them keyed on to the shaft hard and fast, as though they had been the paddle wheels of a steamer, with the result that it was impossible to make a curve of a small radius; and I remember the right angle turn from the street into the inn yard was only made by a succession of backings and fillings, and my impression is that, even with these, we did not accomplish the right angle bend without sacrificing one of the gate posts. We left Reading, I think, about three o'clock in the afternoon; but the return journey was not done nearly so quickly. The stoker, although he had dined, was fatigued, and he allowed the fire-bars to become clinkered. Most of the passengers, I being of the number, tired of sitting inside an omnibus—remember there were no garden seats in those days, nor even "knife-boards"—came outside, and sat along the edge of the roof all round, like undertakers' men on a hearse. How we held on I don't remember, but we arrived at Hyde Park Corner in the height of the season, covered with soot and blacks that we had received from the funnel. I doubt whether this traction engine—for such it was—worked more than experimentally for one or two seasons.

FIC. 13



A single figure—Fig. 12—which will be sufficient for the purpose, shows the boiler of Messrs. Summers and Ogle's invention. It is strictly a water-tube boiler. The tubes are vertical, and have each an internal tube, giving therefore an annular water space. The external vertical tubes are connected at their top and bottom in transverse tubes, which, I believe, were of a ⊂⊃ section, the lower ones to make the water connection, the upper ones to make the steam connection, while the internal tubes served as stays to join the vertical and horizontal tubes together. This boiler was made of charcoal iron, was proved to 364lb. on the square inch, and ran at 240. The boiler weighed $8\frac{1}{2}$ cwt., and had 245ft. of heating surface, including the portion which was occupied by the steam. The iron was $\frac{1}{10}$in. thick. This coach worked very successfully, in a variety of long and short journeys, but, like all the rest, was eventually abandoned.

Fig. 13 gives a drawing of Maceroni and Squire's boiler. It will be seen to be practically Summers and Ogle's boiler, that is to say, vertical water-tubes, but with the internal tubes omitted, and with the side tubes longer than the tubes in the middle, so as to form a partial external wall to the fire-place. Colonel Maceroni was a powerful man with his pen, and those who are interested in the subject of steam locomotion, and are willing to take it from Colonel Maceroni's point of view, are referred to a pamphlet, published by Effingham Wilson, Royal Exchange, and George Herbert, Cheapside, in 1835. There is another pamphlet by Maceroni, I believe, in the following year, called "Maceroni *versus* The Mechanics' Magazine," which may interest students of the subject. This carriage ran very successfully, but I am obliged to close the account of it as usual by saying that it was eventually abandoned.

Fig. 14 shows one construction of the boiler of Church's coach. The fire was made in a water jacketed horizontal portion of the boiler, which at its higher end carried a vertical cylinder having a bottom tube plate through which rose a number of vertical tubes, which, at their top ends, as I remember, was said at the time turned over and outwards like the supports of the ribs of an umbrella, and thus were enabled to pierce the sides of the vertical boiler and to obtain access for the products of combustion which had passed through them to a circular flue space surrounding the vertical part of the boiler. Fig. 15 shows the alternative plan. In this instance the vertical part of the boiler had an internal cylinder, leaving only a thin annular water space. Near the bottom of this inner cylinder small tubes issued, and were bent upwards so as to rise vertically through the top plate of the cylinder; in fact they were like the tubes of Fig. 1 turned upside down. These were true water tubes. The products of combustion arose between these tubes, and escaped by outlets made through the annular water space into the circular flue, which, as in the previous instance, surrounded the boiler. My recollection is that these boilers, or one of them, was put into a coach—or coaches—which actually ran, but I cannot find any particulars of the journeys.

There is a drawing of Griffith's carriage, which was constructed by Messrs. Bramah—for Mr. Griffith—at page 241 of the 1st volume of Limberd's "Mirror," 15th February, 1823. The carriage is stated to weigh 3½ tons, and was destined to carry 3 tons of merchandise, but I have no account of its running. Fig. 16 is a transverse section of the boiler, which consisted of two flat vertical water chambers, placed one on each side of the fire, and connected together by horizontal water tubes—2ft. long and 1½in. in diameter—of which there were 114. The boiler never could be kept tight, and the whole thing was a failure.

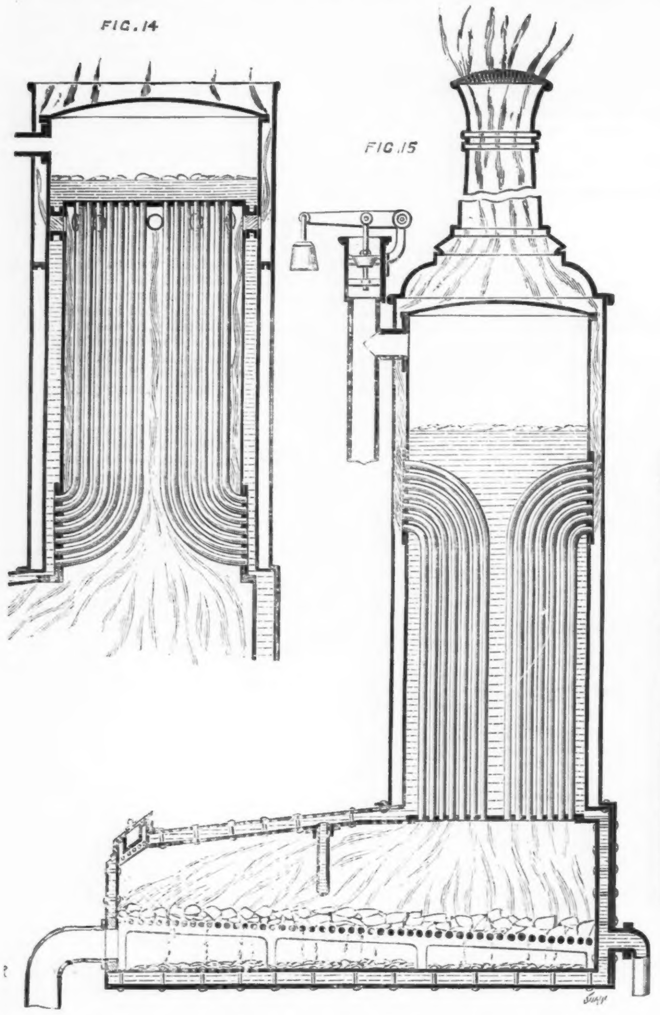
The last steam coach of which I intend to give any description is Scott Russell's. I wish I could give you a drawing of the boiler, but I cannot. As many as seven or eight were built to run between Glasgow and Paisley. These coaches had been running some time when, on the 29th July, 1834, one of them exploded, as it was starting from the Half-way House. Three persons were killed, practically on the spot, and, I believe, two or three of the wounded died afterwards. Mr. Scott Russell did not take out any patent for his boiler except in this sense, that he patented a cubical vessel, made of extremely thin flat sides, but strengthened by innumerable tie-rods, going from side to side. I believe he suggested one for each square inch. He shows no other drawing than this typical vessel, but says, in effect, it would be easy to apply his principle, when flues, &c., are introduced for the purpose of employing the vessel as a boiler. I believe this construction was adopted in the coaches before mentioned. After this explosion, two of the coaches were sent to London. I saw one of them under way. I believe I rode by it. According to my recollection the steam pressure was much reduced, and the speed, I believe, hardly exceeded a walking pace. It is said that one of these boilers burst in Oxford-street, but I did not see it, nor did I know much about it. No one appears to have been injured. The terrible accident at Glasgow had a very damaging effect upon the progress of steam carriages on common roads.

My last reminiscence of a passenger steam carriage on common roads is a comparatively recent one; I refer to the carriage constructed by that most able mechanic, the late Mr. Loftus Perkins. This was purely experimental; it carried only two or three persons. The boiler was the well-known "Perkins" water-tube boiler; the engines were compound, and with the boiler were carried on the framing of the single-steering wheel—it was a three-wheeled vehicle—which was also the driving-wheel, so that the crank shaft was always normal to the direction in which the carriage was going. When speaking of Hancock, I gave him the credit for being the introducer of diminishing "priming" by the use of very small steam pipes. Perkins, with this high-pressure steam of some 600 lb., carried this principle to a still greater extent, and he was in the habit of wearing on his watch chain a piece of pipe having a bore of only ⅛in., through which he had taken the steam for 40-horse power. I am informed, by a letter from Mr. Perkins' son, that this engine is still in use at the Gypsum Works, near Battle.

I do not make any reference to Nairn's carriage, which ran for a long while between Edinburgh and Leith. I do not refer to this because, although no doubt it is one of *my* reminiscences, it is one of so recent a date that it must be included among *your* reminiscences. Neither do I propose to enter into the description of the competition among the self-moving road vehicles in France, which is now taking place, but I am glad to see from the illustrations in the technical papers that the French have appreciated the desirability—indeed, the need—of constructing the vehicles in a manner that should not shock the susceptibility of horses, and, as one who is and always has been much interested in this subject of steam locomotion on common roads, I am very glad to find that it has been taken up by our neighbours, who, having regard to their great engineering ability and their consummate taste, should of all people be likely to obtain a successful result.

FIG. 14

FIG. 15



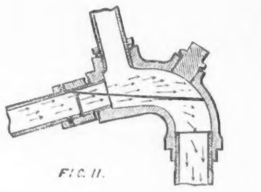
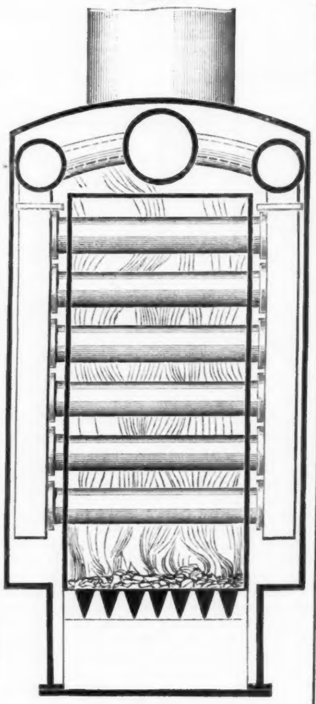


FIG. 11

FIG. 16



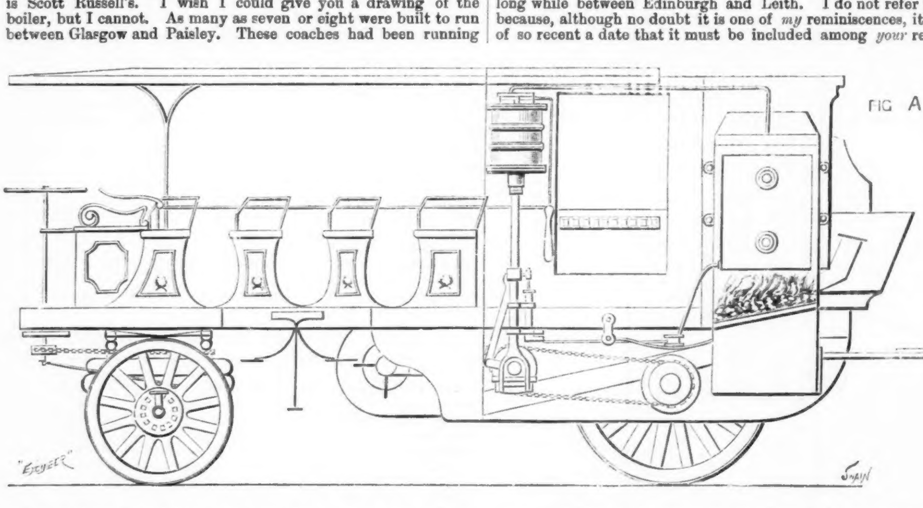


FIG A

---

South Kensington Museum.—We have received the forty-first report of the Department of Science and Art. It contains, among much other information, a statement of the yearly attendances at the South Kensington Museum from the opening of the museum in 1857 to 1893. The total from June, 1857, is 31,805,642, and the number for 1893, 1,174,211. The number of readers attending the Science and Education Library in 1893 was 18,087. The number of readers in the Art Library in 1893 was 22,951. The report also mentions some of the principal purchases made for the museum during the past year. As regarded science instruction, Lord Rosebery and Mr. Acland say:—"In some subjects of science aided by the Department we are of opinion that the instruction given is not sufficiently practical. Although the Department has endeavoured with the staff which has been up till now at its command to insist as far as possible on practical work, yet to test its efficiency has been beyond its power except by examination in the Honours Stage of some few subjects."

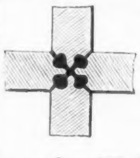
## WELDLESS ROLLED CHAINS.—THE KLATTE PROCESS.

The production of weldless chains is a problem which has occupied the time and taxed the brains of many inventors, but hitherto without any very striking practical results. Perhaps the best known attempt in this direction is that of Oury, who patented in 1881 a process for making chains out of iron or steel bars of cross section by punching and forging in dies, obviously a very costly method.

Mr. O. Klatte, a German engineer, has, however, at length solved the problem in question in a manner which appears likely to prove practically successful, not merely mechanically but commercially. The main process in Mr. Klatte's method is one of rolling, and the preliminary form is also a bar of cross (+) section.

After the bar has passed through the chain rolls it still remains a continuous bar, but has been squeezed by the rolls into such a shape that only the removal of a thin web inside and between the links is required in order to convert the rigid bar into a flexible chain. In the chain bar so formed the links are not in contact with each other—as they would be in a loaded chain—but are separated by the web, so that the length of the bar is less than that of the finished chain.

When the chain bar is cold, the web is removed by punching, and the chain thus produced is cleaned up by emery wheels or in a revolving drum. The links, as they leave the rolls, have generally a somewhat greater width in proportion to length than is required. The final operation, therefore, consists in pressing the links to their final proportions. For this purpose the chain is reheated to a cherry red, and passes through a press which reduces each link to the desired width. The whole process is entirely mechanical, with the exception of such dressing as is always necessary with rolled material. The chain bar is produced by a single passage between four rolls, of which the axes of one pair are perpendicular to those of the other pair. The contact surfaces of each roll are bevelled like a double bevel wheel, so that the lines of contact between the four rolls form an × in a manner which will be clear from the accompanying sketch. Chains of 1in. diameter have already been made by Mr. Klatte's process, and the production of heavier chains is merely a question of power and strength of parts. In practice both + bars and chain bars would be rolled in one heat, a new method of rolling being also employed for the former. The velocity of the chain rolls ranges from 10ft. to 20ft. per second, according to the dimensions of the chain.



A subsidiary advantages of the process is that the links of a chain can be made of greater thickness at the ends than in the middle, in accordance with the requirements of strength, and also in order to allow for wear.

All the experiments have been carried out at the Germania Ironworks—Walzwerk Germania—in Neuwied on the Rhine. We shall shortly publish details of Mr. Klatte's process, which, it may be mentioned, has been very favourably reported upon by experts in Germany.

## COMMERCIAL DISHONESTY AND SANITARY NEGLECT.

A typical example of the low state of commercial morality, and the indifference to sanitary requirements prevailing in Eastern countries, is reported from Resht, a town of between 30,000 and 40,000 inhabitants in the Persian Province of Ghilan. Business is not carried on in Persia on sound principles, chiefly owing to the excessive competition among native traders. The terms of credit are unusually long, cotton goods being generally paid for after the expiration of at least eight or ten months. Native merchants of Tabreez, who buy cotton goods at two and three years' credit from English firms in that city, arrive with their unpaid for goods at Resht, sell them at a loss, and purchase other articles, a number of these merchants passing through the bankruptcy court—or what stands for it—before the three years' credit has elapsed. The Manchester business is chiefly in the hands of men who live on the verge of bankruptcy, and are reduced to that state by the slightest disturbance in the trade. These bankruptcies are nearly all fraudulent, effected with perfect impunity, and are managed in such a way as to be eventually profitable to the bankrupts, who pay 5 or 6 per cent., or even less, and are then discharged. A trader who has recently been bankrupt is considered a good man to do business with for the next few years. As a rule it is not advisable to go before the local courts to enforce a debt, it being usually more economical in the long run to accept any private composition that can be agreed on and obtained.*

The town of Resht has no sanitary arrangements, and everything tends in the opposite direction. There are not any sewers, and although gutters exist in some streets they are worse than useless, having no means of carrying away the accumulated water, and consequently they are oftener than not full of a stagnant green liquid. The rubbish out of kitchens, and stuff that in England goes into the dustbin, here is thrown out in certain corners of streets and open spaces, where it is allowed to accumulate. The privies existing in each house are mere wells varying in depth, and having no exits. Drinking water is obtained from wells sunk within ten to twenty yards of these privies, according to the space occupied by each house and its grounds, but a good deal is left to chance. Water is found at from 5ft. to 10ft. from the surface. Ponds have been artificially made where water out of the street gutters accumulates, and when in winter it freezes, this filthy muddy water is turned into ice, and collected in the ice houses for consumption in the following summer. Bacteriologists would have ample employment in examining the ice universally consumed here, and would probably be horrified at the results. When the cholera broke out in the summer of 1892, and came to Resht *viâ* Enzelli from a Caspian port, resulting in thousands of deaths both in the town of Resht and province of Ghilan, no quarantine arrangements were made in time, and when orders did eventually come from Tehran, and the Resht authorities endeavoured to put them in execution, the arrangements for housing the persons undergoing quarantine were so inadequate and defective, that the Russian consul refused to permit persons under his protection to be subjected to it.

---

Advices from Shanghai announce the arrival of six hundred cases of spindles for a new cotton mill there, and five hundred more cases on their way.

---

* A similar state of things exists in Beyrout.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### THE CHICAGO STRIKE.

Sir,—Your recent leader on the above subject, and the questions asked, and the shrewd suggestions therein, must be my excuse for the following non-technical letter, from the pen of an entirely disinterested observer on the spot. And first, in justice to the real citizens of America, permit me to protest against your, and the *Times*, describing such as "The American Strike," for though Chicago be American, America is not necessarily Chicago. And to this happy fact the speedy and utter collapse of the strike is mainly due. As to California, she is probably in the same relation to America proper, and anyhow, even her "moral effect" does not reach so far inland as to affect Chicago.

You show your own grasp of the situation by properly eliminating the Pullman lockout from the second stage of the disturbances here, and then speculate as to the cause and nature of such disturbance. Well, Sir, the cause was undoubtedly the general spirit of discontent, mistrust, and widespread actual want, that is so alarmingly apparent here; and the nature of it was much more akin to "an insurrection"—to quote your own words—than to "a labour question of the normal kind." Still, though the "insurrectionists"—and this term, obviously, does not necessarily include "strikers" *per se*—were largely composed of Poles, Hungarians, Bohemians, Scandinavians, with a sprinkling of Dutch, Germans, and Italians, it by no means follows that they were rebelling "against the Americans," as you thought they might possibly be. Not but what in all large cities the American citizen is beginning to feel much as did the ancient Egyptian, when the Israelites increased and multiplied so steadily. No, these poor fellows of the baser sort were the rather giving a too practical expression of their discontent and disappointment, at "the cussedness of things in general." But you still ask, why railways in particular were assaulted, and the answer is that, owing to the Pullman Railway conspiracy, railways happened to be the most available victim, and withal they are so much more easily and safely attacked, by reason of their extent and unguardedness, whereas the sacking of a factory or the raiding of a store is an obviously risky procedure where there are any police about, nor are its effects so far reaching. Moreover, most of the "bloated capitalists" are railway stockholders more or less. I fancy some of your London bond-holders would sympathise on this score just now.

To return now to the strike itself, you say, "Unless matters had been planned beforehand, the affair could not have attained its present magnificent proportions." *au contraire*, Sir, had this man Debs—a quondam fireman on the Wabash line, now enjoying £600 per annum for most incompetent administration—been capable of planning beforehand, he would have saved himself the stinging humiliation of a magnificent fiasco. Whereas now he is on trial for inciting to the infringement of interstate commerce laws and delay of mail transit, his only consolation is that this city has a nice little bill to pay to the railway companies for damage done. In other words, there would have been no strike had the Railway Union—his pet creation, which in return has failed him miserably—possessed a more competent and less priggish head; for it stands to reason that no railway strike can be called "general," nor command any success, that fails to include the intellectual departments of engine-drivers and conductors. Since, therefore, these two orders most praiseworthily refused to take up the Pullman quarrel, their action "dammed the show" from the outset, and almost immediately it was found that in the more sober and civilised east no hands at all would obey the mandate of this young upstart Debs.

Towards the end of your article you hardly give the central Government the credit it deserves. So far from being supine, it sent the troops here, not only without a feeble threat of so doing, as would have happened under Mr. Asquith, but positively without being asked—except by its own Post-office department—and when its troops went into action there was none of that milk-and-watery fooling with nervous magistrates and effeminate Riot Acts that so unhappily mars the moral effect of "the assistance of the military" in England.

There is much that calls for comment in your most suggestive article, but I must remember I am writing to The Engineer, and must accordingly keep to the railways only. But, Sir, may I suggest that you missed a point in not working into your article a most opportune allusion to Lord Salisbury's "Immigration of Aliens" Bill, which Lord Rosebery treated in so cavalier a style, a style he would, I trow, modify had he seen the handiwork of aliens here during the strike, and which might in some degree happen in London itself, quite apart from anarchy *per se*.

Michigan Avenue, Chicago, Ill., July 28th. C. W. V.

### PATENT SPECIFICATIONS DEPARTMENT, SOUTH KENSINGTON MUSEUM.

Sir,—I wonder how many of the London readers of The Engineer know of the existence of the above? I fear very few. Having the good fortune to unearth it the other evening, after innumerable turns to right and left among plaster casts, &c., I looked over the visitors' book and found to my surprise that during the whole month of July there were not two dozen signatures. This is not the case at the Patent-office in Chancery-lane; no matter when I go there, the place is reasonably well filled, the visitors' book also testifies to the same. What, then, is the reason of so few availing themselves of its advantages? I think good tough "Red tape." The books, specifications, &c., are stuck into the very darkest corner of the reading-room, there is barely sufficient room given to turn round in. On entering the Museum no indication is given as to the direction you are to pursue—of course I take it for granted that everybody knows that the publications are to be found somewhere in the building. Why is there not a prominent notice inside the entrance giving full directions how to proceed? It looks to me as if the heads of the department regarded it as an eyesore, and, as such, kept it as much as possible in the background—an evil that had to be tolerated, but with the very worst grace. I consider that such a place cannot be put too prominently forward. How many more hundreds of our working classes would avail themselves of it if there were not so many obstacles placed in their way? I cannot speak too highly of the courtesy and attention of the assistant in charge, he doing everything in his power to give any information desired; but, from the number of books that were passing through his hands, I should say he has quite enough to do. I was much struck with the knocking of the electric light engines in some adjoining building; the engineer in charge ought to be a proud man to produce such a knock. I have never heard its like in any other station, it is quite unique. Would it be worth suggesting that the engines and dynamos be placed in a building to which the public had access? A gallery could be used, or railings erected to keep them out of the engineer's way. How many students would then derive both pleasure and information from watching them? Thamis.

August 1st.

### ENGINEERS AND ARCHITECTS.

Sir,—The only purpose, we take it, which was originally intended to be served by an architect's certificate was that of certifying that the work done by a contractor had been completed in a satisfactory manner.

During the last two or three years, it seems to us, a custom has grown up of making the certificates serve another purpose, which in our opinion is very unfair to the contractor; that is to say, when for any reason the customer is unable or unwilling to make payment, the architect's certificate is withheld, and in its absence, under the conditions of many contracts, the contractor is, of course, powerless to take legal proceedings, or at the very best he runs a considerable risk of failure.

During the present year we have had not less than five cases in which certificates have been withheld. In none of them was there any dispute as to the work not having been finished in a satisfactory manner. Had this been otherwise there would, of course, be no point in our dispute.

1. In the first instance, the architect distinctly told us in confidence that the company employing him had directed him to issue no more certificates till they had funds in hand to meet them.

2. In the second case the customer repeatedly expressed his willingness to pay as soon as we got the certificate. The architect did not refuse in so many words to issue the certificate, but he did not reply to our letters, and was always out when we called. In this instance, as we had not the slightest evidence of collusion—although, of course, we could not but suspect it—we could do absolutely nothing.

3. In the third instance the architect promised to issue a certificate if we would give him a commission, and, upon our declining to do this, he took no further notice of our requests.

4. In the fourth case the work was done in a very great hurry, and at much inconvenience to ourselves; the architects were an old-established and most respected firm. They did not refuse the certificate, but delayed from time to time, until six months had elapsed when it was issued. When we produced the document we were informed that the proprietors of the building were in liquidation, and that an application had been made for an order of the Court restraining creditors.

5. In this instance—the only one of the five in which there was a dispute of any kind—a question arose in connection with a trifling sum charged for extras. Owing to this the architect refused a written certificate of the completion of the contract, although he stated he would issue one as soon as the account was adjusted. The proprietors, however, refused to pay anything, owing to the certificate not being issued. In this last instance we shall probably succeed in getting our money, but nothing could be done in regard to the other four; and our purpose in writing is to ask your readers if they are experienced in similar difficulties in connection with architects' certificates.

We do not wish our names to be published for the present moment, for obvious reasons; but you, Sir, will be able to confirm the fact that we have been many years in business. Down to recent times we have never experienced any difficulty, and it seems to us that a new custom must be growing up, on the part of proprietors of buildings, of requesting architects to withhold certificates for financial reasons only. If this is the case, we think that concerted action by a few of the larger firms would be of service. Unless our own experience is unique, we are of opinion that it is absolutely necessary that something should be done in the matter, unless contractors are content to submit to considerable losses.

When a shaky united company is the customer, a delay in certifying for the work done is often an effective weapon in defeating the contractor. Mechanical Engineers.

London, August 11th.

[The writers are members of a firm of the highest standing.—Ed. E.]

### BRIGHTON BEACH.

Sir,—As the inventor of the open groynes system and the stout opponent of solid or large groynes, I have been much interested in reading your article on this subject. You call attention to the different systems that have been adopted by the two towns, Hove relying mainly on its sea-wall, and Brighton on its groynes, and after pointing out that both systems have their serious drawbacks, you suggest that some improved method might be designed.

The great desideratum seems to be to prevent the washing away of the foreshore, while at the same time artificial interference should be avoided as much as possible. For this reason I desire to again call attention to open groynes as providing just what is required to overcome the difficulties you have pointed out. This is no question of opinion, as it is now more than ten years since I erected some on this system, and having examined them within the last fortnight, I am able to describe the result of their working. A number of these groynes, which consist of uprights driven into the foreshore, having horizontal gratings attached to them, after having been erected for over ten years, are now so entirely covered with shingle that only the tops of the uprights and a few isolated parts of the top bar of the gratings can be seen.

Another instance is that within the last twelve months an embankment which has been made along the seashore and faced with rubble stone was seriously assailed by the sea. To protect it open groynes were fixed at right angles to the embankment at intervals along about half a mile; the damage was stopped, and at the present time the gratings are filled with shingle. I think the above may be taken as ample evidence to prove that open groynes do trap and retain shingle, and that, therefore, if fixed in suitable positions they can be relied up to protect the Brighton foreshore, without the serious expense and disadvantages of a sea-wall or concrete groynes. A. Dowson.

39, Old Queen-street, Westminster.

### THE EIGHT HOURS' DAY IN PORTSMOUTH DOCKYARD.

Sir,—In reply to "Keppel" *re* eight hours' day in Portsmouth dockyard. No doubt it would interest a certain faction of the community to know that the dockyard men are dissatisfied with their lot, and also to know that they really have to work all their time in the yard. Surely Keppel must refer to the olden times, when the men commenced work at six o'clock, and worked until six o'clock at night, when they were allowed a stopping time for meals.

But it is of far greater interest to the dockyard men concerned to enjoy the privilege of an eight hours' day, than to receive sympathy from Keppel for the dissatisfaction he supposes to exist. This has been the ideal of a working day for many years amongst the English mechanics, and which they hope to enjoy for many years to come. As for working their whole time, this would appear to cast a very serious reflection on the supervision of the officers. It is nonsense to say that the men are dissatisfied because they have to work forty-eight hours instead of fifty-one hours per week for the same pay.

It is only natural that the men would be expected by their employers to show a little more increased diligence in their work, for which they are amply compensated in the shorter hours. The dockyard work will no doubt bear a very favourable comparison at any time with outside work in point of speed and workmanship.

Perhaps the dissatisfaction heard of by Keppel comes from one of those good people who always have a grievance, and always willing to air it when he can find a willing listener. It is hardly to be expected that unanimity of opinion to exist on any topic amongst a number of men of all grades and classes numbering between 6000 and 7000 men.

The question of apprentices, &c., is foreign to the subject. Doubtless the change is an improvement, but cannot see what this has to do with the Church or its work; and if Keppel is as good a supporter of that institution as he is for the interest of the working class, it would be a benefit perhaps to both parties to hear his experience. A Satisfied Dockyard Man.

Portsmouth, August 9th.

## THE GREAT NORTHERN TRADE ROUTE.

The present disturbance in the Far East involves questions of the largest moment to England. England's life is her trade. The scope of these questions is hinted by the condition in which the present affair has surprised her cable communications with the Chinese seas. It is at last realised how dependent these are upon the attitude of nations which may not be friendly. Hence the prompt revival of the proposal for a direct cable between British Columbia and those coasts. But this suggestion brings into strong relief the still greater need of adequate naval stations north of Hong Kong. The tone of the Russian press, if its utterance can be deemed inspired, shows that such a station can be acquired only by understanding with the Czar or through a war with him. The last contingency is not to be thought of unless in the last resort. It follows that England must consent to go on with her enormous China trade under perpetual menace, or must agree with the Russian as to the acquisition of a naval station.

Except for sentimental notions of prestige, there is no obvious reason why the three naval Powers, England, France and Russia, should not agree on three points suitable to the needs of each respectively and take possession of them. Their natural relative positions would seem to be: the southernmost to France; the middle one, somewhere about the latitude of Shanghai, to England, and the northernmost to Russia. They would thus be acquired at the cost of China and Japan, who would have no alternative but to submit. The Russian would doubtless consent to take his foothold in Corea, where his establishing himself would disturb no existing trade interests. Even if in time his position there should result in his dominating and developing that peninsula, nobody would be injured, and nobody is in position to complain in anticipation. In short, such an arrangement would merely transfer to Russia the rôle which Japan has proposed to herself in her present intervention in that country. Corea would still be opened and reduced to the general use of mankind. Only the work would be under the auspices of the Split Eagle instead of those of the Risen Sun.

The alternative is twofold: first, the three naval Powers may combine to put down Japan and restore the *status quo ante*. This, it must be allowed, is the first impulse of the professional diplomatist. It settles nothing, but it avoids the enormous embarrassment of constructive measures. It is the instinct of your right diplomatist not to cure, but to cataplasm—to cover up, to hide away, and leave the poison to nature. The other alternative is to fall to and fight it out. The last will never be resorted to by a trading nation till it is cornered. Excluding this last, then, as the least probable of the three modes of settlement, we have to observe that a restoration of the *status quo* leaves England with her prestige fatally damaged in the East. At this moment it is plain as a pikestaff to the whole world that without a Northern naval station she is utterly unprepared to sustain a naval conflict in the China seas. It is palpable that a time must come when Russia, even should she secure no such station south of Vladivostock, will hold England's trade at her mercy.

It is impossible that English statesmen should fail to see what is now palpable to all the world beside. The situation for them, it must be allowed, is one of difficulty and embarrassment. To realise just how embarrassing it is a moment's attention must be given to the Canada route as a great through trade route. A New York convention is at this moment considering the enlargement of the Erie Canal. Up almost to to-day the enlargement of this canal was a matter of concern to our West. It has ceased to be so in consequence of the enlargement of the Canadian canals which now furnish the sufficient competition to tide water that accomplishes the purpose of keeping rail rates down. The trade thus created is leading to the establishment of new Canadian steam lines across both oceans, the Atlantic and the Pacific. These lines, with the railway that links them, constitute the shortest possible line of communication between Europe and Eastern Asia. It is the line nearest to a great circle. It is the line which nature and the laws of geometry have marked out as excluding successful competition.

In this light it is fully appreciated both by Canada and by the mother-country. It is, in their eye, the great highway of the future. Yet, unless England secure a naval station somewhere north of Hong Kong, this vital artery must exist subject to the forbearance and goodwill of rival Powers. If, indeed, England is now willing to remain in a position such as this, it will be a marked departure from the policy and the traditions to which her present position is due. Thus the rising truculence in the tone of her press seems fully accounted for. England perforce must grab something out of the present disturbance or her position is far worse than before. Its weakness has been revealed: and not alone that, but the vantage held by the Russian is displayed to the view and conciousness—Asiatic and European alike.—*New York Evening Sun.*

## TENDERS.

The following are the results of an invitation to tender for twenty-four engines and tenders for the Egyptian Government Railways in June, 1894:—

| | £ |
|---|---|
| Franco Belge, Belgium | 40,553 |
| Neilson, Scotland | 41,280 |
| G. Ansaldo and Company, Italy | 43,520 |
| Société des Forges | 44,121 |
| Cockerill, Belgium | 44,121 |
| Marcinelle and Couillet, Belgium | 44,612 |
| Sharp, Stewart and Company, Scotland | 46,560 |
| Austro-Hungary, Austria | 47,476 |
| Dübs, Scotland | 47,760 |
| Sachsche, Germany | 48,742 |
| Henschell and Son, Germany | 49,390 |
| Hanoverische, Germany | 49,423 |
| Suise, Switzerland | 49,842 |
| Vulcan, Germany | 49,934 |
| Vienna, Austria | 50,246 |
| Actien Gesellschaft, Austria | 50,373 |
| Machinen Fabrik, Austria | 50,420 |
| Hohenzollern, Germany | 50,601 |
| Locomotive Fabrik | 50,895 |
| Alsacienne, Germany | 51,085 |
| Beyer, Peacock, England | 51,500 |
| Metallurgique, Belgium | 51,844 |
| Stephenson, England | 53,256 |
| Breda, Italy | 54,313 |
| Kitson, England | 54,480 |
| Berlin, Germany | 55,488 |
| Hawthorn, Leslie, England | 60,600 |

**Railways in Norway and Sweden.**—According to recent Foreign-office reports from Norway and Sweden, it is expected the line of railway connecting Porsgrund and Brevig will be finished this year. This line will be a great acquisition, not only to the particular district, but also to all parts situated on the south coast, as more direct communication will be opened up with Christiania. The town of Stavanger has voted a sum of money towards the continuation of the Stavanger-Egersund Railway to Flekkefjord. The completion of the Swedish railway system is progressing steadily, and the direct line being constructed from the manufacturing town of Boros to Gothenberg, is expected to increase the trade of the latter place. Rails, which had hitherto always been imported from Great Britain, had lately been brought from Belgium for a narrow-gauge railway under construction at Uddevalla. A narrow-gauge railway, twenty-two miles in length, is being constructed from the port of Falkenberg to the interior. A large district has been opened to the trade of Helsingborg by the opening of the Scania-Smeland Railway, from the Astorp Station on the Helsingborg-Hessleholm Railway to Markaryd, a village in the province of Smoland. The railway line from Landserora to Kjeflinge was opened last summer, and a regular steamship line to Hamburg started in the course of the year, thus further improving the existing good communications both by land and sea. The Malmö-Tomelilla Railway has been opened to traffic, and by joining the Cimbrisbamn Tomelilla Railway forms a line from west to east through the entire province of Scunia. A new railway, the Malmö-Gnarp—the seventh in order terminating at Malmö—is being constructed, and will probably be opened for traffic this year. Two railways, the Ystad Gärnäs and the Klagstorp-Rydsgord, are being constructed in the district of Ystad, and expected to be opened this year.

## THE DESIGN OF MAIL STEAMERS, WITH SPECIAL REFERENCE TO THEIR USE FOR WAR PURPOSES.[*]

By Professor J. H. BILES, M. Inst. Naval Architects.

*(Concluded from page 129.)*

IT is hardly necessary to say that for war purposes twin-screws should be adopted, but their adoption renders it more easy and more necessary to adopt short strokes and high revolutions, as it is only by narrowing the base of the engines that good space can be got abreast of them for coal protection. The one point in which a mail steamer may be expected to be superior to a warship is in the efficiency of her machinery. The every-day use of it at its maximum power, under the pressure of commercial necessities, causes it to attain and maintain a high state of efficiency, which is difficult of attainment under other circumstances. This high efficiency exists also in the engine-room staff, and it may therefore be fairly assumed that the machinery of a mail steamer in constant service is more capable of developing its best results than in that of a warship. It is therefore necessary that this machinery should be designed so as to be as well protected as possible in war time, and not in such disregard of this consideration as to expose important parts of it to rapid and easy destruction, as is the case in tandem engines. The stability of these steamers, measured by metacentric height, is of importance in dealing with the question of protection. For sea-going purposes, in an intact condition, one foot of metacentric height is probably sufficient. In vessels with double bottoms any loss of stability due to burning out coal can be made good by the use of water ballast. But for war purposes, on account of the possible flooding of some compartments, it is desirable to have a much greater metacentric height than that stated. If the weight of the cargo that mail steamers carry is replaced by coal, its centre of gravity will generally be higher than that of the cargo, as it will be placed for protection in the vicinity of the water-line. It will be liable to be used, but the use of this part of the total coal will not sensibly affect the stability of the vessel in the intact condition. If any compartments containing coal are flooded in the vicinity of the water-line, there will be some stability maintained by the water-displacing power of the coal; so that even if the centre of gravity of the ship when intact is not affected much by using the coal, its stability in a flooded condition will be. This points to the necessity of having either a considerable metacentric height in fully loaded condition, or of having large water-ballast tanks, so as to vary the height of the centre of gravity as coal is used. Vessels without water-ballast tanks will be at a considerable disadvantage compared with those having them, as they must certainly either carry something like pig iron for ballast, or must be content with a much smaller amount of consumable coal in the ship. Hence it is necessary for war purposes that a mail steamer should have large ballast tanks. Large initial stability is of great value in enabling a vessel to retain some positive stability with a large number of compartments flooded, but it is a disadvantage in the intact condition unless accompanied by bilge keels. These seem, therefore, to be a necessity in a steamer for war purposes.

In considering the possibility of protecting a mail steamer by armour, it must be assumed that this armour is not carried in time of peace. Consequently this armour must be arranged in such a way that it can be readily shipped in time of war If the amount of weight at disposal is sufficient to give a considerable amount of protection, it seems necessary to put it on the side of the ship as vertical armour. The amount of subdivision in a mail steamer cannot be as great in the vicinity of the water-line as it can be in a warship, and less reliance can be placed upon the subdivision to keep the ship in a fighting condition. Hence the necessity for keeping the water out of these compartments. Further, it would be very difficult to ship in a short time large quantities of internal protective deck armour, even if it were practicable to arrange in the original building of the structure a deck in a suitable position and with suitable support. On the contrary, the fitting of side armour upon previously prepared supports would be comparatively easy. The armour and backing should be fitted to the ship while she is building, and then removed; the backing being secured to the armour, so that both might be put upon the ship at one lift, when she is preparing for war purposes.

Fig. 3, page 112, shows a midship section, arrangedin a suitable manner for carrying armour. When the armour is not carried the sharp corners of the shelves would be filled in with wood, as shown on the drawing. The armour belt is shown 5ft. above and 5ft. below the load line. In ordinary times the breadth of the water-line would be less than the full breadth of the ship, and the stability would be less than in the ordinary form. This variation is in the direction of small stability when on ordinary service, with a possibility of increasing it when on war service. This is in the direction already indicated as desirable. If for any reason it is desirable not to have a recess in the side in ordinary service, the recess may be filled in partly by the teak backing and partly by other timber, which would have to be removed in time of war. The outside timber would have to be sheathed with plates, say, ¼in. thick, screwed on to the wood. This would make a good working side in the vicinity of the water-line, where barges usually knock the plating about most. The fitting of transverse armour bulkheads would be more difficult, but with the large hatches common in mail steamers, the plates could be shipped and landed on previously prepared supports. It would generally happen that the belt would be partly above and partly below a deck, so that the work upon the plates of a transverse bulkhead could be done by two separate working parties. There seems to be no great difficulty in arranging for an armour belt which could be fitted during construction, and could be kept in a port where it could be rapidly shipped and fastened in war time.

The deck protection could be provided by fitting what are known as splinter gratings on the top of the ordinary steel or wood deck. These splinter gratings would have to be fitted permanently in the funnels, but could be removable elsewhere. In cases where it seemed to be desirable to extend the belt for only a part of the length of the ship, it would be necessary to carry the splinter grating protected deck to the ends of the ship. To make this deck effectual, it would be necessary to make it a water-tight deck, instead of making it of stringers and ties, as is usually the case with a deck at such a low level. The magazines would be below this deck, and in a ship with twin screws probably the best place for these magazines would be between the tunnels; for the water-tight deck, the transverse bulkheads, the tank top, and the tunnel sides, if carried up to the water-tight deck and down to the tank top, would form the necessary water-tight box which usually encloses a magazine. A special trunk could be fitted to act as an ammunition hoist, which would serve as a ventilator in ordinary times. The weight involved in making this trunk 2in. thick—a common thickness for a warship—would only be ten tons for each trunk, and this could be made part of the original structure of the ship, to be always carried in peace or war. It would be advisable to fit a similar water-tight compartment at the fore end of the ship. The space abreast of the two additional fore and aft bulkheads necessary to form this compartment could be used for carrying fresh water in bulk, and the pipes necessary for filling and emptying these compartments could be fitted so as to act as flooding pipes for the magazines. If for any reason it was not desirable to use the space for fresh water, it could be made available for cargo by having two additional hatches, the ordinary middle-line hatch serving to bring the cargo to the level of the water-tight deck. Over the compartments destined to hold magazines, it would be desirable to fit arrangements for readily shipping protective deck plating of, say, 2in. thick. The splinter gratings fitted over the other part of the deck would be here dispensed with. The only other vital part of the ship necessary to consider is the steering gear. In four of the later ships built with the intention of being armed cruisers, the steering gear has been kept below the water-line. In this respect these vessels are as efficient as the best warships, with the difference that there is no deck protection above them. This protection could be formed either by thick plates or splinter gratings over a water-tight deck, either of which could be rapidly put on board in war time, if previously arranged for when the ship is building.

Little need be said about the facility for working guns. The clear deck space of an ordinary mail steamer gives ample room for working as many guns as the number of men available who can handle them would permit. At each end of the ship, on the forecastle and poop, two 9in. guns can be carried and fired without much special preparation, as mail steamers are usually stronger in these parts than warships. It would not be difficult to adapt these structures to carry 9in. guns with their shields. It would also not be difficult to cut ports in a centre bridge-house for carrying either 6in. or 5in. guns; these ports being kept permanently shut when the vessel was on her ordinary service, or used for the ordinary purposes of the ship. The gun stations could be placed almost anywhere, as the cabins and saloons in the upper deck would probably be removed when the vessel was taken up for war purposes. In the part of the upper deck between the poop and bridge-house and forecastle and bridge-house, there is usually ample room for guns. In some of the later vessels the promenade deck is strong enough to carry guns, and it would be preferable always to make this deck suitable for such a purpose, in order to carry the guns at as great a height as is practicable. The amount of extra material necessary to do this would not be great. It would be as easy to fit either submerged or above-water torpedo tubes as it is in a warship, all the fittings except the part attached to the ship's side being removed and placed in store after having been fitted. To make the vessel suitable for war purposes a conning tower would have to be fitted, the support being permanently worked into the vessel. It will be necessary to take account of the weight of the crew and their stores and provisions, the engineers' stores, and possibly a net defence against torpedo attack. Many items of weight, such as cabins and their fittings, could be removed from a mail steamer in war time.

All the foregoing points affect more or less the design of the vessel, and would have to be taken fully into account in preparing the construction drawings. To give definiteness to the suggestions, the extra weights involved have been calculated for a vessel 500ft. by 57ft. by 40ft. They may be summarised as follows:—

(1) Boilers and bunkers arranged so that all coal may be abreast and beams placed in them so that a temporary flat may be fitted at half height in war time. This involves 40 tons of permanent extra weight of bunker bulkheads, but adds considerably to longitudinal strength of ship, so that savings may possibly be effected in other ways to reduce this. The weight of the temporary steel flat will be 30 tons.

(2) Web frames to be made sufficiently wide between main and lower decks, so that they may form the inside line of a further longitudinal subdivision which shall be fitted only in war time. The longitudinal water-tight work at the decks to which this bulkhead would be connected are assumed to be permanently carried. The permanent weight added by this arrangement, if it be adopted for three-fourths of the length of the ship, will be about 25 tons. The temporary or war time bulkhead will weigh about 45 tons.

(3) To prevent a dangerous heel, if a compartment on one side only should be flooded, the corresponding compartments on opposite sides of the ship should be connected by a pipe, so that when one is flooded the other may be also. The permanent additional weight would be 25 tons. The temporary weight would be 15 tons.

(4) Make main transverse bulkheads of ship double, with a space between which can serve as a well. In this space place a steam pump and also a steam ejector. The extra weight due to this arrangement will be about 25 tons.

(5) Increase capacity of double bottom so that greater power to maintain stability in damaged condition may exist. Adding 1ft. to the depth of the double bottom will add 60 tons.

(6) Permanently protect the main steam pipe and mountings by a tube, say, 1½in. thick and 4ft. in diameter, through which the electric light wires, telegraph wires, voice pipes, auxiliary steam pipes, and all things which cause holes to be cut in bulkheads can be carried. Extra weight due to this, 100 tons.

(7) Recess the side for, say, 300ft., so that armour and backing previously fitted may be readily shipped. Extra weight due to the permanent alteration of structure will be about 110 tons. The loss of displacement due to the recess would be about 140 tons on a 27ft. draught. If permanently filled in with wood, the extra weight would be 300 tons. Armour, 8in. thick on side, and 6in. on transverse bulkhead, with backing 6in. thick, carried for 300ft. on the side, will weigh 1300 tons. Displacement 110 tons.

(8) Make deck over boilers and engines, and orlop deck beyond belt water-tight permanently, and temporarily fit either plates or splinter gratings. The permanent extra weight would be about 30 tons. The temporary weight of deck, including a 2in. shield over magazines, will be about 550 tons.

(9) Fit a 12in. conning tower. The extra permanent weight would be about 10 tons. The temporary weight of conning tower and tube to connect communications would be about 100 tons.

(10) Permanent strengthening for, say, two 9·2in., ten 6in. quick-firing guns, and a corresponding number of small quick-firers. This may involve about 40 tons. The weight of the guns and their fittings and ammunition would be about 600 tons.

(11) The fittings peculiar to passenger and cargo carrying could be removed in whole or in part, say 400 tons.

(12) The crew and stores necessary to equip the ship for war would amount to about 350 tons.

Thus we have a permanent addition of about 605 tons to the vessel, which would be a loss of weight-carrying to this amount. In some ships this would mean loss of freight-earning; but in others, whose earnings depend upon measurement goods, it would only involve a small extra expenditure of fuel to drive the heavier vessel. The net additional weight to be carried to equip the vessel for war as described would be about 2590 tons. Such a vessel on 27ft. draught would have about 5800 tons of total weight carrying in ordinary work, without allowing for the permanent additions described above. After allowing for these and the temporary additions, which make in all 3195 tons, there would be available for coal 2700 tons. This amount of coal would enable the vessel to steam at full speed for ten days at full power, or for twenty days at half power, which is about the proportion the Admiralty regulations of two-thirds natural draught power would amount to. The corresponding speeds would be about 19 and 15 knots, and the distances steamed would be 4500 and 7200 knots. Longer distances could be steamed at lower speeds. The extra cost of the structure would not be considerable, in relation to the total cost, and the modification necessary would detract but little from the commercial efficiency of the vessel, beyond the loss of freight-earning due to the loss of weight carrying. It is believed that such a vessel, when fitted with her removable war equipment, would, for gun, torpedo, and protective capabilities, be little, if any, inferior to our first-class cruisers, while in speed and coal endurance it is believed that such a ship would be superior.

It may be objected that the large size of these vessels makes them unhandy fer manœuvring, but this is largely a matter of rudder area; and when we know that vessels larger than the size chosen can turn a complete circle in five minutes, much of the force of this objection is removed. The loss of money earning in such a vessel due to the permanent additions to structure would vary in different trades. Where the trade is with cargoes so light that there is no chance of the vessel being made too deep in the water by these additions, it is probable that the extra working expenses would be about £2000 per year. The first cost of these permanent additions would be about £25,000, representing about £4000 per year for interest, insurance, and depreciation. In the trades where deadweight is of importance the loss of 600 tons of cargo is a more serious matter. It is difficult for a shipowner to say what loss in money is likely to be involved by such a permanent load, but it is probable that £15,000 per year would be accepted as a solatium for this loss, and this, with the £4000 due to extra first cost, would make a total contribution to the shipowner of £19,000 per year in excess of the subsidy which would be paid for an ordinary mail steamer. The cost of the armour and other protection would be about £160,000, and the guns and mountings £60,000. The interest on this sum at 5 per cent. is £11,000 per annum. This sum, added to the £19,000 above, makes a total of £30,000 per year; for which sum, in addition to the present subsidy, the country would have an efficient warship of great power, instead of a mere auxiliary to a fleet.

This paper has exceeded the intended limits, or something would have been said about the smaller classes of high-speed mail steamers, in whose designs considerable modifications will generally have to be made if the best use is to be got from them in war time. The object in view in writing this paper will have been gained if attention is directed to the great inherent power in our mail steamers to become real ships of war in time of need.

---

[*] Paper read before the Instituion of Naval Architects on July 26th, 1894.

---

## THE BRITISH ASSOCIATION.

THE following is the list of subjects for work in connection with which the British Association has made the annexed grants of money.

SYNOPSIS OF GRANTS OF MONEY appropriated to Scientific Purposes by the General Committee at the Oxford meeting, August, 1894. The names of the members entitled to call on the General Treasurer for the respective Grants are prefixed.

| | £ | s. | d. |
|---|---|---|---|
| *Mathematics and Physics.* | | | |
| *Foster, Professor Carey.—Electrical Standards ... ... | 25 | 0 | 0 |
| *Symons, Mr. G. J.—Photographs of Meteorological Phenomena ... ... ... ... ... ... ... ... | 10 | 0 | 0 |
| *Rayleigh, Lord.—Mathematical Tables (unexpended balance) ... ... ... ... ... ... ... ... ... | 0 | 0 | 0 |
| *Symons, Mr. G. J.—Earth Tremors ... ... ... ... | 75 | 0 | 0 |
| Atkinson, Dr. E.—Abstracts of Physical Papers ... | 100 | 0 | 0 |
| Fox, Mr. Howard.—Reduction of Magnetic Observations made at Falmouth Observatory ... ... ... | 50 | 0 | 0 |
| Rücker, Prof. A. W.—Comparison of Magnetic Standards ... ... ... ... ... ... ... ... ... | 25 | 0 | 0 |
| Harley, Rev. R.—Calculation of certain Integrals ... | 15 | 0 | 0 |
| *McLaren, Lord.—Meteorological Observations on Ben Nevis ... ... ... ... ... ... ... ... ... ... | 50 | 0 | 0 |
| Thompson, Prof. S. P.—Uniformity of size of pages of Transactions, &c.... ... ... ... ... ... ... | 5 | 0 | 0 |
| *Chemistry.* | | | |
| *Roscoe, Sir H. E.—Wave-length Tables of the Spectra of the Elements... ... ... ... ... ... ... ... | 10 | 0 | 0 |
| *Thorpe, Dr. T. E.—Action of Light upon Dyed Colours ... ... ... ... ... ... ... ... ... | 5 | 0 | 0 |
| *Armstrong, Professor H. E.—Formation of Haloids from Pure Materials ... ... ... ... ... ... | 20 | 0 | 0 |
| *Tilden, Professor W. A.—Isomeric Naphthalene Derivatives... ... ... ... ... ... ... ... ... | 30 | 0 | 0 |
| *Reynolds, Professor J. E.—Electrolytic Quantitative Analysis ... ... ... ... ... ... ... ... ... | 40 | 0 | 0 |
| *Geology.* | | | |
| *Hull, Professor E.—Erratic Blocks ... ... ... ... | 10 | 0 | 0 |
| *Wiltshire, Professor T.—Palæozoic Phyllopoda ... ... | 5 | 0 | 0 |
| *Geikie, Professor J.—Photographs of Geological Interest (renewed) ... ... ... ... ... ... ... | 10 | 0 | 0 |
| *Horne, Mr. J.—Shell-bearing Deposits at Clava, &c. | 10 | 0 | 0 |
| *Traquair, Dr. R. H.—Eurypterids of the Pentland Hills ... ... ... ... ... ... ... ... ... ... | 3 | 0 | 0 |
| *Woodward, Mr. H. B.—New Sections of Stonesfield Slate ... ... ... ... ... ... ... ... ... ... | 50 | 0 | 0 |
| *Tiddeman, Mr. R. H.—Exploration of Calf Hole Cave | 10 | 0 | 0 |
| *Bonney, Professor T. G.—Investigation of a Coral Reef by Boring and Sounding ... ... ... ... | 10 | 0 | 0 |
| Evans, Sir John.—Nature and Probable Age of High-level Flint Drifts ... ... ... ... ... ... ... | 10 | 0 | 0 |
| Green, Professor A. H.—Examination of Locality where the Cetiosaurus in the Oxford Museum was found ... ... ... ... ... ... ... ... ... | 20 | 0 | 0 |
| *Biology.* | | | |
| *Sclater, Dr. P. L.—Table at the Zoological Station, Naples... ... ... ... ... ... ... ... ... ... | 100 | 0 | 0 |
| *Bourne, Mr. G. C.—Table at the Biological Laboratory, Plymouth (renewed) ... ... ... ... ... ... | 20 | 0 | 0 |
| *Herdman, Professor W. A.—Zoology, Botany, and Geology of the Irish Sea (partly renewed)... ... | 40 | 0 | 0 |
| *Sclater, Dr. P. L.—Zoology and Botany of the West Indian Islands ... ... ... ... ... ... ... ... | 50 | 0 | 0 |
| *Flower, S. W. H.—Index of Genera and Species of Animals ... ... ... ... ... ... ... ... ... | 50 | 0 | 0 |
| *Geography.* | | | |
| *Ravenstein, Mr. E. G.—Climatology of Tropical Africa | 5 | 0 | 0 |
| *Seebohm, Mr. H.—Exploration of Hadramout ... ... | 50 | 0 | 0 |
| *Mechanical Science.* | | | |
| Kennedy, Professor A. B. W.—Calibration and Comparison of Measuring Instruments ... ... ... | 50 | 0 | 0 |
| *Anthropology.* | | | |
| *Macalister, Professor A.—Anthropometric Measurements in Schools ... ... ... ... ... ... ... | 5 | 0 | 0 |
| *Munro, Dr. R.—Lake Village at Glastonbury ... ... | 30 | 0 | 0 |
| Evans, Sir J.—Exploration of a Kitchen-midden at Hastings ... ... ... ... ... ... ... ... ... | 10 | 0 | 0 |
| *Brabrook, Mr. E. W.—Ethnographical Survey ... ... | 30 | 0 | 0 |
| *Physiology.* | | | |
| McKendrick, Professor.—Physiological Applications of the Phonograph ... ... ... ... ... ... ... | 25 | 0 | 0 |
| *Meldola, Professor R.—Corresponding Societies... ... | 30 | 0 | 0 |
| | £1093 | 0 | 0 |

---

DUCKHAM'S PNEUMATIC GRAIN ELEVATOR AND CONVEYOR.—In our impression of the 20th ult. we published an illustrated description of the Mark Lane, and referred to an elevator then being completed by the East Ferry-road Engineering Works Company for the London Grain Elevator Company. An official trial of this machine was made on the 1st inst., when buckwheat was lifted 37ft. and delivered from barge to barge through an 8in. suction at the rate of ninety-six tons per hour, and through two 8in. suctions simultaneously at a total rate of 180 tons per hour. This was considerably in excess of the estimated efficiency, and was more than could be dealt with by the experienced men the owners employed to weigh on delivery. In the afternoon there was an exhibition of the elevator in operation in the presence of seventy or eighty influential shipowners—merchants and others interested in and having experience in the shipment, transport, discharge, and handling of grain. The Baltic did remarkable work and called forth great praise from the visitors, as did also Mr. Duckham's process for loading grain into ships by the combination of the compressed air and the vacuum process in use on the Mark Lane and Baltic. The Baltic will forthwith take its place at the Royal Albert Dock for discharging some of the American liners arriving there with large cargoes of wheat and maize.

---

* Re-appointed.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The improvement in the Glasgow and Middlesbrough iron markets has assisted business at the local exchanges this week, and the intelligence that the American Tariff Bill has passed has helped to produce a more buoyant feeling among ironmasters. Great hopes are entertained that the long-expected revival may now put in an appearance. In some quarters this expectation amounts to an almost certainty. A circumstance which would seem to partly warrant these views is a report that a leading local firm has received an order from the Japanese Government for several hundred tons of iron, in connection with the naval requirements of that Power in their war with China. It is understood that the order will be followed by others of a still more important character, which will stimulate the local iron trade. Sellers this week, owing to the improved prospects of business, were rather inclined to stiffen prices. Marked bars were quoted £7 10s.; merchant sections, £6 10s.; and common bars, £5 10s. Galvanised corrugated sheets are quoted £9 12s. 6d. to £9 15s. for 24 w.g., f.o.b. Liverpool, and £9 15s. to £9 17s. 6d. delivery London. For hoops the price of £6 7s. 6d. to £6 10s. was, at to-day's—Thursday—Birmingham Exchange, firm, and in view of the increased business which producers of this material are hoping to do with the other side of the Atlantic now that the tariff revision, although not wholly satisfactory, has been brought about, it is quite likely that rates will soon advance. It is estimated that the Americans consume some 40,000 tons of hoops for baling cotton annually, and as the new tariff entirely removes the duty on this iron, makers to-day expressed the hope that they would be able to secure some good American orders. Pig iron is in better inquiry, especially foundry qualities. Staffordshire all-mine hot-blast are quoted 55s. to 57s. 6d.; part-mines, 41s. to 42s. 6d.; and cinder, 38s. 6d. to 40s. Northamptons are 40s. to 41s., and Derbyshires 41s. 6d. to 42s. 6d.

A unique attempt to prevent the closing of the Corngreaves Iron Works of the New British Iron Company is now being made by the employés of that concern. A scheme has been formulated by the men for raising sufficient capital to carry on the works by means of subscriptions from local tradesmen, and the workmen and managers themselves. Something like £100,000 is necessary to purchase the works, and up to Tuesday last the result of the canvass was, it is said, £30,000.

Considerable satisfaction is this week expressed in the Birmingham district at the passing of the American Tariff Bill, although all the relief which had been expected to be granted to the iron and coal trades has not been secured. A number of the Birmingham hardware trades will, however, find material relief. Metallic bedsteads, at present paying a duty of 45 per cent., and of which 240,912 dols. worth were sent from the Birmingham consular district to the United States last year, will get the benefit of a reduction of about 10 per cent. The original revision Bill proposed 30 per cent. on chains, as against 45 per cent. at present charged. It is now expected that something like 35 per cent. has been adopted. Last year's export of chains from this district to the States was between 12,000 dols. and 13,000 dols. Cycles constitute one of the largest departments of local trade with America, and is one of the few items in which the export has been kept up, despite the existing tariff of 45 per cent.

The export of machinery from hereabouts has very much declined in importance, although it still continues to some extent, and this will have the benefit of a reduction from 45 per cent. to 35 per cent. The chief item concerned with it is probably tube-making machinery. Steel tubes constitute an important branch of export, especially for cycle making, and in the last quarter of 1893 27,436 dols. worth were entered in the returns of the Birmingham Consulate under this head. The present duty ranges from 30 to 35 per cent., which the original Bill proposed to reduce 25 per cent., but the probability is that it will be left at about 30 per cent.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—Much the same unsatisfactory position continues to be reported throughout the iron and coal trades of this district that has prevailed for the last few months, and except perhaps that the settlement of the tariff question in the United States may possibly give some stimulus to trade here, the general outlook remains without improvement. There is a continued absence of buying of any weight going on in the iron trade. The coal trade is only saved from more complete depression than has been known for a considerable time past by the extra demand just now coming forward for the supply of requirements in Scotland, and the engineering industries show no indication whatever of reviving activity. In all departments it is a continued dragging on from hand to mouth, buyers and consumers holding back from entering into transactions beyond what they are absolutely compelled, and the prospects as regards the immediate future are about as discouraging as they well could be.

The Manchester Iron Exchange on Tuesday brought together a moderate attendance, but business was again reported as extremely slow, both in raw and manufactured material. For pig iron prices perhaps showed somewhat more firmness to the extent that makers here and there were not disposed to entertain business at the exceptionally low figures which would recently have been accepted, but it could not be said that any actual advance upon late current quoted rates was obtainable. Lancashire makers are still altogether out of this market, where they have to come into competition with district brands, and such business as they are securing is almost so entirely of a special character with regular customers, where they have exceptionally favourable rates of carriage, or where the prices are governed by other considerations, that anything like definite quotations are scarcely possible, and their list rates of about 39s. and 39s. 6d. for forge, to 42s. for foundry, less 2½, at the works, are simply nominal so far as ordinary business is concerned. If anything, rather more firmness is being shown by makers of district brands in holding to what have been the recent quoted rates, and although 3d. to 6d. under these has been taken within the last week or so, it would have been difficult to place orders for Lincolnshire at under about 38s. for forge to 39s. for foundry, net cash, delivered Manchester. In the best foundry brands of Derbyshire some transactions have been put through at prices equal to 45s., net cash, delivered Manchester; but inferior brands are still obtainable at about 43s. net, delivered here. For outside brands coming into this market prices are firm, at the full quotations ruling last week; good foundry Middlesbrough being scarcely obtainable under 44s. 1d. to 44s. 4d. net cash, delivered Manchester. In Scotch iron it is difficult to get any definite quoted prices, as makers have practically little or nothing to offer, and second-hand holders base their prices according to circumstances; but Eglinton could have been bought at about 46s. 3d. to 46s. 6d. net, prompt cash, delivered at the Lancashire ports.

The position in the manufactured iron trade remains practically unchanged; makers report no improvement in the weight of new business coming forward, and it is exceptional where forges are running more than about four days per week. Quoted prices are about as last given, Lancashire bars remaining at £5 7s. 6d., and North Staffordshire £5 10s.; Lancashire sheets £6 17s. 6d. to £7 2s. 6d.; and Staffordshire £7 2s. 6d. to £7 5s.; Lancashire hoops, £5 17s. 6d. for random and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Only a very quiet business continues to be reported in the steel trade, with ordinary foundry hematites scarcely averaging more than 52s. 6d., less 2½, and ordinary basic billets £4 net cash, with steel boiler plates quoted by makers about £6 10s., but readily obtainable from merchants at about £6 7s. 6d. delivered in the Manchester district.

In the metal market there is still only a very moderate business being put through, but the upward movement in raw material gives a firm tone to list rates for all descriptions of manufactured goods.

There was some expectation that the settlement of the wages question in the coal trade might be followed by an improvement in the engineering industries, but any anticipations in this direction have so far proved altogether delusive. Instead of any improvement, the position in the engineering industries has, so far as the employment returns of the trades' union societies are concerned, been steadily growing worse. Last month the Amalgamated Society of Engineers had to report a considerable increase in the number of out-of-work members on their books, and the returns for the present month show a further considerable increase in the same direction, about 1000 additional out-of-work members having come upon the books during the last couple of months, and the returns now show nearly 10 per cent. of the total membership in receipt of out-of-work support. In this immediate district, where some slight improvement was noticeable recently, the position has been getting worse, and there has been a decided increase in the local returns of out-of-work members, which now reach about 9 per cent. of the membership in this immediate district.

The returns as to the condition of trade generally throughout the country also continue very discouraging, and there is no intimation of any prospect of improvement from any of the large engineering centres. In view of this generally depressed condition of trade, the action which has been taken by the men on the North-east Coast, in striking for an advance in wages, is looked upon by the responsible officials of the Society as having been a very ill-advised step, and certainly it has proved a costly one to the Society, as this dispute alone has thrown something like 2000 members on the books for financial support.

In the coal trade the local and inland demand for all descriptions of fuel continues extremely slow, and four days per week represent the full average that the pits are working. The better qualities of round coal meet with only the slowest possible demand for house-fire consumption, whilst the commoner descriptions of round coal continue only in very indifferent request for ironmaking, steam, and general manufacturing purposes. Fairly large orders have, however, been coming into the district for locomotive fuel to meet the requirements of Scotch railway companies who have sent their own wagons to the pits in this district to be loaded up, and this has enabled rather better prices to be got in such cases. Generally, prices for all descriptions of round coal continue very low, with a good deal of cutting and irregularity in the open market. At the pit mouth best Wigan Arley coals only in exceptional cases average more than 11s.; Pemberton 4ft. and seconds Arley, 10s.; common house coals, 8s.; with steam and forge coals, about 7s. to 7s. 6d., something like the last-named figure having been got for locomotive fuel going into Scotland. Engine classes of fuel, although perhaps not quite so great a drug upon the market as they have been recently, are still plentiful and low in price, common slack being readily obtainable at 3s. 9d. to 4s.; medium sorts, 4s. 6d. to 5s., with best qualities quoted at 5s. 6d. to 6s. per ton at the pit mouth.

In the shipping trade a fairly active business is still being done, but this is mostly in connection with supplies which are being shipped to Scotland. No materially better prices are, however, being got, ordinary steam coal not averaging more than 8s. 6d. to 9s., and engine classes of fuel 5s. 3d. to 5s. 9d. per ton, delivered at the ports on the Mersey.

*Barrow.*—The hematite iron trade is still very quiet, and no improvement can be noted during the week. Buyers are only securing small parcels, and those for prompt consumption. From foreign, colonial, and continental sources there is a very poor trade offering. Prices show practically no change on the week. Warrant iron is quoted at 43s. 8d. per ton net cash sellers, and 43s. 7d. buyers, while makers ask 44s. to 45s. 6d. per ton for parcels of mixed Bessemer numbers, net f.o.b. The trade in forge and foundry iron is practically *nil*, and only a limited business is doing in Bessemer qualities.

Stocks of pig iron in warrant stores have been steadily held during the week. Transactions have been few, and only a reduction of 10 tons is notified. There is now in stock 158,323 tons, being an increase of 63,700 tons since the beginning of the current year.

Another furnace has been blown out this week in West Cumberland, and a further one will be stopped in a few days. This is a result of the poor demand for pig iron and the absence of profit to smelters at current prices. There are now thirty-four out of seventy-five furnaces in the district in blast.

Steel makers are still short of orders, and prospects of either stoppage or short time in most of the departments are imminent. There is a fair activity in steel plates for shipbuilding purposes, and the mills are busy on good orders. A fair demand still exists.

Iron ore is quiet in tone at late prices, viz., 8s. 6d. per ton for ordinary qualities.

Shipbuilders and marine engineers are busy, and likely to remain so. Some good repair orders are in hand in addition to the Admiralty and general work, but the inquiry for new tonnage is reported to be very small.

The works recently leased by Messrs. Westray, Copeland, and Co., engineers and ironfounders, at Barrow, have been acquired by Mr. David Caird who has put down a new and valuable plant, and is now commencing business with prospects of a fairly good trade.

Mr. W. B. Peat, of Barrow and Middlesbrough, has been appointed receiver and manager of the Solway Hematite Iron Company, and during the course of the current month will issue a report to the shareholders showing the company's financial position. The closing of these works would be a bad look-out for Maryport.

Shipping is very quiet, and the exports of pig iron and steel during the past week have only totalled up to 10,332 tons, compared with 17,407 tons in the corresponding week of last year, a decrease of 7075 tons. The aggregate shipments of metal this year so far has reached 473,008 tons, against 476,342 tons in the corresponding period of last year, a decrease of 3334 tons. The decrease in steel shipments this year represents 70,786 tons, and the increase in iron shipments 67,452 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The South Yorkshire collieries have not been so busy during the last ten days. Bank holiday had something to do with this, for although St. Lubbock is not much held in the Barnsley district, its generous recognition elsewhere acts upon the trade. Little demand has been reported for house coal, and the business generally is considerably below the average. The steam collieries, which have been sending a good tonnage to Hull and the other Humber ports, are fairly well employed, the men working on an average five days a week. Other colliers engaged in the getting of household and gas coal are only working three days a week. This being the first week under the new arrangement, it was expected that there would be some dissatisfaction when the miners received their wages with a 10 per cent. reduction. More serious than a little grumbling was experienced. Some few concessions in kinds have been made, but nothing large or general enough to vary quotations materially. Silkstones fetch from 9s. 6d. to 11s. per ton; Barnsley house from 8s. 6d. to 10s. per ton; other qualities from 1s. to 2s. lower. The steam coal trade, as already mentioned, is doing a very good business, the tonnage forwarded to the Humber ports being the principal part of the whole output of this district. Prices are steady, and range from 7s. 9d. to 8s. 6d. for Barnrley hards, other qualities being quoted at from 1s. to 1s. 6d. per ton lower. Gas coal is quiet, and prices are unaltered. Manufacturing fuel is dull supplies being very large, and prices low. Good slacks command from 4s. to 5s. per ton. Smudge, 2s. per ton. Inquiries are better for coke, which can now fetch from 9s. to 11s. per ton.

The official return of trade done with Hull in Yorkshire coal, as issued by the Hull Chamber of Commerce, exhibits a satisfactory state of affairs on the whole. This district appears to be rapidly regaining the business which drifted north during the coal strike, and there is the additionally gratifying symptom of trade tending upwards. The total tonnage forwarded to Hull last month from Yorkshire collieries was 221,200 tons, as compared with 183,864 for the corresponding period of 1893, or an increase of 37,336 tons, or 20 per cent. Last month's supply was the largest individual monthly tonnage sent to Hull this year, the next month being May, when 171,856 tons were forwarded to that port. For the completed seven months of 1894 the supply sent to Hull was 1,146,304 tons, as compared with 923,240 tons for the corresponding period of last year. These figures, however, are not so large as those of the same period in 1892 and 1891, when the tonnage was 1,306,920 and 1,304,672 tons respectively. The export of coal to foreign ports from Hull reached a total last month of 107,064 tons, against 76,032 tons for the corresponding period last month. The heaviest weight was taken by North Russia, 33,451 tons, against 21,410 last year. Sweden and Norway took 33,137 tons; Germany, 16,827 tons; Holland, 6310 tons. For the seven months the largest customer was Sweden and Norway, North Russia and Germany coming next. The number of collieries on the list was 177, Denaby Main being at the top with 36,552 tons, or 16½ per cent. of the whole coal trade of the port. The second place is occupied by Monk Bretton with 9632 tons, then follow Thrybergh Hall and Carlton Main with 9496 and 9296 tons respectively. These four collieries sent 64,976 tons, or 29·27 of the whole trade of the port in Yorkshire.

Our foreign trade in hardware and cutlery during July represents a total value of £143,464, against £175,184 for July of last year. This decrease is largely due to the cause which has been so often mentioned. The falling-off in the United States market is owing to the uncertainty about tariffs, which ought now to be at an end with the acceptance of the Senate Bill. The value sent there last month was only £4907, against £21,502. The other decreasing markets have been Russia, France, Spain and Canaries, Chili, Brazil, Argentine Republic, British Possessions in South Africa, British Possessions in East Indies, Australasia, and British North America. The only increasing markets for the month were thus Sweden and Norway, Germany, Holland, Belgium, and Foreign West Indies. The decline in business with the United States for the seven months ending July 31st is best seen by comparison of the figures with those of the corresponding period of 1893. Up to July 31st last year, hardware and cutlery were sent to the United States to the value of £141,177. Up to July 31st last, the figures were only £59,898. In steel—unwrought—our foreign business amounted last month to £172,159, against £148,343 for July of 1893. This considerable increase is mainly caused by an improvement in Russia, United States, Denmark, and British North America. Russia has advanced from £11,538 to £25,625; Denmark, from £3559 to £9844; France, from £7189 to £10,651; United States, from £28,434 to £35,186; British North America, from £9596 to £13,820. Decreases are shown by Sweden and Norway, Germany, Holland, British East Indies, and Australasia.

It is not expected that the Chinese conflict with Japan will have much effect upon orders for war material for either country. Two battleships are being built for the Japanese Government, one on the Tyne, the other on the Thames. The orders for the armour, as already mentioned in The Engineer, have been secured by Messrs. Cammell and Co., Cyclops Works, and Messrs. Vickers, Sons, and Co., River Don Works, both of Sheffield. Deliveries are spread over a series of years, and so far the Japanese Government have not instructed the work to be expedited. There is no probability that the warships will be ready until long after the dispute is settled, and as the expenditure caused by the war will have exhausted the Japanese exchequer, there will be little desire to still further embarrass their treasury. A statement that both the Chinese and Japanese Governments have representatives in England buying up war material has no confirmation so far as Sheffield is concerned, and that city would be the first place where inquiries would be made.

In the lighter trades an improvement is reported in the saw-making houses. These are mainly from Eastern markets. It is pleasant to note that Burmah, which has been so long depressed owing to internal disturbances, is now becoming a fairly good customer. Some valuable orders for circular saws have been recently received in Sheffield during this month. One of these orders is from Burmah, which includes a number of saws 6ft. in diameter. Other foreign markets are also ordering pretty freely.

In addition to the orders for railway rolling stock mentioned last week, as having been received by Messrs. Craven Brothers, Darnall, for the Metropolitan and South-Eastern Railway Companies, as well as for the Cheshire lines, other companies are in the market with a good deal of work. Amongst these is the Midland, which has been placing considerable requirements for material for railway stock. All the companies have been short of wagons for a long period, owing to the suspension in building operations during the coal strike, and in consequence of the stagnation which followed it.

In our steel houses a very hopeful feeling prevails. It is believed that business is now upon the turn. A rapid development in railway material is certain, and although shipbuilding remains exceptionally quiet, several of our local firms are pretty well employed upon heavy marine castings and forgings. There is a very good demand for the higher grades of tool steel from home, foreign, and colonial markets. The expectation of an abundant harvest has stimulated a demand for knives, steel parts, and sections of agricultural machinery. The season in these goods has been better than for several years. In files one or two firms are busy, but generally the state of trade is better than it was.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

An improved condition of trade is generally reported this week in this district, and the tone of the iron and steel market is decidedly more cheerful than has been known for a long time. A large amount of business has been done in some branches, and at better prices than consumers would recently pay. It is not altogether the passing of the Tariff Bill in America that has brought about this welcome change, for there were some signs of improvement before, and consumers and shippers were showing anxiety to purchase. They have delayed purchasing pig iron for autumn delivery as long as possible in the expectation that the strikes would end and prices collapse, but the negotiations between the employers and the men on strike have so far proved abortive, and the difficulties are apparently as far off settlement as ever. And now it is not likely that if peace were soon restored the expected fall in prices would ensue, because the time has arrived when exporters must make arrangements for autumn deliveries. The market has turned more in favour of the sellers, as the compromise effected in America with respect to the Tariff Bill is making its influence felt here, and the metal trades generally will derive as much benefit as any from the step that has been taken. Makers anticipate that an impulse to business will be given, and are, therefore, not inclined to let their iron go at the prices they have recently been accepting, as orders that have been held back pending the settlement of this question will be distributed without further delay.

Good orders have this week been given out for Cleveland foundry pig iron to be delivered next month and in October, and the price generally taken for f.o.b. deliveries of No. 3 has been 35s. 6d., but that will not be taken now even for prompt delivery, though buyers are offering it freely. Nearly all the producers are at present quoting 35s. 9d., and this figure can be got. As a matter of fact, No. 3 is exceedingly scarce, scarcely a maker has any in stock, and the production this week will be less than usual because the furnaces are, as a rule, working badly, owing to the stoppage of last Saturday. The twenty-four hours' cessation of operations has been very injurious to the quality of the iron made subsequently, and the quantity is lessened. Thus there is less No. 3 made just when a better demand has sprung up for it, and more of the lower qualities which were already practically a drug upon the market. On this account there has not been the advance in the prices of forge qualities of Cleveland pig that has been noticed in connection with foundry qualities, and the former are now relatively the cheaper. Usually grey forge is 1s. cheaper than No. 3, and recently it has been only 6d. cheaper, but to-day there is a difference of 2s., for while one has gone up the other has declined. Grey forge is 33s. 9d., and is weak at that. No. 1 Cleveland pig is at 38s., and No. 4 foundry 34s. 6d. In the warrant market more life has been reported during the last few days, and speculators have been buying freely for a rise in prices, which they think can hardly fail to follow the intelligence from the United States. Cleveland warrants have risen to 35s. 9d. cash. In Connal's public warrant stores, on Wednesday night, 94,525 tons of Cleveland pig iron were held, the decrease this month being 867 tons. In consequence of the scarcity of No. 3 in makers' hands, a considerable quantity is now being withdrawn from the public stores, and that fact will have its effect in strengthening the market. For East Coast hematite pig iron the demand has not yet materially improved, but it must do so soon, because more activity has appeared in the steel plate and angle trades of this district, and the consumption of hematite pig must necessarily increase. The quotation for mixed numbers at present is 43s., and little can be bought below that. Foreign iron ore is plentiful enough, and good Rubio can be bought at 11s. 9d. per ton, delivered at furnaces on Tees-side, the freight from Bilbao being very low, about 4s. 10½d. per ton. Pig iron exports from the Tees are not equal to those of last month, or of the corresponding month last year, but are improving.

On Saturday last, or rather from six a.m. Saturday to six a.m. Sunday, operations at most of the furnaces in Cleveland and South Durham were suspended in order that the men might have their demonstration in favour of an eight hours' day, which they are determined to have. The stoppage, though only for twenty-four hours, has seriously affected the quality of the production ever since, and makers have not been able to get their due proportion of the higher qualities this week, so that their loss is not measured by the reduction in the quantity of iron made on the day of the stoppage alone. The men allowed a few furnaces to be kept in operation, viz., those at Seaton Carew, Carlton, and Ormesby Works, where the eight hours' days has been conceded. The Redcar Works were also kept in operation, the employers paying the men 2s. 6d. extra for the day. A furnace at the Ayrsome Works was also working, as it was running on spiegel, and a stop would have been unfortunate, as operations might not have speedily been resumed, and besides this the expense of the stoppage would have been greater than in other cases. Several thousand blast furnacemen met at Middlesbrough, and with bands playing and flags flying they marched down to Southbank, where they passed a resolution expressing their thanks to those firms who had conceded the eight hours, and their determination to have the three shifts per day at the other works. The masters are willing enough to grant the concession if it would not materially enhance the cost of production. They argue that it will, and the experience of the three firms which have adopted the new system is of too short a duration to settle the matter yet.

Manufacturers of finished iron and steel are in some respects better off than they have been for some time; indeed, the steel plate and angle makers have done so well within the last few days in booking orders that they have raised their quotations 2s. 6d. per ton. They have not got any important order from local consumers, for the strike of moulders still keeps the shipyards stopped, and they do not require plate and angles. However, good contracts have been secured from the Scotch shipbuilders, who cannot buy at home, because the steel works there are closed by the miners' strike, and the consequent scarcity of fuel. Steel ship plates are now at £5, and angles at £4 15s., both less 2½ per cent. and f.o.t. The steel rail trade is extremely dull, and exports of railway material from this district have not for years been so small. The stoppage of the Darlington Works will make no difference, because the competition is chiefly with the Welsh and Sheffield producers. The quotations for heavy steel rails with some firms is as low as £3 10s. net at works.

During the last few days the members of Lloyd's Committee have been paying their annual visits to the iron and steel works, shipyards, and engineering works of this district. The members were Messrs. W. H. Tindall (chairman), S. J. da Coster, T. L. Devitt, J. Glover, B. Martell (chief surveyor), and A. G. Dryhurst (secretary).

No further efforts have been made this week to bring to a termination the strike of moulders, which has lasted now for over five months, and is fearfully hampering the shipbuilding and engineering industries of the district. It is throwing out of employment thousands of other workmen; indeed, the number of men on strike is not a tenth of those who are idle in consequence of it. At some of the marine engine works castings have been obtained from Scotland and even the Continent, and operations with them are being more fully carried on. But the men on strike are doing their best to prevent the masters from obtaining castings from other districts, and by threatening to stop the works of any founder supplying castings to an establishment where the moulders are on strike, they have pretty well succeeded in paralysing their masters' business. The demand for forgings is fairly good. The Darlington Forge Company keeps its establishment in full operation employing over 700 men, and the work it has in hand includes crank shafts for the P. and O. Company, twin-screw brackets and stern frames for the Cunard Company, large castings and forgings for the steering gear of H.M. first-class battleships Majestic and Magnificent, rudder forgings for the White Star Line, heavy stern frames for the North German Lloyd's steamers, &c. It has orders for cast steel wheels for the North-Eastern, Great Eastern, London and South-Western, and various Indian and South American railways.

A large and increasing business is being done by the coalmasters of the North of England, there being considerable activity in the demand for both steam and gas coals, and deliveries of the former are very heavy to continental ports, the importers taking advantage of the low freights that now prevail, but which cannot be expected to last long when the autumn demand fairly sets in. Better prices are being realised for steam coals, and 11s. per ton f.o.b., for best Northumberland is paid. Blast furnace coke is stiff at 12s. 6d. per ton, delivered on Tees-side, or 14s. 6d. f.o.b., and buyers are not backward about giving these figures.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE was a strong impression in trade circles towards the close of last week that the colliers' strike was about to terminate. Now, however, less hope is entertained of an early settlement. The leaders of the miners are divided, and violently oppose each other as to the policy to be adopted, while the employers have not in the least degree retired from their original position of uncompromising opposition to the demand for an advance of 1s. per day in their wages. By a majority of 35 to 31, the miners' delegates have adopted a resolution advising the men to go back to work on an increase of 6d. a day, along with a guarantee from the masters that wages shall not be reduced during the next eighteen months. This proposal is meeting with almost violent opposition from large numbers of the colliers, and there is scarcely any likelihood that the employers would agree to it, even were the miners at one in its favour. The strike has now lasted for nearly two months, and done much to retard business in a great many departments of industry besides the iron and steel trades, which remain practically at a standstill.

The Glasgow pig iron market is inactive. Last week the feeling latterly was that, as the strike was thought to be ending, warrants were a likely investment at current prices, and it was reported that several operators on 'Change were picking up fair lots in anticipation of a rise in price. In the last few days, however, the market has been dull, with warrants comparatively neglected. Scotch warrants have sold from 42s. 2d. to 42s. 3d. cash, and Cleveland at 35s. 9½d. one month. Cumberland hematite has exhibited a little more animation in the last few days, as a result of the American tariff provision for the free admission of iron ore. The expectation is that this enactment will stimulate the import into the United States of hematite ore from Spain, leading to at least a temporary increase in its price. As a consequence, holders of hematite pigs have been firm this week, all the more that there is none of this class of iron being produced at present in Scotland. Business has been done in Cumberland warrants from 43s. 9½d. to 43s. 11½d. cash.

The prices of makers' pig iron are as follow:—G.M.B. f.o.b. at Glasgow No. 1 43s. 6d. per ton; No. 3, 42s.; Monkland No. 1, 46s. 6d.; No. 3, 42s.; Carnbroe No. 1, 48s.; No. 3, 46s.; Clyde No. 1, 55s. 6d.; Gartsherrie No. 3, 52s.; Summerlee Nos. 1, 55s. 6d.; No. 3, 49s. 6d.; Calder No. 1, 56s. 6d.; No. 3, 49s. 6d.; Coltness No. 1, 57s.; No. 3, 52s.; Glengarnock at Ardrossan No. 1, 53s.; No. 3, 48s; Eglinton No. 3, 48s. 6d.; Dalmellington at Ayr No. 1, 50s.; No. 3, 46s.; Shotts at Leith, No. 1, 55s; No. 3, 51s.

There is no change in the number of furnaces in blast, which is seven, compared with 61 at this time last year.

The shipments of pig iron from Scottish ports in the past week amounted to 3853 tons, compared with 5576 in the corresponding week of last year. Of the total Italy took 1200 tons, Canada 120, South America 70, India 25, Australia 50, France 15, Holland 670, Belgium 15, China and Japan 450, other countries 185, the coastwise shipments being 1053, against 1678 tons in the same week of 1893.

Business in malleable iron and steel continues upon a most restricted scale. The works are still closed, and neither buyers nor sellers are in a position to undertake transactions with anything like confidence.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced locomotives worth £2270, sewing machines £4850, other machinery £2622, steel goods £4218, and general iron manufactures £14,700. These figures indicate a slight improvement on the shipments of the last few weeks, but they are still unsatisfactory.

Considerable quantities of coals continue to reach the Clyde from English ports. Hitherto the prices obtained have been but moderate. A tendency now shows itself towards advancing rates, but the demand is small owing to so many of the larger consumers having their works closed.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

APPEARANCES seem to indicate that the steam coal trade has entered upon one of those periodical declines which are inseparable from the history of the trade. At present the drooping tendency is slight, and prices this week are only about 6d. per ton less than last. Still the tendency exists, and I note that on 'Change this week, at Cardiff, the demand was only moderate, and the usual sign of weakness, falling prices for seconds, was noticeable. So far coalowners are not much concerned, and some are inclined to think that the depression may pass off. House coal quotations are maintained. Cardiff quotations this week are as follows:—Best steam coal, 11s. 6d. to 11s. 9d.; seconds, 11s.; dry sorts, 9s. 9d.; common small, 5s. 9d.; best small, 6s. to 6s. 3d.; best Monmouthshire large, 10s. to 10s. 3d.; dry sorts, 9s. 9d.; house coal, best, 11s.; No. 3 Rhondda, 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 9d. to 9s.; through, 7s. to 7s. 3d.; small, 5s. Patent fuel quotations are maintained. Pitwood 15s. 9d. Tendency upwards. At Swansea the shipment of patent fuel last week was 3882 tons, Oran taking 1950 tons. Coal shipments a good average.

Two subjects have been well to the front this week in the district, and all other matters have been dwarfed in comparison. The first is the eight hours' legislation for colliers, and the other the American tariff. With regard to the first, the two colliery representatives in the House are opposed, Mr. D. A. Thomas supporting local option, each district being able to regulate its own arrangements, while Mr. Abraham, "Mabon," supports the hard-and-fast line which I have all along contended in this column would be pernicious to coalowners and to masses of colliers. Mr. Thomas's amendment was carried by a majority of five, and it may fairly be taken as settling the matter. New collieries just opening out may try the plan, as the men have no distance to travel underground, but I believe that if resorted to it would be abandoned, as we have seen in other industries.

Enactments with regard to coal-working have always been framed in a liberal and merciful spirit. At the beginning of the coal era, when the law began to interfere with the liberty of the collier, it swept the women and girls out of the pits; then it protected children, and put its interdict upon the employment of boys under a certain age. Since then its action has always been wise, and with a view to the saving and security of life. The measure now thrown out would have been an exceptional piece of hardship, and the monition not to work more than eight hours daily would in many cases practically be limiting actual labour to six hours daily, to the grave loss of the collier.

The other subject, the tariff, is now regarded in Swansea as safe, and though only a compromise has been effected, and the arrangement probably may not be of long duration, still the feeling on 'Change this week at Swansea, as compared with that of last week, is greatly improved; and if labour troubles can only be allayed, bright times are thoroughly anticipated in the near future. I am glad to hear favourable reports of the proceedings at the great colliery enterprise of the Dowlais Company at Aberdare Junction. The water difficulty, which from the first was regarded as the great obstacle, the place being in the centre of the coalfield, has now been overcome, and sinking is going on rapidly. The shale now also gives well-known indications of approaching coal, and it cannot be long before some veins are touched. At the Ader good work is also being done, and Llanbradach has two pits in active operation.

There was a rumour this week that the Great Western Railway was going to reduce coal rates at Swansea, but I have not seen it substantiated. The wish in this case is evidently father to the rumour. If rates were reduced in the case of iron and steel, there would be a good deal of satisfaction, but it would have to be generally done. Steel bars sent from the principal ironworks have to do with various lines linked with each other. I note also that coal from the Rhondda is often in the same condition. It is sent from the Ocean or the Albion on to the Taff Vale, is shunted on to the Brecon, and again on to the London and North-Western Railway if for Birkenhead, or to the Cambrian if for Aberystwith.

I am glad to note the ability with which the Cambrian Railway is worked, the punctuality of its trains, and the marked conveniences enjoyed by passengers in the holiday season. It must, however, be noted that holiday traffic on local lines will show badly this season, which has been a blending of winter, autumn, and summer.

One of the leading ironmasters has favoured me with his opinion of iron and steel prospects, and I must admit that they are not hopeful. Much depends upon American business for tin-plates. If this should improve, so, too, would the tin-bar trade. As for rails, the outlook is bad. What is wanted, he said, is a greater variety of uses for steel; and, until these are forthcoming, we have nothing else to do than to struggle on.

I am glad to hear that the new industry at Cyfarthfa—the brickworks—have turned out a marked success. There is a large make going on just at present, and a full demand. Ironworks not unfrequently get supplies of bricks from the North of England and from Scotland. As far as Cyfarthfa is concerned the management is independent of outside make. It is to be regretted that there is not an opening for Bessemer slag, the same as for basic. Huge hills are now being reared near the principal ironworks, and any quantity would, practically, be given away. The inventive mind found a rich quarry in the refuse from gasworks and other industries, and here is an opening again which may have profitable issues.

Numerous subsidences of land are occurring in the mineral district, notably in the Aberdare and Merthyr Valleys, in the Rhondda, and near Neath, and I hear that actions of law are likely to test the responsibility of landlords.

The periodic movement of the Cardiff Corporation with regard to a harbour trust is again to the front, and so also is a project for the Corporation acquiring the tramways in the way just effected by Newport. With regard to the former, a majority of the Corporation have supported the Trust. The minority, however, is a formidable one, and the magnitude of the scheme, I expect, too vast to be grappled with, especially if, as some contend, Barry should be included. Cardiff has to complete its huge waterworks, carry out its electric lighting, double its tramways, and other incidental matters first. One of the minority suggested the consequences of a strike as a matter for grave consideration in coming to a settlement of the question. The Newport Corporation have been in communication with the directorate of the Ebbw Vale works respecting the rumoured removal of the works, and pointing out the desirability that Newport should be selected as a site.

The secretary of the works has promised to put the proposition before the directorate, and there, for the time, it ends. I cannot state if there is any ground for the rumoured removal. If too big a scheme, the adoption of the Dowlais tactics in having a modernised branch on the sea-board might be feasible. That is the future of the Welsh works, with one or two exceptions. It is fortunate that ironworks have been of a duplex character, with a coalfield as well as ironworks, and in the case of Tredegar and Rhymney this is turning out well.

Iron and steel are only in small demand. One small parcel of rails has gone to Highbridge, and some moderate consignments of steel bars to the tin-plate works this week. Crop ends continue in demand. Dowlais sent off a quantity last week, and an average make of bars. Cyfarthfa continues busy. Two workmen were prosecuted last week for neglecting work, and fined 10s. each.

Large quantities of Bilbao ore have been coming in this week to the leading works. Latest Swansea quotations, iron and steel, are:—Glasgow pig, 42s. 3d.; Welsh bars, £5; steel rails, heavy, £3 15s. to £4; light, £4 7s. 6d. to £4 10s.; sleepers, angles, channels, &c., according to specification. Steel sheets, £6 to £6 5s.; iron, £5 15s. to £6 10s.; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens best, £4 2s. 6d. to £4 5s. Tin-plates: Bessemer cokes, 10s. 3d. to 10s. 4½d.; Siemens, 10s. 4½d. to 10s. 7½d.; best charcoal, 11s. 6d. to 12s. 6d.; ternes, 28 + 20 c., 19s. to 23s.; wasters, 6d. to 1s. less per box than primes; odd sizes usual extras; all delivered in Prince of Wales Dock, Swansea, cash less 3 and 1 per cent. Block tin is advancing, £68 to £68 5s.

Tin-plate shipments show a little improvement, and better is expected next week. Shipment last week, 54,996 boxes; received from works, 40,955 boxes. Some tin-plate works are again closing, but I expect only temporarily. Coke at Cardiff and Swansea quotations maintained.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE outlook in the iron and steel trades remains very much as reported for some time past. The pig iron business is still rather quiet, and orders are not coming to hand freely from any sources. The different departments of the malleable iron trade are also but insufficiently engaged, buying is still restricted to the smallest possible quantities, and prices continue low, with here and there a tendency to decrease.

From the Silesian district the reports concerning the situation of iron business are not very encouraging, the amount of orders booked being exceedingly small, especially in the crude iron department, and prices are as weak as ever, makers having to give way considerably upon the nominal quoted rates to meet the competition of foreign houses. With regard to the employment in the finished iron and engineering industries, rather more favourable accounts have been coming in. Bars and plates are in fair but not very brisk request, and the wire mills are also in good operation. The prices for most articles of finished iron are pretty firm all round.

Iron business in Austria-Hungary has become rather more quiet upon the week; the demand for both crude and finished iron, though still satisfactory, no longer shows the exceeding briskness that has been noticeable for some time past. For the present the blast-furnace works as well as the rolling-mills report themselves even more than sufficiently employed, and are, therefore, enabled to patiently await the end of the quiet season. Iron export has not very favourably developed this year, because on the Roumanian and Eastern markets the Germans are gaining ground from month to month, offering at very low rates. The railway and engineering department is rather badly off for new work, existing orders as well as those holding out being few and of small weight. In Hungary some orders of importance are expected to be given out soon; only just recently the supply of the iron material for the new electric underground railway at Buda-Pesth has been granted to the Rima-Murany Ironworks.

French trade during June of present year is stated to have been as under:—

| Import. | 1894. Frs. | 1893. Frs. | Difference for 1894. Frs. |
|---|---|---|---|
| Victuals | 96,860,000 | 89,054,000 | + 7,806,000 |
| Raw materials | 176,769,000 | 199,661,000 | − 22,890,000 |
| Manufactured goods | 46,946,000 | 46,875,000 | + 371,000 |
| | 320,575,000 | 335,590,000 | − 14,715,000 |

| Export. | 1894. Frs. | 1893. Frs. | Difference for 1894. Frs. |
|---|---|---|---|
| Victuals | 58,948,000 | 57,460,000 | + 1,488,000 |
| Raw materials | 70,987,000 | 63 796,000 | + 7,191,000 |
| Manufactured goods | 122,352,000 | 147,002,000 | − 24,650,000 |
| Parcels sent by post | 5,040,000 | 4,830,000 | + 210,000 |
| | 257,327,000 | 273,088,000 | 15,761,000 |

Though the tone of the French ironmarket has weakened rather than improved, the tendency of prices has hitherto been stated as pretty firm. Regarding the business transactions during the first two quarters of present year, the total import of pig iron, malleable iron, and steel amounted to 800,012 t., which shows a decrease of 11,738 t., or 12·8 per cent. against the corresponding period last year. Export was 103,354 t., showing an increase of 4916 t., or 5 per cent. against last year. Import in iron ore amounted to 788,726 t., against 723,802 t. in the preceding year; while export in iron ore was 114,582 t., against 147,223 t. for the first two quarters of 1893.

A pretty favourable condition prevails on the French coal market, engine classes of fuel being well and regularly inquired for, so that prices could be firmly maintained. The consumption of pit coal in France is estimated on 34,875,000 t. for 1893, against 36,551,000 t. for the year 1892; France yielded 25,738,000 t., while the rest was imported. Production of coal in 1892 amounted to 26,178,000 t.

Since last week the Belgian iron market has not changed, and decidedly not improved. All departments are reported to be but indifferently engaged, while the competition of the German firms prevents the works from venturing upon the long-intended advance in the quotations for bars and sectional iron.

If changes have taken place on the Rhenish-Westphalian iron market since previous letters, they certainly are too insignificant to be noticed. A firm tendency prevails in the pig iron trade, and demand is fairly good for the present quiet season. Forge pig is specially well inquired for, while the business in spiegeleisen drags on in a lifeless fashion. Since last week, when demand could be stated to have slightly improved, no alteration has taken place on the finished iron market. Bars are tolerably well inquired for, though next to nothing has been done on foreign account for some time past; the few contracts that are booked are for home requirements. Girders have been in regular request, generally, makers complaining of depressed quotations rather than demand. The hoop mills are satisfactorily engaged and likely to continue so for several weeks to come. Regarding the plate and sheet trade, it can only be repeated what has previously been told, and there is little prospect that the unsatisfactory condition of prices so justly complained of will improve in the near future. Wire and wire nails as well as rivets are in rather lively request, but prices remain extremely depressed. The situation of the wagon factories has, on the whole, improved, 3750 load wagons having again been given out by the Government Railway Administration. Prices, of course, are low, having been considerably pressed down by South German competitors, but no foreign offers have been accepted this time.

Supposing that the existing means of conveyance will be insufficient during the time of the Berlin Industrial Exhibition in 1896, the firm of Siemens and Halske have submitted a proposal to the City Magistrate offering to construct an electric railway at their own expense from the centre of the town to the place of exhibition on the Treptow Field. The electric railway is to be of the underground system, similar to that at Buda Pesth, which for more than five years has proved most successful in every respect.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 9th.

The plethora of money is evidenced this week by the refusal of the banks of this city to accept more money from the interior at any rate of interest because of their inability to lend what funds they have. The steady outflow of gold, now down to nearly 50,000,000 dols., is alarming the business community more than the Washington politicians. Industrial and commercial conditions are improving a little, but the grand break will not occur until the revenue measures under consideration are disposed of. During the past week seventeen rolling mills started up or increased from single to double turn. Six blast furnaces blew in; four rail mills booked orders for 9000 tons standard and girder. Billet mills have more business offered than they see fit to take. Prices are weak in all channels. Railroad traffic shows some little improvement. The coming November elections will sweep one-third of the Democratic representatives from office in the Northern States, and leave the present dominant party forever in the minority.

## LAUNCHES AND TRIAL TRIPS.

On Friday, the 10th inst., the s.s. Beechley left the Tyne on her official trial trip. This vessel was recently launched by Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, and has been built to the order of the North of Ireland Steamship Co., Mr. W. R. Rea managing owner. She is of the following dimensions: 322ft. by 41ft. by 23ft. 1½in. moulded depth, built on the improved partial awning deck system, cellular double bottom throughout, and all the most modern appliances for the rapid loading and discharging of cargo. Engines, 23in., 37in. and 61in. by 39in. stroke, built by Messrs. Westgarth, English and Co., of Middlesbrough. The vessel will have the highest class at Lloyd's, and has been built under the personal supervision of Mr. Lewis, of Belfast. Mr. Rea and Mr. Lewis both expressed themselves highly satisfied with the results of the trial.

Melton Mowbray Sewage.—A Local Government inquiry was held on Wednesday at the Town Hall, Melton Mowbray, before Colonel J. Ord Hasted, R.E., of the Local Government Board, for permission to borrow £4050 for improvements at the sewage works. Mr. Edmund Jeeves, the Surveyor to the Local Board, explained the scheme, stating that after investigating numerous systems of sewage disposal, the Board had decided to adopt the International system of Ferozone and Polarite as being the most economical and efficient process. The sewage is at present treated by the lime process, which has given rise to serious complaints of pollution and the destruction of fish life. The Board have now determined to abandon the old system of tanks, and to construct others upon the continuous upward flow self-cleansing principle as embodied in the Candy Tank, which has been also adopted by H.M. Government. In addition to the Polarite filters the works will be provided with three clarifiers to economise chemicals and save labour. There was no opposition, and it is intended to carry out the work forthwith.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

1st *August*, 1894.

14,708. Table Cricket Game, C. W. Douglas-Willan and J. Jaques, jun., Bridgend.
14,709. Machines for Boring Articles, A. King and A. C. Oakes, Nottingham.
14,710. Waste Water-closets, J. Day, Wolverhampton.
14,711. Feed-water Purifiers and Heaters, J. Chapman, Swinton.
14,712. Apparatus for Combination with Gas-meters, G. F. Underwood, Kidderminster.
14,713. Antifriction Pulleys, &c., F. Simmons, London.
14,714. Button in Two Parts, W. H. Sladdin, Yorks.
14,715. Traps for Drains, &c., J. Quarnby, Manchester.
14,716. Cycling and Similar Caps, J. Gardner, Manchester.
14,717. Appliances for Controlling or Regulating the Time of Infusion of Tea, J. Crabtree, Lincoln.
14,718. Pneumatic Sole for Boots, J. McKenny and P. Redmond, Dublin.
14,719. Oil Lamp Burners, G. W. Mohrstadt, Birmingham.
14,720 Oil Lamps for Cycles, G. W. Mohrstadt, Birmingham.
14,721. Hair Curling Appliances, J. Walker, Birmingham.
14,722. Smoke Plate, A. Fitton, Manchester.
14,723. Fabric Cutting Machine, F. Wever, Manchester
14 724. Suspending Skirts to Blouses, A. P. Groser, Bristol.
14,725. Knitting Machines, W. I. James and S. Clarke, Stafford.
14,726. Cycle Wheel Construction, T. Cope, Birmingham.
14 727. Surgical Instrument, C. W. Howatson, Perthshire.
14,728. Skate Wheels, F. I. Gibbs and W. Wright, Birmingham.
14,729. Hat Retainer, J. H. Wood, Blackpool.
14,730. Greenhouses, T. Main, Glasgow.
14,731. Driving Gear for Cycles, C. B. Lawson, Glasgow.
14,732. Penstocks and Sluice Valves, M. J. Adams, York.
14,733. Channels for Deodorising Sewage, H. Stoffert, Manchester.
14,734. Pneumatic Tires, P. A. Craven, London.
14,735. Power Looms, J. Angus and W. Aitken, Galashiels.
14,736. Swivel Drawbar for Coupling Wagons, R. J. Stanley, Cardiff.
14,737. Clutch Fastening, G. A. Austin, Bury.
14,738. Boots and Shoes, E. Whatcott and E. Bridgewater, London.
14,739. Longitudinally Folding Bedstead, G. B. Sharpe, Builth, South Wales.
14,740. Ball Bearings, O. Collins, London.
14,741. Maturing Wines, H. A. Leverett and A. Martin, London.
14,742. Folding Box, A. Merritt, C. Batty, and H. C. Brooke, London.
14,743. Photographic Shutters, H. T. de la Crouee, London.
14,744. Drill Stock, G. E. Cornioley and D. Cairns, London.
14,745. Colouring Matters, J. C. L. Durand, D. E. Huguemin, and A. J. J. d Andiran, London.
14,746. Solitaire Stud, A. Walker, London.
14,747. Propulsion of Ambulances, W. and E. Allday, London.
14,748. Lubricators, H. Lucas, London.
14,749. Chain-pulls, The Automatic Chain Company, Ld., and G. H. Gardner, London.
14,750. Bicycles, &c., P. Vincent and A. Vincent, London.
14,751. Attaching Buttons to Garments, G. H. S. Farrant, London.
14,752. Holding Window Sash Cords, L. Robson, London.
14,753. Boxes for the Preservation of Food, W. L. Wise.—(*The Aktieselskabet Carl Lunds Fabriker, Denmark.*)
14,754. Skid for Vehicles, T. Crooke, London.
14,755. Mineral Grate, T. Langer. London.
14,756. Apparatus for Making Studs. C. J. Hewitt Liverpool.
14,757. Goods Showing Appliance, F. A. Wilshere, Manchester.
14,758. Water-colour Paints, G. C. Dymond.—(*The Firm of L. Auerbach and Co. [H. Stoeber's Successors], Germany.*)
14,759. Bottle Stoppers, G. C. Dymond.—(*J. G. Schmidt, Germany.*)
14,760. Treatment of Sewage, H. L. Sulman, London.
14,761. Oxygen Manufacturing Furnace, C. T. Cayley, London.
14,762. Producing Parquetry Surfaces, O. Hocking, London.
14,763. Displaying Placards, E. St. J. Frost and S. Shuttleworth, London.
14,764. Puzzle, J. M. Arnot, London.
14,765. Reproducing Designs, R. Greville-Williams, London.
14,766. Condensers, H. L. Doulton and L. E. Sanceau, London.
14,767. Acid Purification, H. L. Doulton and L. E. Sanceau, London.
14,768. Electric Arc Lamps, A. L. Shepard, London.
14,769. Producing Sulphuric Acid, R. W. Hill, London.
14,770. Producing Sulphuric Acid, R. W. Hill, London.
14,771. Joining Railway Rails, N. Douglas and A. MacDonald, London.
14,772. Block Agglomerated and Briquette Fuels, J. Lyle, London.
14,773. Sausage Stuffers for Meat Chopping Machines, W. von der Nahmer, London.
14,774. Dredging Apparatus, J. C Lang, London.
14,775. Combined Pins, S. W. Pedley, London.
14,776. Lamps, G. C. Dymond.—(*Verbeeck, Briquet, and Co., Belgium.*)

2nd *August*, 1894.

14,777. Comparing Insurance Statistics, W. Schooling, London.
14,778. Tea, Coffee, or other Substance Infuser, W. Pearce, Birmingham.
14,779. Jointing Pipes and Tubes, L. Seager, Sittingbourne.
14,780. Contrivance for Beating-up Eggs, M. S. Wilson, Chippenham.
14.781. Manufacture of Pianofortes, J. and A. Acock, Worcestershire.
14,782. Screw Propellers of Vessels, J. Taylor, Liverpool.
14,783. Bottles, H. Cheesman, Hartlepool.
14,784. Refuse Destructing Furnaces, S. Willoughby, London.
14,785. Trouser Leg Bottom Spring, R. J. Stanley, Cardiff.
14,786. Flushing Syphons, W. Sharp and W. Cruickshanks, Glasgow.
14,787. Cigar and Cigarette Holders, J. W. White, Liverpool.
14,788. Textile Fabrics, J. S. Lenton and R. B. Caldicott, Bradford.
14,789. Tea Cups for Milking Machines, A. Shiels, Glasgow.
14,790. Preventing Scales in Steam Boilers, G. P. Gardner, Glasgow.
14,791 Apparatus for Sifting Cinders, J. Mitchell, Birmingham.
14,792. Saw for Mitre Cutting, &c., E. Pedrazzolli, London.
14,793. Mail Carts, T. Morris, V. Furmidge, J. Morris, and J. Wilkinson, Nottingham.
14,794. Preservation of Ferns, E. W. Hunter, Leeds.
14,795. Cycle Saddles, D. A. Martin, Birmingham.
14,796. Antimaccassar Holder, C. Laight and J. Smith, Redditch.
14,797. Chains for Transmitting Power, W. Andrews and F. Warwick, Birmingham.
14,798. Felloes of Wheels, W. Andrews and F. Warwick, Birmingham
14,799. Golf Irons, Clubs, &c., R. Ramsbottom, Manchester.
14,800. Envelopes for Letters, &c., J. C. Martin, London.
14,801. Raising Lamps, &c., F. W. Vernon and J. Blackham, Birmingham.
14,802. Suspending Swing Seats, &c., R. Hall, Manchester.
14,803. Cycle Lamps, J. Kirk and A. Broadbent, Birmingham.
14 804. Pneumatic Pads for Trusses, T. J. Jackson, Dublin.
14,805. The Gravity Springless Lock, W. S. Brown.—(*G. F. Elsey, Canada.*)
14,806. Receptacle for Coins, &c, A. M. Aspinall, Huddersfield.
14,807. Window Fasteners, R Batey, Halifax.
14,808. Swaging Circular Bodies, G. Hookham, London.
14,809. Tramcar Buffers, J. H Betteley and A. M. Terry, London.
14,810. Sock and Stocking Garter, F. Ballard, London.
14,811. Music Holders, F. D. Cross, London.
14,812. Window-sash Fastener, A. Phelps, Liverpool.
14,813. Appliance for Cleaning Baths, J. Le M. Bishop, Manchester.
14,814. Road Skates, J. S. Cooke, London.
14,815. Liquid Cooling Apparatus, E. Deutsch, Manchester.
14,816. Tables for Invalids, F. J. Moberley, London.
14,817. Dress Hooks and the like, J. Smart, Manchester.
14,818. Apparatus for Loading Coal, E. Jones, Sheffield.
14,819. An Improved Toy, M. W. Lowinsky, London.
14,820. A New Substance for Dyeing Purposes, B. Simpson and Spiller, Ld., and R. J. Friswell, London.
14,821. Treating Fatty Substances, W. O. Robbins, London.
14,822. Inkstands, A. D. Furse, Sunbury-on-Thames.
14,823. Windows, O. Hocking. London.
14,824. Studs, F. Parker, London.
14 825. Hollow Woven Bands, E. Hinnenberg, Germany.
14,826. Bed Rest for Invalids or the like, M. Carver, London.
14,827. Mud Guards for Bicycles, &c., C. W. Price, London.
14,828. Training the Growth of Human Ears, G. Swete, London.
14,829. Steam Engines, H. G. Smith, London.
14 830. Knife and Plate Cleaner, J. F. H. V. Hoop, London.
14,831. Showing Names of Stations, J. S. D. Shanks and T. Harrison, London.
14,832. Machine for Making Butter, A. Daul, London.
14,833. Fluid-pressure Engines, S. Robinson, London.
14.834. Bottles, H. A. Hayden and B. T. Kearns, Wolverhampton.
14,835. Florentine Sun-blinds and Fittings, A. Darling, London.
14,836. Sliding Windows of Railway Carriages, R. Pearce and J. C. Taite, London.
14,837. Dress Guards, A. Vorwerk, Germany.
14,838. Cloth Suspenders, A Steinman, Germany.
14,839. Fixing Hooks to Ladies' Dresses, F. Nüsken, Germany.
14,840. Valve Gear of Engines, J. R. Hopper, London.
14,841. Diaphragm for Phonographs, W. E. Hunnex, Croydon.
14,842. Treating Sugar Cane Juice, H. H. Leigh.—(*G. Cambray, France.*)
14,843. Draught Preventer for Doors, W. H. Thrift, London.
14,844. Securing Metallic Clamps, M. Schubert, London.
14,845. Mechanical Milking Apparatus, C. G. P. de Laval, London
14,846. Manufacture of Cement from Schist, L. Mack, London.
14,847. Storing Electric Energy, J. E. Liardet, London.
14,848. Ladies' Companion or Case, T. L. Jones, London.
14,849. Collapsible Boxes, A. R. Carter and J. P. Robertson, London.
14,850 Filaments for Electric Lamps, R. Langhans, London.
14,851. Retaining Head Coverings, R. H. Wall, London.
14,852. Decorating Earthenware, &c., J. T. Newell, London.
14,853. Assisting Cyclists to Ride, C. H. Guest, London.
14,854. Pneumatic Tires, C. H. Guest, London.
14,855. Pipe Benders, T. Seaton, sen., and J. T. Fraser, London.
14,856. Exacting Sulphur from Raw Pyrites, A. Buisine, London.
14,857. Bedsteads, A. W. Darré, London.
14,858. Purification of Saccharine Juices, J. Y. Johnson.—(*E. Javaux, C. F. Gallois, and F. Dupont, France.*)
14,859. Distribution of Electricity, W. G. and C. W. Little, London.
14,860. Automatic Check Registers, W. Gedge, London.
14,861. Life-buoy and Float, G. V. Fosbery, London.
14,862. Dancing Liquid, R. Biewend, London.
14,863. Propelling Vehicles, J. Gordon and H. Gordon, London.
14,864. Bottle and Pipe Cleansing, M. Pollak, Germany.
14,865. Furnace, M. Pollak, Germany.

3rd *August*, 1894.

14,866. Latch for Setting-on Rods, &c., J. Garside, Dukinfield.
14,867. Unbreakable Ventilating Door, E. Williams, Castleford.
14,868. Removing Sludge from Tanks, F. P. Candy, London.
14,869. Ventilating Gusset for Drawers, &c., A. Ash, Manchester.
14,870. Straight-bore Tobacco Pipes, J. W. Priestley, Lightcliffe.
14,871. Saddle-pins for Bicycles, &c., G. J. Bowcock, Southport.
14,872. Venetian Blinds, W. H. Wilson, Liverpool.
14,873. Impregnating Textile Fabrics, J. Smith, Liverpool.
14,874. Heating Boiler Feed-water, G. Sinclair, Glasgow.
14,875. Transfers for Pottery Ware, J. C. Bailey, Longport.
14,876. Braking Spindles, W. Fisher and W. Duckworth, Halifax.
14,877. Sash Fasteners for Windows, J. L. Travis, Halifax.
14,878. Edge-setter Machines, R. W. and L. Bateman, Halifax.
14 879. Service Flushing Cisterns, A. Taylor, Glasgow.
14.880. Machines for Cleaning Metal, G. Ashford, Newport, Mon.
14,881. Double Seal Scour-out Closet, T. Biggs, Waterford.
14,882. Beehives G. Castleden, Framlingham.
14,883. Drying or Steaming Machines, J. Smith, Liverpool.
14,884. Means for Fastening Boots, A. H. Bancroft, Church.
14 885. Carburetting Water-gas, W. A. Fourness, Manchester.
14,886. Pneumatic Tires, W. Bowden, Manchester.
14,887. Railway Chair and Sleeper, A. E. Muirhead, Glasgow.
14,888. Screw Tap, Collar, Cap, and Wrench, T. G. Blood, Birmingham.
14,889. Science Lanterns, J. H. Barton, Manchester.
14 890. Consuming Smoke and Saving Fuel, G. Stirk, Bradford.
14,891. Spanners, T. C. Maddock, Birmingham.
14.892. Jointing Pipes, J. Dakers and J. Swinburne, Bristol.
14,893. Curtain Ring, H. C. Davidson, Wrotham.
14,894. Soda Crystals, C. P., J., and H. Peak, and A. G. Haddock, Wigan.
14,895. Pocket Protector, H. Bird and F. T. White, Birmingham.
14,896. Fire-escapes, J. H. Meyer, Saltaire.
14,897. Pressing Felt Hats, J. and J. W. Rowley, Manchester.
14,898. Toy Target, M. Sugar.—(*D. Nagg, Belgium.*)
14,899. Gum Pots and other Vessels, J. Edges, London.
14,900. Cycles, C. Byrne, London.
14,901. Boots and Shoes, J. W. Jones and G. Phillips, London.
14,902. Hooks for Dress, E. S. Green, London.
14,903. Treating the Fibres of Flax, T. Burrows, London.
14,904. Heating Apparatus, W. and I. Darby and R. U. Evens, London.
14,905. Neutral Sodium Carbonate, E. Dresel and J. Lenhoff, London.
14,906. Sand-paper Carrying Rolls, A. Pochin, F. H. Pochin, and H. Addison, London.
14.907. Device for Catching Dripping, M C. Lincoffs, London.
14,908. Rudders, H. Lumley, London.
14,909. Cycles, J. Hancock, London.
14,910. Regulating Centrifugal Fans, G. M. Capell, Stony Stratford.
14,911. Locks, G. Mason, London.
14,912. Wire Drawing, C. Berkenhoff, Germany.
14,913. Locking Device for Hooks, H. Amberg, London.
14,914. The "Unique," J. J. Wilson, London.
14,915. Pneumatic Tires, R Waugh, London.
14,916. Sanitary Pipe, P. Stiens. London.
14,917. Joint for Connecting Pipes, A. and F. G. Johnson, London.
14,918. Rendering Proteine Soluble, L. Prochazka, London.
14,919. Mashing and Brewing Process, L. Prochazka, London.
14,920. Turning the Circumference of Belt Pulleys, A. Knöpfel, London.
14,921. Notation of Music, W. Cooper, London.
14,922. Electrically Regulating Signals, W. Fiedler, London.
14,923. Recovering Spirit from Varnishes, A. Gray, London.
14,924. Oil Lamps, W. Perkins, London.
14,925. Pneumatic Wheels and Tires, J. W. Barclay, London.
14,926. Electric Telegraph and Signal, F. Hollins, London.
14,927 Process of Treating Town Refuse, C. Jones, London.
14,928. Apparatus for use in Harmonic Analysis, G. U. Yule, London.
14,929. Cup Handle, C. Asprey and G. E. Asprey, London.
14,930. Hat and Cloak Supports, H. P. Hoghton, Manchester.
14,931. Manufacture of Stockings, H. C. Schott, London.
14.932. Mechanical Toy, H. C. Schott, London.
14,933. Applying Paints to Glass, W. R. McKay and R. S. Moseley, London.
14,934. Artificial Stone, A. Muirhead and G. Hackford, London.
14,935. Construction of Saucepans, M. G. Roberts, London.
14,936. Funnels for Casks, G. Waterfield, London.
14,937. Method of Night Signalling, J. A. Cox, London.
14,938. Ornamentation of Porcelain, W. Grûne, sen., London.
14,939. Protecting Watches, G. J. and C. H. Kirby, London.
14,940. Rotary Engines, M. E. P. Chaboche, London.
14,941. Producing Designs upon Wood by Charring, A. Guattari, H. H. Prall, and G. L. S. Maggiolini, London.
14,942. Protecting Live Steam Pipes, W. Elbers, London.
14,943. Velocipedes, H. Beyer, London.
14,944. Carrying Cycle Accessories, G. E Osmond, London.

4th *August*, 1894.

14,945. Latch Runner for Umbrellas, H. R. Foley, Birmingham.
14 946. Soap, &c, S. Rosenblum and F. L. Bartélt, Keynsham, near Bristol.
14,947. Cork-drawing Machine, W. Ashton, Southport.
14,948. Travellers' Skip, F. Pearson, jun, Nottingham.
14,949. Easel Mount, A. W. Adams and G. Houghton, Reading.
14 950. Wicker Basket with Wood Partitions, W. H. Wyatt, Bristol.
14,951. Rear-driven Safety Bicycles, T. Knowles, Manchester.
14,952. Revolving Receptacles for Waste Water, T. Knowles, Manchester.
14,953. Pneumatic Tires, C. Woolley, London.
14,954. Apparatus for Obtaining Cyanides, J. S. M. Arthur, Glasgow.
14,955. Rocking Chairs, W. S. McLennan and T. Morton, Glasgow.
14,956. Cycle Lamps, J. Parker, T. Sanders, and J. B. Worton, Birmingham.
14,957. Portable Structures, R. F. Hall, Birmingham.
14,958. Combination Cycle Tool, O. Ward and E. Eite, Birmingham.
14,959. Cycle and other Bells, J. Harrison, Birmingham.
14,960. Butt and Hinge for Doors, &c, W. Griffith, Croydon.
14,961. Brace, T. W. Hill, London.
14,962. Cyclists' Rifle Carrier, T. Whitehead, Wolverhampton.
14,963. Coiled Draw Springs for Harness, W. Mills, Sheffield.
14,964. Cycle Handle, T. Deane and J. Winfield, London.
14,965. Covering of Tramcars, T. Staines and J. Leadbeater, Leeds.
14,966. Tools for Burnishing the Heels of Boots, J. G. Grimsley, Leicester.
14,967. Apparatus for Lighting Sewer, &c., Gases, C. Horton, Birmingham.
14,968. Steering Lock for Safety Bicycles, R. W. Smith, Birmingham.
14,969 Steering Lock for Safety Bicycles, R. W. Smith, Birmingham.

14,970. Manufacture of Piled Carpets, A. Webb, G. M. Whittall, and F. B. Fawcett, Kidderminster.

14,971. Multiplying Ruler, P. Folacci and M. Paviot, London.

14,972. Centrifugal Governors, W. Ashton, Manchester.

14,973. Machines for Cleaning Fibrous Materials, W. S. Archer, Manchester.

14,974. Shuttles for Small-ware Looms, H. Cooper, Manchester.

14,975. Can for Oils, C. C. de Waterford.—(*L. Bettenat, France.*)

14 976. Ball Bearings of Wheels, F. J. Lynam, Ireland.

14,977. Cycle Saddles, J. M. Starley and W. S arley, London.

14,978. Manufacture of Stockings, T. and J. Jones, and H. and A. Langdale, London.

14,979. Wax-thread Sewing Machines, F. W. Farr, London.

14,980. Apparatus for Sifting Cinders, &c , J. Squire, London.

14,981. Picks, W. H. Radford, London.

14,982. Dust-proof Bearings for Cycles, W. H Smith and J. W. Hill, Birmingham.

14,983. Colouring Matters, J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, London

14 984. Hot-water Doll, G. L. Wilson, London.

14 985. Treatment of Bicarbonate of Soda, W. L. Wise.—(*Solvay and Co., Belgium* )

14 986. Bleaching Powder, W. L. Wise.—(*E. Solvay, Belgium.*)

14,987. Separation of Caustic Alkalies, W. L. Wise. —(*Solvay and Co., Belgium* )

14 988. Electrolytic Table, W. L. Wise.—(*E. Solvay, Belgium* )

14,989. Triggerless Small-arms Lock, G. H Beaumont, London.

14 990. Manufacture of Brushes, H. F. Reinhold, London.

14 991. Heating Calendar Rolls, H. H. Greenhill, London.

14,992. Rake Holders, A. J. Boult.—(*O. Ehlig, Germany.*)

14,993. Scoops for Groceries, A. J. Boult.—(*B. R. Eichler, Germany* )

14,994. Inkstands, A. J. Boult —(*M. Wiener, Apolda.*)

14 995. Apparatus for Obtaining Gas, P. Dvorkovitz, London.

14,996. Pedal Attachment for Cycles, R. L. Jenks, London.

14 997. Preserving Matrices, C. A. Allison.—(*J. A. Whitney, United States* )

14,998. Ornamental Coverings for Floors, W. W. Wagner, London.

14,999. Pneumatic Tires, H C. Webb, London.

15 000. Driving Electric Machinery, H. Soifranc, London.

15,001. Elastic Tires for Cycles, A. Fendt and A. Uzel, jun., London.

15,002. Lighting Miners' Lamps, W. Ackroyd and W. Best, London.

15,003. Attaching Buttons to Wearing Apparel, H. Fletcher, London.

15,004. Telephonic Installation, G. Ritter, London.

15 005. Adjusting Pulleys, B. Rosenfeld and H. Tschichholz, London.

15,006. Cooking and Roasting Ovens, F. Heinemann, London.

15,007 Type-writing Machines, H. G. Ashley and C. C. Leathers, London.

15 008. Steam Boilers, J. Moore and T. Spencer, London.

15 009. Artificial Legs, W. R. Honsuc'e, London.

15 010. Collar and Shirt Studs, C. H. Collins Birmingham.

15,011. Making Coal Vases, C. Stroud, Wolverhampton.

15,012. Blowing Apparatus, I. Kiralfy.—(*M. Ruble, United States.*)

15 013. Manufacture of Barrels, &c , C. E. Bratt, London.

*7th August*, 1894.

15,014. Vermin Trap, T. W. Moore, London.

15,015. Cycle Saddles, A. G. Brookes.—(*G. O. Draper, United States* )

15,016. Gas-heated Hand Iron, C. Kirby and J. G Liversidge, Leeds.

15,017. Steaming Textile Fabrics, T. Illingworth, Bradford.

15,018. Stoppers for Bottles or Jars, J. V. Clarke, Manchester.

15.019. Bottles, W. Breffit, Castleford.

15,020. Spray, D. Sinclair, Watford.

15,021. Window Conservatories, J. Tonry, Wolverhampton.

15,022. Production of Engraved Rollers, J. P. Hewitt, Stoke-on-Trent.

15,023. Self-acting Railway Signals, W. T. C. Pratt, Newport, Mon.

15,024. Gardening Forks, &c , J. W. Yates, Birmingham.

15,025. Attaching Scales to Knife Hafts, S. G. Richardson, Sheffield.

15.026. Coupling Railway Vehicles, T. Cheetham, Manchester.

15 027. Vacuum Controlling Apparatus, A. Shiels, Glasgow.

15,028. Belting, C. Kertland, Glasgow.

15.029. Advertising, A Standring, Manchester.

15,030. Brake Apparatus, P. Weir, Bristol.

15,031. Mounting Photographic Prints, H. Walker, Altrincham.

15,032. Combination Bottle Stopper, &c , W. Pearce, Birmingham.

15,033. Tires for Cycles, J. Tullo, Glasgow.

15,034. Measuring Electric Currents, W. Thomson, Glasgow.

15,035. Extension Cranks for Cycles, P. C. Noble, Grantham.

15,036. Cycles, F. M. Ketton, Nottingham.

15,037. Knitted Fabrics, R. Hutchinson and J. A. Wilson, Nottingham.

15,038. Attaching Handles to Cutlery, W. Bamford, Rochdale.

15,039. Water Tap, R. Aisbett, jun , and W. Wood, Sunderland.

15,040. Top Lug and Stem for Cycles, G. J Bowcock, Southport.

15,041. Producing Designs on China, Sir H. Doulton and J Slater, Longport.

15,042. Roundabouts, T. Clayton, Manchester.

15,043. Automatic Check Till, T. H. Wem, Birmingham.

15,044. Cradles, Cots, &c., G. Riley, Swinton, near Manchester.

15,045. Life-saving Grating, W. H. Hewett, Kingston-on-Thames.

15,046. Water-tube Boiler, T. Sumner, Liverpool.

15,047. Tie or Scarf Grip, J. Reid, Millom.

15,048. Fog Signals for Railways, R. Gascoigne, Worksop.

15,049. Railway Construction, F. Pfeiffer and C. Lier, Berlin.

15,050. Photographic Dark Slides, W. D. Pepper, Glasgow.

15,051. Laying Electric Cables, R. Middlemass, Scarborough.

15,052. Ticket Pocket, K. Leverkus, Leipsic-Gohlis, Germany.

15,053. Continuous Clockwork Alarum, F. Harrison, Houghton-le-Spring.

15,054. Toy, E. Lycett, Birmingham.

15,055. Fastener for Window Sashes, L. Turnock, Stockport.

15,056. Ropes or Cables, E. S. Bond and G. H. Cooper, Birmingham.

15,057. Fish-hooks, B. S. Martin, London.

15.058. Manufacture of Wire Ropes, W. B. Brown, Liverpool.

15,059. Distributing Soap, G. C. Dymond. —(*W. Wilclow, United States.*)

15,060. Furnaces, G. C. Dymond. —(*A. Albeser, Germany.*)

15,061. Hydraulic Engines, J. E. Schumacher, T. E. Pickering, A. Whittam, and S. C. Platts, London.

15,062. Boring Bit, D. Honeywood and E. L. Austin, London.

15,063. Gas Bracket Lamp-cock, T. Handel, Ilminster.

15,064. Colouring Matters, J. C. L. Durand, D. E. Huguenin, and A. J. J. d'Andiran, London.

15 065. Electrical Contact Apparatus, E. Tyer, London.

15,066. Making Variegated Candles, &c , J. David, London.

15,067. Making Acids, O. Imray. —(*The Farbwerke vormals Meister, Lucius, and Bruning, Germany* )

15,068. Fire-escape, A. Thamm, London.

15,069. Lowering Apparatus, A. H. G. Thamm and J. Leers, London.

15,070. Overhead Electric Conductor, W. J. B ewer, London.

15,071. Steam Boiler and other Furnaces, O. D. Orvis, London.

15,072. Submarine Signalling System, L. J. Blake, London.

15,073. Flower-bolting Reels, H. H. Lake.—(*S D. Barr, United States.*)

15,074. Nut with Cap or Capsule for Bolts, G. Bähr, London.

15.075. Governor for Steam Engines, L. H. Rutherford, London.

15,076. Feed Apparatus for Boilers, F. M. Sandillon, London.

15,077. Valve Mechanism for Engines, G. I. Rockwood, London.

15,078. Cycle Driving Gear, W. and E. Allday, London.

15,079. Invisible Stand for Photographs, S. W. Allen, London.

15,080. Combination of Pencils, C. H. Dumenil and W. H. Brigg, London.

15,081. Lamp Reflectors, E. Tilmann and C. K. Lexow, London.

15,082. Magneto-electric Machines for Cycles, E. Tilmann and C. K. Lexow, London.

15,083. Pneumatic Tires, W. and E. Allday, London.

15 084. Safety Belt for Bathing, H. Prague Bauer, London.

15,085. Yarn Washing and Scouring, J. Tattersall, London.

15,086. Oil Refining, B. J. B. Mills.—(*J. H. and C. H. Campbell, United States.*)

15,087. Controlling Motive Force, H. E. Newton.—(*C. C. Worthington, United States* )

15 088. Letter and other Envelopes, E. Lacôte, London.

15,089. Manufacture of Floor Cloths, A. Hagele London.

15 090. Reciprocating Mechanism, J. G. Lorrain —(*Z. G. Sholes, United States* )

15,091. Indicating Speeds of Shafts, A E. Edwards —(*Count Lippe's Administration Lindenhof, Germany.*)

15,092. Votes Counting Book, W. Watkins, Dorchester.

15 093. Coupling Railway Brakes, S. W. Carlton, London

15 094. Closed Arrangement for Gates, A. Helwig, London.

15,095 Composition for Paving Stones, C. Jost London.

15,093. Stoves for Heating Air, M. Jaeniigen London.

15,097. Winding and Gassing Yarns, H. B. Arundel, Manchester.

15 098. Apparatus for Mounting Diamonds, A. F. Richter, London.

15 099. Automatic Loom Stop Motions, H. Carnier, London.

15 100. Apparatus for Dealing Cards, W. Gedge, London.

15.101. Sowing or Distributing Grain, L. Doneuville, London.

15,102. Chimney Cowls, R. Haddan.—(*P. Perinnon, France* )

15,103. Skate Blades, T. W. Bryant London

15 104. Pulverisers, T. Parker, J. D. Wright, F. F. Stuart, and A. M Colquhoun, London.

15,105. Ink-wells, S H. Boyden and Messrs Cooper Denison, and Walkden, Ld., London.

15,103. Newspaper and other Files, A. P. Fggis, London.

15.107. Oil Heating and Vaporising, W. H. Pearson, jun., London.

15,108 Gun Locks, F. de W. Granger, London.

15,109. Gas Motors, G Schimming, London.

15,110. Stopping and Starting Vehicles, H. Goodwin, London.

15,111. Millinery Trimmings, S. Symons, London.

*8th August*, 1894.

15 112. Cake Baker, J. S. Marshall, London.

15 113. Brace or Suspender Button-hole, A. Breeze, London.

15 114. Spike Ball Puzzle, J. Hazel, London.

5 115. Tricycle, G. Whyte, Guernsey

15,116 Regulating the Action of Pistons, S. Wright, Monmouth

15 117. Velocipede Cranks, A. C. Davison and H. Lucas, London.

15,118. Locking Window Fasteners, R. Cough, London.

15,119. Making Tea and other Infusions, F. T. Bond, London.

15,120. Propelling and Steering Ships, T. Dargue, Glasgow.

15,121. Brushes, J. H. Godman, St. Albans

15,122. Marine Engines, G. W. Clark, Birmingham.

15,123. Chimney-pot and Ventilator, W. Peyton, Halifax.

15,124. Semi-collapsible Pontoon, J. B. Murray and J. P. Turnbull, Glasgow.

15,125. Apparatus for Fare-checking, A. L. Taylor, Liverpool

15,126. Fire-escape, R. H. Johnson, Derby.

15,127. Steam Engine, G. A. Newall, Bristol.

15,128. Flying Apparatus, P. E. Lautenschläger, Manchester.

15,129. Evacuating Lamp Bulbs, A. Malignani, Manchester.

15,130. Shield for Vaccination Spots, M. J. Phillips, Manchester.

15,131. Fittings for Baths, J. and L. W. Shepherd, Davenport.

15,132. Filters, R. Gringan and D. C. Smith, Glasgow.

15,133. Collapsible Crates for Cycles, E. Poizot, Liverpool.

15,134. Locking Stop-rod, W. Whitehead, T. Greaves, J. Dalton, and S. Greaves, Manchester.

15,135. Umbrellas, F. A. Wilshere, Manchester.

15,136. Hat Sweat Bands, L. Marshall, Manchester.

15,137. Advertising, T. A. Allen, London.

15,138. Working Swing Boats, W. Cartwright, London.

15,139. Shuttles, W. Schalck, Germany.

15,140. Deoxidising Textile Fibres, A. Gruschwitz, London.

15,141. Means for Holding Lamps, O. Krumbholtz, London.

15,142. Driving of Pulsometer Pumps, R. Sepp, London.

15,143. The Safety Tissue, V. Jetley and G. Jetley, London.

15,144. Construction of Indian Clubs, H. A. Newth, London.

15,145. Cab Lamp Signal, R. Macdonald, London.

15,146. Lubricating Machinery, C. H. Berry and J. Snowdon, jun., London.

15,147. Incandescent Gas Burners, R. Goehde, London.

15.148. Controlling Liquids, W. C. L. van Schaik, London.

15,149. Windows, L. Robson, London.

15,150. Gas Producers, B. Dawson, London.

15,151. Corset Fastening, W. T. Low and E. D. Hoyland, London.

15,152. Locomotors, C. A. Faure, London.

15,153. Ships' Course Indicating Lamp, N. L. Jacobsen, London.

15,154. Cinder Sifter, E. Geisenberger, London.

15 155. Heating System, A. J. Boult.—(*J. Sander and J. Kühne, Germany* )

15,156. Construction of Fire-proof Floors, J. Roy, Liverpool.

15.157. Musical Toys, A. R. Breial, London.

15,158. Repair of Stockings, A J. Boult.—(*C. Gunst, Germany.*)

15,159. Bicycles, Tricycles, &c., H. Claughton, Liverpool.

15.160. Walking Sticks, A. J. Boult.—(*A. Fiquet, France.*)

15,161. Bust Supporters, H. Schindler, London.

15,162. Removing Creases from Garments, E. M. Molyneux, Liverpool.

15,163. Washing Machines, A. J. Boult —(*W. Schubert and H. Hiltner, Germany* )

15,164. Cash Registering Appliances, C. S. Snell, Cornwall.

15,165. Spark Extinguishing Apparatus, G. Sommersberger, London.

15,166. Treating Eggs, J. Swan, London.

15,167. Detachable Protector for Pneumatic Tires, J. H. A. and E. T. Woods and W. T. Henley's Telegraph Works Company, London.

15,168. Preserving Extracts from Lemons, B. Biggs, London.

15.169. Puncture-closing Device for Pneumatic Tires, G. E. Osmond, London.

15.170. Arc Lamps, J. J. Rathbone and A. Chester London.

15,171. Manufacture of Scent Essence, P. P. Monnet London.

15 172. Inflatable Tires for Wheels, A. Pulbrook, London

15,173. Actuating the Notes of Pianos, H. H. Piffard and R. H. Bishop, London.

15,174. Electrical Rolling Contact-making Device, K. Ast, London.

15,175. Roofing Tiles, M. Bohn, London.

15,176 Ventilating Boots, E. Bills, London

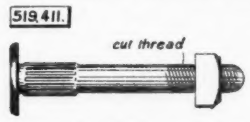
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**519,411.** Bolt, *W. C. North and S W. Sessions, Cleveland, Ohio.—Filed March 4th*, 18·2.

*Claim* —A bolt comprising a head and shank having screw threads cut on the end opposite the head, a portion of the remainder of the shank constructed with longitudinal ribs located a short distance from the head, and formed by the displacement of a portion of the stock constituting the shank, leaving a space between the head and ribs of less diameter than the latter, substantially as described.

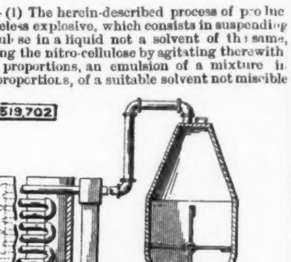
519,411.



**519,702.** Manufacture of Smokeless Powder, *F. G. Du Pont, Wilmington, Del.—Filed August 5th*, 1893.

*Claim.*—(1) The herein-described process of producing smokeless explosive, which consists in suspending nitro-cellulose in a liquid not a solvent of the same, granulating the nitro-cellulose by agitating therewith in proper proportions, an emulsion of a mixture in suitable proportions, of a suitable solvent not miscible to any great extent in the liquid used to suspend the nitro-cellulose and a volatile oil, with a liquid calculated to aid emulsion in proper proportions, hardening and rounding the grains by rotation in an atmosphere of steam, and removing the excess of solvent and the oil by distillation, substantially as described.

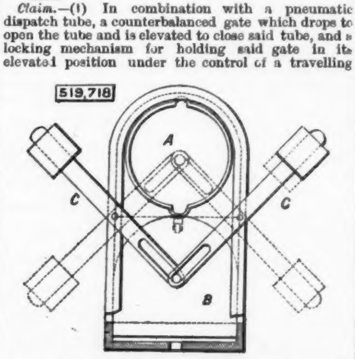
519,702



**519,718.** Gate for Pneumatic Dispatch Tubes, *S. F. Leake, Philadelphia, Pa.—Filed March 1st*, 1893.

*Claim.*—(1) In combination with a pneumatic dispatch tube, a counterbalanced gate which drops to open the tube and is elevated to close said tube, and a locking mechanism for holding said gate in its elevated position under the control of a travelling carrier for releasing said locking mechanism, substantially as set forth. (2) In combination with tube A, the end or outside guide frame $a$, gate B having pivoted counterbalancing levers C, locking pawl $d$, lever $d^2$, link $d'$ connecting said pawl and lever, and actuating mechanism for lever $d^2$ extending into the tube A and operated by a travelling carrier, substantially as set forth.

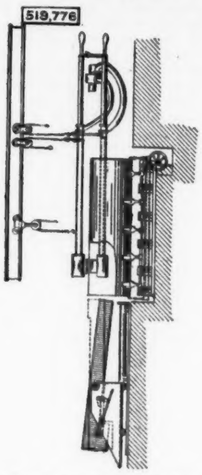
519,718



**519,776.** Welding Apparatus, *C. L. Rowland, Brooklyn, N.Y.—Filed December 22nd*, 1893.

*Claim.*—(1) The combination, substantially as set forth, of a non-travelling cradle having adjustable device for supporting the cylinder to be welded with the seam in the proper plane, facing furnaces movable along the seam, and a horizontally movable anvil also movable along and beneath the seam. (2) The combination, substantially as set forth, of the non-travelling cylinder-supporting cradle, the longitudinally movable facing furnaces, the longitudinally moving anvil, a way or track upon which it moves, and means for moving the anvil uniformly and gradually forward as the work proceeds. (3) In a cylinder welding apparatus, the combination, substantially as set forth, of a pair of horizontally movable over-balanced facing furnaces, their adjustable frame bars supported intermediate their ends, and adjustable connections between the frame bars independent of the frame bar supports and located at one side thereof, whereby the furnaces may be adjusted and locked in fixed relation to each other and to the seam of the cylinder lying between then.

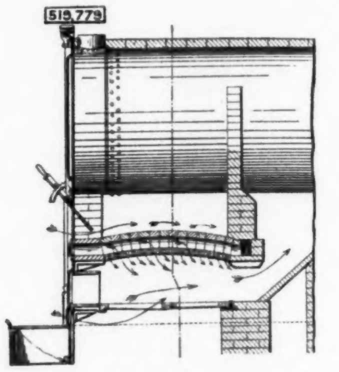
519,776



**510,779.** Smoke-consuming Furnace, *J. M. Thomas, St. Louis, Mo —Filed February 14th*, 1894.

*Claim.*—A steam boiler furnace having an arched down-draught fuel grate of refractory material, supported by the walls of the furnace independently of intermediate support and composed of bars arched longitudinally of the furnace.

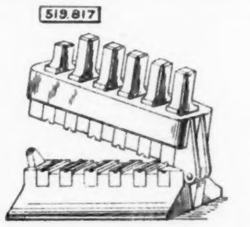
519,779



**519,817.** Swage, *C A. Mette, Santa Cruz, Cal.—Filed October 28th*, 1893.

*Claim* —In a device of the class described, the combination of a base provided with spaced sockets, stationary dies provided with depending tangs engaging said sockets, and lateral shoulders engaging the surface of the base, bracing blocks interposed between said dies a guiding arm hinged to the base and provided with spaced guides and interposed depending bracing blocks, movable dies fitted in said guides and provided with stops, and a finger carried by the base to engage a pocket in the guiding arm, substantially as specified.

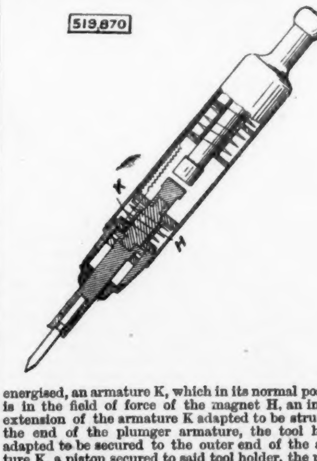
519,817



**519,870.** Magnetic Engine for Reciprocating Tools, *H. S. McKay, Boston, Mass.—Filed July 5th*, 1892.

*Claim.*—In an electro-magnetic engine for reciprocating tools, the combination with two or more magnets or solenoids, a plunger armature adapted to be reciprocated by the same, a magnet or solenoid H situated beyond the other magnets and connected with said magnets in series and so as to be always energised, an armature K, which in its normal position is in the field of force of the magnet H, an inward extension of the armature K adapted to be struck by the end of the plumger armature, the tool holder adapted to be secured to the outer end of the armature K, a piston secured to said tool holder, the piston cylinder, and a pneumatic cushion or spring for said piston and holder, all as and for the purposes set forth.

519,870



# NOTES ON THE STRENGTH OF FRAMED STRUCTURES AS AFFECTED BY ELASTICITY.

By C. F. Findlay, M.A., M. Inst. C.E.

(*Continued from page* 118.)

(7) When M has been determined by means of equations (II.) and (III.), the secondary stress $t$ is obtained from it by the relation $t = \frac{M}{I} r$, where $r$ is the distance from the axis of figure of the link to the extreme edge at which the stress is $t$. When the cross-section is symmetrical $r = \frac{d}{2}$, $d$ being the width of the link in the plane of flexure. This shows the important influence that $d$ has upon the secondary stress. If, for example, in any frame, the depth of each member be doubled, the cross-sectional areas, &c., remaining unaltered, I will be increased in a nearly constant ratio for all the links—about four times—and equations (II.) and (III.) show that M will be increased in the same ratio as I. $\frac{M}{I}$ remains constant, but since $t = \frac{M}{I} r$, $t$ will be doubled. If one link alone be increased in depth, the others being unchanged, the bending moment in all the links united with that one, as well as in the altered link itself, will be increased, and, in a smaller degree, the moments in other links which do not intersect the altered one will also be increased. We thus see that, as far as secondary stress alone is concerned, it is an advantage to make all tension members as narrow as possible in the plane of flexure, and not to give a greater depth to compression members than their length as columns really requires.

This is the advantage gained by the use of eyebars. It is not true, although it has often been said, that the use of eyebars does away with secondary stress, because with the scantlings commonly used for them, the secondary stress in riveted flat bars of the same dimensions would be no greater than the friction of the pins actually used may cause. The advantage of the eyebar, as regards secondary stress, is that it enables bars of small width and considerable thickness to be used, which it would be difficult to unite by rivets, so as to maintain the full strength of the bar. With such bars, whether the joints be hinged or not, the secondary stress is so small as to be negligible. With the wide bars so commonly used in England, this is by no means the case. This point being important, let us illustrate it by considering the simple case of the truss, shown in Fig. 4, uniformly loaded. Suppose the tie-rod in the first instance to be a flat bar, 4in. by ¾in., with a primary stress of five tons per square inch. Let the tension bar C D have also a stress of five tons, and the rafter A C 2·5 tons per square inch. Our object being only to show the effect of varying the section of the tie-rod, suppose the joints at A and B to be hinged, in order to simplify the calculation. For A D, $l$ = 124in., and I. = 4 in inch units. By equation (I.)

$$E \times \theta_{12} = (-2{\cdot}5 - 5) \cot 30 \text{ deg.} + (-2{\cdot}5 - 5) \cot 45 \text{ deg.} = -7{\cdot}5\,(\sqrt{3} + 1) = -20{\cdot}5.$$

By symmetry there is no secondary stress in 2 with a symmetrical load, and therefore equation (II.) gives

$$6 \times -20{\cdot}5 = -\frac{124}{4} \times 2\,M_D^1.$$

$$\text{Therefore, } M_D^1 = \frac{123}{62} = 2 \text{ inch-tons,}$$

Since $r = 2$ and $I = 4$, $t = \frac{M r}{I} = \frac{2 \times 2}{4} = 1$ ton per square inch.

Suppose now that instead of a bar 4in. × ¾in. we use a bar 8in. × ⅜in. in order more conveniently to make a riveted joint, I becomes 16 and $M_D^1$ becomes $\frac{123}{15{\cdot}5}$ or 8 inch-tons. Since in this case $r = 4$ and $I = 16$, we have $t = \frac{8}{16} = 2$ tons per square inch.

(8) If, instead of a simple succession of triangles, we have to deal with such a case as that shown in Fig. 5, or with a lattice girder, it may be shown that the bending moments in the booms will be very much the same as for a simple triangulated girder of the same depth and section. For the web members the case is different. The angles between the vertical posts and the boom will undergo the same deformations as for the simple girder if, as may be assumed, the stresses per square inch are the same in both cases. If the web members are not connected to each other where they intersect, the compression links, such as the post A B in Fig. 5, will require the same width as for the simple girder, and the secondary stresses will be unaltered. If the verticals and diagonals in Fig. 5 are connected at their intersection, $l$ in equation (II.) will be reduced by one-half, and this will cause M to be largely increased. The general conclusion, then, is that if the web members are not connected together at their intersections, the secondary stresses in them will be much the same as in the simple girder, with bracing at the same angles; if they are connected at their intersections, the width of the links must be reduced in the same proportion as their free length, if the secondary stress is not to be increased. This reduction of width would be a perfectly legitimate proceeding from all points of view. The post A B in Fig. 5, if it be riveted to the diagonal tension bar at C, is, as a column, of half the length it would have without that connection, and therefore it only requires to have, in the plane of the figure, half the width and half the radius of gyration it required for the length A B, while its cross-section must be the same in area. Probably the most severely strained from secondary stress of all girders are the lattice girders, sometimes built, of small depth, and with wide lattice bars firmly riveted to each other at every intersection.

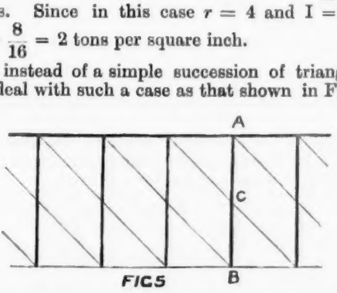


FIG. 5

(9) The idea might suggest itself that secondary stress could be compensated by purposely making the primary stresses excentric to the axes of the links, shifting one of the links at any joint to a definite distance from the intersection of the others, so that the primary stress would produce a bending moment equal and opposite to that of the secondary stress. This would be quite impracticable, even in theory. The only method of avoiding secondary stress would be by introducing initial deformations in constructing the frame, and therefore initial secondary stresses, opposite to those which the load will bring into play. This would present no difficulty to the template maker, but would considerably perplex the erector of bridges. It would mean that the lengths of all the members should be taken from the unstrained diagram of the bridge and the angles between them from a diagram of deformation, or, which is the same thing, that the angles should be taken from the ordinary working drawings, and all the lengths of the various members increased or diminished by quantities equal and *opposite* to the primary strain produced in them by the loads. Considerable force would be necessary then to make the members take the curvature necessary to fit them to their places. An arrangement requiring such delicacy of adjustment could never be carried out successfully in practice. Taking from Table II. the largest of the values of E $\theta$ (which is + 14·9 for the angle between 4 and 16), we see that $\theta$ will be rarely so large as $\frac{15}{12{,}000}$ or ·0012 in circular measure. This angle has an arc of only ·03in. at a radius of 25in., from which it is seen that errors of workmanship may easily produce stresses of similar magnitude to the secondary stresses arising from the loads.

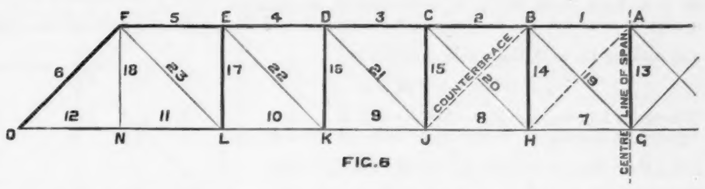


FIG. 6

(10) With regard to the struts, for which it is found that the secondary stress is most serious, it is to be observed that the secondary stress is entirely independent of those considerations which lead to the usual formulæ for the working stress in columns.' These formulæ are empirical, and most of the published experiments on columns are not of a nature to enable deductions to be made from them as to the behaviour of columns within the elastic limit. Whatever be the theory or practice adopted, however, the flexure from deformation of the frame, and the consequent secondary stress must be regarded as superadded to the flexure and stress, arising from other causes, and not as one of the elements allowed for in the column formulæ.

We will now proceed to show how equation (II.) may be made use of for numerical determinations of approximate correctness. If the coefficient $\frac{l}{I}$ be calculated for all the members of a girder, it will be found to be very large for all the members of the web—and where eye-bars are used for the lower boom also—compared to its value for the upper boom. The value of $\frac{l}{I}$ for some of the members of the web will usually be much larger than for others, while still small compared to its value for the upper boom. In those links for which $\frac{l}{I}$ is large, it follows that, other things being equal, M is small. For a first approximation, then, *in determining the values of* M *for the upper boom*, we may neglect altogether the resistance to flexure of many of the web members, and for others we may neglect the resistance at the lower end, since in equation (II.) the coefficient of $M_B^2$ is only half of that of $M_O^2$. With these simplifications the values of M for different points in the upper boom can be determined from equation (II.) with small labour. If the lower boom be of such construction that it is desirable to determine the secondary stresses in it also, a similar method may be applied to it separately. Having, then, the values of M for both booms we can determine them for any web member we may choose by applying equation (II.) to the angles which that member makes with the two booms. If it is desired to go to a second approximation, we should have to go through the booms again, using the values already determined for M in the web members, where in the first approximation M was neglected. It will generally be found, however, that the first approximation is sufficient for practical purposes. The method will be more clearly understood by applying it to one or two cases, and we have chosen for that purpose two railway bridges of about the same span—150ft.—characteristic respectively of American and English practice, and taken at random from published drawings. The loads from which the primary stresses are calculated are the maximum loads the bridges are designed to carry. In the English bridge the equivalent distributed load is:—

| | | |
|---|---|---|
| Dead ... ... ... ... ... ... ... | 1·13 | tons per foot. |
| Live ... ... ... ... ... ... ... ... | 1·39 | „ |
| Total ... ... ... ... ... ... ... | 2·52 | „ |

In the American bridge it is:—

| | | |
|---|---|---|
| Dead ... ... ... ... ... ... ... | ·65 | tons per foot. |
| Live ... ... ... ... ... ... ... ... | 1·42 | „ |
| Total ... ... ... ... ... ... ... | 2·07 | „ |

Take, first, the case of the English design, which is represented in the diagram in Fig. 6.

The necessary data for the calculations are given in the second and third columns of Table I. The third and fourth columns contain the results of a first and second approximation to the values of M in the various members. The fourth and fifth columns contain the values of $r$ and I, which are necessary to deduce from M the values of the stress; and the last column contains the values of the secondary stress for one end of each member at which it is largest.

Table I.

| No. of member in Fig. 6. | Primary stress in tons per square inch. | $\frac{l}{I}$ in inch units. | M* in inch-tons. | | $r$ in inches. | I in (sq. in.)² | Secondary stress in tons per sq. in. (from 2nd approximation to values of M). |
|---|---|---|---|---|---|---|---|
| | | | 1st approximations. | 2nd approximations. | | | |
| 1 | −5·0 | 0·09 | 179 | 182 | 5·25<br>9·37 | 1666 | −0·6<br>+1·1 |
| 2 | −4·8 | 0·09 | 136 | 148 | do. | do. | −0·5<br>+0·8 |
| 3 | −4·4 | 0·09 | 122 | 143 | do. | do. | −0·4<br>+0·8 |
| 4 | −4·3 | 0·11 | 119 | 133 | 5·9<br>8·6 | 1441 | −0·5<br>+0·8 |
| 5 | −3·2 | 0·11 | 103 | 109 | do. | do. | −0·5<br>+0·7 |
| 6 | −3·4 | 0·52 | 30 | 30 | 8·75 | 435 | ±0·6 |
| 7 | +4·3 | 0·11 | 158 | 160 | 8·0 | 1368 | ±0·9 |
| 8 | +4·0 | 0·11 | 121 | 136 | do. | do. | ±0·8 |
| 9 | +4·3 | 0·15 | 79 | 100 | do. | 1067 | ±0·7 |
| 10 | +3·2 | 0·15 | 86 | 116 | do. | do. | ±0·9 |
| 11 | +4·3 | 0·36 | 45 | 31 | do. | 427 | ±0·6 |
| 12 | +4·3 | 0·36 | 45 | 54 | do. | do. | ±0·9 |
| 13 | 0 | 2·3 | 0 | 0 | 5·15 | 70 | 0 |
| 14 | −0·5 | 2·3 | 15 | 15 | do. | do. | ±1·1 |
| 15 | −1·5 | 2·3 | 22 | 21 | do. | do. | ±1·6 |
| 16 | −2·5 | 2·3 | 30 | 28 | do. | do. | ±2·1 |
| 17 | −2·9 | 1·8 | 36 | 35 | do. | 92 | ±2·0 |
| 18 | +1·0 | 2·3 | 21 | 20 | do. | 70 | ±1·5 |
| 19 | +1·3 | 3·7 | 4 | 5 | 4·5 | 61 | ±0·4 |
| 20 | +3·0 | 3·0 | 12 | 12 | do. | 76 | ±0·7 |
| 21 | +3·8 | 1·25 | 34 | 32 | 6·0 | 180 | ±1·1 |
| 22 | +4·1 | 0·96 | 53 | 51 | do. | 234 | ±1·3 |
| 23 | +4·3 | 0·78 | 57 | 56 | do. | 288 | ±1·2 |

* Of the two values of M at opposite ends of each member, the larger only is given in the table. Where the cross section is symmetrical the sign of M is immaterial. In the upper boom, which is of inverted-trough section, the stresses resulting from M are different at the upper and lower edges, and both are given in the last column.

The deformations of the various angles are given in Table II., in which the values of E $\theta$ have been calculated according to equation (I.), and in which E is in tons per square inch and $\theta$ in circular measure.

Table II.

| Joint of boom. | Angle between | E $\theta$ | Angular deformation of boom × E. | Joint of boom. | Angle between | E $\theta$ | Angular deformation of boom × E. |
|---|---|---|---|---|---|---|---|
| A | 13 and 1 | + 7·4 | | G | 13 and 19 | − 6·1 | − 8·0 |
| B | 1 „ 19 | − 1·3 | +12·7 | | 19 „ 7 | − 1·9 | |
| | 19 „ 14 | + 2·9 | | H | 7 „ 14 | − 1·0 | −13·2 |
| | 14 „ 2 | +11·1 | | | 14 „ 20 | − 7·5 | |
| C | 2 „ 20 | − 3·6 | +10·8 | | 20 „ 8 | − 4·7 | |
| | 20 „ 15 | + 1·0 | | J | 8 „ 15 | + 3·7 | −10·7 |
| | 15 „ 3 | +13·4 | | | 15 „ 21 | − 7·9 | |
| D | 3 „ 21 | − 5·5 | +10·0 | | 21 „ 9 | − 6·5 | |
| | 21 „ 16 | + 0·5 | | | | | |
| | 16 „ 4 | +14·9 | | K | 9 „ 16 | + 6·1 | − 9·3 |
| E | 4 „ 22 | − 6·8 | + 7·0 | | 16 „ 22 | − 8·1 | |
| | 22 „ 17 | − 0·9 | | | 22 „ 10 | − 7·3 | |
| | 17 „ 5 | +14·7 | | L | 10 „ 17 | + 8·1 | − 2·5 |
| F | 5 „ 23 | − 7·5 | 0 | | 17 „ 23 | − 7·2 | |
| | 23 „ 18 | 0 | | | 23 „ 11 | − 3·4 | |
| | 18 „ 6 | + 7·5 | | N | 11 „ 18 | + 3·4 | − 8·6 |
| O | 6 „ 12 | + 4·6 | + 4·6 | | 18 „ 12 | −12·0 | |

In the first place let us neglect all values of $\frac{l}{I}$ greater than 2 in calculating M for the booms. This cuts out all the web members except the three tension bars, 21, 22, and 23, and one post 17. Further, in calculating M for the upper boom, assume that, in the four web members retained, M is zero at the lower end of them. Similarly when calculating M for the lower boom, assume that M vanishes at the upper end of the web members. Applying equation II. to the angle between 1 and 13, $44{\cdot}4 = 0{\cdot}09\,(2\,M_A - M_B^1)$, since by symmetry $M_A^{13}$ and $M_G^{13}$ are zero. Also $M_B^1 + M_B^2 = 0$, and therefore $M_A^1 = 247 - \frac{1}{2} M_B^2$.

The similar equation for 1 and 2 at B is

$$76{\cdot}2 = 0{\cdot}09\,(2\,\overset{2}{M}_B - \overset{2}{M}_C - 2\,\overset{1}{M}_B + \overset{1}{M}_A.)$$

Whence, substituting for $\overset{1}{M}_A$ and $\overset{1}{M}_B$ from above we have

$$\overset{2}{M}_B = 171 - \tfrac{2}{7}\,\overset{3}{M}_C.$$

In a similar way we get $\overset{3}{M}_C = 148 + 0{\cdot}27\,\overset{3}{M}_D$.

At D we have $\overset{3}{M}_D + \overset{4}{M}_D + \overset{21}{M}_D = 0$ where $\overset{21}{M}_D$ is given by applying equation II. to the angle between 3 and 21, and making $\overset{21}{M}_J = 0$, the result of which is

$$\overset{21}{M}_D = -\,18{\cdot}5 + 0{\cdot}06\,\overset{3}{M}_D.$$

Whence it follows that $\overset{3}{M}_D = 17{\cdot}4 - 0{\cdot}94\,\overset{4}{M}_D$.

Applying equation II. to the angle between 3 and 4, and using the values of $\overset{3}{M}_C$ and $\overset{4}{M}_D$ already found, we get

$$\overset{4}{M}_D = 134 + 0{\cdot}3\,\overset{4}{M}_E.$$

Proceeding in this way we obtain the value of M at each joint in the boom in terms of its value at the next joint to the left, and eventually we find

$$\overset{6}{M}_F = -\,3{\cdot}3 + {\cdot}43\,\overset{6}{M}_O.$$

Starting again for the lower boom at the joint G, and proceeding from joint to joint, we obtain eventually

$$\overset{12}{M}_N = 37 + 0{\cdot}28\,\overset{12}{M}_O.$$

For the angle between 6 and 12, equation II. gives

$$27{\cdot}6 = 0{\cdot}36\,(2\,\overset{12}{M}_O - \overset{12}{M}_N) - 0{\cdot}52\,(2\,\overset{6}{M}_O - \overset{6}{M}_F),$$

where $\overset{6}{M}_O + \overset{12}{M}_O = 0$, and $\overset{6}{M}_F$ and $\overset{12}{M}_N$ are given above in terms of $\overset{6}{M}_O$. Making these substitutions we find $-\,\overset{6}{M}_O = \overset{12}{M}_O = 3$[illegible] Knowing $\overset{6}{M}_D$ and $\overset{12}{M}_O$, the preceding equations determine the values of M at all the joints in the boom successively.

For the web members the values of M can easily be found when those of the boom members have been determined.

Take the tension bar 22 for example :—

Equation II. applied to the angle between 4 and 22 gives—

$$40{\cdot}8 = 0{\cdot}11\,(-\,100 - 119) - 0{\cdot}96\,(2\,\overset{22}{M}_E - \overset{22}{M}_K),$$

whence $2\,\overset{22}{M}_E - \overset{22}{M}_K = -\,67{\cdot}6$.

Similarly the angle between 10 and 22 gives

$$2\,\overset{22}{M}_K - \overset{22}{M}_E = -\,23{\cdot}0,$$

from which $\overset{22}{M}_E = -\,52{\cdot}7$ and $\overset{22}{M}_K = -\,37{\cdot}9$.

The analysis has here been carried out for the purpose of illustration with a minuteness which would be unnecessary in practice. For instance, the values of M at A and G will not be altered appreciably by supposing the joints at E and L, and all others to the left of them, to be hinged. According to the equations on the previous page, we find that $\overset{1}{M}_A = 179{\cdot}4 - 0{\cdot}001\,\overset{4}{M}_E$, and therefore $\overset{4}{M}_E$ can be neglected in determining $\overset{1}{M}_A$. $\overset{1}{M}_A$ being known, the other values follow in succession.

In general it will not be necessary to proceed to a second approximation; but it is a simple matter to do so if desired. We merely repeat the calculation of M for the joints of the booms, using the numerical values already found for M for the web members in those cases where M had hitherto been neglected. Then, having thus found corrected values for M at all points of the booms, we can recalculate it for the web members. For instance, on the first approximation, in applying equation II. to the angle between 3 and 21, we considered $\overset{21}{M}_J$ as zero. We write it $-\,18{\cdot}6$ when proceeding to a second approximation. Also, at the joint D, instead of

$$\overset{3}{M}_D + \overset{4}{M}_D + \overset{21}{M}_D = 0, \text{ we have}$$

$$\overset{3}{M}_D + \overset{4}{M}_D + \overset{21}{M}_D - 28{\cdot}6 = 0.$$

In Table I. the complete results of a second approximation are given, and it is seen that in all the cases where the secondary stress is considerable the first approximation gave very good results. We have confirmed the validity of the method by working out the results for a small struss rigorously, and comparing them with those given by approximation.

Tables III. and IV. give the data and results for the American bridge represented in Fig. 7.

TABLE III.

| No. of member in Fig. 7. | Primary stress in tons per square inch. | $\frac{l}{I}$ in inch units. | M in inch-tons. 1st approximation. | M in inch-tons. 2nd approximation. | $r$ in inches. | I in (sq. in.)$^2$ | Secondary stress in tons per sq. in. (from 2nd approximation). |
|---|---|---|---|---|---|---|---|
| 1 | −3·4 | 0·17 | 83 | 83 | 7·37<br>9·0 | 1463 | −0·42<br>+0·51 |
| 2 | −3·4 | 0·17 | 84 | 85 | do. | do. | −0·43<br>+0·52 |
| 3 | −3·3 | 0·18 | 80 | 84 | 6·97<br>9·4 | 1312 | −0·45<br>+0·58 |
| 4 | −3·0 | 0·27 | 20 | 23 | 7·25<br>9·12 | 1374 | −0·12<br>+0·15 |
| 5 | +4·2 | 9·37 | 4·4 | 5·5 | 2·5 | 27 | ±0·51 |
| 6 | +4·2 | 9·37 | 2·9 | 3·9 | do. | do. | ±0·36 |
| 7 | +4·3 | 5·76 | 7·0 | 7·6 | do. | 44 | ±0·43 |
| 8 | +4·4 | 4·87 | 3·5 | 3·2 | do. | 52 | ±0·15 |
| 9 | 0 | 1·62 | 5·3 | 3·5 | 6·0 | 185 | ±0·11 |
| 10 | −1·5 | 1·33 | 26 | 24 | do. | 225 | ±0·64 |
| 11 | +3·6 | 50·0 | 1·2 | 1·5 | 1·75 | 6 | ±0·44 |
| 12 | +3·4 | 43·6 | 0·8 | 0·8 | do. | 9 | ±0·15 |
| 13 | +4·2 | 13·5 | 1·3 | 1·3 | 2·5 | 29 | ±0·11 |

The bridge is pin connected, but the bending moments have been calculated on the assumption that all the joints were rigid. It may be seen by examining the results that the friction of the pins would probably be sufficient to prevent any rotation at the joints. For instance, take the joint O at the bearing. The strut 4 has a primary stress of 86 tons. M = 5·5 at O, and the radius of the pin is $2\frac{17}{32}$in. Therefore the coefficient of friction necessary to prevent rotation is $\frac{5{\cdot}5}{86 \times 2\frac{17}{32}}$, or $\frac{1}{23}$. With the post 10 the total stress is 21·8 tons, M = 24, and the radius is $2\frac{7}{32}$ in. Coefficient of friction necessary to prevent rotation $= \frac{21{\cdot}8}{24 \times 2\frac{7}{32}} = 0{\cdot}4$.

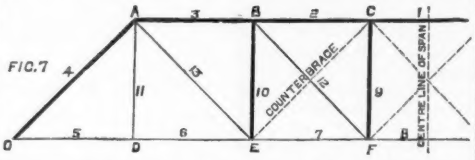


FIG. 7

Considering that the pins are usually a driving fit, the coefficient may easily be higher than this.

As was said previously, the eye-bars in this bridge are of such scantlings that equation II. does not apply, and in practice it would be unnecessary to calculate the secondary stress in them.

TABLE IV.

| Joint of boom. | Angle between | E θ | Angular deformation of boom × E. | Joint of boom. | Angle between | E θ | Angular deformation of boom × E. |
|---|---|---|---|---|---|---|---|
| C | 1 and 9 | + 4·6 | +13·5 | F | 8 and 9 | + 6·6 | −15·4 |
|  | 9 ,, 2 | + 6·9 |  |  | 9 ,, 12 | − 2·9 |  |
| B | 2 ,, 12 | − 4·0 | + 9·9 |  | 12 ,, 7 | − 5·9 |  |
|  | 12 ,, 10 | + 0·8 |  | E | 7 ,, 10 | + 5·1 | − 1·9 |
|  | 10 ,, 3 | +13·1 |  |  | 10 ,, 13 | − 6·3 |  |
| A | 3 ,, 13 | − 6·8 | − 0·7 |  | 13 ,, 6 | − 0·7 |  |
|  | 13 ,, 11 | 0 |  | D | 6 ,, 11 | + 0·7 | −13·2 |
|  | 11 ,, 4 | + 6·1 |  |  | 11 ,, 5 | −13·9 |  |
| O | 4 ,, 5 | + 7·8 | + 7·8 |  |  |  |  |

Table III. has been calculated by applying equation II. throughout, but the values it gives for M in the eye-bars must be considerably in excess of the real values.

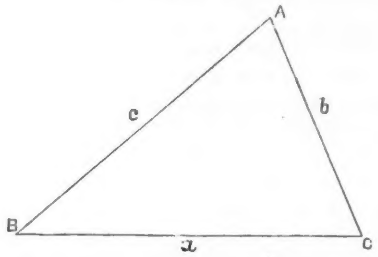
The results tabulated for these two bridges may be studied with some advantage, since the bridges in question are typical of their kind. We have no desire to enter into any comparison of the merits of these types of designs in any other respect than that which we are now discussing. We are fully aware that secondary stress is only one consideration of many that have to be regarded in choosing a type of girder, and we have refrained from giving such references as would identify the bridges we have used for our illustrations, lest it should seem that we wished to suggest such comparisons.

## APPENDIX.

(i.) *To find the change in any angle of a triangle caused by given small changes in the sides.*

The angle A is given in terms of the sides by the equation:

$$2\,b\,c \cos A = b^2 + c^2 - a^2.$$



If A become A + Δ A owing to changes in $a$, $b$, and $c$ amounting to $\delta a$, $\delta b$, and $\delta c$ respectively, we have, by the principles of the differential calculus,

$$-b\,c \sin A \times \Delta A + \cos A\,(b\,\delta c + c\,\delta b) = b\,\delta b + c\,\delta c - a\,\delta a,$$

$$\text{or}\quad b\,c \sin A \times \Delta A = a\,\delta a - a \cos C\,\delta b - a \cos B\,\delta c$$

$$= (b\,\delta a - a\,\delta b) \cos C + (c\,\delta a - a\,\delta c) \cos B,$$

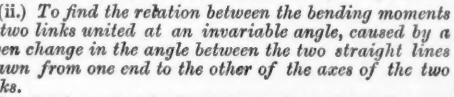
$$\text{whence } \Delta A = \left(\frac{\delta a}{a} - \frac{\delta b}{b}\right) \cot C + \left(\frac{\delta a}{a} - \frac{\delta c}{c}\right) \cot B.$$

When $\delta a$ is due to a stress $t_a$, $\frac{\delta a}{a} = \frac{t_a}{E}$, &c.

Therefore, $E \times \Delta A = (t_a - t_b) \cot C + (t_a - t_c) \cot B$.

(ii.) *To find the relation between the bending moments in two links united at an invariable angle, caused by a given change in the angle between the two straight lines drawn from one end to the other of the axes of the two links.*

Let O A be a straight line joining the ends of the axis of any link, O and A being the points at which it is intersected by the axes of other links forming part of the same frame. Any external forces acting on the link are supposed to be applied at O and A. All the forces acting on the link must be equivalent to two equal and opposite forces P, except in the special case where they are reducible to two equal and opposite couples, a case which we need not consider. Let $p_1$ and $p_2$ be the perpendicular distances from the line of action of P, of O and A. $P p_1$ and $P p_2$ are the bending moments at the ends of the link, which we will call $M_1$ and $M_2$. As drawn in the figure $M_1$ and $M_2$ are both positive, as also are the angles $a_1$ and $a_2$ made with O A by the tangents to the axis in O and A.



Take O as origin and O A as axis of $x$ in employing Cartesian co-ordinates. The moment of P about any point $x$, $y$, on the axis is

$$P \times \left\{p_1 - (p_1 + p_2)\,\frac{x}{l} - y\right\}$$

Therefore, the static equation of equilibrium is

$$\frac{E\,I}{P} \cdot \frac{d^2 y}{d\,x^2} = -\,p_1 + (p_1 + p_2)\,\frac{x}{l} + y.$$

Supposing P—as in the figure—to be positive, and writing $k^2$ for $\frac{P}{E\,I}$, the solution of this equation, subject to the conditions that $y = o$ when $x = o$ and when $x = l$, is:

$$y = p_1 - (p_1 + p_2)\,\frac{x}{l} + \frac{p_2 + p_1\,e^{-kl}}{e^{kl} - e^{-kl}}\,e^{kx} - \frac{p_2 + p_1\,e^{kl}}{e^{kl} - e^{-kl}}\,e^{-kx}\,;$$

When $x = o$ $\frac{d\,y}{d\,x} = a_1$. Therefore,

$$a_1 = -\,\frac{p_1 + p_2}{l} + \frac{k\,\{2\,p_2 + p_1\,(e^{kl} + e^{-kl})\}}{e^{kl} - e^{-kl}}$$

Now, $k^2\,l^2 = \frac{t}{E} \times \left(\frac{l}{\rho}\right)^2$, where $t$ is the primary stress per square inch, and $\rho$ the radius of gyration of the cross section. Whenever the link is of sufficient width to make the secondary stress considerable $k\,l$ will be small enough that $e^{kl}$ and $e^{-kl}$ can be expanded in powers of $k\,l$ and the higher powers neglected. If this be done,

$$e^{kl} + e^{-kl} = 2\left(1 + \frac{k^2\,l^2}{2}\right) \text{ and } e^{kl} - e^{-kl} = 2\,k\,l\left(1 + \frac{k^2\,l^2}{6}\right)$$

Therefore, the above expression becomes:

$$a_1 = -\,\frac{p_1 + p_2}{l} + \frac{1}{l}\left\{p_2 + p_1\left(1 + \frac{k^2\,l^2}{2}\right)\right\}\left(1 - \frac{k^2\,l^2}{6}\right)$$

$$= -\,\frac{p_1 + p_2}{l} + \frac{p_1 + p_2}{l} + \frac{k^2\,l\,(2\,p_1 - p_2)}{6},$$

$$\text{or}\qquad a_1 = \frac{l\,(2\,M_1 - M_2)}{6\,E\,I}.$$

When $x = l_1$ $\frac{d\,y}{d\,x} = a_2$. Therefore,

$$a_2 = -\,\frac{p_1 + p_2}{l} + \frac{k\,\{2\,p_1 + p_2\,(e^{kl} + e^{-kl})\}}{e^{kl} + e^{-kl}}$$

This is the same as the value of $a_1$ with $p_2$ and $p_1$ exchanged each for the other. Therefore,

$$a_2 = \frac{l\,(2\,M_2 - M_1)}{6\,E\,I}$$

If P be negative or the primary stress in the link compressive, the solution of the differential equation is:

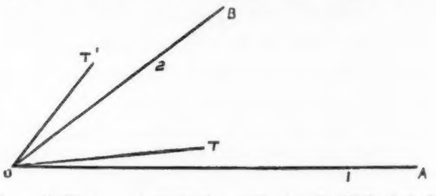
$$y = p_1 - (p_1 + p_2)\,\frac{x}{l} + p_2\,\frac{\sin k\,x}{\sin k\,l} - p_1\,\frac{\sin k\,(l - x)}{\sin k\,l},$$

where in this case $k^2 = -\,\frac{P}{E\,I}$.

Differentiating and expanding in powers of $k\,l$ as before, we obtain exactly the same results.

It is to be observed that these values of $a_1$ and $a_2$ are the same as would have been obtained by neglecting the flexure as affecting the moment at various points in the link, *i.e.*, by putting $y = o$ in the differential equation, but we have preferred the more rigorous method in order to exhibit the degree of accuracy of the results.

If, now, O and B be the ends of the axis of another link united at an invariable angle to the link O A, let these links be distinguished by the letters 1 and 2.



According to what has just been proved,

$$a_1 = \frac{l_1}{6\,E\,I_1}\left(2\,\overset{1}{M}_O - \overset{1}{M}_A\right),$$

where $a_1 = A\,\hat{O}\,T$, O T being the tangent to the axis of the link 1 in O.

$$\text{Similarly,}\quad a_2 = \frac{l_2}{6\,E\,I_2}\left(2\,\overset{2}{M}_O - \overset{2}{M}_B\right),$$

where $a_2 = B\,\hat{O}\,T'$.

Now, $a_1 - a_2 = A\,\hat{O}\,B - T\,\hat{O}\,T' = \theta_{12}$, where $\theta_{12}$ is the change that would occur in the angle between 1 and 2 were there no resistance to deformation at the joint.

Therefore,

$$6\,E \times \theta_{12} = \frac{l_1}{I_1}\left(2\,\overset{1}{M}_O - \overset{1}{M}_A\right) - \frac{l_2}{I_2}\left(2\,\overset{2}{M}_O - \overset{2}{M}_B\right)$$

(*To be continued.*)

---

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Staff Engineers: James Shirwell, to the Terror, additional; Richard Harris, to the Shannon; J. Fielder, to the Victory, additional, for the Pallas. Chief Engineers: George G. Goodwin, to the Bellona; William J. Anstey, to the Pembroke, additional; John Kerr, to the Calypso; Wm. J. Mabb, to the Barrosa; Allan V. Blake, to the Iron Duke; Allan H. Slade, to the Penelope. Engineers: Samuel Godbeer, to the Pembroke, additional; Charles E. Eldred, to the Terror, additional; A. R. Pattison, to the Royal Sovereign; F. W. Highton, to the Wildfire; F. M. Cottam, to the Alarm; Charles J. James, to the Havock; George Ramsay, to the Blanche; Henry E. Tregenna, to the Bellona; W. A. P. Smith, to the Barrosa; Colin M'K. Norris, to the Niger. Probationary Assistant Engineer: H. R. S. Hughes, to the Trafalgar.

## THE IRON AND STEEL INSTITUTE BRUSSELS MEETING.

The autumn meeting of the Iron and Steel Institute was commenced on Tuesday morning at Brussels, under the presidency of Mr. E. Windsor Richards, supported by a large number of past presidents and other members of the Council, and about 400 members, including, besides those from this country, a considerable contingent of German, American, and other foreign members. The proceedings were inaugurated with a reception on Monday evening held by the Communal Council in the Town Hall, where the visitors were received by the Burgomaster and his colleagues; and the formal business began at 10 a.m. on Tuesday, when the President, Council, and members were received by Professor Gillow, the President, M. Briart, the Vice-President, and other members of the local reception committee, in a short but very appropriate speech, which was acknowledged by the President with equal felicity or brevity, so that very little time was lost in compliments.

After the treasurer had given notice of an alteration in the bye-laws to be proposed at the next annual general meeting, to allow members to compound for their subscriptions, and pay a single payment of thirty guineas, the reading of papers was commenced by Professor Gillow, who gave a short sketch of the recent developments in the manufacture of iron and steel in Belgium, dwelling more particularly on the changes wrought by the Thomas and Gilchrist process, illustrating the various points by a well-selected series of statistical data. This occupied only a few minutes, as on account of the paper not being in the hands of the members, it was read from a manuscript in French, no discussion or inquiry being possible. He was followed by M. A. Briant, the president of the Society of Engineers in the Province of Hainault, who may, without dispute, be said to stand at the head of the mining engineers of the country, who read a paper

### "On the Mining Industry of Belgium."

This was an admirable sketch, dealing with all the points of interest in the working of coal in Belgium, where the difficulties are perhaps greater than in any other country, on account of the great amount of disturbance to which the strata have been subjected, and the obstacles to be encountered in sinking through the water bearing dead measures, on the eastern portions of the coalfield where the axes are most developed. These circumstances have led to the necessity of working seams as little as 10½in. thick, while the thickest do not exceed 5¼ft. From the engineer's point of view the most interesting of these details are those connected with the methods of sinking through the cretaceous and Wealden strata, the arrangements for obtaining an adequate output from a deep pit without unduly increasing the speed of winding, and the deep-lift underground pumping engines. Of these parts we give an abstract.

"*Sinking shafts.*—In new winnings great difficulties are sometimes encountered. These include (1) the large amount of water; (2) the loose nature of the rocks. When there is simply much water, while the rock stands well, work can be carried on in the usual manner, by removing the water; it is only a question of unwatering, sometimes difficult, it is true, and always costly, but in itself offering nothing absolutely impossible. Nevertheless, economy in this case causes us to turn to the methods in which the shaft is left full of water. When, however, quicksand is encountered in addition to water, the direct method is no longer possible, and recourse must be had to other processes. Of these the principal ones are the Kind-Chaudron method, long since known in Belgium, and the Poetsch process, which has only recently been introduced. The author shortly described the recent application of both these methods to especially difficult cases.

*Shaft at Ghlin in the Nord du Flénu collieries.*—The following is a section of the strata that had to be passed through:—

| | Metres. |
|---|---|
| Quaternary and Tertiary: sandy clay, sands and gravels | 18·00 |
| Mons limestone, firm ... ... ... ... ... ... ... ... | 6·00 |
| Chalk, white and grey, more or less compact, flint, green sands and blue clay of the upper chalk ... ... | 268·50 |
| Quicksands and gravels with clay intercalated, especially near the bottom... ... ... ... ... ... ... ... | 14·50 |
| Total ... ... ... ... ... ... ... ... ... ... ... ... | 307·00 |

This statement shows how difficult it is to get through the overburden, especially near the bottom. It may be mentioned that the natural water level is 0·50 metres below the surface. The bottom of the tubbing has to bear a pressure of more than thirty atmospheres. Never before had such conditions been experienced, and the problem was the more difficult to cope with as the conditions were altogether unexpected. It was thought that the coal measures would be met with sooner, as they were believed to have been reached at a depth of 292 metres, whence the boring tools had brought up the *débris* of black and grey clay, shale, and fragments of coal resembling cannel. This was only the Wealden clay and lignite (*Aachénien* of Dumont), which was immediately followed by the bed of sand shown on the section. There was then, says Mr. Chaudron, a moment of discouragement, or, at least, of cruel deception. But, he adds, as soon as the first instant of dismay passed, we ardently set to work to find a means for getting through these Aachen sands. The work of sinking, then, comprised two quite distinct stages: (1) Sinking with the shaft full of water down to 292 metres; (2) sinking through the quicksand, and into the coal-bearing rocks to a depth of 324 metres, where a bottom for the tubbing was found.

This is not the place to enter into full details of this subject. It will be understood that the idea of Mr. Chaudron and the engineers who assisted him in his arduous task was to prevent the caving in of the sand as the boring proceeded. They succeeded in sinking telescopic sheet iron cylinders, as had already been done for the sands nearer the surface, but the operations were of course more difficult. Five columns of tubes were thus successively sunk to line the lower 38 metres. After this, the final tubbing was sunk to line the whole shaft to a depth of 324·30 metres, an operation that was crowned with success. Two shafts were sunk in this way to the coal measures. Work was begun in May, 1873. In January, 1874, the sinking plant was ready for work at No. 1 pit. It was finished in 1886, and No. 2 pit in 1887. These shafts are 50 metres apart from centre to centre. The interior diameter of the tubbing at the bottom is 3·65 metres, and this is increased to 4 metres higher up by putting in conical rings at different heights. The total weight of the tubbing amounts to 5000 tons, which cost from 25 to 27 francs. The thickness of the moss-box is 110 millimetres. These latter particulars were given by Mr. Sohier, the present director of the colliery, who has also stated that, according to the account books, the total cost of the sinkings amounted to 4,027,000 francs (£161,080), or an average of 6365 francs (£254) per metre run. This undertaking, Mr. Chaudron says, is by far the most important that has been entrusted to him since his system of sinking with water standing in the shaft has been in use. With this really remarkable example, it may be said that to-day any sinking might be undertaken by this process with every chance of success.

*Shaft at Houssu.*—A more recent process has been applied at the Houssu colliery under similar conditions as regards the stratification, but under much more difficult circumstances. This process was originated by Mr. Poetsch, a German engineer, who had already applied it on several occasions in his own country. Its principle consists in freezing a cylindrical mass in the watery quicksand, and in sinking the shaft in the solid. The means for doing this consist in sinking outside the periphery of the shaft a number of metallic tubes closed at the lower end. These tubes penetrate as far as the impermeable strata which is to constitute the foundation for the tubbing. Inside these tubes, which are about 0·20 metre in diameter, are placed smaller tubes open at the bottom, and extending nearly to the bottom of the outer tubes. A liquid, passing a very low freezing point, is forced into the inner tubes by a pump, and rises through the annular space between the two tubes. The cold liquid acting through the walls of the tubes lowers the temperature of the surrounding ground and freezes it into solid masses, isolated at first, and then joining into one large mass as the operation is prolonged. Finally a resisting cylinder is formed, and permits the shaft to be sunk within it down to the impermeable strata. The shafts at Houssu, as at Ghlin, have to pass through sands belonging to the Wealden formation, which are encountered at a depth of 61 metres below the same cretaceous strata. These sands are of various colours, sometimes clayey near the bottom, but always excessively loose and watery. Their thickness is 11 metres and they rest immediately on the coal series. When the quicksand was reached, the flow of water amounted to 16 cubic metres—3520 gallons—per hour, and it rose to a height of 7 metres. The shafts were to be 4 metres in internal diameter. Eighteen double freezing tubes were sunk in a circle of 5·12 metres in diameter. They started at a depth of 54 metres and reached a depth of 75 metres. A freezing machine on Kropff's system, using the alternate liquefaction and vaporisation of ammonia, was installed on the surface and started December 5th, 1885. It was of a size intended to freeze 450 kilos.—990 lb.—of water per hour; but as it was unable to cool the refrigerating liquid, which was a solution of chloride of magnesium, to − 10 deg. C., a second machine was added seven months afterwards. The lowering of the temperature could then be forced down to − 25 deg. C., which allowed the work to be successfully performed. The operation of freezing lasted from December 5th, 1885, to August 5th, 1887, at which date sinking was commenced. The pit was carried down to the coal measures, after which it was tubbed. The work was completely finished December 22nd, 1887. I would add that in February, 1888, the ground was sufficiently thawed for the withdrawal of the freezing tubes.

Such is a *résumé* of the work made from information supplied by Mr. Alexander, director of the Houssu colliery. The freezing process had not then been applied under such difficult circumstances, and it may be said that this success, which had been preceded by several failures in Germany, has decidedly caused it to rank as a workable method.

*Working at great depths in Belgian coal mines.*—In Belgium the necessity of carrying our coal workings to a great depth in the near future was forced upon us some time ago. Fifty years ago the science sections of the *Academie Royale de Belgique* discussed the means to be employed if workings were carried to a depth of 1000 metres. Professor Devillez, of the Mons School of Mines, whose recent decease is regretted alike by science and industry, answered this question, and proved that the means for extraction, sinking, and ventilation which existed at that time would suffice all needs. Since then these means have been improved, and the ideas of the illustrious professor are as accurate now as they were then. This statement is confirmed by recently installed plants, which I propose to briefly mention. Very shortly after the professor made these assertions, mining engineers no longer hesitated to attack these great depths.

*Shaft at Viviers.*—A shaft was sunk at the Viviers Consolidated Colliery, Charleroi, to a depth of 1140 metres—3750ft.—but unfortunately the expected deposit was not found, and the shaft was abandoned.

*Shaft at Viernoy.*—More recently the Viernoy shaft at the Anderlues Colliery was deepened to 1000 metres—3300ft.—and provisionally abandoned for the same reason.

*Produits shaft.*—The Produits Colliery has lately deepened the St. Henriette or No. 8 shaft, at the north of the royalty, to 1150 metres—3800ft. From this point an incline has been driven to a depth of 1200 metres—3950ft.—the greatest depth as yet reached in the Belgian coal field. In spite of the somewhat restricted dimensions of the shaft, it is hoped that a considerable output will be reached. The workings, however, are in a preparatory stage only, so that I cannot dwell further on this subject. In all instances where the workings are comparatively important, and it is desired to increase the output, it has to be done at depths which, if they do not actually reach 1000 metres, are not far from it. Quite recently this question has presented itself under a different aspect. Apart from the power of the winding engine itself, the quantity extracted diminishes in proportion to the depth, on account of the fact that the original dimensions of the shaft have to be preserved as it is deepened. The shafts are thus somewhat narrow throughout, and this state of affairs will have to be remedied, as it is impossible to use cages carrying two tubs abreast.

*Shaft at Marchiennes.*—Here a problem was presented to Mr. Alfred Soupart, director of the Marchiennes Colliery, and he solved it in a daring and somewhat unexpected manner. The circumstances were as follows:—There were two shafts at this colliery, one 900 metres—3000ft. deep—elliptical in cross section, and from 2·60 to 2·80 metres long; the other circular, with a maximum diameter of 3 metres. From these shafts a very good deposit was worked, giving a large output. Mr. Soupart determined to use both of these as winding shafts, the upcast continuing to be used as such by applying Briart's ventilation trap. In the future these shafts will be carried to a depth of 1200 metres at least. The condition of large output—say 1000 tons daily—could not be met by the then existing four-decked cages, carrying one tub on each deck, except by increasing the engine speed beyond the permissible limit. It was therefore determined to increase the height of the cages to ten and twelve decks respectively. The landings at the surface and the insets at the bottom of the shaft have been increased in number, and the pit-frames are 25 and 30 metres high at the two shafts. The guides are solidly constructed of Vignoles rails in two ways. At No. 1 shaft the rails are opposite one another, and consequently the cages are guided at their ends. As the passing of the cages is very difficult in some confined portions of the shaft, recourse is had to the Soupart system. At No. 2 shaft, Briart guides have been put in. The cages with ten decks weigh 3500 kilos.—7700 lb.—and the twelve-deck cages weigh 4000 kilos.—8800 lb. The dead weight with the empty tubs are 6000 kilos. and 7000 kilos.—13,200 lb. and 15,400 lb.—respectively. The loads amount to 5000 kilos. and 6000 kilos.—11,000 lb. and 13,200 lb. The time occupied in changing is 120 seconds at No. 1 shaft, and only eighty seconds at No. 2. For winding, 120 seconds are required. The total time for each journey of a cage is thus four minutes or more. The output at the present time is from 700 to 800 tons per day, and shortly a total of 1000 tons will be reached. In case of accidents at No. 1 shaft, No. 2 shaft will still give a very considerable output.

*Introduction of machinery in the mines.—Underground haulage.*—Numerous applications of steam-power to transport and drainage have been made in English mines. In Belgium, however, we have long hesitated to introduce underground engines on account of the relatively large excavations required for such machines in England, to which it was thought, and justly so, that our rocks would not lend themselves. It is therefore necessary to limit the excavation and to reduce the dimensions of the motors, of which the construction has to be modified, in order to suit the new conditions imposed upon them. I shall only very briefly mention haulage machinery which is thus introduced in the mines. The engines often occupy a very limited space, although they work the haulage over several kilometres. These machines are now part of our regular equipment, and they work the several known kinds of rope or chain haulage.

*Machinery for underground drainage.—Pumps at the St. Katherine shaft at Bascoup.*—Pumps were slower in becoming acclimatised on account of the difficulty in reconciling the conditions of restricted space with mechanical efficiency. This has been done, however, and as an example I may cite the drainage machinery at the St. Catherine shaft of the Bascoup Colliery, which lifts the water to a height of 360 metres—1180ft. It is installed in a brick-lined gallery of 2·25 metres in interior diameter. The usual foundations, which take up so much room, are omitted, and instead, the machinery is bolted down on strong iron beams solidly built into the masonry. The principal parts of the engine, steam cylinder, condenser, and pumps are arranged tandem-fashion. The principal dimensions are as follows:

| | |
|---|---|
| Diameter of steam cylinder... ... ... ... | 0·67 metres |
| Stroke of steam piston and pumps ... ... | 0·65 ,, |
| Revolutions per minute... ... ... ... ... | 40 to 50 |
| Diameter of the pump cylinders, which are placed side by side ... ... ... ... ... | 0·175 metres |
| Diameter of the condenser ... ... ... ... | 0·320 ,, |
| Diameter of delivery pipes ... ... ... ... | 0·147 ,, |
| Diameter of steam pipes ... ... ... ... | 0·143 ,, |
| Theoretical yield per revolution ... ... ... | 26·16 litres |
| Theoretical yield per minute at 50 revolutions ... ... ... ... ... ... ... ... | 1·308 cub. metres. |

An air reservoir is placed at the bottom of the water column to lessen shocks.

*Pump at La Louvière.*—Another underground pump installed at the La Louvière collieries is still more remarkable, as much on account of its power as of the height of throw, which is 576 metres in a single lift. The following are some of the principal details:—

| | |
|---|---|
| Diameter of motor cylinder ... ... | 0·75 metres. |
| Stroke of piston and pumps ... ... | 0·60 ,, |
| Diameter of air pump .. ... ... | 0·26 ,, |
| Diameter of pump piston... ... ... | 0·11 ,, |
| Diameter of lift pipe... ... ... ... | 0·15 ,, |
| Diameter of steam pipe ... ... ... | 0·195 ,, |
| Revolutions... ... ... ... ... ... | 48 to 68 metres. |
| Theoretical yield per hour ... ... | 43·77 to 62·01 cu. metres |
| Practical yield per hour ... ... ... | 32 08 to 59 55 ,, ,, |

| | |
|---|---|
| Indicated power, horse-power... ... | 117·5 to 167·24 |
| Work in water raised, horse-power | 83·40 to 127·24 |
| Efficiency ... ... ... ... ... ... | 71 to 76 per cent. |

A Baer accumulator replaces the air reservoir to reduce shock and to regulate the movement of the water in the pipes.

Many other underground pumps are at work in Belgium at the present time, all of which are constructed on analogous principles on which it is unnecessary to dwell further.

*Electricity.*—Electricity also has found its way into our mines for generating both power and light. I do not think that the time has yet come to say much about it. All that can be said is that tentative efforts are full of promise for the future.

*The treatment of coal—coke and briquettes.*—Perhaps it is for the reasons set forth above that we find ourselves forced to push the treatment of coal to such extreme limits. It was in Belgium that the classification of coal was primarily carried on to the extent that is seen at the present, and that mechanical sorting originally found such an extended field. It is here that the need for washing the coal, not only prior to its direct sale to the public, but especially before its manufacture into coke and briquettes, was first felt; and it is here also that coke ovens and briquette presses were investigated and improved in order to give the greatest degree of economy. Fifty years ago the manufacture of agglomerated coal, or briquettes, was installed in the district of Charleroi. This industry has grown largely in our country, and it will grow more and more. The need for turning part of the small coal into a more useful form has begun to appear even in more favoured coalfields. It is about thirty years ago that the Belgian engineers, Smets, Dulait, and Coppée, recognised the necessity for using, in the manufacture of coke, those coals which until then had been rejected as insufficiently bituminous. All of them sought to improve the coke oven, and the latter invented the type which we now see adopted everywhere. These apparatus are too well known for us to dwell on here, and I must hasten on to the principal point of which I have to treat.

*Fire-damp and ventilation.*—The history of fire-damp in Belgium can be subdivided into two entirely distinct periods. The first extends from the earliest times up to the year 1847, when the first sudden outburst took place in the Mons seam; and the second from that year until the present time. Several years ago, experiments made in Wales drew the attention of engineers to the function of the very fine and often impalpable coaldust suspended in the air of mines. The experiments were repeated in other coal-producing countries, and in spite of the sometimes contradictory results that they have given, it is now admitted that if these dusts are not explosive by themselves, yet they greatly aggravate explosions of fire-damp when mixed with it, and that, above all, they act to propagate the explosion.

*First period: Slow disengagement.* — Let us here recall the fact that Belgian coals are more dusty than any others, and that this condition tends to increase with the depth. This first period was characterised by gaseous liberation more or less active, but always increasing, and without abruptness. It was admitted in principle that, besides the precautions necessary to protect the gas from contact with any kind of flame, a sufficient and continuous ventilation was sufficient by itself to preserve the miners from the attacks of their constant enemy. The introduction of the Davy lamp into collieries, in spite of the improvements embodied in it, only offered a relative and sometimes doubtful security. The real safeguard consisted in removing the gas from the workings in proportion to its production. I believe I can say with truth that although the glory of having given us the safety or Davy lamp belongs to England, Belgium, in spite of the small extent of her territory, has produced the greatest number of ventilating appliances. Amongst us was first felt the necessity for getting rid of the inefficient and dangerous ventilating furnaces. I must not, however, recall all that has been done in this way, as it has scarcely more than a historical interest. In order to restrict myself to one apparatus that has lived, I will merely mention the Guibal fan, which is universally known and applied. For several years other apparatus, whose chief feature is their smaller bulk, have come to us from other countries, and are running side by side with it. I may instance the Rateau fan, which in addition appears to have the advantage of greater efficiency. If this is really so we shall cordially adopt it, in the belief that we must above all things keep in view the good ventilation and safety of our mines. But if the Guibal fan has to give place to other and more perfect apparatus, the illustrious professor of Mons will still retain the lasting glory of having contributed more than any one to the establishment of the true principles of ventilation and circulation of the air in mines. I must, however, not forget to remind you of what has been done to prevent the ignition of fire-damp by explosives. In this connection I may mention mechanical drills, which, when used in conjunction with wedges, allow us to get through substances that have been the cause of so many accidents. I must also refer to the Thomas-François apparatus, which has replaced explosives not only in the seam itself, but also in driving stone-drifts.

*Second period: Sudden outbursts.*—According to Mr. Gustave Arnould, no outburst of gas had been observed prior to 1847. At first such outbursts occurred on a small scale, and attracted but little attention. In 1865, in a colliery in the Mons district, the first outburst of this kind took place, under strange and altogether extraordinary circumstances. Other explosions soon followed, and caused some of the most dreadful catastrophes that have ever occurred in mining history. The gas showed itself under entirely novel conditions, of which our country seems to have kept the sad and terrible monopoly. Sudden outbursts of enormous quantities of fire-damp occur simultaneously with the extensive projection of broken coal, and this takes place without any warning signs. Floods of inflammable gas invade the roads, the intakes, as well as the return air-ways, driving back the air current, rushing up the down cast shaft, and sometimes taking fire at the furnaces on the surface. It is needless to say that in such a case everything is destroyed, especially the winding gear, which is so urgently wanted on these occasions for getting the men out of the mine. Everyone is overwhelmed in the presence of the enormous jet of flame rushing out of the pit, and lasting as long as the outburst itself. The quantity of gas evolved during this phase of the phenomena has been estimated at 2400 to 3000 cubic metres—84,700 to 106,000 cubic feet—per minute, an astonishing amount that is, however, only an average. What, then, can be the volume in the first stage of the outburst, at the moment of explosion? In the presence of such accidents, it has been and still is asked whether science can ever succeed, not in preventing their recurrence, but in rendering them harmless. To increase the ventilation is altogether illusory in the presence of such enormous quantities of gas to be diluted with air. The best means that has been found up to the present is to keep boreholes in advance at every working face with the idea of draining out the gas from the strata, to restrict the advance, and to so dispose the air-ways that the air-current cannot be reversed. According to official statistics, the application of these measures has already had good results, and the number of victims has sensibly diminished. In all cases, in spite of the most disadvantageous conditions, and above all, of the extremely dangerous work in our collieries, it would be erroneous to suppose that accidents are proportionately more numerous than in other coal districts. As a matter of fact, we find in the *Statisque des Mines, Minières, Carrières*, published by Mr. E. Harzé in 1891, a table giving the average of the number of miners killed yearly during the decade 1881-90 in Belgium and in the neighbouring countries. The average is:—

| | | |
|---|---|---|
| Belgium ... ... ... | 19·92 | per 10,000 workmen employed |
| France ... ... ... | 18·53 | " " |
| Great Britain ... | 19·36 | " " |
| Prussia ... ... ... | 29·34 | " " |

I will stop at this point, gentlemen, and pray you to pardon me if I have wasted the time that you could perhaps have better employed, but you will remember that if coal is the bread of industry in general, it is peculiarly necessary for metallurgy. I have attempted to show you our coalfields as they are, and to demonstrate the difficulties that we have to overcome, difficulties that are unquestionably greater than elsewhere. If we keep our ground under such unpropitious circumstances we can only attribute it, I think I may safely say, to the initiative of our manufacturers, to the knowledge and experience of our engineers, whether in private practice or in the public service, and to the remarkable skill that, in consequence of the difficulties themselves, our industrial population has acquired. Nor must I forget the instruction in mining and in the collateral sciences that is afforded at the two older Mining Schools of Belgium, that of Liége and that of Mons. They have had the good fortune to have had for very many years the instruction entrusted to men of the highest eminence. I have already had occasion to cite the names of Devillez and Guibal, and may be permitted also to refer to that of Mr. Trasenster, who was entrusted with the instruction at the Liége School of Mines at about the same period. A man eminent for his knowledge and for his clear perception of practical requirements, he was a professor without an equal, and deserves to remain life-long President of the Society of Engineers who have graduated from that school."

Sir Lowthian Bell's paper "On the Use of Caustic Lime in the Blast Furnace" was a continuation to that "On the General Economy of the Blast Furnace," read at Darlington last autumn, and besides the special subject indicated in the title, incidentally touched upon the irregularities due to want of uniformity in heat caused by the use of fire-brick stoves, and the increased liability to "hanging" of the charge consequent on the introduction of very hot air in melting. He is still of opinion that the production of pig iron for Cleveland ore can scarcely be effected by less than 20 cwt. of coke per ton for any long continued period, and at Clarence he has scarcely brought it below 21 cwt. As regards the main question of the paper, observations carried on for nineteen weeks on two furnaces using limestone, and two others for seventeen weeks on lime not perfectly calcined, showed that 1·87 units of coke less were required for 20 units of pig with caustic lime. The quality of the work was about the same in each case, and the coke saving was 8·55 per cent. As a matter of commercial policy there was not much to choose between coke in the furnace and coal in the kiln. Small coal used in the kiln is only half the price of coke, but twice as much of it is required to do the same amount of work. To obtain 10,988 tons of lime 2922 tons of small coal were required, costing £838 15s. 9d., or 1s. 6½d. per ton of lime, or per ton of iron made 7·59d. The labour cost is small, but something must be added for wear and tear of the kiln.

In the discussion the President called upon Mr. David Evans, who stated that experiments carried on for six months, thirty years since in Cleveland, showed that no appreciable advantage was to be obtained from the use of caustic lime. Mr. Julian Kennedy and M. Jules Greeiner made a few remarks, without contributing any matter of importance to the discussion; the only speaker on the other side of the question being Mr. C. W. Wood, who stated that he began using caustic lime in his furnaces twenty-five years ago, and had found it sufficiently advantageous to continue the practice ever since. He has, however, introduced an important modification—to which probably his success is largely due—namely, the calcination of the ironstone and limestone simultaneously in the same kiln, which, as pointed out by Sir Lowthian Bell in his reply, utilises the heat developed by the oxidation of ferrous to ferric oxide, after the decomposition of the carbonate of iron. A long note from Mr. Cochrane, in reply to the paper, was presented to the meeting; but as it was impossible to read it, it was decided to print it, so that the discussion on the question may for the present be considered as adjourned.

The third paper read on Tuesday was by Mr. T. W. Hogg, of Newburn Steelworks,

### "ON THE INFLUENCE OF ALUMINIUM UPON THE CARBON IN FERRO-CARBON ALLOYS."

The question, the author said, whether aluminium of itself is capable of producing a change in the condition of the carbon when added to ferro-carbon alloys is one of considerable interest, and as it appears to be generally accepted that the addition of aluminium to white iron causes the carbon to be changed to the graphitic state, it is important to ascertain whether the results which have been obtained by different observers are particular cases only, or whether this property of aluminium may be taken as a general law. Having detailed the results obtained by previous observers, the author went on to say that it appeared that the preparation of a series of alloys containing aluminium in different proportions, and as far as possible keeping out the silicon and manganese, would give results of much interest; and for the opportunity of carrying this out he had to thank Mr. J. W. Spencer, the managing director of the Newburn Steelworks. Two kinds of pure Swedish pig iron were used, one a highly saturated grey pig, and the other a white variety showing a litle grey towards the centre of the pigs. The composition of each is shown in the following table:—

TABLE I.

| | Grey. | White. |
|---|---|---|
| Iron (by difference)... ... ... ... ... | 94·707 | 95·665 |
| Manganese... ... ... ... ... ... ... | 0·22 | 0·11 |
| Carbon (graphitic) ... ... ... ... ... | 3·75 | 0·40 |
| Carbon (combined) ... ... ... ... ... | 0·58 | 3·27 |
| Carbon (total) ... ... ... ... ... ... | 4·33 | 3·67 |
| Silicon ... ... ... ... ... ... ... | 0·70 | 0·48 |
| Sulphur ... ... ... ... ... ... ... | 0·005 | 0·01 |
| Phosphorous ... ... ... ... ... ... | 0·038 | 0·065 |
| | 100·000 | 100·000 |

The several alloys were prepared by fusing the iron in clay pots, and with the exception of the one containing 1 per cent. aluminium, this metal was separately melted and the iron poured into it; the mixture was then again poured back into the pot, and this operation was repeated twice. The alloy was next poured into two moulds, one of iron and the other of green sand, in order that one portion should be cooled rapidly, and the other slowly, and this was done without the addition of any aluminium. The alloys were prepared in quantities of about 60 lb. each, and cast into 3in. square moulds. The quantity of graphite, carbon, and silicon determined in each case were given in a tabular form.

It is to be observed that the most effectual primary change in the condition of the carbon is obtained by the addition of 1 per cent. of aluminium, and each addition after this causes more and more of the carbon to pass into the combined state, until practically the whole of it is in this condition in the 12 per cent. alloy. In all cases the rapidly cooled alloys show a remarkable excess of graphitic carbon over that contained by the slowly cooled alloys; this is the most decided in the case of the alloy with grey pig iron containing 4 per cent. aluminium. As there are so many examples of this, it would be interesting to have a satisfactory explanation, as the phenomena is quite unique. May it not be that the aluminium has actually caused a precipitation of carbon in the molten alloy, and the more slowly cooled portions have partially taken up the carbon again by cementation? It is also to be observed that the total carbon in the case of the white pig alloys is not diminished, any more than that produced by admixture of an element not containing carbon; but in the case of the grey pig high percentage alloy there is a decided loss. The addition of 12 per cent. aluminium to pig iron containing 4·33 per cent. carbon should cause this element to be reduced to 3·80 per cent., whereas only 3·44 per cent. was found.

The general effect of the more rapid cooling upon the fractures has been to produce a much closer grain, and here an interesting fact is well illustrated. He alluded to the deceptive nature of the fractures as an indication of the proportion of graphitic carbon, a circumstance first pointed out by Bell.

In the case of the higher percentage alloys there was an evolution of large quantities of gas on solidification, and although the lower portions of the ingots were perfectly sound, the top portions even on the outside showed numerous honeycombs, completely filled with minute glistening flakes of graphite; in this respect, therefore, the high aluminium alloys resemble the high silicon alloys. This phenomena, however, is not a case of actual separation of graphite from the alloy, but decomposition of the issuing carbonic oxide.

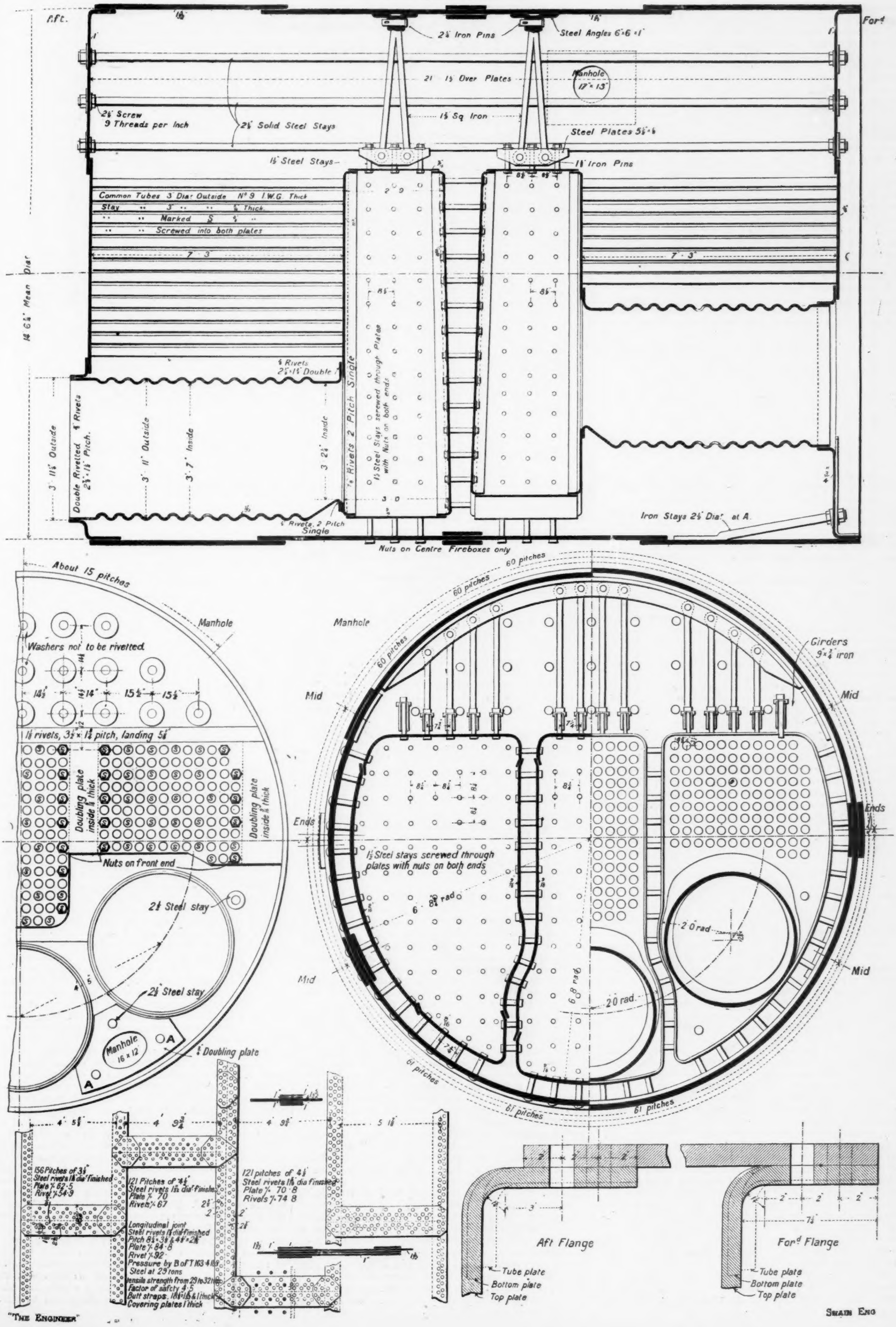
Hadfield has described an interesting experiment wherein aluminium was added to spiegeleisen, with the result that the condition of the carbon and appearance of the fracture was greatly altered, but as it is well known that prolonged fusion of spiegeleisen itself may produce an alloy which is often more or less graphitic in its nature, and in addition to this the quantity of silicon present in his alloys seemed high in proportion to the aluminium, it appeared to be of interest to ascertain the effect of remelting a 4 per cent. aluminium alloy alone, and also with the addition of a considerable quantity of manganese; in each case two ingots were cast to determine the difference between rapid and slow cooling, as in the other alloys.

There is three times as much graphitic carbon present in the more rapidly cooled portion of the alloy; the slowly cooled alloy is very unsound, and the general appearance of the fracture would certainly lead one to expect to find it the reverse of what is actually the case; so far as

# TWIN-SCREW STEAMSHIP DUKE OF YORK—BOILERS

MESSRS. DENNY BROTHERS, DUMBARTON, ENGINEERS

(*For description see page* 147 *ante*)



Aft.
Ford
2½ Iron Pins
Steel Angles 6 × 6 × 1
21 1½ Over Plates
Manhole 17 × 13
2½ Screw
9 Threads per Inch
2½ Solid Steel Stays
1½ Sq Iron
Steel Plates 5½ × 6
1½ Steel Stays
1½ Iron Pins
Common Tubes 3 Diar Outside No 9 I.W.G. Thick
Stay ·· 3 ·· ·· ¼ Thick
·· ·· Marked S ·· ··
·· ·· Screwed into both plates
7' 3
7' 3"
14' 6¼" Mean Diar
8½
¾ Rivets
2½ × 1⅛ Double
Double Rivetted ¾ Rivets 2½ × 1⅛ Pitch
3' 11½" Outside
3' 11" Outside
3' 7" Inside
3' 2⅛" Inside
⅞ Rivets 2 Pitch Single
1½ Steel Stays screwed through Plates with Nuts on both ends
⅞ Rivets, 2 Pitch Single
Nuts on Centre Fireboxes only
Iron Stays 2½ Diar at A.
About 15 pitches
Manhole
Washers not to be rivetted
14½
14
15½
15½
1⅛ rivets, 3½ × 1⅛ pitch, landing 5⅛
Doubling plate inside ⅝ thick
Nuts on front end
2¼ Steel stay
2½ Steel stay
Manhole 16 × 12
A
¾ Doubling plate
60 pitches
Mid
Ends
1½ Steel stays screwed through plates with nuts on both ends
6' 8½ rad
6' 8 rad
2' 0 rad
2' 0 rad.
Girders 9 × ¾ iron
61 pitches
4' 5⅛
4' 9¾
4' 9½
5' 1⅛
156 Pitches of 3½
Steel rivets 1⅛ dia finished
Plate % 62·5
Rivet % 54·9
121 Pitches of 4½
Steel rivets 1⅛ dia finished
Plate % 70
Rivets % 67
Longitudinal joint
Steel rivets 1⅛ dia finished
Pitch 8½ × 3½ & 4½ × 2⅛
Plate % 84·8
Rivet % 92
Pressure by B of T 163·4 lbs
Steel at 29 tons
tensile strength from 29 to 32 tons
Factor of safety 4·5
Butt straps, 1⅛ × 1⅛ & 1 thick
Covering plates 1 thick
121 pitches of 4½
Steel rivets 1⅛ dia finished
Plate % 70·8
Rivets % 74·8
Aft Flange
Tube plate
Bottom plate
Top plate
Ford Flange
Tube plate
Bottom plate
Top plate

"THE ENGINEER" SWAIN ENG

the proportion of graphite is concerned, this alloy is a beautiful illustration of the fact noticed by Bell, and previously alluded to. To ascertain the influence of aluminium upon a high silicon alloy, ferro-silicon was fused and mixed with 4 per cent. aluminium also previously fused; two ingots were prepared as in the other alloys to determine the difference, if any, between rapid and slow cooling. Beyond showing a great change in the grain of the alloy, the result does not give any further important information. The slowly cooled portion was much honeycombed, the cavities being lined with graphite. The rapidly cooled portion appears to be perfectly free from any unsoundness, and the change from the original appearance of the alloy is most marked.

In conclusion, it is shown in the present paper that in the purer classes of pig iron all tendency for carbon to be retained in the combined state is prevented in the most decided manner by the addition of 1 per cent. of aluminium, and that every increase upon this quantity tends to reverse this effect, until, with a large proportion of aluminium, the carbon in white pig iron is retained in its original condition, and the graphitic carbon present in grey pig is entirely changed to the combined state. It is suggested that the exact points for the complete change in each case will vary with the different kinds of iron and the degree of saturation with carbon. The interesting fact is described that the more rapidly cooled ferro-carbon alloys containing aluminium contain a larger proportion of graphite.

Mr. Snelus said that Mr. Hogg's efforts were worthy of much praise. It was only by experiment that advances could be effected in science. Mr. Hogg's results opened new ground for inquiry and investigation. It was very remarkable that an increase of aluminium above 1 per cent. should neutralise the effect produced up to that percentage. Aluminium had previously been tried with steel, and it produced a remarkable effect, but it did not form an alloy; it was all burned out, removing oxygen. Mr. Hogg did form an alloy. More time and experiment were needed. He suggested that some of the large surplus funds of the institution should be devoted to the purpose. Indeed, he did not think the money they had could be more usefully employed than in carrying out experiments. Mr. Perry Nursey supported this suggestion.

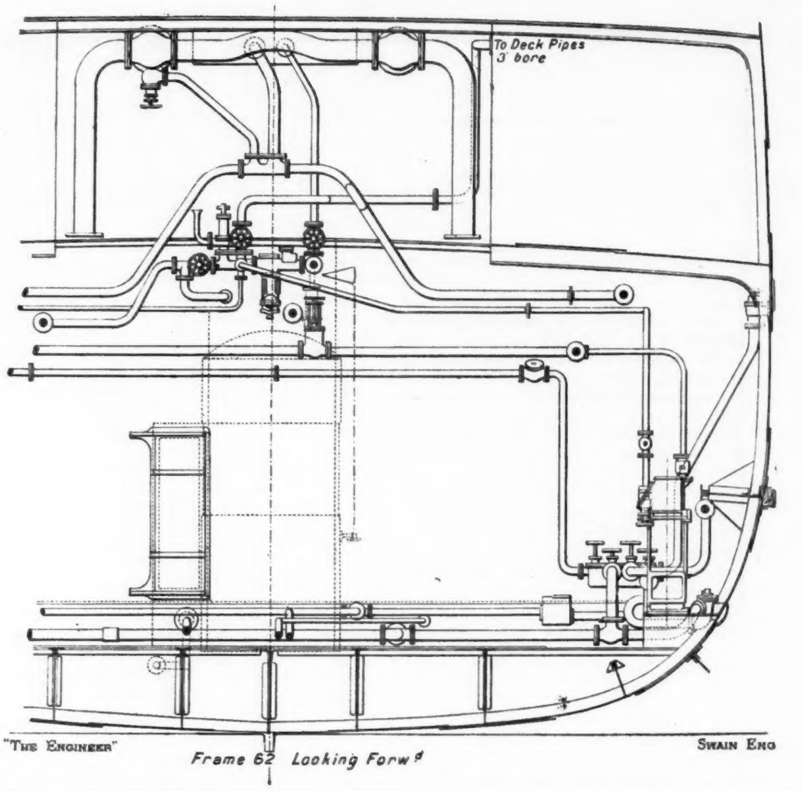
Professor Howe said that under certain conditions aluminium did no doubt favour the separation of graphite, and it was used on a commercial scale in the United States on certain classes of castings for that purpose. He did not think the result of sudden cooling, considered by Mr. Hogg to be unique, was really so. The idea that sudden cooling reduced segregation was little more, he considered, than a theory. There was no doubt that in some forms of pig iron slow cooling and segregation went together, but that was, so far, exceptional.

Professor Turner referred to the effect produced by silicon, which, used in small quantities, produced an effect which was diminished by further additions. He cited Holgate's very complete series of analyses, and was surprised that Mr. Hogg had not mentioned them. Manganese tended to make certain common irons with a strong tendency to whiteness and chilling grey. Some years ago there was used in Birmingham and the district a powder which, when put into a cupola, greatly improved the castings. The composition of this "physic" did not long remain a secret. It turned out to be nothing but ferro-manganese in powder.

Mr. Hogg very briefly replied. The graphite, he said, was found in the cavities, not in the mass of the iron. The cavities were filled with it. What Professor Turner had said was interesting but indefinite. The President proposed a vote of thanks both to Mr. Hogg and to Mr. Hadfield, whose valuable paper was taken as read. These were passed unanimously, and the meeting adjourned, proceeding to Antwerp by a special train at 2 p.m.

## S.S. DUKE OF YORK — CONDENSER AND HEATER CONNECTIONS

(*For description see page* 147 *ante*)



## THE BRITISH ASSOCIATION AT OXFORD.

A DISTINCTIVE feature of the recent British Association meeting at Oxford was the unusually good attendance at the more technical of the Sections, showing better education among the temporary members in particular directions. On the first day of the meeting of the Sections, Section A is usually well attended for the first hour, probably because the letter A has precedence over the letter B, but after the first morning Sections A and B are usually pretty severely let alone, and the temporary floating population of the Association gravitates to the Geographical Section and to the Anthropological Section; in the latter a discussion on men and monkeys, or on prehensile babies, or on the phenomena of ticklishness, are sure to draw a full house. At Oxford, not alone were there large attendances throughout at Section A, but the papers therein were so numerous that for the first time in the history of the Section, on some days it was obliged to sit in triplicate—in three divisions at the same time—to get through the work. Nor was this all; every day it began its work either an hour or half an hour earlier than the other Sections, and sometimes sat later than its neighbours. This was to the inconvenience of those members who wanted occasionally to be elsewhere, and on some days the proceedings were so prolonged as to be thoroughly wearisome. The fact is that the title of Section A, "Mathematical and Physical Science," includes too many subjects, and the meetings of the Section have attained unwieldy and unmanageable dimensions; Section A needs breaking up into smaller permanent divisions, so that for the comfort of the members of the Association it shall keep the same hours as its more fortunate brethren. The application of "the closure" to some of the discussions might expedite work; it was frequently desirable at Oxford

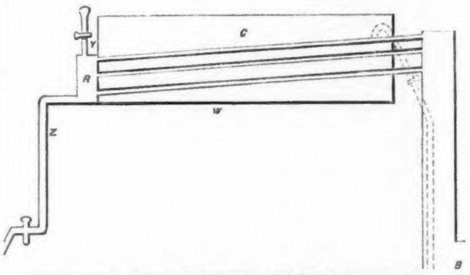
One or more of the London daily newspapers had an announcement of "two" great discoveries made known at the British Association on the same day; the one was the "new gas" in the atmosphere; the other, so it was published, is that the atomic weight of carbon is six, as it was considered to be in the olden time, and not twelve. This announcement originated with a paper read at Section B by Mr. J. A. Wanklyn, in the course of which he said:—"I have now to announce that as the result of most laborious investigation carried on conjointly with my friend and colleague, Mr. Cooper, there exists a multitude of carbon compounds wherein the quantity of carbon in the standard volume is not a multiple of 12, but is a multiple of 6. And the consequence follows that the atomic weight of carbon is 6, as was commonly believed by chemists a third of a century ago. Here is one of these carbon compounds which we have labelled Aa, its formula is $C_{7\frac{1}{2}}H_{15}$, writing the notation in vogue at the present day. We have six other half-carbon substances, viz., $C_{8\frac{1}{2}}H_{17}$; $C_{9\frac{1}{2}}H_{19}$; $C_{10\frac{1}{2}}H_{21}$; $C_{11\frac{1}{2}}H_{23}$; $C_{12\frac{1}{2}}H_{25}$; $C_{13\frac{1}{2}}H_{27}$. The following are the vapour-densities as found and as required by theory:—

| Found. | Theory. |
|---|---|
| 3·69 | 3·63 |
| 4 08 | 4·11 |
| 4·59 | 4 59 |
| 5·02 | 5 08 |
| 5 51 | 5·56 |
| 6 08 | 6 04 |
| 6·53 | 6·52 |

These hydrocarbons exist in the Russian kerosene of commerce, from which they have been extracted by laborious and methodical fractional distillation. Further particulars of the investigation, which has occupied nearly two years, are to be read in the *Philosophical Magazine* for the month of May last, to which reference may be made."

Dr. William Odling, F.R.S., who for so long has disappeared from the Royal Institution and other halls of science in which his face was once so familiar in London, has been for several years, and is now, a Professor at Oxford. In his criticism of the paper, he said:—"In order to arrive at a conclusion of such importance, we must have a great deal more than the boiling point and vapour density. We know that a great number of vapours are mixtures of closely allied bodies, and that the boiling points may be for a long while perfectly invariable, and nevertheless not be the boiling points of one substance, but the boiling point of a mixture of several substances. As I understand, this body in the bottle before us contains of 7½ atoms of carbon, or 15 atoms to the value of 6. If Mr. Wanklyn had from this produced a chloride in which one-fifteenth of hydrogen had been replaced by chlorine, and if from that he had got the alcohol and the aldehyd acid, and so on, and made out the metamorphic relations of these compounds, it would have been very different. But it seems almost preposterous for one to give up such well-established conclusions on such very slender evidence; the evidence must be much stronger in order to convince chemists that the body before us is constituted of 7½ atoms or 15 reduced atoms of carbon."

Messrs. Wanklyn and Cooper used a remarkably ingenious still, of their own invention, in their fractional experiments. Outside it looks like an ordinary still, but it automatically distils liquids in a partial vacuum of its own production, so that low temperatures can be used. Its construction may be explained by the accompanying diagram, in which B is the boiler, and C are three rows of condensing tubes—about a dozen in each row—passing through the tank W. The distillate falls into the receiver R, and conveyed through the pipe Z into a storage tank; Y is an air tube with a stop cock. The inventors say that they find in practice that a great economy of fuel attends the entire arrangement. An important feature of the improved still is that it admits of the easy performance of the distillation at pressures below the ordinary pressure of the atmosphere. If the pipe Z be so prolonged as to furnish a vertical column of liquid 40ft. in perpendicular height, then the distillation may be so managed as to be distillation in approximate vacuum. And if the receiver R be furnished with a suitable pressure gauge or monometer, the distillation may be conducted at any desired degree of reduced pressure by proper manipulation of the two stop cocks in Y and Z. The still creates and maintains its own vacuum. They find that a marked improvement in the quality of the product is obtained by working their improved still at reduced pressures. When heating petroleum liquid, say, for example, "Russian kerosene," the liquid is boiled in the boiler B, and the condenser W is filled with that liquid in a cold condition. The distillate is received in the receiver R, and conveyed through pipe Z into a storage tank, and the liquid employed for cooling is drawn off and replaced.



WANKLYN AND COOPER'S FRACTIONAL STILL

One part of the report of the British Association Committee on "Meteorological Photography," read before Section A by Mr. A. W. Clayden, set forth that—so far as it knew—the only measurements of cloud altitudes which have been systematically organised in this country are those which were begun some years ago at Kew, and it is desirable to have them from other places than near London, for comparison. It has been found easy to obtain well-defined images of clouds, even when the sun is in the centre of the field of view. If, then, two such photographs be taken simultaneously by a pair of cameras some distance apart, there will be a displacement of the image relatively to that of the sun, the amount of which displacement will depend upon various conditions. It will be increased by adding to the focal length of the lens, and by increasing the distance between the cameras. By knowing these values, and the altitude and azimuth of the sun, the distance of the cloud and its altitude above the ground may be calculated. The azimuth and altitude of the sun at the time may be ascertained by calculation, or by direct observation. There seems to be a manifest advantage in thus using the sun as a fixed point of reference, since it provides a means whereby any error in the observation of altitude and azimuth may be effectively checked. The Committee has therefore provided suitable cameras, with lenses of 18in. focus, covering a whole-plate size; the lenses have adjustable shutters which can be simultaneously freed by electrical attachment. At the short distance of 35 yards, they give a displacement of half an inch with clouds 3780ft. distant; this is too small for very accurate measurement, especially with high-level clouds, so it is intended to use them on a plot of level ground by the side of the South-Western Railway near Exeter; this strip of ground is over a quarter of a mile in length, and the cameras can be placed due east and west. This is a different method of measuring the height of clouds to that employed at Kew.

## IMPROVEMENTS AT THE WEST INDIA DOCKS.

The new Blackwall entrance to the West India Docks was formally opened on Thursday, the 16th inst. This well-known dock, the Act for which was passed in 1799, was opened in 1802, and is situated between Limehouse and Blackwall on the Thames, and, as will be seen from the accompanying small map, Fig. 1, by its existence gives the Isle of Dogs an insularity which it never otherwise possessed. It occupies an area of 164 acres, 70 of which are water, and really comprises two docks, which run parallel to each other, viz., the West India Import Dock and the West India Export Dock, each having an entrance to the basin at Limehouse and the basin at Blackwall, and thence from each basin to the river. Adjoining the Import Dock on the north side are eleven warehouses which, with this vast shipping basin, have for many years practically been lying idle, owing to the depth and entrance capacity of the latter being quite insufficient. In March, 1892, the Joint Committee, on the recommendation of Mr. H. W. Williams, the manager, decided, in consequence of the increasing size of vessels, to construct a new and larger entrance at Blackwall, and plans were prepared by Mr. Robert Carr for the construction of a new lock, 480ft. long, 60ft. wide, and 30ft. over the sills. When Messrs. Lucas and Aird, the contractors, commenced to drive the dams for the entrance lock, Mr. Carr was taken ill, and at the end of 1892 was appointed consulting engineer, the actual work of supervision being untertaken by Mr. H. F. Donaldson.

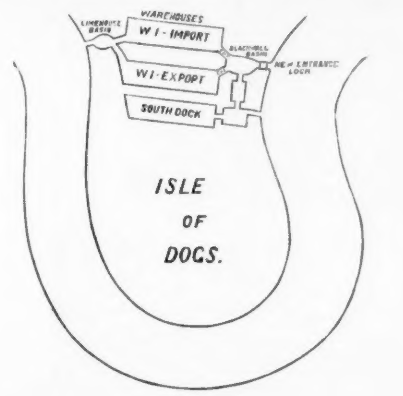


Fig. 1

The new entrance lock opens from the river into the Blackwall basin, and communicates from that basin by means of two new cuts with the Import and Export docks respectively. As at first planned, the cuts were to have been short locks, but the directors decided that they should be open, without gates, the length being insufficient to provide lockage, while, except as a safeguard, locks were considered unnecessary. It was also proposed at the outset that the entrance lock, which is 60ft. wide, should be 450ft. long, but eventually it was resolved that the lock should be 480ft., while the uniform depth of 30ft. over the sills will enable the docks to receive the largest merchant vessels trading to the Port of London. The dock gates, like those at Barry and elsewhere, are opened and closed by means of powerful direct-acting rams, which obviate the difficulty caused by the fouling of the twin screws of steamships when chains are used. Each direct-acting ram, of which there are four, one to each gate, works upon a bridle attached to the heel post, and to a point about two-thirds the length of the gate from the heel post, which has a sufficient amount of play to take up any wear in roller path or heel, or any flotation should such occur from an exceptional high tide. These rams, together with all the hydraulic machinery at the Entrance Lock, have been supplied by Sir W. G. Armstrong, Mitchell, and Co., of Elswick, Newcastle-upon-Tyne. The sluices are ten in number, six being hydraulic direct-acting rams supplied by the same firm, and four hand paddles for use in case of a breakdown. These last were made by the Joint Committee in their own works.

The general design for the lock has not been departed from, except that the effective length has been increased by 50ft., but the Import and Export cuts have practically been entirely remodelled. The original design, with a view to economy, was for the adoption of sheet pile campshedding along one side of each cut, and the removal of the old wall, thus increasing the width to the above-named dimensions. The old wall on the other side was to have been left, and a portion only of the sills removed by divers. In this case the whole of the work would have been done in the wet, without the introduction of dams or excavation, other than the removal of the old wall, which would also have been done by divers. After mature consideration, however, the Joint Committee decided that this should be altered, and the whole of both walls removed from each cut and re-erected upon new lines with two concrete walls of approved section. These walls were designed to do without an invert except under the two railway bridges, where from the jar of the trains it was thought advisable to put in a piece of concrete invert. The widening of these cuts necessitated the lengthening of the railway bridges, which has been carried out by Sir W. Arrol and Company, without interfering with the railway traffic.

It may perhaps be of interest to quote the sizes of the old lock, which were, as to the Blackwall entrance, 191ft. 6in. long, 45ft. wide, and 23ft. 3in. deep, and as to the Import and Export cuts, the former was 162ft. long, by 37ft. 3in. wide by 24ft. 3in. deep, and the latter 160ft. long, by 38ft. wide, by 21ft. 9in. deep. The effective depth is to give an entrance throughout and in the Import Dock for vessels drawing 24ft. to 25ft. of water, which can be increased to 26ft. or 27ft. at pleasure. It must of course not be lost sight of that 18in. of the greater depth will be due to pumping; this pumping machinery, in addition to maintaining the increased level of the water in the dock, makes good the loss of water occasioned by the docking of ships in the neighbouring dry dock. The suction in connection with the pumps is drawn from the river, and the delivery is of a somewhat novel description, on the principle of the domestic bath. We describe it further on. Our plan and elevation—Fig. 2—show the general arrangement of the pumps, with their suction and delivery channels. As already mentioned, everything in the shape of walls, inverts, and so forth, has been carried out by the contractors. The following particulars of the pumping plant constructed by Messrs. Easton, Anderson, and Goolden, may be of interest.

There are four vertical spindle centrifugal pumps, driven directly by horizontal compound condensing engines. The delivery of each pump is 5000 cubic feet per minute, or about 8303·5 tons per hour, on a mean lift of about 7ft., which makes an hourly total for all four pumps of 20,000 cubic feet or 33,214 tons. The pumps will commence two hours previous to high water, and will continue during the two hours of the ebb. The speed of the pumps and engines on the maximum lift. will be 110 revolutions. The fans of the pumps are 74in. diameter, 20in. deep. The special feature in the arrangement of the engines is that the cranks are set opposite each other, the pistons moving in opposite directions, so that the moving parts being approximately the same weight, balance each other. The diameter of the high-pressure cylinder is 15in., that of the low 29in., and the stroke is 16in. The steam and exhaust pipes are so arranged that any one or more of the engines might be worked at a time. An independent horizontal air pump engine is provided, the injection water being taken from the outlet of the culvert from the pumps. The delivery from the pumps passes out of the engine house towards the dock to an 8ft. culvert close to the dock, through which it descends to the bottom of the dock, where a pipe 9ft. in diameter is laid across the bottom of the entrance to the dock, having four vertical outlets with hoods above them which deflect the water, the idea being to distribute it so that it shall not interfere with shipping. At the trial run made at the opening, it was observed that no disturbance was noticeable at the surface of the water. It is also hoped that this arrangement may tend to keep the entrance clear of mud. The steam for the engines at 100 lb. pressure is provided by single flue Cornish boilers 6ft. 6in. diameter, 33ft long, each fitted with eight Galloway tubes and Adamson's rings. The firing is effected by Vicker's mechanical stokers, into the hoppers of which the coal is raised by a Jacob's ladder and screw traverser. The gates have been designed by Sir Alexander M. Rendel, and constructed by the Thames Ironworks and Shipbuilding Company, and are semi-floating and double-skinned, built of iron where exposed to the water, and on steel frames where not so. The heel and mitre posts on the closing sill are of greenheart, and the hollow quoins and stone sill are of granite.

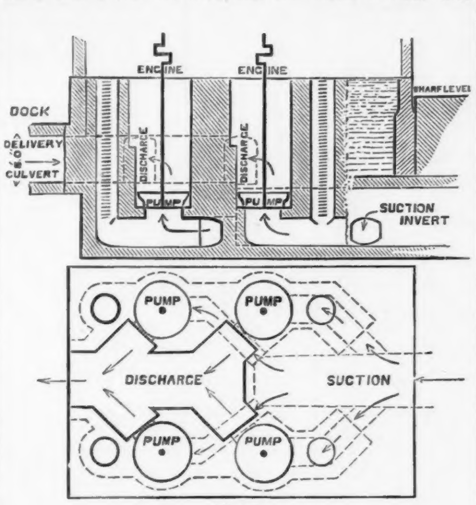


Fig. 2

It being necessary to deepen the Import Dock, a certain amount of dredging has had to be done to give the requisite depth. Before this work was commenced there were two rows of buoys in this dock, the majority of which have now been removed, and a lesser number of screw moorings of the most approved type are in course of being laid down in their place. It was also considered that the North Quay would not provide sufficient facilities for the class of vessels which it is hoped will now frequent this dock, and the extension of the quay for about half a mile of its length has been constructed for the Joint Committee by Mr. John Price, of Great George-street, Westminster. This extension is now being equipped with hydraulic movable cranes by Messrs. Tannett, Walker, and Co., of Leeds. These cranes will each be capable of dealing with 30 cwt., and any heavier lifts will, as in other docks, be dealt with by floating cranes.

It may be of interest to note that the original estimate for the work, viz., £200,000, has not been exceeded, and that the work has been actually completed within both the cost and time specified, notwithstanding that several material and costly additions have since been made to the design. The new entrance will be opened for the docking and undocking of vessels and barges on the 1st September, 1894.

## HARBOURS AND WATERWAYS.

*Harbour accounts.*—The returns of shipping for the past year which have been published show a decided improvement on last year. At Bristol the net amount to be met out of the city rates is £3964, against £18,288 in the previous year. The payments include a considerable sum which has to be paid to a sinking fund for repaying the money borrowed. If this be excluded, and the concern treated as an ordinary joint-stock company, the net revenue would be equal to paying a dividend on the capital of £2,100,000 of 2½ per cent., after allowing 4 per cent. on a proportionate amount of debentures and preference stock. The registered tonnage of vessels entering the port was 780,485, being the highest ever recorded, and an increase of 124,636 tons over the previous year. Including coastwise tonnage the total is 1,541,713. The increase is due chiefly to the expansion of the grain trade, the imports reaching 3,485,365 quarters, or more than a million greater than in the previous year. The import of petroleum also increased from 39,771 tons in 1893 to 42,141 tons last year. The imports of timber have increased, but provisions have decreased. On the Mersey there has been an increase during the past year of 40,231 tons, but this is 27,000 tons less than in 1892. The amount of tonnage on which rates have been paid during the year has been 9,960,902 tons, against 9,468,539 tons last year, and 9,968,697 tons in 1892. The coastwise tonnage constitutes about 28 per cent. of the whole trade. Coasting sailing vessels have fallen off 67,678 tons, but steamers have increased 22,620 tons. As at Bristol, the revenue depends largely on the import trade. The recent want of development in the shipping trade at Liverpool is accounted for by the greater facilities given on the Clyde and in the Thames and the Humber. It is estimated that the population for the district for which Liverpool is a distributing centre ten years ago was nine millions, about the same as that round London, but while the population round both centres has increased about one and a-half millions, the tonnage of the port of London has risen to 12,860,109, while that of Liverpool has only reached 10,600,076 tons. The recent report of the Chamber of Commerce of Liverpool seems to indicate that high charges, want of facilities for handling and transporting goods, and high railway rates, as compared with other ports, are the causes which are checking the growth of the trade of the docks. At Dundee there has been a falling off of revenue of £4630. This is accounted for principally by a diminished import of jute. On the Tyne, at the Commissioners' docks, for the first half of this year there has been an increase of ninety-two vessels, of 109,000 tons, in the vessels loaded and despatched, but a decrease of 8700 tons in the merchandise handled, and an increase of 149,800 tons in coal and coke. Owing to the erection of the new staiths at Dunston, the increase in the traffic in the upper part of the river has been very large. The Commissioners have given instructions for the dredging above Newcastle to be proceeded with as rapidly as possible.

*Aberdeen.*—A report has lately been made to the Harbour Authority as to the removal of the rock which constitutes the bed of part of the navigation channel, in order to obtain a depth of 30ft. at high water or spring tides, or 18ft. at low water. This rocky shoal extends continuously along the south side of the channel for a length of 1600ft., continuing westward for 300ft. in irregular detached masses. It consists principally of mica schist and gneiss. The surface is very irregular, being interspersed with cavities filled with clay. The total quantity of rock to be removed is estimated at 52,000 cubic yards. One hundred and thirty-five trial borings have been made, of which eighty-six were blasted, at a cost of £447, or £4 9s. 4d. per hole, the quantity of rock disturbed by blasting being 3½ cubic yards per hole. The estimated cost for blasting and dredging the rock with a single drill was 30s. per cubic yard. The rock drill used was suspended from the gantry of one of the hoppers, and was lifted at the rate of sixty strokes a minute by a steam winch.

*Leith.*—After the works for the construction of the new dock sea wall had been in progress for some time they were stopped, owing to the death of the managing partner in the firm of contractors who had undertaken the contract. The work was subsequently given to Mr. John Best, who has since been engaged in carrying it out. The amount to be paid to the representatives of the retiring contractors was left to be settled by Sir A. Rendel, the engineer of the Commissioners, and he has awarded that the sum of £8000 is due from the Commissioners to the late contractor for work done and plant on the ground. Messrs. Kinnear, Moodie, and Co. will lose several thousand pounds from this unfortunate stoppage and transfer of their contract.

*The Clyde.*—A commencement has been made with the new graving dock at Cessnock. It is to be 800ft. long, and will open into the new dock.

*Portsmouth.*—Mr. Kinniple has made a report to the Corporation on the proposed improvement of the Camber. The full scheme suggested is estimated to cost £70,000. It is now only proposed to dredge a channel 50ft. wide, and to widen the Camber so as to provide an increased water area of 2900 square yards, and also an improvement in the berthing accommodation available for large vessels at all states of the tide. The estimated cost of this work is £30,000.

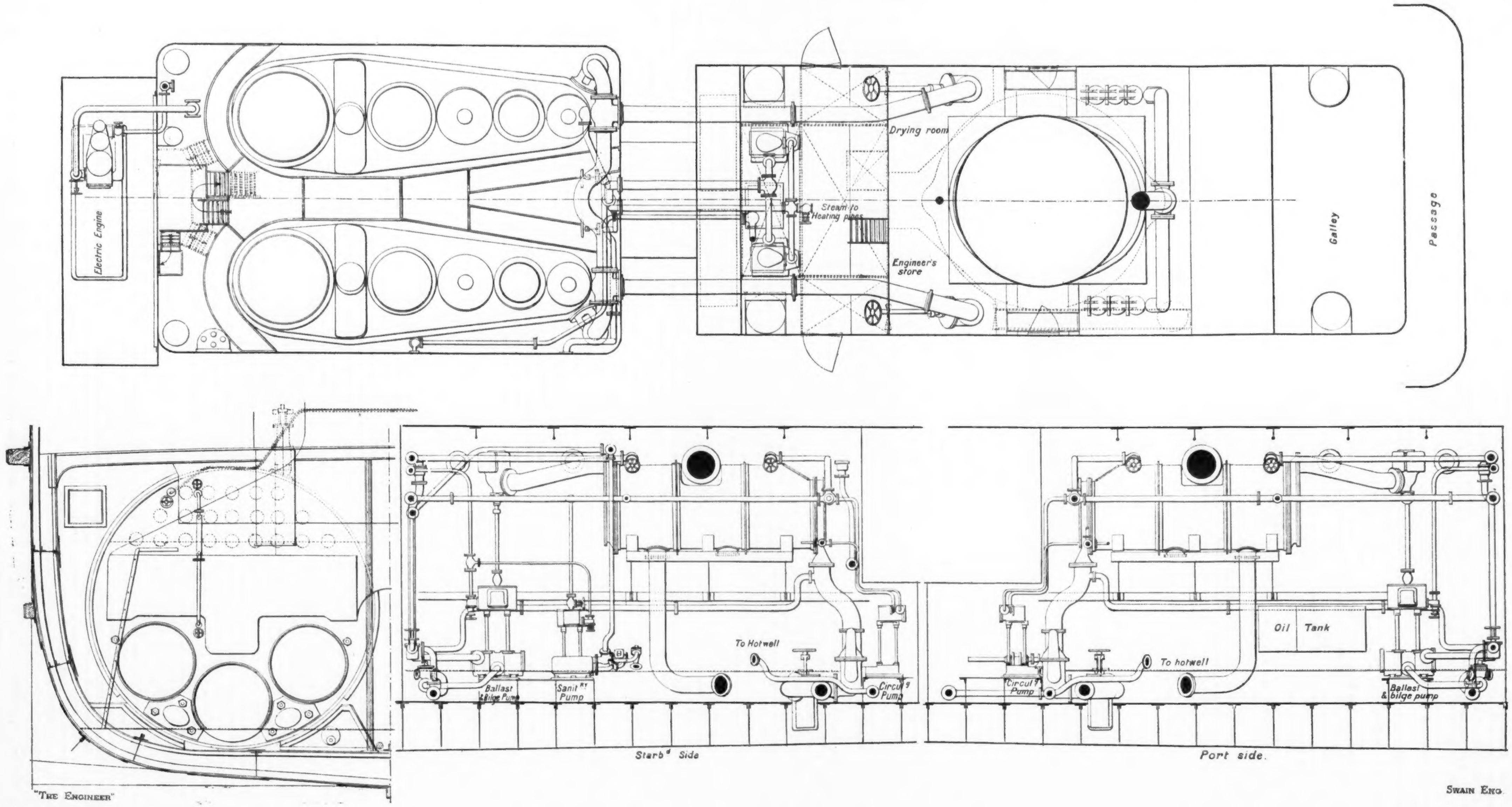
*Workington.*—Negotiations have been going on for some time past between the Town Council and Lord Lonsdale as to the purchase of the dock at this port, which is his property. A report has now been obtained from Mr. Meik, C.E., as to the value of this dock and the cost of construction of a new dock. Mr. Meik puts the value of the existing dock at £75,066, and the cost of enlarging and making necessary alterations to bring it up to the requirements of the port at £149,000, a total of £224,066. The cost of converting the harbour into a dock and buying up Lord Lonsdale's interest he estimates at £279,706. The course Mr. Meik advises as giving the greatest advantage is the construction of an entirely new dock, the cost of which, with parliamentary and other expenses, is estimated at £214,282. The proposed dock would be 630ft. long by 500ft. wide, and to accommodate vessels 320ft. long, 40ft. beam, and 22ft. draught, capable of carrying 4000 tons.

*Copenhagen.*—It is expected that the new free port will be opened in the course of this year, or about twelve months before the opening of the North Sea and Baltic Canal. It is not intended that this new port shall be exempted from harbour and dock dues, but from customs duties. The new free port, with a certain amount of adjoining territory, will be totally exempted from all customs examination and control, and also from all customs duties, it being intended solely for the transit trade. Copenhagen has steamship communication with all the Baltic ports, with West Sweden and Norway, and with the most important European harbours, and with North America. Foreign steamers, of a total burden of 745,200 tons register, discharge at Copenhagen, a considerable part of their cargoes being passed on to the Baltic ports. The idea of establishing a free port for this transit trade is of long standing, but the construction of the North Sea and Baltic Canal, and the danger to Denmark from the threatened competition of Hamburg when the canal is opened, finally decided the Danish Government to undertake the works for the construction of the port, which will now soon be opened. The site of the new Free Port is to the north of the old harbour, and it has been constructed on land reclaimed from the sea. The water area is about 57 acres, and about 95 acres are included in the free territory. There are two basins, one 1300ft. long by 620ft. wide, with a depth of 24ft.; the other is

# THE TWIN-SCREW STEAMSHIP DUKE OF YORK

MESSRS. DENNY BROTHERS, DUMBARTON, ENGINEERS AND SHIPBUILDERS

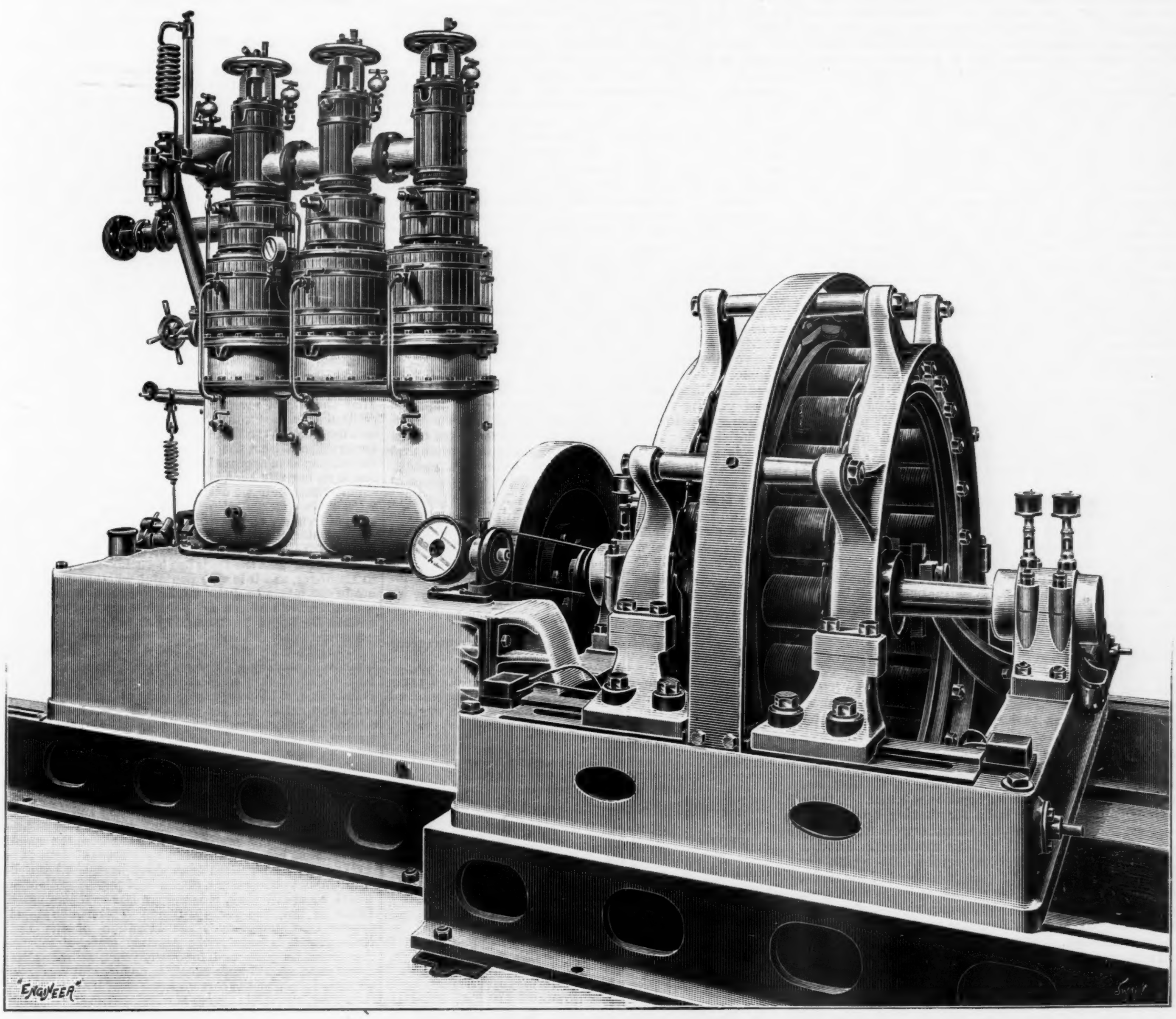
(*For description see page 147 ante*)


Drying room
Steam to Heating pipes
Engineer's store
Galley
Passage
Electric Engine
Ballast & bilge Pump
Sanit.ry Pump
To Hotwell
Circul.g Pump
Starb.d Side
Oil Tank
To hotwell
Circul.g Pump
Ballast & bilge pump
Port side.
"THE ENGINEER"
SWAIN ENG.

PLAN OF ENGINES, AND ARRANGEMENT OF CONDENSERS AND BOILERS

# BRISTOL ELECTRIC LIGHT STATION—ENGINES AND ALTERNATOR

MESSRS. WILLANS AND ROBINSON AND MESSRS. SIEMENS BROS. LONDON, ENGINEERS



divided into two, one branch being 980ft. long by 460ft. wide, and the other 2650ft. by 800ft., with a depth of 30ft. A breakwater is built outside the entrance to protect it from the north and east. The quays will be accessible for ocean steamers drawing over 30ft. As there is no tide in the Sound, and only rarely for a short time ice enough to block the navigation, the harbour will be accessible at any time. The great advantage claimed for Copenhagen as a port and distributing centre is this accessibility at all times. Hamburg is about seventy miles from the mouth of the Elbe, and Bremen, fifty-six miles from the mouth of the Weser. These rivers are only navigable for large vessels during tide time, and in winter are often closed for long periods by ice. The Sound, through which access to Copenhagen is obtained, has only been closed for any considerable period during two winters. From 1881 to 1888 it was open all the winter through, and from 1889 to 1891 was only closed by ice for ten days. In spite of the increased traffic, the stranding and wreck of vessels in Danish waters round the Scaw and through the Sound is decreasing. This is due to better lighting and more efficient pilotage. Still the number of wrecks is very large. Out of the 30,000 vessels which annually pass through the Sound, 210 are stranded, in addition to which nearly 200 vessels are lost at the entrance to the Elbe and the Weser and in the adjacent seas. These accidents generally occur to vessels without pilots. The German authorities claim that the decrease in distance for vessels trading to German ports, and passing through the English Channel, or from any port between Dover and the island of Bornhalm, and using the new Baltic Canal instead of the Scaw route, will be 200 miles. This, at a speed of ten miles an hour, shows a saving of twenty hours. From this, however, has to be deducted about ten hours, caused by the reduced speed at which the vessel will have to pass through the canal. From the ports on the east coast of England north of the Humber, from which a considerable part of the coal for the Baltic is exported, the saving in distance will be very little, while from the Scotch ports the distance by the Scaw will be less than that by the canal. A pamphlet has recently been issued by Mr. C. K. Hausen, of Copenhagen, in which is fully set out the advantages of the port of Copenhagen, as compared with the German free ports, when the North Sea and Baltic Canal is opened, in which he contends that, considering that the charges at Copenhagen will be lower than those of Hamburg; that any saving in distance by the canal to the southern ports of this country, or to transatlantic ports, will be absorbed by the slower rate at which steamers will have to navigate the canal, as compared with the Sound; and that any small saving in time will be more than compensated by the payment of the canal dues; that the access to Copenhagen is at all times safer and less obstructed by ice, and that the draught of water is much greater than to either Hamburg or Bremen; the free port of Copenhagen will be a much more advantageous distributing centre for the transit of goods to the Baltic ports than those to which the new canal will give access.

*Canals.*—In compliance with a memorial from the traders on the Royal Canal of Ireland, the Board of Trade have sent General Hutchinson to hold an inquiry at Dublin, and to make an inspection of the waterway. The matters complained about by the traders are, that the canal is so choked with weeds and mud that the draught of the canal is reduced in summer from 4ft. 6in. to 2ft. 8in.; that the tow-paths are out of order, and dangerous for the horses; that the lay byes and wharfage accommodation have been allowed to deteriorate; and that the accommodation in the Spencer Dock is quite inadequate. At the inquiry at Dublin evidence was given in support of these allegations, and afterwards the inspector proceeded to view the canal.

*American canals.* — The completion of the Manchester Ship Canal has given a stimulus to similar enterprises which have been before the public for some time past in America. Thus both Washington and Baltimore have schemes for connecting those cities by means of a ship canal with New York. It is said that previous to the opening of the Erie Canal, Philadelphia was the first city in the States, and that her commercial supremacy was lost when that great waterway was opened. Since then she has fallen to the third place, and if the proposed canal connecting Baltimore with New York should ever be carried out, Philadelphia would only take the fourth place. At present large steamers take three tides to get out of the long and tortuous river leading from Philadelphia to the sea. It is therefore proposed to construct a ship canal 44 miles long, 11 miles of which would be through the existing Delaware and Raritan Canal, which would have to be enlarged. The proposed width is 90ft. bottom and 150ft. top, with a depth of 20ft., the summit level being 50ft. above the sea. The exit from the canal at the New York end would be near Sandy Hook. The cutting would be principally through low alluvial soil. There would require to be two tidal locks and four lift locks. The estimated cost is about three million pounds. The other scheme is for a canal across the peninsula intervening between the Chesapeake and Delaware Bays, doing away with the present detour of 200 miles round by the capes, and saving from 175 to 200 miles in distance. It is not intended to follow the Chesapeake and Delaware Canal, as it is considered that the relief to the port of Baltimore would be small. Seven different lines of direction have been surveyed for the proposed canal, the distances varying from 106 to 149 miles, the actual cutting varying from 14 to 53 miles, and the estimated cost from about two to ten millions of pounds. Three to five locks would be required. There is also a projected scheme for uniting the Hudson River with the Great Lakes, by a waterway of a size suitable for large vessels, towards which a vote of £10,000 has been granted for the necessary surveys.

## BRISTOL ELECTRIC LIGHT WORKS.

In The Engineer of the 25th of May last we published an account of the Bristol Electric Light Works, with which were given a number of engravings from the working drawings of the station. We now publish above and on page 172 a general view from a photograph of the engine and dynamo-room, and a separate view of one engine and alternator. For a description of the plant now illustrated, we may refer to page 435 of our impression of the 25th May last.

The Federated Institution of Mining Engineers.—The annual general meeting of the members of the Federated Institution of Mining Engineers will be held in Newcastle-upon-Tyne on Wednesday, September 5th, at 12 noon, in the Wood Memorial Hall of the North of England Institute of Mining and Mechanical Engineers, Newcastle-upon-Tyne. Arrangements have been made for visits to collieries on September 6th. The following papers will be read, or taken as read:—"The Stetefeldt Furnace," by Mr. C. A. Stetefeldt; "Walling and Sinking simultaneously with the Galloway Scaffold," by Mr. John Morison; "Timber Bridges and Viaducts," by Mr. Morgan W. Davies; "Explosions in Nova Scotian Coal Mines," by Mr. Edwin Gilpin, jun.; "The Shaw Gas Tester for Detecting the Presence and Percentages of Fire-Damp and Choke-Damp in Coal Mines, &c.," by Mr. Joseph R. Wilson. The following papers, which have been printed in the "Transactions" of the Institute, will be open for discussion:—"Geology of the West Yorkshire Coalfield," by Professor Lupton; "The Transmission of Power by Compressed Air," by Professor Goodman; "The Baum Coal-Washing Machinery," by Mr. F. Baum; "Notes on Coal-Getting by Machinery," by Mr. T. H. Wordsworth; "Photography in Coal Mines," by Mr. H. W. Hughes; "The Coalfields of Sonora, Mexico," by Mr. James Overend; "The Oil Shale Industry of France," by Mr. G. Chesneau; "Spontaneous Combustion in Mines," by Mr. W. S. Gresley; "The Friction of, or the Resistance to, Air-Currents in Mines: Addenda," by Mr. D Murgue.

## BELGIAN MACHINERY AT ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

Messrs. J. Jaspar and Co., of Liége, have one of the most varied sets of exhibits in the Machinery Hall. In the railway material class they show two instruments, to which they give the names of "Dromoscope" and "Dromopétard." The first of these is an apparatus for measuring the speed of trains, and is intended principally to act as a check on drivers, and to prevent them going too quickly at certain parts of the line. It consists of a standard carrying a dial, on either side of which hangs a weight. Fifty yards before the locomotive reaches the instrument the front wheel presses down a lever, connected with the dromoscope by a wire, and thus releases a finger on the dial, which is caused to turn by one of the weights. When the same wheel is level with the instrument it depresses a second lever, which releases the weight on the opposite side of the standard and stops the pointer on the dial. The apparatus is so regulated that the pointer makes one complete revolution when the train is travelling the desired speed. If this speed be exceeded, the dial is so marked that the finger points to the velocity in miles—or kilometres—per hour at which the train passed over the fifty yards between the two levers. This apparatus might be useful in England, but it is hardly possible to conceive a train travelling too quickly on Belgian lines, excepting where there are crossings or points; and in this case the arrangement of wires would have to be modified, and made more complicated. The dromopétard is an appliance intended to give drivers warning of excessive speed. When the velocity is normal, a fog-signal is placed in position to be detonated by the engine; but when it is too great, the wheel, in pressing down a lever, causes a pendulum to swing and draws back the signal out of the way.

At their principal stand, besides a large assortment of perforated plates, steel, iron, brass, copper, and zinc, with every variety of perforation, they show several dynamos and arc lamps. They also exhibit a working model, which they have made for the University of Liége, of a 2000-ton hydraulic press at Messrs. Cockerill's works. It is one-eighth of the natural size, and beautifully executed. But their most interesting exhibit is a Boulengé chronograph, for measuring the velocity of rifle bullets.

Several Belgian firms have very good exhibits of machine tools. Amongst the largest exhibitors of these are Messrs. Ant. Fétu-Defize and Co., of Liége. Their newest tool is a planing machine, for cutting the teeth of bevel wheels. It has two cutters—one for the shoulder and the other for the root of the tooth. Another is a very solidly constructed double boring machine intended chiefly for boring the two ends of locomotive connecting-rods at the same time. They also show a circular saw for metal, a band saw with automatic movement of table in both directions, a large lathe for turning up a pair of wheels, several other lathes, a hydraulic press for railway wagon wheels, and several milling machines. Another exhibit is a grindstone dressing machine, in which the tool travels backwards and forwards in front of the stone. A steam hammer which they exhibit is suspended from steel springs, like carriage springs, by means of leather straps passing through the hammer head. This hammer has a leather brake, at the end of which is a wheel. This wheel acts as a counterbalance, and at the same time the driving strap passes over it, so that by tightening it the blows are made heavier. Messrs. Fétu-Defize also exhibit some Otto gas engines, in which the governor differs from the Otto engines by other manufacturers. It is an ovaloid disc, with balls underneath, and working in a pan. A small brass model of their gas engine runs at 350 revolutions a minute.

Messrs. J. and M. Demoor, of Brussels, show some large milling machines. One of these, vertical, with automatic table, will work 26in. by 12in. and 19in. deep. Another has two cutters, which can either be 10ft. apart or can approach to within 26in. of one another. This tool has two circular tables, which have independent automatic movements in all directions. A horizontal double miller for plummer blocks, &c., has a table which, besides the usual movements, can be made to oscillate. Another horizontal miller will take 28in. wide by 16in. high, for a length of 7ft. 6in. A boring lathe, 26in. above the bed, has ball bearings throughout. The table has all the movements, including the circular, either automatic or by hand.

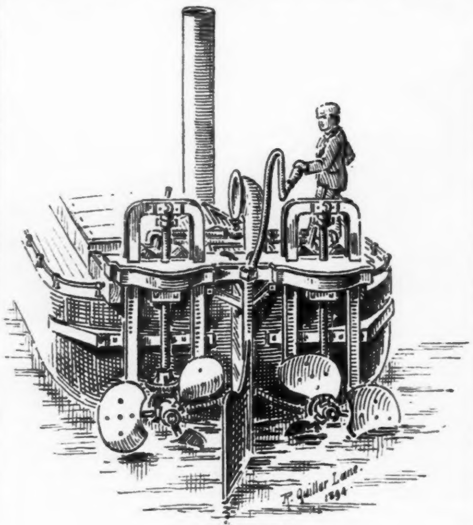
Another lathe which also has ball bearings is a turret lathe, which will turn up to 2ft. diameter by 5ft long.

One of Messrs. Demoor's specialities is their screw-cutting and bolt-making tools. For screw threads, instead of the usual dies, straight cutters are employed. An ordinary stock, for screwing by hand, is replaced by a circular tool-holder with three cutters. Each of these cutters has several grooves, and when once set, they cut the thread at one operation. Larger machines, driven by hand or power, and cutting up to any diameter of screw, are on the same principle. In one which is exhibited with five fixed cutters, there is an automatic stop. This stops the machine directly the bolt head reaches the tool-holder. Whatever the size or shape of the thread, it is cut to its full depth at the first stroke. The other bolt-making tools are intended for producing machine-made bolts when it is required that heads, nuts, &c., should be absolutely identical in shape. In these, one machine turns the bolt to the exact diameter required; or, if necessary, different parts to different diameters, faces the underside of head and the point of the bolt; another machine shapes the sides of the bolt heads and nuts, automatically bringing them to an exact gauge; whilst a third faces the nuts and the tops of the bolt heads. A 40in. circular saw for hot iron, and a band saw, like that shown by Messrs. Fétu-Defize, also form part of this exhibit.

The most interesting appliance shown by Messrs. Demoor is a 25-ton testing machine, the invention of M. Delaloe, of Paris. It can be used for testing tension, compression, or torsion; and as the pressure employed is registered in three separate and independent manners, the probability of accuracy is greatly increased, since the three can be compared continually throughout the trial. The machine, which occupies a space of 7ft. 4½in. by 2ft. 3½in., stands on a cast and wrought iron frame. It consists chiefly of two cylinders, with which are connected the jaws holding the piece to be tested, and a pump or compressor to force the liquid which is used—generally oil—into the front cylinder. This pump is driven by a screw connected with two hand wheels. The smaller of these, which works direct, serves to start the pump, or for returning the compressor after a test. The larger one, which drives the screw of the pump by means of a worm-wheel and pinion, is intended to be used when greater force is needed. Either of these hand wheels can be put into gear as required. On the side of the machine is a steelyard with a sliding weight. This is attached to the piston of the back cylinder, with which, as mentioned above, the jaws holding the piece to be tested are connected; so that, by sliding the weight, the strain may be read on the steelyard. The cylinder is filled with an incompressible liquid, and in communication with it is a pressure guage. As the guage has been graduated from the steelyard, it is not necessary to allow for friction, &c., or to consider them as possible causes of error. The third method of recording the stress is by means of an apparatus similar to a Richards steam-engine indicator. The piston of this is also in connection with the back cylinder, so that it rises with the stress; whilst a cord passing round the barrel carrying the paper is fastened to a point on the piece to be tested, at a determined distance, In testing, the pencil first makes a line which is almost vertical, as the prolongation is at first very slight; but at the elastic limit there is a sudden bend, and the curve gradually flattens, till the point of rupture is reached. The maximum needle on the pressure gauge, and the weight on the steelyard, each show the breaking strain; but the diagram shows how the prolongation has varied with the stress throughout the whole test, and especially at what stress the elastic limit was reached. With slight modifications, the procedure for compression or torsion is the same as when testing for tension.

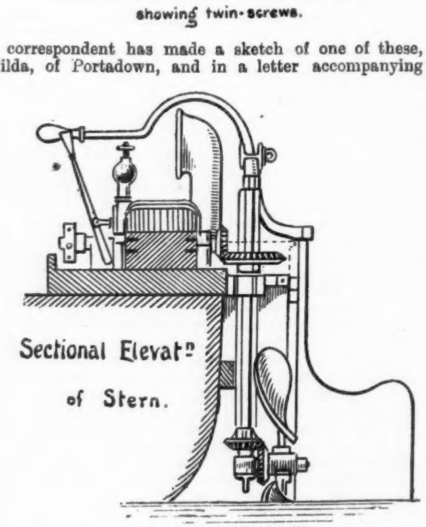
## TWIN-SCREW PROPELLERS WITH ADJUSTABLE IMMERSION.

Under this title we published, on the 10th inst., a paper by Mr. Barcroft giving the results of trials of barges fitted with these screws and driven in some cases by oil engines.



Stern view of "Hilda" of Portadown, showing twin-screws.

A correspondent has made a sketch of one of these, the Hilda, of Portadown, and in a letter accompanying the sketch, which we here reproduce, he says:—"Each screw is driven by a separate engine—a Vosper two-cylinder engine—placed as shown, and driving the vertical shaft by means of bevel gear. The propeller is driven by a pair of mitre wheels, the screw revolving freely on the short horizontal stud shaft fixed to the footstep, as shown in the section, which is not to scale, however. The rest explains itself, I think. The barge is shown 'light,' and the screws very little immersed. When she was loaded the water would, I think, cover the bosses, but probably no more. The man in charge seemed to have her under complete control, and steered by simply making one screw revolve much faster than the other."



## GERMAN STEAM SHIPPING IN SOUTH BRAZIL.

The British Consul at Rio Grande Do Sul, in a recent report on the trade of that State, observes:—"The continued steamship competition by German lines has had disastrous results to British steam shipping to the ports of Porto Alegre, Rio Grande Do Sul, and the South of Brazil, the Germans having succeeded in getting the bulk of the carrying trade of this State—previously British—and the only trade of importance the former had not got into their own hands. The steam trade with South Brazil is one of growing importance, and one which might have been surely held with the same determination and energy, such as was shown by the German companies when they found that British shipowners were apathetic and careless; but, judging by what has occurred here, it looks as if British energy, enterprise, and foresight, were things of the past.

"When the recent revolution compelled the entire Brazilian merchant fleet to remain idle in port, it was felt certain that this coast would in a few weeks be served by a mass of steamers under the British flag, and that they would find an opening into Brazilian trade which would last long after peace had been restored, but this has not been the case. One British steamer came out in competition in 1892, and though a financial success, was not followed by others. After the recent revolution, beyond the entrance into competition of a very mild nature with the German steamers now carrying on the Brazilian coasting trade, of four British steam lighters from the River Plate, no steamers under the British flag have appeared, and although one of an influential line is on her way here, she has been so badly supported by shippers that no more of the same line are likely to follow.

"The two German lines have combined as to agents and rates of freights, and have sent out here four huge lighters, each capable of carrying 600 tons of cargo, and a powerful steam tug to tow them on the lake to and from Porto Alegre. The result is that the trade has been diverted from Liverpool to Hamburg, and it is very doubtful whether that port will not in the future hold the entire Southern Brazilian steam traffic. The decrease in British shipping entering Rio Grande Do Sul in 1893 was 17,199 tons, or 33·82 per cent. under the entry of 1892.

"German trade with Porto Alegre is increasing and British trade is diminishing to some extent, owing to the better facilities afforded by the German steamship companies from Hamburg, and the lower freights by sailing vessels from the same port, which are generally much less than those from Liverpool, ruling from £1 7s. 6d. to £1 15s. per ton for the former, as against £1 15s. to £2 5s. per ton, and 10 per cent. primage, together with an additional 6 to 7 per cent. on these amounts, cost of lighterage, &c., for the latter.

"The trade in wrought iron, and to a great extent in steel, has been diverted from England to Germany in consequence of this. The machinery for a large cotton and wool mill here was recently all got from Germany, though this is probably mainly due to the foreman, by whose advice the machinery was selected, being a German.

"It is to be regretted that there have not been British shipowners to carry out a determined policy, and although it would be uphill work, it is not too late to regain much that has been lost, and perhaps more. This can be stated with greater confidence, since the intention of the Brazilian Government to restrict the coasting trade to the national flag must be postponed for many years, and the Brazilian merchant fleet will have much to do before it can regain the position it held at the commencement of 1893."

Railways in China.—Last summer the railway from Tientsin was carried to a point just inside the Great Wall, and trains now run so far. The engineers are occupied with the section, 100 miles long, between the Great Wall and Chin-chou Fu, an important city on the coast, some distance to the west of Newchwang. This is the most difficult portion of the whole line, and will require two years to complete. As soon as it is finished an extension will be made from Chin-chou to some place near Moukden, and simultaneously a branch line will be constructed between the Moukden neighbourhood and the port of Newchwang. After the completion of these, the next step will be to take the line on from Moukden to Kirin *viâ* Kuanchengtzu, the most important inland market in Manchuria. The annual sum devoted by the Imperial Government to the construction of the line is £400,000. There is a considerable population in the three provinces together, 20,000,000 on a very moderate computation—and many more are ready to join them from Shantung, just across the gulf. The railway will thus not merely aid in bringing down produce, but will carry settlers to the lands where they are wanted."

Performances of White Star Steamers.—The White Star Line steamer Britannic, on her last homeward trip, leaving New York at 7.8 a.m.—12.8 p.m. Greenwhich mean time—on Wednesday, the 1st August, arrived at Queenstown at 9.56 p.m. on Wednesday, the 8th inst., thus occupying 7 days 9 hours 48 minutes on the passage. The Britannic has excelled this on three or four occasions during the twenty years of her running, but having regard to the length of time she has been at work, it is certainly remarkable enough to call for special notice. This was her 207th round voyage. In September, 1890, the Britannic crossed from New York to Queenstown in 7 days 6 hours 55 minutes, and the striking uniformity of her daily runs in both instances is shown by the following comparison of her logs:—

| | | 1890. | | | 1894. |
|---|---|---|---|---|---|
| August | 28 | 292 | August | 1 | 75 |
| ,, | 29 | 372 | ,, | 2 | 364 |
| ,, | 30 | 377 | ,, | 3 | 375 |
| ,, | 31 | 370 | ,, | 4 | 367 |
| Sept. | 1 | 376 | ,, | 5 | 370 |
| ,, | 2 | 377 | ,, | 6 | 370 |
| ,, | 3 | 387 | ,, | 7 | 370 |
| | | | ,, | 8 | 371 |
| ,, | | 261* | ,, | — | 145* |
| Knots | | 2812 | Knots | | 2807 |

*To Queenstown.

| | D. | H. | M. | | D. | H. | M. |
|---|---|---|---|---|---|---|---|
| Passage, | 7 | 6 | 55 | Passage, | 7 | 9 | 48 |

The Britannic reached the Mersey on Thursday afternoon week, shortly after two o'clock, and her mail was being delivered in Liverpool at four o'clock the same afternoon. The same company's steamer Teutonic arrived at New York on Sunday morning at 2.30, having performed the passage in 5 days 20 hours. The Majestic also has made an excellent run homewards. She left New York at 2.20 p.m.—7.20 p.m. Greenwich mean time—on Wednesday, the 8th inst., and arrived at Queenstown at 7.16 on Tuesday night, having crossed in 5 days 23 hours 56 minutes.

## RAILWAY MATTERS.

Engineers are already at work making surveys for the railway which is to be constructed between Samarkand and Tashkend.

It is reported that a railway will be constructed by Northern and English capital from Atlanta to South Brunswick, a place possessing capital shipping facilities, about five miles from Brunswick, Charleston.

The Hungarian Minister of Commerce, according to the *Standard*, has granted a concession for the construction of an underground electric railway in Pesth, which will be two English miles in length, and will pass from Giselaplatz to the Thiergarten. It will be the first electric underground railway in Continental Europe. It is to be opened on the 1st of April, 1896.

It is proposed that the new line to be constructed by the South-Eastern Railway Company, co-operating with the London, Chatham, and Dover Railway Company, should commence by a junction with both systems at Maidstone, thence to Headcorn, Tenterden, and Appledore; there would thus be junctions with the South-Eastern Railway, both at Headcorn and Appledore.

Although it is less than eight years since the first cable car line was established in St. Louis, since that time rapid transit by cable and electricity has been generally adopted, and there are now only two horse-car lines in the city, one of which is soon to be changed into an electric line. During 1893 about fifty miles were added to the truck mileage, £1,000,000 spent in reconstruction and improvements, and 95,180,550 passengers carried.

The Paris, Lyons, and Mediterranean Railway Co. is building forty compound locomotives with "cut-water" shaped shields in front of the boiler, the funnel, dome, cab, &c., all being similarly wedge-shaped. We doubt if much more than excessive ugliness is obtained by the design, our own experiments in England having shown that a train with the front and hind vehicles so shaped showed hardly any decreased resistance, the side resistance or friction being the principal cause of loss of effect.

A correspondent, writing from Forfar concerning the West Highland Railway carriages, says:—"I have nothing but praise for the rolling stock, from a passenger's point of view at least, except in the matter of ventilation. The windows of the corridor coaches are fixed immovably in their frames. The ventilators used do work, but the air supplied to them enters above the windows so far above the part of the compartment occupied by passengers that the effect is inappreciable." Differences of opinion are, however, so great, that what our correspondent thinks inappreciable might be quite sufficient for others.

The Russian Government has lately received applications from several large foreign manufacturing firms for permission to build workshops in Russia for the manufacture of rails and locomotives. The applicants urge that, in view of the present extension of the Russian railway system, Russian factories are no longer in a position to supply the demands of the railway companies, who are therefore frequently compelled to place their orders abroad. The *Railway News* says that owing to the customs tariff at present existing in Russia, the companies have to pay much higher prices for foreign than for home material, and it is represented that the establishment of foreign factories in Russia will obviate this drawback.

Mr. Charles Liddell, the eminent railway engineer, died on the 10th inst. in his 82nd year. He was associated with George Stephenson in the construction of the old North Midland line from Derby to Leeds in 1835. His latest work was the Manchester, Sheffield, and Lincolnshire extension to London. He was the chief engineer of that company's Derbyshire lines from Beighton to Heath—constructed by Messrs. Logan and Hemingway—and from Heath to Annesley, constructed by Messrs. Balding and Yerburgh. Mr. Liddell was connected with others in the construction of the Danube and Black Sea Railway, and the Novara and Lake Orta Railway, and he laid the Varna and Balaclava cables during the Crimean War, and some cables in the Levant. Railway construction was, however, his favourite work.

There are twenty railways working in Colorado, with over 5270 miles of line, at a rateable value of £6,400,000 and employing 12,000 workmen. These railways pass through a district presenting many difficulties not met with in other sections of the country, yet accidents are very rare. The total earnings of the Denver and Rio Grande Railway, the largest system in the State, for 1893, were £1,559,876, a decrease of £284,471, or 15·43 per cent. under those of 1892. According to the British Vice-Consul at Denver, although the earnings of the other lines cannot be obtained, it is safe to say that they suffered from the commercial depression in a similar proportion. During the year the Atchison, Topeka and Santa Fé system, working the Midland Railway in Colorado, the Rio Grande Southern Railway, and the Union Pacific Railway, went into the hands of receivers.

In the year 1892 one rail broke for every seventy-five miles of line in the United Kingdom; or, taking England alone, one rail broke for every sixty-two miles of line. The London and North-Western Railway broke one rail for every 75½ miles; the London and South-Western, one for every 31½; the London, Chatham, and Dover, one for every 17½; and the Metropolitan, one for every five miles of line. *Indian Engineering* says that on the Rajputana Railway one rail broke for every 164 miles of line; on the North-Western, one for every 248 miles; on the Eastern Bengal, one for every 126 miles; and on the O. and R. Railway, one for every sixty-nine miles. On the four Indian railways referred to, the breakages amounted to 4·399 iron and 31·41 steel rails; or, 35·809 steel and iron rails per annum, on a length of about 5500 miles. That is, one rail broke on an average per annum on each 153 miles of line. This compares well with the seventy-five miles average of English railways.

The following interesting details in connection with the Great Western Railway Company's Works were given to a party of members of the British Association on recently visiting the establishment at Swindon. The construction of the locomotive works was commenced in 1842. In 1861 were erected rolling mills for the manufacture of iron rails. From 1875 the quantity of iron rails manufactured was gradually diminished, and the last lot was rolled in 1878. Since then the mills have been used for the manufacture of merchant iron, the average turn-out being from 160 to 200 tons per week. The carriage works were commenced in 1868, and have been enlarged from time to time. In 1873-4 new foundries were built and additions made to the locomotive works; and the total area now occupied by works and yards is 208 acres. Upwards of 300 tons of chairs are cast every week for the permanent way. At the time of the change of gauge, in May, 1892, a few hundred wagons were sent to the Bridgwater workshops, and, with that exception, all the broad gauge rolling stock was sent to Swindon to be converted or broken up. In order to receive it, thirteen miles of additional sidings were laid down. There were 195 broad gauge locomotives, and of these 130 had been so constructed that they were readily convertible to narrow gauge. In July, 1892, when the work of conversion was in full progress, the total number of hands employed in the locomotive department was 5758, and in the carriage, wagon, and stores departments 4157, making a total of 9915. Since the completion of this work some reductions have been made, and the numbers in July, 1894, were: Locomotive department, 5388; the other departments, 3972; total, 9360. In addition there are about 300 men employed in the traffic and permanent way departments at Swindon.

## NOTES AND MEMORANDA.

A number of Government surveyors who have been engaged in a survey of Popocatepetl have reached the summit of the volcano, whose altitude they have fixed at 19,643 Spanish feet above the level of the sea. The circumference of the crater is 14,000ft. An elaborate study is being made of the smoking rents and other phenomena of the volcano.

At a recent meeting of the Paris Academy of Sciences a paper was read on "Direct Autographic Record of the Form of Periodic Currents by means of the Electrochemical Method," by M. P. Janet. A battery of fifteen steel styles, connected with fifteen points of the circuit taken, so that the difference of potential between consecutive points was about four volts, gave traces on prepared paper which indicated the characteristics of the discharge through the circuit.

In their report of the composition and quality of the London water supply for the month ending July 31st, William Crookes, F.R.S., and James Dewar, F.R.S., state that in the report for June they recorded an excess of 0·58in. of rain over the average. July, they say, has been a still wetter month, the rainfall having been 3·27in.—an excess of 0·89in. over the twenty-five years' average of 2·38in. No wonder it seemed to be a wet month when we learn that the rainfall was 37 per cent. more than the average.

A basket for melting out lead joints formed of three pieces of old sheet iron is mentioned in the *Engineering Record*. Two of the pieces, one for each end of the basket, are V-shaped, the inner semicircle fitting around the pipe so that the piece acts like a flange about 10in. larger than the pipe. The third piece of iron is 18in. long and bent to fit the ends, a basket being formed in this way having the shape of the casing of a gate valve. A number of inch holes are punched in the bottom for draught, and handles attached to the sides, through which an iron rod is passed over the main to hold the basket in place when in use. It was intended to employ hot coke in burning out the joints, but owing to the small body of fuel and its consequent rapid cooling, this was found unsatisfactory, and dry wood is used.

A boy eats two ounces of ice. Let us see what is the approximately thermodynamic equivalent of the work he has made his interior do, assuming he takes five minutes to eat it. In melting the ice, taking the latent heat of fusion at 143 units, and the specific heat the same for the colouring and sweeting admixture as for the ice, he will require eighteen units to reduce the ice to water. To raise it in temperature to that of his inside, he will require seven more units, or a total of 25 British thermal units. Taking the mechanical equivalent as 777 foot-pounds, this will be equal to 19,425 foot-pounds. If the boy weighs 100 lb., he will have called upon his stomach to do as much heat work as would, with a machine having unit efficiency, raise him 194ft. high, or a rate of heat extraction equal to nearly an eighth of a horse-power.

In a recent number of the *Comptes Rendus* is a contribution to the study of the structure of steel, by M. F. Osmond. With moderately hard steel, containing 0·45 per cent. of carbon and 0·35 per cent. of manganese, the structure was found to vary gradually in samples all originally heated to 825 deg. C., and quenched in water at 15 deg. C. after cooling to 720 deg., 690 deg., 670 deg., 650 deg., and 640 deg. respectively. Hardening from 640 deg. left the structure almost the same as slow cooling. With hard steel, containing 1·24 per cent. carbon, the variation is more rapid; the temperature of maximum hardening lies very near to that of no hardening. The structure, as studied by polished surfaces, in steel of moderate hardness gives information concerning (1) the maximum temperature of heating, (2) the temperature from which it has been hardened, and (8) the rate of cooling.

Some slag cement experiments made by R. W. Mahon, at the Maryland Steel Company's Works near Baltimore, are reported in a recent issue of the *Journal* of the Franklin Institute, and show unusually good results. The limestone used in the blast furnaces of the company is procured near Baltimore, and is of two varieties, one low and the other rich in magnesia, the former being preferable for cement making. The slags were granulated carefully, and ground so as to pass through a 100-mesh sieve. They were then mixed together, the best combinations having less than 30 per cent. of silica and over 47½ per cent. of lime. To get the best results, to such a mixture was added a quarter of its weight of slacked lime. Briquettes made in this way, and allowed to harden for twenty-eight days in air, or one day in air and twenty-seven in water, broke under a tensile strain of from 210 lb. to 375 lb. per square inch, depending upon the conditions of hardening.

The "Interim Report of the Committee appointed to Inquire into the Proximate Constituents of the Various kinds of Coal," British Association, Oxford, August, 1894, shows that this Committee has started its labours. Coal from Hutton Seam, which is bituminous and used as a gas coal, has been used in the following investigations. Heated with ether it yields a yellow solution, with blue fluoresence. Alcohol, benzene, and petroleum ether dissolve but little from it, the solutions being similar to the ethereal solution. On this coal, acetic anhydride and glacial acetic acid have but little effect as solvents; but a solution of sulphur dioxide in glacial acetic acid, when heated at 100 deg. with the coal in a closed pressure flask, becomes dark in colour and—on the addition of water—yields a light yellow precipitate. The precipitate is soluble in ether, and the solution on evaporation leaves an oily residue. Turpentine heated in a pressure flask with the powdered coal, darkens and acquires a greenish-blue fluoresence. Aniline dissolves an amorphous solid from the coal when heated with it; the solid is precipitated from aniline by means of hydrochloric acid. This solid leaves resinous residues from its alcoholic and benzene solutions, is oxidised by dilute potassium permanganate yielding a dark brown solution, containing potassium carbonate and potassium salts of organic acids. The coal itself also reduces permanganate and yields a dark-coloured solution, containing amongst other things oxalic and other acids.

What is called a new branch of metallurgical science has just been opened up in France, which is likely to have an important influence upon the iron and steel industry in that country. This discovery is due to the researches of the Commission which was formed in 1891 by the French Government, with a view of determining upon some more accurate method of testing constructive material than at that moment existed in France, and to the absence of which was attributed—however groundlessly—the failures of important bridge and other works that had become unpleasantly frequent. A report upon the inquiry of the Commission has just been drawn up by MM. L. Baclé and Debray, who set forth results that are considered by them, and by those who thought the Commission necessary, to be of the greatest value to the metallurgical industry. By the aid of a microscope it is said to be found possible to detect molecular changes in metals, that vary according to the constituents of which they are composed. The changes of appearance are of almost infinite variety; and each of these appearances are said to show accurately the presence of certain elements, some of which may be in such small quantities as to be undetected by chemical analysis. For instance, the presence of phosphorus in tin bronze causes a characteristic granular appearance that cannot be confounded with any other constituent, and the smallest quantity of aluminium will produce a distinct change in the metal. The value of this new science of "Metallography"—as it is called—lies particularly in the fact that it will allow of the most delicate alloys being made, and it opens up a very wide field for metallurgical research; but its value in bridge construction seems remote, and does not point the way to design bridges that will stand with insufficient material, nor to avoid the necessity for experience in the proper disposition of material.

## MISCELLANEA.

The Gohna Lake rose 30ft. 2in. last week, and is now within 27ft. of the top of the dam.

Garbage treatment works at New Orleans have recently been started. The garbage is first steamed and then exposed to naphtha vapour, as at the cities of Providence and Cincinnati.

The Greenwich Hospital Pensions of £50 a-year for Chief Engineers, rendered vacant by the deaths of Fleet Engineer W. B. Minhinnick and E. O. Crichton, have been awarded to Fleet Engineers B. F. Pine and C. M. Collins, R.N.

A German tank steamer named the Heligoland recently sailed from Philadelphia to Hamburg, with a cargo of 1,200,000 gallons of naphtha in bulk. This is the first time that naphtha has ever been shipped in bulk across the Atlantic.

The tender of Messrs. John Penn and Sons, engineers, of Greenwich, for the construction of the propelling machinery, &c., of the new first-class battleship Illustrious, shortly to be laid at Chatham Dockyard, has been accepted by the Admiralty.

The first-class battleship Resolution, which has just returned to Sheerness from the naval manœuvres, is docked at Chatham for the purpose of being fitted with bilge-keels. The Royal Sovereign and the Empress of India, the two flagships of the Channel Squadron, are also to be fitted with bilge-keels.

There is a National Association of Master Bakers and Confectioners, but this is apparently not able to cover all the ground, and the London Master Bakers' Protection Society is discussing the project of standard samples of foreign flour, and at the last meeting of the Protection Committee a report was received, from which the following is a passage:—"It was necessary to fix a standard by which they knew they would get the same quality, be it higher or lower, as they were getting to-day, as fixed by the standard to be adopted."

A recent explosion, with a loss of seven lives, at Corfu, is stated to have been caused by a torpedo, which is believed to have escaped from the British Mediterranean Fleet, and to have been picked up and sold to a Jewish marine store dealer. We think this is hardly probable, as torpedoes under no circumstances carry their war-heads during practice. It might possibly have been a mine which had missed fire, but which, if it had been left in this dangerous condition, would point to most exceptional carelessness on the part of the naval officers engaged.

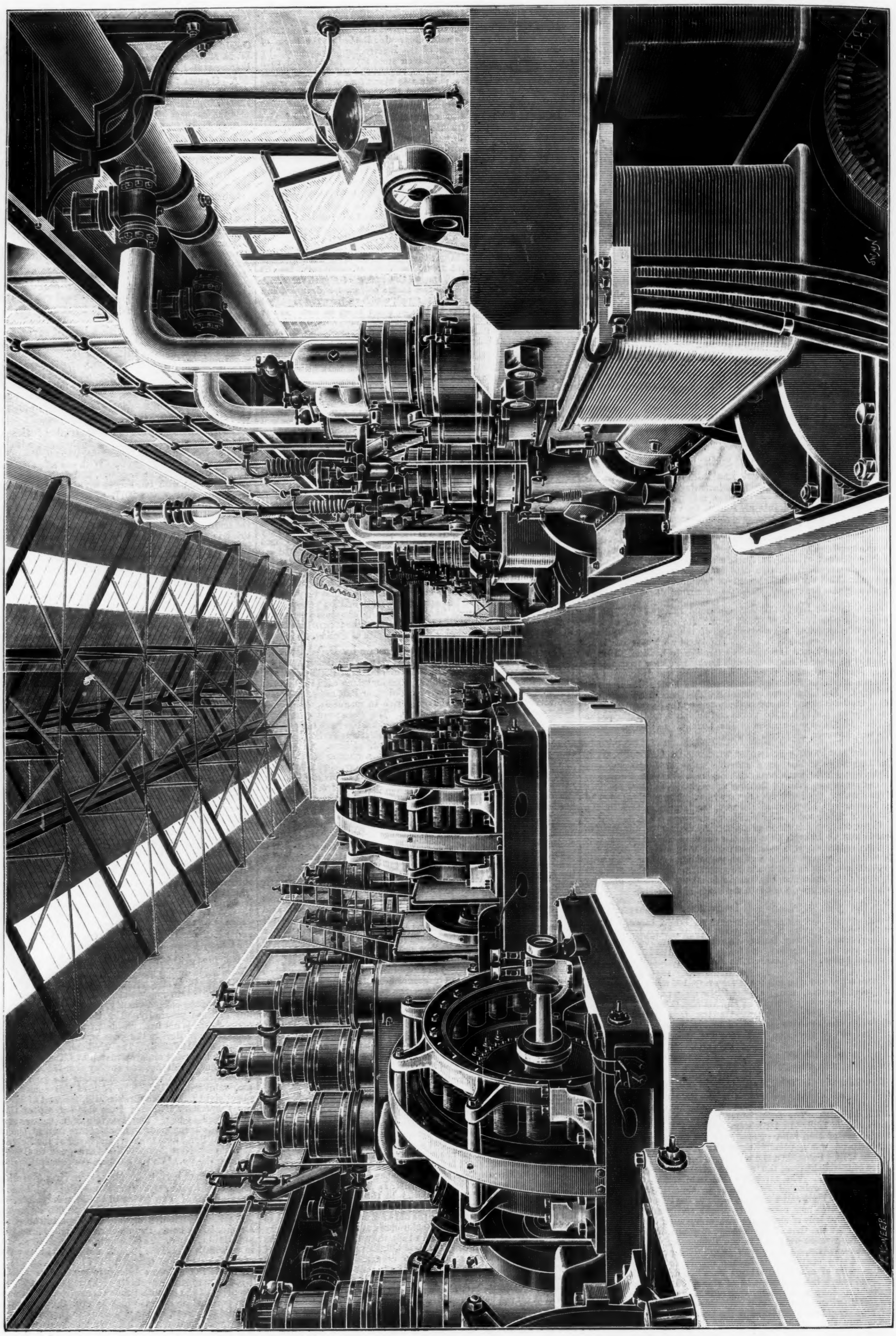
The official report of the trial of the U.S. cruiser Minneapolis gives figures of the trials made with one, two, and three screws. Each trial lasted eight hours, the speed throughout being a little under 10 knots. With one screw it was 9·73 knots, with 1920 indicated horse-power, and a consumption of 4630 lb. of coal per hour; with two screws the speed was 9·71 knots, the indicated horse-power was 2017, with a consumption of 4773 lb. of coal per hour. The third trial, with all the three screws, was made at a speed of 11·6 knots; the indicated horse-power was 2491, and the hourly coal consumption 6411 lb. An interesting point which this trial shows is that while it took something more than 2500 indicated horse-power to obtain 11·6 knots, it took more than eight times this power to give the ship a speed of 23·07 knots, showing thereby the great economy effected in low-speed running.

The East River tunnel built by the East River Gas Company has been completed, having been commenced in 1892. "The tunnel," *Engineering News* says, "is 2516·4ft. long, 8½ft. high by 10ft. wide, runs under Blackwell's Island, and comes out on the New York side at Seventy-first Street. The top of the tunnel under the channel on the New York side at the point of nearest approach to the bottom of the river is 40·93ft. below the river bottom; while under the channel on the Brooklyn side, the nearest approach of the top of the tunnel to the river bed is 82·33ft. The depth of water in the channel on the New York side is 65ft., and in the channel on the Brooklyn side is 30ft. The shafts are each 9 ft. square, the one on the New York shore being 135ft. deep, and that at Ravenswood being 147ft. deep. The tunnel under Blackwell's Island goes through solid rock. Under the river it is lined with iron plates surrounded by liquid concrete, which makes a solid bed. It will be used to convey gas to this city from gasworks on Long Island.

The annual report of Mr. George F. Lyster, engineer of the Mersey Docks and Harbour Board, which has just been issued, gives some particulars about the dredging operations at the bar of the Queen's Channel at the mouth of the Mersey. The report is interesting, both on account of the improvement effected at the bar and of the work performed by the great dredger Brancker. The total quantity of sand removed in twelve months was 4,407,150 tons, making a total of 6,845,860 tons removed since the beginning of operations. The depth of water in a buoyed channel 1000ft. wide is not less than 20ft. in any part at extreme low water of spring tides, and outside the buoys there is also considerable depth, 19ft. at one side and at least 15ft. on the other. The Brancker's size enables her to work during weather in which it would be impossible for smaller vessels to work. She has filled herself with sand in 35 minutes. In one period of 24 hours she received no less than 39,000 tons of sand, and in a week of five and a-half days 183,000 tons. Other dredgers have operated in the Crosby Channel.

So far nothing tangible has yet resulted from the efforts made during late years to establish the iron-making industry in New South Wales, although attention has from time to time been directed to many natural advantages possessed by several districts of the colony, namely, deposits of iron ore, with coal and flux in close proximity. The iron made in the colony at the present time is not from ore, but from scrap, and the quantity so manufactured during the year was 2190 tons 11 cwt. 1 qr. 4 lb., valued at £14,786 6s. The Eskbank Iron Works, where this industry is carried on, are situated at Lithgow, on the western side of the Blue Mountains, and employ about 150 men. In the Broken Hill district there were raised during the year 1051 tons of iron ore, valued at £1198. The bulk of this comes from Balaclava, about eight miles from Broken Hill, the rest of it being taken by the Proprietary Company from the outcrop of the lode. It is solely used as flux. The *American Manufacturer* says that a fresh attempt is being made to manufacture iron at Onehunga, in New Zealand. Some men formerly employed at the Eskbank Ironworks, at Lithgow, New South Wales, have gone to Onehunga, and are starting the works on the co-operative principle.

The French Silk Machine-weaving Syndicate, according to the *Moniteur Officiel de Commerce*, has published some interesting statistics of the working of the French machine loom industry. This working includes no less than 25,008 looms divided among 209 mills, distributed among ten departments—Ain, Ardèsche, Drôme, Isère, Loire, Puy-de-Dôme, Rhone, Sasne-et-Loire, Savoie, and Haute Savoie. The department of the Isère, which abounds in waterfalls, has alone 73 mills and 12,438 looms; the department of the Rhone comes second with 51 mills and 3778 looms. 141 mills and 15,041 looms belong to contractors who work for the Lyons manufacturers. Sixty-eight mills and 9967 looms are the property of the manufacturers themselves. This method of direct and personal working, which is still the exception, is gaining ground each year, and in this manner there is being accomplished the transformation of an industry which, only twenty years ago, was carried on at home in small workshops, both in the towns and country districts. The number of hand-weavers, which was from 50,000 to 60,000 at Lyons under the Restoration, scarcely reaches 10,000 at the present time; and, further, the weavers find little to do, as they are unable to stand against the progress of machine weaving.



THE BRISTOL ELECTRIC LIGHT SUPPLY WORKS—ENGINES AND MACHINE

MR. W. H. PREECE, F.R.S., AND MR. GISBERT KAPP, M. INST. C.E., ENGINEERS; MESSRS. WILLANS AND ROBINSON AND MESSRS. SIEMENS BROS., CONSTRUCTORS

(*For description see page 169*)

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, August 24th, 1894. Page
Notes on the Strength of Framed Structures as Affected by Elasticity. (Illustrated.) .. 161
The Iron and Steel Institute—Brussels Meeting .. 163
Twin-screw Steamship Duke of York—Engines .. 165
The British Association at Oxford .. 166
Improvements at the West India Docks. (Illustrated.) .. 167
Harbours and Waterways .. 167
Bristol Electric Light Works. (Illustrated.) .. 169
Belgian Machinery at the Antwerp Exhibition .. 170
German Steam Shipping in South Brazil .. 170
Twin-screw Propellers with Adjustable Immersion. (Illus.) .. 170
Railway Matters .. 171
Notes and Memoranda .. 171
Miscellanea .. 171
Leading Articles—Railway Traffic and Revenue—Oil Engines .. 173
The Yorkshire Coal Trade, the Scotch Strike, and the Pit Lads' Strike—Coals and Coal Manufacture—Torpedo Boat and Shipbuilding in France—Hadfield's Projectiles for Treated Plates .. 174
Literature .. 174
Parliamentary Notes .. 174
Kidderminster Water Works. (Illustrated.) .. 175
The Hibernia—The Fastest River Boat Afloat. (Illustrated.) .. 176
The Phœnix Drilling Machine. (Illustrated.) .. 177
Methods of Determining the Dryness of Steam. (Illustrated.) .. 177
The Most Economical Temperatures for Steam Engine Cylinders, or Hot *v.* Cold Walls .. 178
The Temperature Entropy Diagram. (Illustrated.) .. 179
Letters to the Editor—Rough Notions of the Mechanisms of Chemical Action—Entropy .. 179
Patent Museum, South Kensington—The Eight Hours' Day at Portsmouth Dockyard—Engineers and Architects—The Locomotives of the United Kingdom .. 180
The Junior Engineering Society in Wales .. 180
Japan Notes .. 180
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire—The Sheffield District—The North of England 181
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. 182
American Notes .. 183
Launches and Trial Trips .. 183
The Patent Journal .. 188
Selected American Patents .. 184

## TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

N. C.—*The inside wheel in almost all cases.*

A.M.I.C.E.—*We believe that the drawings you want have already been published in more than one journal dealing with yachting.*

W. C. (Battersea).—*The engine would not be reversed simply by running it with the steam cut off. Engines have been reversed by the drivers when running at higher speeds than you mention.*

T. M. (Alleghany).—*There is no reason why the marine engine should not work as economically on land as in the ship. On land it might always have dry steam, which would give it an advantage as compared with the wet steam it might often get at sea.*

Cotswold.—*You would have very great difficulty in getting an appointment on the big liners, not having been trained in marine work. Examination will not help—that would come after. You could, however, enter the Navy by passing the examinations of the candidates for entry as probationary assistant-engineers. See advertisement in our issue of the 27th ult.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* | £0 14s. 6d. |
| *Yearly (including two double numbers)* | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* | £0 18s. 0d. |
| *Yearly* | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* | £1 0s. 3d. |
| *Yearly* | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

# THE ENGINEER.

*AUGUST* 24, 1894.

## RAILWAY TRAFFIC AND REVENUE.

The Railway Returns for 1893, presented to Parliament by the Board of Trade, and issued at the close of last week, present some striking features, reflecting the perturbations of labour and trade in the United Kingdom. The gross receipts for the year amount to £80,632,000, or £1,460,000 less than in 1892. If we eliminate the miscellaneous class of receipts, which of themselves show an increase, and confine our attention to the actual income from traffic, we find that the falling off is as much as £1,685,000. In the receipts from the conveyance of passengers there is an increase of nearly £187,000. It is therefore in the goods traffic that we find the cause of the deficiency, the receipts from that source being diminished by £1,872,000. The income from the goods traffic source has never been so low since 1888, whereas the receipts from the passengers have never been so high. The revenue from the former source last year was under 51 per cent. of the total receipts, a lower proportion than is recorded in any year since 1857. On the other hand, the receipts from passengers were in a higher proportion to the total last year than at any date subsequent to 1867. The working expenses in 1893 were £45,695,000, or a trifle less than in 1892, and taking 57 per cent. of the total receipts, a higher proportion than in any previous year. The net receipts were in the proportion of 3·60 per cent. to the total paid-up capital, a lower ratio than appears at any date since 1860, when this kind of reckoning was first available. On no occasion do we find the ratio reaching 5 per cent., the nearest approach being 4·74 per cent. in 1872. The total paid-up capital exceeds £971,000,000. Less than £35,000,000 was the amount which the capitalist received on this enormous investment last year. Above £53,000,000 of ordinary capital on constructed lines yielded no dividend whatever, whereas in 1892 the capital thus without return was barely £43,000,000. It is also to be observed that the capital per mile of line open was higher last year than at any previous date, the amount being £47,000. Only four years earlier it was £44,000. The traffic receipts per mile of line open were less than in any of the three years immediately preceding, and the amount per train mile was lower than at any previous date, though the difference compared with 1892 was only a farthing. The amount is now very nearly threepence under five shillings, whereas in 1856 it was only three farthings under six shillings, and as late as 1874 was 5s. 8d. The miscellaneous receipts, including proceeds from rents, tolls, navigation, and steamboats, show a continual increase, amounting last year to 4·70 per cent. of the total receipts.

The particulars as to the number of passengers carried during the year introduce us to the interesting problem as to the progressive variation among the classes. On the whole there was an increase of 8,741,664 in the number carried, exclusive of season ticket holders. In the first class there was a decrease of 553,342, and in the second a decrease of 1,858,173, making a total decline in these two classes of 2,411,515. Against this we have to put an increase of 11,153,179 in the third class. The enormous preponderance of the third class appears when we take the actual number carried. Thus, the first class were not much more than 30,000,000, the second class a little under 60,000,000, and the third class 783,000,000. If we go back a step, and compare 1892 with 1891, some facts of importance will appear. Whereas last year there was an increase of above 11,000,000 in the third-class journeys, in 1892 the increase was more than 20,000,000. The first-class passengers underwent some increase in 1892, but the loss in 1893 more than neutralised this advance. In the second-class there has been a continuous decline since 1891, the entire loss being 3,388,000. By way of summary, we may state that the increase of all classes taken together in 1892 was a little under 19,000,000, and that of the third-class alone more than 20,000,000. In 1893 the increase of all classes was 8,741,000, and of the third-class above 11,000,000. Coming to the pecuniary results, we find a decline in the receipts from the first and second class, and an increase in the third class, as also in respect to season tickets. An increase of rather more than £64,000 appears on the whole. Adding on the charges for excess luggage, parcels, and the receipts for the conveyance of carriages, horses, and dogs, together with nearly a million for the mails, the entire revenue from the passenger traffic becomes £35,849,449, being an increase of nearly £187,000. In the receipts from passengers, the holders of season tickets account for as much as £2,583,000. This shows an advance on the previous year. But the third class furnish more than two-thirds of the passenger revenue, apart from the mails and other miscellaneous items.

We have already remarked the decline in the receipts from the goods traffic. Out of the total decrease of 1,872,000, minerals are accountable for £1,425,000. In the carriage of merchandise there is a decline, and in live stock some increase. In Scotland there was an increase for the carriage of minerals, but in England the falling-off from this source was large, being as much as £1,479,000. With respect to the working expenditure of the lines, amounting to nearly £46,000,000, what are termed traffic expenses absorbed more than £14,000,000, while the cost of locomotive power exceeded £12,000,000. The maintenance of way and works took nearly £7,500,000, repairs and renewals of carriages and wagons £3,900,000, and general charges nearly £2,000,000. Rates and taxes continued to go up, and rose to £2,587,796. The number of miles travelled by the trains was nearly 323,000,000, equal to three times the distance of the earth from the sun, with more than 40,000,000 of miles to spare.

It is worth while looking back to see how this wonderful system of locomotion has grown. The length of line open for traffic at the end of last year was 20,646 miles. At the close of 1853, the length was 7686 miles. Accordingly there has a been growth of very nearly 13,000 miles in the space of forty years. The average has thus been 324 miles per annum, and it happens that the increase last year was 321 miles. The amount of capital paid up, per mile of line open, showed a tendency to decrease down to the close of 1870, at which date it had a lower proportion than that of seventeen years earlier, being little more than £34,000, per mile in comparison with £35,523. After 1870 the proportion rapidly rose, until now we find it just over £47,000, the highest figure yet on record. The gross traffic receipts per mile of line open have increased by more than one-half during the forty years from 1853, although the traffic receipts per train mile are now lower than in any previous year. In the same period the receipts from the passenger traffic have fallen from a proportion of one-half the total to less than 45 per cent., though this was higher than for the previous quarter of a century. The total traffic receipts in 1853 were singularly small, being only a little over £18,000,000, or more than £2,000,000 under the receipts a year later. We now witness a fluctuation in a contrary direction; last year showing a great falling off compared with the year preceding. But there is no doubt better times are coming, and there appears to have been considerable improvement during the past half year. Working expenses seem destined to increase, partly owing to the intervention of the Board of Trade in the matter of hours. The growing burden of rates and taxes is the subject of general complaint, the chairman of the Great Western Company denouncing it as "a horribly increasing expenditure." The chairman of the Great Northern has remarked that—during the last half year—the rates and taxes imposed on the principal railway companies considerably exceeded a million sterling, being an increase of £100,000 over the corresponding period of 1893. In the payment of Government duty the companies are, on the whole, effecting a reduction; apparently by the expedient of charging Parliamentary fares for third-class passengers. The large increase of the third class assists this measure of economy, and must tend to bring about other changes in due course. In many ways the railway system of the United Kingdom has been so modified as to make it widely different from what it was forty years ago, though that length of time extends scarcely so far back as the date of the Great Exhibition.

## OIL ENGINES.

Although the competitive trials recently carried out at Cambridge did not bring to light any essentially new form of oil motor, yet several engines which were only known as to details of construction by the makers, were not only exhibited, but ran through whole or part of the trials; and these engines were, with but one exception, made on the principle of direct conversion of the oil into a gas on its way to or in the cylinder. Great strides have been made in a few months towards the construction of a satisfactory and economical oil engine, and except in one or two cases simplicity has not been overlooked in the endeavour to produce an engine which will give good results, and not be a copy of other engines. Several different ways of arriving at a similar result were shown, but the difference was more apparent than real; one or two essentials were traceable throughout the changes of form of details which tended to hide them.

We are probably destined to see in a comparatively short time a great development in the construction and use of the oil engine, and the rapid progress of the past year or so warrants the belief that another year will witness equally great strides. The oil engine offers so many advantages for small powers and for portable and traction purposes, that even an increase in the price of oil will not much decrease its rapidly extending application. The fact that it needs no boiler, no fire, no gas holders, and very little water, and that its fuel can be bought everywhere, must make it the future motor for very many purposes, not excepting launches. The objections with respect to smell will gradually pass away with the improvements which will make the engine as clean as a corporation water works pumping engine, and as free from offensive smell.

Separating the engines as exhibited in the trial shed, into two main classes—namely, those which had and those which had not separate or independent vaporisers with vaporiser lamps—we have two classes which seem to be widely different, and which, in details of construction, are so, but which, in working, are not so. The simplest of all systems is, of course, that under which the heat of combustion of one working charge provides the heat for vaporising the oil for the next, and, when supplemented by the heat mechanically produced by the compression of the charge, fires it. Simplicity, it would seem, could go no further; and for economy, no better means could be imagined. Remarkably good results are achieved by the engine which works on this system, and one feels that it ought, and perhaps may, yet be the means of obtaining the greatest economy. At present, however, equally good or better results in this respect are obtained from engines which depend for their working on a distinct and separate oil-burning lamp for heating the vaporiser and ignition tube, or, in some cases, for heating the latter only. Some of the lamps used for this purpose consumed a quantity of oil which is small compared with the total, but even so it is a separate quantity which the first-mentioned system does not use at all. Now not only does the engine which employs the lamp use rather less oil per brake-horse power, but it does this with less oil in its cylinder by the quantity the lamp consumes. Further than this, it will be observed that the heat which is generated by this lamp, and only partly taken up by the vaporiser and ignition tube, passes away without any possibility of contributing to the heat converted into work in the cylinder. The question arises, How is it that the system by which the combustion of the whole of the oil used takes place in the cylinder, the presumably best possible condition for an internal combustion engine, does not secure, as yet carried out, the most economical results? The efficiency of the engine ought, one would say, to be higher by an amount somewhat greater than the entropy of the lamp oil and its vapour. Why is it not? If the oil were used with different kinds of burners to heat water in a steam boiler, we could understand differences dependent on the construction of the boiler and of the burners; but here we have the whole heat of combustion of the fuel used, absolutely confined within the walls of the working cylinder of the engine, and yet the efficiency of such an engine is inferior, or no better than that in which a not inconsiderable part of the heat of combustion of the fuel used must be lost.

We can imagine that a first consideration of this question would lead to the remark that the heat required for raising the temperature of the oil, and for evaporising it, is the same or as great in the simple engine as in the independent vaporiser engine, and that the entropy of the subsequently compressed charge of mixed working gases is the same. That, in fact, whether the entropy acquired during evaporation is due to heat supplied within the cylinder by combustion therein, or to heat supplied to a vaporiser by external combustion, its value is the same. This, however, only partly states the case, for apart from the less efficient use of the oil which is burned outside the cylinder, the engine in which the oil is heated and vaporised in this cylinder, merely loses or imparts so much less heat to the jacket cooling water, or may be supposed to do so.

The case is further modified in those engines which employ an external lamp only to maintain the incandescence of the ignition tube, the heat required to raise the temperature of the oil and to vaporise it being supplied by the working cylinder itself. The oil for vaporisation is contained in a jacket surrounding the combustion chamber. In this case almost the whole of the heat due to the combustion of the oil consumed in the lamp might be expected to appear as an excess over that used in the lampless engine, but it is not so. The question then arises, What is likely to be the difference between the entropy-temperature diagram of oil, gas, and air, for an engine in which the whole entropy change takes place in the cylinder, and that in which the same change takes place partly in the cylinder and partly in a separate apparatus, and in which the conditions are affected by a water jacket? The difference might be expected to be as great as it would be between two gas engines, one of which is supplied with gas in the ordinary way, and the other with gas distilled from coal in the working cylinder or chamber directly connected with and open thereto, by heat otherwise passed away in the jacket water and the exhaust.

In the simple engine vaporisation takes place under conditions which have not been included in any thermodynamic considerations yet published, simply because the conditions are new. In it entropy is acquired by the substance used, partly under conditions of constant pressure, and partly under conditions which are neither those of constant pressure nor constant volume. The resulting effect may be evaporisation under conditions which are similar to those of constant volume vaporisation, the effect of compression being merely a more rapid rise in pressure by accumulation. Instead of external work of vaporisation under constant pressure in the ordinary sense, there is vaporisation under constant volume conditions, with external work done upon the substance. With the influence of the water jacket always at work the entropy change during compression may be nil. It is not likely that the report of the Cambridge trials can afford much help on these questions. The figures with regard to the relative entropy change in the jacket water of the different engines could only be of use with oil measurements of great accuracy. From these and the indicator diagrams it may be possible to make some guesses as to cause of the highly economical results obtained by the independent vaporiser engines, and their great similarity in this respect, or even superiority over the simple engine, which might be called the internal entropy engine.

There are claimed for the independent vaporiser several advantages which relate to the working of the engines under varying conditions, and also to the easy determination of the period of ignition apart from other adjustments. In practice there may sometimes be advantages in this respect, but they were not called into play at the Cambridge trials. The simple engine to which we have alluded was represented only in the Hornsby-Akroyd engine, although the action on simple lines was shown by Messrs. Clarke, Chapman, and Co., one of whose engines was run for a considerable time without any separate means of ignition, the electric spark igniter being cut out. In this engine vaporisation is effected by exhaust heat, and is, of course, dependent on and affected by exhaust heat changes. The separately heated vaporiser and ignition tube have advantages where a very variable load has to be carried, because it is possible to reduce consumption by frequent misses which could not be permitted with the internal entropy engine. With the latter it may become necessary to start the vaporiser when a load varies much or falls for a considerable time below a minimum, but as against this it may be noted that the other engines burn a lamp not only at starting but always. The oil engine in its several forms presents many features of great thermodynamic interest, and the point to which we have referred is one of the first to which attention may be usefully directed, unless it be made second to the invention of better, cleaner, and simpler, if not quicker means of starting than are now available.

◆

### THE YORKSHRE COAL TRADE, THE SCOTCH STRIKE, AND THE PIT LADS' STRIKE.

One of the most remarkable circumstances in connection with the Scotch miners' strike is the little effect that it has had on the coal trade of the country. Some of the pits in Durham and Northumberland have been beneficially affected, but although the struggle has lasted nine weeks, it has had very little effect on the Yorkshire coal trade. This is an interesting fact for the Scotch miners and their advisers to consider. During the last fortnight many collieries in Yorkshire and Derbyshire have been set down owing to the revolt of the surface men and pit lads, and one of the largest in South Yorkshire is still idle. The local feast which has been celebrated during the week has caused the collieries within a radius of four or five miles to be stopped for two or three days, whilst Monk Bretton has suspended operations for a full week. Notwithstanding all these curtailed influences, there is plenty of coal stacked at the pits and in wagons awaiting orders. Although the mischief done has been great, the coalowners of the county, which met at Sheffield on Tuesday, failed to decide the question, and the miners' officials have made arrangements for a meeting of the Joint Committee of coalowners and men's representatives to be held at Sheffield to-day Friday, in order, if possible, to come to some definite arrangement respecting the rate of wages to be paid to the surface men and pit lads. These lads are the pony drivers and banksmen of the Yorkshire collieries, and they have risen in revolt against a 10 per cent. reduction. There is more reason for their strike than in many of the ruptures caused by their seniors in the coalfield. When the miners' leaders, by a series of strategical manœuvres well timed and cleverly carried out, succeeded in enforcing 40 per cent. advances, it was only the underground workers who participated in the sudden flush of prosperity. Now that it is necessary under the two years' truce to take 10 per cent. off, those who did not get it—the boys and the banksmen—not unnaturally ask, Why should we be required to give that which we have not got? The difficulty ought not to be of long duration. The meeting of the Conciliation Board to-day should settle it. Coalowners no doubt interpret the 10 per cent. reduction in wages as applying to all classes of workers. In fact. the miners' leaders interpreted the agreement in that light as well, so they issued an order that it was to be enforced all round. The pit lads and the banksmen, however, have had the courage to say "No; we got none of your 40 per cent. advances, and therefore it is not just to call upon us to make any reduction." The lads have the sympathy of the public on their side. The general feeling is that those who did not get the spoils cannot be expected to give any. If the 10 per cent. reduction is too little unless it is conceded by every class of workers, it is clear that sufficient should have been demanded to meet the emergency, but it should have been demanded from those who got the increased pay, not from those who got none. It is not the first time that collieries have been set down through the action of pit boys, and although it is an amusing instance of "the tail wagging the head," this time the tail wags with fair cause.

### COALS AND GAS MANUFACTURE.

The effect of the alteration in the condition of the coal trade and in the price of coals must be marked on the gas manufacture, though the effect is not yet fully evident. Some years ago we traced at length in The Engineer the course of the fall in the price of coals on gas manufacture in the case of a company close to the great coalfield of Durham; and it may be now interesting to glance at its statistics again. In the year ending with June, the company carbonised some 29,665 tons of coal. The total quantity of gas sold is not stated — part being for public lighting; but 240,040,900 cubic feet were sold apart from that contracted for, and judging by the receipts for the gas contracted for, the production was considerably in excess of the 10,000 cubic feet per ton, which once used to be aimed at, but is now generally surpassed. The cost of the coals deposited at the works is, of course, increased, and it now averages about 8s. per ton, but there is included a small quantity of Cannel coal for enriching purposes. It is noticeable that the yield of coke for the year was a little over 18,700 tons, and as over 4,700 tons were used in the manufacture, and there was a slight addition to the stock, the 13,500 tons or thereabouts sold for £5662 after the cost of labour, cartage, &c., was deducted, represents a fair price for the residual. Generally it may be said that concurrently with the rise in the price of the coals used in the manufacture of gas, there is some improvement in the receipts from the sale of residuals, though not always to a concurrent extent. It would appear that even on the verge of the chief of the gas coalfields, the cost of the coal is increasing to the gas companies, but there will be the counterbalance of an enlarging production and of better results from the residuals. Year by year an increase in the number of the gas stoves that are let out on hire, and thus the revenue is being derived not only from the gas used as an illuminant, but also from that used for purposes of heat and power. In the case of the company we have referred to, the rental of gas meters for the year was £1260, whilst that from gas stoves has already risen to £352, or more than a fourth of that of the meters, so that the enlarging use of gas for this method of consumption is now becoming very marked. And it is to be noticed that it is in very large degree a day consumption, so that it is doubly a benefit, giving a demand that occurs at a time when that for purposes of illumination is at its lowest. It would thus seem that though the gas manufacture has to pay more for its raw material, there is the opening out of the additional sources of use and of revenue that will in the end more than make up for any loss that follows from the use of electricity for the purposes of artificial light, and that will give an even better revenue to the companies engaged in the manufacture.

### TORPEDO-BOAT AND SHIPBUILDING IN FRANCE.

The new sea-going torpedo boat, Le Chevalier, constructed by M. Normand, of Havre, has lately been tried with excellent results, and its rate of speed was higher than any hitherto attained in France. The boat has a length over all of 44 metres, and its beam at the water-line is 4·38 metres, while its displacement is 118 tons. One of the principal modifications in the design of the boat is the placing of the rudder in front of the propeller, so as to avoid the necessity of extending the keel as a support for the rudder frame. The screws are placed in two transversal planes, and turn in the same direction. The machinery is composed of two triple-expansion engines, each one working a propeller, and they are supplied by two boilers upon the Du Temple system. M. Normand has profited by his own experiments, and the experiences of Messrs. Yarrow, in suppression vibration, and this is done partly by equalising the weight of the pistons. At the trials the engines developed 2800-horse power without forced draught, and the consumption of coal did not exceed 900 grammes per horse-power per hour. Under these conditions the speed attained was 27·22 knots. The famous boat, which ought to attain a speed of 30 knots, is still in its experimental stage, and M. Normand himself does not seem to be very sanguine as to its ultimate success. The law which was passed in France last year reducing the premium upon foreign-made vessels sailing under the French flag to the profit of vessels constructed in that country, has already given a stimulus to the native shipbuilding industry. Though only commenced at the beginning of this year, the Ateliers et Chantiers de Normandie, belonging to MM. Laporte et Cie., have just been inaugurated at Quevilly, near Rouen. The plant is very extensive and is of the newest description. There are five stocks upon which vessels of large dimensions can be built. At the inaugural ceremony the keel of a steel sailing vessel of 2500 tons was laid down for a new company at Nantes, which has been formed under the title of the Societe Anonyme des Voiliers Nantais. As several other contracts are being entered into, the prospects of the shipbuilding industry at Rouen are encouraging.

### HADFIELD'S PROJECTILES FOR TREATED PLATES.

Messrs. Hadfield have for some time past advocated a shot with a special form of head for the attack of treated plates, and Dr. White, the Director of Naval Construction, has given facilities for experimenting with it recently on board the Nettle. The details of the trial are not published, but Hadfield's shot behaved very well compared with those of the service form, showing considerable advantage in penetration. The projectile was broken up, but not to the same extent as those of service form. Further trials may be looked for, we presume, and we do not know the precise shape of head, so that it would be premature to venture an opinion on the prospects and merits of this shot. Our impression as to the action of treated plates, as we have before said, is that their power consists in fracturing the shot's point. When this, for any reason, is not effected the treated plate seems to offer no advantage. This has been illustrated by shot striking at low velocities and also at very high ones. The wrought iron cap assists the shot simply because it prevents fracture. Consequently the wrought iron cap when tried in Russia against non-treated plates offered no advantage, being fired under conditions when the shot would not break without the cap; indeed, under these circumstances it must offer a slight additional obstacle to its penetration, but imperceptible in its amount. It is easy to see that Hadfield's blunt point is less likely to break than a sharp one. On the other hand, any device which enables a sharp point to remain unbroken ought to offer advantages over a blunt-pointed shot for direct penetration. The question of service conditions has, however, to be considered. We should much like to see more firing at an angle with treated plates.

## LITERATURE.

*The Next Naval War.* By Captain S. Eardley-Wilmot, R.N. London: Edward Stanford.

We cordially welcome this latest addition to the literature of this class for several reasons. Anything, whether written or spoken, which will help to stimulate the public mind to an intelligent interest in the first line of defence of the country is a subject for gratitude, for the ignorance and apathy of the mass of the inhabitants of these isles where the Navy is concerned is to the last degree astonishing and deplorable. When we have a book, notwithstanding that it be small such as this, by an officer of great and recent experience in his profession, his statements and opinions should be doubly interesting and instructive. We are glad to see that the book before us is now in its third edition, for whatever expectations the politician may have for the future, the more widely the strictly naval points are driven home the better. In his story of the defeat of the unsupported Mediterranean Squadron by the stronger French fleet, Captain Eardley-Wilmot emphasises points upon which there should be no real difference of opinion. They are the insufficiency of our system of manning the fleet, the divided control of War-office and Admiralty in the defence of our ports, and the lack of co-operation generally between the two services, and perhaps in a less degree, the want of accommodation at Gibraltar for the temporary repairs of our ships. The last difficulty might be met to a large extent by the increase of our Mediterranean fleet, for the rest a good deal more is wanted. They are matters vitally affecting our position as a naval power. We shall not attempt to tell the author's story; that should be read and re-read. The torpedo attack on the ships in Portsmouth Harbour may strike some as improbable, but it is quite possible under the existing system, and as might be expected when Captain Eardley-Wilmot is the writer, a good deal is made of the torpedo as a weapon of attack.

*The Junior Engineering Society.* Record of Transactions. Volume III. Twelfth Season 1892-3. Edited by W. T. Dunn, Secretary. London: The Society.

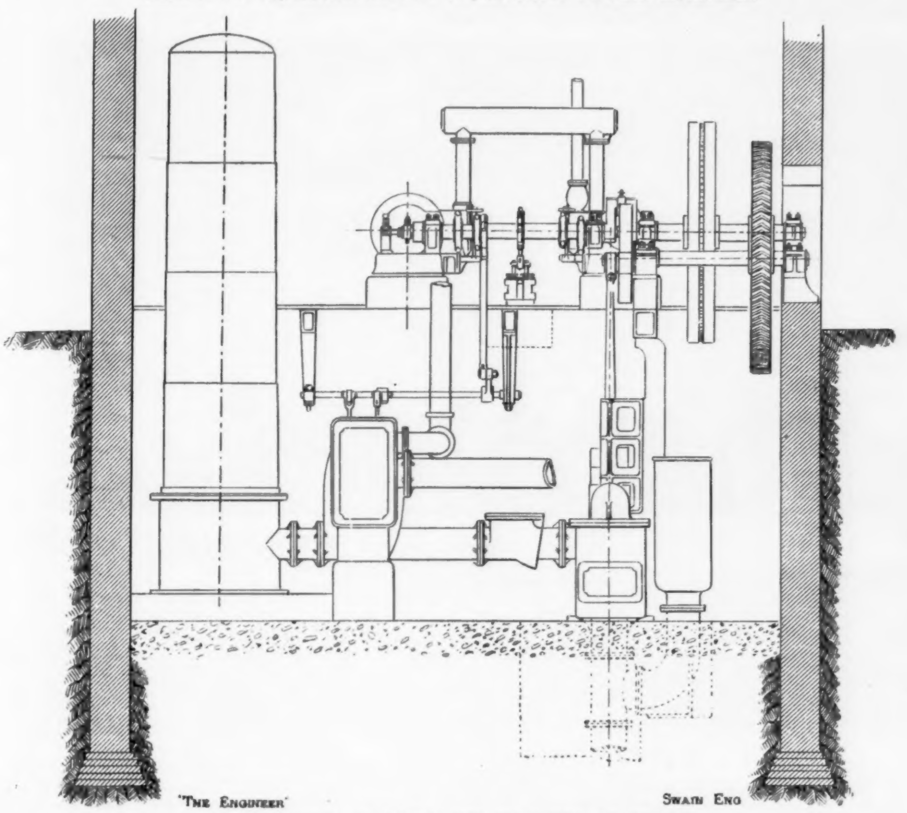
This Society, founded in 1884, now numbers about four hundred members, and by the very active attention of its secretary it has succeeded in attracting a good deal of support, and has published a considerable number of admirable presidential addresses and papers read and discussed. The society has always had an eminent man as a president, but he is not expected to afford time for more than two or three appearances. They include Dr. William Anderson, Sir E. J. Reed, and Professors Kennedy, Unwin, Perry, Thompson, and lastly, Dr. John Hopkinson. The volume before us contains papers on Electro-motors of Small Power, by D. T. and A. C. Heap; Cost of Electric Supply, by Dr. Hopkinson; Expansion Curves, by W. J. Tennant, a paper which is accompanied by a very useful diagram, or what would be so with a little fuller description, which will probably be given in another volume; Feed-water Heaters, by W. H. De Ritter; Gold Mining Machinery, by A. H. Brunly; Sanitary Engineering of Dwellings, by R. W. Newman; and Water-tube Steam Boilers, by H. Fraser, and numerous well written notices of visits to works.

## PARLIAMENTARY NOTE.

*Railway in Uganda.*—On Monday questions were asked in both Houses as to the policy of the Government with reference to Uganda. Amongst other matters, Lord Kimberley stated that the Government had in view a monthly transport service to Uganda, and that a steamer and some launches were to be sent out for service on Lake Victoria Nyanza. Unfortunately no satisfactory answer could be obtained as to the construction of the proposed railway. Lord Kimberley said, "With regard to the inquiry what we are doing in the matter of roads, I would point out that it is very difficult for us to undertake any considerable works of that sort on account of the uncertainty of the position we occupy with regard to the East Africa Company. Until we come to terms with them it will be difficult for us to embark on any considerable works of that kind even if they were thought desirable." On the whole it is to be gathered from the attitude and statements of the Government that it is not at present impressed by the necessity, or even the expediency, of a railway at all.

# KIDDERMINSTER WATERWORKS—PUMPING MACHINERY

MESSRS. WORTH, MACKENZIE AND CO., STOCKTON-ON-TEES ENGINEERS

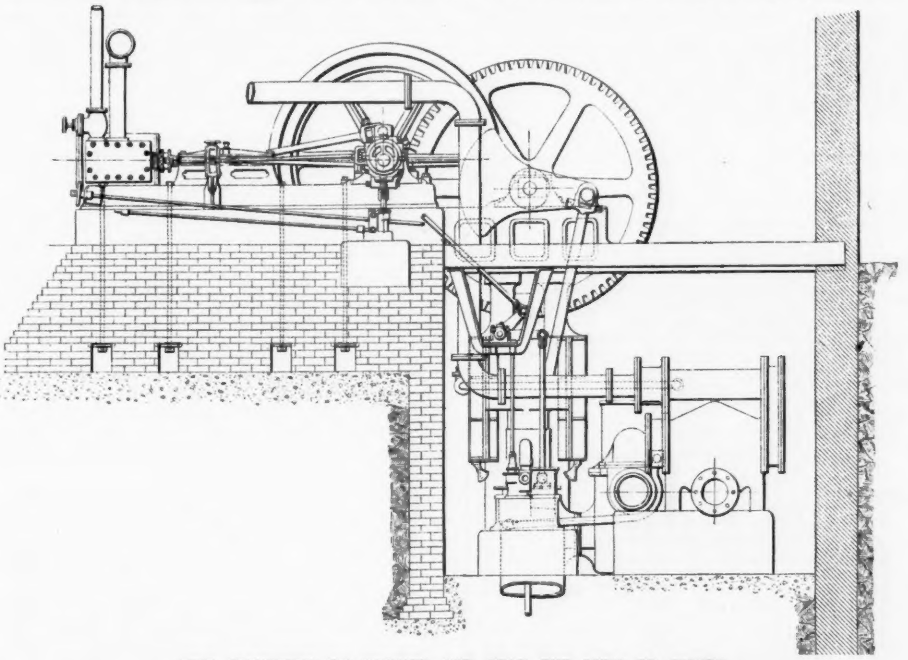


SIDE ELEVATION OF PUMPS—END ELEVATION OF ENGINES

## KIDDERMINSTER WATER WORKS.

Kidderminster may consider itself exceptionally fortunate in its water supply, which is drawn from deep bore holes in the new red sandstone rock, and is of excellent quality both for domestic and manufacturing purposes, having an average hardness of only 8·58.

These works were commenced in the year 1870, when a well 8ft. diameter was sunk to a depth of 113ft., and from the bottom of this well a 12in. bore hole was put down to a total depth of 500ft., a supply of 360 gallons per minute being obtained. Two horizontal non-condensing engines were erected, each having a single cylinder 20in. diameter, with a stroke of 3ft. 6in., with variable expansion gear of the "Meyer" type. The engines were supplied with steam by two Lancashire boilers working at 60 lb. pressure, and drove, through spur gear, a set of three-throw lift-pumps fixed in the well; only one engine and boiler were required to drive the pumps, the other being in reserve, the engines and boilers being thus in duplicate, but not the pumps. The pumps delivered into a reservoir on an adjoining hill top, from which the town was supplied, but the extension of the town causing the pressure from this reservoir to be insufficient, a stand-pipe was erected to give 30ft. additional head. In course of time this also became inadequate, and in the year 1885 a new reservoir was constructed on the top of a higher hill, about a mile from the pumping station; this reservoir holds about 2,000,000 gallons, and is sufficiently high to supply any part of the town. But again, in the year 1889, it became necessary to augment the supply from this pumping station, and for this purpose an additional well was sunk outside the present engine house, 4ft. 6in. diameter and 108ft. deep, with a 12in. bore hole, to a depth of 377ft., and a 6in. bore hole a further depth of 246ft., making a total depth—from the surface—of 623ft.; this well added about 140 gallons per minute to the available supply.



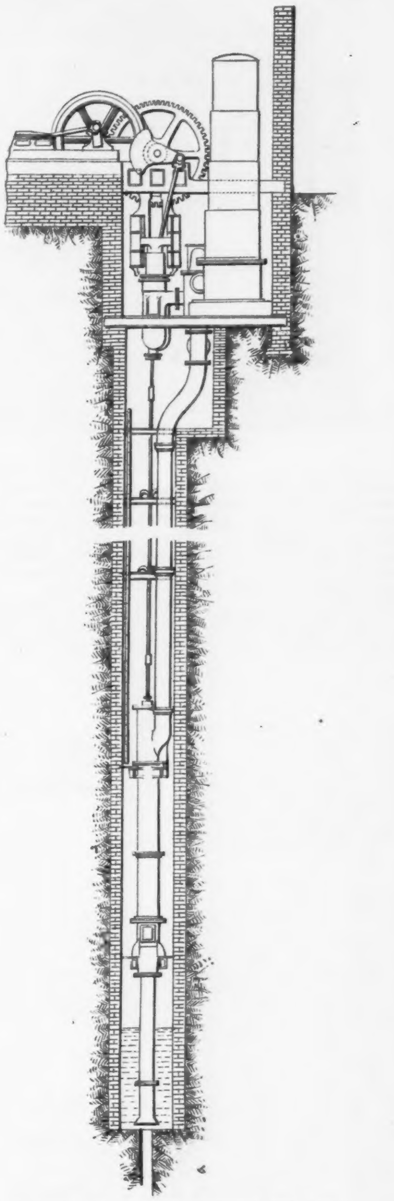
SIDE ELEVATION OF ENGINES AND GEAR—END VIEW OF PUMPS

The wells are only ten yards distant from one another, and a tunnel was bored from one to the other at a depth of 105ft.; a sluice valve is fixed in this tunnel, so that the wells can be isolated for repairs.

As the standing level of water in the well is at about 75ft. from the surface, and the pumps were partly drowned soon after the engine was stopped, and in addition, the arrangements for access to the valves being very inconvenient, it was resolved, on the advice of the borough engineer, Mr. A. Comber, C.E., to put down a new pump in the new well, specially arranged for convenient access, and also to put down economical compound engines to drive same. Of the various tenders sent in for this work three were chosen for further consideration, and a sub-committee was appointed to visit and inspect, in conjunction with the borough engineer, the work done by the selected firms. The last visit paid was to inspect the engines erected by Messrs. Worth, Mackenzie, and Co., Stockton-on-Tees, for the Stockton and Middlesbrough Water Board, and the Hartlepool Gas and Water Company. The committee were much pleased with these engines, and finally the contract was placed with that firm, and the plant they supplied is illustrated by the engravings we publish herewith. These engines were designed by Messrs. Worth, Mackenzie, and Co., and had to fulfil the following stipulations of the waterworks committee, viz., to raise, if required, 800 gallons per minute to a height of 200ft., working with the existing boilers at 60 lb. pressure, but to be readily convertible into triple-expansion when new boilers were put down, to require the minimum quantity of steam under both circumstances, and to be moderate in first cost. The old pumps, which did the work in one lift, having given a great deal of trouble, it was stipulated that the pumping should be done in two lifts.

The engines are coupled horizontal compound surface-condensing, with cranks at right angles, the cylinders being 14in. and 24in. by 24in. stroke, both cylinders are steam jacketed, and have separate hard cast-iron liners, and for conversion into triple-expansion the low-pressure liner would be reduced in diameter to about 22in., and a new high-pressure cylinder added tandem behind the present one. The high-pressure engine's bed plate is machined at the back end to allow of an additional piece being readily attached for carrying the 9in. cylinder.

In order to divide equally the work between the two cylinders, and to ensure the best possible use of the steam, both cylinders are provided with an expansion valve, adjustable while the engine is running, from 5in. to 15in., and provided with indexes showing the point of cut off. Full boiler pressure is used in both cylinder jackets, and the cylinders being lower than the boiler, a small pump is provided to drain each jacket. These pumps are 2in. diameter by 3in stroke, and deliver the condensed steam into the main feed pipe at a point between the feed heater and boiler; the rams, valves, glands, and bushes of these pumps are all gun-metal. The pistons are of cast iron, with largely extended bearing surface to prevent wear; the rings are the maker's angle section, fitted with Mather and Platt's patent steel coils. The piston-rods are of forged steel, connecting and excentric rods of forged iron, all finished bright; the crank shaft is of forged steel, made in two pieces, one piece having two cranks and pins forged solid with it, and coupled to the high-pressure engine in the manner usually adopted for coupling paddle-wheel shafts. This arrangement prevents any wear that may occur in the outer portion, due to the weight of the fly-wheel and gear, from injuriously affecting the engine bearings.



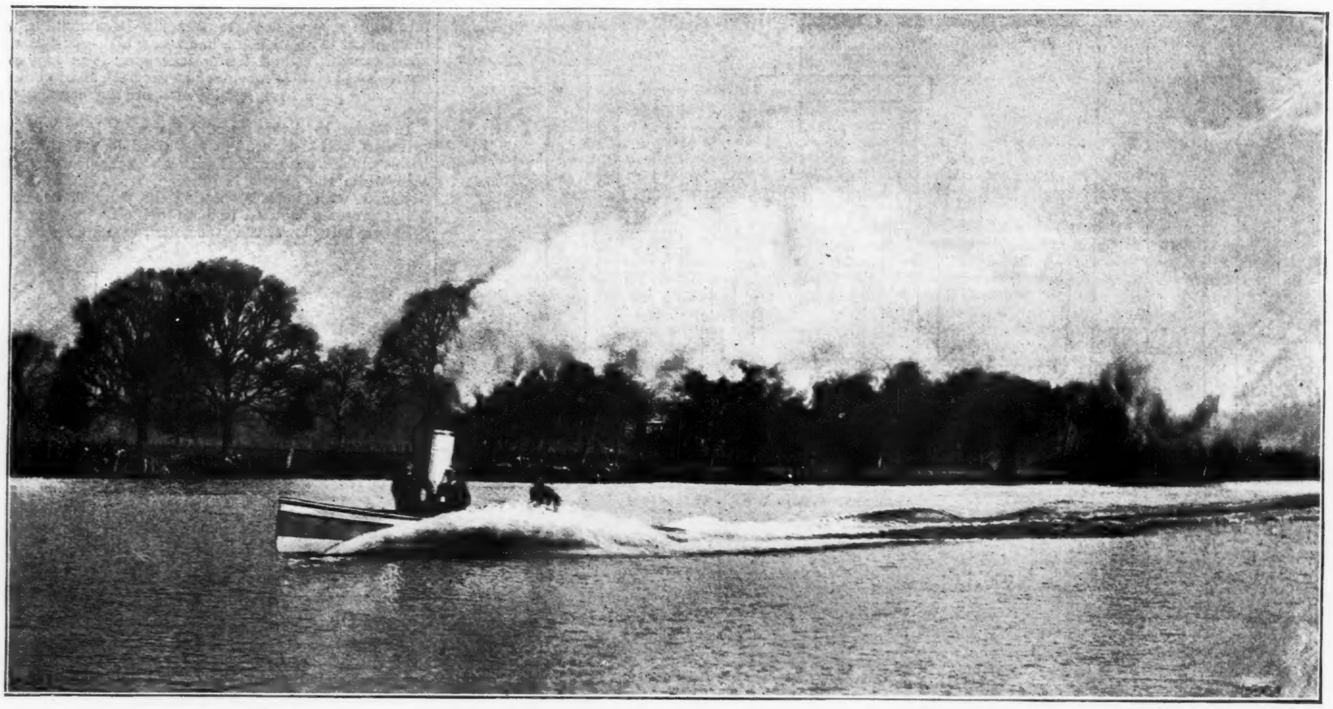
DRIVING GEAR AND SECTION OF WELL

All the bearings on the engine are phosphor bronze, and the crank shaft bearings are adjustable both vertically and horizontally. The fly-wheel is 8ft. 2in. diameter, four tons weight, turned up bright, and provided with barring rack. The gear consists of massive cast iron spur wheel and pinion, with double helical teeth, pinion 1ft. 9⅞in. diameter, and spur wheel 8ft. 6⅝in. diameter, 4in. pitch, and 9in. broad. The second motion shaft over the well is of forged steel, 6¾in. diameter at the bearings, and 7¼in. diameter at wheel seat; a cast iron crank with balance weight is keyed on the outer end of this shaft, and the remainder of the balancing necessary is provided for in the spur wheel.

The steam from the low-pressure cylinder passes through brass tubes, around which the feed-water circulates on its way to the boilers, thus raising the temperature to about 140 deg.; after passing through these tubes, the steam descends, and enters the tubes of the surface condenser, around which

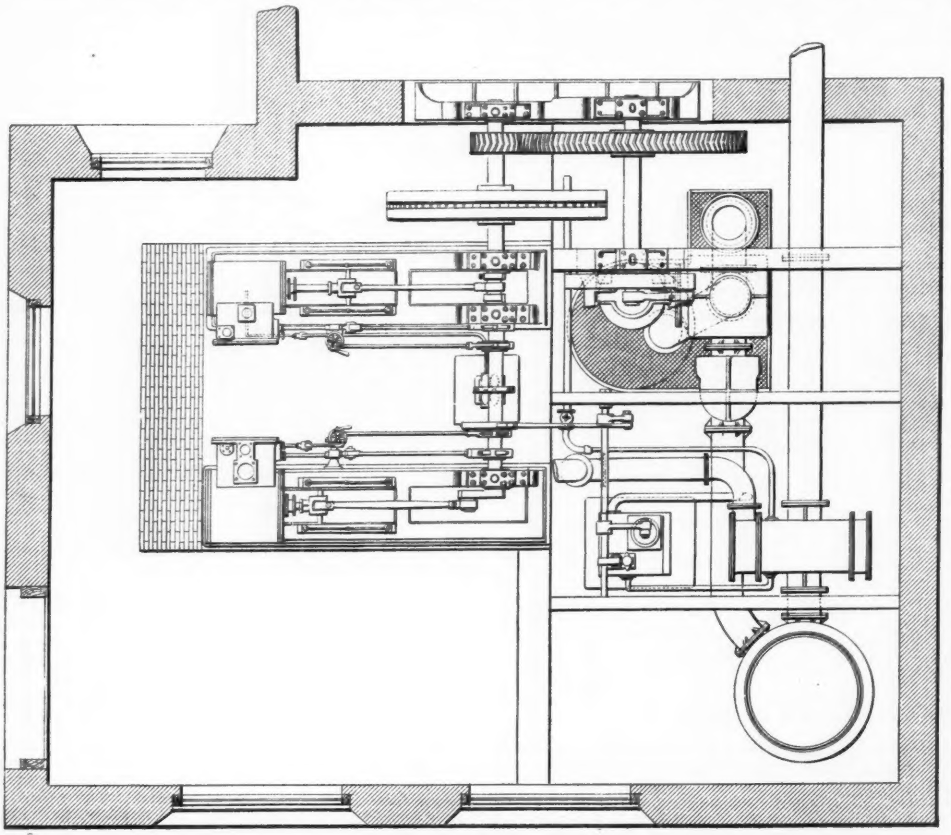
# THE HIBERNIA—THE FASTEST RIVER LAUNCH AFLOAT

DESIGNED BY MR. G. F. C. DES VIGNES; BUILT BY MESSRS. SIMPSON AND STRICKLAND, TEDDINGTON



passes the whole of the water being pumped. The air pump is 10¾in. diameter, 12in. stroke; the feed pump is 2¾in. diameter by 3½in. stroke, both worked from a rocking arm driven by an excentric on the engine shaft. The pumps, condenser, air vessel, non-return and relief valves, are all arranged on a lower level than the engines, and reached from the engine-room by an iron ladder.

The well pump is 18in. bore, with a stroke of 4ft., and the top cover of this pump is 72ft. below the ground, being thus 3ft. above highest water level. A platform is placed in the well, conveniently arranged for removing cover, when the bucket and bottom clack can be readily withdrawn. Below the top cover there is a breeches pipe forming the junction with the rising main, and below this again there is a length of pipe 19in. inside diameter, to the lower flange of which the working barrel is connected. The suction pipe is 14in. diameter, the lower end of which reaches to a depth of 107ft from the surface.



KIDDERMINSTER WATER WORKS—PLAN OF MACHINERY

As it was intended to repair the machinery in the old well as soon as the new works were started, after which repair the water could always be kept down in the wells, doors are arranged above the suction valve and pump bucket, by means of which access to the valves can be had in a readier manner than drawing through the top. The suction and bucket valves are of best gun-metal, of the double-beat type, and the bucket is provided with phosphor bronze rings. The force pump at the top of the well has one ram 18$\frac{11}{16}$in. diameter, worked by a connecting-rod from the balanced crank; a steel rod is continued from the bottom of the ram, passing through a gland on the bottom of the ram pump, and connected to the rod working the lift pump. These rods are connected together by machined sword joints, so as to be easily and quickly disconnected, should it be necessary to draw out the pump bucket. These rods are of forged iron, and are guided by rollers so as to decrease the friction. The valves of the ram pump are eighteen in number, of hard gun-metal, and of the spiral wing type, and doors are arranged so that the valves can be readily examined when necessary. After leaving the valve box of the ram pump, the water passes through the non-return valve into the air vessel, which is 4ft. diameter by 20ft. high, and from the air vessel it passes through the surface condenser surrounding the tubes in which the steam is condensing, and thence direct to the town's main.

No official trials of these engines have been carried out to ascertain the exact coal consumption. A rough trial by the Corporation's own men, during the first week the engines were running, showed a consumption of 1 ton 13 cwt. per twenty-four hours, as against 4 tons 13 cwt. by the old engines in the same time, the result over twelve months proving equally satisfactory. Of this result, the *Kidderminster Shuttle*, in the report of the meeting of the Town Council, in the issue of November 12th, 1892, gives the following particulars:—"The new engines started on the 27th of October last have been in constant work, and performed the duty satisfactorily. . . . There has been a saving of 1016 tons of coal = £345, and a gain in water pumped of 8,512,360 gallons. The annual cost of repayment of principal and interest on the sum expended on the new engine house and engines is £213, so that there is a clear saving of £132 per annum in favour of the new engines as against the old." The Mayor, in moving the adoption of the report, also says:—"With regard to the work of the Drainage and Waterworks Committee, he was pleased to see that a great saving in coal had been effected by the new engines, and they were very much indebted to the borough engineer for his skill and energy in having the alterations made. The saving was something altogether out of the ordinary run. He hoped similar alterations might be made at the other engines belonging to the Corporation. Spending money sometimes was the truest economy."

We give the above report somewhat fully, because the Mayor's concluding remarks might with advantage be considered by many Town Councils. We believe there are scores of cases in which pumping engines are using three times the fuel necessary, and in which judicious alterations would give similar results to those obtained at Kidderminster.

In the autumn of 1892, the old well and bore hole having been cleaned out and deepened, a practically new pump was fixed in this well, and driven by one of the old high-pressure engines. This pump was designed by the borough engineer, to work in the valve boxes, pipes, and connections of the old pump, and the work was carried out by the Corporation's own men; it has made a thoroughly substantial and efficient job, and having been fixed at a lower level, and the old well being also the deeper, it can draw the water down to a level about 5ft. lower than the new pump. In consequence of this about another 10 per cent. increase of supply has been obtained, and this was all needed in the dry season of 1893. But as this pump had to be driven by the old wasteful high-pressure engine, it was resolved to compound this engine, and this work was also entrusted to Messrs. Worth, Mackenzie, and Co.

In the engine as compounded the cylinders are 12½in. and 29¼in. diameter by 3ft. 6in. streke, with expansion valves to both cylinders; the feed-heater, surface condenser, air and feed pumps belonging to the new engines are all arranged to be common to them both, and to be connected to one engine or the other in a few minutes as may be required. The whole cost of these alterations will be covered by the saving in coal in twelve months' working, and as the pumps in either the new or old well are capable of lifting much more water than the well can yield, the deepening of the wells for increased supply, which will probably have to be undertaken in another year or so, will be rendered an easy matter.

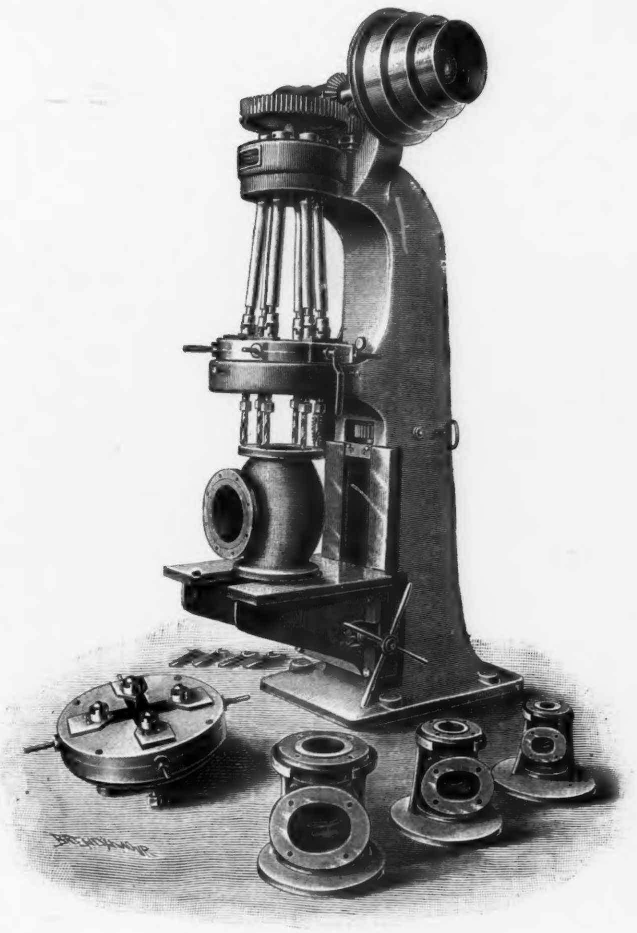
In addition to the pumping plant above described, the supply was also increased in the year 1879 by sinking another well and bore hole near the town; the yield from this well is about 380 gallons per minute, which is pumped direct into the town main by a pair of condensing beam engines with bucket-and-plunger pumps.

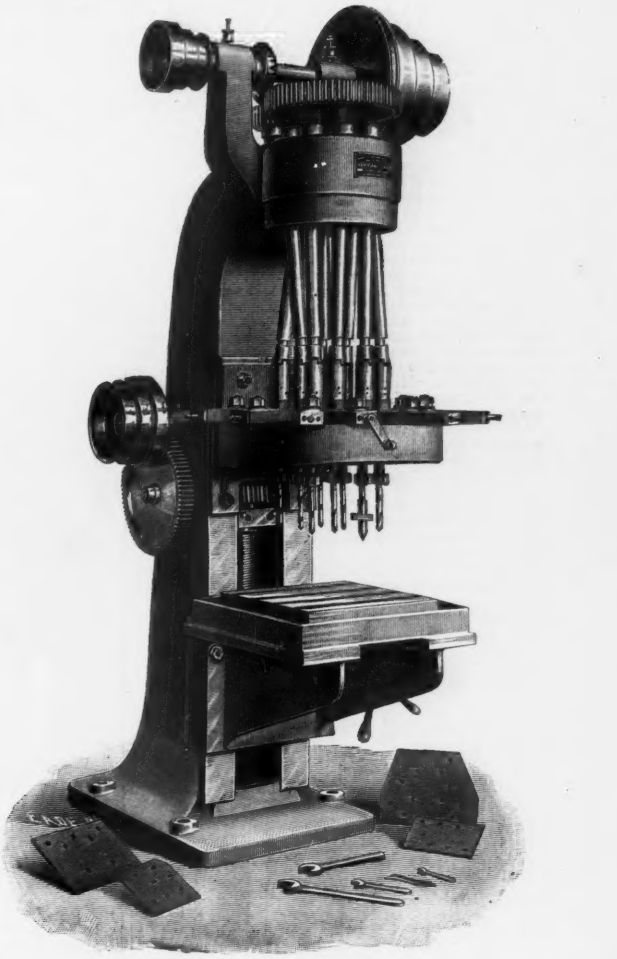
## THE HIBERNIA—THE FASTEST RIVER BOAT AFLOAT.

The above engraving represents the Hibernia, a boat built and engined from the designs of Mr. G. F. G. De Vignes, by Messrs. Simpson and Strickland, at Teddington. It is, we believe, the fastest boat of its size afloat, and a trip in it is an experience. At ordinary speeds the Hibernia behaves like an ordinary boat, cutting her way through the water and leaving a moderate impression in the form of shore waves. With a slight touch of the regulator she leaps forward, and as the speed increases, she gradually sinks a little by the stern, rises a little at the head, until at a certain high speed the bow rises clean out of the water, and the boat flies along at the top of it, throwing a double wall of spray, between which she flies at a speed of about 29 miles an hour with the stream, and

# MULTIPLE DRILLING MACHINE—ANTWERP EXHIBITION

MESSRS. HABERSANG AND ZINZEN, DUSSELDORF, ENGINEERS





26¼ miles against the stream, as measured and remeasured at Mousley. There is but little chance of making these speed trials, and very great risk in making them in this part of the river, for amongst other difficulties which arise are the objections which owners of houseboats urge against having their boats lifted up on the banks and left there. Some idea of the power of this boat, which is the property of Mr. R. H. Lebat, of Hampton Wick, may be gathered from the following statement of dimensions and engine power:—The length of the boat is 48ft. 3in. over all; breadth, 7ft. 3½in.; draught, 1ft. 4½in.; and depth of propeller below the water line, 2ft. 5in. The boiler is of steel, locomotive pattern, with barrel $\frac{5}{16}$in. thick, quintintupal riveted in longitudinal seams. The engines are two-cylinder, both high-pressure, 7½in. diameter, stroke 6in., revolution about 750 per minute up to 1050 revolutions per minute when doing the highest speed. The propeller has three blades of hammered double shear steel with carefully prepared surface and knife edge, keyed in a wrought steel boss and accurately balanced. The engines are of small dimensions, except in the wearing and hard-working parts, and here the dimensions are very large, and at first glance disproportionately strong. Every detail has been most carefully designed, and carried out with equally careful workmanship and excellent finish. The boat was built for Mr. Lebat, chiefly for umpire work at regattas and coaching university crews, and it began coaching for the last races within an hour of steam being first raised. From that time to about three weeks ago the boat ran over 3300 miles without the touch of a spanner, and at that time the propeller, having hit the good hard below Richmond, it was necessary to examine it, and the engines were at the same time examined, but no adjustment was necessary except in the two big ends. We have never seen a finer piece of work than these little engines, and Mr. Lebat is to be congratulated on the high quality and performance of both engines and boat.

## THE PHŒNIX DRILLING MACHINE.

In The Engineer of August 3rd there was a short notice of a new multiple drilling machine, made by Messrs. Habersang and Zinzen, of Düsseldorf, which is being exhibited at the Antwerp Exhibition. Several different types of this machine are made, of which our illustrations show two, both vertical, but the same principle is being applied to horizontal drilling and boring machines.

The chief peculiarity in this machine is, that the shaft which carries the drill is in three lengths: the upper or driving piece, the lower one which carries the drill, and the length which connects the two. This middle piece is joined to the others by clutch couplings. The inside of each clutch is hollowed out, and a steel ball is placed between the two lengths. The connecting pieces are in two parts, with spigot and faucet joint. Underneath the spigot is a strong spiral spring, which serves to press the two ends of the middle length against the balls. A central vertical shaft is driven by means of bevel gearing from a horizontal shaft carrying a belt pulley, and on this shaft is a spur wheel, driving six spur pinions on the upper lengths of the drill shafts. Thus these upper lengths are always vertical, and their centres are always in the same position. The lower lengths, which carry the drills, are also always vertical, but they can be made to change their positions, and the method of effecting this change constitutes the difference between machines Figs. 1, 2. The middle lengths have generally an oblique position, but the springs are sufficiently powerful to ensure that the balls are always pressed firmly into their sockets. A belt from a pulley on the main shaft to another one at the side of the machine drives a worm wheel, by which the table is slowly raised, as the drill spindles cannot be lowered.

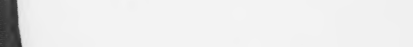


Fig. 3—DRILL SPINDLE HOLDER

The A type of machine—Fig. 1—is intended for drilling flanges or similar objects, where it is necessary that all the holes should be equidistant from a common centre. They can be made with five, eight, or any other number of spindles, but the one shown in the illustration has six. The lower lengths, holding the drills, are carried by a circular drill holder, supported by a ring projecting from the middle of the cast iron frame of the machine. When four equidistant holes are required, the holder which is in position is taken out, and the one shown on the ground is substituted. The drill holder has radial slots, allowing the guides which carry the drills to move to or from the centre. These guides are connected with one another by bevel gearing, and they work on screws. The end of one of these screws projects, and when turned to the right by means of a wrench or key, it moves all the drills further apart, whilst turning to the left brings them nearer together. By means of a scale on the drill-holder, and an index on one of the guides, the machine can be set to the pitch circle required without measuring. In the smallest current size of this machine the diameter of the pitch circle varies from 1¼in. to 4in., and in the largest from 4in. to 16in.; but horizontal machines are being made with pitch circles up to 40in. diameter. For boring holes in the flanges of pipes, &c., the horizontal machine is made with two sets of drills, and the position of the heads are adjustable so that the flanges at each end of a pipe can be bored simultaneously.

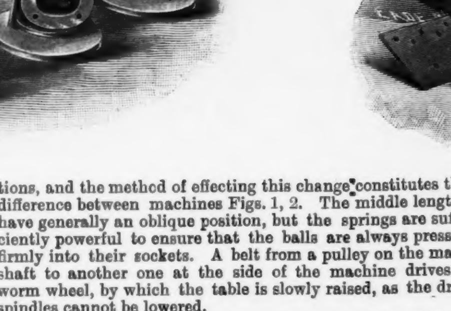


Fig. 4—DRILL SPINDLE HOLDER

The jointed drill spindle is the same in the machine—Fig. 2—as in the one already described; but instead of the circular drill holder there is a strong ring with a circular slot. Separate holders are provided for each drill spindle, and these are held in position by a bolt running in the circular slot. There is also a slot in each of these holders, so that they can be made to slide backwards and forwards, as well as to take any position round the circle, and they are then secured by the bolt. When necessary, the plate carrying these holders is divided into degrees, so that the machine may be set for the same work as the other. But in this machine the chief advantage is that the drills may be set in any irregular relative position, so that the larger sizes of the machine are useful for cover plates and similar pieces of structural ironwork, and the smaller ones for knife handles, locks, &c. 360 ¾in. holes were recently drilled through ⅝in. iron plate in an hour by an 8-spindle machine, and one of the smaller machines has drilled 1000 holes in the same time.

The two smaller illustrations show the drill holder of a third type of vertical machines combining the advantages of the other two. Radial grooves are cut in the circular piece, which carries the drill guides, and there are similar grooves in the guides. When a strip connecting these is inserted they can only move radially. In Fig. 3 the drills are equidistant, whilst in Fig. 4 they are in no regular position. In the larger machine there is an ingenious arrangement for preventing the waste of oil. All that falls on the table passes down a pipe into the receptacle in the frame, from which it is raised to the top of the machine by a small centrifugal pump, to be used again.

## METHODS OF DETERMINING THE DRYNESS OF STEAM.[1]

By W. C. Unwin, F.R.S., M. Inst. C.E.

The determination of the quality of steam, or its wetness, has come to be of very great importance both in boiler trials and engine trials. It was in the classical researches of G. A. Hirn at Logelbach in Alsace, in 1854-57, and in subsequent experiments by MM. Grostête, Hallauer, and Leloutre, and other members of the Société Industrielle of Mulhouse, that the great importance of the action of water in the steam engine cylinder was first clearly recognised. It was perceived that the water present in the cylinder, and which may amount to 50 per cent. of the steam introduced, was due to three distinct causes:—(a) Initial wetness of the steam; (b) condensation in the mass of steam due to adiabatic expansion; (c) the action of the cylinder wall. An accurate discussion of the results of an engine test is impossible if the initial condition of the steam is unknown, both because the total heat per pound of steam received by the engine depends on its dryness, and because water introduced with the steam increases the prejudicial action of the cylinder wall.

---

[1] Report of the Committee, consisting of Sir F. J. Bramwell, Bart. (chairman), Professor T. H. Beare, Mr. Jeremiah Head, Professor A. B. W. Kennedy, Professor Osborne Reynolds, Mr. Mair Rumley, Mr. C. I. Wilson, and Professor W. C. Unwin (secretary).

In boiler tests the evaporative efficiency is measured in pounds of water converted into steam per pound of coal. But if part of the feed-water supplied leaves the boiler as water entrained in the steam, the real evaporation is less than the apparent evaporation. The entrained water must be allowed for in estimating the evaporative efficiency of the boiler. Further, a boiler which supplies wet steam is a bad boiler, because wet steam is prejudicial to the efficiency of the engine, and it should be one object of a boiler trial to determine whether the steam is of good quality.

The earliest attempts to determine the amount of moisture in steam which have come to our knowledge were made during some boiler trials by a committee of the Société Industrielle of Mulhouse.[2] This committee tried three methods:—(1) A method of separation: The whole of the steam was taken through a spare boiler, without fire, in the expectation that the moisture would be deposited. The increase of water in the spare boiler during a trial was measured, and that part of the increase due to condensation by radiation was determined by a special experiment. (2) A condensing method suggested by Hirn: Some of the steam from a boiler under trial was condensed and its total heat determined. By comparing the total heat per pound with that of dry saturated steam the amount of moisture was ascertained. (3) A chemical method: Salt was introduced into the boiler, and the diminution of saltness of the boiler water during a test determined. It was assumed that moisture in the steam would be of the same saltness as the boiler water, and therefore the amount of salt removed measured the wetness of the steam. In these early trials only the second method appeared to give reasonable results. But the committee did not place full reliance on any of the methods tried.

*Origin of the water suspended or entrained in steam.*—There are three sources of the water found in steam:—

(1) By ebullition boiler water is projected into the steam space. Part falls back, but part is carried on in the steam current. The extent to which wetness may be thus produced depends on the activity of the ebullition, the area of the water surface, the volume of the steam space, the position of the steam valve, the density of the steam, and other circumstances. In certain conditions of the boiler water it foams, and the steam space is filled with vesicles. Under such circumstances the mechanically produced priming may be excessively severe.

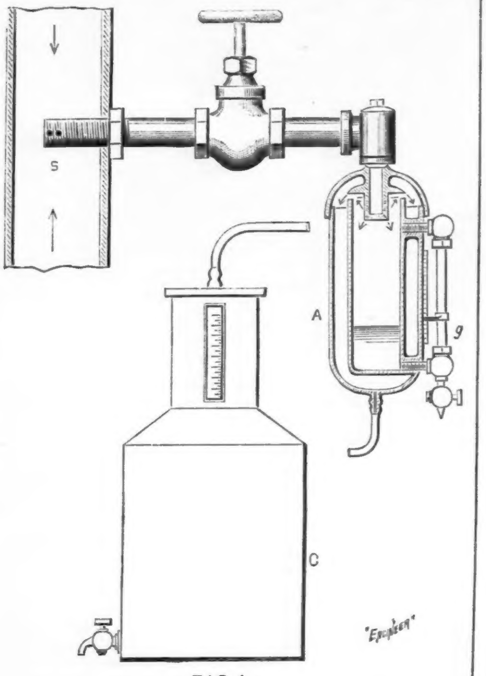


FIG. 1

As to priming of this kind some observations of Mr. Thornycroft on a boiler with glass ends are very instructive.[3] He states that "waters which cause priming on boiling produce foam, consisting of a mass of bubbles of various sizes. Water which is very bad produces bubbles so durable as to remain a considerable time without breaking, and by them the steam space of a boiler may be entirely filled. So soon as this takes place, instead of simply steam leaving the boiler, the discharge consists of foam, which is broken up in its rapid passage through the steam-pipe. With pure water, steam retains no film of liquid for sufficient time to be seen.

(2) The steam in the boiler is subject to variations of pressure. Bubbles formed under water rise to a region of less pressure. Fluctuations of pressure arise from the intermittent demand for steam. During expansions water must be formed as mist throughout the mass of the steam. It is difficult, however, to suppose that any great quantity of moisture is thus produced.

(3) The steam in the steam space of the boiler, and when flowing through the steam pipes, loses heat by radiation from the boiler roof and the surfaces of the pipes. To this must correspond condensation of part of the steam. Probably in some cases very considerable amounts of moisture are produced in this way.

*Methods of determining the wetness of steam.*—Very different methods have been tried by different observers to determine the amount of moisture in steam. Some method is required sufficiently accurate for practical purposes, and not involving excessively delicate measurements or complicated apparatus. It is proposed to describe all the methods which have been tried which seem at all likely to be useful, and finally to give the results of some comparative trials made for the committee which throw light on their relative trustworthiness.

I. *Weighing method.*—A method of direct weighing of a known volume of a sample of steam has been proposed by Guzzi[4] and Knight.[5] A copper globe is used as a measuring vessel, which is placed in a receiver connected with the boiler or steam pipe. After filling it is taken out and weighed. Let V be the volume of the globe, $w$ the weight of wet steam in it. Let $(1 - x)\,w$ be the moisture, and $x\,w$ the steam in the globe, and let $v$ be the volume in cubic feet per pound of dry steam in the same conditions of pressure and temperature. Then

$$(1 - x)\,w = w - \frac{V}{v}$$

$$x = V/vw$$

The method is one obviously of excessive difficulty.

II. *Separating method.*—Attempts have been made to ascertain the amount of moisture in steam by measuring the quantity of water trapped in a separator, between the boiler and engine, through which the whole of the steam passed. Probably such separators are too small relatively to the amount of steam flowing through them to detain the whole of the moisture. Mr. G. A. Barrus, in using a small separator in connection with a super-heating calorimeter, noticed that very nearly the whole of the moisture was caught by the separator. In that case the quantity of steam passing through the separator is small.[6] More recently Professor Carpenter, of Cornell University, has brought out a form of separating calorimeter of small size which can be applied almost anywhere on a steam pipe or boiler, and which can be used with very great facility. The separating calorimeter—Fig. 1—consists of a vessel A, about 12in. by 3in., consisting of an inner chamber and a jacket. The steam from the steam pipe S passes first into the inner chamber, where the moisture is separated, and thence into the outer chamber. The separating chamber is, consequently, almost perfectly protected from radiation. As the water accumulates in the inner chamber its level is shown by a gauge glass $g$, and the amount can be read off on a scale. A very small orifice at the bottom of the outer chamber regulates the amount of steam discharged. The steam as it escapes passes through a flexible tube to a simple form of condenser C. The increase of weight of the condenser in any given interval of time is noted, and the amount of water deposited in the same time in the separator. If $x$ is the dryness fraction of the steam, $w$ the weight of water caught in the separator, and W the weight of steam condensed,

$$x = \frac{W}{W + w}$$

The scale on the separator is graduated to $\frac{1}{100}$ths of a pound. There is also a gauge glass and scale on the condenser, graduated to read pounds and tenths at a temperature of 110 deg. Fah. But as the variation of volume of the water with temperature affects the readings considerably, it is best to weigh the condenser, or at any rate to determine a correction of the scale for temperature. Professor Carpenter states that the dryness of the steam after passing the separator was tested in the laboratories of Sibley College by several observers, and with steam carrying from ½ per cent. to 60 per cent. of moisture. In every case the separation of the water from the steam was complete and perfect.[7] Other tests have been made with moderately dry steam, using the separating and throttling calorimeter simultaneously, and the results were practically identical. The instrument is very simple to use, and requires no pressure gauges or thermometers.

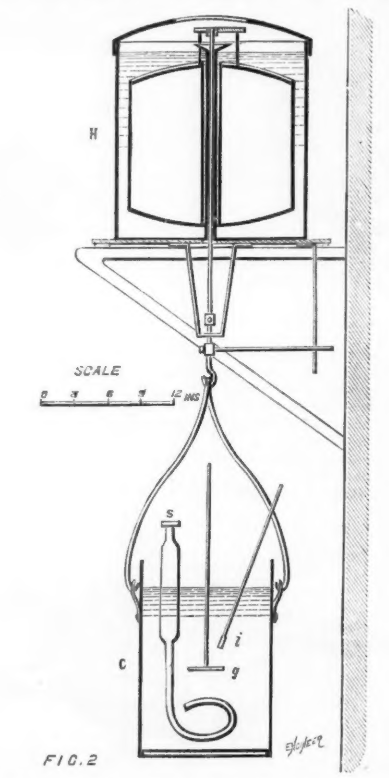


FIG. 2

III. *Condensing method.*—Suppose a known weight of the steam condensed and its total heat determined. By comparing this with the total heat of an equal weight of dry saturated steam, according to Regnault's Tables, the amount of moisture in the steam can be determined. The apparatus designed and used by Hirn in the Mulhouse trials in 1859—Fig. 2—is, so far as we know, the most convenient and perfect apparatus hitherto used in trials of this method. It consists of an iron vessel C, about 1ft. in diameter, furnished with a loose cover. This is the condenser. A small pipe and cock in the steam pipe deliver steam, through a small orifice near the steam pipe, into the pipe S. An agitator $g$ and a sensitive thermometer $i$ are provided. The condenser is suspended from a hydrostat H, which permits extremely accurate weighing of the amount of steam condensed. Let $x$ be the dryness fraction of the steam, $w$ the increase of weight of the calorimeter. Then the condenser has received $x\,w$ lb. of dry steam and $(1 - x)\,w$ lb. of water at the steam temperature. Let W be the weight of water initially in the condenser plus the equivalent reckoned as water of the condenser itself. Let $t$ be the temperature of the steam, and $i$ and $f$ the initial and final temperatures of the condenser water. Then

$$x\,w\,(1116 - 0{\cdot}71\,t) + w\,(t - f) = W\,(f - i)$$

$$x = \frac{W\,(f - i) - w\,(t - f)}{w\,(1116 - 0{\cdot}71\,t)}$$

To arrive at satisfactory results the temperatures must be read to $\frac{1}{10}$ deg. at least, and the weight of steam condensed determined very accurately. Further, it is desirable that the temperature $i$ should be about as much below the temperature of the place where the test is made as the temperature $f$ is above it. A correction is easily made for the small fall of temperature by radiation during the time the agitator is used to secure uniformity of temperature. Suppose the agitator is used for two minutes and the temperature $f$ then noted. The temperature is again noted two minutes later. The small observed fall is the loss in the interval by radiation, and is added to the observed temperature $f$ as a correction. In the Mulhouse experiments the initial and final temperatures of the condenser were generally about 60 deg. and 110 deg. Fah. The following table gives the results of the Mulhouse tests in 1859. They were made very carefully, and Hirn himself directed the tests.

The committee at Mulhouse in discussing these results point out their variability, and remark that a mean of numerous observations should be taken. This is probably true when the test is made on a small scale. In Mr. Willan's tests 1 cwt. of steam was condensed in each test, and this gives what is virtually a mean of numerous smaller tests. In the case of Trial 23, the Mulhouse Committee thought that the calorimeter underestimated the amount of priming water.

About 1860, Joule used a calorimeter very similar to the above, in order to determine the total heat of steam and verify Regnault's results. The paper describing the experiments[8] is interesting as showing that fairly accurate results can be obtained by this method, used on a small scale, when the observer is sufficiently skilful. The amount of steam condensed was only from 8700 to 14,100 grains in each test. Temperatures were read to three decimal places. The weight of water in the condenser was about 140,000 grains. The steam flowed into the condenser for two minutes. The steam must have been almost perfectly dry, as the following—mean—results show:—

| Pressure of steam. In. of mercury. | Total heat. Observed. | Total heat. By Regnault's tables. |
|---|---|---|
| 37·25 | 638·43 | 638·77 |
| 57·52 | 644·77 | 642·87 |
| 111·58 | 655·45 | 649·60 |

The method has been often used in determining the wetness of steam in boiler trials, but very often the arrangements have been so rough that no reliance can be placed on the results. A calorimeter of this kind is called in America a barrel calorimeter. The barrel test is carried out thus:—An ordinary oil barrel is used, fitted with an outlet valve. A set of tests are made following each other rapidly, and an average of the results is taken. The barrel is filled and a trial made, the results of which are discarded. The object seems to be to heat up portions of the apparatus and the barrel itself. The barrel is then refilled, weighed, and the temperature of the water taken. A steam pipe connected to the boiler is then blown through to warm it, and a movable pipe is attached leading to the barrel. The steam valve is then opened and the steam condensed in the barrel, till the temperature has risen to about 110 deg. Fah. The valve is shut, the movable pipe removed, the water stirred, and the barrel again weighed and its temperature taken. It is obvious that the proceeding is a very rough one. Losses of heat by radiation, &c., tend to make the observed total heat too small, and therefore the moisture in the steam too large. On the other hand, evaporation from the barrel tends to make an error of the opposite kind. It is known that in using this method in a rough way negative results are sometimes obtained.

BOILER TRIALS AT MULHOUSE.

*Trials with Hirn's Calorimeter on the Quantity of Water Entrained in Steam.*

| No. of trial. | Date, 1859. | Boiler. | Level of water, mm. | Pressure in boiler in atm. | Weight of water entrained, grams. | Weight of water entrained, per cent. | Remarks. |
|---|---|---|---|---|---|---|---|
| 1 | Sept. 6 | Prouvost | Nearly constant. | 4·0 | — | 16·0 | The water levels are the heights of the water in the boiler above bottom of gauge glass.<br>Trials 6 to 16 with steam taken from top of steam pipe. |
| 2 | 6 | | | 4·7 | — | 3·3 | |
| 3 | 6 | | | 4·75 | — | 3·4 | |
| 4 | 7 | | | 4·4 | — | 3·5 | |
| 5 | 8 | | | 4·15 | — | 3·4 | |
| 6 | 16 | | | 4·5 | — | 3·7 | |
| 7 | Oct. 5 | Molinos & Pronnier. | — | 4·6 | — | 4·6 | In trials October 5 to 11 steam was taken from top of steam pipe.<br>In Trials 15, 17, 25 steam was taken from the outside of a bend in the steam pipe. |
| 8 | 6 | | — | 4·8 | 37 | 4·2 | |
| 9 | 6 | | — | 5·2 | 54·7 | 7·1 | |
| 10 | 8 | | + 28 | 4·75 | 19·8 | 2·2 | |
| 11 | 8 | | 0 | 4·8 | 20·1 | 1·9 | |
| 12 | 8 | | + 15 | 5·2 | 26·8 | 2·4 | |
| 13 | 8 | | — | 5·2 | 37·8 | 4·8 | |
| 14 | 11 | | − 15 | 4·75 | 20·8 | 2·5 | |
| 15 | 11 | | − 15 | 4·75 | 43·5 | 6·8 | |
| 16 | 11 | | − 15 | 4·75 | 120·4 | 12·5 | |
| 17 | Oct. 12 | Molinos & Pronnier. | − 25 | 5·1 | 40·5 | 4·4 | Trials 14, 16, 18, 24, with steam from the underside of the same bend.<br>Trials 14 and 15, 16 and 17, 24 and 25, were made at the same time.<br>In Trials 27 and 28 steam was taken by a pipe opening at the centre of the steam pipe.<br>In Trial 23 a great deal of water was carried by the steam and discharged by the relief valves. |
| 18 | 12 | | − 15 | 4·6 | 17·3 | 2·0 | |
| 19 | 12 | | − 35 | 5·0 | 34·6 | 4·2 | |
| 20 | 12 | | − 10 | 4·7 | 35·8 | 3·7 | |
| 21 | 12 | | +100 | 5·0 | 56·4 | 6·4 | |
| 22 | 13 | | +210 | 5·3 | 46·1 | 4·9 | |
| 23 | 13 | | +250 | 5·25 | 111·8 | 11·8 | |
| 24 | 13 | | +190 | 5·4 | 16·8 | 2·0 | |
| 25 | 13 | | +220 | 5·1 | 25·0 | 2·8 | |
| 26 | 13 | | +180 | 5·1 | 37·0 | 4·4 | |
| 27 | 14 | | — | 5·1 | 42·2 | 3·6 | |
| 28 | 14 | | + 85 | 5·0 | 35·4 | 1·6 | |
| 29 | Oct. 17 | Zambaux. | + 70 | 4·4 | 60·9 | 6·9 | Trials 29 and 31 with the same arrangement as 27 and 28. |
| 30 | 17 | | + 75 | 4·3 | 10·6 | 1·4 | |
| 31 | 18 | | + 50 | 4·6 | 38·4 | 3·7 | |

Omitting Trial 23, the mean amount of water carried by the steam was 4·4 per cent.

Mr. P. W. Willans uses this method also to determine the wetness of the steam in his engine trials.[9] Mr. Willans uses a very large condensing tank weighing full about three tons, and placed on the platform of a weighing machine. The tank was first balanced so that the weighing machine lever just rose. Then a standard hundredweight was placed on the platform of the machine, and the poise adjusted so that the lever again just rose. The hundredweight was then removed, the temperature of the condenser was noted, and the steam condensed in the tank till the lever rose—making an electric signal. The steam at that moment was turned off, and the tank contained exactly one hundredweight of condensed steam. The condensing water was then stirred and the temperature taken. The thermometers were sensitive—1 deg. C. corresponded to 1in. in some of them—and they were carefully compared with standard thermometers. A very small radiation correction was made. The value of the dryness fraction found on different days was ·9996, ·9638, ·9949, ·9646, ·9976, ·9893, 1 0072, 1·0048, ·9987. The mean of all is 0·9911, showing an average of about 1 per cent. of moisture in the steam. In spite of the large scale on which the experiment was tried and the care taken, the results are rather discrepant, and two of them give values which it would seem must be erroneous.

(*To be continued.*)

# THE MOST ECONOMICAL TEMPERATURE FOR STEAM ENGINE CYLINDERS, OR HOT *v.* COLD WALLS.*

By BRYAN DONKIN, M.I.C.E.

To obtain the maximum economy, and to reduce condensation in steam engines to a minimum, should be the object of the engineer. More especially is this the case because he has to deal with such a very sensitive vapour as steam, which is easily and quickly affected when brought in contact with highly conductive metal walls. In working with steam cylinders the aim should be to obtain the maximum area of indicator diagram with the smallest amount of water, and not only to keep all the internal surfaces as dry as possible, but also to reduce to a minimum the depth to which the heat penetrates the walls. The author wishes to call attention to the importance of the question of the most suitable temperature of cylinder walls. It is with a view to determine this point, if possible, for a given set of working conditions, and a given temperature of steam, that the following considerations are laid before you. To diminish initial condensation, experiments have shown that it is essential to reduce the difference of temperature between the steam and metal in contact with it. If this difference is small the exchanges of heat between the metal and the steam will be less rapid, and a smaller proportion of the surface of the metal will be heated and cooled per stroke. In most steam engines the cylinder walls are much colder than the steam, and consequently from 40 to 50 per cent. of the steam entering is condensed during admission. But if the walls are hotter than the initial steam, condensation is much reduced. In a number of experiments, extending over several years, the author has invariably found that the nearer the wall temperature is to the temperature of the working steam, the greater the economy. When, as is often the case, the walls are 40 deg. to 60 deg. colder than the steam, both condensation and consumption of steam are greatly increased. In surface condensers the thin pipes are kept about 60 deg. to 80 deg. Fah. cooler than the exhaust steam, by means of cold water circulating round them, and efficient condensation is thus obtained. In steam engine cylinders, where the contrary effect ought to be aimed at, the arrangements made result unintentionally, but generally with complete success, in condensing great quantities of steam, by presenting large surfaces much colder than the hot vapour.

---

[2] "Report of MM. E. Burnat and E. Dubied," *Bulletin de la Société Industrielle de Mulhouse*, 1859.

[3] "Circulation in the Thornycroft Water-tube Boiler," Trans. Inst. Naval Architects, 1894.

[4] *Review Industrielle*, 1878, page 102.

[5] *Journal* of the Franklin Institute, 1877, page 358.

[6] See Barrus "Boiler Tests," Boston, U.S.A., 1891, page 258.

[7] See "Experimental Engineering," by R. C. Carpenter, New York, 1892, page 400.

[8] The scientific papers of J. P. Joule, vol. i., p. 482.

[9] "Economy Trials of a Non-condensing Steam Engine," by P. W. Willans, "Proceedings" Institution Civil Engineers, vol. xciii., page 23.

* Paper read before the British Association at Oxford.

Experiments show that walls hot, relatively to the steam, give economical, and walls relatively colder, uneconomical results. On the other hand, the metal cylinders may be heated too much, and heat sent to waste into the condenser or the air. This is the other extreme to be guarded against, but it is seldom found in practice. Unquestionably the walls can be too hot as well as too cold for the maximum economy. When, however, the temperature of the surfaces is somewhat higher, or about equal to that of the steam, the best results in steam economy are generally attained. This will hold good for any cylinder in any type of engine, single, compound, or triple. The walls should be rather hotter than the working steam inside. External radiation should be considered, and it must not be forgotten that to raise the temperature of the cylinder increases the loss under this head, which, however, is relatively small. The experiments added will, it is hoped, prove the marked advantage of raising the temperature of the walls. There are various ways of making these boundary surfaces hotter, the most usual being the application of steam jackets to the cylinders and covers. Another method is the use of superheated steam, which has been found by experiment to produce considerable economy. Not only does this steam raise the temperature of the walls considerably, but being superheated, it is able to part with its extra heat without condensing. A third arrangement is to pass the gases of combustion from a steam boiler or other furnace round the cylinder, thus forming a jacket of hot air. This has been tried but with little success, as the hot gases not only part with their heat very slowly, but deposit soot and dirt. Hot mercury jackets have also been used, as well as jackets having a vacuum in them. In steam engines it is important, not only to diminish the volume of the clearance spaces at each end of the cylinder, but especially to reduce the extent of the clearance boundary surfaces. All useless projections and hollows should be avoided, because it is the total areas of these surfaces that is heated and cooled at each stroke. In other words, so many pounds of iron are raised in temperature so many degrees, and it is heating up this weight of metal that produces condensation. The character of the clearance surfaces, whether rough from the sand or turned, clean or dirty, and their position, whether vertical, inclined, or horizontal, will also have some influence on the condensation. This is proved by recent experiments, which have shown that the water drops, caused by condensation, run off more or less easily from the surfaces, according to whether they are rough or smooth, and thus affect the transfer of heat by altering the thickness of the non-conducting film.

*Methods of taking the temperatures of cylinder walls.* — As the cylinder wall temperatures have such an important influence on the working of steam engines, it is desirable to adopt some reliable and practical method for ascertaining them. They should be taken in each experiment, and the working conditions of the engine varied. The author has employed a system which he has found convenient and easily applicable; but he hopes that as the subject is more appreciated, other methods may be proposed, particularly for taking the temperature of the innermost part of the cylinder walls, say from 2 mm. to ½ mm. thick. In quick-running engines it is this fractional thickness that fluctuates with the whole temperature of the steam range, often 100 deg. to 150 deg. per stroke. For some years the method adopted by the author has been to drill small vertical holes, 3in. long, into the cylinder walls or covers. In an ordinary 1in. wall, four or five holes, 1½ mm. diameter, can be made. These are filled with mercury, and mercurial thermometers about 1 mm. diameter introduced into them. In some of the earlier experiments 4 mm. diameter holes were used with 3 mm. thermometers. With an engine not working and with a given pressure of steam in the jackets, it is easy to check these temperatures, as they ought practically to correspond with those of the steam. Other ways of verifying this method were also adopted and found satisfactory.

Experiments have shown that the cylinder wall in any working engine is divided into two parts, the outer portion remaining at a constant temperature, and the inner, or what may be called the "periodic" portion, being heated at each steam, and cooled at each exhaust stroke. The relative proportions of these two sections, or the depth to which the heat penetrates the metal, depends chiefly upon the speed of the engine and the temperature of the cylinder. In the larger and non-fluctuating portion of the metal wall, the temperatures taken in the way above described are correct. In the smaller "periodic" part, however, the results will not be quite so accurate, as the fluctuations of temperature in the metal lag, to a certain extent, behind those of the steam, and the readings will be only a mean, and not represent the whole range of metal temperatures, except perhaps in very slow running engines. Had it been possible to use some more perfect type of electrical or metallic thermometer, the range of temperature of the part of the wall nearest the steam, shown in the thermal gradients, would no doubt have been greater, as represented by the dotted lines. It is, however, a difficult problem to determine accurately the highest and lowest temperatures of this innermost portion of the cylinder wall, say, 1 mm. thick, with an engine running at 200 revolutions, and having a temperature range of, say, 100 deg. But this question does not affect the comparison of the temperatures of the walls in these experiments, as they were taken in the same way throughout. The method has been described in papers in the "Proceedings" of the Institution of Civil Engineers, and thermal gradients are added both for jacketed and non-jacketed cylinders. A certain weight of metal, forming part of the internal surface of an engine cylinder, is first cooled to nearly the temperature of the condenser, and, during the next stroke is heated up very rapidly, about 100 deg. to 150 deg., to the temperature of the steam, at the expense of the heat contained in it. In a non-jacketed engine for instance, running only at 35 revolutions per minute, and having 1in. walls, the temperature at a depth of about 8 mm. from the internal surface was found to be constant, but at 1½ mm. from this surface the mercury in the thermometer rose and fell regularly at each steam and each exhaust stroke. The depth of heat penetration for the same speed is much smaller with hot than with cold walls; there is less weight of metal to be heated up by the steam at each stroke, and condensation is found to be less. From observations on a non-jacketed Revealer, with walls much colder than the steam, it has been found that the drops formed by the condensation of the steam vary from about 1·20 mm. diameter to 4 mm. diameter, but with hot-jacketed walls they never exceeded about ½ mm. The effect of time—or the duration of a stroke—should also be considered when studying the transfer of heat from the steam and the cylinder walls. Taking two experiments on the same engine not jacketed, one running at 220 revolutions, and the other at 117 revolutions, the temperature of the wall and the cut-off being about the same in both, the gain in economy was found to be 11 per cent., due to the higher speed. At the small number of revolutions, the time allowed for condensation on the walls was double, but nearly all the condensation takes place before the piston moves.

(*To be continued.*)

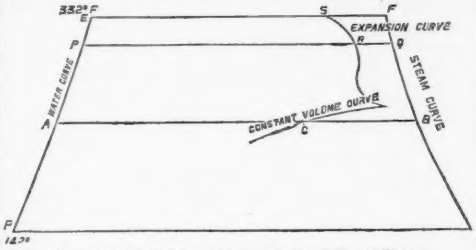
## THE TEMPERATURE ENTROPY DIAGRAM.*

By H. F. W. BURSTALL, M.A., Wh. Sc., Assoc. M.I.C.E.

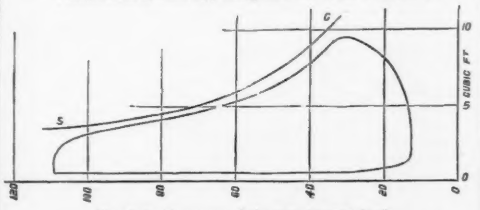
THE author has recently given an account of the construction and uses of this heat diagram before Section G of the British Association at Oxford, and in the present article proposes to deal with the question from a common-sense point of view. We are all familiar with the pressure volume diagrams which the indicator gives us direct from the engine; on such a diagram an area represents the external work that is done by the expanding gas contained in the working cylinder. It is often useful to know not only the work done, but also the heat which has had to be expended, to enable the engine to give out the external work; this heat is shown graphically by the temperature entropy diagram, which, in spite of its formidable name, is by no means difficult to construct and interpret. To the engineer the word entropy has no physical meaning, and it is often supposed that only the mathematician can deal with such quantities.

In order to fix the ideas, let the reader imagine for a moment that he has before him a vessel containing 1 lb. of water above absolute temperature denoted by T—that is, the temperature is measured from a zero 461 below the zero of the Fahrenheit scale. Now, let a small quantity of heat, say of thermal units, be added to the water, which, will of course, raise its temperature. If we divide the heat added by the absolute temperature T, we obtain a quotient which is called the entropy of the water for the given charge. In the case of water, the entropy is obtained by imagining the heat to be continuously added in very small quantities, and each time dividing by the absolute temperature at which heat is added, we thus obtain a very large number of very small quotients. The sum of the quotients has to be obtained mathematically, the result being that if we commenced adding heat when the temperature of the water was T and ceased when the temperature was $T^1$, the entropy for 1 lb. of water is $\log \frac{T^1}{T}$—the Napierian logarithm is obtained by multiplying the common logarithm by 2·3026. When the water reaches a certain temperature depending on the pressure, further addition of heat causes no further increase in the temperature, but the added heat is entirely expended in the formation of steam. The amount of heat required to convert 1 lb. of water into steam at the same temperature is found from the tables, and—to obtain the entropy—all that is required is to divide the latent heat of the steam by its absolute temperature.

It is convenient in drawing the diagram to calculate the entropy from 32; but any other temperature may be chosen. In the heat diagram vertical ordinates represent temperatures, and horizontal ordinates entropies. The water curve is first drawn by obtaining values of $\log \frac{T^1}{T}$ by intervals of, say, 10 deg. for the whole range required. The entropy of steam at the various temperatures is then calculated from the tables, and the values thus obtained are the lengths of the horizontal lines between the two vertical curves. The curved line opposite to the water curve represents the expansion of dry steam, and is the equivalent of what are called saturation curves on the pressure volume diagrams. In order to plot the actual expansion line of any engine on to the heat diagram, we make use of the fact that points along a line of constant temperature show how much steam at that stage has been formed from the pound of water, and the fraction $\frac{PR}{PQ}$ gives the percentage of steam, or what is generally called the dryness fraction. These dryness fractions are calculated for various points on the expansion curve of the indicator diagram, and the corresponding points found on the heat diagram. By joining these points, we obtain the equivalent on the heat diagram of the expansion line, and from that curve it is by no means difficult to see when heat is passing from the steam to the cylinder walls, or *vice versâ*. When the valve opens to exhaust, we have the pressure falling at constant volume until the bottom of the indicator card is reached. To draw these constant-volume lines is a simple matter. Let A B—Fig. 1—be a horizontal line at temperature T, and V the volume of 1 lb. of dry steam at that temperature; $x_0$ and $v_0$ the dryness and volume at the point where the constant volume curve commenced. If we take $AC = AB \frac{x_0 v_0}{v}$ C will be the point where the constant volume line cuts the line of constant temperature.



Temperature, Entropy Diagram, for 1 lb. of Steam



Absolute Pressure, 1 lb. per square inch

From the nature of the diagram, a vertical straight line expresses the fact that the entropy of the steam remains unchanged during the expansion, while the temperature alters; therefore constant entropy implies that no heat is added, or a vertical straight line represents the equivalent of what are known as adiabatic expansions on the pressure volume diagrams. By the aid of these principles it is easy to interpret the diagram of any given engine; when the expansion line tends towards the steam line the steam is receiving heat from the cylinder walls, and the water condensed in the earlier stages is re-evaporating; during the constant volume process heat is passing from the steam to the walls, as the curve there tends towards the water-line.

The area A E F D represents the heat available for useful purposes, the engines working between the given temperatures of admission and exhaust; this is the amount of heat which an engine could utilise if there were no losses due to initial condensation, incomplete expansion, &c. The area A E S R C is the heat utilised by the engine under consideration, and the area lying between the line S R C and F D is the amount of heat which the engine has wasted from preventible causes.

The writer considers that the heat diagram can be of real use to those who are engaged in practical work of engineering, as the diagram is a tool which will show graphically, and without abstruse mathematics, where losses of heat take place. As will be seen, the diagrams need only be made once as regards the steam and water lines, and tracings made from the drawing when it is required to tabulate the performance of any given engine.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### ROUGH NOTIONS OF THE MECHANISM OF CHEMICAL ACTION.

SIR,—The following pretends to be no more than speculative, yet it may convey some idea serving as a useful provisional working theory perhaps—in the absence of any—of the *modus operandi* of chemical changes.

We assume molecules to be elastic in order to harmonise with the conservation of energy, and to explain the vibrations of molecules counted by the spectroscope. Secondly, we assume molecules to be of some open structure, so as to be got at or worked by the action of a medium—which freely penetrates even solids through the open molecular structure; and, for simplicity, molecules are taken on the average to have in three dimensions equal extension. The medium we suppose to be constituted as a gas with very minute atoms of excessively long mean path, so as to explain gravity according to a letter—for instance—published in THE ENGINEER, April 10th, 1891, "On the Dynamics of Gravity."

The gross molecules can then be forced together at their edges by the pressure of the streams of excessively minute atoms, which fly through the molecular open structure, sometimes bending the elastic molecules into crystalline forms, natural figures of pressure comparable somewhat to cells of bees.

The gross molecules being elastic and open—elastic filament of some kind—possess an elasticity of form which they tend to conserve, so that their open structure resists with some force attempts to bend it. This resistance in the case of some molecules may be so great as to prevent any notable bending of the molecular peripheries under the pressure of the streams of the atoms of the gas when any two of these gross molecules come into contact. Their elasticity of form prevents "combination," prevents that bending—supposing the filament structure of the molecules to be naturally curved, or even sometimes regularly circular—essential to ensure contact over an adequate surface-length for holding together under the pressure of the streams of minute atoms of the medium.

But let us assume two diverse molecules, say a molecule of hydrogen and one of oxygen, to touch each other at their peripheries. Then one molecule at least of these two may have a comparatively small form-elasticity—perfectly elastic, but less rigid—so as to bend or yield enough under the pressure of the atomic gas, whereby mutual contact over a considerable length of the molecular peripheries is ensured, or the two molecules consequently combine.

What is the effect of this? To shake the molecules violently, as is manifest, and if they are flexible they will vibrate and generate waves in the medium. We see then a flash of light at the combination of the mixed gases oxygen and hydrogen. Also vibratory motion can generate translatory motion, just as translatory motion can generate vibratory. Two freely-suspended vibrating tuning forks placed suddenly in contact will bound apart with some energy, converting vibratory motion into translatory motion, just as—conversely—two rapidly translated tuning forks will be thrown into vibration by their collision. So as we reason independently of scale, oxygen and hydrogen molecules translated towards each other are thrown into vibration, and this vibration of the compound molecules—steam—throws other compound molecules into violent translation whenever encountered, so that in this way—by the simple conversion of vibratory motion into translatory—an energetic translatory motion of compound molecules is set up; and this phenomenon, as a whole, we call the "explosion" of the mixed gases oxygen and hydrogen.

The explosion is initiated by some violent disturbance—a flame a spark, or a very energetic concussion—driving a group of molecules together into adequate proximity; and the wave of translatory motion thus set up spreads from the disturbed centre through the gas, knocking other peripherally elastic molecules into suitable proximity, or thus is their form-elasticity overcome sufficiently for chemical combination.

So it appears we may explain chemical "affinity" generally or broadly as an effect dependent on the elasticity of form of open structural molecules, or on their powers, greater or less, to retain the elastic shape possessed when they are free, which is synonymous, of course, with the power initially to resist approach.

An exceptionally unbending molecule would tend, as we may conceive, to group other more flexible ones about it as a centre; and it may seem relatively easy by the above considerations to explain the explosion of unstable compounds—including solids—by a mere touch. The molecules grouped about each other are nearly bent enough to ensure such a length of peripheral contact as to augment the effective pressure of the medium over the joined parts sufficiently to entail a new and more intimate approach, which occurs even by the slight pressure of the hand, accompanied by a fresh "explosion."

To turn to another branch of this subject briefly: We may remark that molecules united at their extreme edges or boundaries, which constitute crystalline structure, cannot slide or glide over each other, but—according to this view—a crystalline structure must break in any attempt to elongate it notably—take cast iron for example.

But if the elastic molecules be not united at their extreme edges, if they be jostled up sideways in layers, so that the filament boundary of one molecule may, for instance, cross another molecule diametrically or irregularly, as by the processes of rolling or hammering; then the molecules under an applied tensile stress can evidently slide over each other without parting, and so this may account for a bar of malleable iron stretching or elongating with ease when pulled. The molecules of the bar not being joined at their extreme edges or boundaries—as is essential to constitute the regular crystalline structure of cast iron, for instance—can glide, so it may be explained also, possibly, how the same molecules can sometimes assume the symmetrical shapes of crystals and sometimes not; how the same material may, under certain circumstances, be crystalline and under others not so.

To pursue the investigation further would be easy, but the above may serve as a sample of mechanical ideas of small scale motions and reactions under premises very simple, which we may venture to present. Moreover, we may be confident that simplicity of groundwork is the thing to be expected in the case of mechanical processes of whatever kind or scale which effectively serve their end.

S. TOLVER PRESTON.

Hamburg, July, 1894.

### ENTROPY.

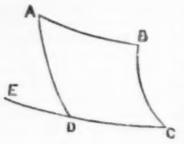
SIR,—Although Dr. Lodge declined to comply with Mr. Oldknow's request to give his own definition of entropy, he did define what he means by change of entropy, viz., that it is equal to the heat added during isothermal expansion, divided by the absolute temperature of expansion. We are therefore in a position to compare Dr. Lodge's change of entropy with the change calculated in accordance with Maxwell's definition of entropy. I have demonstrated that if Carnot's theory of heat is true, neither isothermal expansion nor compression is possible, and no one has attempted to point out any flaw in my demonstration, which, in fact, cannot be refuted. If then Carnot's theory of heat is true, Carnot's cycle cannot be carried out in the way described by Carnot, but the direct cycle can be so carried out, if the theory of the convertibility of heat and work is true, with the exception that the temperature of the source of heat must be greater than that of the operative substance during isothermal expansion, and the temperature of the body which receives the heat must be less than that of the operative substance during isothermal compression, so that the reverse Carnot cycle is an impossibility.

---

* Precis prepared by the author of Paper read before Section G of the British Association at Oxford, 14th August, 1894.

Maxwell gives the following definition of entropy:—"Let the body expand or contract without the communication of heat till it reaches the standard temperature, the value of which on the thermodynamic scale is T. Then let the body be kept at the standard temperature and brought to the standard pressure, and let H be the number of heat units given out or absorbed during this process. Then the entropy of the body in its original state is $\frac{H}{T}$."

Both Maxwell's definition of entropy, and Dr. Lodge's definition of change of entropy, are therefore based on the assumption that heat and work are convertible. Let, then, A B, B C, C D, and D A, represent the four stages of the direct Carnot cycle carried out in accordance with the theory of the convertibility of heat and work, A B being the stage of isothermal expansion. Let $t_1$ $t$ represent the temperatures on the Boyle and Marriotte scale of the stage of isothermal expansion and compression respectively, and let $T_1$ T represent the same temperatures on the absolute scale. Let $p_1$ $v_1$ represent the pressures and volumes at A, $p_2$ $v_2$ at B, $p_3$ $v_3$ at C, and $p_4$ $v_4$ at D. Let D E represent the curve of isothermal compression, when the pressure is raised from $p_4$ to P. Let P be adopted as the standard pressure, and T as the standard absolute temperature. In accordance with Maxwell's definition, the entropy of the body in the thermal state, denoted by the adiabatic curve A D, is equal to the heat emitted during isothermal compression, from the pressure $p_4$ to the pressure P, divided by the absolute temperature T, or is equal to



$$\frac{p_4 v_4 \log \frac{P}{p_4}}{T} = \frac{a\, t \log \frac{P}{p_4}}{T}$$

and the change of entropy produced by the heat added during isothermal expansion at temperature $T_1$ from the pressure $p_1$ to the pressure $p_2$, is equal to the heat emitted during isothermal compression at the temperature T from the pressure $p_3$ to the pressure $p_4$ divided by T, or is equal to

$$\frac{p_3 v_3 \log \frac{p_4}{p_3}}{T} = \frac{a\, t \log \frac{p_4}{p_3}}{T}$$

According to Dr. Lodge's definition of change of entropy, it is equal to the heat added during isothermal expansion at temperature $T_1$ divided by $T_1$, or is equal to

$$\frac{p_2 v_2 \log \frac{p_1}{p_2}}{T_1} = \frac{a\, t_1 \log \frac{p_4}{p_3}}{T_1},$$

because the ratio of the pressure is the same in both adiabatic expansion and compression, and therefore also in isothermal expansion and compression. If, therefore, the zero of the Boyle and Marriotte scale refers to the same thermal state as the zero of the absolute scale, so that $t_1 = T_1$, $t = T$, Maxwell's change of entropy is equal to Dr. Lodge's change of entropy, but otherwise not. Fashionable *fin de siècle* thermodynamicians are therefore in this dilemma: If they affirm that the zero of the Boyle and Marriotte scale refers to the same thermal state as the zero of the absolute scale, since the symbol, $a$, represents a constant number of foot-pounds, they have to admit that both entropy and change of entropy have nothing to do with the thermal state of the body, and, therefore, nothing to do with the science of thermodynamics. If they affirm that the zero of the Boyle and Marriotte scale does not refer to the same thermal state as the zero of the absolute scale, they have to admit that Maxwell's entropy is *toto cœlo* different from Dr. Lodge's entropy.

What is an entropy temperature? Is it supposed to be a temperature on Thomson's Absolute Scale? Entropy is neither a property of heat nor a property of matter. Why should the heat which has to be abstracted during isothermal compression, or added during isothermal expansion, in order to make the adiabatic curve of the relations between the pressure and volume coincide with an arbitrary standard adiabatic curve be called entropy: I must point out to "X." that the word is *entropy* not *entrophy*, and therefore has nothing to do with *nourishment*; and why the artifice should ever have been thought of use in the solution of thermodynamic problems surpasses the power of my imagination to conceive. WILLIAM DONALDSON.

August 17th.

### PATENT MUSEUM, SOUTH KENSINGTON.

SIR,—In connection with "Thamis's" letter in your issue of August 17th, it seems singular that unhappy visitors should be turned out of the above institution in broad daylight, a tidal wave of policemen sweeping them out at 4 p.m. winter and 6 p.m summer.

Perhaps it would tax too much the powers of the hardly-used electric light engine with the painful knock, mentioned by "Thamis," were it called on to contribute to the lighting of these galleries; but an ordinary individual would imagine that at any rate a few modest gas lights could be supplied, so that this interesting collection might be open at hours when business people could avail themselves of the opportunity of inspecting the exhibits, which, to many persons, are at least as interesting as the plaster casts, &c., over the way. E. J.

August 18th.

### THE EIGHT HOURS' DAY IN PORTSMOUTH DOCKYARD.

SIR,—It gave me much pleasure to read an "Old Dockyard Hand's" letter in THE ENGINEER of Friday. He seems to "know all about it," and we shall have some much wanted information.

I said that the men did not like the eight hours because they had to work all the time. I understand that the men undertook to turn out as much work in eight hours as they had before turned out in nine hours. Will your correspondent dispute this? I think not. If not, then it is clear that the men must work harder than they have done hitherto. That is precisely what I said, and I now repeat that there is widespread discontent in the yard in consequence.

As to the rate at which work is done, it is simply scandalous. I have seen the big slotting machine in the turnery working with an 18in. stroke paring the edge of a flange 2in. thick, the tool "going up on Monday, and coming down on Friday." In the same shop on the 12ft. face-plate, I have seen a 3ft. brass plate, an air-pump cover, or such like, with the tool cutting at the rate of 9ft. per minute. I could cite a dozen cases like that. The tools are about three-quarter speeded as compared with private shops.

As to the examinations, the facts are simply as I have stated them. The dockyard chaplain examined the boys, and for the most part he passed the dockyard men's sons instead of outsiders. It was quite natural and proper that he should give the benefit of the doubt to these lads, but the Radical party leaders hold the Established Church to be an abomination, so they "got rid of the parson" and got the Civil Service men to examine, with the result as I have said, that the sons of the dockyard mateys are left out in the cold, and the leaders who brought the change about are anything rather than popular in the dockyard. Now, either what I have said is true or it is not, and I challenge your correspondent to prove that I am wrong. Here are my questions.

First, is it or is it not a fact that the authorities insist on getting as much work done in eight hours as was previously done in nine hours?

Secondly, is it or is it not a fact that the men as a whole are disatisfied, because they have to work so much harder, and numerous little games have been stopped?

Thirdly, is it or is it not true that since "the parson was got rid off," the percentage of dockyard mateys' sons admitted as apprentices has been enormously reduced?

Before your correspondent answers these questions, I would advise him to talk to as many mates as he can handily manage. I fancy I know as much of the dockyard as he does, and I do not hesitate to say that I wish we had the old arrangements back again. KEPPEL.

Portsmouth, August 18th.

### ENGINEERS AND ARCHITECTS.

SIR,—With reference to the letter signed "Mechanical Engineer," although not in business on my own account, I have had a good many specifications through my hands, mostly, I may say, electrical, and it appears to me that far too much is left "to the satisfaction of the engineer." Is not the clause I have alluded to far too loose, and if sufficiently guarded, is its necessity obvious?

Of course, I am quite aware that it is in many cases quite impossible to specify in detail each minor item of an important contract, something must of necessity be left to the discretion of contractor and engineer, but I am referring to the general character of too many specifications.

To take an example. An architect accepts a tender on his specification (?) for the electric lighting of a new building, "the work to be done to the satisfaction of the architect," who trusts to making up his lack of knowledge of the subject by what he can pick up afterwards whilst the work is in progress. The result is either that the contractor under this clause is compelled to put in material, &c., which is far above what could be reasonably inferred from the specification, or that the contractor is refused his certificate, solely because the architect has seen something he likes, and insists on its adoption, quite regardless of the fact that such good material was not clearly specified, and that it is not covered by the contract price. I have had more than one case of the sort come before me, and I may say that I am not referring to contracting firms who will do jerry work if allowed, but those who will always give good value for their price. I was informed whilst in Sydney—Australia—some few years ago, that this clause was almost entirely suppressed in Brisbane, by a combination of builders refusing to tender for any work the specification for which included this clause. With regard to the moral question, I think there can be no doubt.

I consider that after a contract has been signed, the engineer or architect has no further concern with questions of cost, save only such adjustment of price as may be necessary on account of alterations or deviations from the original scheme—often necessary, and usually provided for by the specification—his duty being merely to see that the contractor maintains the standard of workmanship and material as laid down by the specification; and I also hold that when work is completed to the specification, or better, if contractor likes, that the engineer is then bound to issue his certificate, quite regardless of whether the purchaser is able to pay the money, his certificate being merely to the effect that certain work has been properly completed under the contract. In short, my own opinion is, that the engineer is in the position of an unbiassed judge between contractor and purchaser. G. T. P.

August 18th.

### THE LOCOMOTIVES OF THE UNITED KINGDOM.

SIR,—The following list, which I have compiled from the official details, shows the locomotive engines possessed by each company on the 31st December, 1893:—

| | Engines. |
|---|---|
| London and North-Western | 2735 |
| Midland | 2217 |
| North-Eastern | 1799 |
| Great Western | 1700 |
| Lancashire and Yorkshire | 1181 |
| Great Northern | 983 |
| Great Eastern | 962 |
| Manchester, Sheffield, and Lincolnshire | 715 |
| Caledonian | 698 |
| North British | 698 |
| London and South-Western | 636 |
| London, Brighton, and South Coast | 434 |
| South Eastern | 392 |
| Glasgow and South-Western | 335 |
| London, Chatham, and Dover | 210 |
| Taff Vale | 190 |
| Great Southern and Western | 178 |
| North Staffordshire | 142 |
| Great Northern of Ireland | 137 |
| Furness | 122 |
| Midland Great Western, Ireland | 114 |
| North London | 105 |
| Highland | 101 |
| Great North of Scotland | 92 |
| Rhymney | 72 |
| Metropolitan | 71 |
| Hull and Barnsley | 69 |
| Barry | 67 |
| Cambrian | 67 |
| Belfast and N.C. | 65 |
| Somerset and Dorset, Joint | 61 |
| Metropolitan District | 54 |
| Dublin, Wicklow, and Wexford | 54 |
| Waterford and Limerick | 46 |
| Midland and Great Northern, Joint | 39 |
| London, Tilbury, and Southend | 31 |
| Brecon and Merthyr | 29 |
| Maryport and Carlisle | 27 |
| Belfast and County Down | 26 |
| Alexandra Dock, Newport | 24 |
| Mersey | 18 |
| City and South London Electric | 16 |
| Wrexham, Mould, and Connah's Quay | 16 |
| Cork, Bandon, and South Coast | 16 |
| Severn and Wye | 12 |
| Londonderry (Sunderland) | 11 |
| Rhondda and Swansea Bay | 10 |
| Waterford and Central, Ireland | 10 |

There are also a number of small lines which possess from one to nine engines each, details of which it is not necessary to give.

Some of the companies—for instance, the Midland, Great Western, &c.—have in addition a number of old or duplicate engines which they do not include in their returns.

The total number of engines on 31st December, 1893, as officially reported, was 18,032. CLEMENT E. STRETTON, C.E.

Leicester, August 13th.

## THE JUNIOR ENGINEERING SOCIETY IN WALES.

THIS society, founded in 1884, has followed the lead of a large number of varied associations in selecting Cardiff as the place for its central annual gathering, prompted by the very hearty welcome extended by Sir W. T. Lewis on behalf of the Marquis of Bute, by the Dowlais and Cyfarthfa Iron and Steel Companies, the Barry Docks and Railway, and various leading industries. It has added to the comfort of the members that the commodious building of the South Wales Institute of Engineers in Park-place was unreservedly placed at their service.

On Monday they arrived in Cardiff from Weston-super-Mare, and in the absence of Sir W. T. Lewis, who was unfortunately unable to be present, were received at the pontoon by Captain Pomery, Mr. Hunter, Mr. David Morgan, and other representatives of the Bute Docks, and at once proceeded to inspect the many and special features of the East, West, and Roath Docks. Under such guidance, very systematically directed, the coal shipping appliances, hydraulic machinery, &c., were brought under notice, and most fortunately the members were enabled to include a thorough examination of the largest steamer that has ever entered the port of Cardiff. This was the Knight Batchelor, lying in the Roath Dock, with a carrying capacity of 9000 tons. She was built by Connell and Co., of Glasgow, and is being loaded with Powell Duffryn coal for India.

The cubic capacity of the steamer is 400,819ft. Her crew consists of fifty Lascars, five engineers, captain, and three officers, four European quarter-masters, a carpenter, and steward. After an exhaustive round, in which the special merits of the Lewis Hunter lift were favourably commented upon, luncheon followed, to which the Society was invited, on behalf of Sir W. T. Lewis, by Captain Pomery, and the remainder of the day was devoted to an examination of the Dowlais Works, Cardiff, under the guidance of Mr. Forster Brown, and the Cardiff Tin Stamping and Enamelling Works by the manager, Mr. Whittaker.

The unavoidable absence of Sir W. T. Lewis at the luncheon was the subject of regret by the Bute officials, as well as by prominent members of the Society. Captain Pomery remarked that, like themselves, Sir William was an engineer, who at one time had all the world before him; and at the present time he was one of the leading mining engineers of the country.

On Tuesday the members visited Cyfarthfa Works. They were met at the railway station by the secretary, Mr. Rogers; the chief engineer, Mr. Hamley; the furnace manager, Mr. Warton; the chief cashier, Mr. Harpur; the mill manager, Mr. Jones; and Lieut. Evans, son of the general manager, and after lunch proceeded to the works, where the new industry, the brick work, was keenly inspected, and its novel features of utilisation of waste forces noted. From thence to the coke ovens, where the leading features, and especially the gravitation of the coke to the blast furnaces, was noted. Next the blast engines and the engine room, all of which came in for high commendation. The engines in this department are of the finest type, duplex, and of great power, one by Davy Bros., Sheffield, date 1888, another by Stevenson, Preston. The great cleanliness and perfect clock-like movement of all come in for special comment, as does also the blowing engine by Adamson, of Manchester; the hydraulic engines by Tannett and Walker, Leeds; and the Galloway range, which was also another of the economic utilisation features of the works. The furnaces and the Bessemer, the rolling, and the mills generally, were next visited in order, and favourable comment passed on the "Skid" engine, which, under the guidance of a mere lad, transferred with great rapidity the steel bars from one point to another.

The visitors had not time to go over all the details, and had to leave the fitting shops, which are in perfect order, as well as the Cyfarthfa "exhibits" unvisited, but they had ample evidence given of the ability with which the leading ideas at Cyfarthfa are carried out, lessened manual labour, promptitude of make from the furnace to the finishing department, utilisation of waste heat, and the adoption of mechanical and engineering appliances in all possible ways. A mass of finished steel bar ready for rolling was the last detail that came under notice, and the members with unreserved praise hastened to the concluding visit of the day—the great colliery of the Dowlais Iron Company, at the Aberdare Junctra, where they were met by the management and taken over the whole of the colliery area, noting the great fan, winding engines, and perfect appliances now ready for the output of coal which apparently is in the near future.

On Wednesday the Society proceeded to Barry Dock, and were received by the officials and afterwards by Lord Windsor and Mr. Archibald Hood, and made a thorough and exhaustive inspection of the whole of the Barry Docks, which claims, and with justice, to take a high stand in mechanical engineering and electric appliances, into which we shall enter in our next. The reception by Lord Windsor was most gratifying, and the members wound up the day with a visit to Penarth Docks, where again the officials, Mr. Thomas, Captain Bangally, and others, extended a very cordial welcome, and gratified the Society with the advanced character of the means for rapid shipment. Mr. Beazley, jun., was present, representing the esteemed manager of the Taff Vale Railway.

## NOTES FROM JAPAN.

(*From a Correspondent.*)

IMMEDIATELY before the war broke out between China and Japan delegates from several of the Loochoo Islands were sent to Tokio to petition the Japanese Government to connect the islands with Kagoshima by a submarine telegraph cable. Owing to the outbreak of the war, however, there has been no satisfactory termination to the negotiations; but it is probable that at its conclusion they will be renewed, and, in fact, as a direct result of the war, improved telegraphic communication with Japan is likely to result.

The knowledge of the Japanese of telephonic and telegraphic matters now compares favourably with European information on these subjects; also, although any European novelty is readily adopted by the Japanese, the national instinct of protection tends to exclude goods manufactured in Europe; and the Japanese prefer to copy our inventions, but to manufacture goods for home consumption by means of Japanese labour, and with Japanese capital. Whatever may be the outcome of the war, however, the result will be seriously to impoverish the Japanese Exchequer, and if the rapid progress which has been going on during the last twenty years is to be continued, the Japanese will perforce have to welcome European capital, and to some extent European skilled labour.

Great difference of opinion exists as to the internal resources of Japan. A mining expert, however, who has had practical experience in the island in connection with the Ashio Copper Mines, regards the outlook in this direction as a very favourable one; and whatever may be the value of the natural resources of Japan, the Japanese are such a go-ahead race that the country should prove a good market for European enterprise, more particularly in connection with engineering work. The large amount of water-power in the island is extremely favourable to electric lighting schemes, and, where heavy plant is concerned, that of English manufacture should find a good market. Where heavy machinery is not required to turn out any given class of apparatus, the Japanese, who are skilful mechanics, produce good work, and in connection with those branches of electricity to which they have turned their attention, improvements in apparatus have been effected which bring Japanese instruments often to a pitch of perfection superior to similar instruments of English manufacture. Prices are, however, high, but the jealousy of European-made goods, to which we have referred above, is sufficient to procure a sale of home-made goods, even where the prices of these are high.

Electric lighting is progressing fairly rapidly, and two new installations have recently been put down—one at Okayama, and one at Maebashi, the former having a steam plant, and the latter a water-wheel. Both these places are now important towns, and the authorities, in adopting the electric light, have only followed an example set by other towns of the same standing.

A serious competitor to the electric light, however, is the incandescent gas light, which is making considerable progress, particularly in Yokohama, where, at the Club Hotel, it has surplanted the electric light. The railway stations at Yokohama and in Tokyo are also being lighted on this system.

The accidents in connection with the earthquake which took place in June have demonstrated the unsuitability of brick buildings to Japanese conditions of existence. The native lath and plaster structures scarcely suffered; and even in the event of their coming down, the materials are so light that serious injury seldom results. Nearly all the modern brick buildings, however, have suffered severely, and if the earthquake had occurred in the night, great loss of life must have resulted. In some few instances, where the brick buildings were of exceptionally solid construction, they withstood the shock, and the iron chimneys which are used in connection with some of the electric lighting stations were also quite unharmed. The experience gained in connection with the recent earthquake will probably lead to an extensive adoption of these chimneys, in place of those of brick construction, nearly all of which came to the ground in places where the shock was severe.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

Authoritative details are this week available of the changes in the American tariff as they affect the iron and steel railway material, and some other of the trades of this district. Iron and steel sheets valued at three cents per lb. or less, from 10 w.g. up to 20 w.g., will now pay a duty of 0·7 cents per lb., against 1 cent per lb. under the old tariff; sheets up to 25 w.g. 0·8 cents per lb., and thinner than 25 w.g. 1·1 cents. Galvanised corrugated sheets are rated at ¼ cent per lb., above the rates just mentioned upon the corresponding gauges, as against ¾ cents under the old tariff. Polished or planished sheets are rated at 1¾ cents, against 2½ cents, and cold-rolled sheets are rated at ⅛ cent per lb. more than the corresponding gauges of black sheets. Iron and steel hoops are rated at 30 per cent. *ad valorem* against 1 cent per lb. under the old tariff. Special provisions are made respecting cotton ties cut to lengths for baling cotton. Ties of 8in. or less in width, and less than ⅜in. thick, and not thinner than 10 w.g., will have to pay 1 cent per lb.; from 10 w.g. to 20 w.g. 1·1 cent per lb., and thinner than 20 w.g. 1·3. cent per lb. Wire rods from Nos. 0 to 6, valued at 4 cents or less per lb., are charged 0·4 cents per lb. against 0·6 cent formerly; and rods over 4 cent per lb. in value, ¾ cent per lb.

On railway and other engineering material, the new American duties are:—Wheels—whether iron or steel, or whether wholly or partly finished—and tires, 1¼ cent per pound, as against 1¾ cents; axles, or parts thereof, 1½ cent. per pound, against 2 cents formerly; and forgings for locomotives, steam engines, or vessels, 1·2 cents per pound, against 1·8 cent per pound. Other iron or steel forgings, of whatever shape or in whatever stage of manufacture, not specially provided for in the Act, are rated at 1½ cents per pound, as against 2 3 cents per pound, always supposing that this charge does not amount to less than a 35 per cent. *ad valorem* duty. Boiler or other tubes are to be now charged 25 per cent. *ad val.* against 2½ cents per pound, and chains of all kinds 30 per cent. *ad val.* against 45 per cent. Castings not forming finished parts of machinery, and not otherwise specially provided, are rated at 0 8 cent per pound.

Interesting reference to a scheme of profit-sharing tried some time ago at Messrs. Tangyes' engineering works is made in a report which has lately been issued from the Labour Department of the Board of Trade. In October, 1883, the firm—who then employed about 1500 hands—introduced a profit-sharing scheme, by giving some of their men bonds for £50, current for one year and issued annually, entitling the holders if continuously in their service during the year, to receive interest "at the same rate per cent. per annum as the rate per cent. per annum declared by the company on their ordinary share capital for the year." If the holder of a bond died before the end of the year, his family became entitled to receive the principal sum secured thereby. After a time it was thought that these arrangements involved an undue degree of publicity in regard to the affairs of the firm, which is a private company, and it was decided that as from July 1, 1889, the bonds should bear a fixed rate of interest—five per cent. Thus profit-sharing was, after a few years' trial, abandoned.

A scheme of profit-sharing which is still in existence at the Spring Vale Furnaces, Wolverhampton, of Sir A. Hickman, M.P., was commenced in 1891, and has reference to about five hundred men. The amount distributed—as bonus—is a fixed percentage of the profits; no interest on capital is charged. At the end of the year the amount is divided in proportion to the wages earned between all the men who have worked during the whole year. The bonus is paid in cash. At the same time a bank was started, in which the men were invited to deposit, 5 per cent. per annum interest being paid on all amounts remaining at least a month. The average ratio of the bonus paid in 1892 and 1893 to wages has been 2·7 per cent. In regard to the results of the adoption of profit-sharing, Sir A. Hickman writes:—"I cannot say that there has been any perceptible result. On the whole, it is considered that as yet the experiment has not been fully tried."

The dispute with the surfacemen and the boys in the North Staffordshire coal trade is practically over, a result due to the conciliatory spirit exhibited by the Midland Coal, Coke, and Iron Company, who employ between 2000 and 3000 hands, and whose works have been closed for some weeks.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—A decided improvement has come over the iron market here, and during the past week or so buyers have been showing much more anxiety to place orders, with the result that a considerable weight of business has been put through, chiefly in pig iron, and makers have been in a position to secure better prices than have been ruling for some time past. Whether this improvement is of a permanent character remains, however, to be seen; there is still no indication that the actual requirements of consumers have increased in proportion to the larger volume of business put through, and perhaps to some extent the greater weight of buying is to be explained by anticipations that the revised American tariff, by stimulating activity in other industries, may indirectly help to give a stronger tone to the iron market rather than any present really reviving activity in the iron trade itself. Consumers and merchants have, no doubt, come to the conclusion that there is little or no probability of prices touching any lower point than has been reached recently, so that even the remotest prospect of outside influences tending to strengthen the position of makers would be sufficient to bring forward orders and contracts which have been held in abeyance; and this might sufficiently account for the extra weight of buying that has been going on during the past week or so. Any improvement so far has scarcely been felt outside the increased demand for pig iron; finished iron makers do not report any larger volume of business doing, and except that the prospect of having to pay more for raw material is necessarily compelling them to take a firmer stand with regard to the prices of finished iron, it can scarcely be said that in this branch of trade the position has materially altered. The steel trade also remains without any appreciable change, and very low prices continue to rule, both for raw and manufactured material.

The Manchester Iron Exchange on Tuesday scarcely brought together an average attendance, many of the usual representatives being away at the Brussels meeting of the Iron and Steel Institute. There was, however, a decidedly improved tone throughout the market, and in pig iron especially a considerably increased weight of business was reported. The tendency towards a stronger tone in prices for pig iron, to which I referred last week, has evidently brought forward previously hesitating buyers, and during the last few days more anxiety has been shown to settle renewals of contracts which had been held in abeyance, with the result that instead of the persistent hanging back and pressure on the part of buyers for further concessions upon quoted rates, makers have been enabled to secure slight advances upon the sales they have made. Lancashire makers, who have all along been considerably above the market as compared with the quotations for low-priced district brands offering here, have not, so far, made any quotable change in their list rates, but they are less disposed to meet buyers with concessions, and are firm at about 40s. for forge to 42s. for foundry, less 2½, at the works. Lincolnshire makers, who have been by far the lowest sellers in the market, having secured a moderate amount of orders at advances of quite 6d. on the prices they were prepared to accept a week or so back, are now holding out for an advance of fully 1s. per ton; and although this advance has scarcely as yet been established by actual transactions of any moment at the maximum figures, they are mostly now firm in quoting 39s. for forge to 40s. for foundry, net cash, delivered Manchester. In Derbyshire iron there has also been a strong upward move, foundry brands having been advanced in some case 1s. and in others 2s. per ton, quotations being now about 45s. and 46s. net cash delivered Manchester. It is reported that at one of the Derbyshire pig iron works, furnaces have been put on eight hours' shifts, which it is estimated will increase the cost of production something like 1s. per ton, and it is expected that other works in the district will have to follow suit, so that this in itself must still further tend to enhance the price of Derbyshire brands. With regard to outside brands offering here, makers of good named foundry Middlesbrough have put their quotations up to 45s. net cash, delivered Manchester. Of Scotch iron there is so little offering in the market that it is scarcely possible to obtain really definite quotations, but it would be difficult to place orders for Eglinton at under about 48s. net prompt cash, delivered at the Lancashire ports.

No very material change can be reported with regard to the position in the finished iron trade. Perhaps here and there a little more buying has been going on, but makers still report only a limited weight of business coming forward, and forges continue short of orders, four days per week being about the average that most of them are working. In view, however, of the upward move in raw material, makers are showing a tendency to harden up in their prices, and although there is no quotable change, £5 7s. 6d. to £5 10s. would now represent the minimum figure for Lancashire and North Staffordshire bars, delivered in the Manchester district. Other descriptions of finished iron remain much as last reported, Lancashire and Staffordshire sheets averaging £7 to £7 5s.; Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

In the steel trade, also, the position remains much as last reported, except that hematites are showing a slight hardening, ordinary foundry hematites not now being quoted under 53s., less 2½ delivered in this district; but ordinary basic billets do not average more than about £4 net cash, and steel boiler plates could be bought readily at £6 5s. to £6 7s. 6d. delivered in this district.

In the metal market the decided upward movement in raw material has brought forward more inquiry for manufactured goods, in anticipation of some advance in list rates which has since been announced by makers to the extent of ½d. per lb. on recent list quotations.

The engineering industries throughout this district continue generally but very indifferently off for work. Here and there orders are reported to be coming forward more freely, but this does not represent any improvement of a general character, and the outlook for the future can scarcely be said to show any really better prospect. The monthly report issued by the Steam Engine Makers' Society is not of quite so unsatisfactory a character as that of the Amalgamated Society of Engineers, to which I referred last week, but does not show any improvement as regards the returns of out-of-work members, which still represent about 5½ per cent. of the total membership in receipt of donation benefit. In the reports as to the condition of trade from the various districts, stationary engine builders throughout the principal Lancashire engineering centres are reported to be fairly off for orders, but other branches of the engineering trade are returned as only very quiet, with no present indication of any reviving activity.

The coal trade throughout Lancashire continues in a very depressed condition, and but that the protracted strike of miners in Scotland has necessitated a considerable weight of both round coal and engine fuel being purchased in this district to meet requirements of consumers in Scotland, the position would have been about as unsatisfactory as could well be imagined. So far as local requirements are concerned, these would consequently have sufficed to keep pits going half time, and even with the extra demand for coal and fuel to be sent into Scotland, four days per week represents the full average that the collieries are working. The better qualities of round coal are a complete drug upon the market, and there is a good deal of underselling to clear away stocks that accumulate, but the average quoted prices remain at about 11s. for best Wigan Arley, 10s. for Pemberton 4ft. and seconds Arley, and about 8s. for the lower qualities of round coal, suitable for house-fire purposes. Local requirements for iron-making, steam, and general manufacturing purposes, also continue very limited; but in steam coal and engine fuel a good deal of the surplus supplies, which would otherwise have been thrown upon the market, are being sent away either by rail or shipment to Scotland, and this is helping somewhat to steady prices, although these are extremely low—not averaging more than 7s. to 7s. 6d. for steam and forge coals, 3s. 9d. to 4s. 3d. for common engine fuel, 4s. 9d. to 5s. 3d. for the medium qualities, with some of the best descriptions of engine fuel quoted at 5s. 9d. to 6s. 3d. per ton, at the pit mouth.

In the shipping trade business continues fairly active, largely, however, on account of shipments to Scotland, but there is also more doing for Ireland, Lancashire colliery owners being now in a position to regain a good deal of the business which was lost during the strike last year, and then went into the hands of the Scotch coalowners. Prices, however, are not more than maintained at late rates, common round coals for steam purposes not averaging more than 8s. 9d. to 9s. and engine classes of fuel 5s. 6d. to 6s. 9d. per ton delivered at the ports on the Mersey.

*Barrow.*—The pig iron trade, so far as hematites are concerned, is depressed to a greater degree than has been known for years. Makers of iron complain about the scarcity of orders on foreign account, and there is very little doing with home buyers. Were it not for the local demand, business would be almost nil. Prices are easy at 43s. 5d. net cash sellers, and 43s. 4d. buyers. Makers quote 44s. to 45s. per ton for mixed Bessemer numbers net f.o.b. They have only 33 out of 75 furnaces in blast. Last year there were 35 furnaces in blast.

Iron ore is more depressed than ever, as the consumption in the district is smaller, and there are still only small consignments going to Scotland. Eight shillings and sixpence is still the value of ordinary sorts, but 12s. to 14s. is the price for the best qualities net at mines.

Steel makers are short of orders in all branches save that of ship plates, and no new orders of moment have been booked for plates lately, and there are very few in the market, either for heavy or light sections. Billets and hoops are quiet, and nothing is doing in slabs, wire rods or blooms, while merchant steel generally is very quiet. Tin-plate bars give promise of a better market, now that the American tariff has been amended, and it is anticipated there will be a fairly active autumn and winter's trade in this department.

The shipbuilding and marine engineering trades are busy, chiefly on Admiralty work. No new orders are, however, reported. The demand for ordinary steam marine is very quiet. Repair orders are receiving some attention, and other orders are expected. The Fleetwood and Belfast Line are in want of another fast twin screw steamer.

The coal and coke trades are very quiet, but although supplies are adequate, prices are firm; 17s. is still the quotation for East Coast coke at West Coast furnaces.

The general engineering, ironfounding, and boiler-making trades are very quiet.

The trade of Barrow generally is depressed, although shipbuilders are busy. This is the only industry in the town which is busy.

The shipping trade remains very quiet. Exports of pig iron and steel from West Coast ports during the week have represented 13,281 tons. Last year in the same week they reached 22,981 tons, a decrease of 9703 tons. The aggregate shipments to date represent 486,289 tons, compared with 498,630 tons in the corresponding period of last year; a decrease of 12,341 tons. Freights are low and unremunerative.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The reduction of wages has followed the severe depression in trade so far at least as coal is concerned. Languor affects all collieries, but most materially those producing the qualities required by gas companies and the pits employed in the household sorts. Supplies of the latter are very largely in excess of the demand. This, of course, has the inevitable effect of causing buyers to hold off, in the belief that by delay they will get what they require on easier terms. Coalowners, on the other hand, are determined that values are as low as they can be, simply because they have no possibility of still further reducing the cost of production. They are not likely to modify their present attitude, and, on the whole, they have the best of the struggle, as prices are fairly well maintained.

Business is affected somewhat by the action of the pit lads, who stoutly resist the reduction of 10 per cent. imposed under the Conciliation Board arrangement. Their argument is not unreasonable. They say they did not get the 40 per cent. advance, and therefore they have no 10 per cent. to give back. Consequently, as pits cannot be worked without boy labour, the lads are giving several collieries "play" when the colliers neither expected nor desired it. They could scarcely have taken a less favourable season for their action, for the summer demand is now so light that a pit closed here and there is of little account in the general supply. At present the tonnage to London is decidedly below the average. Silkstone house coal is quoted at from 9s. 6d. to 11s. per ton; Barnsley softs from 8s. 6d. to 10s. per ton; Flockton, 8s. 6d. to 9s. 6d. per ton. Although the season is now well advanced, steam coal is steady, a very heavy tonnage being sent to Hull and the other Humber ports. Barnsley hards are from 7s. 9d. to 8s. 6d. per ton; other qualities 9d. to 6d. per ton less. Manufacturing fuel is in full supply, but light request, thus reflecting the poor business at present being done in the iron and steel trade, as well as in the mills of the textile districts, particularly in the localities where cotton is the staple production. Slacks cannot command more than from 3s. 6d. to 5s. per ton; smudge and small coal very dull; coke in quiet request at from 9s. to 11s. per ton. Coalowners find it at present more profitable to convert their small coal into coke, for which they find a fairly good market in Lincolnshire and Northamptonshire for smelting purposes. A considerable quantity of coal is now being shipped from the Yorkshire pits to Scotland.

In the iron and steel industries, although the business done is far from adequate, there are signs of movement. Railway material, chiefly in rolling stock, is now being freely ordered for the home companies and for India. Large "lines" for railway carriages, wagons, locomotives, &c., have recently been given out, and others are certain to be placed soon. These orders mean a good demand for buffers, springs, wheels, tires, and axles, as well as for the various steel parts required for engines. Amongst the companies in the market with good orders is the Midland, who are in need of further engines, wagons, and carriages.

The decision of the American Senate, embodied in their Tariff Bill accepted by the House of Representatives, to admit iron ore free of duty, has had the effect of stiffening quotations for hematites, which are now at slightly increased quotations, viz., 51s. 6d. to 53s. per ton. This is an advance of 6d. per ton, but it would excite no surprise if before these lines are published a further rise took place. The fact is that this country does not produce sufficient ore for her own requirements, to meet which Spain and Sweden are laid under contribution to the extent of one-third. These are the sources from which the United States will no doubt draw what they want. Our manufacturers do not regard this feature of the new Tariff arrangements as an unmixed benefit. The abolition of duty on raw material, many of them say, will cheapen and stimulate manufactures in the States, and make competition with our people still keener. The presence of American buyers in the Spanish and Swedish markets will also cause English iron and steel makers to pay more for their raw material.

The new American Tariff is received favourably in the quarters chiefly engaged in the lighter industries. Cutlery manufacturers, in particular, are thankful the uncertainty is over. The new duties will not very greatly benefit this city, but they put an end to the waiting game which has practically paralysed all trade. It is conceded that Sheffield can never again have the business it once enjoyed with the States, for the excellent reason that the Americans are now quite able to supply themselves in many classes of goods they once obtained exclusively from this city. For the balance of work that is left, the Germans are keen competitors. In the superior grades of articles, both in carvers and pen and pocket cutlery, the chief trade will still be in Sheffield-made productions.

An improvement is reported in the local engineering branches, largely attributable to increased enterprise in invention. Some important patents, of which more may be heard soon, have recently been taken out by Sheffield engineering firms. There is a slight, but very slight, change for the better in the demand for machinery. In chilled irons the American monopoly is reported to have been met and broken by English makers, who now command the continental market.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The improvement in trade which was reported last week has been even more pronounced this week, and a very substantial amount of business has been done, not only speculators but also consumers buying pig iron freely, as they believe that the upward movement will continue, for it appears to be general, the metal markets, the stock exchange, and the money market all exhibiting more favourable features, and therefore the likelihood is greater that the revival will be maintained. Good orders have within the last few days been booked for Cleveland pig iron, chiefly of No. 3 quality, and the fact that exports so far this month have been poor, and that the stocks will probably show a greater increase even than last month, has no effect in preventing the rise in prices. Under ordinary circumstances this would have a depressing effect upon the market, but the activity that has been shown in buying counteracts this, and no one pays any attention to the present increasing stocks, as the prospects appear so favourable. Speculators seem to regard the future of the iron trade as encouraging, as they have been operating rather freely, and this is significant when it is remembered that it is a long period since they would have anything to do with warrants. Consumers have been brought out, and have apparently given up their policy of buying from hand to mouth only, but both at home and abroad they are anxious to arrange for iron for forward as well as prompt delivery. The revival will be helped forward by the autumn demand which is now setting in.

Another very hopeful feature which cannot but have a good influence upon trade is that the strikes which have for so long seriously hampered business are about to come to an end. It is believed that the Scotch strike cannot last more than a week or two longer, and the strike of moulders and pattern makers in the North of England, which has been in progress for nearly twenty-four weeks, and has thrown out of work fully 20,000 men engaged in other branches of trade, will be ended in a few days in all probability, because the men have at last agreed to the proposal of the employers that the dispute shall be submitted to arbitration, the award to take effect from the day the men resume work. Each side is to choose an arbitator, and the two arbitrators are to choose a referee, who shall be a barrister or a County Court judge. The moulders, it will be remembered, originally came out because the employers declined to give them an advance of 3s. 6d. per week, on the ground that, though trade had become brisker, the value of the product had not increased. Subsequently the men modified their claim, making it 2s. per week advance, and since then the masters have claimed a reduction from the wages that ruled when the strike began, trade having changed considerably for the worse of late, chiefly through the action of the men in thus stopping work. The men were rather averse to the arbitrators being commissioned to consider anything but their claim, as that was the cause of the strike; but they have now admitted the right of the arbitrators to adjudicate upon a reduction, seeing that the circumstances of the trade have changed so much. The men are to return to work at once, and the award is to date from the time when operations are resumed. The strike has been a most disastrous one for the district, as it has affected so many other branches of trade, and punished very severely about ten times as many workmen as those actually engaged in the strike. We may now look for the early re-opening of the shipyards which have been closed, and the consumption of steel plates and angles will be increased, as well as that of hematite pig iron. A number of engineering works have also been idle for lack of castings, and these will be able soon to recommence operations.

Sales of No. 3 Cleveland pig iron have been large this week, and have been mostly made at 36s. 3d. per ton for prompt f.o.b. delivery, and some business has been done at 36s. 6d., this being 1s. advance upon the price that ruled for some weeks prior to last week. A considerable number of orders have been placed for delivery up to the end of the year at 36s. 4½d., but producers are now chary about selling for forward delivery. No. 3 Cleveland pig is said to be scarce in makers' hands, and that this is so is evident from the fact that a considerable quantity has had to be withdrawn from the public warrant stores. There is, however, likely to be an increase in stocks reported for the month, but it will be in the commoner qualities, and not in No. 3. Forge qualities are much more plentiful than they were; they have been more largely produced during the last fortnight, because since the blast furnacemen took their holiday on the 11th inst. the furnaces have worked badly, producing more than their usual proportion of forge iron, and this has been rather a drug upon the market, and the advance in them has only been 6d. instead of 1s., as in No. 3, grey forge being offered at 34s. 3d. For No. 4 foundry, 35s. is the figure. The warrant market has been brisker this week than for a long season, and in prices there have been considerable fluctuations, as much as 6d. in a day. Cleveland ordinary warrants have been at 36s. 6d. cash, and closed on Wednesday at that. The improvement in hematite pig iron has been very slight so far—hardly 3d. per ton, but will be greater when the moulders' strike is over, and the shipyards and steelworks are able to resume operations fully. Mixed numbers of East Coast hematite pig can still be bought at 43s. per ton, f.o.b., and makers are able to buy good Rubio ore at 11s. 9d. per ton delivered on Tees-side, though 12s. is the general figure.

In finished iron and steel business is improving a little, but production is further curtailed this week, because most of the mills and forges on Tees-side are idle, the workmen being generally given a holiday during the Stockton race week. Orders are more freely distributed to manufacturers, and the tendency of prices is upwards. Steel ship plates are quoted £5; steel boiler plates, £6; steel ship angles, £4 15s.; iron ship plates, £4 15s.; iron boiler plates, £5 15s.; iron ship angles, £4 12s. 6d.; iron engineering angles, £4 17s. 6d.; common iron bars, £4 17s. 6d., all less 2½ per cent. and f.o.t. The demand for rails and railway materials is most unsatisfactory, and it is years since the export of rails from the North of England was so small as it is now. The competition is extremely keen, and it is not likely that the stoppage of the Darlington Works will make the situation any more tolerable for those who are keeping on, because there are so many establishments at home and abroad short of orders. Heavy steel rails can be bought at £3 10s. net at works. The demand for steel billets is somewhas stronger, and exports of these to the tin-plate manufacturers of South Wales are fair. A good amount of bridge work is being turned out, but there is not much doing in steel girders for building purposes.

The coal trade in this district is decidedly active, especially in the steam coal branch, and heavy shipments are made to the Continent, where merchants are availing themselves of the low freights to lay in stocks. The freights to many ports are the lowest ever known, and shipowners cannot but be great losers when accepting them. Best Northumberland steam coal is quoted 11s. per ton f.o.b. Durham coke of good quality cannot well be had under 12s. 6d. per ton, delivered equal to Middlesbrough, or 14s. 6d. f.o.b. The death took place this week of Mr. John George Russell, of Shencliffe, near Durham, manager for many years for Messrs. Ferens and Love's collieries. Mr. Morrison, of the Newbattle Collieries, Dalkeith, has been appointed manager of the Cramlington collieries in succession of the late Mr. Shelton. The death is also announced of Mr. J. A. Haswell, for many years connected with the locomotive department of the North-Eastern Railway at Gateshead. He was one of the pupils of Robert Stephenson.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been more active in the past week than for a considerable time previously. A good deal of speculation has taken place in warrants since the passing of the American Tariff Bill, and prices have steadily advanced. Scotch warrants have risen fully 1s. per ton, more than one-half of which has occurred this week. Business has been done in Scotch warrants from 42s. 8½d. to 43s. 4d. cash. Hematite has been done at 44s. 5d. to 44s. 6½d. Very little inquiry has arisen for Cleveland warrants, the consumption of this class of iron in Scotland just now being much curtailed by the stoppage of the ironworks.

The demand for makers' iron is quiet; but stocks are very light, and prices continue to advance. Gartsherrie, Eglinton, Carron, and Langloan pig iron are all unobtainable in the open market, and merchants decline to quote prices for these. G.M.B. f.o.b. at Glasgow, No. 1, is quoted 44s. 6d. per ton; No. 3, 43s.; Carnbroe, No. 1, 48s.; No. 3, 46s.; Monkland, No. 1, 47s.; No. 3, 43s.; Clyde, No. 1, 56s.; No. 3, 50s. 6d.; Summerlee, Nos. 1, 56s.; No. 3, 50s.; Calder, No. 1, 57s.; No. 3, 50s.; Coltness, No. 1, 57s.; No. 3, 52s.; Glengarnock at Ardrossan, No. 1, 51s. 6d.; No. 3, 48s.; Dalmellington at Ayr, No. 1, 50s. 6d.; No. 3, 46s.; Shotts at Leith, No. 1, 56s.; No. 3, 51s.

The shipments of pig iron from Scottish ports in the past week have been very light, amounting to only 1456 tons, compared with 4932 tons in the corresponding week of last year. There was despatched to the United States 25 tons, India, 28; Australia, 100; France, 10; Germany, 50; Holland, 485; Belgium, 20; Spain and Portugal, 60; China and Japan, 200; other countries, 170; and coastwise, 308, against 2118 in the same week last year.

One furnace having been put out at Coltness, there are two at these works left making ordinary iron and four at Shotts, these six being all that are blowing in Scotland. Some time must elapse before the output is materially increased.

The business in finished iron is of comparatively little importance. Makers are not in a position to book orders. In many cases their men would gladly be at work, but the miners' strike prevents them. The makers are not inclined, except in cases of absolute necessity, to keep their works going at a time when fuel is advancing, and when there is little chance of obtaining substantially higher rates for their products.

The shipments of iron and steel manufactures from Glasgow in the past week embraced sewing machines worth £6561; other machinery, £5061; steel goods, £4698, and miscellaneous iron goods, £10,970.

The steel works remain closed, and business, for forward delivery, has really scarcely any existence.

The coal trade is quiet. Colliery owners who had stocks to sell have in many instances had them cleared out, and home consumers are now largely dependent upon supplies from England, which now come to hand in considerable quantity, and are sold at fairly moderate prices. The shipping trade in coals shows no improvement. The shipments for the week amounted to 7653 tons at all the Scottish ports, compared with 170,977 tons in the corresponding week of last year. Prices of coals are somewhat higher.

At several of the collieries this week numbers of miners have been at work, and they have had to receive police protection from the crowds striving to molest them. Renewed efforts have been made in a semi-private way to bring about some arrangement of the strike, but these have all hitherto failed, the demands of the men being impossible of realisation. The strike has been continued for about nine weeks. In many places the men and their families have been reduced to the point of starvation. Subscriptions are freely given for their relief, but these prove quite inadequate. The general trade of the country is suffering severely from the strike.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE quietness which I noticed last week as characterising the steam coal trade continues, and prices are evidently slowly receding. The impression, however, on 'Change at Cardiff is that the lull is only a temporary one. House coal prices keep up well, and that is satisfactory, considering that we are nearing the time when contracts will come to the front; and if present quotations can be retained, there will not be much cause for complaint.

The latest quotations on 'Change, Cardiff, for steam coal are as follow:—Best steam, 11s. 3d. to 11s. 6d.; seconds, 10s. 9d. to 11s.; dry coal, 9s. 9d.; and small, 5s. 6d. to 6s. 3d. It was noticeable that best small coal on Monday touched 6s. 3d., but the next day fell to 6s. Best steam fell 3d. from Monday to Wednesday.

Best house coal is still selling at 12s. 6d. to 13s., but this is for specially selected; at present good house coal can be obtained for 10s. 9d. to 11s., and No. 3 Rhondda for 10s. 6d.; brush, 8s. 6d. to 8s. 9d.; small, 6s. 6d. to 6s. 9d.; No. 2 Rhondda, 8s. 6d. to 8s. 9d.; through, 7s. to 7s. 3d.; small, 5s. to 5s. 3d. Coke prices keep up fairly well, and I note that though Cyfarthfa is now making a great quantity with admirable appliances for turning out the best kind, there is still a percentage of Dinas Main coke used there. Rhymney cokes and Llwynypia are well to the front. Latest quotations are a slight improvement upon those of last week. Cardiff: furnace, 15s. to 16s. f.o.b.; foundry, 17s. to 17s. 6d.; and special foundry, 20s. to 21s.

Pitwood market is improving, and great quantities are being sent up to the principal collieries. Few have any idea in the outside world of the large quantities used, and the prominent figure they make on the cost sheet. Still, in no case have I heard of the adoption as in some North of England collieries, of steel pit props. The complaint is that they are too rigid, and have not the "giving" character of timber. This is or was also one of the objections to the substitution of steel for wood sleepers, though I see that Bombay is in the market for large quantities, which are being turned out at Dowlais Works, Cardiff.

The present quotation for pitwood is 15s. 9d. for ordinary ex-ship. There is no material alteration for patent fuel, which is in moderate demand Cardiff. Swansea dispatched 10,000 tons last week. In iron and steel there is also only a moderate demand, steel bar being the principal, and colliery rails. Judging from the quantity of iron ore coming in, ironmasters have still faith in the future. Not only are large consignments being received of Bilbao, Tafna, Garucha and Porman, but a fair quantity of Cumberland ore, which is specially rich, with a percentage of 58 per cent. This contrasts well with Bilbao, with its average of 48 to 50 per cent. Best Rubio is at 11s.; Tafna and Garucha at 10s. 6d., and Porman, 9s. 9d. to 10s. per ton, c.i.f., Newport or Cardiff.

The change which has taken place in the ironworks of Wales was forcibly brought to mind by the remark of an old inhabitant of the district this week, who remembered the time when four thousand iron ore miners were employed by Cyfarthfa alone, and now, though a small quantity is worked from the coal pits, there is not a single iron miner specially employed, and all the old mine pits are closed.

The leading quotations this week for iron and steel are little if any different to those of last week. Heavy sections, steel rails, are at £3 15s., and light £4 7s. 6d. to £4 10s. Bessemer steel bars are at £3 18s. 6d. I have had an opportunity this week of seeing some remarkably fine samples, but unfortunately the capacity of make is a good deal beyond the demand. Furnaces here and there idle, and blank days are common matters in the district. Blaenavon works, Cyfarthfa, Dowlais, Ebbw Vale, and others are replenishing their iron ore stocks. Pig stocks are large in several localities.

The chief export of late has been iron to Santos, under the heading of "2086 pieces." If it had been tons it would have been more up to the desire of ironmasters and shippers.

In the Briton Ferry district sixteen mills and the finishing departments have been fully employed, and the make of pig is quite up to the average. Notices of temporary stoppage are up at some of the works while the canal is being repaired. I am glad to note that the Earlswood Tin-plate Company is pushing on the completion of their works, and a start next week is expected.

Generally there is little change in the tin-plate trade. On 'Change Swansea the impression is that an alteration for the better will begin to show itself in the middle of next month. Make and shipment have been of late fairly equal. Last week at Swansea 47,510 boxes were received from works, and 48,480 boxes shipped. Vessels are coming in freely to load for America, Canada, Hamburg, Genoa and Leghorn. The stock now held at Swansea is 286,908 boxes. Prices are the same, Siemens, 10s. 9d. to 10s. 11d.; Bessemer, from 10s. 4½d. to 10s. 9d. f.o.b.; wasters, from 9s. 6d. These are the lowest figures prevailing for ordinary cokes, but the Wilson Tariff Bill, the passing of which has given a good deal of satisfaction, must shortly improve matters.

The Rhondda and Swansea Bay line, through to Swansea, is to be opened on the 1st October. The Neath Bridge was swung for the first time on Saturday, and is stated to have worked most satisfactorily.

Trouble would appear to be looming in the coal trade. Mr. Abraham, M.P., "Mabon," is stated to have written a letter read at an Aberdare meeting on Saturday, in which the hon. member intimates "that if the employers persisted in maintaining their uncalled for and intolerable position in refusing check weighers to tender evidence, when selected by the workmen, he could not, notwithstanding the pain it gave him, see his way to promote the maintenance of the sliding scale at the sacrifice of principle and right." At the Aberdare meeting the subject in dispute was discussed at great length, and it was decided to ascertain by ballot the opinion of the colliers generally.

I may add that the miners' representatives are not altogether unanimous in supporting "Mabon," so it is to be hoped that after a free discussion the storm will blow over.

The Albion is again in full work. The outcome of the explosion has been a good deal of discussion and experiment in regard of shot firing and the extension of an explosion by coal dust.

The men of No. 2 Pit, Llanbradach, are on strike. They demand 4s. 9d. per day plus the percentage, but the management is only prepared to pay 4s., or agree upon contract prices while opening the colliery, pending the identity of seam, and a fixed price list of all items of labour in the colliery.

On Monday the Vale of Glamorgan Railway was practically begun with the cutting of the sod, by Messrs. Butler and Baker, contractors. The viaduct in Porthkerry Park is to be a fine engineering achievement. It is to contain seventeen arches have an entire length of 1000ft., and be 100ft. high.

The electric lighting of Monmouth is to be carried out.

Taff Vale receipts last week were £15,647 as compared with £5945 for the corresponding week last year, when the colliers' strike was on, and but for prompt action of the authorities the whole district would have been plunged into a ruinous condition.

Latest Swansea quotations show an improvement on pig iron. Glasgow warrants are at 43s. 4d.; hematite, 44s. 5½d.; Welsh bars from £5; sheet iron, £6 to £6 10s.; steel, £6 5s. to £6 10s. Block tin shows an advance of £3 10s. upon the week. Prices are now £71 10s. to £71 15s. Anthracite maintains the same figures, 8s. 9d. to 12s. 6d., according to quality.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

A FAIRLY satisfactory business has been doing in iron and steel this week, and the reports coming in from the different markets are a trifle more cheering. Prices remain pretty firm all round. The state of the Silesian iron industry is much the same as was reported in former letters. Some of the blast furnace works remain tolerably well employed, while others have had to limit their production considerably, during the last month; the Gleiwitz works, for instance, has blown out one blast furnace which had been put on ordinary pig in the spring, when the demand for that sort had been specially brisk. At the rolling mills a fair activity is generally maintained, the demand for sheets being remarkably good; plates, on the other hand, are but very weakly called for. Steel makers still complain of the scarcity of orders for rails, and quotations are extremely depressed, with little or no chance for an improvement. Nails and rivets are in poor request.

The situation of the Austro-Hungarian iron market continues to be quite satisfactory. Upon the week a brisk demand has been experienced in almost all branches of the pig iron trade, and in the manufactured iron department, likewise, a very lively tone prevails. The steel trade is, if anything, even a trifle more brisk than in former weeks. List rates for both raw and finished iron show little or no change since previous reports, and are, all things considered, fairly remunerative.

Pretty satisfactory accounts are given of the condition of French iron trade, and though, on the whole, few large purchases are made, producers as well as dealers show much firmness, and the quiet but confident tone repeatedly noted has been well maintained. French import and export in coke and iron was, for the first two quarters of present year, as under:—

| | Import. | | Export. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Coke | 742.580 | 689,908 | 21,660 | 25,038 |
| Pig iron | 32,938 | 46,627 | 55,862 | 49,431 |
| Malleable iron | 9,771 | 9,793 | 10,589 | 10,668 |
| Steel | 2,927 | 2,776 | 6,556 | 5,270 |

Only a very slow inquiry for either raw or manufactured iron is reported from the Belgian iron market. As regards pig iron the tone, taking it all through, was rather easier; manufactured iron makers, as a rule, report that branch of trade as only in a very unsatisfactory condition, and the works that are largely dependent upon export are very short of orders. Changes in quotations cannot be quoted; indeed, a further decrease is almost impossible, as makers in most cases are working their mills at a loss, and many of them would, therefore, prefer a general stoppage to further reductions in prices.

Belgian trade in iron and steel, during the first two quarters of the present year, was:—

| | Import. | | Export. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Iron ore | 929,028 | 869,740 | 106,604 | 87,070 |
| Steel | 9,178 | 7,041 | 354 | 271 |
| Steel bars | 195 | 242 | 9,328 | 3,253 |
| Steel rails | 188 | 284 | 32,301 | 15,117 |
| Steel manufactured goods | 5,426 | 3,847 | 11,389 | 8,189 |
| Pig iron | 119,684 | 58,309 | 6,978 | 10,591 |
| Scrap iron | 12,768 | 9,625 | 4,281 | 4,014 |
| Iron wire | 3,663 | 2,966 | 285 | 420 |
| Girders | 153 | 100 | 19,087 | 27,431 |
| Iron rails | 4 | 38 | 55 | 11,455 |
| Iron manufactured goods | 5,905 | 6,099 | 71,389 | 65,375 |
| Nails | 263 | 359 | 3,498 | 3,354 |
| Hardware | 2,119 | 1,778 | 8,679 | 9,957 |
| Castings | 667 | 2,104 | 9,089 | 6,910 |
| Rolling stock | 747 | 738 | 9,976 | 16,092 |
| Machines | 10,133 | 7,731 | 15,722 | 14,775 |

The amount of coal and coke imported into Belgium during the first two quarters of the present year is reported to have been as under:—

| | Coal. | | Coke. | |
|---|---|---|---|---|
| From— | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Germany | 295,608 | 274,994 | 151,524 | 116,701 |
| England | 138,773 | 164,432 | — | — |
| France | 179,595 | 185,181 | 4,233 | 2,651 |
| Low Countries | 41,728 | 40,529 | 722 | 846 |
| Other countries | 353 | 12 | — | — |
| Totals | 656,057 | 665,148 | 156,479 | 120,198 |

It is characteristic of the Rhenish-Westphalian iron business that, in spite of sufficient, and in some instances even brisk, employment, prices do not show the slightest inclination to rise. In the iron ore trade only a moderate demand is coming forward, but quotations are firmly maintained. For spathose iron ore M. 7 to 7·90 p.t. has been paid last week, while roasted ditto fetches M. 11 to 11·50 p.t. at mines. Inferior qualities are paid with M. 9 to 11·20 p.t. net at mines. A very slow business is still being reported in the pig iron trade. Spiegeleisen, which has been in somewhat better inquiry this week than last, still stands at M. 52 p.t.; while Rhenish-Westphalian forge pig No. 1 is in fair request at M. 46 to 47 p.t., and No. 2 is paid with M. 40 p.t. Hematite costs M. 63 p.t.; foundry pig No. 1, M. 63, No. 3, M. 54 p.t. Basic, though very quiet at the present moment, firmly maintains the old price of M. 45 p.t. German Bessemer is quoted M. 49 to 50 p.t. Luxemburg forge pig is to be had at 48 f. p.t., free Luxemburg. There is very little to note in connection with the malleable iron trade; bars are in tolerably good call and so are hoops, but girders have experienced some neglect, and the prices for that article are, therefore, rather inclined to weakness. Good activity is maintained at the plate mills, the heavier sorts of plates being in specially good request. The demand for sheets continues lively, and some of the mills will be well engaged up to end of the year; but prices are, if possible, worse than ever, having shown a strong tendency to decrease lately. The requirements for gas and waterworks having been exceptionally large this year, the tube mills are, as a rule, in vigorous occupation; pretty good orders have already been booked for next year, so that this branch of industry is well off, at least so far as employment is concerned. At a late tendering for fish-plates, M. 108.10 p.t., was the lowest offer, others ranging between M. 110 and 127 p.t. Latest list quotations, per ton at works, are as under:—Good merchant bars, M. 110; rivet iron, M. 125 to 128; angles, M. 120; girders, M. 90 to 95; hoops, M. 113 to 118; billets in basic and Bessemer, M. 81; heavy plates for boiler-making purposes, M. 150; tank, do., M. 130 to 135; steel plates, M. 125; tank do., M. 115 to 120; sheets, M. 125 to M. 135. Siegen thin sheets, M. 130. Iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

The Saar mines have produced 537,545 t. of coals in July of the present year, and sold 501,195 t. Production for the same month last year was 484,070 t., while the consumption amounted to 462,305 t.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 16th.

The salient features of the American markets are moderate stocks, guarded production and low prices. Everything betokens an increase in production. The termination of the tariff deadlock is hailed with delight. There will be an early improvement, because of the low condition of stocks everywhere. Unfavourable crop reports induced a spurt in speculation. Railroad traffic continues without any improvement whatever in a general way. Prices of material of all kinds are low. An occasional effort to push speculation fails. While the banks have more money than they can lend, the directors are more conservative than ever, and only the best paper meets with favour. The iron trade is somewhat better, but even with the increase to 110,000 tons per week, only about one-half capacity is employed. Steel rails are dull at 24 dols., steel billets 19 dols., with 18 dols. offered for late deliveries. Work is getting better in the foundries and machine shops. A foundation has been laid for a general and permanent improvement in internal trade. Manufacturers will be anxious to take advantage of the low range of prices on the first sign of a genuine advance in business.

## LAUNCHES AND TRIAL TRIPS.

On the 16th Messrs. R. Craggs and Sons launched from their Middlesbrough yard a steel screw steamer, of the following dimensions:—Length, 178ft.; breadth, 28ft.; depth moulded, 14ft. 2½in. She will be fitted with triple expansion engines, by Messrs. Westgarth, English, and Co., of Middlesbrough, having cylinders 14in., 22½in., 37in. by 27in. stroke, with a boiler 12ft. by 10ft. working at a pressure of 160 lb. The vessel has been built to the order of Messrs. Whiteway and Ball, of Torquay, and will take the highest class at Lloyd's.

On Saturday afternoon Messrs. R. Craggs and Sons launched from their Middlesbrough yard a vessel having some novel features, built to the order of Mr. Joseph Constant, of London, on account of Messrs. William Cory and Son. The vessel is fitted as a sea-going towing craft, to carry 350 tons deadweight. She is entirely self-trimming, and the dimensions are specially suited for delivering cargoes at certain wharves in the river Thames. Her dimensions are as follows:—130ft. by 21ft. by 9ft. 8in. moulded. On leaving the ways she was named the Coral.

A few days since the s.s. Bulgaria, the second steamer built by Wigham, Richardson, and Co., at their Neptune Works, for the Bulgarian Steam Navigation Company, went to sea for a very successful trial trip off the river Tyne. The Bulgaria is a yacht-like steel screw steamer, 250ft. in length by 33½ft. beam, rigged as a two-masted schooner, and has very elegantly finished accommodation for first and second-class passengers. During the trial trip a high speed was obtained, and the engines worked without the slightest hitch of any kind, giving complete satisfaction to both the builders and the representatives of the owners.

The new steamer Louth, built by Messrs. Blackwood and Gordon, Glasgow, for the City of Dublin Steampacket Company, made its official trial trip last week on the Clyde. The vessel measures 260ft. by 34ft. by 16ft. 9in. The first-class saloon will accommodate seventy passengers. The engines are of the triple-expansion type, of 2750 indicated horse-power. The space allotted to cattle is large, enabling 500 head of cattle to be carried, and the ventilation is worked on an automatic principle, giving a current of air in stormy weather as well as in good. Electric light is used, supplied by Siemens Bros. and Co. The lamps number eighty-two, including those used for the cattle holds. Large electric reflectors are erected for cargo and cattle unloading. The holds are fitted with bull's-eye globes, to stand roughest usage. The Louth's tests extended over a six hours' run, and the first run she did the distance, 14½ knots, in fifty-seven minutes, being loaded with 700 tons deadweight.

On the 20th inst., Messrs. Cumming and Ellis, Inverkeithing, launched a steel sailing barquentine, 145ft. by 27ft. by 14ft., designed to carry 600 tons deadweight on a 12ft. 6in. draught. The vessel has been built for London owners, and is intended for their trade from St. Petersburg to Vladivostock. She is classed 100 A1 at Lloyd's, and built with double bottom containing 108 tons water ballast. The double bottom is divided into three separate spaces, which can be filled independently, and as the vessel is intended for the carrying of a general cargo, little attention requires to be paid to the stowage, as the vessel will be trimmed by the filling or emptying of the different compartments in the double bottom. A steam winch and donkey boiler are fitted on the main deck, and the vessel carries a steam launch, which is to be used for towing in light or head winds. The vessel has a full poop and monkey forecastle. Accommodation for the captain is provided aft, while the crew are berthed in a deckhouse on the main deck. Poop deck and forecastle deck are of Oregon pine, the main deck being of iron.

The s.s. Aberdeen, which has been built and engined by Messrs. Fleming and Ferguson, Paisley, for the Government of Canada, for protection of the coast fisheries, &c., has recently completed a series of runs, and on the measured mile attained a mean speed of over 13 knots. She is fitted with electric light in cabin, holds, and on deck, and has also a powerful search light of the Admiralty pattern. The boilers, which are of the firm's water-tube type, with natural draught raised steam in one-fourth of the time allowed in ordinary tubular boilers, and when under full steam showed no signs of priming and almost no variation of water in the gauge glasses. The boilers and machinery during the trials worked without hitch. At the trials there were present Mr. J. T. Milton, chief engineer, Lloyd's surveyors, London; James Mollison, chief engineer surveyor of Lloyd's, Glasgow; and W. T. Courtier-Dutton, representing the British Corporation for the Survey and Registry of Shipping. The Aberdeen has been built to the specifications and plans of Captain M. P. McElhinney, nautical adviser to the Government of Canada, who came over to be present at the trials, and during construction the vessel has been under the supervision of Messrs. NcNicholl and Co., Glasgow.

On Saturday afternoon Messrs. R. Napier and Sons launched from their shipbuilding yard at Govan, the steel screw steamer Nineveh, of about 4000 tons gross, built to the order of Messrs. Geo. Thomson and Co., of Aberdeen and London. The general dimensions of the vessel are: Length over all, 386ft.; breadth, 45ft.; depth, 32ft. The hull and machinery have been constructed under special survey to Lloyd's highest class, and modern appliances have been provided for the rapid handling of cargo. There is also an electric lighting installation, and refrigerating chambers for the transport of frozen meat, &c. Accommodation amidships has been provided for about fifty first-class passengers forward of the engines, and in order to obtain better light and ventilation, the dining saloon has been placed on the upper deck, a music saloon and smoking-room being on the promenade deck. The state-rooms are situated on the main deck. The 'tween decks have accommodation for a large number of third-class passengers, with separate entrances in a deckhouse aft. The captain and navigating staff have their quarters on the bridge deck beside the chart-room, the engineers' cabin being on the upper deck, near the engine-room. The machinery consists of a set of triple-expansion engines, capable of indicating 3000-horse power, designed to give the vessel a speed of 13 knots, with two double ended steel boilers for a working pressure of 160 lb. The vessel has a cut-water bow and figurehead, and a three-master's rig. Miss Muriel Thompson, daughter of the late Cornelius Thompson, cut the cord, and as the vessel moved down the ways Mrs. Duff Henderson named her the Nineveh. The machinery has been constructed at the builders, Lancefield Works. When completed, the Nineveh will be commanded by Captain Allan.

Messrs. Wm. Simons and Co., of Renfrew, launched from their yard, complete, the Percy Sanderson, the largest and most powerful hopper dredger afloat. It has been constructed to the order of the European Danube Commission, and will be employed principally in deepening the entrance to the Soulina mouth of the river Danube. It is of the stern well type, that is to say, instead of the bucket ladder being projected through the fore end of the vessel, it is adapted to dredge at the stern. This arrangement enables the vessel to encounter heavy seas more easily, and facilitates the steering and handling. The hull is constructed of steel to Lloyd's requirements, and the hopper compartments have a capacity for nearly 1300 tons of dredgings. Water ballast compartments are provided, and the hull is divided into ten watertight compartments. The buckets, which are of great lifting capacity, are capable of dredging to a depth of 35ft., a depth which is considered quite sufficient for the present requirements. The dimensions of this dredger are:—Length, 227ft.; breadth, 40ft.; depth, 17ft. Two sets of triple-expansion engines are provided for driving twin propellers; they also drive the dredging machinery, either set being capable of answering this purpose. Steam is derived from two mild steel boilers constructed to Lloyd's rules, for a working pressure of 160 lb. per square inch. The loaded speed of the dredger will be at least eight knots per hour. Powerful steam mooring appliances are provided at the bow and stern, also steam hoisting engines for raising and lowering the bucket ladder and the suction pipes. The hopper doors are lifted by steam. The dredger is lighted throughout by electricity. Besides the endless chain of buckets referred to on starboard side, there is fitted a powerful centrifugal sand dredging pump, fitted with suction pipes of 22in. diameter, driven direct by a pair of triple-expansion engines of 300 indicated horse-power; the suction pipe is also capable of dredging to a depth of 35ft. under the water line. This vessel has been constructed to the requirements of Sir Charles Hartley, of Westminster, and Mr. Charles Kubl, the resident engineer to the Commission, Mr. Wilson Wingate acting as inspecting engineer.

On Saturday a cargo steamer with passenger accommodation was launched from the Walker Shipbuilding Yard of Messrs. Sir W. G. Armstrong, Mitchell, and Co. The vessel is of the three type deck with poop, bridge, and forecastle. Her dimensions are:—376ft. by 47ft. by 30ft. 6in., and she is capable of carrying a large cargo on a moderate draught of water. Power is being provided for a speed of 12 knots. Lloyd's requirements for their highest class have been fulfilled. The propelling machinery is on the triple-expansion system, working at a pressure of 160 lb., and steam is supplied by three single-ended boilers, fitted with forced draught on Howden's system. The appliances for loading and discharging the vessel have been carried out in such a way as to secure the shortest possible delay in port. State-rooms are provided for about sixty first-class passengers. A dining saloon, capable of accommodating this number at one sitting, ladies' boudoir and library, and a commodious smoking-room are placed on deck. The vessel has been built to the order of the British and Colonial Steam Navigation Company, under the superintendence of Mr. H. A. B. Cole, representing the owners.

The s.s. Strathord went on her trial trip on the 21st inst. from Hartlepool. This vessel is a sister to the s.s. Strathness and s.s. Strathnairn, and is the third of the four steamers built by Messrs. Wm. Gray and Co. to the order of Messrs. Burrell and Sons, of Glasgow. She carries 6400 tons deadweight, and is 376ft. 6in. in length, with a breadth of 47ft. and depth of 29ft. 9in. Her engines have been supplied by the Central Marine Engine Works, and are of the triple-expansion type, having cylinders 27in., 43in. and 72in. in diameter respectively, with a piston stroke of 45in. Steam is supplied by two large single-ended boilers, worked on the Howden forced draught system, the steam pressure being 170 lb. per square inch. The air fan is in the engine-room, and is driven by a separate vertical engine. Mechan's triple automatic engine-room telegraph is fitted. The trial of the ship and her machinery was witnessed by Mr. J. C. Stewart, the superintending engineer for Messrs. Burrell and Sons.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

*9th August*, 1894.

15,177. Rails for Street Tramways, F. H. Gill, London.
15,178. Composition for Covering Boilers, G. W. Stones, Halifax.
15,179. Ships' Sidelight Scuttles, G. N. Arnison, jun., Sunderland.
15,180. Boots, W. Norman, Taunton.
15,181. Gully Shoot, J. J. Green and W. Oates, Halifax.
15,182. Compressing Fire-lighters, E. Pollard, Bradford.
15,183. Cutting Grooves in Fire-lighter Blocks, E. Pollard, Bradford.
15,184. Gauze Weaving, W. Strang, Glasgow.
15,185. Advertising Machines, G. Simpson, Glasgow.
15,186. Steam Motors, W. M. Walters, Liverpool.
15,187. Brush-boxes, H. E. Turner, Dorking.
15,188. Automatic Circulation of Water in Steam Boilers, C. L. E. Melsom and A. S. Morrison, London.
15,189. Slide Carriers for Optical Lanterns, W. Hunt, Glasgow.
15,190. Grinding Astigmatic Lenses, G. Prescott, Dublin.
15,191. Fire-escape, T. Gibbs, Hawley, near Dartford.
15,192. Light Railways, R. C. Sayer, Bristol.
15,193. Card Clothing, W. H. D. Uhlhorn, Manchester.
15,194. Tires, F. W. Brown, York.
15,195. Valves, G. Grossmann, Manchester.
15,196. Wire and Pale Fences, A. A. Wade, Leeds.
15,197. Machine for Cleaning Tin-plate, G. J. Record, London.
15,198. Means for Forging Nails, J. Luschowski, Liverpool.
15,199. Bottle Stopper, F. A. Maquet, Liverpool.
15,200. Waste Products of Gas Engines, G. and G. W. Bell, Liverpool.
15,201. Travis Motion of Spinning Mules, T. Ainsworth, Preston.
15,202. Cleaning Fur, W. Warburton and H. H., A., and A. Turner, Manchester.
15,203. Stuffing, &c., for Upholstery, J. Chadwick, London.
15,204. Ventilation of Hats and Caps, B. H. Bonner, London.
15,205. Colouring Matters, T. R. Shillitto.—(*J. R. Geigy and Co., Switzerland*)
15,206. Evaporating and Distilling Apparatus, W. Hood, London.
15,207. Paper and Fibrous Envelopes, W. Hood, London.
15,208. Flushing Cistern, D. G. Cameron, London.
15,209. Attaching Pneumatic Tires, J. Goodman, London.
15,210. Mine Ventilating Machinery, W. D. Simmons, London.
15,211. Receptacle for Infusing Tea, W. Lawes, London.
15,212. Power Hammers, T. Jameson.—(*R. M. Reay, United States.*)
15,213. Machines for Winding Yarns, H. Deutsch, London.
15,214. Hydraulic Motor for Vehicles, E. H. Toulmin, London.
15,215. Appliances for Swimming, G. Woollven, London.
15,216. Apparatus for Moistening Air, E. Mertz, London.
15,217. Photographic Gelatine Films, A. J. E. Hill and A. A. Barratt, London.
15,218. Soap-holding Device, A. J. Boult.—(*E. Hoffmann, Germany.*)
15,219. Preventing Influences between Electrical Lines, E. Müller, Liverpool.
15,220. Railway Carriage Window Sashes, M. E. Elder, Liverpool.
15,221. Stamping Plates, &c., W. H. Bleckly and the Pearson and Knowles Coal and Iron Company, Ld., Liverpool.
15,222. Disinfecting Dwelling-houses, &c., M. Wilson, London.
15,223. Golf Clubs, W. Hillman, London.
15,224. A Hood to Enable the Wearer to Breathe in Places Filled with Smoke, F. Wanz, London.
15,225. Converting Cast Iron into Malleable Iron, S. Hufty and J. K. Caldwell, London.
15,226. Indicating the Temperatures of Ovens, G. G. Brodie and J. D. Prior, London.
15,227. Manufacture of Water Cisterns, R. B. Evered, London.
15,228. Manufacture of Soaps, J. O. Klimsch, London.
15,229. Bottle Stoppers, H. H. Lake.—(*C. N. Brisco, United States.*)
15,230. Match Stand for Tables, A. H. Higginbottom, London.
15,231. Vulcanising and Drying Wood, C. Howard, London.
15,232. Panoramas, H. H. Lake.—(*E. Giordani, Italy.*)
15,233. Covering or Awning for Tramcars, &c, F. Ferguson, London.
15,234. Flower Holder, S. I. Gear, London.
15,235. Ferrules for Umbrellas, P. J. Cockrom, London.
15,236. Spanners, E. C. Cumming, London.
15,237. Handles of Umbrellas, &c., A. M. Jones, London.
15,238. Collar Studs, T. Ferrand, London.
15,239. Ink-bottles, B. Lees, London.
15,240. Foot Coverings, E. Lawrence, London.
15,241. Window Sashes, E. Andrews, London.

*10th August*, 1894.

15,242. Automatic Delivery Machines, W. Northorpe, London.
15,243. Steam Engines, J. Holloway, West Cowes.
15,244. Pneumatic Pads for Horse Collars, C. Esson, Liverpool.
15,245. Lubricating Spindles, R. Wood.—(*A. Coulter, Russia.*)
15,246. Communicating Rotary Motion, J. R. Alderdice, Belfast.
15,247. Starting and Stopping Tramcars, G. Gilchrist, Glasgow.
15,248. Registering Cab Distances, G. Baty, Stockport, near Manchester.
15,249. Utilisation of Waste Heat, C. J. Bagley, L. Roberts, and the Moor Steel and Iron Company, Stockton-on-Tees.
15,250. Baby Carriages, W. H. Dunkley, Birmingham.
15,251. Manufacture of White Lead, W. B. Priest, London.
15,252. Applying Brakes to Cycles, G. B. Main, Glasgow.
15,253. Corks, E. J. Frewen, Dublin.
15,254. Socks, L. Ousey, London.
15,255. Water Motor, R. Bray, Huddersfield.
15,256. Bath Glove, J. Wyatt, London.
15,257. Woven Driving Belts, J. C. Fisher, Manchester.
15,258. Manufacture of Lamp Shades, H. O'Reilly, London.
15,259. Carding Attachment, H. Thornton, Rochdale.
15,260. Cutting the Teeth of Saws, A. Rösle, Liverpool.
15,261. Nails, C. March, Glasgow.
15,262. Facing Inside Cylinder Valves, A. L. Daviess, Sheffield.
15,263. Caps and Guards, &c., for Cutlery, E. Price, Sheffield.
15,264. Wire-weaving Machinery, A. E. Wale, Birmingham.
15,265. Purification of Sewage Matters, S. Brown, London.
15,266. Manufacture of White Lead, E. van den Hoff, London.
15,267. Cord-holders for Window Blinds, F. W. Hitchin, Birmingham.
15,268. Protector for Pockets, &c., A. J. Nathan, London.
15,269. Manufacture of Tooth Paste, S. Levy, London.
15,270. Preventing the Twisting of Threads, G. M. Schreiber, London.
15,271. Improved Toy, A. E. Adshead, Manchester.
15,272. Oil or Hydrocarbon Engines, J. E. Weyman, Guildford.
15,273. Making Machine Bearings, J. D. Noble, Bristol.
15,274. Hand-driven Mechanism, S. J. Pocock, London.
15,275. Penholders, H. P. Clemetson, London.
15,276. Diaphragms for Electrolytic Purposes, M. Kiliani, Walter Rathenau, C. Suter, and Elektrochemische Werke Gesellschaft mit Beschränkter Haftung, London.
15,277. Tobacco and Cigarette Pouch, H. Manning, London.
15,278. Lock-stitch Sewing Machine, H. Manning, London.
15,279. A Combination Match-box, H. Manning, London.
15,280. Duplex Shirt-note Cuff, H. Manning, London.
15,281. Apparatus for Testing Wool, S. Jackson, London.
15,282. Ploughing by Electricity, F. Brutschke and H. Schimpff, London.
15,283. Improved Food Products, J. Campbell, London.
15,284. Advertising Bottles, &c., E. Gauche and J. L. Perréal, London.
15,285. Railway Carriage Couplings, B. C. M. P. de Lisle and G. P. Main, London.
15,286. Printer's Furniture, H. H. Lake.—(*A. Villa, Italy.*)
15,287. Washing Machines, H. W. Kolb, London.
15,288. An Improved Blind Roller, M. E. Reilly, London.
15,289. Wire Fences, P. R. J. Willis.—(*I. C. Allen, United States.*)
15,290. Washing Coal-tar, &c., S. B. Boulton, T. B. Haywood, H. E. Boulton, and H. Fergusson, London.
15,291. Apparatus for Paring Vegetables, C. Wolf, London.
15,292. Sinking Bore-holes in Quicksand, F. Honigmann, London.
15,293. Coal-screening Apparatus, D. Davy and Davy Bros., Ld., London.
15,294. Fuel Economisers, &c., J. G. Calvert, London.
15,295. Rings for Carrying Curtains, W. Woolf, London.
15,296. Tubulous Boiler with Superheater, W. Schmidt, London.
15,297. A New or Improved Settee, A. van Hoorn, London.
15,298. Sausage-filling Machine, W. von der Nahmer, London.
15,299. Supports for the Purposes of Observation, A. E. Wilson, London.
15,300. Rocking Chairs, A. Courquin, London.
15,301. Device for Use in Bath Chairs, C. H. Davey, London.
15,302. Water-closets, O. Elphick, London.
15,303. Manufacture of Biscuits, A. Smith, London.
15,304. Metallic Packing for Piston-rods, C. F. Churchill, London.
15,305. Yellow Coloured Silk, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
15,306. Fire-dogs, J. Fletcher, Birmingham.

*11th August*, 1894.

15,307. Manufacture of Gunpowder, L. G. Searson, London.
15,308. Stamping Piece-goods, J. F. Bramwell, Manchester.
15,309. Horseshoes, J. F. Bennett, W. Smith, and J. Wing, Sheffield.
15,310. Signalling upon Railways, J. Cocks, Manchester.
15,311. Gauges of Paper-cutting Machines, T. Smith, Manchester.
15,312. Gas Engines, J. F. Bennett and F. H. Stacey, Sheffield.
15,313. Cigar and Cigarette, &c., Cases, A. Ryan, London.
15,314. Fasteners for Millinery, E. P. Scruby, London.
15,315. Fasteners for Wearing Apparel, E. P. Scruby, London.
15,316. Gas Engines, J. F. Bennett and F. H. Stacey, Sheffield.
15,317. Manufacture of Lead Pigments, W. B. Priest, London.
15,318. Cork Drawers, N. S. McMillan and J. C. Stevenson, Liverpool.
15,319. Weaving Fabrics, G. H. Sargent and R. H. Coupe, Bradford.
15,320. Barometers, D. Logan, London.
15,321. Telephone Cords, G. Schrimpff and R. Riffelmacher, Manchester.
15,322. Can-making Machines, A. Johnson and H. C. Black, Glasgow.
15,323. Purifying Petroleum, J. Schrader, Liverpool.
15,324. Socks for Boots and Shoes, J. Gamble and H. Garland, Liverpool.
15,325. Surfacing Plugs and Cocks, J. Deam, Liverpool.
15,326. Brakes for Carriages, &c, H. Hollick, Coventry.
15,327. Varnishing Metal, J. Perl and P. Hermann, Berlin.
15,328. Studs, J. Brown, jun., and N. T. Thomson, Glasgow.
15,329. Preventing Mail Carts Running Away, C. Ellsworth, Glasgow.
15,330. Sash Frames of Windows, &c., W. Nicol, Glasgow.
15,331. Check-valves, W. Hinchliffe, Wakefield.
15,332. Mitre-cutting, &c., Block, W. O. Bailey, London.
15,333. Fluid Pressure Engines and Motors, J. Holt, London.
15,334. Freezing Mixture, H. Mansfield, London.
15,335. Steel Wheel for Cycle Purposes, A. F. Sage, London.
15,336. Compound Steam Engines, T. G. Clayton, London.
15,337. Liquid Cooler, J. G. Davies, London.
15,338. Candle Extinguisher, J. B. Goodwin, London.
15,339. Obtainment of Precious Metals, J. Mactear, London.
15,340. Horseshoes, C. Coplantz, London.
15,341. Cycle Tires, M. Boudard and H. A. Shelton, London.
15,342. Coupling Hold-backs to Carriage Shafts, G. C. Dymond.—(*S. F. Robbins, United States.*)
15,343. Tires for Cycles, &c., H. Claughton, Liverpool.
15,344. Improved Surgical Syringe, G. P. McGrath, Manchester.
15,345. Wheels for Carriages, &c., A. W. Thompson, Liverpool.
15,346. Cutting the Teeth of Bevel Wheels, G. C. Dymond.—(*P. Langen, Germany.*)
15,347. Rotary Brushes, F. Miotto and A. H. Simpson, London.
15,348. Chemical Compounds, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)

15,349. Boots and Shoes, C. Eisenberg and H. Humelet, London.

15,350. Couplings for Vehicles, G. Mellen and J. E. Sprague, London.

15,351 Evaporative & Surface Condensers, E. Theisen, London.

15 352. Pavements for Streets, W. M. Hodges, London.

15,353. Electric Motors, W. Routledge, London.

15,354. Apparatus for Cooling Purposes, A. J. Boult.—(*H. Dessolier, Algeria.*)

15,355. Refuse Destructor, W. Chambers, London.

15,356. Closing Electric Switches, D. T. Bostel, London.

15,357. Raising Water for Draining Purposes, J. W. Titt, London.

15,358. Wrenches, A. G. Brookes.—(*E. O. Ely, United States*)

15,359 Producing Flood-tight Joints, H. C. Platts and T. Lowther, London.

15,360 Arc Lamps, J. W. Rogers. London.

15,361. Antiseptic Agents, J. Y. Johnson.—(*Dr. F. von Heyden, Germany*)

13*th August*, 1894.

15,362. Frames of Umbrellas, &c., J. M. Cracknell, Ipswich.

15,363. Withdrawing Props in Mines, W. Sylvester, Longport.

15,364. Utilisation of Waste Steam, J. Wild, Manchester.

15,365 Dyeing Fibres, W. B. Hart and C. McKerrow, Manchester.

15,366. Concentrating Sulphuric Acid, I. Levinstein, Manchester.

15,367. Stoves, J. Gratton, W. Watson, and J. Taylor, Nottingham.

15 368. Brick Kilns, T., A., W. and H A. Martin Bristol.

15,369. Down-draught Preventers, J. Shaw, Willington-on-Tyne.

15,370. Bucket Jaws, J. Ellis, Bangor.

15,371. Paper and other Fasteners, G. Tucker, Birmingham.

15 372. Lamp Clips, F. J. Miller and C. A. Miller, Birmingham

15,373. Fixing Spiral Springs, D. Cremmen, London.

15,374. Saw-sharpener, G. C. Dymond.—(*F. Schmaltz, Germany*)

15,375. Polishing Mops, C. Taylor and T. H. Pearce, Birmingham.

15,376. Shades of Electric Lamps, &c. J. Whitehead, Birmingham.

15,377. Rod or Roller Curtains, A. Marsden, Stockton-on-Tees.

15,378. Nosebag for Horses, &c., A. Zillwood, Southampton.

15,379. Pianoforte or Orchestra Stools, T. Gapes, London.

15,380. Ventilators, R. R. L. Rosoman, Southampton.

15 381. Bushed Stop-rod for Reed Looms, J. Cook, Hyde.

15,382. Adjustable Swell for Reed Looms, J. Cook, Hyde.

15,383. Balling Heads for Fibres, H. Priestman, Halifax.

15 384. Ladies' Under Garment, M. C. Macgillivray, Glasgow.

15,385. Cycles and Wheeled Vehicle, G. B. Main, Glasgow.

15,386. Stay and Corset Busk and Eyelet, J. Farrow, Wavertree.

15,387. Billiard Tables, R. W. Wyett, Victoria, Australia.

15,388. Funnels for Filtering Purposes, H. J. Hands, East India.

15 389. Water-closet Joints and Pipes, H. Johnston, Liverpool.

15,390. Coal Vases, G. H. Shackleton, Bilston.

15,391. Pneumatic Tires for Cycles, A. I. Rath, Birmingham.

15,392. Mandolin-autoharp, A. L. Gautier, London.

15,393. Soda Water, A. Wedlich and T. Chaloupka, London.

15,394. Transporting Perishable Goods, J. H. Bowley, London.

15,395. Cycle Garments, W. Edwards and A. Gamage, London.

15,396. Electric Tramways, J. Hopkinson, London.

15 397. Cuffs and Sleeves of Garments, W. Green, London.

15,398. Long-arm, S. L. Gorer, London.

15,399. Covers for Pneumatic Tires, C. F. Dusart, London.

15,400. Colour Printing Machines, H. Brissard, London.

15,401. Vehicles. A. Leblanc, London.

15,402. Pattern Machines, F. W. Golby.—(*R. Kuöschke, Russia.*)

15,403. Automatic Alarm Device, C. H. Krützfeldt, London.

15,404. Lubrication of Bearings, S. Straker, London.

15,405. Tubular Section Steam Boiler, T. Henderson, London.

15,406. Cigarettes, G. C. Dixon, London.

15,407. Horse Blanket and Cover, J. Hopewell, jun., London.

15,408. Horse Blanket and Covers, J. Hopewell, jun., London.

15,409. Holder or Fastener for Gowns, J. G. Clegg, London.

15,410. Printing Machines, E. T. Cleathero and E. W. H. Walker, London

15,411. Railway Brake, C. C. Clifford and J. Carter, London.

15,412. Mashers, G. H. Zane, A. M. Snyder, and C. T. Worrell, London.

15 413. Heating Liquids and Air, E. Fudickar, London

15,414. Telephonic Call Bells, F. G. Warrell, London.

15,415. Fixing Cranks to Shafts, K. F. Lagergren, London.

15,416. Cabinets for Collections, &c., F. Dippel, London.

15,417. Construction of Fire-places, W. H. Haslam, Manchester.

15,418. Liquid Measures, W. P. Meadows, London.

15,419. Miners' Picks, W. K. Birkinshaw, London.

15,420. Device for Supporting Umbrellas, O. Cohen, London.

15,421. Device for Supporting Umbrellas, O. Cohen, London.

15,422. Winding Engine and Apparatus, J. Rousse, London.

15,423. Brake for Warp Beams, R. Haddan.—(*A. Biedermann, Germany.*)

14*th August*, 1894.

15,424. Electro-motors, D. Cook, Richmond.

15,425. Picking Hops, D. Young.—(*The Mills Hop Picking Machine Company, United States.*)

15,426. Extension Cranks, T. F. Bourne, London.

15,427. Pole Propeller and Pipe Motors, G. Paterson, Co. Fermanagh.

15,428. Fire-grates for Boilers, J. E. Rogers, Birmingham.

15,429. Conducting Electricity, J. Lindley and G. E. Sutcliffe, Mirfield.

15,430. Feeding Paper from a Web, J., F., and J. Y. Foster, London.

15,431. Spiral Spring Spoke, J. Phethean, J. Brown, and T. Charnock, Bolton.

15,432. Deadlights of Ships' Sidelight Scuttles, G. N. Arnison, jun., Sunderland.

15,433. Dyeing Colours on Fabrics, H. Wylie and J. Morton, Glasgow.

15,434. Puzzles, G. F. Fitter and W. H. Egginton, Birmingham.

15,435. Packing Rings of Pistons, W. Bagshaw, Nottingham.

15,436. Checking Pickers in Looms for Weaving, F. Jowett and J. Normanton, Halifax.

15,437. Winding Window-blind Rollers, J. Cook, W. Swarbrick, and H. Bernard, Lancashire.

15,438. An Improved Spittoon, J. Waltho, Stockport.

15,439. Pneumatic Tires, G. C. Moore, Manchester.

15,440. Tunnels, A. S. Dandridge, Manchester.

15,441. Apparatus for Filtering Sea Water, J. Pfister, Manchester.

15,442. Sketching Easels, T. Pursey, Edinburgh.

15,443. A Bench Vice, I. Carruthers, Sussex.

15,444. Danger Railway Signal, C. F. Williams, Monmouth.

15,445 Hydraulic Riveting Machine, W. Fairweather.—(*The Babcock and Wilcox Company, United States.*)

15,446. Telescopic Dark Tent Stand, W. M. Lynslager, London.

15,447. Window Sash Fasteners, J. H. Foote, London.

15,448. Attachment to Doors to Contain Notices, J. Westaway, London.

15,449. Treatment of Cancer, &c., J. Westaway, London.

15,450. Fasteners for Gloves, O. P. and G. O. Elterich, London.

15,451. Sharpening Razors, J. W. C. Kleeberg, London.

15,452. Electric Arc Lamps, H. H. Lake.—(*R. Drysdale, United States*)

15,453. Measuring the Amount of Gases, B. C. Tilghmann, jun., London.

15,454. Boiler Furnaces, D. J. McKenzie and W. Martin, London.

15,455. Telegraphic Transmitters, F. F. Howe, London.

15,456. Shaving Head-rests, S. J. Sewell, London.

15,457. Pipe and Cigar Lighter, E. H. Wheeler, Surrey.

15,458. Golf Bags, W. G. Davidson, London.

15,459. Metal-mesh Bows, D. Robinson, London.

15,460. Fire-proof Floor, J. Sheppard and F. Dashwood, London.

15,461. Hook and Eye Fastenings, D. Davidson and A. C. Clapp, London.

15,462. Casting Metals, R. Keostermann.—(*J Kudliez, Austria*)

15,463. Measuring Alcoholic Liquids, A. Bassett, London.

15,464. Rollers for Printing Fabrics, G. A. Muntz, London.

15,465. Bench Cramps, J. Hampton and J. Hampton, London.

15,466. Concrete and Iron Girders, F. G. Edwards, London.

15,467. Steam Road Rollers, E. T. Wright, London.

15,468. Solution of Sweet Carbamides in Oils, A. Sommer, London.

15,469. Treatment of Coal Dust, A. McDougall, Liverpool.

15,470. Prevention of Explosions in Mines, A. McDougall, Liverpool.

15,471. Condensing Rays of Light, A. Sciascia, London

15,472. Garment Clasps, S. Schwarz, London.

15,473. Making Green Oxide, F. L. Slocum and C. Y. Wheeler, London.

15,474. Sash Fastener, T. Beevers, J. A. Nealon, and W. Brett, London.

15,475. Compound Steam Engines, W. Schmidt, London.

15,476. Colour-printing Apparatus, H. H. Lake.—(*L. Josz and G. Pechenino, Italy.*)

15,477. Manufacture of Lace Curtains, E. Cope, London.

15,478. Repair of Pneumatic Tires, G. E. Osmond, London.

15,479. Valves for Pneumatic Tires, G. E. Osmond, London.

15,480. Pressure-regulating Valves, F. M. Sandillon, London.

15,481. Railway Switches, &c., D. MacPherson, London.

15,482. Article of Furniture, G. W. Ashwell, London.

15,483. Damping Gumming Sheets, W. J. Reynolds, London.

15,484. Miners' Trucks, E. Edwards.—(*E. Heinel, Germany.*)

15,485. Heating Apparatus, E. Edwards.—(*C. Müller, Russia.*)

15,486. Manufacture of Coke, E. Edwards.—(*The Internationale Gesellschaft für Torfverwaltung, Germany.*)

15,487. Apparatus for Filtering Water, H. Kowalski, London.

15,488. Surveying Instruments, W. Hinton, London.

15,489. Device for Curling Hair, W. S. Cooper, London.

15,490. Steam Generators, R. W. Mewes, London.

15,491. Gas Stoves, W. L. Wise—(*A. Rothenbach, Switzerland.*)

15,492 Treatment of Clothes, S. O. Cowper-Coles and H. B. Ransom, London.

15,493. Manufacture of Butter, J. H. H. Duncan, London.

15,494. Coin-freed Mechanism, A. Sussmann and F. Zahn, London.

15,495. Curtain Hangers, A. J. Boult.—(*J. G. Beck, Germany.*)

15,496. Turning Over the Leaves of Music-books, J. L. Lister, London.

15,497. Sighting Cards, J. H. Hogg, London.

15,498. Apparatus for Ventilating, R. W. McGregor, London.

15,499. Candle Holder, V. D Lake, London.

15,500. Device for Carrying Umbrellas, J. J. Osborn, London.

15*th August*, 1894.

15,501. Water-closet for Ships, &c., R. B. West, Isle of Wight

15,502. Spindles, C. Butterworth, Manchester.

15,503. Thread Guides of Winding Machines, E. Morris, Halifax.

15,504. Cutters for Cutting Metal Rods, J. B. Howard.—(*R. Filecek and Stephan Schwal, Germany.*)

15,505. Producing Heat from Petroleum, A. and M. A. Hobbs, Monmouth.

15,506. Volt Meters, F. Brown, Birmingham.

15,507. Joint for Connecting Water Taps, J. Barker and T. Handley, Rochdale.

15,508. Restraining Runaway Horses, J. Gorman and A. Bolt, Bristol.

15,509. Rug-strap Handles, J. Bailey, Walsall.

15,510. Ropes for Core-making, J. Butler, Manchester.

15,511. Chromo-lithography, T. H. Sale and W. Stead, Manchester.

15,512. Machinery for Spinning, W. S. Bancroft, Halifax.

15,513. Castings in Cement, G. Booth and M. Bolton, Stockton-on-Tees.

15,514. Cycles, H. Lucas, London.

15,515. Stands for Displaying Caps, T. Griffiths, London.

15,516. Carriage Lamps, W. T. Webber, Birmingham.

15,517. Malt and Hop Barm, G. Bartlett and W. Pearsall, Birmingham.

15,518. Lathe for Potters' Use, J. R. Pratt and W. E. Piercy, Staffordshire.

15,519. Securing the Handles into Jugs, T. Weir, Dublin.

15,520. Slabs for the Beds of Billiard Tables, J. Goodfellow, Glasgow.

15,521. Machines for Blowing Textile Material, J. A. Hart, Blackburn.

15,522. Manufacture of Fibre for Fabrics, A. Millar, Glasgow.

15,523. Saddle Framing, P. L. Renouf, Birmingham.

15,524. Steering Cycles, J. and H. J. Brookes, and P. L. Renouf, Birmingham.

15,525. Cure for Influenza, J. Wallace, Dublin.

15,526. Furnaces for Refuse, S. Willoughby, London.

15,527. Automatically Re-corking Casks, H. W. Rice, Nottingham.

15,528. Syringes, J. Macqueen, London.

15,529. Cutting Bobbins, J. H. Bale and W. H. Urch, London.

15,530. Stand for Paper-hangings, T. R. Shillito.—(*C. M. Patterson and H. B. Patterson, United States.*)

15,531. Indicating Device for Doors, H. B. Diamond, London.

15,532. Weldless Steel Chains, G. Stephenson, Glasgow.

15,533. Adaptation of Telephonic Sounds, T. J. Howell and F. Lake, London.

15,534. Vessels Containing Liquids, C. S. Snell, Cornwall.

15,535. Distance Indicators, A. J. Boult.—(*C. F. Briault, France.*)

15,536. Edge Setting Machines, A. Pochin, London.

15,537. Corkscrews, J. A Kruseman, Liverpool.

15,538. Velocipede Wheels, M. Boudard and H A. Shelton, London.

15,539. Machines for Cropping Cloth, J. and W. Burns, London.

15,540. Spray Producer or Fountain, C. R. Shilling, London.

15,541. Ruling Device, C. H. Davy, London.

15,542. Pipe Joints, F. R. Adair, London.

15,543. Steps or Ladders, W. R. Yates, London.

15,544. Automatic Safety Holder for Dresses, K. Wanaus, London.

15,545. Non-explosive Reservoir for Lamps, A. J. and A. A. Stonely, London.

15,546. Saddle Bars, J. A. Torrens, London.

15,547. Stays for Steam Boilers, R. T. Preston, London.

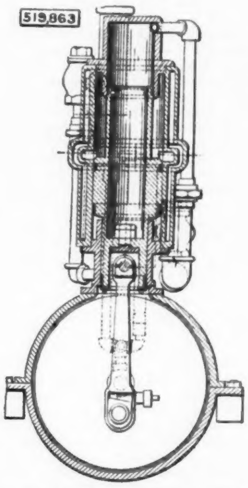
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**519,863.** Gas Engine, *D. C. Luce, Brockton, Mass.—Filed April* 14*th*, 1893.

*Claim.*—(1) A gas engine, comprising in its construction a cylinder having a central combustion chamber provided with an inlet port at each end and a centrally-located exhaust port, and charging chambers at each end of the combustion chamber and of less diameter than the latter, and each having a port, a piston having a central portion which fits the combustion chamber and receives the impact of the explosions, and extensions which fit the charging chambers, check-valved passages connecting the ports of the charging chambers with a fluid supply, and check-valved passages connecting said first-named passages respectively with the ports of the combustion chamber. (2) A gas engine, comprising in its construction a cylinder having a central combustion chamber provided with an inlet port at each end and a centrally-located exhaust port, and charging chambers at each end of the combustion chamber and of less diameter than the latter, and each having a port, a piston having a central portion which fits the combustion chamber and receives the impact of the explosions, and extensions which fit the charging chambers, check-valved passages connecting the ports of the charging chambers with a fluid supply, check-valved passages connecting said first-named passages respectively with the ports of the combustion chamber, and hot tubes communicating by restricted passages with the second check-valved passages.

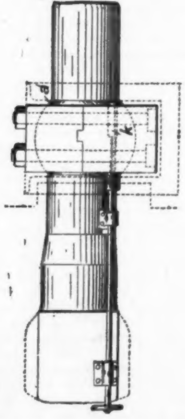
519,863



**519,965.** Gun Mounting, *J. L. Norris, Washington, D.C.—Filed July* 27*th*, 1893.

*Claim.*—(1) In a field gun or other ordnance, the combination of a spherical portion *a'* formed on the gun in lieu of trunnions, and a clip of corresponding spherical form internally, and bearing upon and supporting said spherical portion of the gun and adapted to grip and lock the gun firmly in position when required, the said spherical portion and the clip constituting a form of ball and socket or modified universal joint, substantially as shown and for the purpose specified. (2) In a field gun or other ordnance the combination with a spherical portion formed on the gun in lieu of trunnions and a corresponding spherical clip, of wedge pieces *k k* and means for operating them to grip and lock the gun, substantially as described.

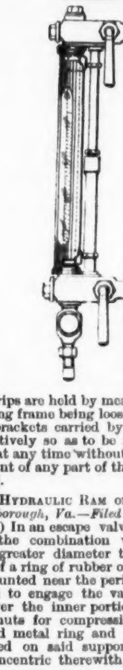
519,965



**519,957.** Guard for Water Gauges, *J. A. Hopkinson and J. Hopkinson, Huddersfield, England.—Filed December* 15*th*, 1893.

*Claim.*—(1) For a glass water gauge, the combination of the upper and lower brackets mounted respectively on the steam and water arms of the gauge, a frame loosely resting in said brackets, and glass loosely resting in said frame, substantially as described. (2) For a glass water gauge, the combination of upper and lower brackets mounted respectively on the steam and water arms of the gauge, a frame made in one piece loosely resting in said brackets, and flat glass strips loosely resting in said frame, substantially as described. (3) For a glass water gauge, a shield or guard comprising a frame in which readily removable flat glass strips are held by means of turnbuttons, said glass carrying frame being loosely supported in upper and lower brackets carried by the steam and water arms respectively so as to be readily attachable and detachable at any time without requiring the removal or adjustment of any part of the gauge, substantially as described.

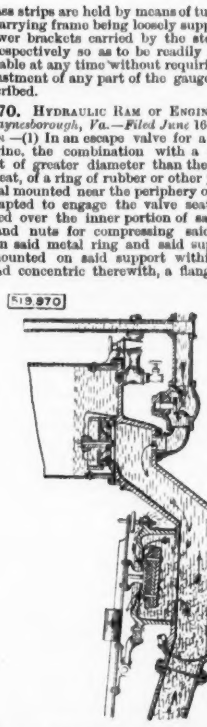
519,957



**519,970.** Hydraulic Ram or Engine, *W. A. Rife, Waynesborough, Va.—Filed June* 16*th*, 1893.

*Claim*—(1) In an escape valve for a hydraulic ram or engine, the combination with a circular ridgid support of greater diameter than the interior of the valve seat, of a ring of rubber or other yielding elastic material mounted near the periphery of said support, and adapted to engage the valve seat, a metal ring mounted over the inner portion of said rubber ring, bolts and nuts for compressing said rubber ring between said metal ring and said support, a rubber disc mounted on said support within said rubber ring and concentric therewith, a flanged valve stem mounted over said rubber disc, and bolts and nuts, adjustably connecting said support, said rubber disc, and said flange together, substantially as and for the purposes described. (2) In a hydraulic ram or engine, a circular delivery valve provided with a metallic body perforated with curved gridiron ports, a flap of leather or similar material mounted over said ports, a perforated rubber disc beneath said valve body, a perforated ring provided with curved ribs secured beneath said perforated rubber disc, and means for securing the said valve body, leather flap, rubber disc, and perforated ring together, substantially as described.

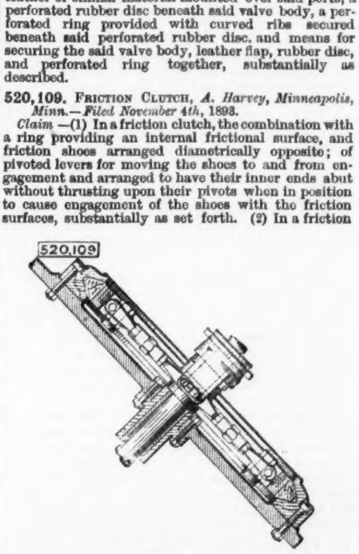
519,970



**520,109.** Friction Clutch, *A. Harvey, Minneapolis, Minn.—Filed November* 4*th*, 1893.

*Claim*—(1) In a friction clutch, the combination with a ring providing an internal frictional surface, and friction shoes arranged diametrically opposite; of pivoted levers for moving the shoes to and from engagement and arranged to have their inner ends abut without thrusting upon their pivots when in position to cause engagement of the shoes with the friction surfaces, substantially as set forth. (2) In a friction clutch, the combination with opposite radially movable shoes and a circular frictional surface; of radially arranged levers having loose pivotal connections with a shifting device, whereby their ends may be thrust to contact, substantially as and for the purpose set forth. (3) In a friction clutch, the combination with a ring having an internal annular groove; of friction shoes; levers for operating them, the levers having their inner ends arranged to abut; a shifter having arms to which the inner ends of the levers are pivoted in slots permitting longitudinal movement of the levers; and arms extending from a hub on the shaft and attached to the shoe carriers for causing them to rotate with the ring, substantially as set forth.

520,109



## THE IRON AND STEEL INSTITUTE.

ON Tuesday the members of the Institution left Brussels at 2.0 p.m. by special train for the Antwerp Exhibition. About half way, what might have been a very serious accident occurred. The train slowed down for signals. It appears that the driver had not sufficient experience in the use of the Westinghouse brake on very long trains. Applying it too quickly, the back of the train pressed on the front, compressing the buffer springs. The moment he released the brake on the engine the buffer springs acted; a very violent jerk took place. The draw bar between the leading brake van and the first passenger coach gave way. The side chains broke as a matter of course. The brake pipes fell apart, and the automatic action instantly jammed the brakes hard down, and the train stopped suddenly. One gentleman received a bad black eye, another had two teeth loosened, and a third was flung full length on the carriage floor. The engine went away with the damaged carriage, placed it in a siding, and came back for the train, which reached Antwerp without further accident. There was a reception held beneath the dome, Antwerp officially welcoming the visitors. In the evening there was a special illumination of the grounds, and the visitors returned to Brussels by special train at 10.30.

At the commencement of the proceedings on Wednesday, the second day of the meeting, the President, whose term of office expires in May, 1895, announced in accordance with the usual practice that the Council had selected Mr. David Dale as his successor, a nomination which was viewed with considerable satisfaction by the members present. Mr. Dale's connection with the Institute has been so long and intimate—he having acted as honorary treasurer since its foundation—that the choice of the Council seems to be particularly appropriate.

The first paper read—"Notes on Electrical Power"—was by Mr. Selby-Bigge. We reproduce it in full on another page.

It dealt with a subject of much importance and attracting a great deal of interest just now. The discussion which followed was of very little importance. There was no one present, indeed, who possessed sufficient experience or knowledge of the subject to add much information to that supplied by Mr. Selby-Bigge—and even if there had been, time was not available for long speeches.

Mr. Wicksteed said that, inasmuch as the motor performed best, as he understood, when running at 800 revolutions, it was probable that much loss of efficiency might occur when the speed was lowered. He wished to know if this was the case, because the speed of the motor must vary a good deal. A crane appeared to supply an admirable means of testing for efficiency, because the weights lifted being known and the power expended being known, all the elements of information were supplied in actual foot-pounds per minute expended by the engine, and represented by the weight lifted by the crane. He wished furthermore to know how, for foundry work, the speed could be controlled. In lifting a pattern, for example, out of a mould, the lifting had to be done very slowly and cautiously.

Sir I. L. Bell said it was a regrettable fact that the electrical engineer was spoiling the landscape by using up the waterfalls, and to him, at least, it was small compensation for the loss of a lovely cascade, to be told it was lighting a little town, which he had never before heard of, twenty miles off. But his principal object in rising was not to find fault, but to say that his sons were about to apply electricity to drive the large quantity of machinery in their ammonia soda works, so satisfied were they with what they had seen in Belgium.

Mr. Louis said that it might interest the members to know that a cascade on the north side of Hellvelyn had recently been utilised to provide power for working the Greenside lead mine, a considerable distance away, with much success. Electricity was employed at the mine, both in pumping and boring. Only a small dam had been required to impound the water.

Mr. Webb pointed out briefly that electricity was admirably adapted for driving textile machinery, and was gradually finding its way into spinning mills. He was followed by Mr. Adamson, who said that it was hard to realise the loss incurred in shop and overhead travelling cranes driven in the ordinary way. In one case which he mentioned, the overhead traveller in a shop 250ft. long was driven by a fly-rope running at a speed of 4500ft. a minute. Between 11 and 12-horse power were required merely to keep the rope running. He was confident that not 33 per cent. of the indicated power of the engine reached the load to be lifted. If electricity was used, he felt confident the efficiency would be at least 50 per cent. Leaving the question of cranes, he pointed out that one of the great advantages of electric driving was that tools could be put down just where they were wanted. This was a matter of very great convenience in boiler shops. It often happened that it was desirable to rearrange the tools in a shop. Nothing was easier with electric driving, nothing more troublesome when lay shafts and belts were used. He felt certain that in the future all textile machinery would be driven direct by motors from one great central engine in each mill, and that nothing but electric cranes would in a short time be employed.

Mr. Selby-Bigge, in reply, said that it would probably not pay to employ special slow motors referred to by Mr. Wicksteed, as they were heavy and expensive to make. But they were not wanted; because in all overhead travellers, whether driven by hand or steam or electricity, there were several motions obtained by gearing and clutches. But when electricity was employed the clutch and gearing were got rid of, a separate motor being employed for each special motion. A most important application, he considered, of electricity was to driving the live rollers of rolling mills. In one case where 50 to 60-horse power of steam was used in this way, it was found possible to do the whole work with six motors of 8½-horse power each, which took up the work one after the other as the bar passed over the rollers. As to textiles, it was most admirably adapted to the purpose, and was already largely employed in a big mill in Ghent. One of the great advantages of electric driving was that the ammeter and volt meter reported at once to the engineer what was going on; he could see at a glance what power was being expended. Leaks and losses of all kinds automatically reported themselves in the office; with steam nothing of the kind was possible. The losses going on daily were enormous and unknown. In one instance he found that 76 per cent. of the whole power of the engine was wasted in driving line shafts and belts alone. And although this was perhaps exceptional, still enormous loss of power did no doubt almost always go on. This could, as he said, be avoided by the use of electricity. A vote of thanks was passed to Mr. Selby-Bigge for his paper.

The next paper was by Mr. J. A. Lencauchez,

### "ON THE MANUFACTURE OF STEEL IN THE OPEN HEARTH."

This paper was given at considerable disadvantage, having been hurriedly prepared and circulated in the meeting without illustrations, owing to the delay of the author in supplying the manuscript. Such delays are not unknown in societies whose members, all living in one country, are more amenable to secretarial control, and therefore, can scarcely be avoided in the Iron and Steel Institute, where the members are pretty much at large all over the world. The author, after noticing some experiments made at Styring-Wendel in a rotary furnace, with the addition of an artificial blast to promote decarbonisation by direct oxidation, described a furnace used in the production of dead soft steel at the Escaut and Meuse Works at Anzin, in the north of France. This is an open hearth furnace with plunging gas burners, and a slightly domed roof of the ordinary pattern which can be supplied with air under pressure from tuyere tubes in the roof near the spring of the arch, as well as at the top of the melted metal in the bath. The roof is made double, with an intermediate space through which the air for the top blast is admitted. The bed of the furnace as well as the noses of the gas and air ports are built in bricks made of Eubœa magnesite. The action of the blast is two-fold; the upper tuyeres promote the combustion under the roof of carbonic oxide evolved in the bath instead of allowing it to burn in the regenerators, where it is comparatively inefficient, while the lower ones at the hearth level supply air for the direct oxidation of the carburised metal in a similar manner to the action of the blast in the cupellation of argentiferous lead. Another modification in construction was the use of thin, closely-set, parallel walls of brickwork for the heat intercepting mass in the regenerators, instead of the ordinary chequer work, in order to diminish the chance of lodgment of dust by avoiding horizontal surfaces.

As regards the results obtained at the works of Escaut and Meuse at Anzin, where the method is mainly the pig and scrap process, the proportion of pig iron has been increased relatively to that of the scrap iron, of which the chief component is old rails. The charges are made up of two-fifths of hematite iron, and three-fifths of old iron, scrap, &c., for the production of extra soft steel, with an elongation of 25 to 30 per cent. Since the application of blowing the results have always been very satisfactory. In twenty-five effective working days the minimum outturn per month is 1000 tons of sound ingots. The average useful production per day of real work is from 40 to 42 tons, with a consumption of 275 kilogrammes—605 lb.—of coal in the producers per ton of ingots, including lighting up. The fuel used consists of about 58 per cent. of run of the mine from Flènu, and 42 per cent. of small coal of 4 centimetres, from Bruay. The number of heats is regularly four per twenty-four hours throughout the month. The silica roof lasts a minimum of 200 heats. Before the introduction of the blow-pipe arrangement in the roof, the furnace only produced 30 to 32 tons of steel per twenty-four hours, but, thanks to the dust catchers arranged as described above, too frequent stoppages have been obviated, and the monthly production previously mentioned has been attained. Prior to blowing, with the furnace working under the same conditions as to quality of steel and fuel, the coal used in the producers amounted to 340 kilogrammes—748lb.—per ton of steel made.

Only one Root's blower is used, and the following particulars show the progress of the operation, with an average charge of 10,800 kilogrammes — 10·8 tons:—Natural draught, twenty minutes; blowing during charging, one hour; blowing before complete fusion two hours, twenty minutes; natural draught, one hour forty-five minutes. The total duration of the operations is thus five hours twenty-five minutes. Whilst blowing, the gas is turned full on, and the pressure of the blast is 0·580 metre — 22·84in. The greatest pressure that the Root's blower is capable of producing is 0·750 to 0·800 metre—29·53in. to 31·50in. Under these conditions, the amount of air blown in per second for the six tuyeres is 0·397 cubic metre—14 cubic feet—and for the whole operation, it amounts to 4764 cubic metres—168,148 cubic feet—or about 30 per cent. of the total quantity of air.

The great economy of blowing-in air in the manufacture of steel in the open hearth is thus rendered clearly visible. It was intended to make some trials with the blast at higher pressures, and also with the ore process. Some suggestions bearing in this direction are as follow:—In the new plant, to make use of the blast from a Bessemer blowing engine, giving a pressure of 1·75 kilogrammes (3·85 lb.). This will enable the quantity of blast to be reduced to 10 or 15 per cent. of the total amount of air, and it is here that the use of the great development of the air regenerators will appear, for the hot air in excess will be forced down on to the bath by the tuyeres. Besides this, it will be possible to inject hot air through the tuyeres; but this complication does not appear to our minds to be necessary, unless the furnace is close to the hot-air stoves of a blast furnace.

The procedure with a furnace, or, better, with two furnaces, would be as follows: The metal is fused at a relatively low temperature in a slightly oxidising flame to obtain the desulphurisation by the manganese contained in the pig iron, or added in the form of ferro-manganese. The slag is mainly composed of sulphide of manganese and lime, and after rising to the surface is skimmed off. By slightly raising the tenperature of the bath and by blowing, nearly all the silicon and phosphorus is oxidised, and the bath is rabbled as formerly. Lime is added to neutralise the last traces of phosphoric acid, and the bath is again cleaned. Combined with the blowing, it will be possible to oxidise, by successive additions of hematite, magnetic oxide, or other ores, which should be as pure as possible and with calcareous gangues. It will be, however, advantageous to diminish the use of these oxides to a minimum, especially if they are difficult to obtain. The elimination of sulphur, phosphorus, and silicon is effected at temperatures lower than that at which decarburisation commences, or, in other words, at which carbonic oxide is generated. At these relatively low temperatures the basic walls do not suffer. The refining of the metal thus obtained can be finished in a second furnace, the first one forming a sort of a washing furnace. Decarburisation can be performed with a very small minimum of ore, or the ore may be entirely omitted, for the points that will have to be looked after are the shortening of the operation, as well as the most economical results. The smaller the quantity of ore, the less will be the amount of slag, the shorter will be the time required for mending the lining, and the lower will be the cost of making iron into steel. To sum up, the object of blowing air into the open hearth is not only to increase the outturn, but also to refine as much pig iron as possible by air. This ought to lead us to much less costly conditions, owing to the smaller quantity of slag, and its removal at a relatively low temperature. The use of the blast allows the temperature of the hearth to be very easily and rapidly varied, and it is applicable to existing furnaces.

Some amusement was caused by the President, after stating that the paper was essentially one to bring forth communications from the younger members of the Institute, calling upon Mr. James Riley to begin the discussion. Mr. Riley stated that he had used blast in the open hearth furnace, but the advantage was not sufficient to compensate for the complication introduced in working.

Mr. Snelus thought the great advantage of the open hearth over the Bessemer process was in the extra yield obtained when iron ore was used as the softening material, and this would be lost if direct oxidation by air were to be adopted. Mr. Bauerman pointed out some features in the design, recalling the top blast of the earlier gas fired furnaces, and which had in course of time been mostly given up in favour of natural draught.

Mr. Paul thought that the melting down might be accelerated by the use of blast, but that if hot air were used as suggested the roof would probably be melted down in twelve hours, and that, generally, intense local heating at any point in the furnace was to be deprecated. He had found the chequer work in basic furnaces to stand for six months without cleaning. As in the filling the regenerators, straight walls like those used by the author were advantageous for heating the gas, but for the air ordinary chequer work was best.

Sir Lowthian Bell thought that the top blast might be more useful in preserving the roof by keeping off the body of flame rather than promoting intensity of combustion.

The discussion on Mr. Lencauchez's paper, although not protracted, lasted till noon, so that only a very short time was available for the remaining papers on the list. One of these by Mr. R. de Soldenhoff, on the "Manufacture of Coke," which had been prepared with a view to full discussion, was taken as read, as on account of the lamented decease of the author since the paper was written, the proposed discussion was necessarily abandoned. Mr. W. C. Macmillan briefly explained the construction and method of working of two new forms of colour gauges for use in the determination of carbon in steel by the Eggertz process, one of them being based upon the comparison of tints reflected from white dye through a colouring of coloured liquids when observed in the field of a total reflecting eyepiece above; and the other on direct observation of the light transmitted through the columns from a reflector placed below. These instruments, although comparatively simple, contain several ingenious refinements in construction intended to do away with sources of error in appreciating tints of colour that accrue in the older methods of colour determination. The following table summarises the results obtained with the two forms of instrument, pattern A being that depending on the observation of reflected, and pattern B of transmitted light.

| Steel mark. | Carbon found by combustion. | Carbon found by colour gauge. | |
|---|---|---|---|
| | | Pattern A. | Pattern B. |
| A.... | 0·15 | 0·16 | 0·16 |
| B.... | 0·22 | 0·22 | 0·21 |
| C.... | 0·43 | 0·42 | 0·43 |
| D.... | 0·46 | 0·47 | 0·46 |
| E.... | 1·41 | — | 1·42 |

In these tables A, D, and E represent the British Association standard steels, Nos. 4, 3, and 1 respectively.

The last paper read before the final adjournment on Wednesday was by Mr. A.P. Wilson, on the

### "IRON ORES OF THE MEDITERRANEAN SEABOARD."

This was a short summary of the different iron ore deposits existing at different points in Spain, Italy, Algiers, and further East in the islands of Greece and the Levant, but dealing more particularly with those of the southern provinces of Spain which lie within reasonable distances of shipping ports, and which may therefore be likely to become of importance in the not very distant future, when the supply from Bilbao must diminish if it does not entirely cease. In the opinion of the writer, the iron ore producing provinces of the south of Spain, and especially those of the province of Almeria, will unquestionably play a large part in the immediate future as exporters of iron ore. The ores from this province are already fairly well known, and the output, which at present is steadily growing, will shortly increase with great rapidity. Several purchases of mines in the southern provinces of Spain have been made during the last two years, chiefly by Bilbao mine-owners, and as soon as these properties have been opened up, and transport to the coast has been provided for, a great and sudden increase in the quantity of iron ore exported from these provinces may be confidently predicted. There are ores of every class in the southern districts—brown hematites, low in iron, high in water both free and combined, and producing about 80 per cent. of smalls; hard and purple-hematites, carrying 55 per cent. of iron and 3 to 4 per cent. of manganese, 80 per cent. being lumps; and manganiferous ores containing over 50 per cent. of iron, and 12 per cent. of manganese. The principal iron ore producing provinces of the South of Spain are Murcia, Almeria, and Malaga, and the production for the past three years has been as follows;—

| | 1891. Tons. | 1892. Tons. | 1893. Tons. |
|---|---|---|---|
| Murcia | 350,000 | 388,000 | 300,000 |
| Almeria | 163,224 | 174,350 | 115,000 |
| Malaga | 99,589 | 70,700 | 55,000 |
| Totals | 612,813 | 633,050 | 470,000 |

The decrease in production for 1893 is accounted for to a great extent by the coal strike which took place in England in that year. Freights consequently increased, and during the latter part of the year it was almost impossible to obtain boats, so that work had to be suspended at many of the mines. It will be seen that the production of the whole of the south of Spain is at present only from one-sixth to one-eighth of that of Vizcaya alone; but year by year, as the produce of the latter declines, that of the former may be expected to increase, and the outputs of the North and South will gradually approach one another. The deposits, however, of the southern provinces are not in any way so extensive as that of Bilbao; it is probable that all the workable deposits at present known in the South do not contain more than one-half the quantity of ore that was once available in the Bilbao mines. On the other hand, however, the mines of the South have several advantages over those of the North. Labour is there considerably cheaper, the climate is much drier, and freights, taking the average of the whole year, are not in excess of those which are paid from the nearer port of Bilbao. A large proportion of the ore, too, is superior to the Bilbao ores, the southern Campanil being of better quality than the average Bilbao Campanil, in that it contains more iron and less silica, whilst the northern district cannot boast of such ores as the manganiferous ores of Herrerias in Almeria and of the Cartagena district in Murcia. The lowness of Mediterranean freights is accounted for by the fact that larger steamers can load at ports on the southern coast of Spain than at Bilbao, which is known to be a shallow-water port; moreover, the amount of despatch-money earned under charters of steamers from the south of Spain is very large, amounting to 2s. per ton or thereabouts. This dispatch is not earned from steamers which load at Bilbao. An estimate was made and an average taken of the freights paid from the south of Spain to the east coast of England, and it was found, after taking into consideration the profits under the charter party, that the freight from the south of Spain for that period was somewhat less than that paid from Bilbao. At the present moment the freight from Bilbao to Middlesbrough is between 5s. and 5s. 6d.; whilst from the south of Spain ports—such as Garrucha and Almeria — it is 8s. 3d., a difference at first sight therefore of 3s. per ton in favour of Bilbao; but when it is considered that steamers from the south of Spain pay 10d. per ton for loading and 10s. per hour despatch at both ends, which, as mentioned before, is worth 2s. per ton, and that they also pay a higher rate for discharging than the actual cost, it will be seen that the emoluments under charters from the south of Spain amount to more than 3s. per ton. As the tonnage of the world is increasing rather than decreasing in size, it is only fair to suppose that the difference in favour of the south of Spain will be further demonstrated as times goes on. The principal iron ore mining centres in the south of Spain are:—Cartagena, Calasparra, Morata, and the Sierra Enmedio, in the province of Murcia: Herrerias, Sierra de Bèdar, and Sierra Alhamilla, in the province of Almeria; and Marbella, Robledal, and Estepona, in the province of Malaga.

In no case do these southern deposits occur as true lodes or veins; they have invariably been produced as beds or deposits by a system of replacement. They occur for the most part upon schistose rocks, and are covered by limestone or dolomite. There can be no doubt that at one time the limestone rested on the schist rock, and that, in the course of ages, they were gradually dissolved by acid waters carrying iron, which metal replaced the dissolved limestone. As a general rule, there is in these southern deposits no clear division between the iron ore and the limestone, the former, as it were, growing into the latter. Hard, isolated masses of limestone occur also in the midst of the ore bodies. On the other hand, the division between the iron ore and the underlying schist is quite clear and well-defined. At the point of contact the schists are generally altered or decomposed to a soft white clay or kaolin, whilst lower down they are hard and of a blue colour. The deposits are all situated in the slopes of mountain ranges, and are in most cases very favourably placed for working by open-cast.

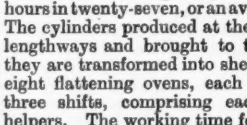
After the reading of Mr. Wilson's paper the formal business, including votes of thanks to the Reception Committees of Brussels, Charleroi, and Liége, the Communal Authorities of Brussels, whose co-operation did so much to ensure the success of the meeting, occupied only a few minutes, and the meeting adjourned at 12.30 p.m. on Wednesday. Having regard to the numerous counter-attractions presented to the members by one of the brightest and liveliest cities in Europe, their attendance was kept up with commendable regularity throughout.

On Wednesday afternoon the members were left to follow their own devices. Messrs. T. Cooke and Son had arranged a carriage drive in Brussels, all the principal places of interest being visited. This was well patronised. At 8.30 his Majesty the King of the Belgians, who is an Honorary Member of the Iron and Steel Institute, gave a reception and conversazione at the Palace, which was crowded. All the state rooms, save the great ball room, were thrown open; an admirable band supplied music. In one of the conservatories refreshments were provided on the most liberal scale. His Majesty, although in uniform and attended by several officers, did not assume state. He moved among his gratified guests and performed the duties of a host as a gentleman entertaining ladies and gentlemen. It is not remarkable that his Majesty and the Queen, who was not in Brussels, are excessively popular.

On Thursday, August 23rd, members left Brussels by two special trains from the Midi station at 8.20 and 8.40 a.m. The trains consisted each of about twenty first-class coaches, weighing each 17 tons, and drawn by very powerful engines. The arrangements were as follow:—The party was divided into groups, each provided with a distinguishing badge, of different colours, and bearing letters. "A," going by the first train, visited Pit No. 5 of the Bascoup Company. After inspecting the shaft, the screening and washing plant, &c., the members passed into the *Cité ouvrière* No. 1, thence on foot, by way of the park of the Château of Trazegniès—the property of the Bascoup Colliery—to the Trazegniès Railway Station, where train was taken to Charleroi. The Mariemont and Bascoup Collieries raise 1,200,000 tons of coal annually. "B," the second group, proceeding by the 8.40 train, visited the establishments of Baume and Marpent at Haine St. Pierre. "C," the third, travelling by the same train, visited the Mariemont Glassworks at Haine St. Pierre, about 1000 yards from the station of that name. 12.30 p.m., lunch at Charleroi. 2.30 p.m.: Four groups were formed, visiting — 1, The Marcinelle and Couillet Works at Couillet; 2, the "Glaceries de Charleroi" at Roux, near Courcelles; 3, the Marchienne Collieries at Marchienne, and the Sacre-Madame Colliery at Dampreny; and 4, to the Jonet Glassworks at Charleroi. 5.55 p.m.: Left Charleroi for Brussels.

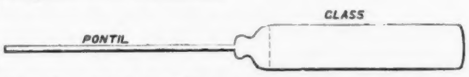
We shall confine ourselves for the present to the movements of group "C." On the arrival of the train at Mariemont, the party proceeded to the glassworks, the Verreries de Mariemont. These works are wholly devoted to the production of window glass of all kinds, under the management of M. Paul Noblet. We cannot do better in the first instance than reproduce here the contents of a card placed in the hands of each of the visitors.

"The sheet glass works of Mariemont were founded in 1828. These works are exclusively engaged with the manufacture of window glass: single or 16 oz. per foot, 21 oz. per foot, 24, 26, 28, 32, 36, and 42 oz. large sizes and ornamental glass. They occupy 600 workmen. Their means of production consist in two tank furnaces working without interruption. The two furnaces are of the vault form, and with independent burners in order to allow the partial repairing of each of the furnaces without stopping the fires. The gas generators are of the vertical column type, supplied with a heavy charge of coal and forced draught under a horizontal fire, allowing the exclusive use of small coal. The heating surface of the two furnaces represents respectively 100 square metres and 75 square metres, producing together an average monthly area of 1,500,000 square feet of blown glass. The two together contain 560 tons of melted glass. These furnaces employ 210 men, viz.: sixty blowers and sixty gatherers. The workmen are equally divided into three shifts, these working each eight hours, with one hour interval between each shift. Consequently, each furnaceman works eight hours in twenty-seven, or an average of 215 hours per month. The cylinders produced at the furnaces are cracked open lengthways and brought to the flattening ovens, where they are transformed into sheets. The works have also eight flattening ovens, each of them being worked by three shifts, comprising each one flattener and three helpers. The working time for the flatteners is the same as for the blowers. The flattening ovens are heated with coal-gas coming from the gas generators with natural draught—Siemens' system. The cylinders to be flattened are progressively heated in an arch oven and then flattened on a stone which is carried on a trolley, after which the sheets are conveyed towards an annealing furnace, where they are advancing gradually till their coming out of the apparatus. In each flattening oven there are two flattening stones carried on trollies with a siding. This arrangement enables the flattener to work without interruption. From the flattening ovens the sheets are sent to the cutting-rooms, where they are cut into panes, following the usual trade sizes, then classified according to their sizes and qualities into lots of 100ft., 200ft., 300ft., and then packed and shipped. The Belgian sheet glass works are exporting 95 per cent. of their production. Their principal outlets are England, the United States of America, after which come India, China, and Japan, the English Colonies, and the Mediterrenean."



The tank furnace has very largely superseded the old-fashioned pot furnace. It is in plan of the shape shown in the sketch. Internally it is some 30ft. long, and half as wide. The mixture of sand, alkali, and "frit," or broken glass, is charged from time to time through the door B. As it melts and glass is formed, the molten "metal" gradually finds its way to semicircular end in which are openings C C C, through which the glass is withdrawn by the workmen. The heat, which is extremely intense, is supplied by gas producers, modifications of Siemens' type, air being forced in by vertical steam jets, blowing down into trumpet-mouthed air pipes. The whole roof of the furnace is so carried in the buck staves that it can be raised or lowered a little, so that when worn it can be dropped slightly to preserve it the right height above the "metal." For the benefit of the visitors, M. Noblet had provided a wooden screen at some distance in front of the charging door, and in this was fitted a large pane of blue glass. Each of the visitors was handed a small pane of the same material, and with the aid of these two it was possible to see from end to end of the furnace, and the sight will not be readily forgotten. When the gas was turned off there was visible a vast grotto. In the front a mass of sand, bubbling and heaving and boiling. Further on a pool of partly molten sand, and near the end D a placid pool of molten glass reflecting the roof and sides, the whole quivering and shimmering in the intense heat. From time to time appeared the end of a rod, black by contrast, really bright red hot; or the end of one of the great glass cylinders, also black by contrast. Then the gas valve was opened, and over all floated lazily lovely violet clouds of flame. There was no noise, no violence, no turmoil. It was impossible to believe that here was a temperature which only the best firebricks from Dinas can withstand for any time. There were, we think, few among the visitors—all men well versed in furnaces and high heats—who could resist an exclamation of admiration as they looked at what we have vainly endeavoured to describe. It must not be forgotten that in the glass tank furnace the utmost care is used to obtain a perfectly clean heat, and the atmosphere was accordingly within the furnace almost entirely free from dust.

In making the glass, a boy takes a "pontil," a tube of iron about 8ft. long, and weighing 22 lb. He dips the end of this into the furnace and collects some glass on it, withdraws the ball and allows it to cool a little, and so goes on until the weight becomes greater than he can manage. Then the blower takes the pontil and collects more glass, until he has a ball twice the size of a man's head. This he rests in a hollowed block of wood, and, blowing through the pontil, begins to form a globe. Next, standing on a platform, he begins to swing the globe backwards and forwards like a pendulum, blowing the while, and so the globe becomes a cylinder. It is heated from time to time by thrusting it into the furnace for a moment, and so at last we have a cylinder of glass some 3ft. long and a foot in diameter, with a hemispherical end. On to this end a boy dabs a little bit of hot glass. This apparently causes a fine crack. The cylinder is thrust into the furnace for the last time. The end of the pontil is stopped by the workman's thumb. The air expands, there is a little explosion, and the end of the cylinder opens. Then we have a cylinder on the end of the pontil as in the sketch.

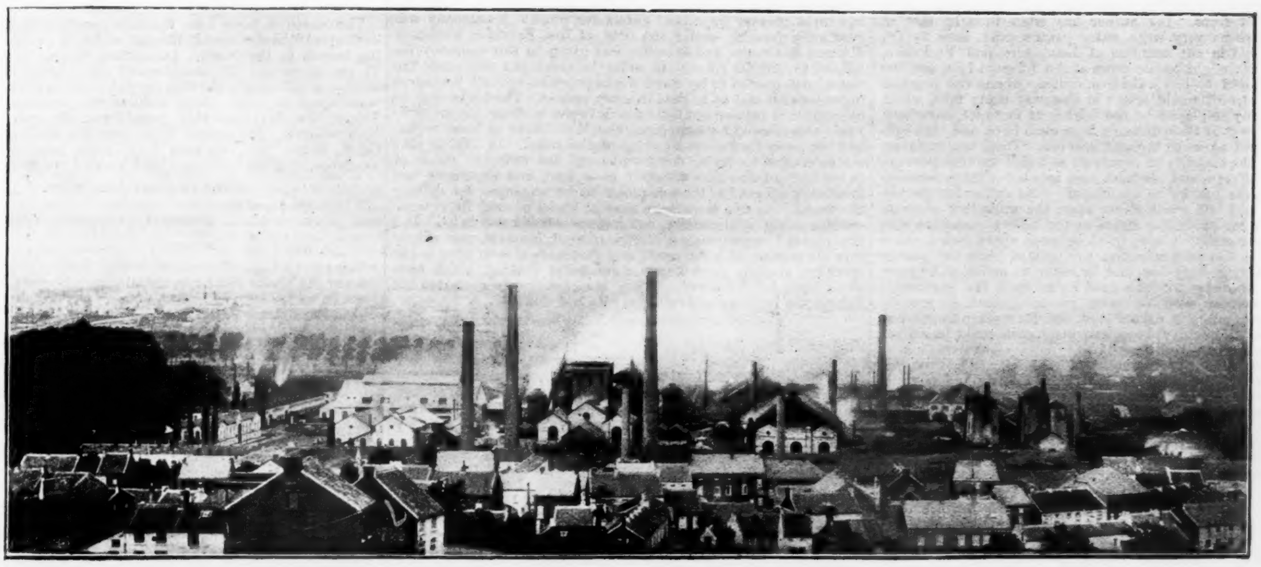


Then the cylinder is laid on a species of wooden "horse," and a boy applies a string of molten glass round the dotted line. This he then knocks away, and applies the point of a cold iron rod to this heated ring. Instantly a crack runs round and the pontil is free. The glass cylinders cool very quickly. They are carried away two at a time, one under each arm, by girls, to another department. Here laid once more on horses of wood, a little fat coal dust is sprinkled along the lower part, and a stout red-hot bar of iron is worked backwards and forwards inside the cylinder for a minute, then a touch of a cold iron and the cylinder cracks from end to end; the workman gives it a tap with the flat of his hand, and one edge flies inside the other—thus, —lapping over by half an inch, so much is the glass in tension. The cylinders are then placed in cool ovens, and flattened out by a man with a block of hard wood on the end of a rod.

So much for the general character of the process. The width of the sheet is limited by the length of the cylinder; some of the best men produce cylinders as much as 6ft. long. The dexterity and skill with which a red-hot glass cylinder, weighing some 70 lb., is manipulated, must be seen—it cannot be realised from any description.

Much is heard about cheap labour in Belgium. It is certain that as far as the Mariemont Glass Works are concerned, labour is not cheap. The blowers are a very fine body of men. Great strapping lean fellows, with the muscles of the right arm curiously developed as compared with the left. The average earnings of the picked men who produce the long cylinders are £24 a month, or £6 a week. That of the next class is £18 to £20 a month. The lowest wages paid are to children, who get 65f. a month. It must not be forgotten that no Sundays are kept. The works run day and night from one end of the year to the other. Nearly all the hands, certainly all the blowers, are on piece work; and the regulation of the working hours is their affair more than that of the company. Many of the blowers have as much as £3000 invested. But all is not gold that glitters. The labour is so peculiar and so severe, that the number of men who possess at once the necessary skill and the requisite physique are very scarce. To all intents and purposes they are skilled athletes, and none of them are over forty-five years of age. After that they have to take a second place, making the short cylinders, and of course earning smaller wages. So far as we could learn, it seems that the wide glass makers do not possess the necessary skill until they are about twenty-eight or thirty, and do not retain the necessary strength and suppleness after they are forty. The girls, who are employed in large numbers, are fat, good-looking, and merry. The children, too, have nothing of an oppressed or hunted air; they are rather, on the contrary, disposed to be assertive, and they certainly earn more money than it is at all usual for children to get. It will be seen that eight-hour shifts are worked, but there is no law on the subject, nor any fixed rules. The matter is one of arrangement among the hands themselves. So long as the furnaces are kept going and the output is maintained, the company cares very little how the men do their piecework. There is no machinery of any kind in the place; the boilers are only used to supply steam for the air injectors. All the arrangements in the works are of a very superior description. The discipline is good, and the hands, taken all round, intellectual, comfortable, and well-to-do, by comparison with many other places.

About 12.15 a.m. the party left the glass works and trudged back through the rain to the station, whence the train conveyed them to Charleroi. Here they were joined by the party which had gone to Bascoup, augmented by a German contingent. In an upper chamber in the Bourse a splendid luncheon was served to over 500 persons at 12.30 p.m. A noteworthy feature was the music, supplied by the Fanfare du Circle d'Dagnelies, a band which is, we believe, held to be one of the best in Belgium. They played with a dash and *elan* which we have never heard equalled. "God Save the Queen" was splendidly rendered, and cheer followed cheer. Then came the "Brabançon," the national air of Belgium, which was encored. Then followed "Der Wacht am Rhein;" but it was noteworthy that no French air was played. *The* success of the day, however, was Wagner's "Entr'acte et Chœur des Fiançailles de Lohengrin." The speeches made were very few, very short, and very good. The luncheon was in every respect a success, to which the leader of the band, M. Dagnelies, largely contributed. The luncheon was given by Les Industriels des Bassins du Centre et de Charleroi, and reflects the greatest credit on all concerned. The 23rd of August will no doubt long be remembered by many an Englishman with pleasure. But the meal was a short one, the train waited to convey the party to the great works of Couillet. There were, as will have been seen from the programme, other places open, but the great body stuck to Couillet.



THE COUILLET IRON AND STEEL WORKS, BELGIUM

Some idea of the appearance and arrangement of the place may be gathered from the reproduction of a photograph on this page. The origin of the works dates back to the beginning of the century. In 1821 there was a forge and puddling furnace for the production of nail rod iron. In 1825 the production of pig iron was started on a small scale, in a little blast furnace erected at Hauchies, near Couillet. The success attained was such that, in 1828, a much larger furnace was put up. In 1834 rolling mills were added. In 1835, under the auspices of the Society for Promoting National Industry, the Société Anonyme de Marcenelle et Couillet was founded. The establishment at present employs about 5000 hands, and almost everything that can be made of iron or steel is produced. The blast furnaces are of the type usual in Belgium. The steel works are provided with Bessemer converters and two Siemens open-hearth furnaces, one of eight, the other of 15 tons capacity. In the rolling mills the most noteworthy feature is a splendid three-high mill, which was employed during our visit in making large building joists, which were turned out in lengths of about 60ft., and then cut into threes by a circular saw. The engine driving this mill is of the reversing type, with three horizontal cylinders, non-compound, and a modified Joy's valve gear. It is a splendid piece of work; we believe we are right in saying that there is not a three-cylinder rolling mill engine in England. The admirable smoothness with which the Couillet engine worked, with its three cranks at equal angles, commended it to those who saw it; and the example set by Couillet is, we fancy, certain to be followed. The Bessemer blowing engines are a fine job, but might be improved by augmenting the areas of the admission valves. The electric light is used all over the works.

We have said that almost everything is made at Couillet, and among others may be mentioned steel shot and shell, and Grüson cupolas in chilled cast iron. The engine works cover a good deal of ground; and in the locomotive department there stood end-to-end one of the little engines used for working steam trams and a very powerful engine for the Belgian State Railway. In the shops, however, we noticed nothing very noteworthy in the shape of tools, and the boiler work, although excellent, conforms to Belgian and not to the best English practice. We did not see a flanging press or a hydraulic riveting machine, and all the rivets are caulked as well as the rest of the boiler.

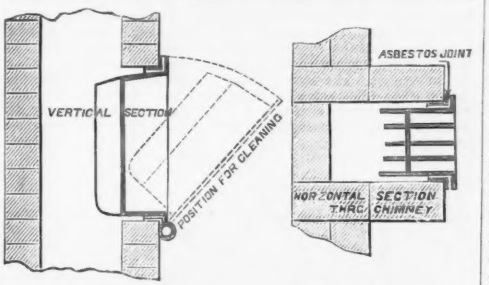
In all the steel works visited there is much in common, and lack of space this week prevents us from going into detail about the Couillet works. In our next impression we shall have a good deal to say concerning the Angleur Steelworks, much of which will apply generally to steel and iron making throughout Belgium. The Couillet works are supplied with coal from the company's mines at Marcinelle, Mont-sur-Marchienne, and Fiestaux, ably managed by M. Mockel. There are fifty-four seams worked, representing a total thickness of 25 metres. The average depth is 430 yards, and the deepest pit is 750 yards. There is at the works a complete coke oven plant, on the system of Smet and of Bruant. The coke is made in very narrow ovens, out of which it is pushed by a ram, worked by a steam engine. The plate mills of the company are at Châtelineau; but these works were not included in the excursion.

The company possesses in all five blast furnaces, 250 coke ovens, 60 puddling furnaces, 25 re-heating furnaces, a complete Martin-Siemens plant, 10 cupolas, 10 rolling mills, three foundries, three boiler shops, 100 forge fires, 14 locomotive engines, to say nothing of the colliery plant. In 1889 there were turned out products to the value of 15,000,000 of francs, or nearly one million sterling. The coal raised was 400,000 tons, and 68,000 tons of coke were made; 100 locomotives were constructed. The great three-high mill has since been added; but we have no precise data of the turnout in recent years. It is probably much what it was in 1889.

Very elaborate arrangements are made for providing pensions, schools, and medical aid; but these would deserve an article to themselves, which we may possibly publish at another time. In our next impression we shall deal with the visits paid on Friday to the works at Liége.

## KNIGHT'S HEATER OR THERMOSOTE.

THE Thermosote illustrated by the accompanying engraving is an apparatus based on the principle of conduction and radiation of heat. It has been invented to save some of the heat which has hitherto been wasted up the chimneys of kitchen ranges, and to utilise it for heating bedrooms above. The radiator or thermosote is let into the wall of the chimney, where it passes the room it is desired to warm. It is made of cast iron, the part containing the radiators being hinged as shown in the section, so as to be easily cleaned. In most cases it can be fixed by a bricklayer in a few hours. The heat trapped by it is sufficient it is said to make all the difference between a cold and a warm bedroom, and makes a fire unnecessary. A further advantage is that wherever the thermosote can be fitted into kitchen chimney walls, or into those of rooms in which a fire is burned through the winter, it does a great deal to make the house dryer. It is the invention of Mr. J. H. Knight, of Barfield, Farnham.



## LORIS' BULLET AND DAGGER-PROOF CUIRASS.

ON the occasion of the trial of Mr. Maxim's shield at the theatre of the Aquarium, we reported that Mr. Loris asked permission to fire at the cuirass first exhibited, and perforated t on the proper left side, it being only plated down the centre. Mr. Loris has, during the last few days, exhibited two cuirasses of his own in the theatre of the Crystal Palace. One of these is ½in. thick, and is intended to resist pistol bullets or dagger thrusts. The other, 2½in. thick, is to keep out the service rifle ammunition, and even steel bullets. The powers of both were very fairly tried. The smaller one was repeatedly fired at with pistols, and in case of any question as to the strength of the dagger thrust, the offer was made to any one of the audience, to try for himself. The heavier cuirass was fired at with the service ammunition and resisted penetration completely. The smaller cuirass was handed round to the audience who examined and handled it freely, and it was bent on the back of a seat to show flexibility. It was stated to contain no metal of any kind, and to consist of fibre whose character is kept secret. Recovered bullets, both steel and lead, were exhibited on request. They were more abruptly flattened than those which had been stopped by the Dowe cuirass, and they did not exhibit the pitted surface which was seen in the Dowe cuirass bullets. In fact, judging from the appearance, it might have been supposed that the bullets had entered some strongly resisting substance which was of a tough plastic character backed by metal. The steel bullet simply had its point flattened, the lead service bullet was set up in a smooth, shapeless lump, but it was not spread out as if it had struck steel abruptly. Whatever the non-metallic fibre is that is employed, it is differently treated from that in the Dowe cuirass, and is less suggestive of asbestos, but it is little use to guess further. Unquestionably the cuirasses were good ones, and would, we think, hold their own as to weight and power against any we have seen. It is impossible to speak absolutely as to relative powers without full trials, but these had the advantage in form and convenience. A man with the Maxim or the Dowe cuirass resembled a man walking with a sandwich advertisement. No great stress is to be laid on this beyond marking a further stage of manufacture, as the same material might be shaped better if not too thick. Mr. Loris undertakes to provide a revolver and dagger-proof jacket weighing only 6 lb. It is to be regretted that he could not have brought forward his cuirass when the public interest was excited, and not when it had cooled down considerably.

We have only noticed the trial of the cuirass. It was, however, one part of a programme exhibiting the powers of Mr. Loris as a marksman, and also of a very young girl, Altina, and these powers are very striking. After the usual shooting of egg shells, fixed in various positions round the head and body of a dummy figure by Mr. Loris and Altina, followed feats which now take place commonly, but against which we strongly protest, namely, the William Tell class of exhibition, that is, shooting eggs off the head and out of the hands of a living person. Altina is a singularly beautiful and graceful young girl; had it been generally known what a sensational performance was being enacted, probably a much larger audience might have been gathered. It is no doubt most absorbing to watch a succession of apparently hairbreadth escapes experienced by so interesting a maiden, but that does not make it justifiable. An experienced man, at all events, knows the risk he incurs if he exposes himself, like Herr Dowe, who has recently paid for his confidence by being wounded, or Maxim, who has a wife who makes him promise not to stand fire; but a child cannot judge of possible contingencies. We have used the word "apparent" hairbreadth escapes, because we do not want to overestimate the risk run. Altina put on what appeared to be a silk skull cap, with a point perhaps 5in. long. This cap we were allowed to examine on our protesting as to the risk run, and we were glad to see that it was steel, and we hope proof against pistol balls. This gave in all perhaps 7in. margin for the bullet to go low before killing the girl, and no doubt it is very unlikely at the few yards distance of the firing, that so perfect a marksman as Mr. Loris would fire a bullet 7in. lower than he intended.

TESTS of the new pneumatic guns have been carried out at Sandy Hook. In the first experiment a charge of 500 lb. of dynamite was fired a distance of a mile and a-half. According to the *Times* there was a tremendous explosion, and a column of water was raised 100ft. high. In the next test a charge of 50 lb. of dynamite fell at a distance of three and a-half miles. Should the official tests be considered successful a dynamite gun battery, consisting of two 15in. guns and one 8in. gun, will be mounted near the extreme point of Sandy Hook, so as to sweep the channel leading to the lower bay. A continuation of the experiments consisted of speed tests, the best result being ten shots in fifteen minutes. By the contract forty minutes were allowed. The other conditions imposed have nearly all been fulfilled. The most important of these were that it should be able to project a shell containing 500 lb. of high explosive to a range of 2000 yards, one containing 200 lb. to a range of 3550 yards, one containing 100 lb. to a range of 4500 yards, and one containing 50 lb. to a range of 5500 yards.

# NOTES ON ELECTRIC POWER, WITH SPECIAL REFERENCE TO WORKS DRIVEN BY ELECTRICITY IN BELGIUM.*

By D. Selby-Bigge.

Last May the author of these few notes had the honour of submitting to the Iron and Steel Institute a paper on "Electricity as a Motive Power in the Iron and Steel Industries," in which he treated the subject somewhat closely, and at considerable length. Three months having barely elapsed, it would be difficult for him to find sufficient new matter from which to write an entirely new paper on the same subject without running the risk of frequently repeating himself; he will therefore abandon any idea of writing a fresh paper, and will ask the members of this Institute to consider the following notes in the light of a short supplementary communication relating to what has already been done in this country in the way of practical applications of electric power.

The attention of electrical engineers in England has of late been so much taken up with the design, laying down, and starting to work of central electric lighting stations in our different towns, and electric lighting work in general, that the question of applying electricity for power purposes has certainly not received at their hands the same amount of investigation that it has from our Belgian and continental friends. Such countries as Switzerland and Northern Italy are exceptionally situated as regards natural sources of power, such as water, and it was only to be expected that they should take a lead in transmitting electricity to be utilised for power purposes in the driving of factories, &c.; and, indeed, a considerable amount of work has already been carried out by the Oerlikon Company, Messrs. Ganz, of Buda Pesth, Messrs. Siemens and Halske, of Berlin, and many other well-known firms, in this direction.

The economy to be derived from driving factories or works electrically, utilising water as our source of power, requires but little comment from the author, as the advantages cannot but be self-evident to any engineer; but electricity has done much to enhance the commercial value of water-power. Hitherto, valuable power in the shape of waterfalls, situated in distant hills and inaccessible places, has been allowed to run to waste for years, and would be doing so still, were it not for the advent of electricity, which has provided such simple and economical means for the conversion of this power, its transmission over enormous distances with trifling loss, and its application to almost any industrial undertaking at the far end of the line. The great Niagara scheme will doubtless furnish the best illustration of such a utilisation of force. The author has often thought that in countries where no very large water powers exist, such as the powers available in our counties of Lancashire and Yorkshire, turbine dynamos might be laid down at the different falls, and the power distributed to one collective centre, where the greatest demand for current would arise; in this way many falls, which though formerly employed in the driving of factories, have been abandoned owing to their distance from main lines, and high railway dues, would again be brought into use. There are, however, many, if not the majority of countries, in which water-powers are few and far between, and the next best means for the economical driving of works has to be considered. The author has already pointed out, and laid great stress upon, the utilisation of waste furnace gases for producing steam in the boilers connected with the electric generating plant; in those cases where such a course is feasible, the cost of production per unit of electrical energy must necessarily be very low, and in order to arrive at a figure, it would be necessary to put a fixed value upon the quantity of waste gases used for firing the boilers, providing steam for running the electric generators at a fixed load, and for a given time. The cost of wages, oil, waste, upkeep, and incidentals could be arrived at in the ordinary manner.

The question of cost of production of electricity to be employed in driving engineering works, steelworks, shipyards, and factories of any description, must necessarily be of the first importance when considering an application of electric power; and in order to convey an accurate idea of the probable cost, the author will refer to some of the Board of Trade returns of electric lighting stations in England for 1893, showing what has been the cost of production to different companies.

| Name of company. | Total H P capacity of engines | Cost of production and distribution per unit delivered to consumers. | | | | |
|---|---|---|---|---|---|---|
| | | Coal | Oil, waste, water, engine-room, stores and carbons. | Salaries of engineers and wages | Repairs and maintenance. | Total. |
| | | d. | Low tension.<br>d. | d. | d. | *d.* |
| Liverpool .. .. . | 1800 | 0·93 | 0·16 | 0·88 | 0·14 | 2·11 |
| Westminster .. .. | 4530 | 0·78 | 0·19 | 0·95 | 0·35 | 2·27 |
| | | | High tension. | | | |
| Newcastle district . | 1200 | 0·83 | 0·28 | 0·85 | 0·14 | 2·10 |
| Newcastle supply .. | 1200 | 0·63 | 0·18 | 0·77 | 0·53 | 2·11 |

From the above table it will be seen that the cost of production, including coal, oil, waste, water, salaries of engineers and wages, repairs and maintenance, amount, in the case of the Liverpool company, to 2·11d., and in the Newcastle companies to very much the same figure. The Westminster company has a cost of production of 2·27d. These figures are about the lowest that have yet been attained in England, where coal has been used in the production of electricity. From the figures given above, the ratio of the expenditure for coal, compared with the total cost of production, can be deducted, and will be found very interesting. The Newcastle Supply Company has the very low figure of ·63 out of 2·11 set down for coal, but coals are sometimes cheap at Newcastle, and this is perhaps an exceptional case. It is hardly correct to compare an electric power station with an electric lighting station, but it may be taken that in power work, where it is possible to use larger generators than is usually advisable in electric lighting stations, the cost of production should be rather less than more, and when waste furnace gases are available the cost of production should certainly not exceed one penny per unit of 1000 watt hours.

In laying out new works which are intended to be driven electrically, or even in remodelling old ones, it is necessary to have a correct knowledge of what working efficiencies one may reasonably expect from various sized dynamos and motors, in order to be able to form an exact opinion as to the power it is necessary to provide in order to drive the works. The author's own experience in these matters would lead him to suggest that for large-sized power generating dynamos of 300-horse power, 500-horse power, 800-horse power, and 1000-horse power, an efficiency of between 90 per cent. and 92 per cent. may be expected. In the case of motors, the following:—

| | | | | | | |
|---|---|---|---|---|---|---|
| For | 3-horse | power | motors | an efficiency of | 78 | per cent. |
| ,, | 5 | ,, | ,, | ,, | 80 | ,, |
| ,, | 8 | ,, | ,, | ,, | 84 | ,, |
| ,, | 11 | ,, | ,, | ,, | 86 | ,, |
| ,, | 16 | ,, | ,, | ,, | 87 | ,, |
| ,, | 20 | ,, | ,, | ,, | 87 | ,, |
| ,, | 40 | ,, | ,, | ,, | 89 | ,, |

As to the loss in transmission through heating of cables, leakage, &c., this should not exceed 3 per cent. in cases where the motors are situated at distances from the generating source of not more than 300 yards, and 5 or 6 per cent. where the distance does not exceed 500 yards. This, however, cannot be taken as a hard-and-fast rule for every case, but it will be found to apply in the case of most works, and the expenditure of copper in the mains will not be found to be prohibitive.

The main and great advantages to be derived from electric driving in works may be summarised as the following:—(1) The concentration in one highly economical plant of the generation of power for the whole of the works, and great reduction in coal consumed per unit of work done. (2) Reduction in wages, owing to the very small number of officials required in connection with such a plant. (3) Transmission of the energy generated, with very trifling loss, to the different parts of the works. (4) Absence of main shafting, countershafting, pulleys, bearings, and belts, and heavy cost of upkeep in connection therewith. (5) Absence of long lengths of steam pipes, and losses due to condensation. Absence of scattered and separate boilers. (7) Absolute control over the economical running of the works owing to the self-indicating nature of electric motors, and the immediate detection of any undue losses which so often occur in mechanical forms of power transmission. (8) Great economy in work of an intermittent nature and varying loads, a direct proportion between the indicated horse-power of generating engine and work given out by motors being obtained. (9) Very small cost and size of foundations involved in works driven electrically. (10) Great facility for alterations and extensions, without any modification being necessary to the original plant.

The points referred to above are perhaps the most salient, but there are many others which appear on the surface in practical work. The whole contention of the author in advocating electricity as the right and proper agent for operating new works, and as a means whereby old works can be remodelled, may be summarised by the one word "economy." In no country, perhaps, have engineers looked more thoroughly and closely into the economics of electricity as applied to power work than in Belgium, and the author trusts that reference by him to works driven by electricity in this country may not be out of place at the present meeting. In the first instance he would refer to an installation which has now been at work for some considerable time, viz., that of the National Arms Factory, at Herstal, near Liége. To give a full account of these important works would necessitate a paper to be written solely for this purpose; the author will therefore confine himself to giving a brief description of them, with a few figures as to results obtained. Mr. Leon Castermans, in a communication which was published in the *Revue Universelle des Mines*, stated that towards the end of 1886 the principal arms manufacturers at Liége formed a syndicate with the intention of laying down works to carry out in a rapid manner important orders for guns. A company was eventually formed, under the title of the Fabrique Nationale d'Armes de Guerre, end an order was given to this company for 150,000 to 200,000 rifles. In order to carry out this work the society determined to lay down works provided with all the latest improvements and up to date in every respect. The works were to be capable of turning out 250 rifles in twelve working hours. Two years were allowed for completing the installation of these works, and two years for the construction of the rifles. In 1890 a plan was submitted for laying down works—all the different means of power transmission were minutely gone into, and electricity was eventually adopted as the sole power to be employed for driving the works. At this time there were no works of such importance running solely by electricity, and a precedent did not exist. The Compagnie Internationale d'Electricité went, however, most closely into the matter, with the result that they were able to offer to the syndicate absolute guarantees for successful working, which have since been fully realised. When these works were started the Compagnie Internationale d'Electricité laid down—

| | | | | | |
|---|---|---|---|---|---|
| 9 | motors of | 16-horse power | = | 144-horse power | |
| 2 | ,, | 21 | ,, | = 42 | ,, |
| 2 | ,, | 37 | ,, | = 74 | ,, |
| | | Total .. .. .. | | 260 | ,, |

For each motor the Compagnie Internationale d'Electricité guaranteed—for the 16-horse power, a commercial efficiency of 87 per cent.; for the 21-horse power, a commercial efficiency of 87 per cent.; for the 37-horse power, a commercial efficiency of 89 per cent., so that the available power would be produced by an initial power of—

$$\frac{144}{0·87} = 165·5$$

$$\frac{42}{0·87} = 8·34$$

$$\frac{74}{0·89} = 83·1$$

$$\text{Total} \; .. \; .. \; .. \; .. \; 296·9\text{-horse power.}$$

As the loss by canalisation would not be greater than 2 per cent.,

$$\frac{296·9}{0·98} = 303\text{-horse power}$$

at the dynamo terminals. In addition to the above there was a large amount of lighting to be considered, and the power eventually adopted was an engine and dynamo combined of 500-horse power. This dynamo is of the shunt-wound type, and suitable for a tension of 125 volts; there are twenty pole-pieces formed in the form of a circle round the armature, and allowing a play of 6 millimetres to the latter. The armature, on account of its large dimensions, some 17ft., had to be built up *in situ*. The current is taken from two commutators, one on either side of the armature, by eighty metallic brushes; the current is taken away to the main distributing switchboard by four underground cables. The commercial efficiency—that is to say, the ratio between the electric energy available and the energy transmitted to the shaft by the engine—was guaranteed to be 90 per cent. The carcase, which is in steel, of the dynamo weighs 10 tons; the armature alone weighs 10 tons; the copper in the magnets weighs two tons; and the armature coils 600 kilos. The particular characteristic of this dynamo is that not only is it driven direct by the steam engine, but that the armature itself forms the fly-wheel of the engine. The motors about the works drive different line shafts. The efficiency of transmission, that is to say, the ratio between the power available and the effective horse-power developed by the steam engine, is given by the product of the three efficiencies—

98 per cent guaranteed for the dynamo.
98 per cent. guaranteed for the conductors.
87 per cent. guaranteed for the motors.
= 76·6 per cent.

The installation at Herstal has now been running continuously for three years, and until recently the entire works depended solely on the running of this single dynamo, both for light and power. About 2000 hands are employed at the works. Up to the present, the large dynamo has never been the cause of the cessation from work for a single minute. The installation has of late been considerably extended, and an additional 300-horse power plant has been laid down. The speed of the large engine and dynamo is only sixty-six revolutions per minute. The engine employed, being of the Corliss compound condensing type, was built by Messrs. Van de Kerkchove, while the dynamo was constructed by the Compagnie Internationale d'Electricité, under the direction of Mr. H. Pieper.[*] The 300-horse power plant consists of a combined Willans engine and Pieper dynamo, running at about 350 revolutions per minute, and it is interesting to compare the results obtained with these two engines. The efficiency of the Corliss combined plant—that is to say, the efficiency of the engine and dynamo taken together under full load—is about 77 per cent. The dry steam consumption of the engine per indicated horse-power per hour = 14·34 lb. The dry steam consumption of the engine per electrical horse-power per hour = 18·75 lb. On the other hand, we get the highest efficiency from the quick running plant. The efficiency of the Willans engine and dynamo combined at full load is about 85 per cent. Dry steam consumption per indicated horse-power per hour = 16·03 pounds. Dry steam consumption per electrical horse-power per hour = 18·19 pounds. Any one visiting the installation at Herstal cannot fail to be struck with the wonderful organisation in the works, and the result obtained during the past three years in driving these works electrically has been an unqualified success. At the zinc works of the Vieille Montagne Company, near Jemeppe, a large electric power installation has recently been laid down. The works were formerly driven by a large number of steam engines, which took from 60 lb. to 88 lb. of steam per indicated horse-power per hour to drive them, and required a number of enginemen to attend to them.

The question of driving the works by means of hydraulic power, compressed air, and electricity were examined in turn, and it was decided to lay down a regular central power station, and to drive the works by means of electricity. The station is placed alongside the railway, so that coal may be brought right up to the boiler-house by truck. Three Babcock and Wilcox boilers have been laid down—one acting as spare, while the other two provide steam for a 600-horse power compound condensing engine, on the Friekart system, built by the Société Cockerill, at Seraing, which drives direct a Pieper fly-wheel dynamo of 600-horse power at a speed of 80 revolutions per minute. The dynamo is wound for a pressure of 500 volts. Every provision is made in the engine-house for a second section of 600-horse power, of a similar character to the first. The water from the Meuse, situated at a distance of 2700 metres from the generating station, is pumped to the works by a 45-horse power motor, and the current is further utilised in operating two electric wharf cranes for loading and unloading the boats. The motors laid down at present are of the following sizes:—

| | | | | |
|---|---|---|---|---|
| 5 | motors | of | 1 | horse-power. |
| 7 | ,, | ,, | 2 | ,, |
| 6 | ,, | ,, | 2½ | ,, |
| 6 | ,, | ,, | 5 | ,, |
| 4 | ,, | ,, | 7 | ,, |
| 2 | ,, | ,, | 10½ | ,, |
| 4 | ,, | ,, | 14 | ,, |
| 2 | ,, | ,, | 45 | ,, |
| 1 | ,, | ,, | 64 | ,, |

It is now proposed to add the following motors:—

| | | | | |
|---|---|---|---|---|
| 1 | motor | of | 80 | horse-power. |
| 1 | ,, | ,, | 14 | ,, |
| 5 | ,, | ,, | 1 | ,, |
| 1 | ,, | ,, | 10 | ,, |

The current is taken from the main generator to the main power switchboard, and is carried through eighteen circuits to distributing boards in the works. In addition to the power, there are 75 arc lamps and 500 incandescent lamps in the works. As the tension of 500 volts is too high for the latter, a continuous current transformer is used, which reduces the pressure to 100 volts. During the day time this transformer charges a battery of accumulators. The motors drive, amongst other things, joiners' shops, forges, fans, machine tools, saws, pumps, lifts, washing machines, crushing machines, brick-making machines, &c. &c.

*Efficiency of the Installation.*

| | | | |
|---|---|---|---|
| The efficiency of the | steam engine is .. .. .. .. | 90 | per cent. |
| ,, ,, | generating dynamo .. .. .. | 90 | ,, |
| ,, ,, | circuits at full load .. .. .. | 98 | ,, |
| ,, ,, | motors .. .. .. .. .. .. | 86 | ,, |

which gives a total efficiency of 0·685. Such are briefly the outlines of the Vieille Montagne installation. Electric power installations have also been laid down, and are working most successfully, at the Royal Arms Factory at Liége, where the coal consumption has been much reduced; at the works of Messrs. Dietrich and Co., at Luneville, and at the celebrated glass works of the Val-St.-Lambert. At this last place there are six motors, eighty-six arc lamps, and 1100 incandescent lights.

---

* Read before the Iron and Steel Institute at Brussels.

[*] This installation has been fully illustrated and described in The Engineer.

---

# THE MOST ECONOMICAL TEMPERATURE FOR STEAM ENGINE CYLINDERS, OR HOT *v.* COLD WALLS.*

By Bryan Donkin, M.I.C.E.

(*Concluded from page* 179)

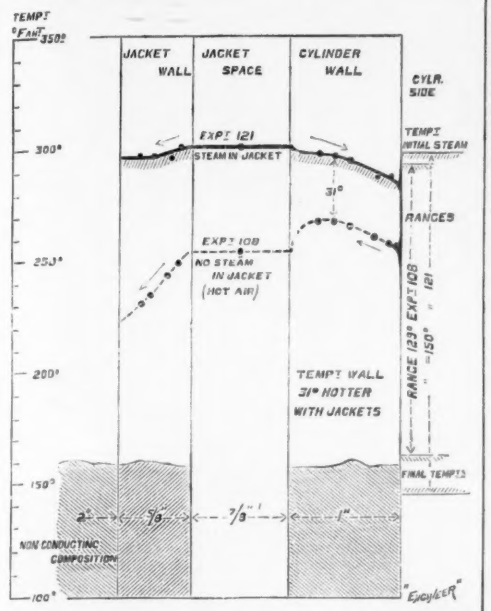
*Experimental results.*—The following short abstracts are from a paper detailing a series of some eighty experiments, lately accepted for publication by the Institution of Mechanical Engineers. Permission has been granted to quote such portions as bear upon the question of the advantages of hot, and disadvantages of cold cylinders. These experiments were made on a single-cylinder engine, 6in. diameter by 8in. stroke, expressly designed for experimental research. The engine could be worked so as to vary considerably the temperature of the walls, and was made to run condensing or non-condensing, jacketed or non-jacketed, single or double-acting, at different expansions, with saturated or superheated steam in the cylinder or jackets. Only one set of conditions, however, was varied at a time. Two experiments—first series—were made with 50 lb. of saturated steam, with the cylinder non-jacketed and condensing, at 220 revolutions per minute, double-acting. In these tests the only condition varied was the number of expansions, from 5¾ at $\frac{1}{12}$ cut-off to 2½ at $\frac{5}{16}$ cut-off. The cylinder walls in both cases were colder than the initial steam. The steam consumption per indicated horse-power hour fell from 43½ lb. at the earlier cut-off to 35½ lb. at the later. The temperature range of steam in the cylinder varied from 135 deg. to 128 deg. The indicated horse-power varied from 4¾ to 7½. As the number of expansions diminished from 5¾ to 2½, a greater weight of steam per hour passed through the engine, namely, 184 lb. and 269 lb., and the temperature of the walls was correspondingly increased from 233 deg. to 264 deg. In other words, the difference of temperature between the initial steam and the internal surface for the walls was reduced from 65 deg. to 31 deg. respectively. The rate of condensation during admission per square foot hour diminished considerably with the increase of wall temperature, from 515 lb. to 264 lb. Comparing the two experiments, when the difference between the temperature of the steam and that of the cylinder walls was decreased 34 deg., and the temperature of the walls raised, the result was not only to reduce the initial condensation one half, but to produce an economy of steam consumption of 18½ per cent. The thermal efficiency—or percentage of heat converted into power to the total heat received by the engine—was increased from 5·3 per cent. to 6·6 per cent., or 25 per cent. The percentage of steam present at cut-off and release were both considerably raised; all these advantages were obtained, although the number of expansions was diminished. There were eight experiments with different expansions in this series, but only two are given, as all the results are consistent.

In the next two experiments—third series—working with 50 lb. saturated steam, non-jacketed, double-acting, at 220 revolutions, and non-condensing, the only condition varied was the number of expansions, from 4¾ at ⅛ cut-off to 1¼ at ¾ cut-off. The indicated horse-power varied from 3 in the one to 8·4 in the other. The cylinder walls were colder than the steam by 54 deg. and 16 deg. respectively. The steam consumption per indicated horse-power hour was 62 lb. and 44·4 lb. respectively. The range of steam temperature in the cylinder was about 85 deg. The temperature of the cylinder walls increased in these experiments, with the quantity of steam per hour passing through the cylinder—183 lb. and 373 lb.—from 246 deg. with the greater, to 282 deg. with the smaller expansion, or a rise of 36 deg. The condensation during admission per square foot fell from 440 lb. to 105 lb., or say four times as much with colder walls. The thermal efficiency increased from 3·8 to 5·4 per cent. Comparing these two non-condensing trials, an increase of 36 deg. in the cylinder wall temperature resulted in a reduction of 28½ per cent. in steam consumption; the initial condensation with colder, being four times greater than with hotter walls. The thermal efficiency was 42 per cent. greater with warmer walls. The percentage of steam present at cut-off and release was considerably increased. These advantages were obtained with a decrease in the number of expansions. There were six experiments in this series, but only two are given.

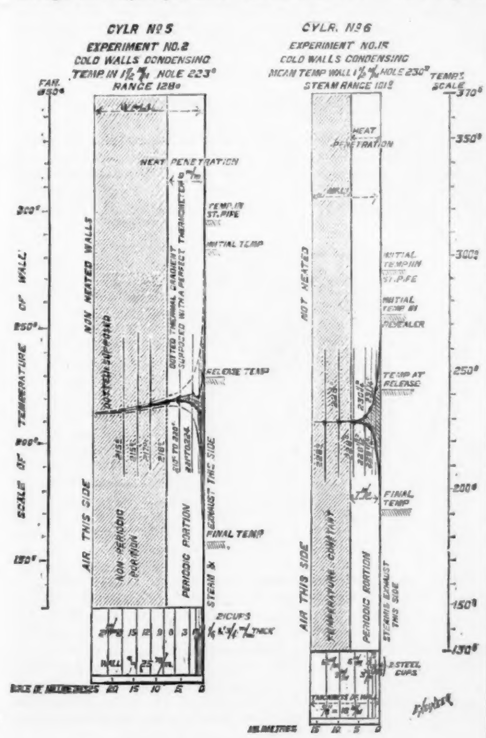
---

* Paper read before the British Association at Oxford.

We now come to two experiments—fourth series—working with 50 lb. of saturated steam non-jacketed, single acting, and condensing. The number of expansions was varied from 4¾ at ⅕ cut-off, to 1¾ at ½ cut-off, speed 227 revolutions. The indicated horse-power was 2 in the first case and 4 in the second. Steam per indicated horse-power hour 56 lb. and 46 lb. respectively, and steam temperature range about the same. The temperature of the cylinder walls was raised with the quantity of steam per hour passing through the engine—110 lb. and 190 lb.—from 223 deg. in the former to 266 deg. in the latter, or an increase of 43 deg. The amount of initial condensation per square-foot hour decreased from 576 lb. to 336 lb. The thermal efficiency increased from 4 to 5 per cent. The walls were 73 deg. cooler than the initial steam in the first, and 32 deg. in the last trial. Comparing these two experiments under the conditions given, 43 deg. increase of cylinder temperature resulted in 18 per cent. economy of steam consumption, 25 per cent. greater thermal efficiency, and 42 per cent. less initial condensation. The percentage of steam present at both cut-off and release was largely increased. Here, again, the above advantages were obtained with a decrease in the number of expansions. The plotted results of the four experiments of this series—two of which only are given—are consistent, and verify the better results with hotter walls.

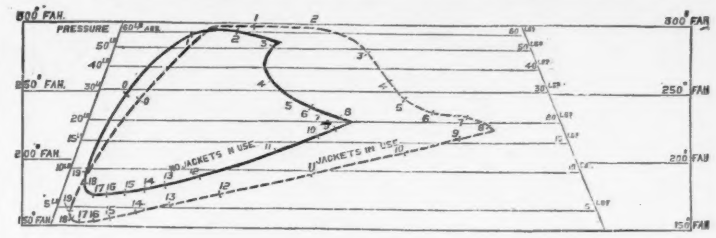


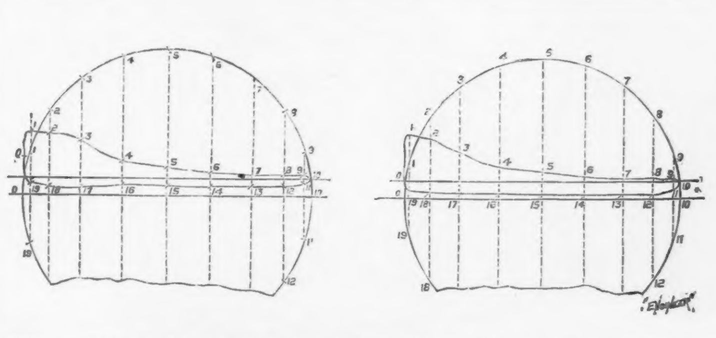
Two experiments—Series 6—were made with 50 lb. saturated steam, cylinder non-jacketed, non-condensing, and single-acting; revolutions, about 220; number of expansions, three at ⅓ cut-off in the first, and 1⅓ at ¾ cut-off in the second. This was the only difference in these two experiments. The walls were cooler than the steam 49 deg. at ⅓ cut-off giving 1⅓ indicated horse-power. and 22 deg. at ¾ cut-off with 3⅓ indicated horse-power. The pounds steam used per indicated horse-power hour were 80·7 and 60·4 respectively. The range of steam temperature was about the same. The cylinder wall temperature rose from 246 deg. in the first to 276 deg. in the second, and the thermal efficiency from 2·8 per cent. to 3·8 per cent., both increasing with the quantity of steam passing through the engine per hour—112 lb. and 202 lb. On the other hand, the initial condensation per square-foot hour fell from 311 lb. to 139 lb. Comparing the two experiments, 30 deg. higher cylinder wall temperature reduced the initial condensation about one-half, decreased the steam consumption per indicated horse-power 25 per cent., and raised the thermal efficiency 35 per cent. The percentage of steam present at cut-off and release was much greater.



This gain was obtained with much fewer expansions. All the experiments in this series confirm the above results.

Two experiments—ninth series—were made with and without steam jackets, double-acting and condensing. In these trials with saturated steam at 50 lb. pressure and speed 218 revolutions, the same cut-off was used, viz., $\frac{3}{16}$, and the number of expansions kept constant at 3¾. The only condition varied was that the engine worked in the one case with no steam in the barrel and cover jackets—in other words, with hot air in the jackets—and in the other with steam at 50 lb. pressure in them. The indicated horse-power were 6·6 and 6·8 respectively. The consumption of steam per indicated horse-power hour was 41¼ lb. without, and 28⅓ lb. with jackets in use, the steam temperature range being about the same in both. The temperature of the cylinder walls was 255 deg. without jackets and 284 deg. with the jackets working; the rate of initial condensation per square-foot hour was 460 lb. and 217 lb. respectively; the thermal efficiency was 5·7 and 8·1 per cent. Walls colder than initial steam, 42 deg. and 14 deg. respectively. Thus in these two experiments at the same speed, cut-off, and steam pressure, and all other conditions being exactly similar, raising the temperature of the walls 29 deg., by working with steam in the jackets, gives the following advantages:—Initial condensation diminished one-half, gain in steam consumption 31 per cent.; thermal efficiency increased 41 per cent.; steam present at cut-off and release increased about 50 per cent.





Many other experiments were made, all at the same cut-off with and without steam jackets in use. The number of expansions was varied in each, but only after the set of two tests had been made, to determine the different economy of steam jackets at different expansions. An increase of economy with the hotter walls was always verified, the thermal efficiency was greater, and the rate of condensation very considerably reduced, with an increase in the percentage of steam present at cut-off and release. In another set of experiments upon small cast iron cylinders, mostly 5½in. diameter, an account of which was published in the "Proceedings" of the Institution of Civil Engineers, vol. cxv., the temperatures of the cylinders were also considerably varied. The chief object of this series was to determine the relation between the temperature of the cylinder wall and the amount of steam condensed per hour per unit of internal surface. The experiments were made at constant volume without piston, with about 50 lb. pressure of steam, and at 35 fillings per minute. Some forty experiments were carried out in all, condensing and non-condensing, with saturated and superheated steam. The wall temperatures were varied from 218 deg. to 348 deg. Fah., the temperature of the steam being kept constant at 297 deg., and with a cylinder-wall temperature of 218 deg. and saturated steam of 297 deg. Fah. —or the walls colder than the steam by 79 deg.—43½ lb. of steam. were condensed per hour per square foot of internal surface. With the highest wall temperature in these experiments, viz., 348 deg. Fah., using superheated steam, the minimum amount of condensation was obtained, only 1·3 lb. of water per square foot hour. The proportion between the internal surface in square feet and the volume in cubic feet was also varied. It was found that superheated, as compared with saturated steam, invariably resulted in much less condensation, and the walls were always found to be hotter. This was probably the chief cause of the diminished condensation and the increase of economy. The heat penetration into the metal walls varied much, according to their temperature. With cold walls at about 230 deg. it was about 8 mm.; with hot walls at a temperature of about 330 deg. it was only about 2 mm. The total steam used was measured in each experiment, and indicator diagrams were always obtained. From the difference between the actual steam consumption and that shown by the diagrams at release, in each experiment, the quantity of steam condensed was deduced. The indicator diagrams were much larger with the hotter than with the colder walls, or, in other words, much less condensation took place. In a few experiments the internal surfaces were varnished, and this was found to reduce condensation, the amount of steam present, both at cut-off and release, being greater with the varnished walls. A heat balance was made in each test. Less heat penetration into the walls always corresponded with less internal condensation. A description and drawing is appended of the condensation of steam in a steam jacket, giving the appearance of the drops formed.

*Temperature—Entropy diagram.*—A drawing is appended showing the diagram of two tests on the experimental engine, one with and one without, steam in the jackets. This diagram follows Mr. McFarlane Gray's and Captain Sankey's method, with the addition of twenty points for twenty equal times of the crank pin. Such diagrams show well the exchanges of heat between the steam and the walls. The temperature of the cylinder walls has a greater effect with small than with large cylinders, as the ratio of surface to volume is greater; this is verified by experiments on steam jackets, which give better results in smaller than in larger engines, both running at the same speed. The various tests on the experimental engine mentioned above lead to the conclusion that the range of steam temperature in the cylinder per stroke has much less influence on the consumption of steam than the temperature of the wall. In a steam engine a higher as compared with a lower speed generally means a greater weight of steam passing through the engine per hour, and more economy; the reason being that this additional weight of steam increases the temperature of the cylinder, and produces less condensation. Watt some 130 years ago wrote:—"On reflecting further, I perceive that in order to make the best use of steam it is necessary that the cylinder should be maintained always as hot as the steam which enters it." Such logical reflections soon resulted in his famous invention of the steam jacket. Professor Ewing in his interesting new work on the steam engine, just published, says:—"As steam fluctuates in temperature with phases of admission, expansion, and exhaust, there is a complex give and take of heat between it and the metal it touches, and the effects of this have an enormous influence in reducing the efficiency by increasing the consumption of steam." Professors Kennedy, Cotterill, Unwin, Boulvin, Dwelshauvers-Dery, and others, including D. K. Clark and Lieutenant-Col. English, have written on these important and complicated exchanges of heat between steam and metal. In addition to this, there is the effect of the water drops and films, &c. Hirn was the first to study and describe these phenomena accurately. It is the difference of temperature between the steam and the metal that is the chief cause of the rapid transfer of heat during a stroke; the "head" of heat is also constantly varying, and the ratio of surface to volume changes rapidly with the various positions of the piston.

*Summary.*—The above paper, and the tests on the experimental steam engine, with cold and hot walls, may be very shortly summarised, as follows:—The most uneconomical results were always obtained when the cylinder was colder than the entering steam, producing considerable initial condensation. Drops of all sizes were formed up to 3 mm. diameter, running down the cold surfaces, and there was considerable depth of heat penetration into the walls. During each stroke heat was given up by the steam to raise the temperature of the internal surfaces, after their exposure to the exhaust temperature. At cut-off and release there was a great deal of water in the cylinder.

The most economical results were always obtained when the cylinder was at nearly the same temperature as that of the entering steam, with much lower rates of condensation. The drops were very much smaller in size. The penetration of heat into the metal walls was much less, and a smaller amount of steam was required to heat the innermost surfaces after they had been cooled by the condenser. The percentage of steam present at cut-off and release was very much increased.

*Note of the results of condensation of steam, giving the formation of drops on glass and metallic walls, as seen through a glass steam jacket, with 20 lb. and 50 lb. pressure of steam.*—After a drop, about 5 mm. diameter, has run down the vertical cast iron walls, its path looks nearly dry. The formation of the finest particles of water or globules, say $\frac{1}{20}$ mm. diameter, is next seen on the same path. These then very gradually increase in size from $\frac{1}{10}$ to ⅕ and to ½ mm. diameter. The drops, irregularly shaped, next run together until they become 4½ to 5 mm. wide. After this they fall by gravity, dragging other smaller drops on their path. These drops have been photographed. On the horizontal metallic surfaces the same formation of drops takes place. With greater transmission of heat there is greater condensation, and the drops run down more frequently. There is no uniform film on the surfaces, but drops are produced gradually increasing in size and then running down. Note.—All temperature in Fah. degrees.

THE RUSSIAN GOVERNMENT are desirous of placing a contract for the building of two large steamers for the transport of rails. After five years' service the Government will purchase the steamers at cost price.

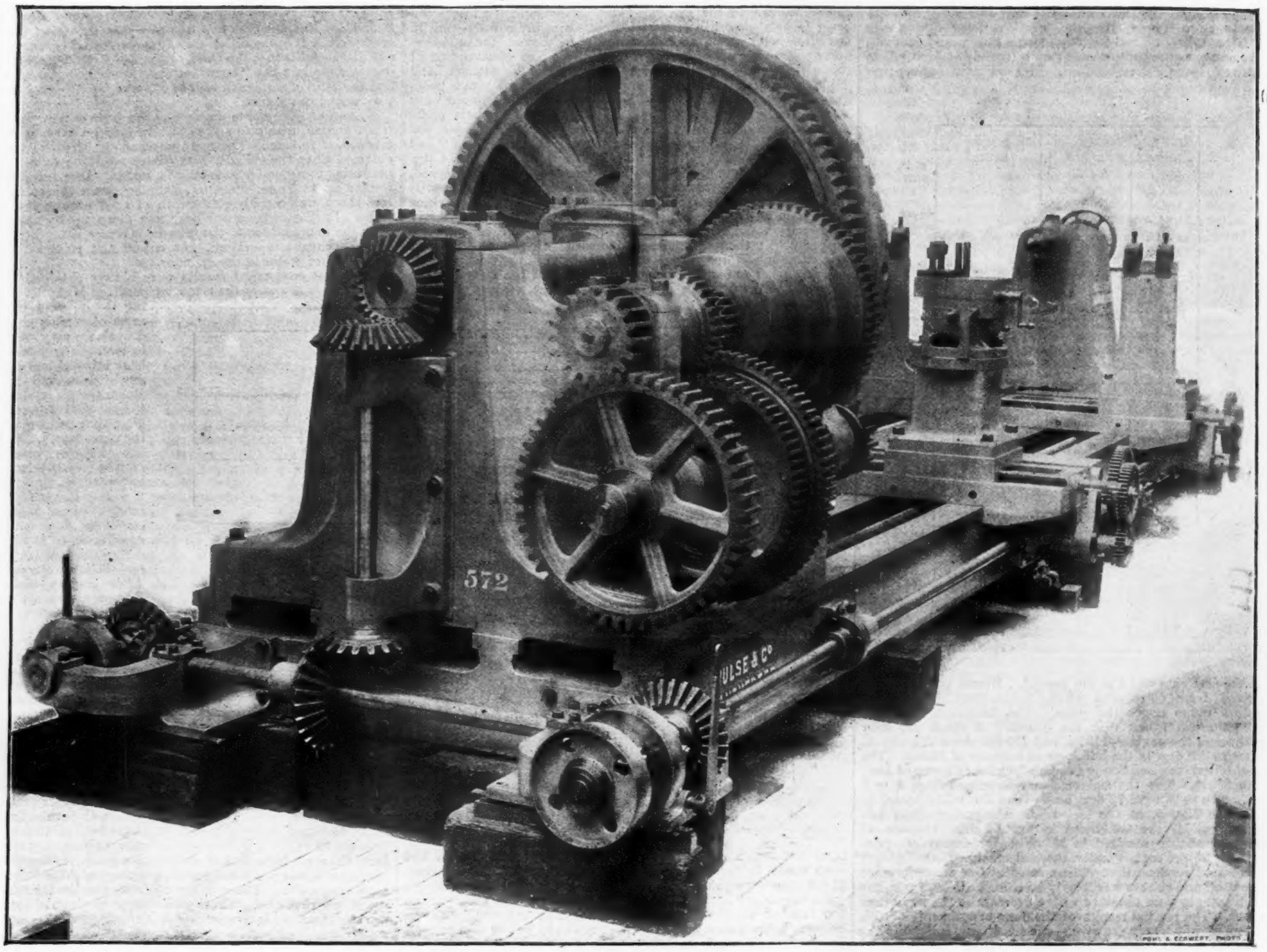
WHITWORTH SCHOLARSHIPS.—The following is a list of candidates successful in the competition for the Whitworth Scholarships and Exhibitions. Scholarships, tenable for three years: John Ball, James H. Smith, Harry Verney, Charles F. Smith, £125 a-year each. Exhibitions, tenable for one year: Frank Fisher, William M. Thornton, John W. Hinchley, William D. Young, Alexander L. Mellanby, William T. F. Trunchion, Henry Deanesly, William T. Swinger, Arthur W. Ashton, Arthur E. Mascall, William Rosbotham, Joseph J. Kirwin, Charlie W. Cairns, John W. Button, Sydney Eraut, Charles E. Pickles, Richard G. Allen, Alexander Craig, Thomas S. Usherwood, Walter Eraut, Lewis E. Limming, Sidney E. Lamb, Francis J. Russell, Edgar R. Sutcliffe, George F. Hambly, William Gore, Thomas S. Cockrill, William H. James, Harry J. Peachey, James N. Boot, £50 each.

DEATH OF MR. HENRY FAIJA.—We regret to announce the death, on August 21st, of Mr. Henry Faija, whose name is so well known in connection with cement industry. Mr. Faija was a member of the principal engineering and learned societies, viz., the Institution of Civil Engineers, Institution of Mechanical Engineers—1869-1889—British Association, Royal Institute of British Architects—Honorary Associate—Society of Arts, and Society of Engineers, of which latter body he was Vice-president at the time of his death, and but for his untimely removal would have succeeded to the chair in due course. He at various times contributed papers to all the above Societies on the subject of which he had made a special study, and was awarded premiums by the Society of Engineers for papers read before that body in 1888 and 1889. The latter papers were prepared with the object of combatting the "magnesia" scare which occurred at that time owing to the Aberdeen failures, and conclusively proved that the supposed destructive effect of sea water on a properly manipulated cement concrete was a scare and nothing more. In 1881 he wrote a treatise entitled "Portland Cement for Users," which has since run through more than one edition. The work of his office and laboratory will be continued for the benefit of the bereaved family.

DREDGING THE MERSEY BAR.—According to the recently-issued annual report of Mr. G. F. Lyster, engineer to the Mersey Docks and Harbour Board, upon the general state and progress of the Liverpool and Birkenhead Docks, the sand pump dredgers Brancker, and Nos. 5 and 7, were continuously dredging at the bar and shoal parts of Crosby Channel. The total quantity of sand removed during the twelve months was 4,707,920 tons, of which 4,407,150 tons was from the bar, and 300,770 tons from the Crosby Channel—at which Nos. 5 and 7 were exclusively engaged for about five months, and the Brancker at certain times when prevented by weather from working at the bar. The total quantity of sand removed from the bar since the commencement of operations was 6,845,860 tons. The depth of water within the buoyed channel—1000ft. wide according to the latest soundings—was not less than 20ft. in any part at low water extreme spring tides. For a space of 500ft. wide outside the buoys, on the south side, there were not any soundings under 19ft.; and for a space of similar width outside the buoys on the northern side the least depth was 15ft. The Brancker during the year's continuous working came fully up to the expectations formed from her construction and size, being able to remain at work on the bar during weather which prevented the smaller vessels from working. The time of filling a load varied, according to the nature of the material raised; but it has been done in thirty-five minutes. In one period of twenty-four hours 39,000 tons, and in a week of five and a-half days, 183,000 tons of sand were removed.

# QUADRUPLE-GEARED DUPLEX CRANK LATHE

MESSRS. HULSE AND CO., MANCHESTER, ENGINEERS



## QUADRUPLE-GEARED DUPLEX CRANK LATHE.

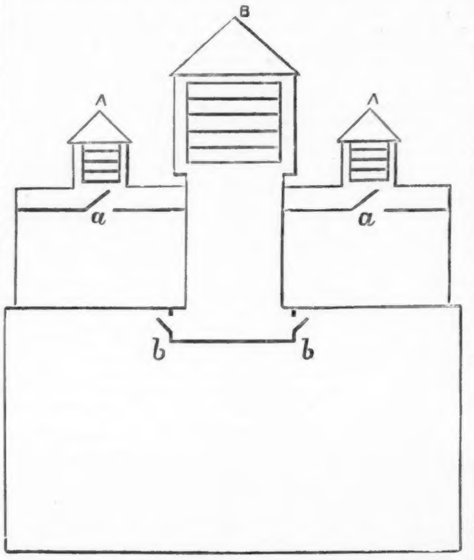
Our illustration shows a massive and powerful patent quadruple-geared duplex lathe, recently constructed for Messrs. Wm. Jessop and Sons, of Sheffield, by Messrs. Hulse and Co., Ordsal Works, Manchester. This lathe has been specially designed for dealing with marine crank shafts of the largest sizes, but is capable also of turning and boring other large steel castings and forgings up to 12ft. diameter and 30ft. in length. There are rests for four cutting tools, two operating at the front and two at the back of the lathe. These are respectively mounted upon four independent sliding carriages, each provided with swing frame, change-wheels, reversing gear, and rotating nut, in order that any one or more may be sliding while the others are surfacing at the same or various rates of traverse, and in the same or different directions, according to requirements. Two non-rotating steel guide screws firmly secured to the bearings at the end of each, and with swing bearings at intervals between, are placed one between each pair of the longitudinal box girders of the slide bed, and upon these the nuts underneath the carriages are revolved. Rotary motion for the feed traverse is transmitted to the carriages from the fast headstock through vertical and horizontal steel shafts and bevel gearing, while for traversing the carriages quickly by power along the bed the horizontal shafts are driven by strap pulleys direct. The changes from feeding to quick traversing are readily effected by clutches and levers. The fast headstock has a face-plate and chuck 10ft. diameter, cellular in form, externally geared, and fitted with cast steel jaws and screws. The gearing is double and quadruple, affording sixteen changes of speed uniformly graduated. The main spindle is of forged steel running in hard gun-metal steps, square in outline, and the back bearing has collars, propeller-like, for taking the end thrust. The changes from one gear to another are rapidly and easily effected.

The movable headstock spindle is traversed by a screw, with worm and wheel for forcing the centre into the work, and a hand-wheel operating direct on the screw gives quick adjustment. This headstock is traversed to any position along the bed by one or other of the sliding carriages, to which it may readily be coupled for the purpose. Two of the top rests have compound slides, and two are specially narrow for turning crank-pins and inside webs. One of each kind is interchangeable between the two front carriages, and one of each between the two back ones. The compound back rest has its vee inverted, in order to withstand a heavy "up" cut without vibration. As will be gathered from the foregoing description, there are no intermittent feeders. The large steel forgings and castings of the lathe, it may be added, are of Messrs. Jessop's special steel.

## AN IMPROVED SYSTEM OF VENTILATION.

We here illustrate by means of a small diagram a ventilating system which has been introduced by Mr. Albert Napper, of Guildford. It has been tried with success in a large hall, and we think any possible solution of the many mysteries in connection with ventilation cannot fail to be acceptable to engineers, particularly to those who are engaged on sanitary or architectural work.

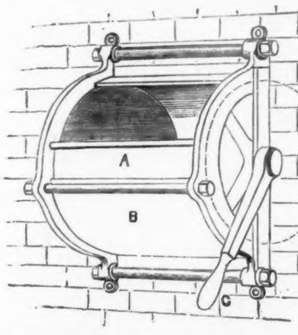
It will be seen from the accompanying diagram that a shaft B is placed in the centre of the ridge of the roof, and carried through the space between the roof and the ceiling into the room below. Under this shaft is an enclosed chamber fitted with hinged flaps—*b b*—one at each end, which automatically regulate the admission of air, care being taken that the flaps are not allowed to drop quite to the horizontal line, so that the air falling on to the floor of the chamber may be directed upwards and thus dispersed without a draught. This air, from its density, will readily fall to the floor and force the rarefied and foul air up to the ceiling, through which it will pass by means of small openings into the loft above.



To force the rarefied air out of the loft against the pressure of the dense external atmosphere, the same atmospheric pressure is brought to bear upon it from above. This is effected by placing two small shafts—A A—one on each side of the central shaft, on the ridge, and opening directly, but for the intervention of the adjustable flaps *a a*, on to the heated air in the loft. Thus a free supply of cold air is obtained, forcing, Mr. Napper says, the foul air up from the hall into the loft, where it is met by the same atmospheric resistance above, thus placing the foul air between two currents of cold air. It seems that the cold air has an immediate action in reducing the bulk of the warm air in the loft, and thus produces a partial vacuum which demands air from below. This does not appear to be sufficient to account for the cooling of the large body of air concerned, and the result is probably in a measure due to the upper strata of the warm air, in coming into contact with the cold, gaining so much in density that there is but little resistance left to its escape by one or both of the smaller shafts. Whatever the physical action may be, the desired end is obtained, viz., a continuous supply of fresh air into the hall, and that without draught. The mode of operation thus set forth is as described to us by Mr. Napper, but with regard to the functions of the outlets A A it may be said that their action in any way except as outlets is not quite obvious.

## A NOVEL DUST TRAP.

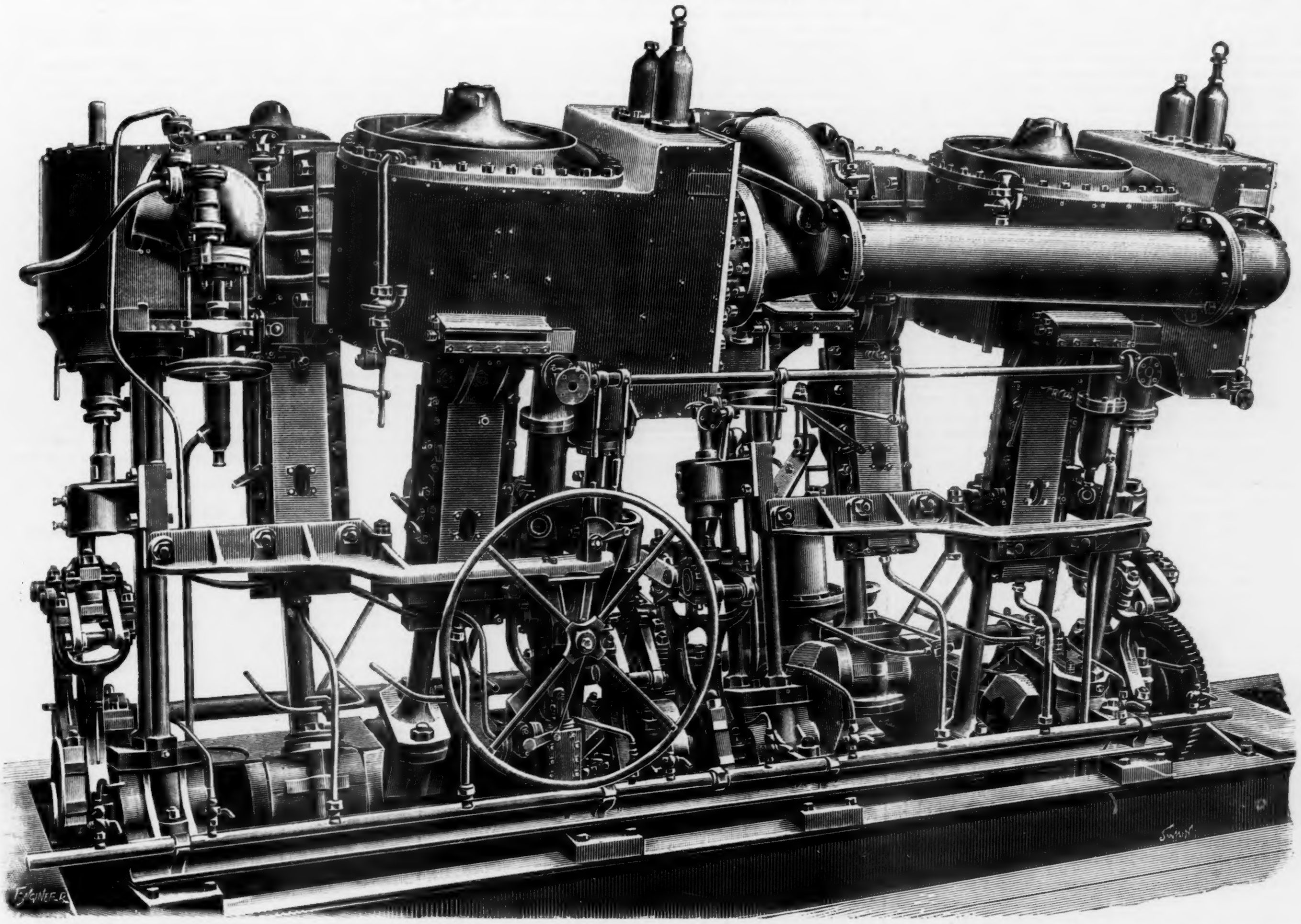
The dust trap here illustrated is intended to take the place of the ordinary shoot door. It appears to have so many advantages over the ordinary hopper that we think it is entitled to some notice. It is made by Messrs. Hall, Beddall and Co., of Waterloo-road, S.E., and consists of a drum-like hopper A working in a cylindrical casing B; a lever C is provided by means of which the hopper is actuated. When the trap is opened, dust and refuse can be safely put in, and then, by an upward movement of the lever C, the hopper is carried round and emptied down the shoot on the other side of the wall, the orifice being closed simultaneously with the revolving of the hopper. It is claimed that this perfect closing of the trap prevents any inroad of vitiated air from the shoot. The hopper revolves in dust-proof bearings to obviate clogging.



The quantity of petroleum used for firing the main boiler plant at the World's Columbian Exposition, Chicago, amounted to upwards of 31,000 tons, and the work done is stated to have totalled 32,316,000 horse-power hours. This makes the consumption of oil about 2·1 lb. per horse-power hour.

# ENGINES OF H.M.S. DARING AND DECOY

MESSRS. J. I. THORNYCROFT AND CO., CHISWICK, ENGINEERS

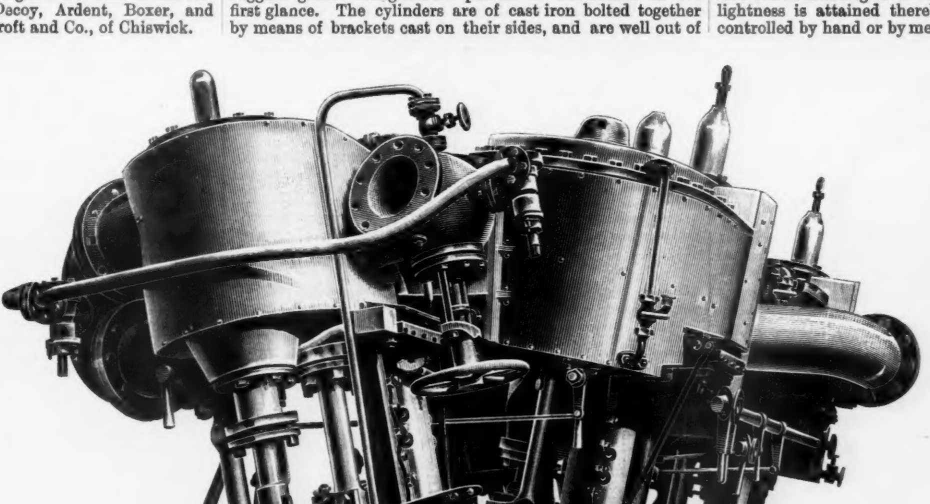


## ENGINES OF H.M.S. DARING AND DECOY.

We give above illustrations of engines as fitted in the torpedo boat Destroyers Daring, Decoy, Ardent, Boxer, and Bruiser, by Messrs. J. I. Thornycroft and Co., of Chiswick.

The principal feature in their design is the inclination of the engines, which are four in number — high, medium, and two low-pressure— overhanging alternately to port and starboard; the low-pressure engines are the aftermost. The centres of effort of each couple are not quite opposite one another—the deviation being that due to the obliquity of the engines with respect to one another, so that when one piston is at the top of its stroke the other is at the bottom. The foremost couple of course give twice the power given by the after couple, and exert their turning moment on the crank shaft at right angles to that of latter. This system has been specially introduced by Mr. Thornycroft in order to obviate vibration, and we understand that the Daring on her trials was remarkably free from this trouble. We may here remind our readers that her record speed against the tide was 29·268 knots.

The diameters of the cylinders are as follows:— High-pressure, 19in.; medium pressure, 27in.; and two low-pressure of 27in., with 16in. stroke. The condensers, two in number for each boat, are not shown in the engravings. Each has a cooling surface of 2100 square feet, the air pumps, one for each condenser, having buckets 16¾in. in diameter, with a stroke of 5½in. The crank shaft is of steel, 6¾in. diameter at journals and 7½in. diameter at pins, constructed by the Dennistown Forge Company, of Dumbarton. The connecting-rods are hollow, and also of steel—as are, in fact, all the rods, there being scarcely any wrought iron about the engine at all. The valve motion is adjustable in every part, which is a most valuable property in fast running engines like these. The shortness of the excentric rods is rather striking in comparison with the length of the valve spindles, but this is rendered necessary by the position of the weigh-shaft, which is actuated by an all-round gear, and situated conveniently low down at the back of the engines. Altogether the parts are unusually accessible, and suggest great strength and powers of endurance at the first glance. The cylinders are of cast iron bolted together by means of brackets cast on their sides, and are well out of one another's way, so that the interior of the valve chests can be easily examined and attended to—more easily, in fact, than they have been hitherto in torpedo boats of the Destroyer class.



ENGINES, H.M.S. DECOY, END VIEW, LOOKING AFT

The columns supporting the cylinders are continuations of the main bearing bolts, but, as will be seen, they do not interfere with the lifting of the main bearing caps, and additional lightness is attained thereby. The all-round gear can be controlled by hand or by means of a small steam engine. The exhaust takes place through the backs of the slide valves through the balance rings, as plainly shown in the side elevation.

The Daring and Decoy are 185ft. long, by 19ft. beam, with a draught of 7ft. The three other vessels already named slightly differ from these two in size, but the machinery is the same in all five. The Thornycroft boilers employed are of the pattern described and illustrated in page 238 of our issue of the 23rd of last March.

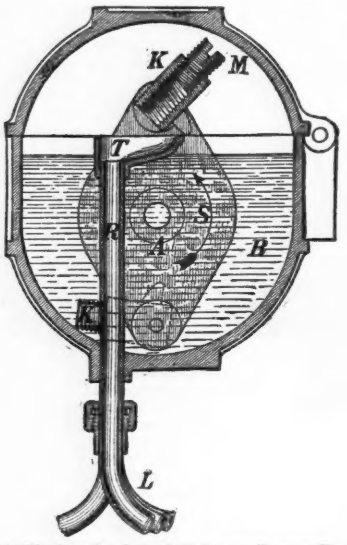
## ELEVATOR AND LIFT MACHINERY.

We can, as yet, find nothing in the shape of tall structures comparable with the lofty buildings of New York and Chicago, but recent buildings both in London and provincial towns indicate rapid advance in this direction. However regrettable from an artistic point of view such a tendency may be, tall buildings are certain to increase both in number and in height in all localities where ground is exorbitantly high in price. Such buildings have created a large demand for fast-running passenger elevators and the supply of these, together with the machinery required for operating them, already forms quite a considerable branch of the engineering trade. Apart from the actual hoisting apparatus, the supplying of such accessories as steam and gas engines, electric motors, hydraulic pumps and accumulators, &c., is generally open to the trade at large, usually falling to the share of local firms. In cities where low and high-pressure water, gas, and electric current supplies are available, a very wide choice is presented in regard to the methods to be adopted in running elevators in particular cases. Probably the simplest plan, consistent with the requirements of smooth running and absolute control, lies in the employment of a cylinder of considerable length, using gravitation water to press down a piston with rod attached to overhead pulley and wire rope gear. This method, though simple and inexpensive as to first cost, involves the loss of a cylinder-full of water for every run, and at the meter price usually charged by corporations the water bill mounts to a formidable sum when the elevator is in frequent use. An obvious step towards economy is to employ a pumping engine to force water to a tank placed at a sufficient elevation to give the required pressure. By this means the same water can be used over and over again, and the meter charge is done away with. A gas engine is usually employed to drive the pump, but the gas bill for the same amount of work is usually found to be much less than that for water, and in spite of the extra cost for plant and attendance, many such installations are working in a highly satisfactory manner, with the additional advantage that in case of temporary derangement of the pumping apparatus the use of gravitation water can be easily resorted to.

Gas engines are also employed to a limited extent for high-pressure hydraulic installations, water being forced by a suitable pump into an accumulator, which feeds the elevator cylinder as required. If the gearing is arranged to throw the driving belt of the engine on to a loose pulley when the accumulator is full, allowing the engine to run light till a further demand for water is created, the arrangement works with considerable economy as far as the gas bill is concerned, but the first cost and complexity of the plan are against its adoption. Electro-motors are also used to some extent for operating elevators through the intermediacy of accumulators, the current being automatically switched off when the need for pumping ceases. The comparative cost of running such installations depends principally, of course, upon the price paid for motive force. Recently in a locality where the electric current is charged at the rate of 7d. per unit, and gas at 2s. 6d. per 1000ft., an electro-motor of the Brush type driving pumps against 700 lb. accumulator pressure was temporarily replaced by a gas engine of about 8 actual horse-power. The engine worked constantly for ten and a-half hours per day against a full load, no fast-and-loose pulley arrangement being provided. After a month's working, the cost of the gas burnt was found to be practically the same as that of the electric current used during an equal length of time. This tells in favour of the gas engine in this particular instance, as the electro-motor controlled by an automatic shunting device was in motion little more than half the number of hours run by the gas motor. But an electro-motor may be admirable where a gas engine would be quite out of place, and again the motor is liable to be thrown out when high-pressure water is available, even though the cost of power, per unit of energy, be considerably greater. The electric current is also used to a very considerable extent for driving elevators directly by means of motors operating the winching drums, and, of course, in such cases the current may be generated *in situ* by steam or gas engines, derived from the street mains where a public supply is available. Elevators may be worked in many different ways, and there is great scope for ingenuity in the arrangement of their operating machinery—practice not having yet settled down into hard-and-fast lines.

## NEW LUBRICATOR FOR BEARINGS.

We here give an illustration of a "Multiple" lubricator, for which is claimed, among other advantages, a great saving of oil. The engraving shows a section in which B is the oil box, through the bottom of which is placed a number of tubes R. These tubes are provided with funnels T, and connected outside with tubes to the different bearings.



The oil is lifted to the funnel T by small cups K, which are placed on the revolving plates S. These plates are fastened to the axle A, which passes through the oil box, and is connected to a ratchet-wheel and lever to any moving part of the engine. In the course of revolving the cups empty the oil into the various oil pipes, and the quantity each cup supplies can be regulated by the screw M, which forms the bottom of the cup. Each bearing can therefore be provided with the necessary quantity of oil required. Much smaller feed pipes than those ordinarily employed can be used. The makers are Messrs. William Reid and Co., of Fenchurch-street, E.C.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineer: W. M. Teak, to the Pembroke, additional. Staff engineers: John S. Watch, to the Walleroo; G. Parsons, to the Apollo; and Richard G. Willby, to the Orlando. Chief engineers: Arthur W. Turner, to the Sharpshooter; and Thos. C. C. Hughes, to the Speedwell. Engineers: F. G. Jacobs, to the Goldfinch; Septimus Ham, to the Dart; W. P. Chapman, to the Rapid; J. M. Simpson, to the Lizard; Albert E. Cox, to the Orlando; Edgar H. Ellis, to the Vivid, additional; Howard Bone, to the Sharpshooter; Thomas H. B. Bishop, to the Pembroke, and Henry T. Winney, to the Victory, both additional. Assistant engineers: John S. Hare and John Murphy, to the Orlando; Reginald W. Skelton, to the Centurion; and A. Whitmarsh, to the Vivid.

## A WOOD-CARVING MACHINE.

A new wood-carving machine, called the "Eclipse," invented by Messrs. Ryland and Bird, may be seen at work by those interested at The Mart, Station-road, Brixton, London. Fig. 1 gives a general idea of its construction, and Fig. 2 goes more into details.

A peculiarity of this machine is the elasticity of the motions which can be given to the cutting tool, combined with sufficient rigidity. The tracing pointer and carving tool are mounted on the front portion of a rectangular frame, extending over the machine table; this frame is mounted so that it will rock freely in its bearings; it can be moved in a line parallel to the front of the machine, and to and from the front and back of the machine table.

The back member of the tool frame is in the form of a shaft, on which are freely mounted one or more pairs of guide pulleys for the cutter driving band or bands. In slots or guides at the lower parts of the machine standards is mounted a countershaft, on which are loosely mounted one or more pairs of guide pulleys, and said countershaft is weighted or acted upon by springs to give it a normally downward tendency. The machine frame is fitted with a driving shaft carrying a long drum, and said driving shaft may be driven by a treadle or by power acting upon a driving pulley fixed thereon.

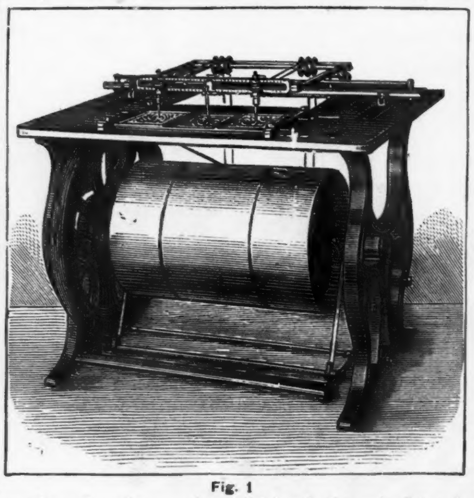


Fig. 1

A driving band for each cutter or carving or engraving tool is passed partly around the drum, then partly around the several pairs of guide pulleys above described, and partly around the driving pulley of the carving or engraving tool. The guide pulleys are capable of sliding along their carrying shafts, and the cutter driving band or bands is, or are, capable of travelling along the long drum. By the above construction of parts the tracing point and the carving or engraving cutter or cutters are capable of being moved in any direction over the pattern, and work without in any way affecting the driving of the cutter or cutters.

What with the guide pulleys sliding along their carrying shaft, and the driving bands of the cutters sliding wherever the tension draws them upon the long drum, and what with like freedom of motion of several other parts, the working parts of the machine seems as flexible as india-rubber, yet are sufficiently rigid. The machine will cut in any direction, and will undercut to a considerable extent. A boy can work it; indeed has been working it for a few months past. The few of these machines at present made are worked by a treadle. Power carving machines are, however, about to be constructed, also a miniature machine for amateurs. The amount of give-and-take with this machine, because of its tension gearing, prevents the heating of the bearings of the tools, which are necessarily driven at high velocities, and the length of wood which may be worked with it is unlimited. The machine seems to be able to carve anything, busts included. Various specimens of work done by it are on view, and more can be executed under the eyes of the spectator. The ligaments used with this machine are not leather bands but cylindrical lengths of catgut, treated occasionally with pure linseed oil gold-size, then allowed plenty of time to dry. The machine is patented in many countries.

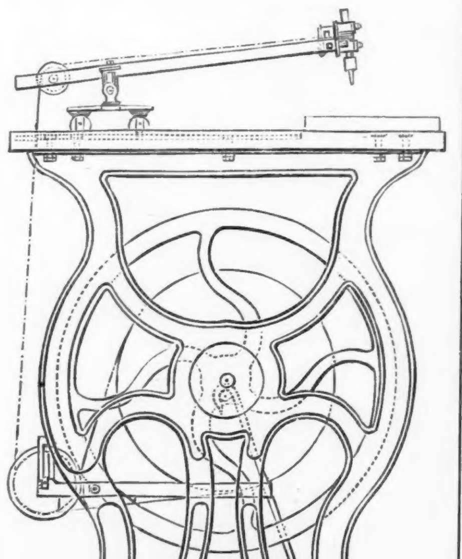


Fig. 2

## GREAT NORTHERN RAILWAY—RECONSTRUCTION OF A BRIDGE OVER THE DON.

Among the many bridges that the Great Northern Railway Company has found it necessary to reconstruct, is one directly north of the station at Doncaster, and over the Don Navigation. As in all cases of reconstruction, the real difficulty to be overcome was the removal of the old and fixing the new structure without interfering with the traffic of the seven companies using the bridge. Including shunting trains, upwards of 200 pass over the bridge every week day. On Sundays the traffic is considerably lighter, consequently the change had to be made on that day, the time fixed upon being between the departure of a train leaving Doncaster at 9.15 a.m. and the arrival of one at 10.50 a.m., giving one hour and thirty-five minutes for the operation.

We give this week the first of several illustrations of this work, which has been most satisfactorily carried out by Messrs. A. Handyside and Co., of Derby. Fig. 1 shows the old bridge moved out, and the new bridge fixed. Fig. 2 shows the girder unloaded, and ready for being moved out. Fig. 3 is a general view of the main girder, resting upon a steel trolley. Fig. 4 is the girder unloaded and ready to be moved out. It is identical with Fig. 2, taken from another point of view. The operation was very simple in principle, the old girder was moved out while the new one was moved in. The details of the method employed we shall give next week.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### LOCOMOTIVE ENGINE BOWS.

Sir,—I see it stated in the newspapers that forty locomotives have been built by the Paris, Lyons, and Mediterranean Railway, the fronts of which have been designed in the form of "bows," similar to a ship, in order to cleave the air and reduce resistance at high speeds, and that a saving of 10 per cent. of the coal consumption, speed for speed, is said to have been effected.

Six years ago I made some theoretical investigations of this subject, and arrived at the conclusion that it was certainly worth while adopting such an arrangement in express trains. I laid my views before several of the leading locomotive superintendents, with the object of inducing them to undertake the experiment, but the idea met with a number of objections, and I did not attempt to follow it out. Difficulties in the way of getting at the engine and of shunting were suggested, and it was thought that the head resistance was so insignificant compared with the skin friction and the effect of a side wind that it might be neglected. It seems obvious, however, that the effect of a directly opposed resistance due to the motion of air at a speed of sixty miles per hour—which would be nearly 20 lb. per square foot—is at least comparable to the frictional resistance, both between air and train and wheels and rail, produced by a side wind of similar force, and even that is of comparatively seldom occurrence.

I would point out, however, that it is probably of equal importance to have the tail of the train formed in the same way, so that the air may be replaced as gradually and gently as it is displaced in front. This is not at first sight so obvious, but it is undoubtedly true in the case of a ship moving in water, where the energy of the particles, which would otherwise be entirely dissipated in fluid friction, produces a forward pressure on the vessel. It is not said whether this is being done on the French railway referred to, but it is probably not, and this may account for the difference between the saving of coal effected and the result estimated by calculation, which comes out considerably higher.

Now that a foreign railway has adopted this improvement, it may be hoped that English engineers will be enlightened enough to follow it up, more especially as we have a larger proportion of high-speed trains in this country than in any other, and it is to these in the first instance that it should be applied.

Stephen Smith.

3, Howard-place, Edinburgh, August 24th.

[Experiments carried out many years ago proved that with speeds up to forty miles an hour not the smallest advantage was gained by fitting wedges or bows to the ends of trains.—Ed. E.]

### ENGINEERS IN AUSTRALIA.

Sir,—I consider it my duty through your columns to warn civil engineers against coming to Australia in the hope of securing engagements. The total stoppage of public works, and the almost bankrupt condition of the colonies, have thrown great numbers out of employment, over three hundred engineers, surveyors, and draughtsmen having been dismissed from the Victorian Railway Department alone, while the other departments have been similarly retrenched.

Even when an appointment is obtained the remuneration is so low that only those who are in dire necessity would accept it. For instance, I enclose an advertisement from a colonial newspaper calling for applications from qualified persons to fill the combined offices of engineer, secretary, rate-collector and valuer to a Shire, and engineer, secretary, rate-collector and caretaker to a Waterworks Trust at a total salary for the eight offices of £150 per annum, out of which the successful candidate has to keep a horse and pay his own expenses. The applicants included one M.I.C.E., also one M.C.E.—Master of Civil Engineering—and member of the senate of Melbourne University. As a road labourer with his horse and cart receives ten shillings a day, this will show how miserably professional men are paid.

Then, again, there is a sort of boycott against the employment of "imported" men, the *sine quâ non* for advancement being what is called "colonial experience." This is a term which might be explained as ignorance of the first principles of engineering science, together with a capacity for drinking bad whisky and a facility for using bad language.

I have met men who have come out here only to be disappointed, and I hope this letter may prevent a recurrence of the same. I enclose my card, and shall be pleased to afford any information I can supply about the Australian colonies to your readers.

Melbourne, Victoria, July 2nd. Britisher.

### THE FORBAN.

Sir,—With reference to a paragraph contained in your last issue, will you allow us to state that the Forban is not yet in its experimental stage, as she will be launched only at the beginning of 1895. Augustin Normand and Co.

Havre, August 27th.

### ENTROPY.

Sir,—In my letter of August 17th, I stated a question with regard to the name entropy wrongly. Although the error is self-evident, I shall feel obliged if you will allow me to correct it. The question occurs in the last paragraph. After the word "expansion," and before the words, "in order," the words "divided by the standard absolute temperature" should be inserted.

August 29th. William Donaldson.

## RAILWAY MATTERS.

It is stated that a strategic narrow gauge railway line is about to be begun between Brest and Conquet, a distance of 37 kilometres.

The Great Southern Railway of Spain continues to push on its line towards Granada, but as there are so many difficulties to contend with, the time for its completion is very doubtful.

The strengthening of the old bridges on the Madras Railway is progressing satisfactorily. The substitution of stronger girders for the Thootha Bridge on the North-West Line is completed.

Negotiations are pending between the Russian Government and a well-known French company for the supply of a considerable quantity of rails required to complete the Trans-Siberian Railway.

According to the British Vice-Consul at Kieff, towards the end of 1893 the South-Western Railway, whose general offices are at Kieff, placed an order with the South Russian Dneiper Works for 8046 tons of steel rails at the price of £11 per ton.

The construction of the Trans-African Railway has progressed so rapidly that the line is now in full operation as far as the Lower Cazengo, a length of 160 miles, and the track of about 170 miles connecting it with the upper course of the same river will be opened for traffic in October next.

The construction of the railway between Saga and Tsukazaki about 45 miles from Nagasaki, Japan, was commenced last year. According to the British Consul at Nagasaki, the immediate approaches to that place present great engineering difficulties, and the Kiushiu Railway Company does not seem disposed to grapple with them nor to meet the expense.

The mineral district of Krivoi Rag in South Russia has received further attention from the Imperial Government, and a branch line of railway, running close alongside the mines and quarries, has recently been opened, thus greatly facilitating the transport of the various minerals raised from the workings, amounting in the case of iron ore to 800,000 tons a year.

A little book by Mr. P. J. Vinter on the Great Western Railway and its expresses, gives information as to the speeds attained and other details of the Great Western service. It is interesting to note that the daily mileage of its express trains to-day is 9000, against about 3000 in 1888. It is published by Hoyton and Cole, Plymouth.

According to the *Gazeta Handlowa*, of Warsaw, the projected railway from Warsaw to Ostrolenka is not to be a direct line between those two places, but is to join the Vistula line at Jablonna, where the communication with Warsaw will continue on the existing line. The permanent way has been constructed as far as Zagroby on the left bank of the river Narew, but no rails have yet been laid down. The works for the extension of the line to Ostrolenka are to be commenced in the autumn.

The New York Railroad Commissioners who were asked to act as judges in the prize competition of the Metropolitan Traction Company for a motive power system for street railways, which should be superior to the trolley system, have issued a statement giving the recent correspondence between them and the Metropolitan Traction Company relative to the withdrawal of the prize of £10,000. The Commissioners state that they regret exceedingly the unsatisfactory termination of the affair.

The scheme submitted to the Jura-Simplon Railway Company for making a tunnel through the Simplon has been approved in principle by the Swiss Federal Council, which will now submit it to the Italian Government. According to the terms of the contract the tunnel is to be finished in five and a-half years with a single line of rails, and is to be so constructed as to admit of its being eventually widened for a second line of rails. The cost of the first undertaking is 54,500,000f., while the second line will involve an additional expenditure of 15,000,000f.

The Linares Almeria Railway progresses, although somewhat slowly, owing to the delay of the Government in paying the subvention, but it is confidently stated that £720,000 is to be voted by Parliament to meet this subvention. During the past year the contractors have imported for the railway 73,736 pine sleepers, weighing 5080 tons; 1094 tons rails and accessories, 1564 tons bridge iron, 140 tons material for shops and stations, 436 tons wagons and wheels, 299 tons of iron for the station building, three locomotives and their tenders, 13,168 tons cement and hydraulic lime. It is expected that the line will be opened for traffic as far as Guadix by the end of the year.

According to a recent Foreign-office report, the short railway of 2¾ miles length, from Tafia to Pernik, was opened in the early summer of 1893, thus enabling the output of the coal mines at the latter place to reach Tafia at a much smaller cost for transport. Considerable difficulties were met with on this line, owing to repeated landslips, but these seem to have been overcome. Great satisfaction has been expressed by the Bulgarian authorities with that portion of the rails for this line which was purchased from British firms, both as to quality and cheapness, and it is to be hoped that a British firm will secure the contract for the new line from Tafia to Roman, a distance of 67·1 miles. The contract for the construction of this line, after a keen competition, fell to a Bulgarian Syndicate for £859,000. Other railway schemes were under discussion during the past year, notably one for the construction of a direct line from Tarambey, where the Bulgarian State line joins the Oriental Railway Company's line to Tambody, from whence the line to Bourgas is again in the hands of the Bulgarian Government. It is calculated that if such a line were constructed, the Bulgarian authorities, holding the communication between the port of Bourgas and the interior entirely in their own hands, would be able largely to reduce the freights now exacted by the Oriental Railway Company.

Not long ago some articles were published in the *Times* on the subject of light railways, giving a general account of the method in which the benefits of cheap railway transport had been extended to thinly-populated agricultural districts in foreign countries without the great expense of first construction and equipment that are involved in building such railways as our Board of Trade rules require. A correspondent, in writing recently and giving some particulars of a line of this character, which may be regarded as typical, and which has been at work for two years successfully, says:—"One great advantage of this narrow gauge and portable permanent way—an advantage which our British engineers have not, perhaps, considered—is the facility with which farmers and others can lay down a temporary siding or branch which can be moved about into any field or to any warehouse or barn where there may be a few train loads to pick up. With the line we are now considering this advantage has been largely realised." He further states that no stations were built further than an open shed with a small office to hold a weighing machine and to lock up parcels. Tickets to passengers are issued on the train by the conductor. Last year—the only complete year it has been in operation—it carried 27,235 passengers, and during the beetroot season, lasting two months, it carried over 15,000 tons of beetroot. The results were sufficient to show that in ordinary years the department will receive an income from the line. Indirectly, the population all benefit by the saving in cost of carriage and in the cost of keeping up the roads to a larger extent than they lose by the increase in rates or taxes to pay interest on the capital cost of the railway.

## NOTES AND MEMORANDA.

The Queen has approved of the new denominations of standards for electrical measurement.

Professor Campbell, of the Lick Observatory, has announced that the planet Mars presents no evidence of having an atmosphere.

An eminent German scientist, Professor Kohlrausch, has made experiments with the purest water which he could obtain, and finds that a column of 1in. has a resistance equal to a copper wire of the same cross-section passing twenty-five thousand times around the earth.

The amount of the world's supply of tin for the year 1893 is given officially in the annual report of Dr. D. T. Day. The total amount for the year was 67,237 tons, classed as follows:—English production, 8650; Straits' shipments to Europe and America, 38,874; Australia shipments to Europe and America, 5579; Banca sales in Holland, 5418, and Billeton sales in Java, 5211.

According to the June report of the Metropolitan Water Supply, the number of miles of streets containing water pipes constantly charged in each water company's district within the metropolis is as follows:—Chelsea, 85¼; East London, 185; Grand Junction, 135; Kent, 177½; Lambeth, 202; New River, 339; Southwark and Vauxhall, 160; West Middlesex, 133; total, 1416⅜ miles.

In the return of the gas testings for the week ending August 18th, W. T. Dibdin, F.C.S., enters as the highest mean illuminating power in standard candles that of the Blackfriars-road supply, from the South Metropolitan Gas Company, viz., 17·3, the lowest being those of the two Chelsea districts, supplied by the Gas Light and Coke Co., and the Old Ford district, supplied by the Commercial Gas Company, which were 16·1.

At a recent meeting of the Paris Academy of Sciences a paper was read on "Manganese Steel," by M. H. Le Chatelier. The anomalous results found previously by the author in studying the electric resistance of—13 per cent.—ferro-manganese are explained by the formation of two allotropic varieties of the metal. The temperature of transformation is 740 deg., that temperature at which soft iron passes from the magnetic to the non-magnetic state.

In London 2378 births and 1284 deaths were registered last week. Allowing for increase of population, the births were 242, and the deaths 271, below the average numbers in the corresponding weeks of the last ten years. The annual death rate per 1000 from all causes, which had been 17·6, 17·4, and 17·1 in the preceding three weeks, further fell last week to 15·4. In Greater London 3215 births and 1671 deaths were registered, corresponding to annual rates of 28·2 and 14·7 per 1000 of the estimated population.

One of the little-known compounds of iodine is the iodomercurate of copper, $HgCu_2I_4$. It is prepared by adding solution of cupric sulphate to a boiling solution of Meyer's reagent; part of the iodine is liberated, and a black precipitate thrown down, which becomes bright scarlet on cooling. At temperatures of about 150 deg. Fah. this becomes black, and regains its colour on cooling. If painted on a bearing, it at once shows any heating long before it can do mischief. In engines, where there are many bearings, and some difficult of access, this should be useful. Marine engineers take notice.

The bind used in the recent experiments at a Cumberland colliery with a view of making coal briquettes without admixture of pitch or lime, is partly a waste product, the remainder costing on an average from 20s. to 28s. per ton, according to yield and demand. From 4½ per cent. to 5 per cent. of the bind is added to the coal, and a briquette is obtained which neither cracks or crumbles, but which burns freely in an ordinary fire or under steam boilers, either with or without forced draught, leaving no slag or clinker. The tenacity of the bind is stated to be such that it permits the moulding of briquettes 4in. by 2½in. by 1½in.

In the report on the condition of the Metropolitan water supply during the month of June we read that the water in the Thames was 7in. above the average summer level, and at its lowest point 5in. below that level. The total rainfall during the month at West Molesey was 1·92in. The average daily supply delivered from the Thames during the month was 108,945,415 gallons; from the Lea, 52,911,162 gallons; from springs and wells, 34,884,036 gallons; from ponds at Hampstead and Highgate, 170,590 gallons, the last being used for non-domestic purposes only. The daily total was therefore 196,911,203 gallons for a population estimated at 5,447,027, representing a daily consumption per head of 36·15 gallons for all purposes. The relative proportions of the supplies from the above various sources were as follows:—From the Thames, 55·33 per cent.; Lea, 26·87 per cent.; springs and wells, 17·72 per cent.; ponds, 0·08 per cent.

Some tests of centrifugal pumps under high lifts are described by Mr. Gerard Lavergne in a recent issue of the *Genie Civil*. The design of the pump was modified so that the discharge through the wheel casing is taken through a narrow orifice extending around the entire circumference of the casing. This orifice gradually widens outward to allow the water to arrive without shock in a spiral collector surrounding the pump and leading into the discharge pipe. The width of the orifice is such as to give the required flow at the velocity due to the head against the pump, with an allowance 0·6 for contraction. Diagrams are given of the efficiency of the pump in terms of the lift for deliveries varying from 1 to 5·4 gallons a second and lifts up to 164ft. The maximum mechanical efficiency of the pump was found to be but 58 per cent., and occurred only with the greatest flow, about 5·4 gallons. The maximum efficiency for any given rate of delivery occurred when the lift was between 50ft. and 60ft. Another pump was constructed after these trials, in which the form of the blades and of the casing was altered from that first adopted, and with this pump an efficiency of 65 per cent. was obtained with a discharge of 6·6 gallons under a head of 65·6ft. and an efficiency of 68 per cent. with a discharge of 7·8 gallons under a head of 32·8ft.

An open scale barometer, showing minute variations of pressure, is the invention of Mr. C. O. Bartrum, and is made by Mr. J. J. Hicks, of Hatton-garden. It consists, says the *Times*, of a tube between 4ft. and 5ft. long, terminating in a cistern. The lower half contains mercury, and the upper a light fluid which forms the manometric index. About its middle the tube is expanded into a bulb about 3in. long, in which the two fluids meet. It is plain that a rise of mercury in the bulb will cause a much greater rise of the light fluid in the narrower upper tube, the amount depending on the sectional area of the bulb as compared with that of the upper tube. If the diameters of the bulb and cistern be each 1·5in. and that of the upper tube 0·02in., then an increase of 1in. in pressure as shown by a mercurial barometer will appear on the scale as 8·2in., or in other words, the scale is more than eight times as open as that of an ordinary barometer. Small changes of pressure can therefore be read with ease. The liquid in the upper part is methyl salicylate, a substance with a specific gravity about one-twelfth that of mercury, and a very small vapour tension at ordinary temperatures. The last point is important, as on it depends the excellence of the vacuum, and, consequently, of the instrument, for which the maker claims great sensitiveness and accuracy of reading to 1·200th of an inch. It can be made with as open a scale as a glycerine barometer, which is five or six times as long, and is, moreover, liable to become inaccurate in course of time on account of the vacuum being impaired by the infiltration of air through the glycerine. From this defect Bartrum's instrument is said to be free.

## MISCELLANEA.

H.M.S. Assistance is for sale.

It is stated that the supports of the lighthouse on the Fastnet Rock are unsafe.

During the past financial year 8000 miles of wire were added to the Indian telegraph system.

A technical meeting of the Photographic Society on limelight apparatus was held on the 28th inst.

The two new Russian ironclads, the Sevastopol and St. Peter and St. Paul, will be launched at St. Petersburg next October.

The new Russian battleship Rostislav, building at Nicolaieff, is to be a slightly modified Sissoi Veliki, of about 9000 tons displacement.

A printing exhibition will be held in Russia in 1895. If possible, there will also be a convention of persons connected with the craft and lectures given.

A stream of water has broken into the workings of Eppleton Colliery, one of the group owned by the Hetton Coal Company, and stopped operations.

A vessel of 1500 tons has been launched as close to Paris as St. Denis-sur-Seine. She is a steel sailing vessel named the Geneviève for the Société Navale d'Armament.

The launch of the new cruiser Calabria, which is being built in the royal dockyards of Spezia for the Italian Navy, has been provisionally fixed for the 20th of September.

There has been received at the Frankfort Arsenal, U.S., from Germany more than 3000 lb. of smokeless powder, which will be sent to Sandy Hook for test in the big guns.

The floating pontoon dock, built on the Tyne to the order of the Manchester Ship Canal Pontoon and Dry Dock Company, is now in position at Mode Wheel. The pontoon dock is 270ft. long by 63ft. wide.

The Admiralty have withdrawn the paid-off Indian troopships Euphrates and Serapis from the list of ships for sale, and have called for an estimate for new boilers and engines. The cost for each ship is estimated at £42,000.

We hear that the construction of the telegraph line between Burmah and China is being proceeded with. The course of the line will be from the Nampaung Fort, situated to the north-east of Bhamo, to Momein, *viâ* Manwieng, a distance of about 190 miles.

Mr. J. C. R. Okes, of 39, Queen Victoria-street, E.C., formerly associated with the late British Gas Engine Company, has been appointed sole representative in London and Southern Counties for the National Gas Engine Company, which has extensive works at Ashton-under-Lyne.

The new torpedo gunboat Harrier, off Plymouth, on Tuesday underwent a successful eight-hours steam trial. Her engines, with natural draught, developed 2696 horse-power, or nearly 200 beyond the guarantee, and her speed was 18 knots an hour, against 16·9 and 17·1 attained by her sister vessels Halcyon and Hazard.

Six schemes have been put forward in the Paris Chamber of Deputies for establishing a communication between England and France, which are as follows:—(1) A tunnel under the Channel. (2) A bridge over the Channel. (3) A transmarine tunnel. (4) A tubular railway. (5) A mixed passage. (6) A steam-ferry carrying a train.

For the convenience of travellers to the Continent, a special arrangement has come into force between the South-Eastern Railway Company and the International Sleeping Car and European Express Trains Company, by which a new special inquiry and ticket-office has been opened at the entry to the continental departure platform at Charing-cross station.

The contract for the extension of the Union Dock at West Hartlepool for the North-Eastern Railway Company has been secured by Mr. T. D. Ridley, of Middlesbrough, who completed the extension of the same company's Middlesbrough Dock. The area which the extension will cover is at present used as a timber dock, and this will be converted into a deep water dock.

The blocks used in the mahogany pavements in Paris are of real Brazilian mahogany of peculiar fine texture and colour. This wood is much more expensive than that ordinarily used for the same purpose. The actual cost of the new road will be fifty francs per square yard. It is an experiment at the best, the hope being that the durability will compensate for the outlay. The street in question is the Rue Lafayette.

A small steel cruiser of exceptional speed and radius of action is to be laid down at Brest. She is to do 23 knots at her forced draught trials, and 20 knots for four-and-twenty consecutive hours. The armament will consist of ten 3·9in. 28-pounder quick-firing and twelve 1·85in. 3-pounder quick-firing guns. There will be merely pole masts without military tops. In order to keep the vessel always at the same draught of water, arrangements are to be made whereby in proportion as her coal and provisions are exhausted water will be admitted to certain compartments.

The Nobel Company have given notice of appeal to the House of Lords against the judgment in the recent Cordite case pronounced by Mr. Justice Romer and unanimously affirmed by the Judges of the Appeal Court. Mr. Maxim is also desirous of fighting a claim for infringement of one of his patents for the production of smokeless powder. He has asked and obtained permission to proceed in the same manner as the Nobel Company, *i.e.*, by way of what is called a "friendly action," in which Dr. Anderson, on behalf of the Government, will be the defendant.

Staff-Engineer New, of H.M.S. Barfleur, seems to like his little joke. In an interview with a representative of the *Pall Mall Gazette*, headed, in the issue of August 17th of that organ as "Six Hundred Water-tight Doors," we abstract some information of a decidedly "new" description. For example, we first read that all the machinery in the ship is "in duplicate;" also that reservoirs for compressed air "come in handy" when there are torpedoes, "these gigantic horrors," to fire. A stoker's lot, we read further, is not so bad as a policeman's. What a pity it seems that this interviewer was unable to proceed with the ship on a forced draught run. He might then have thought otherwise. It is interesting also to read of the strength of the helmsman who with one finger is able to move the steering-wheel. But what are all these details when we learn that the horse-power of the Barfleur is 13,160 tons? "The engine-rooms are models of completeness," the article goes on; "in the first which I visited is an engine for circulating water through the main condenser." Wonderful! By the way, it would be interesting to know how the other condenser gets on. Perhaps it does not condense at all. The auxiliary condenser, on the other hand, blossoms forth into an importance hitherto unrecognised. It clearly discharges a greater function in the Barfleur than it has ever been known to do before single-handed. Altogether the machinery is of a most curious description, for we read that "the engine which drives the starboard screw does its duty without making the slightest noise." The stokeholds are described as lofty and roomy, light and airy. The luxury, too, of the stokers' bathroom—a wonderful ship! We must avail ourselves of the first opportunity that occurs of inspecting this unique battleship.

# GREAT NORTHERN RAILWAY—BRIDGE OVER THE DON

MR. R. JOHNSON, M.I.C.E., ENGINEER

*(For description see page 192)*

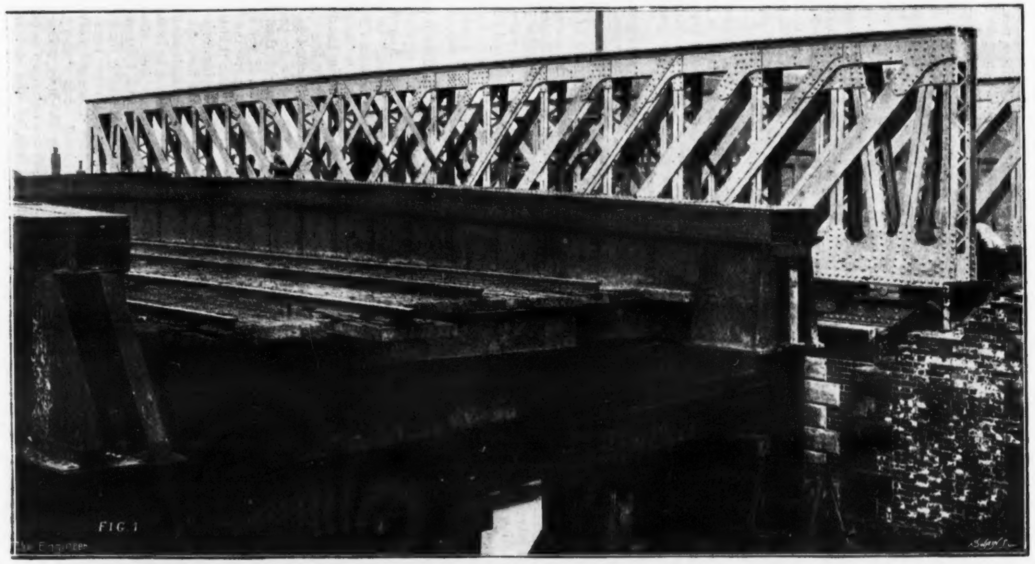


FIG. 1

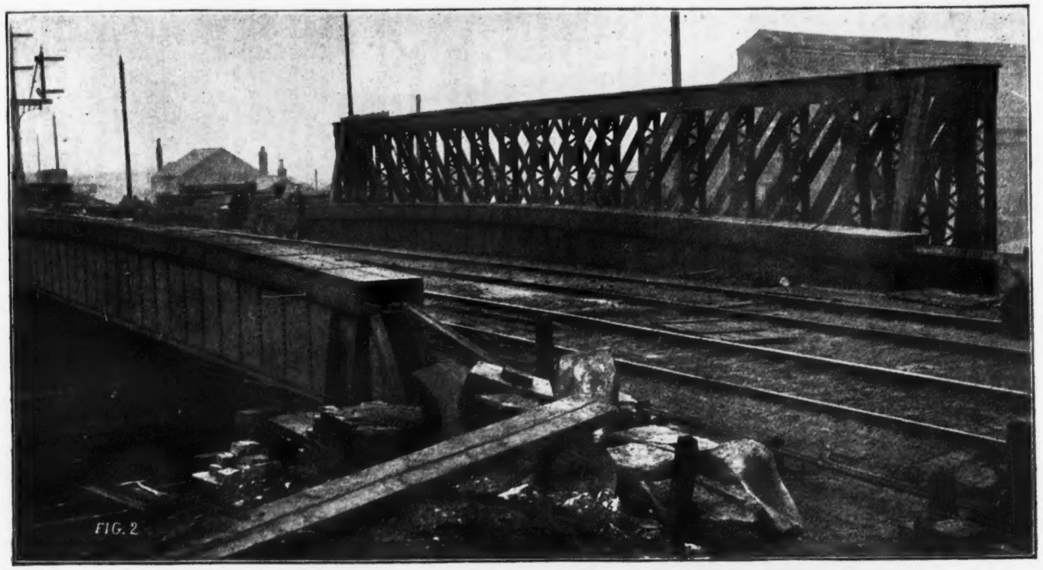


FIG. 2

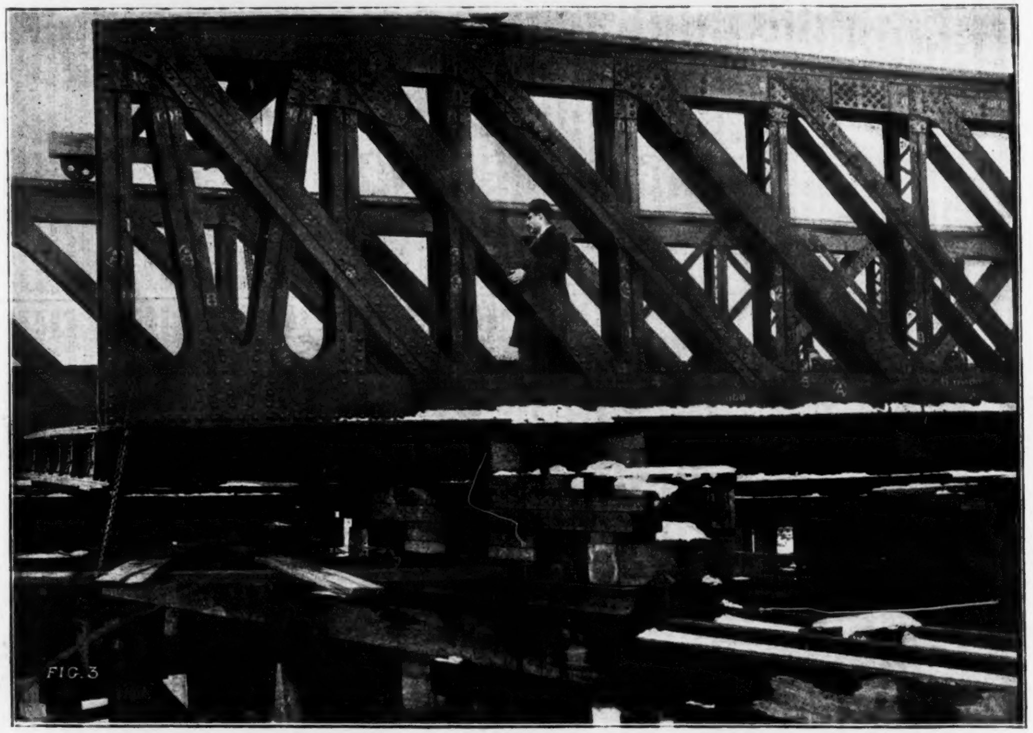


FIG. 3

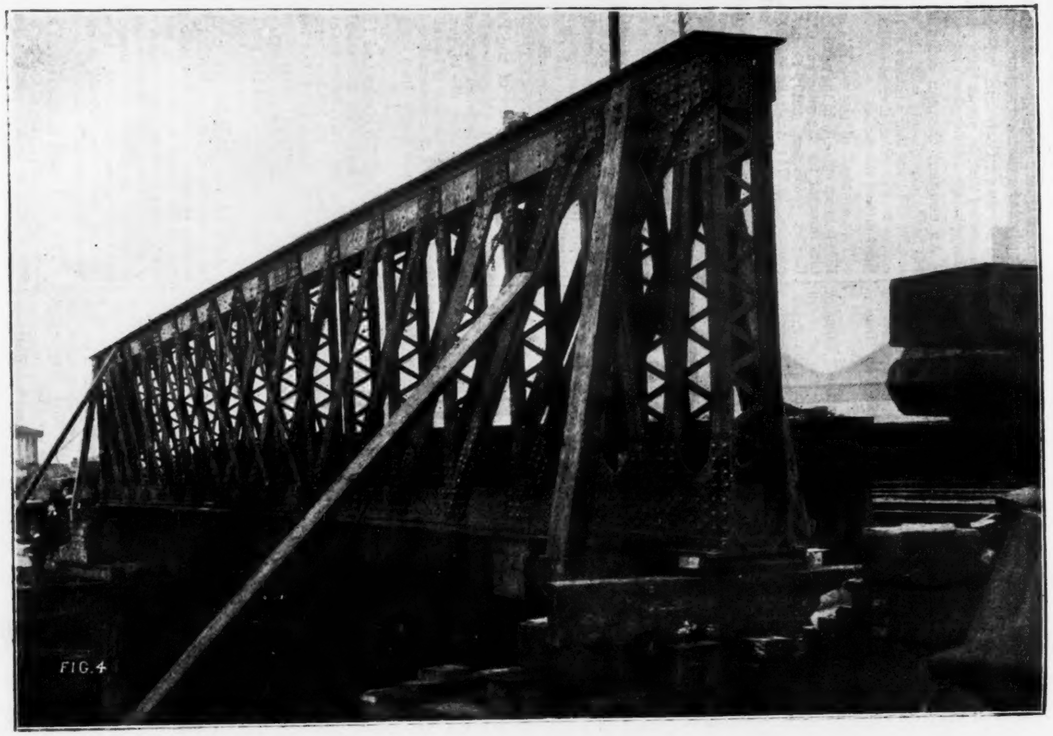


FIG. 4

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, August 31st, 1894. Page

The Iron and Steel Institute .. .. .. .. .. .. .. .. .. 185
Knight's Heater or Thermosote. (Illustrated.) .. .. .. .. .. 187
Loris' Bullet and Dagger-proof Cuirass .. .. .. .. .. .. 187
Notes on Electric Power, with Special Reference to Works Driven by Electricity in Belgium .. .. .. .. .. 188
The Most Economical Temperature for Steam Engine Cylinders, or Hot v. Cold Walls. (Illustrated.) .. .. .. .. .. 188
Quadruple-geared Duplex Crank Lathe. (Illustrated.) .. .. 190
An Improved System of Ventilation. (Illustrated) .. .. .. 190
A Novel Dust Trap. (Illustrated.) .. .. .. .. .. .. 190
Engines of H.M.S. Daring and Decoy. (Illustrated) .. .. 191
Elevators and Lift Machinery .. .. .. .. .. .. .. 191
New Lubricator for Bearings. (Illustrated) .. .. .. .. 192
A Wood-carving Machine. (Illustrated.) .. .. .. .. .. 192
Great Northern Railway—Reconstruction of a Bridge over the Don. (Illustrated) .. .. .. .. .. .. .. .. 192
Letters to the Editor—Locomotive Engine Bows—Engineers in Australia—The Forban—Entropy .. .. .. .. .. .. 192
Railway Matters—Notes and Memoranda—Miscellanea .. .. 193
Leading Articles—The Part of Coal Dust in Mine Explosions .. .. 195
The Alignment of Tunnels—Railways in Siam—The Machinery Trades and the American Tariff .. .. .. .. .. .. 196
Work and Workers in Belgium .. .. .. .. .. .. .. 197
Literature .. .. .. .. .. .. .. .. .. .. .. .. 197
Books Received .. .. .. .. .. .. .. .. .. .. .. 197
The Navigable Balloon at the Antwerp Exhibition. (Illus.) .. 194
Methods of Determining the Dryness of Steam. (Illustrated.) 199
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. .. .. 200
Notes from Lancashire—The Sheffield District—The North of England .. .. .. .. .. .. .. .. .. .. .. .. 201
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. 202
American Notes .. .. .. .. .. .. .. .. .. .. .. 203
Reconstruction of a Bridge over the Seine .. .. .. .. 203
The Patent Journal .. .. .. .. .. .. .. .. .. .. 203
Selected American Patents .. .. .. .. .. .. .. .. 204
Paragraphs—Whitworth Scholarships, 189—Death of Mr. Henry Faija, 189—Dredging the Mersey Bar, 189—Naval Engineer Appointments, 192—Transportation Exhibits at the Chicago Exhibition, 198—Launch of a New Liner, 203.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

D. B. (Exeter).—*You can send us on the model if you think proper, but we cannot accept any responsibility about it.*

K. and Co. (Antwerp).—*We have already illustrated the Laval turbine applied to drive a dynamo in our impression for October 20th, 1893. If you have any new features to describe we shall be glad to hear further from you.*

A. M. B. (Quebec).—*You cannot do as well in the kind of practical technical education here as, according to your description, you can at the Pratt Institute. The "Construction of Modern Locomotive" articles are completed. Sectional drawings mentioned not given. Some other points on American locomotives in* The Engineer, *August 17th.*

### OSCILLATING v. INCLINED COMPOUND PADDLE ENGINES.

*(To the Editor of The Engineer.)*

Sir,—I shall be very much obliged to any of your readers for an expression of opinion based on experience of the relative merits of these two systems. Engines of both classes are used in the fast traffic between this country and the Continent. The Zeeland S.S. Company adheres to the oscillating system, while the Belgian Government boats use inclined engines. Both types have been built on the Clyde. Which is the better?

London, August 29th. Voyager.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

London Association of Foremen Engineers and Draughtsmen.—Saturday, September 1st, at Cannon-street Hotel, at 7 p.m. Monthly Meeting. Paper: "A Visit to the Scotch Leval Shale Mines," by James J. Pike.

The Federated Institution of Mining Engineers.—Wednesday and Thursday, September 5th and 6th, at Newcastle-on-Tyne. Annual general meeting. Numerous excursions will take place.

### DEATHS.

On the 21st inst., at his residence, Riverbank, Sunbury-on-Thames, Henry Faija, M.I.C.E., of Old Queen-street, Westminster, and Harcourt-terrace, South Kensington, aged 49 years.

On July 30th, suddenly, at Johannesburg, South Africa, James French, Assoc. Mem. I.C.E., age 48 years, second son of William French, surveyor, late of Delahay-street, Westminster.

# THE ENGINEER.

*AUGUST* 31, 1894.

## THE PART OF COAL DUST IN MINE EXPLOSIONS.

While the Home-office is apparently hesitating to resume and continue on its own account the experiments commenced by Mr. Hall in Lancashire, with regard to the explosive qualities of coal dust in mines, mining engineers and colliery managers in South Wales are making efforts to solve the problem for themselves by tests which are carried out on what may be called for the nonce the "voluntary principle." In the locality there is undoubtedly a great deal of dissatisfaction with the verdict of the coroner's inquest into the causes of the death of the victims of the Albion Colliery disaster. It is not surprising or unnatural that the finding should be regarded as inconclusive. What can be expected of an ordinary coroner's jury—and here were two juries and two coroners, because of the deaths falling in two jurisdictions—when questions of the greatest delicacy and complexity have to be determined? How can the most "highly respectable" body of jurors decide on matters when mining experts have had to confess that for their final opinion they are awaiting more positive evidence? It is only the gravity of the calamity which calls attention to the insufficiency and inefficiency of our present method of investigating its causes. If colliery explosions and terrible death-rolls were of as common occurrence as, say, railway accidents, the coroner would inevitably be supplemented or superseded by an engineering expert who would take all the scientific evidence he could get, and present to the Government a report which should at all events have the merit of being impartial and scientifically precise.

The South Wales mining engineers are even now in doubt as to the relative strength of the explosive powers of coal dust in different pits; in different measures in the same pit, and in different pits dipping to the same measures. The question may be said to depend very largely, if not mainly, on the relative moisture of the workings. But to put it in that way bears too much of the appearance of a platitude. If it were possible to discover a denomination for this standard, one would prefer to say that the question depended more particularly upon the power of absorption, the capacity of saturation, of the roadways and roof throughout the working places, from the downcast shaft right away to the "face." No coal mine is really dry; but there are many in which Welsh coal, and especially the subsidiary seams, run through strata which for long distances seem impervious to water; and on this difference between dryness and moisture of the atmosphere of a pit—it is to South Wales we are especially referring—rests the undetermined issue under which the coal dust is dangerously explosive whether as dangerously explosive as fire-damp, or more explosive intrinsically, because of its fiery gaseous particles, than four times the quantity or volume of the carburetted hydrogen which one looks to as an incident of all coal mining explorations.

Some of these "voluntary" experiments were begun early in the month at the Lower Duffryn Collieries in the Aberdare Valley, not far from the spot whence "in the '30's" the first steam coal was carried—in a portmanteau it is reported—for examination on the London market. The coal measures worked there are not identical with those of the Albion seams, but they bear many points of resemblance in the hardness of sections of the coal and the flocculence and volatility of the dust. The point here was to test which was the safest class of explosive to use in connection with the coal dust of the 2ft. 9in. and 4ft. seams of these Lower Duffryn Collieries—dust taken from the "face" of the workings, as well as from the roadways. The first shot was of gunpowder, $1\frac{1}{2}$ lb., covered with coal dust from the 2ft. 9in. headings and roads. This caused a large flame, and the odour of burning coal dust was distinct at ten yards distance. With no coal dust, and the same quantity of gunpowder, the second shot resulted in a very much smaller and clearer flame. Compressed powder was next tried, covered with coal dust from the 4ft. seam, and again there was a large flame and a distinct odour of burning coal dust. The pit screens yielded a quantity of very fine dust, which was exploded by a charge of 1 lb. of gunpowder and two balls of compressed powder. There was now a greater flame, and heat felt at a still greater distance. Then we came to dust taken from the face of the mine, and the results surprised many an old practical observer. A quantity of dust from the stalls in the 4ft. seam was charged with 1 lb. of gunpowder and two balls of compressed powder, and this brought out a greater volume of flame and intensity of heat than came from the old dust that had hung and clustered about the roadway and headings. From about this stage the interest of the story increases to mining engineers. To the same amount of the coal dust from the face a charge of $\frac{1}{2}$ lb. of roburite was applied, ignited by electricity. It caused a loud enough report, but there was no perceptible flame. From the face of the 4ft. seam dust was taken. The charge was $\frac{1}{2}$ lb. ammonite in one case, and the other 1 lb. compressed powder placed at short intervals. The ammonite was first exploded; the compressed powder within a few seconds. The ammonite caused no flame; the compressed powder exploded in a blaze that might have set a pit on fire. Under the same conditions $\frac{3}{4}$ lb. carbonite was used, and no flame was emitted. To the extent to which their value may be ultimately proved, these experiments would seem to show that of the two forms of explosives used where coal dust is in the atmosphere of a mine, gunpowder in any form provokes a dreadful retort—to put it only in that way—while the high explosives are, as far as our knowledge at present goes, if not innocuous, in every way to be preferred.

But notwithstanding these demonstrations, there was still a difficulty to overcome. The colliers required to be convinced not only that gunpowder was unsafe, but that ammonite or some other high explosive would equally serve the purpose of economically dislodging the coal—that is to say, without shattering it into fragments. It was therefore arranged in the following week that a series of object lessons should be given at the same colliery for the instruction of Mr. David Morgan, miners' agent, and a deputation of the workmen. Mr. Morgan and the colliers, it should be premised, were strongly prejudiced in favour of gunpowder as an agent they were thoroughly familiar with, as one easily handled, and as one, moreover, which they refused to regard as dangerous, when skilfully used. If this be borne in mind, the conclusions forced upon the workmen's minds by the experiments will be recognised as the more important. The colliers and their agent were, in fact, convinced against their will. Mr. David Morgan shall be left, for the most part, to tell the story in his own words. So far as blasting was concerned, it was found that carbonite was more serviceable than ammonite, inasmuch as it did not smash the coal to the same extent as the latter, though Mr. Morgan estimates that carbonite is, weight for weight, only 50 per cent. stronger than gunpowder, and not 100 per cent., as the manufacturers claim. Then came the question of the effect of the shots as potential causes of the ignition of fire-damp or coal dust. During the experiments, twenty-eight shots of high explosives were fired. "Although I and the men most carefully watched," Mr. Morgan says, "we failed to distinguish the slightest appearance of flame, thus leading us to the conclusion that both carbonite and ammonite are harmless in the matter of igniting coal dust." And next, for the comparison with gunpowder. "We placed some 150 lb. of perfectly dry coal dust on a sheet of iron, and under it a carbonite cartridge, which was ignited by electricity. This blew up the dust in large clouds in every direction; but none of it ignited, and we saw no trace of a flame. The same experiment was tried with ammonite, with the same result. We also tried the same thing with both loose gunpowder and with a cartridge of compressed gunpowder; in both cases flames were given off, and the dust ignited in all directions." Mr. Morgan, however, adds that he and the miners with him could not be sure that the whole of the dust was ignited, and accordingly they were still unconvinced that a blown-out shot, even if it ignited the dust close by, could cause a general explosion.

Mr. E. M. Hann, the general manager of the Powell Duffryn Collieries, and Mr. Gwilym Jones, the mine manager at Lower Duffryn, thereupon made provision for another experiment, under conditions by which the action of a blown-out shot could be reproduced. "First of all," says Mr. Morgan, "we placed about 2 cwt. of coal dust in front of a three-holed cannon, and put about $\frac{1}{3}$ lb. of loose powder in each hole, firing them simultaneously into the heap of dust. One of them made an effective flame of dust. The others merely blew the dust away to a slight extent. We repeated this experiment, and in this case neither of the shots ignited the dust. We then placed the same dust with some more on a metal sheet, and placed under it a carbonite cartridge. This cartridge was fired by electricity, and blew the dust in large clouds into the air, but with no trace of flame. At the moment the dust was thoroughly diffused a cartridge of compressed powder was fired into the dust cloud, and instantaneously it ignited, huge flames bursting in all directions." Mr. Morgan sums up finally with this deliverance:—"I unhesitatingly say that in the case of dry and dusty mines the use of gunpowder should be prohibited, and carbonite or some other flameless explosive used, unless by some means the gunpowder can be made flameless, which a manufacturer of compressed powder told me can be done. If we had only competent and skilled miners working in our mines, the dangers from a blown out shot would be very remote, for a skilled and experienced collier hardly ever has such a thing as a blown out shot. But unfortunately we have many unskilled colliers brought into the mines lately, who are unable to judge properly what work a shot can do."

On these points Mr. William Galloway, M. Inst. C.E., a well-known mining engineer and a Professor of the University College of Cardiff, makes a suggestion which is worthy of a wider circulation than that of the Cardiff journal in which his letter appeared. "It has occurred to me," he says, "that I might usefully offer to conduct some experiments with coal dust on a moderately large scale at a few of the principal mining centres of the district, so that those who have not seen coal dust in actual combustion might have an opportunity of doing so almost at their own doors. To this end I am prepared to devote the necessary time, and to provide the apparatus and assistance at my own cost." Why is Mr. Galloway so late in making this philanthropic offer? He asks the question himself, and answers it in his own way:—"Before or about the time of the appointment of the Royal Commission on Accidents in Mines, in the beginning of the year 1879, Mr. Archibald Hood, who has always been in the forefront of the coal dust question, proposed to me, and I agreed, that he should ask the Monmouthshire and South Wales Coalowners' Association to vote the sum of £1000 wherewith to build an apparatus at some central point in the coalfield by means of which the correctness of the coal dust theory, which was then comparatively new, might be demonstrated on an imposing scale. For several years previously—since 1875—I had been conducting experiments with coal dust in smaller apparatus. At that time, however, the matter fell into abeyance, for the Royal Commission referred to was instructed amongst other things to inquire into the influence of coal dust. It may seem strange after the prominence that has recently been given to Faraday's remarks about coal dust in 1845, that this was practically the first official notice taken of coal dust as a possibly important factor in colliery explosions."

His complaint continues that thirty-four years have elapsed, and nothing so far has been done by Act of Parliament or statutory rules of management, and scarcely a single tribute paid to the danger of coal dust as a cause of colliery explosions, until the Royal Commission on Coal Dust was appointed. "I suggested to that Commission," Mr. Galloway writes, "at a very early period of their existence, that the best means of convincing themselves and the public would be to erect an apparatus as large as a roadway in a mine, and to create explosions of coal dust within it, in the natural state, in the presence of all who could be induced to come and see. At the request of one of the members of the Commission, I went carefully into the matter, and recommended that an apparatus 7ft. in diameter and 200 yards long be built in a field near the Naval Collieries. I offered to give my services gratuitously, designed the apparatus, took tenders for its erection, and made arrangements with the owners of the colliery. The estimated cost was £5000. The matter was allowed to drop, ostensibly on account of its cost. The Commission has issued its report. But there appear to be still unbelievers. Hence my present offer, which I hope will meet with better success."

## THE ALIGNMENT OF TUNNELS.

There are probably very few railway engineers who, while serving their time in the field and in the office, under the "chief," were not made acquainted with, and expected to believe, the story of the two separate headings of a tunnel which were carried past one another instead of meeting, if not exactly, at any rate within that permissible limit of lateral deviation which is so gratifying to the resident engineer. Very few tunnels of dimensions worth recording, no matter how accurately they might have been aligned, or how truly they might have been driven, have had the good fortune to escape the wearing of this cap, whether it fitted them or not. Any one that had a curve in it was doomed. It is also stated—at least it was in a version given many years ago—that the fact of the "overlap" was ascertained by the circumstance of one of the gangs knocking off for dinner a minute or two before the other. The naturally acute hearing of the former, no doubt sharpened by appetite, enabled them to distinguish distinctly the sound of the jumpers, picks, shovels, hammers, and axes of their retreating comrades. In some remarks made by the President of the Institution of Civil Engineers in opening the discussion on a paper—"Tunnels on the Dore and Chinley Railway"—to which we shall presently more immediately refer, that gentleman cited a tunnel at Liverpool which rumour had impeached as the culprit, but it has been contended strongly that the honour, if any, belonged to a similar engineering work carrying the railway into Cork. Mr. Giles very truly remarked that "since that time better methods had been introduced to set out tunnels, and how necessary it was that in the setting out of preliminary work of that nature, the greatest possible accuracy should be observed."

The setting-out or alignment of a tunnel may be classed under three heads. First, the ranging or alignment above ground; secondly, that below, either in a heading or in the full section of the tunnel; and, thirdly, what may be termed the vertical alignment, or the transference of the surface-line to the subterranean one. Should the tunnel, similar to the longest two existing at Mont Cenis and Mont St. Gothard, be constructed without shafts, the vertical alignment is not required, as presumably the tunnel would be ranged from points observed directly from each extremity. In other words, the line of direction being given by the fixation of a couple of terminal points at any visible distance from the ends of the tunnel, the alignment may be obtained either by setting up the instrument, whether a plain transit or a theodolite, over the nearest point, sighting backwards, reversing and ranging forward, or by absolutely ranging the line backwards from the fixed points. It is extremely rare that the contours of the ground beneath which the tunnel is situated are sufficiently favourable to allow of one extremity being visible from the other; that is, to permit of the total length being ranged forward in either one direction or the other. The more general case is that in which, while the ends of the tunnel themselves are not sightable the one from the other, yet a summit level obtains from which as a common point, even if, as frequently occurs, the ends are not visible, points in the direction of the line of trace can be accurately determined, marked, and rendered available for the alignment of the face headings or driftways. The distance at which these points are located from the mouths of the tunnel will depend upon the physical features of the surface, but it is really a matter of little moment how far off they may be situated, so long as they are fairly within the range of the instrument employed. With this proviso, the farther off they are the better, as they admit of a more accurate and delicate adjustment by the cross wires of the telescope. In the Bletchingley tunnel these terminal points were situated at a distance of two miles from the extremities of the tunnel, and consisted of small, solidly built brick piers, painted black, with a white line in distinct relief on them. In setting out the Totley tunnel, a full and interesting description of which is given in the paper already mentioned, namely, "Tunnels on the Dore and Chinley Railway," by the late Percy Rickard, M. Inst. C.E., and read before the Institution of Civil Engineers, January 23rd of the present year, terminal points were also used. They were aligned by forward and backward sighting from a summit level, where an observatory had been built from which a view was obtained of a very extensive tract of the whole country. These two points were about 9000ft. and 7000ft. measured horizontally from the respective extremities of the tunnel. The distance of the same points from the summit observatory was over three miles, but by employing as a mark a board painted black, with a 3in. white line on it, fitted with a plummet and fixed by guy ropes, and placing behind the board at a few feet from it, so as to avoid shadow, a white calico screen, the mark could be distinctly distinguished so long as the sun was in front of the screen. These satisfactory results appear to agree with those generally obtained in a similar manner. It is now well established, both by past and present experience, that for long distances, white against black shows up best, and *vice versâ* for short distances. In the setting out of both the Totley and Cowburn tunnels, the latter being on the same line of railway, a black board, 2ft. by 1ft. 6in., faced with white cardboard, on which was drawn a broad arrow with varying widths of shaft, was levelled with a spirit level and supported from the back with light iron stays and used for short distances.

At each of these two terminal points described, as well as at six other stations, placed where marked changes in the contours of the ground occurred, observatories were built, for the location of the transit instrument used in aligning the tunnel. They were hollow, of brickwork in cement, capped with stone, with a large flat cast iron plate, having a hole 6in. wide in the centre let into the cap and run with cement, upon which the transit instrument rested. A brass scale of a width of 1½in., and divisions of inches and twentieths, was fixed across the central hole in the plate, and a plumb line from the centre of the instrument could be dropped through the hole to touch the side of the scale. It may be fairly questioned whether all these observatories are needed for a tunnel 6229 yards, or a trifle over 3½ miles in length. We do not go so far as to unreservedly endorse the views of some engineers, who maintain that—except in the case of very long tunnels—observatories are not required, and that strong permanent marks, over which a theodolite can be set up as often as required, will answer all the purposes of lining out and fixing the positions of the shafts. An inspection of the longitudinal section of the ground over the Totley tunnel, will point out that the observatories on the eastern side of the summit limit serve principally for checking the lines run from the summit and terminal stations. The plain transit instrument is generally used for aligning tunnels, as it is less complicated and has fewer adjustments than the theodolite; though a slight drawback may be found in the necessity for removing the cross-level every time the telescope is reversed, unless the operator is satisfied with one general levelling for each series of observations. It was suggested in the discussion that the compass might be employed, in the place of the transit; but such an idea is utterly inadmissible, and the very enunciation of it must sound very strangely in the ears of the modern engineer, who would as soon think of using a plane table or a box sextant. We are not aware of a single instance in which an instrument, so conspicuously inaccurate and imperfect as the compass, has been employed for the alignment of a railway tunnel worthy of the name. Even in mines, its ancient stronghold, it is being rapidly discarded; and, whenever practicable, the preference is given to the ordinary theodolite slightly modified in its arrangements and parts, to suit the exigencies of subterranean explorations. Without in the least underrating the value of the transit, we have no hesitation in stating from a long practice that a 6in. transit theodolite by a first-rate maker, in the hands of a skilful and experienced engineer, can be made to do anything and everything in connection with railway work, with an accuracy, precision, and fidelity which leave nothing to be desired.

As most tunnels are provided with shafts, the transference, or vertical alignment of the trace of the tunnel from above to below ground, is effected through them. The problem is to determine a vertical plane, perpendicular to the transverse axis of the tunnel, bounded by lines forming the surface and subterranean alignments, and connected at the points where the shafts occur by the vertical alignment, which may be regarded in the light of so many ordinates. The simplest case is obviously where the vertical plane passes through the longitudinal axis, that is where the shafts are ranged along the centre line of the tunnel. It should be mentioned that so far as the simple alignment is considered, the words tunnel and heading are used in the same sense. Instances have occurred in which the shafts have been run parallel to the centre line of the tunnel, and in the tunnel at Mont Cenis shafts—which more correctly might be termed drifts—were driven into the headings from the adjacent hillside. A similar example occurred in the Clifton tunnel, where a vertical alignment was set out from a station on the other side of the river Avon, through a horizontal gallery, ranged so as to intersect the centre line of the tunnel. The distance between any two consecutive ordinates in the vertical plane of alignment should be as great as possible, but unfortunately the diameters of shafts are generally of dimensions so limited as to restrict this length to about 8ft. or 9ft., and often to a less amount. Exceptions sometimes occur, as in the well-known Box tunnel, nearly two miles long, on the Great Western Railway, where some of the eleven principal shafts are 25ft. in diameter. A still more remarkable example may be found in the Kilsby tunnel, which has a main shaft 65ft. in diameter. Again, in the tunnel under the Hoosac Mountain, in Western Massachussetts, which has a total length of 4¾ miles, the shafts are not all of a cylindrical form. Some are in the shape of parallelograms, 13ft. by 6ft., others 14ft. by 8ft., and one is elliptical, with major and minor axes of 27ft. and 15ft. respectively, of which the former is in the direction of the trace. In effecting the practical transference of the centre line down the shafts, the old methods have been either abandoned, or partially employed under greatly ameliorated conditions. The apparatus employed for the Totley tunnel consisted of a winding drum, upon which the wire was wound, mounted upon an iron frame, with a ratchet and pawl to secure it in any position. The wire, which was weighted, passed over an adjusting screw, and was readily brought into line by turning the screw in either direction as required.

A few words regarding the "thirl," as the meeting of the separate headings is termed, will conclude our article. It might be supposed that the more numerous the shafts, and consequently the greater the number of ordinates in the vertical plane of alignment, the less would be the divergence at the points of junction of the different headings, or of the different independent lengths of the centre line, supposing the tunnel to have no headings, of which that at Sydenham furnishes an instance. Experience does not universally confirm this *primâ facie* rational and common-sense view of the subject, and a little consideration will discover the cause of the discrepancy. Every separate operation, or every repetition of the same operation, is not only a source of error, but undoubtedly a cause of actual error, even if of an amount too insignificant to be appreciable. Consequently, every transference of the centre line is attended with some slight error, which, in the event of the position of any particular shaft not being sightable from either the summit or terminal stations, and therefore requiring to be fixed by ranging from a previously determined shaft, might become cumulative. In the one case, the accuracy of the underground alignment depends upon that of a number of independent short lines, which may or may not have been set out from the same fixed points. On the other hand, the centre line of the shaftless tunnel underground is ranged from each end from two unalterable terminal stations. The total deviation of the headings in the Totley tunnel was 4½in., or 1in. in every 555 yards of heading, a very satisfactory result. In the Mont Cenis tunnel which is shaftless, the horizontal deviation is given as *nil*. But in the similar work at Mont St. Gothard, the total error amounted to 13in., or 1in. in every 627 yards, assuming the "thirl" to have taken place at about midway. In instituting this comparison, some additional credit may be fairly given to the St. Gothard tunnel, having regard to its great length, which closely approximates to nine miles and a-quarter.

◆

## RAILWAYS IN SIAM.

According to the United States Vice-Consul General at Bangkok, there are two railways in Siam, one from Bangkok to Pakwam, completed and opened in 1893, the other a royal line from Bangkok to Karat in the northern part of the kingdom, in progress. The former is 25 miles long, of 39·37in. gauge, and depends principally for its support upon the traffic between those two places. It was constructed with private capital, and is considered a success, being already able to pay dividends of 5 per cent. The latter is 140 miles long, one-third of which is completed. After surveys had been made, and plans and specifications prepared for this line, tenders were invited by advertisement in 1891 for its construction. Several American contractors, after receiving copies of the plans and specifications, refused to consider the matter, as in their opinion no one could construct the line unless he had some particular kind of old iron, and other obsolete stock which he could work off on such a contract, and that the whole thing, from start to finish, was absurd. In January, 1892, the contract, to include the completion and equipment of the line, with rolling stock, stations, freight and passenger accommodation, telegraph lines, and everything necessary to make a complete railway, was let to an English company for £625,000. The time for completion was fixed at five years. The work has been going on for 2½ years. The line pierced some of the finest rice producing territory in Asia, to which it will be of great benefit in bringing the product to the markets, a course now carried on by row boats on canals and rivers. Another, and probably the principal object of the line, is the development of the country beyond the hills of Karat, now practically wild. Its soil is said to be capable of producing as much as any other part of Siam. It is reported that the Government intends to extend the line some distance beyond Karat, its originally designed terminus. Among the many difficulties with which railway construction in Siam is attended are:—A general want of confidence between employers and employed, each seriously questioning the stability of the other; the question of labour, as coolies have to be imported from China at great expense, and it is doubtful after arrival whether they will go on with the work for which they were imported. As the demand for such labour in the city is considerable, and the wages are higher than those they would get from the railway, they frequently leave their importers in the lurch, and go to work in the city. As they are so much alike in general appearance, it is almost impossible to identify the fugitives among the vast crowds of their countrymen, and they are usually given up for lost. The work of building construction is very different from those of the United States. The coolies use hoes instead of picks and shovels, and baskets instead of horses and scrapers. All supplies have to be delivered by canal and river, and as these have to depend upon the tides, they are frequently left high and dry. The inability or unwillingness of the labouring classes to push matters is discouraging. There is nothing to be gained by hurrying them, as they take their time with everything. Malaria and other diseases are also serious obstacles to those stationed in the interior.

## THE MACHINERY TRADES AND THE AMERICAN TARIFF.

To the machinery trades of this country the new American tariff is likely to add industrial activity mainly by increasing the general prosperity of British and American industries. To American and English trade alike the removal of the uncertainty which has long overhung the tariff question is sure to mean revival. From this renewed vigour the machinery trades must obtain enlarged orders. But it is gratifying, too, that there is some chance of doing a better business with America direct in certain classes of machine tools and machinery. The tariff on imported machinery has been reduced from 45 to 35 per cent. *ad valorem*, and already a few of the Yorkshire machinists in particular are anticipating enhanced buying. The Americans can make practically all the woollen machinery they require, and no additional inducements offered to English makers would enable our home firms to obtain much of a footing in the States. In regard to specialities, such as jute and flax machinery, the conditions, however, are entirely different. Nearly all the flax and jute machinery used in America is supplied by this country, and mainly by Yorkshire. If, as seems likely, the jute factories become busier, the American manufacturers will most probably be under the necessity of increasing their resources and giving out additional orders. In that case, the almost inevitable result will be a larger demand for Yorkshire machinery, coupled with improved prices. That the machinery trade with America is worth cultivating is proved by the circumstance that last year the exports of all classes of machinery to the States were valued approximately at £666,000, of which £317,000 worth was textile machinery despatched in the first half of the year. The prospect of an increased trade in machinery with America, coming at a time when additional orders are reported at Glasgow locomotive works, and a development of business is noticeable among the railway material firms of the Sheffield centre, is very gratifying.

### WORK AND WORKERS IN BELGIUM.

AN observant Sheffield manufacturer who has just returned from the meetings of the Iron and Steel Institute at Brussels is of opinion that the principal cause why the Belgians beat us in several branches of the iron and steel trades is their cheap labour. In the round of the various works he saw nothing in the way of machinery superior to what we have in England—their forging presses he thought much inferior to those in Sheffield—but the men work ten hours a day, Saturdays included, for much lower wages than are given in England for eight hours a day. St. Monday—going off to cricket or football matches on Monday—is an unknown institution among the Belgians. Four shillings a day was about the highest wage he heard of. On the pit banks he saw women employed in large numbers. On one there were twenty females and three boys. The former were mainly from sixteen to forty years of age. Their wages were not one-half those of the men. At forty the females seemed to have ended their work, for none he saw were older. What becomes of them? The girder mills appeared to be fully employed, with Great Britain as their chief market. Some of the visitors were anxious to see through the sheet mills, of which a good deal had been heard, but none were open to inspection. The railway carriage and wagon mills were considered by the Sheffield manufacturer inferior to those in his own district. Everywhere there were signs that business was good, all the workshops seeming to be running full time. One feature of the pit and furnace life he noted and appreciated. At every place there was provision for the men divesting themselves of their working garb, thoroughly cleansing their persons, and walking away home in other apparel, leaving their soiled clothes behind them for next day's employment. This feature of Belgian industrial life he regards as capable of wider application in England. The gentleman whose opinions we reproduce has overlooked certain features of Belgian life, however, which tend to counterbalance the difference in wages. On this point we shall have something to say at another time.

## LITERATURE.

*A Practical Treatise on the Steam Engine.* By ARTHUR RIGG. London: E. and F. N. Spon. New York: Spon and Chamberlain. 1894.

THIS is a new edition of the book which was very warmly received when it first appeared in 1878—a book which was written for the practical engineer, but which has found even more readers among the students and teachers of the numerous technical colleges which now exist all over the world. When we reviewed it in 1878 we referred especially to the masterly and very practical way in which the author had dealt with numerous questions not previously treated, such as the influence of the reciprocating parts of steam engines as affecting the design and working of high speed, high-pressure engines.

Everyone practically interested in the design, construction, and performance of the steam engine will welcome this new and revised edition. Although the book is written from the point of view of the practical engineer rather than from that of the teacher in engineering colleges and schools, the author combines practical and theoretical instruction in his explanations of the essentials of a very large number of illustrations of engines and allied apparatus. He uses the illustrations more as examples than as designs to be slavishly copied, and throughout he gives that kind of information which enables the reader to apply workshop experience in modifying the designs to suit requirements. The part of the first edition which formed an essay on the forces developed by reciprocation has been extended by recent developments of the author's public system. The now common use of high speeds makes this essay more than ever valuable. In the sixteen years which have passed since the old edition was published, many changes have been made in steam engine design and practice, and some of these are illustrated by new plates, which are now increased to 103 in number. We could have wished that the author had replaced some of the designs of previously existing types by more modern examples. For instance, it would have been better to have replaced the portable engine, illustrated, by designs which better represent present practice, and especially we may refer to the portable engine of American design, which can only be inserted as an example of what not to do.

The author has now included a discussion of the experiments made by Mr. Willans, and an explanation of his straight line diagram. Mr. Rigg's readers could have dispensed with the three pages concerning Carnot's reversible heat engine theorem which leads him to the statement that a perfect steam engine working with a range of 200 Fah. will have an efficiency of 0·262. "That is," he says, "nearly three-fourths of the heat supplied to an engine working under the ordinary conditions, but supposed to be perfect, and therefore reversible, would be unavailable for conversion into work. It will thus be seen that the efficiency of an engine depends solely on the range of temperature within which it works." It is quite time that this sort of thing were omitted from books of the kind. There is nothing that makes it incumbent for a sane practical engineer to mix up the real engine with an ideal with which it cannot in the nature of things ever be comparable.

It may be mentioned also that the argument used concerning the effect of raising steam pressures, and the diagram used to illustrate it, leads the author, as it has done many who have preceded him, to incorrect conclusions. The area of the diagram may be increased by 28 per cent. by doubling the pressure, but the small expenditure of heat necessary to obtain this gain makes the gain well worth having. Willans' diagram—Fig. 2, Plate 3, "Proceedings" Institute Civil Engineers, vol. xciii.—might have been usefully referred to on this point.

These matters, however, do not affect Mr. Rigg's general treatment of steam in the steam engine as the various questions arise throughout the book in connection with compression, expansion, compounding, clearance, and allied matters affecting design.

There will, perhaps, always be some questions which an author of a book like this will treat inadequately, although he is known to be well versed concerning them. In speaking of governors, the author refers to one designed by Willans, and says:—"It dispenses with the evil known as hunting, and yet gives a regularity sufficient to satisfy the requirements of electrical engineers, although far from being so perfect a governor, in principle or in practice, as the Knowles governor previously described." This is all that is said on the question of hunting; and yet the author must have many times overcome the evil which everyone is most anxious to "dispense with."

Although Mr. Rigg has not entered at any very much greater length than previously into thermodynamic questions, we may predict for this new edition at least as favourable a reception as that which was accorded the first by the learner, the teacher, and the practical engineer.

*Progress in Flying Machines.* By O. CHANUTE, C.E. New York: The *American Engineer and Railroad Journal* Office. 1894.

WHEN Mr. Maxim read his paper recently before the Mechanical Section of the British Association at Oxford, Lord Kelvin, in the course of the discussion, took great pains to describe a small screw-propelled flying apparatus of toy proportions which had been made some years ago by his brother, the late Professor James Thompson. Mr. Maxim had described the aëroplane flying machine, so fully described in our impression of the 10th inst., and Lord Kelvin expressed his belief that a better flying machine could be constructed by using the powerful screw propellers which Mr. Maxim had described, but on vertical instead of horizontal axes. The little machine which his brother had made consisted of two small screws, revolving in opposite directions, and driven by twisted elastic india-rubber. James Thompson was deterred from pursuing what he had done in this direction under the impression that the atmospheric resistance experienced by propellers and things propelled was very much greater than it is now known to be, and was indeed known to one writer at least, namely, Sir John Robison, even before James Thompson's time.

In connection with the recently renewed attention to aërial navigation, the book before us is of considerable interest, as furnishing a concise and clear account of a large proportion of all the known work of an experimental kind which has been done with the object of making a flying machine. It is noteworthy that, amongst the machines designed many years ago, namely, in 1845, was one which precisely anticipated the form suggested by Lord Kelvin and claimed as a development of his brother's invention. It was made by a Mr. Cossus, who was, however, anticipated by Mr. John Bourne, who tried models with screws, but gave up his experiments because no motive power appeared to be forthcoming.

More recently, Dienaide, a well-known French engineer, made many experiments about the year 1871, followed by several others, including Forlanini, who in 1878 made a small flying machine driven by a little steam engine. With this model Forlanini obtained a good many figures with regard to the lifting power of screws working in air. Edison subsequently made some experiments, but he was not so successful in aërial mechanics as he has been in electro-mechanics. At present the lifting power obtained by Mr. Maxim by means of aëroplanes and horizontally acting screws, namely, 2·5 lb. per square foot of plane, is greater than has been obtained by any other experimenter, and the thrust obtained by his screws is by far the greatest yet achieved. According to Mr. Maxim the friction of these screws in air is almost unappreciable—an experimental observation which is confirmed by Professor Langley, but some experiments carried out some time ago by Mr. Vogt prove that previous observers were not so fortunate in this respect. There is plenty of room for opinion as to the relative merits of the aëroplane and the vertical screw for lifting and propulsion, and at present it seems to be more easy to make a machine that will fly than to predicate its behaviour or its management if allowed to fly. It is quite possible that with regard to this part of the problem of flight a good deal will have to be learned on the lines of the successful experiments of Herr Otto Lilienthal, who has constructed a system of dirigible wings by means of which he has successfully flown considerable distances in the air by springing from elevated positions, or by getting a sufficient impetus by running down part of a steep hill, and in this way getting his wings spread, and then floating off after the manner of the flight of sea birds without wing motion. To learn to fly by wings such as those devised and used by Herr Lilienthal will be a matter for gymnastic exercise and persistent effort, much as is the performance of many feats by acrobats, and even the learning to ride a bicycle; but it is not improbable that the commencement of human flight may be by these means.

*Tidal Rivers: Their Hydraulics, Improvement, and Navigation.* By W. H. WHEELER, M. Inst. C.E. London: Longmans, Green, and Co. 1894.

IT can hardly be said that the past half century has made any very material additions to the essentials of the science of the hydraulics of rivers. Since the writings of Robinson, David and Thomas Stevenson, Rennie, D'Arcy, and Bazin, none of very remarkable character have been published. There is not perhaps room now for any very novel treatment of this part of the subject, and the chief purpose of modern literature upon it has been to present in a more concise form, the available theory of river and harbour engineering in connection with modern facilities for carrying out works on a large scale with the modern machinery and materials, and also to give examples of recent works and a record of the results of their existence. In this sense Mr. Wheeler's book will be welcomed as a valuable aid to engineers and others interested in the hydraulics, improvement, and navigation of tidal rivers. It commences with an excellent notice of the development of hydraulic science from the point of view of the river and harbour engineer, and this is followed by an historical account of works carried out for improvement and navigation. Mr. Wheeler is of a severely practical turn of mind, and any one reading his chapters on the motion of water in tidal rivers, and on the transporting power of water, will soon find that he does not waste time or space on controversial and academic questions, but quietly deals with that which is useful and necessary, and simply drops any theory or hypothesis which time has proved untenable. In the chapters on the tides and physical condition of tidal rivers, bars at their mouths, principles to be observed in their improvement, and on littoral drift, there is much which is due to his personal observation and experience. This is also true concerning the chapter on dredging, in which the various modern methods mostly followed, and particularly the method of removal and maintenance by erosion and pumping, are dealt with in a practical way as the result of experience. In the chapters on the requirements of navigation and the buoying and lighting of tidal rivers, we have extensions of the articles by the author which have appeared in THE ENGINEER.

A chapter on surveying tidal rivers and estuaries is followed by one on what is probably quite a modern proceeding in connection with the hydraulics of estuaries, namely, the employment of working models for investigating the action of currents and the travel of sand, a method due to Professor Osborne Reynolds, and followed up by a committee of Section A of the British Association, of which Mr. Wheeler was a member. Since this time Mr. Vernon Harcourt has experimented with a model of the Seine, and the author has with models of other river estuaries, and the result of the experiments is a confirmation of the belief that results fairly approximating those actually occurring are artificially obtained.

Mr. Wheeler's book concludes with accounts of examples of river improvement in Great Britain and on the Continent, and, with appendices, giving titles of books relating to tidal rivers, French and English hydrographic and nautical equivalent terms, abbreviations used on marine charts, &c. &c. It is one of those books which those concerned must possess.

*Elementary Lessons with Numerical Examples in Practical Mechanics and Machine Design.* By ROBERT GORDON BLAINE, Assoc. M. Inst. C.E. London: Cassell and Co. 1893.

THIS is a revised edition of a very useful little book, founded on the lectures and system of teaching adopted under Professor John Perry at the Finsbury Technical College. A careful examination of its contents confirms the remark made in an introduction by Professor Perry, in which he says the exercises are framed "to fix firmly in the mind of the student the fact that a certain principle is of importance outside the examination rooms. He is not tempted to calculate in cases where actual experimental trial and observation will show him the best solution of a problem; and when he works out an answer which every practical illiterate mechanic knows to be ten times too great, he will not complacently rest satisfied with this absurd answer, and talk about its being 'theoretically right.'" It opens with the estimation and summation of quantities by the polygons of forces, the terms being explained according to modern notions, but with examples which make things clear. Work and energy questions are dealt with in units common in the "British Engineer's" world; and velocity ratio and mechanical advantage are illustrated by drawings of real screw and hydraulic jacks and a crane, so that a practical notion of these things is learned with what used to be called the natural philosophy of such things. Power, efficiency, &c., are learned with reference to measurement of electrical quantities, flow of a stream and its power, water through a turbine, and so on, power from an indicator diagram, and power for traction purposes. The questions following the lessons on force, mass, acceleration, and the kinetic energy of rotating bodies relate to flywheels for steam and gas engines, with different permissive variations from uniform velocity. Belt driving, and dynamometers as work-measuring machines receive adequate treatment; and that of the strength of beams, springs, and the steam engine, make it an elementary treatise on practical mechanics which one would wish to place in the hands of a student.

### BOOKS RECEIVED.

*Theoretical Mechanics' Fluids.* By J. Edward Taylor, M.A., B.Sc. (Lond.) London: Longmans, Green, and Company. 1894.

*Particulars of the Warships of the World (extracted from Lloyd's Register Book,* 1894-95.) London: 2, White Lion-court, Cornhill. 1894.

*Chats on Invention.* Being an attempt to train the faculties of invention. By John Martin. London: Offices of *Invention.* 1894.

*A Record of the Transportation Exhibits at the World's Columbian Exhibition of* 1893. By James Dredge. London: Offices of *Engineering;* and New York: Jno. Wiley and Sons.

*The Next Naval War.* By Captain S. Eardley-Wilmot, R.N. With an illustration by Chevalier E. De Martino. Second edition. London: Edward Stanford. 1894.

*Forty-first Report of the Department of Science and Art of the Committee of Council on Education, with appendices.* London: Printed for her Majesty's Stationery Office by Eyre and Spottiswoode. 1894.

*The Working and Management of an English Railway.* By the late Sir George Findlay, general manager of the London and North-Western Railway. Fifth edition, revised and enlarged, with portrait and biographical sketch. Edited by S. M. Philp. With numerous illustrations. London: Whittaker and Company. 1894.

## THE NAVIGABLE BALLOON AT THE ANTWERP EXHIBITION.

The time when exhibition authorities relied solely, or even principally, on exhibits to attract the public has long passed. They now depend on music, flowers, fountains, and fireworks, but above all, on "side shows." A successful attraction like the Eiffel Tower, or the Ferris Wheel, is not only a fortune to its promoters, but is effective as an advertisement, and will bring thousands to an exhibition who take no special interest in anything shown in the galleries.

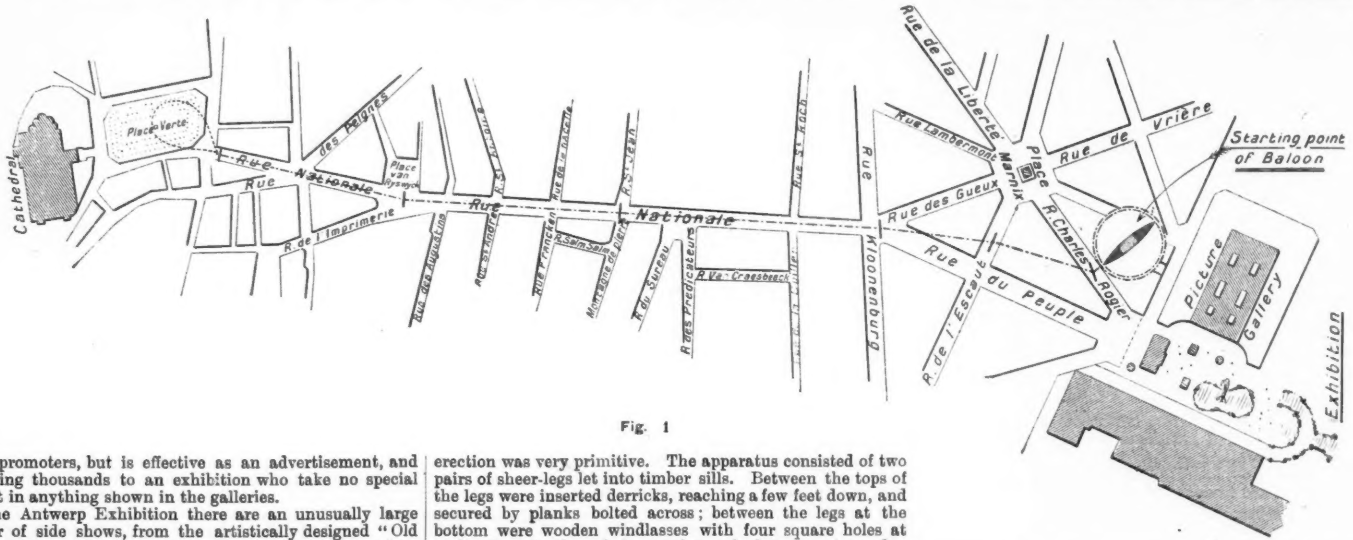


Fig. 1

At the Antwerp Exhibition there are an unusually large number of side shows, from the artistically designed "Old Antwerp" down to the usual allurements of a country fair. But the great attraction, or what the French call the *clou* of the whole Exhibition, was to have been the navigable balloon. In the design of this balloon, and the arrangement of its accessories, there is nothing which should render it impossible to ascend, and to be driven by electricity from the Exhibition grounds to the Place Verte, provided there is little or no side wind; but whether its inventor will be able to steer it against lateral pressure, and turn it at the end of its course, is a question that nothing short of actual experiment can decide. In any case, as from various unforeseen accidents the balloon is even yet not quite ready, its completion will not be of much use in drawing the general public to the Exhibition, though as a scientific experiment it will be not less interesting than if it had been in working order at the beginning of May.

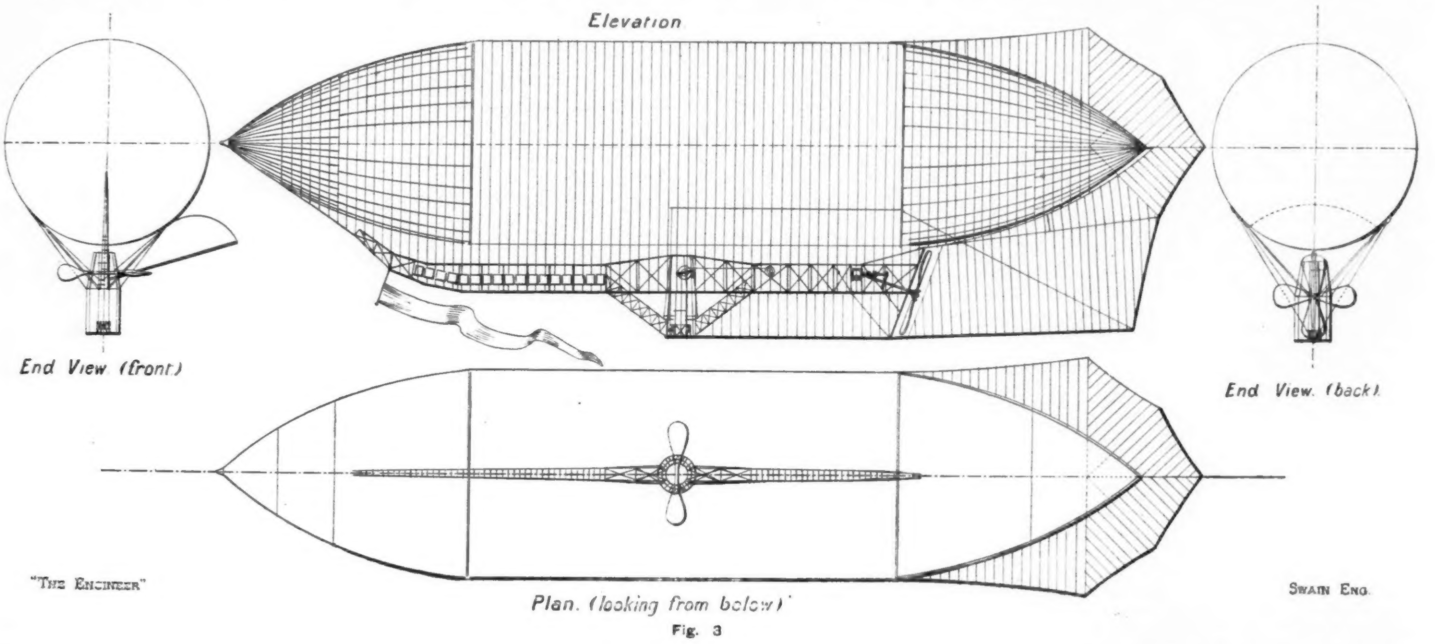


Fig. 3

The chief point of difference between this balloon and all those which have preceded it is in the method of applying the motive force. Instead of turning the propeller by hand, or by steam or other power generated in the car, it is to be worked by electricity, conveyed to the balloon through a flexible cable from dynamos at a central station. Practically, the principle is the same as with electric tramways, except that the balloon will resemble a tramcar without brakes. But it will be subjected to another difficulty from which tramcars are exempt: it will not always be easy to maintain electric connection, whilst it will be extremely difficult to re-establish it if accidentally interrupted whilst the balloon is in the air.

The electricity is generated by a pair of 200-horse power gas engines, made by Messrs. Fielding and Platt, driving dynamos which, with switches and other electric fittings, have been supplied by the Oerlikon Works. To obtain gas for these engines, as well as for inflating the balloon, a complete plant has been erected by the Dowson Economic Gas and Power Company, of Westminster.

It was at first intended that the balloon should travel from the Exhibition to the Bourse, on the roof of which there was to be a station; it was also proposed in some instances to carry the cables on the tops of existing telegraph poles. But the postal authorities not only refused to sanction the use of the poles, but objected to the cables crossing any lines of wire; so a shorter and straighter route had to be selected. It was then decided—see dotted line on Fig. 1—to go straight down the Rue Nationale, which enters the Place Verte on the opposite side to the Cathedral, to turn the balloon above the Place Verte, and to return by the same route to the starting point. Six steel lattice trestles, 100ft. high, were erected last May to carry the cables. They span the road from pavement to pavement, having an average width of 80ft. Fig. 2 shows the trestle at the end of the Rue Nationale furthest from the Exhibition; the others are less ornate. They are all made of 3½in. by 3½in. by ⅜in. angles, with 2in. by ⅜in. flat plates; the legs being 20in. square at the bottom, and 12in. square at the top. They were each put up in one piece, and the method of erection was very primitive. The apparatus consisted of two pairs of sheer-legs let into timber sills. Between the tops of the legs were inserted derricks, reaching a few feet down, and secured by planks bolted across; between the legs at the bottom were wooden windlasses with four square holes at each side. In these holes workmen had to insert wooden capstan bars, climb up, and by means of their own weight hanging on the bars, turn the windlasses. The arrangement of the top of the trestles will be seen more clearly from the drawing of the trolley—Figs. 4 and 5. The current is conveyed from the generating station by three parallel cables of galvanised steel wire an inch in diameter. These, which are each 1400 yards long, are in one piece, and were made by Messrs. Bullivant and Co., of Mark-lane.

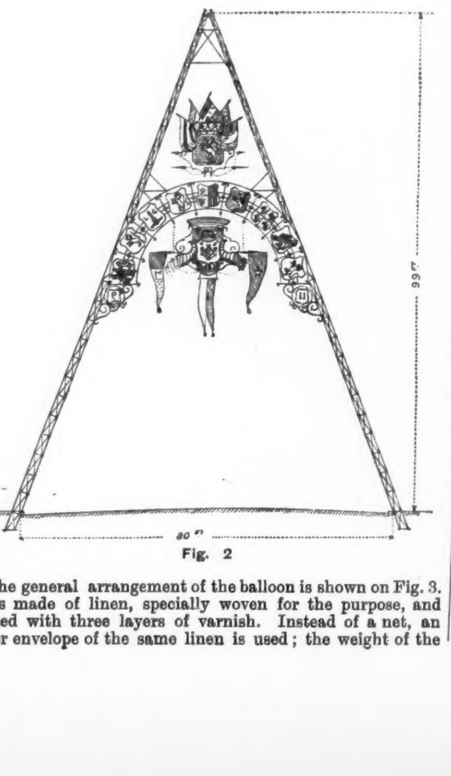


Fig. 2

The general arrangement of the balloon is shown on Fig. 3. It is made of linen, specially woven for the purpose, and coated with three layers of varnish. Instead of a net, an outer envelope of the same linen is used; the weight of the double covering being about four tons. It is spindle-shaped, 57ft. in diameter, and from the foremost point to the end of the rudder measures 284ft. Its cubic capacity is 500,000ft. A valve at the top for letting out the gas has a papier-maché frame. It is 4ft. diameter, and weighs only 70 lb. The car is made of steel gas piping, covered with wickerwork, and as may be seen by the illustration, it is of very peculiar shape. The centre is cylindrical, 8ft. in diameter, and reaches down much lower than the front and back portions. Of these the front is intended for passengers; it is entirely closed, but with windows. The back is for the crew, and contains the dynamo for transmitting the power to the screw; it is shown on Fig. 6, and is also from the Oerlikon Works. Its casing is of papier-maché, and though it is capable of transmitting 125-horse power, its weight is a little under a ton. The screw has four blades, its diameter is 26ft., and M. Léon Champy, the inventor, has calculated that in calm air the balloon will be able to travel twenty-five miles an hour, and that consequently he will have sufficient force at his command to be able to drive the balloon against a strong wind. The connection between the three cables and the dynamo in the car is made by an elastic cable, which passing over a drum with an automatic coiling arrangement in the car, terminates in the trolley shown on Fig. 4. The captain's station is in the cylindrical central portion of the car, and from it he will be able to increase or diminish the speed of the balloon, as well as to raise, lower, and steer it.

Antwerp is not the most suitable locality that could be found for aëronautical experiments, as the sudden gusts of wind from across the Scheldt will make steering more difficult than it would be in a steady breeze. It is also to be regretted that a course could not be chosen in which it was not necessary to make such a sudden turn of the balloon, as will be required at the Place Verte, and that the experiment was not first tried with a smaller balloon, so that the resistance to side winds might be less. Still, we hope to be able to report in a few weeks that M. Champy has had a satisfactory trial run, for it is certain that if aërial locomotion succeeds at Antwerp, it will soon be tried elsewhere over a longer course.

---

Transportation Exhibits at the Chicago Exhibition.—We have received a copy of the contents and preface of "A Record of the Transportation Exhibits at the World's Columbian Exposition of 1893," by James Dredge. The preface promises a great deal that will be of undoubted interest to all those who are interested in or connected with transportation by railways, and readers generally will agree with the author in his estimate of the extent to which the world of to-day is dependent for almost everything upon facility of communication by railway and by steamship. The book which is to contain this record will be published at the offices of *Engineering*, and by Messrs. John Wylie and Sons, New York. The index shows that the record is intended to cover even more ground than its title indicates.

# NAVIGABLE BALLOON, ANTWERP EXHIBITION—TROLLEY AND MOTOR

(*For description see page* 198)

Fig. 4

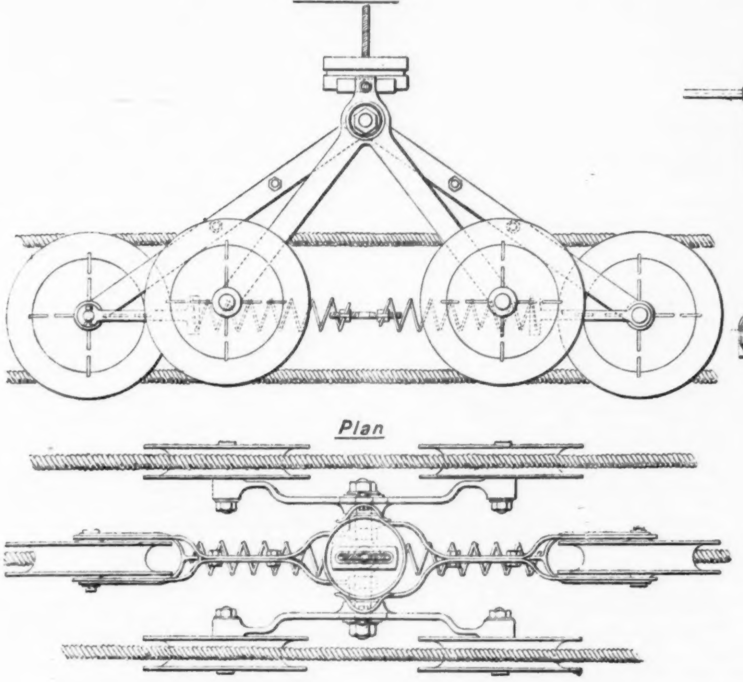


Fig. 6

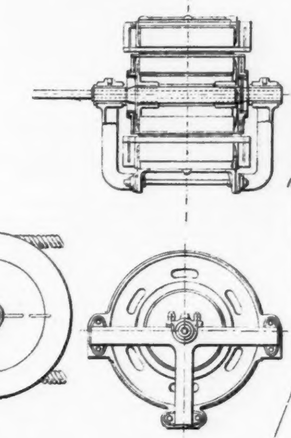
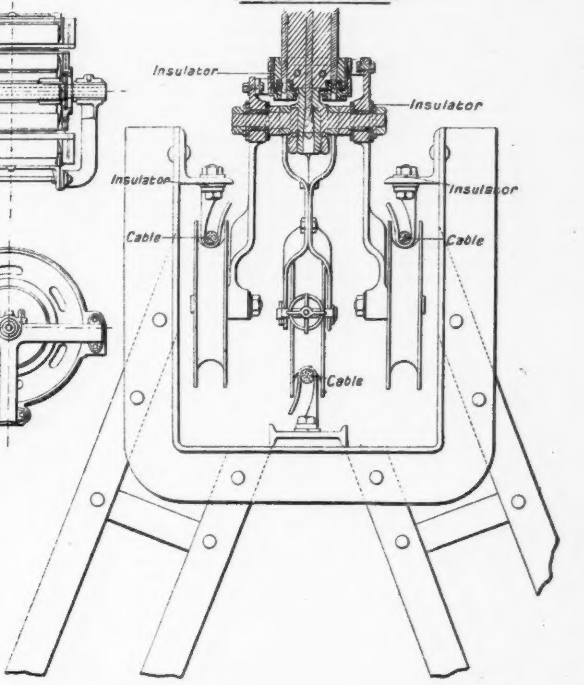


Fig. 5



"THE ENGINEER" SWAIN ENG.

## METHODS OF DETERMINING THE DRYNESS OF STEAM.[1]

By W. C. UNWIN, F.R.S., M. Inst. C.E.

(*Continued from page* 178)

IV. *Continuous condensing method.*—The difficulties of the ordinary condensing method have led Mr. Barrus, Mr. Hoadley, and other observers to adopt a process of continuous steady condensation. The steam may be condensed ($\alpha$) in the condensing water, or ($\beta$) in a surface condenser. The first method[10] may be carried out by the apparatus shown in Fig. 3. The steam passes from the steam pipe S to a small injector $i$. The condensing water is drawn from the tank A, and the mixed water and condensed steam are discharged into the tank B. If $W_1$ is the decrease of weight of A in any interval, and $W_2$ the increase of weight of B, then $w = W_2 - W_1$ is the weight of steam condensed. Thermometers $t$, $t$, give the temperatures of the water entering, and mixed steam and water leaving the injector. Let $t_1$, $t_2$ be these temperatures, and $t$ the temperature of the steam. Then, if $x$ is the dryness fraction,

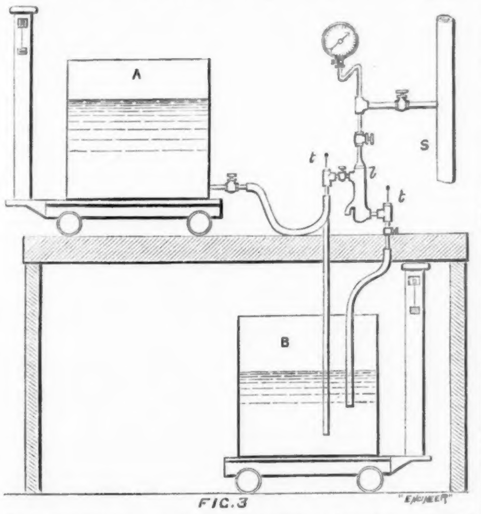


FIG. 3

$$w\left\{(t-t_2)+x\,L\right\}=W_1\,(t_2-t_1)$$

$$x=\frac{\frac{W_1}{w}\,(t_2-t_1)+t_2-t}{L}$$

$$=\frac{\frac{W_1}{w}\,(t_2-t^1)+t_2-t}{1116-0\cdot71\,t}$$

Mr. Barrus has used a surface condenser—Fig. 4—consisting merely of a short vertical pipe in a vessel through which cooling water circulates. The condenser is supplied with cooling water at a fixed rate of flow. Then, as the condensing surface is constant, the rate of condensation is constant, and the rise of temperature of the cooling water is constant. Condensation is carried on for any convenient period, and the condensed steam run off for weighing. Simultaneously a series of readings are taken of the temperature of the water entering and leaving the condenser, and of the condensed steam. The radiation correction can be determined by observing the fall of temperature in the condenser when the supply of steam and cooling water is stopped.[11] The continuous condensing method seems likely to be more accurate than the ordinary method, but the arrangements are more complicated.

V. *Method by superheating.*—Mr. G. H. Barrus about 1890 devised a calorimeter in which the steam to be tested passed through a chamber jacketed with superheated steam. The steam was thus dried and superheated. The quantity of heat required was inferred from the fall of temperature of the superheated steam. The orifices of the inner steam pipe and outer jacket ware equal, so that the same weight of steam passed through each. Hence no weighing was necessary. If $t_1\,t_2$ are the temperatures of the superheated steam entering and leaving the jacket, and $t_3\,t_4$ the temperatures of the steam entering and leaving the inner chamber, then the superheated steam in the jacket has lost $t_1-t_2$ degrees of temperature, and the sample steam has been dried and superheated $t_4-t_3$ degrees. If $x$ is the dryness fraction and L the latent heat of the steam in the inner chamber,

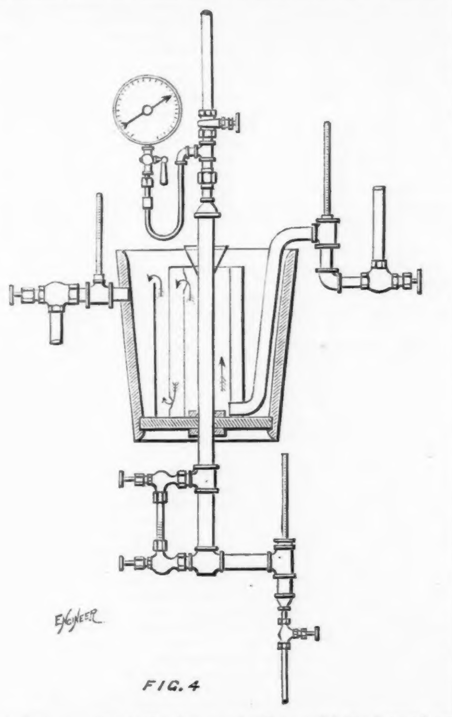


FIG. 4

$$0\cdot48\,(t_1-t_2-l)=L\,(1-x)+0\cdot48\,(t_4-t_3)$$

$$1-x=0\cdot48\,(t_1-t_2-l--t_4+t_3)\div L$$

$l$ is a small correction for radiation. Only four thermometer readings are necessary for a determination. The calorimeter is only suitable for nearly dry steam, and appears to be superseded by the simpler throttling and separating calorimeters. A description will be found in "Boiler Tests," Barrus, Boston, 1891, page 18, and in "Experimenal Engineering," Carpenter, page 386.

VI. *The wire-drawing method.*—This was first proposed by Professor Peabody. Mr. Barrus and others have devised modified forms of the apparatus. It depends on the principle that slightly moist steam is superheated by wire-drawing. Fig. 5 shows Mr. Barrus's arrangement[12] of the apparatus. The steam passes from a chamber A to a chamber B through a very small aperture—$\frac{1}{18}$in. in diameter. The full steam pressure is in A, and the pressure in B differs little from atmospheric pressure. Thermometers $t$, $t$, give the temperatures of the chambers. Let $t_1\,t_2$ be the temperatures of the steam before and after wire-drawing, and $t_3$ the temperature of saturated steam corresponding to the pressure in B. $_2-t_3$ is the amount of superheating of the steam in B. Let $h_1$, $L_1t$ be the liquid heat and latent heat of steam at $t_1$; $h_3$, $L_3$, corresponding quantities for steam at $t_3$.

$$h_1+x\,L_1=h_3+L_3+0\cdot48\,(t_2-t_3)$$

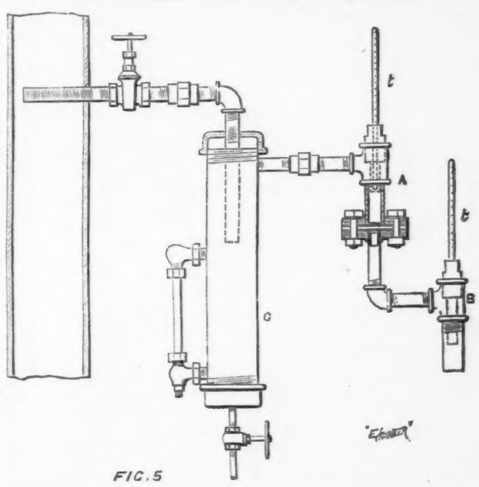
$$x=\frac{h_3-h_1+L_3+0\cdot48\,(t_2-t_3)}{L_1}$$

Or taking the specific heat of water constant:—

$$x=\frac{t_3-t_1+L_3+0\cdot48\,(t_2-t_3)}{L_1}$$

$$=\frac{1116-t_1-0\cdot19t_3+0\cdot48t_2}{1116-0\cdot71t_1}$$

No weighing is required, and temperatures only have to be observed. The apparatus must be in operation for twenty to thirty minutes before observations are commenced. Then observations may be begun and continued for as long a period as is desired. It is not a mere small sample of steam, therefore, which is observed, but a considerable quantity taken from the steam pipe at a uniform rate. The observations are as simple as possible, and the apparatus is used with the greatest facility. Presently some tests will be given tending to show that the instrument is very trustworthy. Suppose the steam is initially quite dry. Then $x = 1$ in the formula above.



FIC. 5

$$h_1+L_1=x_3+L_3+0\cdot48\,(t_2-t_3)$$

$$t_2=0\cdot604t_1+0\cdot395t_3$$

From the small excess of pressure over atmospheric pressure $t_3$ is about 214 deg. Then

$$t_2=0\cdot604t_1+84\cdot5.$$

This may be termed the normal temperature in the chamber B for dry steam. In proportion as the temperature falls below this the steam is initially moist. If it contains initially more than a certain amount of moisture, the temperature in the chamber falls to 214 deg. or below it, and no calculation of the dryness is possible. If $t_2 = 220$ deg. and $t_3 = 214$ deg. are taken as the limiting values for which the instrument can safely be used, there being then 6 deg. of superheating in B, then

$$x_{\min}=\frac{1181-t_1}{1116-0\;71t_1}$$

and

$$(1-x)_{\max}=\frac{0\;29t_1-65}{1116-0\;71t_1}$$

give the minimum initial dryness or maximum amount of initial moisture in steam for which the apparatus is suitable.

| $t_1 =$ | Greatest initial moisture per cent. |
|---|---|
| 250 deg. | 0 80 |
| 300 deg. | 2 44 |
| 350 deg. | 4 21 |
| 400 deg. | 6 13 |

VII. *Combined separating and wire-drawing method.*—To extend the usefulness of the wire-drawing method Mr. Barrus added a separator—C, Fig. 5. The steam first passes through the separator, leaving most of its moisture, and the remainder is measured by a wire-drawing calorimeter. When thus arranged the use of the instrument is much more complicated, as the amount of steam flowing through and the amount of moisture separated must be weighed. A condenser must therefore be used, at any rate occasionally, to determine the amount of steam flowing in a given time. Assuming the orifice to remain unchanged, a formula can be found for the weight of steam discharged per minute at any given pressure.

---

[1] Report of the Committee, consisting of Sir F. J. Bramwell, Bart. (chairman), Professor T. H. Beare, Mr. Jeremiah Head. Professor A. B. W. Kennedy, Professor Osborne Reynolds, Mr. Mair Rumley, Mr. C. I. Wilson, and Professor W. C. Unwin (secretary).

[10] Carpenter, "Experimental Engineering," page 375.

[11] See Peabody, "Thermodynamics of the Steam Engine," page 232; Carpenter, "Experimental Engineering," page 380.

[12] See "A Universal Steam Calorimeter," by G. H. Barrus, Amer. Soc. Mech. Engineers, 1890.

VIII. *Superheating by addition of heat.*—A method has been proposed by Mr. W. R. Cummins,[13] in which a vessel of constant volume is used, completely surrounded by a steam jacket. Steam is at first blown through both jacket and vessel till there is a fair sample of the steam to be tested in both. Next the jacket and vessel are cut off from the steam pipe and from each other. The steam in the jacket is then heated by compression—by a steam compressing pump—or by heating. The simultaneous rise of pressure and temperature in the vessel containing the sample of steam are observed. While moisture is evaporating the relation of pressure and temperature will follow Regnault's law. From the moment when superheating begins the pressure will increase much less rapidly with the temperature. Let $t_1$ be the temperature of the sample of steam initially, $t_2$ the temperature at which superheating is observed to begin, $v_1$ $v_2$ the corresponding specific volumes of dry saturated steam, $x$ the initial dryness of the steam, V the volume of the vessel, and $w$ the weight in pounds of steam admitted. Then

$$V = x\,v_1\,w = v_2\,w$$

$$x = \frac{v_2}{v_1}$$

where the specific volumes $v_2$ $v_1$ can be calculated from the observed temperatures $t_2$ $t_1$. The method is quite accurate in principle, but it would involve considerable skill to carry out accurately, and it does not appear to have been actually tried.

IX. *Chemical methods.*—These suppose that some soluble salt is added to the boiler water so as to form a solution of known strength, and that of all the feed supplied to the boiler part is evaporated and flows away as steam, part as priming water. The former removes no salt; the latter is of the saltness of the water then in the boiler. Hence, either the decrease of saltness of the boiler water or the amount of salt present in the steam can be used in determining the amount of priming water in the steam. Most commonly table salt (NaCl) has been used because the amount in solution can be easily determined by the nitrate of silver method. In other cases sulphate of soda has been used, the sulphuric acid being determined by precipitating with chloride of barium. It is convenient to describe three variations in the way in which the chemical method is applied.

(*a*) *Decrease of saltness of the boiler water measured.*—Salt is introduced with the feed till the boiler water contains 1 or 1½ per cent. of salt. Then, during a test in which the amount of feed is measured, a sample of the boiler water is drawn off at the beginning and end of the test. Care must be taken that the level of the water in the boiler—as shown by the gauge glass—is exactly the same, when the two samples are taken. Let W be the weight of water in the boiler, and $s_1$ $s_2$ the percentage of salt in the two samples. The amount of salt removed from the boiler during the test is $W\,(s_1 - s_2)\,/\,100$. Let $w$ be the amount of feed supplied, and $x$ the dryness fraction of the steam. Then $x\,w$ lb. of pure steam are generated, and $(1-x)\,w$ lb. of priming water carried over. The mean saltness of the priming water is $(s_1 + s_2)\,/2$. Hence

$$\frac{(1-x)\,w}{100}\,\frac{s_1+s_2}{2} = \frac{W}{100}(s_1 - s_2)$$

$$x = 1 - \frac{2\,W}{w}\,\frac{s_1 - s_2}{s_1 + s_2}.$$

The method deals with the whole amount of steam produced, and not with mere samples of it. On the other hand, the disadvantages of the method are:—(1) It measures only priming water mechanically projected into and carried by the steam, and not moistness produced in other ways. (2) Great exactness of analysis is necessary, the difference of saltness being a small quantity. (3) The feed, being continuously supplied at one part of the boiler, tends to produce, in spite of the circulation, a non-uniform distribution of saltness throughout the mass of water in the boiler. If the saltness is not uniform, the difference of saltness of the samples gives a quite erroneous result. If there is salt in the feed-water, it can be allowed for. This method was first used at Mulhouse in 1859; much later it was revived, and is often called Brauer's method.

β. *Percentage of salt in the steam determined.*—At intervals during a test, samples of the boiler water are taken, and at the same time some steam is condensed in a small surface condenser. Equal quantities of the water samples are mixed together, and also equal quantities of the condensed steam. Let $s_1$ be the percentage of salt in the averaged sample of boiler water, and $s_2$ that in the averaged sample of condensed steam. If $x$ is the dryness fraction of the steam, each pound contains $x$ lb. of steam and $1-x$ lb. of water of the saltness of the boiler water.

$$(1-x)\,s_1 = s_2$$

$$x = 1 - \frac{s_1}{s_2}$$

The disadvantages of this method are:—(1) That very small portions of the steam are tested, and as the mechanical action producing priming is probably irregular, it is very uncertain whether they fairly represent the average condition of the steam. (2) The accurate determination of $s_1$ can only be made if the boiler water is uniformly salt. (3) The amount of salt in the steam is very small compared with that in the boiler water, so that the accurate determination of $s_2$ is difficult.

γ. *Escher's method.*—A quite different method of considerable interest has been proposed by Mr. R. Escher, of Zurich.[14] Mr. Escher considered the case of a boiler fed with impure water. Of the salts in solution some are thrown down as incrustation, others remain in solution. In the boiler water during working there is a steady concentration of these soluble salts, which tends towards a fixed limit. At this limit the priming removes as much salt in the form of concentrated boiler water as the feed brings in. Let $s$ be the saltness of the feed-water in pounds per pound of water, and $k$, the saltness at any given time of the boiler water. Then each pound of steam removes $(1-x)\,k$ lb. of salt, while each pound of feed introduces $s$ lb. of salt. In steady working when the limit is reached

$$(1-x)\,k = s$$

$$x = 1 - \frac{s}{k}.$$

Let $k/s = c$, the ratio of concentration of the boiler water. Then, for example, if the boiler water contains twenty times as much salt as the feed, $x = 1 - \frac{1}{20} = 0{\cdot}95$ or the steam contains 5 per cent. of priming water. The method assumes that the feed contains a definite percentage of easily soluble salt, and that the trial has continued till the maximum concentration is reached. But if the boiler is freshly filled it may be a long time before the limiting condition is reached. Let W be the quantity of water in the boiler in pounds, and F the quantity of feed per unit of time. Let $k$ be now the saltness of the boiler water at $t$ from the beginning of the test. In a short interval $d\,t$ the quantity of salt $F\,s\,d\,t$ enters the boiler with the feed, and the quantity $F\,(1-x)\,k\,d\,t$ is carried away in the priming water. The increase of salt in the boiler is therefore

$$W\,d\,k = F\,[s\,d\,t - (1-x)\,k\,d\,t).$$

Let $W/F = a$. Then

$$a\,d\,k + (1-x)\,k\,d\,t - s\,d\,t = 0.$$

Integration gives $$k = \frac{s}{1-x} + \frac{C}{e^{\frac{1+x}{a}t}}$$

The constant of integration is obtained by putting $k = s$ when $t = 0$.

Let also $\frac{1+x}{a}\,t = n$. Then

$$s = \frac{s}{1-x} + C$$

$$k = \frac{s}{1-x}\left(1 - \frac{x}{e^n}\right)$$

$$c = \frac{k}{s} = \frac{1}{1-x}\left(1 - \frac{x}{e^n}\right)$$

From this equation, $c$ being ascertained by analysis of the boiler, water, $x$ can be determined at any period of the test. As the equation is not easily solved $x$ may be approximated to thus. If $c$ is the concentration after $t$ hours working, a first approximation to $x$ is $$x_1 = 1 - c.$$
Put this in the expression above for $c$; a value $c_1$ will be obtained which would be the concentration in the time $t$ if $c$ were the limiting concentration. Then assume

$$\frac{c}{c_1} = \frac{c_{max}}{c}$$

$$c_{max} = \frac{c^2}{c_1}.$$

This an approximate value of the maximum concentration in unlimited time. A second approximation to $x$ is

$$x_2 = 1 - \frac{c_1}{c^2}.$$

Mr. Escher has not directly suggested how his method could be used in the case of a boiler fed with pure feed-water, or, say, with water containing too small an amount of chloride to give a sufficiently rapid concentration. But it might easily be applied by pumping in with the feed at intervals of an hour a known quantity $w$ of a saturated salt solution. The quantity $w$ might be so arranged that the concentration at the end of the test was such that the boiler water contained about 1 per cent. of salt. A preliminary assumption as to the amount of priming would have to be made in settling what quantity of salt to introduce. The salt method by measuring the decrease of saltness of the boiler water was first used at Mulhouse in 1859. In the trials then it failed to give satisfactory results. In some of the tests an apparent increase of saltness of the boiler water was found which must have been due to the saltness being ununiformly distributed in the boiler. At Düsseldorf in 1880 the method of measuring the salt in the steam was tried, sulphate of soda being used.[15] Ten samples of boiler water and condensed steam were taken in each test. The results were discrepant, giving 0·21 to 9 per cent. of moisture in the steam in different tests.

*Use of the salt method in the Berlin trials of portable engines in* 1883.—The most careful tests by the salt method which have been found are some made by Dr. Bunte in Munich, in some trials of portable engines under the direction of a commission appointed by the German Government.[16] In these tests both the decrease of saltness of the boiler water and the amount of salt in samples of condensed steam were determined. They throw some light, therefore, on the relative trustworthiness of the two proceedings. Concentrated salt solution was introduced into the boilers before beginning a test till the boiler water contained 1 to 1½ per cent. of salt. At the beginning of each trial, and with the water at normal level in the gauge glass, a sample of boiler water was taken; at some intermediate times and at the end of the trial similar samples were taken. The boiler water was taken from the gauge cock. To prevent evaporation in taking the sample it was drawn off through an india-rubber tube into a vessel containing 500 c.c. of cold distilled water. Exactly 500 c.c. of boiler water were drawn off, so that the sample had half the saltness of the boiler water. The chlorine was determined by a nitrate of silver solution containing 10 per cent. of normal solution, with the addition of chromate solution as an indicator. For the steam samples the steam was taken from a cylinder or valve chest cock. From 200 to 1000 grammes were condensed at intervals of about an hour. In Trial I., on the Dolberg portable, the boiler water samples showed the same saltness at the beginning and end of the test. Intermediate samples showed very slight variations, attributed by Dr. Bunte to variations of water level in the boiler. In five samples of condensed steam an addition of 0·2 to 0·3 c.c. of silver solution gave a colour reaction. Dr. Bunte calculates that the priming must have been less than 0·1 per cent. Both methods, therefore, showed that there was practically no priming. Identically similar results were obtained in trials of four other boilers. But in one trial there was considerable priming. In Trial IV., on Siegel's portable, the sample of boiler water taken at the beginning showed 199 c.c. of 10 per cent. of normal salt solution, and that at the end 191 c.c. per 100 c.c. This corresponds to a loss of 4 per cent. of the salt in the boiler, or to 1·7 per cent. of priming. In the steam tests different samples yielded 24·3, 20·3, 6·8, 4·0, 0·3, 0·2, 0·3, 25·5, and 7·3 c.c. of 10 per cent. of normal salt solution per 100 c.c. of condensed steam. After thoroughly cleansing the apparatus by blowing through, 2000 grams of steam were condensed, and gave 9 c.c. per 100 c.c. The amount of salt in the steam was therefore extraordinarily variable. The highest result, 25·5 c.c., per 100 c.c., corresponds to 12·8 per cent. of priming. Dr. Bunte thinks that foaming occurred. It will be seen that in most cases the salt test fails to indicate any appreciable priming. It must be inferred that the mechanical mixture of boiler water with the steam is ordinarily an action of insignificant importance. In one trial where there was great priming, shown by the working of the engine as well as by the salt test, the results are extremely discrepant, and apparently Dr. Bunte thinks that the real amount of priming was greater than the salt tests indicate. The salt test was used in some tests of boilers at the Frankfort Exhibition, in 1891, by a committee presided over by Dr. Schröter[17]. The tests lasted eight days for each boiler. Salt was fed into the boiler till the boiler water contained about 1½ per cent. After the boiler had been working a day two samples were taken, one of the boiler water from near the evaporating surface, one from the nearest water separator in the steam pipe. The samples were drawn off through a cooling pipe to prevent evaporation. The amount of salt in the samples was determined by the nitrate of silver test, and also that in the feed supplied to the boilers. The following table gives the results:—

*Determination of Priming by Salt Test in Trials at the Frankfort Exhibition*, 1891.

| Name of Boiler. | Feed-water used. | Salt in boiler water, per cent. | Salt in water from steam pipe, per cent. | Salt in feed-water, per cent. | Moisture in the steam, per cent. |
|---|---|---|---|---|---|
| 1. Essen Cornish .. | Ordinary Water Co. | 1·524 | 0·00116 | 0·00146 | 0·076 |
| 2. Dortmund Water-tube .. .. .. | Purified | 1·229 | 0·00138 | 0·00195 | 0·112 |
| 3. Ratingen ,, | Ordinary | 1·146 | 0·00155 | 0·00148 | 0·135 |
| 4. Kaiserslauten ,, | Purified | 1·442 | 0·00122 | 0·00193 | 0·085 |
| 6. Nürnberg ,, | Ordinary | 1·610 | 0·00246 | 0·00164 | 0·151 |

These results are given chiefly to confirm the general result shown in nearly all experiments, namely, that the amount of priming estimated from a salt test is an insignificant percentage.

*Comparison of the salt methods with other methods.*—It is clear that the general result obtained when the salt test has been used is that in ordinary cases there is very little moisture in the steam. Some trials made lately by Professors Kennedy and Unwin gave the same result. On the other hand, some trials simultaneously with the salt method and one of the other methods, such as the wire-drawing or separating method, have given this result: that the moisture in the steam indicated by the salt method was only about one-tenth as great as that shown by the other methods, and that not in steam taken from a steam pipe at a distance from the boiler, but in steam taken directly out of the boiler itself. It is clear that the salt test can only indicate boiler water mechanically mixed with the steam by ebullition, not moisture produced in other ways. It might be expected, therefore, that the salt method would give a larger dryness fraction than other methods. Whether the great difference is entirely attributable to this cause, or in part to inherent difficulties in the salt method, cannot at present be ascertained. It would rather seem that the Escher method, which apparently has never been tried, would give the best results, if used in a case where the trial extended over a week or more. A subordinate question is this. Some engineers have thought that the salt method was specially suitable for boiler trials because it gave directly what may be called the mechanical priming, although other methods were more suitable for engine trials where what is wanted is a knowledge of the absolute quality of the steam. This view seems to be founded on a misapprehension. In determining the efficiency of a boiler it is necessary to know how much of the feed leaves the boiler as steam and how much as water. If, in steam taken directly from the boiler, there is more moisture than corresponds to mechanical priming, that is as much a deduction from the evaporation of the boiler as if it were mechanical priming. The product of the boiler is so much wet steam, and the value of this steam depends on its dryness. The total heat utilised depends on the dryness. It is not at all important how the moisture came into the steam provided it is there. The only point to attend to in a boiler trial is that the steam tested should be taken directly from the boiler, and not from a steam pipe in which condensation due to radiation may have been going on. It is equally desirable that in an engine test the steam should be taken from the steam pipe very near to the engine.

(*To be continued.*)

---

# THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(***From our own Correspondent.***)

IRON and steel masters from this district who have returned from the Brussels meeting of the Iron and Steel Institute are greatly impressed with the progress which Belgium has made in iron and steel manufacture since the previous visit of the Institute twenty years ago. It is stated that the Belgians have gone ahead in a most remarkable fashion. They have adopted the basic process of steel making to a very considerable extent, with hydraulic power and so forth. In the opinion of some of our local ironmasters, the Belgian works are equally equipped in every respect to the North of England and other leading steel works in this country. The essential difference between English and Belgian works is in the matter of labour. A Belgian is engaged twelve hours a day, but his pay is much less than that given to the Englishman. At a good bar mill producing twenty tons per turn, the roller, it is stated, does not receive more than 5s. a day. In England the pay would be £1 a day. Belgian fitters toil twelve hours a day for 3s. 4d.

Disappointment is expressed by local ironmasters that under the new American Tariff Act hoops used for cotton baling purposes, and known in the English trade as cotton ties, although substantially reduced in duty as compared with that imposed under the old tariff, are still scheduled at a rate which is almost prohibitory—something like £5 a ton. The manufacture of these hoops for the United States, although a "season" trade, was for many years amongst one of the most profitable and important lines of the South Staffordshire industry. Further, it is asserted that the American iron and steel masters themselves are now selling these hoops delivered at the principal depôts in the cotton growing States cheaper than any such material can be bought in this country.

A careful review of the changes brought about by the new tariff shows that with few exceptions the tariff remains thoroughly protective. The average duties are still as high as those of European countries, which remain distinctively on the Protectionist platform. The duties, it is true, have been lowered in many instances, but are still sufficiently high to keep out most foreign competitors. At the same time, the changes that have been made are well in the right direction, and it is satisfactory to remember that McKinleyism cannot be restored for another three years, even should the Republicans control the next two Congresses.

It is gratifying to be able to report a continuance of the iron trade revival on the Birmingham and Wolverhampton Exchanges, to which I referred two weeks ago. Pig iron has now risen fully 1s. 6d. to 2s. per ton; and some makers are even asking an advance of 2s. to 2s. 6d. on Derbyshire, Lincoln, and similar makes. Steel and merchant iron has advanced 2s. 6d. per ton, and sheet iron 5s. The improvement is distinctly the result of the increased confidence engendered by the settlement of the American tariff question, and its continuance is expected.

An important meeting of the Coal Trade Wages Board was held on Wednesday to receive the accountants' return of the average selling prices of coal and slack during the months of May, June, and July last. The examination of the employers' books was ordered subsequent to the recent reduction of wages in the Federation districts. The accountants return the net price at 5s. 10·81d., and under the sliding scale the employers claimed that thick coal miners' wages should be reduced from 4s. 8d. to 4s. 2d. "per day or stint," and thin coal miners' wages from 3s. 8d. to 3s. 3½d. per day. The men's delegates expressed great surprise at the large diminution in prices shown, and complained of the employers underselling. They appealed to the owners not to enforce the full reduction, and after consultation the masters announced that without forming any precedent they would agree that thick coal wages should now stand at 4s. 4d., and thin coal wages at 3s. 5d.

The Oldbury Railway Carriage and Wagon Company has just received an order from the Nippon Railway Company, of Japan, for one hundred railway carriages. The order consists of eight first-class, sixteen second-class, and seventy-six third-class carriages. The gauge of the railway is 3ft. 6in., and the carriages are built on the English principle, with cross compartments, side-doors, and lantern roofs. They are 23ft. 3in. long, and 7ft. 3in. wide, the body, framing, and panelling being of teak highly varnished. The wheels are fixed, and each carriage is fitted with the vacuum automatic brake. The under frames are of pressed steel. The third-class carriages have five compartments, and are open above the seat backs from end to end. Each first-class carriage has two saloon compartments, with lavatory compartments between. Woven cane seats run along both sides and one end, and are provided with cushions and backs of buffalo hide. The interior panelling is of French polished sycamore, with bandings and mouldings of teak. The second-class carriages are similar to the first-class, excepting that the seats are upholstered with Vulcan leather cloth, and the interior is grained and varnished.

I regret to have to announce the death of Mr. John Roberts senior partner in the firm of Messrs. J. and S. Roberts, ironfounders and engineers, of West Bromwich, one of the oldest-established and best-known firms in this district. Mr. Roberts, who was seventy-seven years of age, died at his residence after an illness of eight weeks.

---

[13] "Transactions" North-East Coast Inst. of Engineers and Shipbuilders, 1893.

[14] *Civilingenieur*, 1879, page 51.

[15] "Untersuchungen von Dampfmaschinen u.s.w. der Gewerbe-Ausstellung in Düsseldorf," 1880—Aachen, 1881—p. 13.

[16] Report by F. Schotte, *Civilingenieur*, 1884.

[17] THE ENGINEER, June 8th, 1894.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—The stronger tone which has recently been coming over the iron market is being well maintained. The hardening up in pig iron has been followed by a considerable weight of buying, and although merchants and consumers have followed the upward movement in pig iron very hesitatingly, makers have been able gradually to secure their advanced rates. The question just now asked is whether this spurt in buying will continue long enough to give a permanent lift to prices; it would not seem at present to be backed up by increased requirements for actual consumption, but to be due rather to consumers and merchants who have held back, being more anxious to contract, in the belief that prices have got to the lowest possible point, and that any further move must be upwards. It is of course quite possible that very shortly, when requirements have been satisfied, there will again be a lull in the market; but the fairly-large orders which makers have now got on their books, coupled with the generally extreme lowness of stocks, have so strengthened their position that there is little probability of prices getting back to the excessively low figures which were being taken a week or so back. The improvement—such as it is—has, however, not made itself appreciably felt beyond the pig iron trade. Finished ironmakers, although the increased cost of raw material has compelled them to take a firmer stand, with regard to manufactured iron are in no materially better position; and the steel trade, even with the continued stoppage of production in Scotland, remains in only a very unsatisfactory condition.

The Manchester Iron Exchange on Tuesday brought together about a fair average attendance, and a more hopeful tone prevailed generally throughout the market, with a further upward tendency in prices. Any real improvement is, however, still chiefly confined to pig iron, in which a considerable weight of business has been put through, and buyers have had to follow the advance reported last week. Lancashire makers, although they have not yet made any actual upward move upon their list rates, have been securing more business at their full prices, and are firm at 40s. for forge to 42s. for foundry, less 2½, at the works. Moderate sales of forge iron have been made on this basis where local makers have favourable rates of carriage in their competition with district brands, whilst in foundry qualities they have booked a moderate number of small orders in the Manchester district at prices equal to about 44s. 6d. delivered. The chief weight of buying has, however, been in what are still relatively low-priced district brands. Lincolnshire makers, who last week had booked a fair business at quite 6d. over their recent quotations, have since been able to secure a further advance of 6d., considerable transactions having been put through at about 39s. for forge, to 40s. for foundry, net cash, delivered Manchester, and as they are now in most cases fairly well sold, they are not quoting under 39s. 6d. to 40s. 6d. respectively for forge and foundry delivered here. Buyers have scarcely yet been got up to the maximum figures now being asked, but as makers are indifferent about selling, it would seem likely that any further orders which are placed will only be accepted at full rates. Derbyshire makers also continue to stiffen up in their prices, and most of them do not at all care about selling in any quantity, 45s. to 45s. 6d., net cash, being now about the minimum figures for foundry qualities delivered in the Manchester district. For good named foundry, Middlesbrough makers still quote 45s. net cash, delivered equal to Manchester, but this figure has not been got on any real weight of actual business. The very few holders of Scotch iron are scarcely quoting any actually definite prices, but it would be difficult to place orders for Eglinton under about 48s. and 48s. 6d. net prompt cash, delivered at the Lancashire ports.

In the finished iron trade there is still no really material improvement to report. An increased number of inquiries are, however, coming forward, and buyers show more disposition to place orders, but the actual business done is still only of comparatively small weight. Makers are, however, hardening in their prices, and although there is no really quotable advance, orders could not be placed on the same favourable terms as would have been accepted a week or two back, and there is a disinclination to sell at current rates, except for actual specifications, makers, in view of the upward movement in raw material, naturally showing no disposition to commit themselves to forward engagements. Delivered in the Manchester district, Lancashire and North Staffordshire bars are not quoted under £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths. In the steel trade rather more business in some directions is reported, but the position generally remains without any real improvement. For ordinary foundry hematites 53s., less 2½, remains about the average figure, with steel billets still readily obtainable at about £4 net cash, and steel boiler plates £6 7s. 6d. to £6 10s. per ton.

In the metal market there has been a further upward move in list rates for manufactured goods, representing an all-round advance of ¼d. to ½d. per lb., and inquiries have been coming forward more freely during the last week. Delivered in the Manchester district, quoted list rates for manufactured goods are now as under:—Solid-drawn brass boiler tubes, 5¾d.; solid-drawn brass surface condenser tubes, 6¾d.; solid-drawn copper tubes, 7¼d.; patent red metal tubes, suitable for locomotive and marine boilers and condensers, 7d.; brazed copper gas and steam tubes, 6¼d.; brazed brass gas tube, 6d.; brass wire, 5¼d.; copper wire, 6¼d.; rolled brass, 5¼d.; yellow metal bolts, 4¾d. per lb.; cold rolled copper sheets, 54s. per cwt.; and copper bolts, £55 per ton.

The condition throughout the engineering industries remains much as reported for some time past. There is still no indication of any really increased weight of new work coming forward, and although here and there in exceptional cases more activity is reported, establishments generally continue only moderately off for work, and very few of them more than kept going from hand to mouth.

The prospects of the Manchester Ship Canal, although the improvement is very slow, are steadily moving in the right direction, and Mr. J. K. Bythell, the newly-appointed paid chairman of the company, was able to make a fairly satisfactory statement at the eighteenth ordinary meeting of the shareholders, held on Tuesday, in Manchester. In round figures 2,200,000 tons of traffic had been moved on the canal during the six months, and, although some people might be disappointed, he thought, considering all the difficulties in the way, they had made a very good beginning. With regard to the engineering portion of the work, satisfactory progress has been made in bringing the canal into full working order. The most important portion of the work has, of course, been the dredging of the waterway to get a full depth of 26ft. This work, which has been actively carried on, will, according to the report, soon be completed, and I understand that already there is practically a depth of from 25ft. to 26ft. in the Canal from end to end. The great difficulty in the way has been the enormous amount of sewage brought down into the Canal by the rivers Irwell and Mersey, which, in addition to materially increasing the amount of dredging to be done, has given rise to very serious complaints as to the unsanitary condition of the Canal, especially between Barton Locks and the Manchester and Salford Docks. With regard to the equipment of the Canal, the dock sheds that were in progress early on in the season have all been completed, and active operations are going on in the erection of the additional large three-storey sheds, of which full details have already been given in THE ENGINEER.

A 30-ton crane is now in operation, and twenty additional hydraulic cranes, which are being constructed, will shortly be ready for work. Operations will also soon be commenced for the construction of the jetty, outside the Eastham Locks, Parliamentary sanction for which has been secured, and tenders obtained for carrying out the work.

The coal trade, so far as local and inland demand is concerned, continues extremely quiet, but with the close of the month no further alteration is being made in the quoted prices. The leading Manchester colliery concerns, who have been forced by outside competition into various reductions during the past month, have now got down to the minimum figures, and at the district and Council meetings of the Lancashire Coal Sales Association it has been decided that no change shall be made in the official quoted rates. The better qualities of round coal still hang upon the market and accumulate in stock, whilst requirements for steam coals and engine fuel are just now being materially affected by the holiday stoppages in various manufacturing centres, which in most cases are being extended beyond the usual period. There is still some low-cutting in the open market to clear off stocks, but generally quoted rates remain at 11s. to 11s. 6d. for best Wigan Arley, 10s. to 10s. 6d. for Pemberton 4ft. and seconds Arley, 8s. to 8s. 6d. for common house-fire coals, 7s. to 7s. 6d. for steam and forge coals, with engine classes of fuel ranging from 3s. 9d. to 4s. 3d. for common sorts, to 4s. 9d. and 5s. 3d. for good medium qualities, and 6s. for some of the best descriptions.

In the shipping trade a fair amount of activity continues to be reported, chiefly in cargoes for Scotland, although some check has been given to buying during the past week, owing to anticipations of an early settlement of the Scotch strike. Prices remain about as last quoted, steam coal averaging about 8s. 9d. to 9s., and engine fuel, 5s. 6d. to 5s. 9d. per ton, delivered at the Garston Docks or the High Level, Liverpool.

It would seem not unlikely that the meeting of the Coal Trade Conciliation Board, which is being held to-day—Friday—in London, to consider an application made by the miners' representatives for a clear definition of the terms embodied in the resolution with reference to the 10 per cent. reduction in wages, may give rise to considerable contention with regard to the recent wages settlement. Some of the official leaders of the Miners' Federation express themselves strongly that, whilst the coalowners have been very keen in carrying into full effect the first clause of the agreement, with reference to taking off the last two advances of 5 per cent.—and in some cases, it is alleged, have gone even beyond the stipulated reduction—there has been rather a disposition to ignore the second clause with regard to the minimum rate of wage, and a strong case is being prepared for submission to the Conciliation Board, where the men complain that the coalowners are endeavouring to enforce reductions in wages to a greater extent than they are entitled to. The question of the day-wagemen, which has given rise to considerable trouble, is also to be brought forward; and the Board will be asked to include in the minimum wage agreement not only the miners, but all the underground workmen employed at the federated collieries.

*Barrow.*—Although during the past week there has been a very steady tone in the hematite pig iron market, makers have not done a large amount of business. On every hand the inquiry for iron continues to be poor. Consumers are only placing orders for iron just sufficient to cover their immediate want, and are content at that, having no disposition to go further and place for delivery at some future date. At some of the places on the coast the orders are almost worked out, but these makers are in a position to give immediate delivery, and are consequently booking some small orders. Others are engaged on orders booked some time ago. Taking the whole district through, the trade is being carried on very much on the hand-to-mouth principle. Prices are about the same, and makers are asking 44s. 6d. to 45s. 6d. per ton for mixed numbers of Bessemer iron, net f.o.b. In the warrant market holders are quoting 44s. 6d. per ton, and some iron has changed hands at that figure. The stores of warrants have been steady during the week, and still stand at 158,323 tons. Thirty-three furnaces are blowing, out of a total of seventy-six built.

Steel makers have nothing new to report. Business is very slack so far as new transactions are concerned, and in some of the mills the contracts are almost worked out. Taking all round there is a very limited business offering to makers. Rails are little sought after, and prices are a trifle easy. Shipbuilding material has been inquired after, but the demand is not by any means as good as it was a short time ago, mainly on account of the fact that shipbuilders are not booking any fresh orders. Tin-plate bars are a poor business, as also are hoops, and there is scarcely any request for the following:—Blooms, billets, slabs, or wire rods. Prices are nominally as follows:—Heavy rails, £3 15s.; light, £5 5s.; colliery, £5 10s.; ship-plates, £5 7s. 6d.; angles, £5 10s.; boiler plates, £6 per ton; tin bars, £3 17s. 6d.; blooms, £4; billets and slabs, £4 5s. each; wire rods, £6 12s. 6d. to £6 15s.; and hoops, £6 15s. per ton.

There is nothing new to note in the shipbuilding, engineering, and boiler-making trades. They are all fairly well employed, but no new orders are to hand.

Iron ore is in quiet demand. Average qualities are quoted still at 8s. 6d. to 9s. 6d. per ton net, at mines. East Coast coke is at 17s. per ton.

The export shipping trade is quiet. The returns show a decrease on last week's shipments. Up to date there is now a decrease of 11,000 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

ALTHOUGH the output of the Barnsley district has been considerably lessened through two causes—the "play" caused by the feast holidays, and the lads' strike setting several collieries down—the stoppages have occasioned very little inconvenience, the supply quite equalling the demand. The boys, being subject to no trades union, play a free hand, and being usually easy to lead one way or the other, the trouble may break out in any district at any time. Most of the pits now working are waiting the action of the coalowners and miners' leaders in regard to the difficulty. A further conference took place on Friday at Sheffield. Mr. A. M. Chambers, President of the South Yorkshire Coalowners' Association, met representatives of the Miners' Association, including Mr. E. Cowey, President of the Yorkshire Miners' Association, and Messrs. J. Murray and W. Parrott. The conference, which lasted two hours, was conducted in private, and the result, which did not transpire, is expected to lead to an early settlement. It is urged, on behalf of the boys, that wages of less than 3s. a day shall not suffer any reduction, but to this the employers are opposed. Should an arrangement not be arrived at, the difficulty will be referred to the next meeting of the Conciliation Board. The employers have expressed their willingness to draw the line at all wages below 2s. 6d. a day. This compromise has been accepted by the Miners' Association, but the lads have still to be reckoned with.

In the meantime the house coal trade continues quiet, and little business is doing, buyers restricting their orders to immediate requirements. Hardly an average tonnage is being sent to London, and although coal is being despatched to Scotland, the weight is not heavy enough to exert any appreciable influence upon the bulk of the business. Concessions have been made in some instances to force sales, but coalowners generally stand out for current rates. For Silkstones, 9s. 6d. to 11s. per ton is still quoted; Barnsley house, 8s. 6d. to 10s. per ton; Flocktons, 8s. 6d. to 9s. 3d. per ton; inferior grades, from 8s. per ton. A fair demand, considering the advanced stage of the season, is still reported for steam coal, the Hull and other Humber ports taking a considerable tonnage from Yorkshire pits. Railway coal is being rather heavily delivered under contract, and prices remain steady generally. Barnsley hards make from 7s. 9d. to 8s. 6d. per ton; other qualities from 7s. per ton; gas coal in better demand at 7s. to 8s. per ton; manufacturing fuel is supplied largely in excess of demand, the market being very dull, and prices ranging from 3s. 6d. to 4s. 6d. per ton; smudge and small coal very weak and low-priced. Coke unchanged. A number of important coal contracts have been settled during the week, including the supplies for the Leeds Corporation Gas Works. These fresh contracts have, as a rule, been placed at last year's prices.

The improvement in the iron trade is certain to operate favourably on the steel industry. Although the prices of material are unsatisfactory, orders are obtained more readily, and, with the increased demand, a rise in quotations is only a question of a little time. The advance of 1s. per ton in hematites is a certain indication of better quotations ruling ere long. In crucible steel more activity is now reported, and the animation is certain to be increased as soon as the benefits of the lowered duties under the new American tariff begin to be experienced. The passing of that measure has promptly benefited the lighter staple trades. During the last week the exports from the Sheffield Consular District doubled in value. The improvement applied to all cutlery and steel products, as well as the wider range of goods taken by the United States markets. On the day following the acceptance of the modified tariff cablegrams were received in the city urging the immediate delivery of cutlery ordered some months ago. At present there is an exceptional rush to get on the market, and this, it is expected, will be followed by a steady trade. A leading steel manufacturer who was seen by the Correspondent of THE ENGINEER on Tuesday, stated that he was already very busy on American account, with every prospect of a sustained good trade throughout the year.

In well-informed circles here the belief is freely expressed that China will soon be in a position to operate heavily against Japan. Agents acting on behalf of China have arranged, and are arranging, for important supplies of military material, including quick-firing rifles, and these will, at an early date, be in the hands of the Chinese soldiers, who are singularly clever in effectively adopting new weapons when once the principals let their prejudices be broken down by the exigency of events. The Chinese are good soldiers when well led, and as there will be no lack of assistance in that direction, and abundant war material of a good type shortly in their country, the Chinese are expected to give a definite turn to hostilities ere long.

The leading East End establishments are busily employed upon the production of war material. The authorities do not seem greatly concerned over the new projectiles which have originated through the Russian process. Our local firms who have offered shells for experiment have not yet had the opportunity of having their productions officially tried, and it is now pretty certain that the Admiralty have no immediate idea of modifying the armour from the original specifications. No doubt, in the event of the projectile giving very startling results, provision will be made in future orders to meet the emergency. At present the work in hand for our Government is being proceeded with according to the terms of order received at the outset.

The tone in the iron market is decidedly more animated. This has been particularly pronounced during the last seven days. Consumers exhibit a general desire to cover their requirements in pig iron, instead of merely buying from hand to mouth, as has been the rule for a long time. This, of course, has led to the market being fairly buoyant, with a tendency to higher values. An increase of orders in the works of the iron and steel markets, if only to a moderate extent, would at once lead to an appreciable advance in quotations. At present values may be stated as follows:—Hematite, mixed numbers, 53s. 6d. to 54s. 6d., subject to discount and delivered at Sheffield; Lincolnshire forge numbers, 32s. 6d. to 33s.; No. 3 foundry, 34s.; Derbyshire forge, 34s. to 35s.; foundry, 38s., net at works. Bars, £5 5s. to £5 10s.; sheets, £7 to £7 10s.

Messrs. W. Jessop and Sons, Brightside Works, Sheffield, have just made some important additions to their plant for large marine work. Among the machinery newly laid down is a 69in. crank lathe with four rests and a 50ft. bed, constructed by Messrs. Hulse and Co., of Manchester. Another tool is a lathe with a 60ft. bed, intended for straight shafting and other plain work, constructed by Messrs. Smith, Beacock, and Tannett, of Leeds. This lathe is provided with four saddles and two fast headstocks, one with powerful treble gear, and in it either one long shaft or two shorter ones may be turned simultaneously. The firm have also added a horizontal boring and drilling machine, for various kinds of work. At the Brightside Works are at present being completed a number of shafts, large cast steel rudders, hydraulic cylinders, dredger and other castings and forgings for land and marine purposes, with shaft brackets for battleships, the latter including a set, making the third for the Spanish Government. Each of these brackets weighs 15 tons.

A further extension of the Yorkshire coalfield in the Doncaster district is contemplated. An agreement has been entered into for the working of the minerals on the Arksey-with-Bentley and Wheatley estate. The first hole borings have been made, and they confirm the opinion already expressed by geologists that the Doncaster coalfield is one of the most valuable in the country yet undeveloped.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE improvement in trade continues, and is not confined now to the raw material only, but has extended to other branches of the iron and allied industries, a feature which is considered satisfactory, and it justifies the opinion that the revival is brought about more by ordinary than by speculative influences. It is true that speculators have been very active during the last three weeks, but when it is remembered that they have for nearly two years fought shy of the iron market, because they did not see their way to invest their capital profitably, it is evident that they now take a more favourable view of the prospects. That better times are to be looked for is apparent from the improvement that is taking place in all the metal markets, and particularly in copper and lead, besides which the rise in silver is having a good influence. The shares of companies engaged in the iron and steel trades have also advanced in value, and it would appear to be the general belief that better times have commenced. Buyers are now anxious to purchase iron for autumn delivery, and it does not seem likely that they will do any better by waiting. It seems likely that the strike of Scotch miners will very shortly collapse, as the leaders are quarrelling, and some of the men are going back to work in spite of the picketting that is carried on. The Scotch coalmasters are proving themselves too much for the Federation, powerful though its leaders deem it to be. The strike has acted rather detrimentally to the trade of this district, where it was expected to lead to greater activity. It was thought that a good deal more Cleveland iron than usual would be consumed in Scotland because of the almost total stoppage of the Scotch blast furnaces, but on the contrary less has been taken, as the cessation of operations at the Scotch mills and forges and foundries has been more complete than was looked for, as fuel was obtained with such difficulty. When, however, the Scotch strike is over there will be a brisk demand for Cleveland pig from across the Border, because the consumers of pig iron will be able to start their operations at once, while it will be some time before the Scotch furnaces will be in a position to furnish adequate supplies of iron. This strike in Scotland accounts for the poor shipments of pig iron that are reported from the Tees this month. The exports to the Continent are quite as good as are usual in August, but to Grangemouth they have been very quiet, and the result is, that the August exports are smaller than those of almost any month this year, and they fall short of those of the corresponding month last year. This month they have reached 70,907 tons, as compared with 79,441 tons in July, 1894, and 82,183 tons in August, 1893, all to 29th. This decrease, coupled with a smaller local consumption, owing to the holidays at the mills, forges, and foundries on Tees-side last week, lead to the inference that stocks of Cleveland pig iron will this month show an increase of at least 10,000 tons; and thus in June, July, and August, months when substantial decreases in stock are usually looked for, there will have been rather heavy increases—and this notwithstanding that the make has been reduced this month by the stoppage of the furnaces for the blast furnacemen's holiday on the 11th. Connal's stock of Cleveland pig iron has declined; because No. 3 in makers' hands has been so scarce for prompt delivery that people have had to draw upon the quantity in the public stores, and on Wednesday night Messrs. Connal and Co. held 90,570 tons, or 4822 tons decrease this month.

The better prices for pig iron are being maintained, and orders have been booked freely for No. 3 from merchants and consumers at 36s. 3d. per ton for prompt f.o.b. delivery, while 36s. 6d. is now the general figure of producers. Early in the week some small lots were sold by merchants at 36s. 1½d., but nothing less than 36s. 3d. is now thought of, and the fluctuations in warrants have little influence upon the general market. No. 4 Cleveland foundry pig has been realising 35s. and gray forge pig has been raised to 34s. 3d. The hematite pig iron market is yet in a rather indifferent condition, and has not felt the improvement that has appeared in Cleveland pig. There have been sales of mixed numbers of East Coast hematite pig this week at 42s. 9d., and the quotation is now 43s.

Unfortunately, the efforts that have been made to bring about a settlement of the moulders' dispute have not been attended with success, and the strike, which has now lasted twenty-four weeks, appears to be as far off a termination as ever. Both the masters and men are agreed upon the question of settling the difficulty by arbitration, but cannot agree upon the basis to be arbitrated upon. The men insist that the arbitrators shall be called upon to adjudicate upon the claim made by the men for an advance of 2s. in time wages and 5 per cent. on piece prices, and that only. This was the question originally in dispute, but the employers have since made a claim for a reduction of wages, and they hold that this claim should be submitted to the arbitrators as well. On Monday there was a conference at Newcastle between the masters and the delegates of the men, when the former submitted the two following proposals, either of which they would accept as a settlement:—(1) That three expert referees be appointed with full power, to whom the matter below in dispute between the parties be submitted, and whose decision shall be binding on both employers and employed, viz.:—Whether, considering the state of trade, the moulders are justified in asking for an advance of wages, or whether the employers are justified in asking for a reduction of wages. The Court to decide whether there shall be any change either way, and if so, how much. (2) Should the contracting parties be unable to agree upon three expert referees, then each party shall appoint their own expert referee, and these two shall select an arbitrator, who shall be either a barrister or a County Court judge. The alternative proposal was that a truce be declared for six months, the employers agreeing that the wages of no trade will be interfered with during that time. These reasonable proposals the men reject, for they want the claim of the employers ignored altogether. It is greatly to be regretted, for the sake of the thousands who are thrown out of work through the action of these moulders, that this week's negotiations have proved abortive.

Some branches of the finished iron and steel trades exhibit an improvement, the demand being larger, and prices better. They all speak more hopefully of the prospects, and it is probable that the works of Messrs. Dorman, Long, and Co., at Middlesbrough, will shortly be reopened, and set fully in operation again. During the stoppage they are putting down a considerable amount of new plant. The new works of the Bedson Steel Wire Company at Middlesbrough, which have been in course of construction for over eighteen months, are to be opened next month, and will consume a considerable quantity of steel billets. At these works electricity will be extensively used as a motive power for small machines.

At the finished ironworks in the North of England the question of the shortening of the hours of labour is being taken up by the men, and at a meeting of delegates held at Darlington on Saturday it was resolved, "That this meeting of delegates, representing the works connected with and outside the Board of Conciliation and Arbitration, is prepared to advise the workmen to make the following offer to the employers:—That in all mills the charging shall be so arranged that no mill shall stop before one o'clock or continue working after two o'clock on Saturdays, except in cases of accident over which neither employers nor workmen have control, as no man would desire to leave heats in the furnace." The whole of the men will have to vote upon this before it is submitted to the employers.

The members of the Newcastle and District Association of Foremen Engineers and Draughtsmen, and also those of the kindred association in the Middlesbrough district, visited the North-road Locomotive Works of the North-Eastern Railway on Saturday, by invitation of Mr. Worsdell, locomotive superintendent of the line. Locomotives in all stages of construction were seen, and particular attention was called to two which had just been completed—a passenger express engine, and a new bogey passenger tank engine, a type of twenty to be built by the company. The latter is fitted with a new steam sanding apparatus.

The coal trade is brisk, and sellers are securing good prices for their produce. The increased activity is due partly to the larger requirements of Scotland, and if the Scotch miners' strike collapses these will drop off. At present a large tonnage of steam, gas, and manufacturing fuel is forwarded both by sea and rail. Coke is also in good request, and the price is well maintained.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron market has been scarcely so firm this week. The upward movement in prices has been arrested, and the amount of business doing is also smaller than last week. Business was done in Scotch warrants from 43s. 5d. to 43s. 3½d. cash. Cleveland iron is comparatively neglected, and there is scarcely anything doing in hematite warrants.

The prices of makers' iron are as follow:—G.M.B. f.o.b. at Glasgow, No. 1, 45s. per ton; No. 3, 43s. 6d.; Carnbroe, No. 1, 47s.; No. 3, 46s.; Monkland, No. 1, 48s.; No. 3, 43s. 6d.; Summerlee, No. 1, 56s.; No. 3, 50s.; Calder, No. 1, 58s.; No. 3, 50s.; Coltness, No. 1, 59s.; No. 3, 52s. 6d.; Glengarnock at Ardrossan, No. 1, 56s.; No. 3, 50s.; Eglinton, No. 1. 54s.; No. 3, 47s; Dalmellington at Ayr, No. 1, 50s.; No. 3, 47s. 6d.; Shotts at Leith, No. 1, 56s. 6d.; No. 3, 50s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 4213 tons, compared with 6230 in the corresponding week. Holland took 1125 tons; Italy, 400; Canada, 410; South America, 20; India, 160; Australia, 310; France, 10; Germany, 240; Belgium, 20; Spain and Portugal, 140; China and Japan, 137; other countries, 115; coastwise, 1126, against 3451 tons in the same week last year.

There is no change in the number of furnaces in blast, which is six, compared with forty-six this time last year. Makers and consumers alike are holding their hands at present, and there is no likelihood of work being resumed until the miners return to the collieries.

The utmost stagnation prevails in the finished iron and steel trades. Merchants are doing a little, but it consists only of meeting the more clamorous wants of the trade. The works are all closed, and the gatherings on 'Change are productive of very little business.

The export trade in iron and steel manufactures is poor. In many cases makers of machinery are doing scarcely anything, and the exports of finished iron and steel are reduced to a minimum. The week's shipments from Glasgow embraced sewing machines worth £360, other machinery £10,140, steel goods £2625, and miscellaneous iron goods £11,000.

There is very little doing in Scotch coals. The entire shipments in the past week amounted to only 6330 tons, compared with 165,111 in the corresponding week of last year. One half of the entire shipments went from Leith to Grangemouth. Glasgow only shipped 639 tons, whereas the clearance of the same week last year was 51,000 tons. The total coal shipments for the year to date show a decrease of about 740,000 tons. On the other hand, fair quantities of coals are being received from England. It is estimated that the arrivals in the past week would amount to close on 50,000 tons. Prices are moderate, and the demand is slow.

The miners have been asked to vote this week on the question whether they will still adhere to the demand for an increase of 1s. per day, or accept 6d. with a guaranteed minimum wage for two years. The latter is the proposal of the English Federation, and has been received with a good deal of favour. It is not expected, however, that the coalmasters will agree either to the one proposal or the other. The view they take is, that the miners' demand was thoroughly unreasonable from the first. It was impossible for the masters to give the advance ten weeks ago, and their circumstances are not better but worse now.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

LABOUR agitators never seem to profit by past experience, and the old absurdity of creating a rupture when there is a lull in trade and a declining market is being repeated amongst the seamen at Newport and Cardiff. Mr. J. H. Wilson, M.P., has issued a notice on behalf of the Sailors and Firemen's Union, "That the rate of wages to be paid henceforth should be as follows: Steamers, sailors £4 per month, firemen £4 5s., cooks, stewards, boatswains, and carpenters in proportion; sailing ships, seamen £3 2s. 6d. Sailors and firemen arriving in port under these wages are requested to immediately give in their notices, and at once to report themselves to the Wages Committee."

Demonstrations, addresses by Mr. Wilson and others, have been the feature of the week, and I have heard of cases of ships being "blocked." Shipowners generally ridicule the whole thing, and say that Mr. Wilson could not have selected a worse time. Mr. John Cory is reported to have said "that he would willingly let him have half a-dozen of his ships for the Black Sea: that he should take all the profit, and he would make him a present of £50 into the bargain." "It is simply childish," he added, "to strike at such a time. It is not a question of profit now but of clearing expenses." Numbers of boats are being laid up on account of the slackness of trade, and one day last week five large steamers were pointed out to me lying idly in the mud waiting for custom.

Three steamers were blocked at Newport, Mon., up to Tuesday mid-day, when the full rate of wages demanded was paid, and the men signed on. At Barry some instances also of concessions to the seamen have occurred, but at Swansea there is no agitation up to the present. Whether the strike will extend there or not is uncertain, as it is stated that better wages are paid there than at Cardiff. It is thought that in some cases the agitators may succeed in getting their demand; but in the face of slack times, and with a lessening demand for steam and house coal, the majority of shipowners will prefer to put up their steamers and sailers, and the recoil upon the seamen will be a serious one.

Grave fears are entertained that trouble is looming in the Welsh coal trade. A hundred men of the Ferndale Collieries are out in consequence of some dispute, and it was reported midweek that the mass of the collieries of Ferndale are in sympathy. Overtures have been made by the management, but have not yet been accepted, and a mass meeting has been called. The men contend that a distinct breach of the sliding scale has been attempted If the belief of alarmists, and even of "Mabon," were accepted, we are threatened with another attempt to destroy the sliding scale; but I have greater faith in the good sense of the mass of the colliers than to think them capable of so foolish an act.

Troubles are attending North-Welsh collieries, and at one of the largest, Bettisfield, a strike has taken place for a 10 per cent. advance.

An important meeting of the Cambrian Miners' Association was held on Monday, when the question was discussed as to the best means to release the surplus moneys belonging to the various relief funds throughout the country, for the purpose of forming a central fund, with a view of relieving all sufferers from mining accidents. Mr. Abraham, M.P.—"Mabon"—who was present, suggested that a Bill should be passed through Parliament, and this view was adopted.

With such an excellent organisation existing as the Miners' Fund, with all "machinery" in capital working order, the course evidently should be to make it the receptacle of all funds, and thus avoid the expenses of another institution.

If quietness prevails on 'Change in respect of the coal trade, there is a certain degree of briskness this week in collieries, and new undertakings are being pushed ahead well. The sinking in both of the Aber pits is going on well; and at the Dowlais Colliery, now that the water has been grappled with, sinking is pushed on vigorously. The pumping machinery is of great power, so there is no fault to be found, or the management accused of neglecting the dearly bought experiences of the neighbouring colliery of Penrhiwkiber. I am glad to see, however, that at length a turn in the tide is visible, and the yield to investors is close upon 10 per cent.

Powell's Duffryn coal, which one sees in evidence at Newport, Mon., at the Bute, and at Barry, will shortly have accessions. Two pits are being sunk below Bargoed, and all the pits in the Rhymney Valley are doing full time.

I noticed an unusually large number of laden Rhymney Ironworks wagons on Saturday last at Cardiff, a good indication of Mr. W. Smith's activity.

The Campagna, with Lewis Merthyr steam coal, has beaten the record. The Lewis Merthyr, formerly known as the Coedcae, has an able manager in Mr. Richards. Mr. W. Rees is the mining engineer.

Good work is reported of the new sinking of Mr. Christmas Evans, of the Dinas Main Collieries, who is sinking to the deep.

At Swansea the coal trade is brisk, and also at Newport, Mon., where of late the tonnage coming in has been very large, and handled with an efficiency which would have won hearty encomiums from the late Sir George Elliot.

At Swansea some concern is felt at a mischievous rumour circulated, that owing to a blunder in the draughting of the coal clause of the American tariff, the imports of anthracite coal are forbidden. If true, this would be a serious blow in the face of a steady export from Swansea of this class of coal to the United States. Swansea coal shipments last week were close upon 40,000 tons; in patent fuel business was not so brisk.

On 'Change, Cardiff, this week, coal prices were much about the same as they were last week, and were better than on Saturday. Best qualities steam were quoted from 11s. 3d. to 11s. 6d.; seconds, from 10s. 9d. to 11s.; best Monmouthshire, 10s. to 10s. 6d.; small, 5s. 6d. to 6s. f.o.b. On house coal the influence of improving weather, after nearly six weeks rainy and stormy weather, was shown perceptibly. Latest quotations are:—Best households, 11s.; seconds, 10s. to 10s. 6d.; No. 3 Rhondda, 10s. 6d. to 10s. 9d.; brush, 8s. 6d. to 8s. 9d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 6d. to 9s.; through, 7s. to 7s. 3d.; small, 5s. Coke is in moderate demand. Cardiff prices:—15s. to 16s. for furnace; foundry, 17s. to 20s. 6d., according to brand. Pitwood is in good demand, 15s. 9d. ex-ship. Iron ore dull, from 9s. 6d. to 9s. 9d. Porman, and 11s. to 11s. 3d. Rubio.

Iron and steel exhibit a trifle more vitality. Ebbw Vale is busy with bar, rails, and sleepers, Blaenavon moderately well occupied, and at Cyfarthfa and Dowlais a fair average make of steel bar is being turned out. I noticed last week that the Dowlais consignment of bars on the Taff showed an increase. "Parcels" of rails are on the increase; a cargo went to Demerara this week, and a consignment to Highbridge. Brown and Lennox, at Pontypridd, are busy, and the various foundries are moderately brisk. Competition keen. Swansea quotations this week are as follows:—Glasgow warrants, 43s. 5d.; Middlesbrough No. 3, 36s. 4½d. prompt; Welsh bars, £5 to £5 2s. 6d.; angles at usual extras. Sheet iron, £6 to £6 10s. f.o.t. at works; steel, £6 5s. to £6 10s., with the usual extras for higher gauges. Bessemer steel tin-plate bars, £4 2s. 6d. to £4 5s.; Siemens best, £4 5s. to £4 7s. 6d. Steel rails, heavy, £3 17s. 6d. to £4; light, £4 10s. to £4 12s. 6d. f.o.t.; sleepers, angles, channels, &c., according to specification.

A cablegram has been received from America notifying that the Tariff has become law, and increased animation is fully expected in tin-plate. Increased business has set in already, and prices show a little advance, at present confined to a few pence. Makers are holding on and refuse to sell forward. Last prices are:—Bessemer cokes, 10s. 6d. to 10s. 9d.; Siemens, 10s. 9d. to 11s.; ternes, per double box, 28 by 20 c., 20s., 21s., 22s., to 24s.; best charcoal, 12s. to 12s. 6d., according to finish; wasters, 6d. to 1s. per box less than primes; odd sizes usual extras. All delivered in Prince of Wales' Dock, Swansea, cash, less 3 and 1 per cent.

Anthracite is from 8s. 6d. to 12s. 6d., according to quality. Block tin, £71 12s. 6d. to £71 17s. 6d. Patent fuel, 10s. 6d. to 11s.

Present state of tin-plates, Swansea, 303,871 boxes.

I much regret to announce the death of Mr. Brewer, Chief Engineer on the Taff Vale Railway. Mr. Brewer's father was locomotive engineer to the late Crawshay Bailey, who was one of the pioneers in the introduction of locomotives into Monmouthshire. Mr. Brewer was a pupil and afterwards assistant to Mr. Williams, the late Taff engineer, and at his death succeeded him. No one had a more accurate knowledge of the specialities of the line than he, or made a more efficient witness on Parliamentary Bills. He was only in his fifty-second year.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THERE has been very little alteration in the iron trade of late, both the raw and the finished iron department being but quietly engaged, while prices continue very low. For the present there is a general hesitation about placing orders, and it is not safe to make any predictions, but the expectation is that autumn business will be fairly good. The Silesian iron market maintains a quiet tone. Pig iron continues in weak request, and the different sorts of malleable iron are also but slowly inquired for; indeed, manufacturers will find it very difficult to keep their concerns going regularly unless further contracts can be secured. The steel works as well as the iron foundries remain in rather a poor condition. Export of iron and iron manufactured goods to Russia has considerably decreased of late.

Demand and inquiry continue to be fairly good on the Austro-Hungarian iron market, and a regular activity is maintained at the works. Bars as well as plates meet with a lively request, while the inquiry for girders shows a slight decrease. Stocks are not large, and the works in many cases stipulate rather long terms of delivery. The business in rails and railway requirements continues extremely unfavourable. Export trade is limited, while the demand on local account has been fairly satisfactory.

The reports that are given of the French iron business may be considered as rather favourable, though orders of importance have not been received for many weeks past, but there is a sufficient amount of work secured to keep the mills quietly but regularly engaged. Changes in quotations have not taken place lately.

Belgian iron business drags on in a lifeless fashion. Here and there an improvement in demand has been perceptible, girders in steel, for instance, and plates being in lively request, but, taking it all through, the tone of the market is decidedly weak. Export in iron or steel has been uncommonly dull of late, only for girders and wire a few orders have been placed. List quotations for July and August of present year show no changes whatever. Up to date Luxemburg foundry pig is quoted 48f. p.t.; forge pig, 46f. p.t.; merchant bars, f.o.b. Antwerp, No. 1, 110f. p.t.; No. 2, 115f.; No. 3, 120f. p.t.; free Belgian station, No. 1, 112·50; No. 2, 117·50; No. 3, 122·50 p.t.; girders, f.o.b. Antwerp, 107·50 to 110f. p.t.; iron plates for export, No. 2, 125f., No. 3, 145f. p.t.; steel plates, 142f. p.t.; steel rails, 95f. p.t. Of the forty-two existing blast furnaces twenty-nine only were in blow at the end of July, of which fourteen produced 1220 t. forge pig, three produced 235 t. foundry pig, while twelve yielded 1150 t. basic per day. The following shows production of pig iron in July and during the first seven months of present year:—

| | July. | | 1st January to 1st August. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Forge pig .. .. .. | 36,000 | 31,920 | 225,820 | 243,590 |
| Foundry pig .. .. | 7050 | 6821 | 54,465 | 46,641 |
| Basic .. .. .. .. | 34,500 | 22,010 | 241,650 | 149,635 |
| Totals .. .. .. .. | 78,150 | 60,751 | 521,935 | 439,866 |

Affairs on the Rhenish-Westphalian iron market continue very much as last reported. Buyers are still extremely careful about placing orders, and only cover their immediate requirements, while producers, on the other hand, do not care to sell at the reduced prices that are offered them. The Siegerland Works have considerably limited their output lately, and quotations have become a trifle more firm. Compared to last week, the demand for spiegeleisen as well as for forge pig and basic has somewhat improved. There is little to note in the malleable iron business, except that the bar trade has been a trifle less lively than before, but a sufficient amount of orders has been secured previously, and so the works can be kept going quite regularly; prices exhibit pretty much firmness generally. Girders are in moderate request at weak quotations. The situation of the hoop trade continues favourable, demand being brisk and prices firm. The plate and sheet trade is pretty active, and there is a good employment maintained at most of the foundries. All sorts of wire and wire nails are languid. The total production of pig iron in Germany, including Luxemburg, was for July of present year 476,894 t., of which 145,132 t. were forge, pig, and spiegeleisen, 41,726 t. Bessemer, 209,283 t. basic, and 80,753 t. foundry pig. Production in July, 1893, amounted to 413,771 t., in June, 1894, it was 471,922 t. From January 1st to 31st of July, 1894, no less than 3,125,965 t. were produced, against 2,815,731 t. for the same period the year before.

German import in iron was, for first two quarters of present year, as under:—

| | 1894. | 1893. | 1892. |
|---|---|---|---|
| | t. | t. | t. |
| Pig iron<br>Scrap iron .. .. .. .. .. | 122,414 | 80,233 | 90,495 |
| Rails .. .. .. .. .. .. .. | 56,797 | 44,965 | 56,616 |
| Wire .. .. .. .. .. .. .. | 102,307 | 91,747 | 95,372 |
| Plates .. .. .. .. .. .. .. | 41,731 | 32,314 | 30,469 |
| Hardware .. .. .. .. .. .. | 142,292 | 116,919 | 96,561 |
| Fish-plates and sleepers .. .. | 19,143 | 17,251 | 16,645 |

Export to Russia was

| In June. | | During first two quarters. | |
|---|---|---|---|
| 1894. | 1893. | 1894. | 1893. |
| t. | t. | t. | t. |
| 16,755 | 8887 | 60,335 | 42,631 |

During the first quarter of the present year 6692 t. iron were sent to Russia, in April export amounted to 17,076 t., in May it rose on 19,072 t., and in June it was 16,755 t. The amount of rails sent to Russia was, for the first two quarters of 1894, 3342 t.; for 1893 it was 173 t. only; and for the same period in 1892 it was 498 t. German trade in coal was in tons as under:—

| | 1894. | 1893. | 1892. |
|---|---|---|---|
| | t. | t. | t. |
| Import in June .. .. .. | 420,241 | 431,955 | 361,937 |
| During first two quarters .. | 2,147,780 | 2,205,210 | 1,610,059 |
| Export in June .. .. .. | 706,786 | 678,491 | 670,305 |
| During first two quarters .. | 4,301,491 | 4,281,291 | 3,997,571 |

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 23rd.

Dealers in iron, steel and railway equipments and supplies are living in anticipation of large orders from railway corporations during the next two months. The subject of better equipment is now being considered by boards of several systems, under the strong recommendation of the engineering management. It is pointed out that less money has been expended in repairs, equipments and betterments during the past year than for any of many years past, that both cars, engines and machinery for repair shops are needed, and that a general improvement ought to be made when supplies can be had on such reasonable terms. The voters of this city will vote for or against a scheme to build an underground rapid transit system, which it is estimated may cost 50,000,000 dols. Agitations are being started in the State looking to the construction of 500 miles of ship canal connecting Albany with Lake Erie, and also with the St. Lawrence opposite Montreal. The objective point is to divert to New York more or less traffic of the North-west, which now passes down the St. Lawrence. Other important engineering enterprises are under consideration, but enterprise must await more inviting financial conditions.

## RECONSTRUCTION OF A BRIDGE OVER THE SEINE.[*]

By R. Audra.

The railway crosses the Seine no less than five times between Garenne-Bezons and Rouen. The bridges were originally of timber, but about thirty-five years ago they were reconstructed with cast iron arches. One of them was destroyed in the war of 1870, and afterwards rebuilt with straight girders. The others have been a source of anxiety almost ever since their construction, and particularly of late years with the increase in rolling loads; the spandrils have cracked in many places, the cause of which is assigned to the torsional stresses arising from the transverse bracing between different ribs.

A careful study of the structures has led to the decision to rebuild the whole series of arched bridges, and the present article describes the reconstruction of the first, recently opened for traffic. It is called the "Pont du Manoir." The first idea was to replace the cast iron arches by wrought iron arches, but the condition of the foundations was such that it was considered dangerous to disturb the condition of loading of the piers to the extent which such an operation would have involved. The next solution was to replace the arches by girders on the same piers, and to reconstruct each bridge in halves, so as to have always one line of rails available for the traffic. It was found, however, that this plan would require six years for completion, even if more than one of the bridges was taken in hand at the same time. It was considered inadmissible to hamper the business of the railway for so long a period, and another plan was considered, viz., that of making a temporary bridge, so designed as to serve for each structure in turn during reconstruction. This was found to be more costly than building new bridges altogether, and, after certain difficulties about deviating the line had been overcome, the plan of making entirely new bridges was decided on.

At the "Pont du Manoir" the old bridge was in six spans, while the new one is in three spans, with a total width between abutments of 668ft. The foundations were laid by compressed air on a chalk foundation, the greatest depth below low water in the river being 42ft. The girders are double-webbed lattice girders 26ft. 3in. deep, 29ft. 6in. apart between centres. The cross girders are 3ft. 3in. deep and 14ft. 7in. apart, with trimmers carrying a floor of $\frac{5}{16}$in. flat plates. The cross girders are attached to the lower boom, and the main girders braced overhead. The girders are continuous over the piers, and were erected by launching out from the abutments. The stresses during erection by this method were greater than they will be in use under the greatest rolling load. The bridge cost £80,100, independently of deviations, &c., and of the demolition of the old bridge.

Launch of a New Liner.—Messrs. F. Schichau and Co., of Elbing and Dantsic, recently launched from their yard in Dantsic the Prinz Heinrich, a steel twin-screw steamer of 6600 tons register, built to the order of the North German Lloyd for the company's mail service to China and Australia. Her dimensions are:—Length over all 454ft. breadth 51ft., depth 33ft. She will have accommodation for about 80 first-class, 80 second-class, and 1000 third-class passengers. The vessel is specially arranged for service in the tropics, the first-class cabins being all on the upper deck. The second-class accommodation is on the poop, and the third-class on the main deck. The promenade deck is 200ft. in length, and has a permanent wooden awning, on the top of which are placed the lifeboats. The steamer is driven by two sets of triple-expansion engines, indicating each 2500-horse power, of a new type first introduced by Messrs. Schichau two years ago on the Austrian ironclad Tegetthoff. The *Times* says the naming was performed on behalf of Prince Henry—after whom the vessel is named—by the commandant of Dantsic, Lieutenant-Colonel Mackenzen, with the Emperor's consent. The Prinz Heinrich is a sister ship to the Prinz Regent Luitpold, which has lately made her trial trip at Dantsic, obtaining a speed of 15½ knots. These two twin-screw steamers are the first large ocean steamers built by Messrs. Schichau, who have hitherto built only fast torpedo vessels and men-of-war. The ships of the North German Lloyd are for the most part British built, but the Prinz Heinrich and Prinz Regent Luitpold, being intended for the mail service to China and Australia, for which the company receive a subsidy from the Imperial Government, had to be built in Germany under Government supervision, in accordance with the terms of the mail contract.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

15*th August*, 1894.

15,548. Line-throwing Guns, R. Deane, London.

15,549. Machines for Washing and Drying, F. Vinten, London.

15,550. Cycle, C. A. Briner, London.

15,551. Securing the Doors of Lifts, Z. A. R. Nesbit, London.

15,552. Making Cigarettes, C. V. A. A. de V. Beauclerk and W. Brodrick-Cloete, London.

15,553. Velocipedes, A. H. L. Grivel, London.

15,554. Elastic Tires for Cycles, E. Gérard and A. Picon, London.

15,555. Universal "Tel," J. Forrester, London.

15,556. Shears, C. Smith.—(*E. Smith, New Zealand.*)

15,557. Shades for Lamps, A. H. Weston, London.

15,558. Preservation of Perishable Substances, D. A. Sutherland, London.

15,559. Photographing Circular Surfaces, A. H. Smith, London.

15,560. Motive-power Engines, Sir E. F. Piers, London.

15,561. Manufacture of Cartridge Cases, R. D. Sanders, London.

15,562. Fire-grates for Furnaces, H. J. Piron, London.

15,563. Sheet-metal Pulleys, O. W. Ketchum, London.

15,564. Manufacture of Azo-dyes, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)

15,565. Motor for obtaining Motor Force, L., E., J., and A. Guilbaud, London.

16*th August*, 1894.

15,566. Mowing Machines, P. Pierce, Wexford.

15,567. Testing Roller Mill, A. Steiger, London.

15,568. Fastening Knife Blades in Handles, G. E. Malcham and T. S. Yeomans, Sheffield.

15,569. Stands for Supporting Cycles, T. P. Davies, Manchester.

15,570. Needle Threader, T. W. Johnson, Redditch.

15,571. Applying Pressure to the Rollers of Wringing Machines, R. Varley and J. P. Wolfenden, Keighley.

15,572. Tea Infuser, E. Delarne, Birmingham.

15,573 Storage of Electric Force, J. T. Cathcart, Newburgh.

15,574. Corsets, C. Rubens, London.

15,575. Gasaliers, C. Smith, Birmingham.

15,576. Fluid Metres, H. H. Frost, Manchester.

15,577. Toys, H. P. Lavender, Walsall.

15,578. Horseshoes, J. Sutherland and J. Anderson, Glasgow.

15,579. Lever Motion for Window Blinds, R. Halliwell and J. Lawton, Oldham.

15,580. Mud Guard for Vehicles, R. Ferguson, Glasgow.

15,581. Hair-pins, J. T. Gray, Glasgow.

15,582. Pantographic Engraving Machines, T. Nixon, Glasgow.

15,583. Knitting-machines, R. Wallwork, Manchester.

15,584. A Recess in Flat Nails, H. E. Holloway, Wolverhampton.

15,585. Apparatus for Condensing Smoke, E. Davies, London.

15,586. Machinery for Drying Spent Hops, E. Davies, London.

15,587. Propelling Cycles, G. Pirnie, Dundee.

15,588. Adjustable Beds for Invalids, T. Turner, Ketton.

15,589. Plastering for Ceilings, F. H. Jung, Salisbury.

15,590. Machinery Belting, H. N. Brent and F. Marsh, South Weald.

15,591. Machinery for Preparing Tobacco, R. A. Sloan and J. E. L. Barnes, Liverpool.

15,592. Cycles, H. W. Ashby, Dublin.

15,593. Manufacture of Waterproof Material, J. A. Turner, Manchester.

15,594. Corset, M. Wutow, Manchester.

15,595. Fly Trap, J. Thornhill, Gainsborough.

15,596. Combined Match-box and Windguard, A. E. Parsonage, London.

15,597. The Kimberlead, J. M. Kimber, London.

15,598. Shelves for Holding Books, &c., A. W. Lambert, London.

15,599. Air Hub and Valve for Cycles, J. R. Rickard, London.

15,600. Electrically Heated Curling-tongs, O. March and A. Winterbottom, London.

15,601. Forcing Liquids from Casks, L. and F. Kohout, London.

15,602. Combination Gun and Pistol, M. W. Fairbanks, London.

15 603. Driving-gear for Cycles, S. C. Eisenhart, London.

15,604. Apparatus for Washing Metallic Ores, C., W., and G. K. Craig, London.

15,605. Life-saving Raft, F. Foord, London.

15,606. Heating Apparatus, A. J. Boult.—(*P. R. Horn, Germany.*)

15,607. Manufacture of Glass, R. C. Baker, Liverpool.

15,608. Spittoons, G. C. Dymond.—(*C. Wellhöfer, Germany.*)

15,609. Cover for Coal-cellars, W. Moore, Manchester.

15,610. Surgical Bandages, G. C. Dymond.—(*The Firm of Kahnemann and Krause, Austria.*)

15,611. Envelope and Bag Machines, G. R. Clarke, Liverpool.

15,612. Heating Apparatus, A. J. Boult.—(*P. R. Horn, Germany.*)

15,613. Frames of Umbrellas, S. Learoyd, London.

15,614. Signalling Apparatus, P. S. Pilcher, London.

15,615. Spikes, C. K. Welch and J. J. Hadley, London.

15,616. Water Gauges, W. Stricker and K. von Koeppel, London.

15,617. Registering Telephonic Conversations, A. Münch, London.

15,618. Fire-escapes, J. C. Merryweather and C. J. W. Jakeman, London.

15,619. Apparatus for Closing the End of Torpedo Tubes, G. J. Carter, London.

15,620. Burning Refuse, R. A. Chesebrough, London.

15,621. Manufacture of Dye-stuffs, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)

15,622. Lubricators, F. Jaeger, London.

15,623. Golf-clubs, H. H. Cordes, London.

15,624 Safety Attachment for Hat-pins, H. H. Cordes, London.

15,625. Book Holder, J. Sanderson, London.

15,626. Miners' Safety-lamps, T. Thomas, London.

15,627. Band-driving Gear, E. Dagnall, London.

15,628. Torpedo, W. Green, London.

15,629. Apparatus for "Chiming" the Staves of Casks, J. Russell, London.

15,630. Fastening Device for Collars, V. F. von Ried, London.

15,631. Spraying Liquids under Pressure, L. Rusden and R. Eeles, London.

15,632. Heating Crucibles, A. C. Girard and E. A. G. Street, London.

15,633. Dog Kennels, H. R. Newburgh-Stewart, London.

15,634. Hair-curling Device, E. F. Lewis, London.

15,635. Window Fasteners, H. J. Fox, London.

15,636. Sash Fasteners, F. Stewart, London.

15,637. Tap and Measuring Device, E. Clairmonte, London.

15,638. Cream Elevators, T. T. Sabroe, London.

15,639. Extinguishing Apparatus for Oil Burners, O. Wollenberg, London.

15 640. Switchback Railways, &c., E. Lacy, London.

15,641. Cutting Toothpicks, &c., R. F. S. Molesworth, London.

15,642. Inflating Pneumatic Tires, A. J. Boult.—(*R. Hoffmann, Germany.*)

15,643. Optical Lantern, J. Airs, London.

17*th August*, 1894.

15,644. Drying Stereo-matrices, R. H. Healey, London.

15,645. India-rubber Cushion for Chair Legs, W. F. Taylor, Sheffield.

15,646. New Game, J. H. Matthews and J. Jaques, jun., London.

15,647. Adjustable Drill Rest, J. Barlow and L. T. G. Evans, Nottingham.

15,648. Protecting the Ends of Bales of Paper, J. Grime, Halifax.

15,649. Swell Springs of Looms, T. Walsh and J. F. Lowe, Manchester.

15,650. Apparatus for Cooking, &c., E. W. Parish, Leicester.

15,651. Construction of Gully Traps, R. Lawton, Longport.

15,652. Cycle Foot-rests, J. A. Beard, Birmingham.

15,653. Cycle Lamp Brackets, J. A. Beard, Birmingham.

15,654. Pistons, S. H. Wright, Ganarew Manor House, near Monmoth.

15,655. Bottles, F. Holbrook, Derby.

15,656. Needle Case, A. B. Knight, London.

15,657. Condensation Lubricators, W. Graham and J. S. Fleming, Dundee.

15,658. Atmospheric Gas Burners, T. Fletcher, Manchester.

15,659. Mules for Spinning, S. H. Smethurst, Manchester.

15,660. Heel Protector, W. C. West, London.

15,661. Twisting Machinery, A. Combe and T. Magee, Halifax.

15,662. Securing Handles to Knives, W. Seedhouse and A. J. Hobson, Sheffield.

15,663. Spoke Grips, W. A. Lloyd and J. Blyth, Birmingham.

15,664. Felting Spherical Articles, T. M. Cockroft, Leeds.

15,665. Inducing Sleep in Cases of Insomnia, V. Gorgias, Liverpool.

15,666. Weighing Apparatus, J. Greenhough, Liverpool.

15,667. Trunk Box, L. Mansbridge, London.

15,668. Fluid Motors and Pumps, J. Bow.—(*J. Farquharson, Chili.*)

15,669. Combination Tube-expanding Drift, J. McKay, A. Young and A. Hardy, Newcastle-on-Tyne.

15,670. Composition Stairs or Steps, J. Lauder, Glasgow.

15,671. Preserving Sausage Skins, &c., J. McBride, Glasgow.

15,672. Folding Eye-glasses, J. Frohn, London.

15,673. Shutters for Photographic Cameras, J. B. Irving, Liverpool.

15,674. Boiler Furnaces, J. Sutton, Liverpool.

15,675. Vehicle Propelled by Electricity, E. S. Colchester, London.

15,676. Composition Paint, J. and A. Tennant, London.

15,677. Sliding Window Sash Holder, J. W. Evans, London.

15,678. Bakers' Ovens, R. H. Craine and D. C. Craine, London.

15,679 Double Centrolinead, J. H. Spanton, Dartmouth.

15,680. Increasing Adhesion between Rails and Wheels, J. C. Chapman and F. Holt, London.

15,681. Spanners, J. Chandler and A. Krafft, Manchester.

15,682. Puzzle, G. H. Mason, Birmingham.

15,683. Packing Glass for Transit, K. Fraser, jun., London.

15,684. Coal Economiser, S. A. Cackett and K. E. Darlow, London.

15,685. Games, A. Sweetser and G. Royle, London.

15,686. Furnace for Destruction of Refuse, T. B. Grant, London.

15,687. Pneumatic Boot Stretcher, H. W. C. Cox, London.

15,688. Fire-bars, C. H. Jones, West Bromwich.

15,689. Garment Pattern Delineated Materials, A. Kenealy, Herts.

15,690. Corsets, T. R. Williams, London.

15,691. Waterproof Mud Shield for Cyclists, J. J. Allan, London.

15,692. Ticket Punches, J. S. Comrie, London.

15,693. Knife-cleaning Machines, H. and E. White, London.

15,694. Electric Arc Lamps, E. H. Maret, London.

15,695. Velocipedes, J. Harrington, London.

15,696. Shirt-front and Stud Protector, E. Palmer, London.

15,697. Operating Valves of Engines, C. E. Beaumont and C. P. Wallington, London.

15,698. Electric Appliances for Boiling Liquids, F. W. Schindler, London.

15,699. Steam Boilers, C. Finger, London.

15,700. Employes' Time Recorders, N. M. Watson, London.

15,701. Stoppering of Bottles, B. M. Persicaner, London.

15,702. Treating Siliceous Material, S. B. Archdeacon, London.

15,703. Packing Cases for Ammunition, J. T. Coffin, London.

15,704. Photographic Cameras, R. Krügener, London.

15,705. Gas Cooking Stoves, C. Holmstrom, London.

15,706. Governing Marine Engines, &c., T. Casson, London.

15,707. Door, &c., Locks, T. Dace and A. Single, London.

15,708. Ventilating Boots and Shoes, W. H. Hunt, London.

15 709. Device for Holding Ropes, T. Lee and J. Edwards, London.

15,710. Bicycles, B. Madoc, London.

15,711. Bottles, R. Hornby, London.

15,712. Drying Voltaic Cells, D. B. Morison, London.

15,713. Tobacco Pipes, W. Y. Yates, London.

15,714. Securing Feminine Apparel, W. F. Beattie, London.

15,715. Device for Heating Irons, J. Rees, London.

15,716. Postal Envelopes, A. A. Hill, London.

15,717. Horseshoes, W. Smith, London.

15,718. Fire-proof Paper, H. H. Leigh.—(*C. B. Schneider, Holland.*)

15,719. Covers for Pneumatic Tires, J. Morran, London.

15,720. Packing Ammunition, W. J. Holt and J. Davis, London.

15,721. Hydrocarbon Engines, W. D. and S. Priestman, London.

18*th August*, 1894.

15,722. Variable Speed Gear, L. Tolch, London.

15,723. Twisting Fibrous Material, J. and R. S. Dawson, Bradford.

15,724. Dirt or Road Scraper, J. Tweedle, Birkenhead.

15,725. Saddles for Cycles, J. B. Brooks, Birmingham.

15,726. Water-tube Boiler, J. T. Jameson.—(*H. MacColl, Spain.*)

15,727. Cleaning Jute, C. Malley, J. Brett, and W. H. Hughes, Liverpool.

15,728. Panel for Painting, R. H. Bentham, Lancashire.

15,729. Preserving Buildings in Case of Fire, R. W. Papineau and C. B. Beresford, London.

15,730. Carding Engines, E. and W. H. Crowther Halifax.

15,731. Hydraulic Rams, P. Decoeur and W. H. Bailey and Co., Ld., Manchester.

15,732. Spindles for Doubling Frames, R. Taylor, jun., Manchester.

15,733. Measuring Distances, E. E. A. Schelin, London.

15,734. Apparatus for Breaking Coal, W. Pegge, Swansea.

15,735. Carbonating Drinks, T. Barker, Bolton.

15,736. Chlorhydric Acid, W. J. C. Marie, London.

15,737. Phonographs, A. Wilkinson, Bradford.

15,738. Heating Cylinders of Steam Engines, F. Hamer, London.

15,739. Spools and Bobbins, F. J. Ermen, Manchester.

15,740. Water-closets, L. Brandis, Germany.

15,741. Tobacco Pipes, C. Fulton and K. Fulton, Lancashire.

15,742 Fastening for Boots, &c., J. B. E. Field, London.

15,743. Apparatus for Flower-pots, W. C. Henderson, London.

15,744. Increasing the Draught in Boilers, H. C. Ashlin, London.

15,745. Supporting Curtains, T. W. Crowther, Liverpool.

15,746. Water-wheels, J. F. Hopkins, jun., Liverpool.

15,747. Coin-freed Gas Meters, H. Simmonds, Manchester.

15.748. Converting Reciprocating Motion into Rotary, F. van der Laan, Liverpool.

15,749. Writing Block Characters, G. C. Dymond.—(*C. A. Schoepff, Germany.*)

15,750. Boiler Furnaces, G. C. Rhodes and W. Topham, Bradford.

15,751. Bottles, J. Lindsay and J. Rogers, London.

15,752. India-rubber Rings for Jug Bottoms, C. R. Aitken, London.

15,753. Collar Stud and Tie Clip, H. Catton, Essex.

15,754. Police Call Whistle, &c., G. S. Rayson, London.

15,755. Repairing Stone Steps, &c., J. Elliott, Hastings.

15,756. Damp-resisting Materials, R. J. Goddard, London.

15,757. Oil Lamps, J. Chandler, Manchester.

15,758. Stage Illusions, J. N. Maskelyne, London.

15,759. Weighing Machines, T. E. Halford.—(*H. Siefert and G. Jaeger, Germany.*)

15,760. Pneumatic Tires for Cycles, W. Reithoffer, London.

15,761. Treating Zinc Ores in Furnaces, R. Biewend, London.

15,762. Metal Teapots and Urns, L. C. Davidson, London.

15,763. Agricultural Machine, P. A. Randall.—(*S. A. G. Hashim, Syria.*)

15,764. Carriage Springs, G. Hughes.—(*V. Candotti, South Africa.*)

15,765. Calendar Stand or Frame, C. Tyler, London.

15,766. Non-slipping Band for Tires, H. W. F. Mogg, London.

15,767. Railway Permanent Ways, H. Causeley, London.

15,768. Device for Fastening Gloves, W. J. Sanders, London.

15,769. Skirt Facing, E. C. Gauge, Bristol.

15,770. Electric Heating Apparatus, J. A. Kingdon, London.

15,771. Preventing Gas Explosions, C. Gautsch, London.

15,772. Confectionery, L. Fulda, London.

15,773. Burning Liquid Fuel, J. L. Osborn.—(*C. Neuhaus, Austria.*)

15,774. Electric Cables, H. A. C. Saunders.—(*R. Grecy and W. J. Murphy, ———.*)

15,775. Fire-resisting Curtains, &c., E. Taylor, London.

15,776. Cigarette Machines, G. A. Wills.—(*D. B. Strouse, United States.*)

15,777. Invert Sugar, J. Y. Johnson.—(*J. E. Pellegrini, Spain.*)

15,778. Alcohol, J. Y. Johnson.—(*J. E. Pellegrini, Spain.*)

15,779. Ink Stands, C. R. Söderström, London.

15,780. Manufacture of Soap, G. Stecken, London.

15,781. Roller Skates and Vehicles, G. Fauquet, London.

15,782. Carbon, C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell, London.

20*th August*, 1894.

15,783. Rails of Tramway Permanent Way, H. Cockill, Bradford.

15,784. Furnace for Heating Steel, &c., J. Immel, Berlin.

15.785. Self-acting Wheel, W. Shaw, Cumberland.

15,786. Joint Horse Bit, P. Spohr, Manchester.

15,787. Carbonising Machine, G. and J. E. Tolson, Dewsbury.

15,788. Rotary Engines, T. Firth, London.

15,789. Thermodynamic Motors, F. W. Crossley and J. Atkinson, Manchester.

15,790. Stable or Storm Lanterns, A. Shaw, Kilmarnock.

15,791. Dustbin, E. F. Thorpe, London.

15,792. Corrugated Sheet Glass, W. L. Pilkington, Liverpool.

15,793. Insect Traps, J. D. McNally, Liverpool.

15,794. Device for Moistening Labels, J. Grant, Derby.

15,795. Keels for Yachts, J. Leach, Southampton.

15,796. Automatic Inflated Sock for Boots, L. Wacks, Leicester.

15,797. Course and Heel Indicator, J. C. Dobbie, Glasgow.

15,798. Banjos, C. A. W. Drury, Bristol.

15,799. Oilers, T. H. Price and F. Westwood, Birmingham.

15,800. Waste Water Flushing Apparatus, J. Clayton, Denton.

15,801. Stop Valves, A. Turnbull, Glasgow.

15,802. Motors, J. Maynes and C. L. Watchurst, London.

15,803. Extinguisher for Lamps or Stoves, J. H. Ross, Birmingham.

15,804. Brooding Apparatus, J. Koch, Berlin.

15,805. Making Combustible Capsules, P. Nussbaum, London.

15,806. Wet Spinning Frames, J. Gamble and A. Combe, Halifax.

15,807. Winding Machines, A. Combe, Halifax.

15,808. Making Boots and Shoes, T. J. Paxton, Northampton.

15,809. Wicker Mud-guard for Velocipedes, J. Ives, London.

15,810. Pocket, G. W. More and H. C. Trulock-Campbell, London.

15,811. Chimneys, F. Jacks, Liverpool.

15,812. Springs for Cycle Saddles, T. Middlemore, W. A. de Lattre, and T. Evans, London.

15,813. Sewing Machines, F. A. Mills and J. Mundell, London.

15,814. Boxes for Powdered Substances, &c., G. H. Watkins, Liverpool.

15,815. Apparatus for Spinning Flax, J. V. Eves, Manchester.

15,816. Automatic Telegraph Apparatus, P. Douglas, Liverpool.

15,817. Stoves, J. Strecker, London.

15,818. Manufacture of Fireclay, &c., F. Young, Liverpool.

15,819. Curtain Slide for Magic Lantern, G. Davenport, London.

15,820. An Improved Bed Castor, W. J. Hobbs Margate.

15,821. Marking Stamps, C. H. Thompson, London.

15,822. Indicating the Names of Stations, W. Ralston, Manchester.

15,823. Oil Stoves, E. Rippingille and W. Brandon, London.

---

[*] "Proceedings," Institution of Civil Engineers, vol. cxv., 1893—94.

15,824. Pneumatic Tires, H. S. Phillips, London.
15,825. Electric Cartridges, H. Brocklehurst and H. Constien, London.
15,826. Shaft Couplings for Vehicles, G. Brownlees and R. C. Miller, London.
15,827. Files for Letters, F. W. Golby.—(*E. Hélie, France.*)
15,828. Cycle Gear, C. A. Allison.—(*A. M. Martin, Australia.*)
15 829. Axle Files, J. B. Baugh, London.
15,830. A Fire-guard Flap, H. T. Dobson, London.
15,831. Stand for Holding Office Maps, S. Sachs, London.
15,832. Barb Wire, E. Schöneberg, London.
15,833. Manufacture of Beer, A. W. Billings, London.
15,834. Bricks, H. Wood, London.
15,835. Boys' Knitted Drawers, R. M. Appleton, London.
15,836. Printing Inks, B. Angel and T. W. Lack, London.
15 837. Machines for Stitching Buttons, W. Beecroft, London.
15,838. Pipe Valve Testing Apparatus, E. Berg, Berlin.
15 839. Chain Loops or Suspenders, M. Guttmann, London.
15,840. Raising Windows, W. G. F. Garland and W. Shears, London.
15,841. Penknives for Penholders, W. C. Prideaux, London.
15,842. Fly Netting, F. J. Coltman and A. Whitby, London.
15,843. Telegraphic Transmission, L. Boudet and P. Lacombe, London.
15,844. Pneumatic Tires for Wheels, T. Rouse, London.
15,845. Swinging Gates, W. R. White, London.
15 846. Tin Openers, H. Saqui, H. N. Brent, and F. Marsh, London.
15,847. Precipitating Precious Metals, H Sulman, London.
15,848. Increasing Tenacity of Metals, A Newton.—(*A. Nobel, France* )
15,849. Projectiles, A. V. Newton.—(*A. Nobel, France.*)
15,850. Discs for Weavers' Beams, C. Diederichs London.
15,851. Cooking Range for Coal or Gas, A. Stecke, London.
15 852. Wood Screw-cutting Machine, H. Weiland, Germany.
15,853. Advertising Wheel, S. W. Halfyard, jun., London.
15,854. Machinery for Painting, &c., A. Slater, London.
15,855. Machine for Cutting Mortices, A. Slater, London.
15,856. Apparatus for Housing Timber, A. Slater, London.
15857. Manufacture of Barley or Groats, M. Martin, London.
15,858. Permanent Ways, J. Claret and O. Wuilleumier, London.
15,859. New Dye Manufacture, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
15 860. Pins for Suspending Garments, L. Heinemann, London.
15,861. Fixing Rubber Tires to Iron Tires, C. Burkill, London.

21*st August*, 1894.

15,862. Razor Strop, F., R., and O. Kampfe, London.
15,863. Grating Box and Door Trap for Sewers, W. Stead, Leeds.
15,864. Cork Handle, W. Ashworth, Dukinfield.
15,865. Driving Gear for Cycles, J. Monk, T. Ainsworth and J. Lang, Preston.
15.866. Govenor for Steam Engines, &c., J. P. Hall, Manchester.
15.867. Pull Handles, T. R. Leigh, Manchester.
15.868 Safety Cock, G. T. Ellis, Birmingham.
15,869. Divisonal Trays for Bottles, T. Hill, Kingston-upon-Hull.
15.870. Foot Presses, J. Bates, Birmingham.
15.871. Locks for Cycles, C. A. and F. J. Miller, Birmingham.
15,872. Cycles, J. Hargreaves, Manchester.
15,873. Match Boxes, H. Burnham, London.
15,874. Spinning and Doubling Frames, A. Hitchon, Accrington.
15,875. Method of Fixing Wood Paving, L. Walker, London.
15,876. Propellers for Canal Boats, F. Aldritt, Dublin.
15,877. Wet Spinning Frames, J. Barbour, Belfast.
15,878. Fire Lighter, A. W. Burgess, Worcester.
15,879. Feathering Paddle Wheels, J. W. Lampson, Glasgow.
15.880. Preserving Trousers, &c., P. H. Sauerbier, Glasgow.
15,881. Filtering Apparatus, W. Oliphant, London.
15,882. Bicycle Lock, R. M. Fenn, Nottingham.
15,883. Smoking Pipe, E. Brown, Manchester.
15,884. Handles for Files, &c., J. W. Whittington, Sheffield.
15.885. Non-heat-conducting Materials, J. C. S. McLay, London.
15,886. Manufacture of Chlorine, S. A. Sadler and R. H. Wilson, London.
15,887. Explosive Compounds, G. J. Buechert, London.
15,888. Explosive Fluid Engines, A. Rigg, London.
15,889. Wheels and Carriages, J. Fage and W. Dimes, London.
15.890. A Sciographic Set-square, J. H. Spanton, Dartmouth.
15.891. A New Metallic Alloy, R. A. Smith, London.
15,892. Press for Holding Bacon, G. J. Perry, Croydon.
15,893. A Device for Fastening Gloves, J. Riley, London.
15,894. Wire Safety Pin, J. Riley, London.
15,895. Closing Plaquet-holes, H. W. Wilson, London
15,896. Nut-locks, D. M. Fulton, London.
15,897. Lamps, E E. Hantz, A. Hantz, and A. Hantz, London.
15,898. Driving Gear for Velocipedes, G. Jellinek, London.
15,899. Copper Castings, Siemens Bros. and Co., Ld. —(*E. Obach, Germany.*)
15,900. Shunt Arc Lamps, Siemens Bros. and Co., Ld. —(*Messrs. Siemens and Halske, Germany.*)
15,901. Safety Fittings for Pockets, H. Adler, London.
15,902. Drawing Rods, A. C. and J. L. Wright and T. Mansfield, London.
15,903. Atomisers or Spray Producers, H. M. Dunlap, London.
15,904. Velocipedes, C. Beard, London.
15,905. Pianos, A. J. Harland, London.
15,906. New Alimentary Product, &c., I. Gilson, London.
15,907. Bottling or Filling Machines, J. J. Varley, London.
15,908. Screw Stoppers for Bottles, J. J. Varley, London.
15,909. Pneumatic Tires for Wheels, J. S. Smith, London.
15,910. Preventing Collisions, R. Haddan.—(*F. Robine, France.*)
15,911. Granulating Mills, F. W. Eddy, London.
15,912. Manufacturing Cork Boards, F. W. Eddy, London.
15,913. Manufacturing Cork Boards, F. W. Eddy, London.
15,914. Artificial India-rubber, A. V. Newton.—(*A. Nobel, France.*)
15,915. Fastening Wearing Apparel, N. Bergheim, London.
15.916. Cutting Cards with Bevelled Edges, B. McHugh, London.
15,917. Locks, K. E. Ebert, London.
15,918. Automatic Controlling Valves, H. A. House, H. A. House, jun., and R. R. Symon, London.
15,919. Manufacture of Beer, L. Wagner and J. Marr, London.
15,920. Primary Batteries, G. H. Reid, London.
15,921. Electrical Propulsion of Boats, A. G. New and A. J. Mayne, London.
15,922. Fluid-pressure Brakes for Railway Cars, C. R. James, London.
15 923. Machine Sheep Shears, P. M. Justice.—(*W. M. Noakes and E. J. Clarkson, Australia* )
15,924. Landing Nets, A. Holmes. London.
15,925. Railway Couplings, J. W. Tolar and B. D. Langston, London.
15,926. Picks, J. Z. Coblens, London.
15 927. Inside Shoes, J. H. Foss, London.
15,928. Apparatus for Winding Yarns, T. Coulthard, jun., London.
15,929. Letter or Figure, G. Upson and J. Fitzgerald, London.
15,930. Journal Boxes, W. W. Wainwright, London.
15,931. Bicycles, F. W. Brewster, London.
15,932. Spring Holders or Clips, E. J. Pettersson, London.
15,933. Barrel Heads, G. C. Dymond.—(*W. C. Blundell and G. P. Dold, United States* )
15,934. Ink Reservoir for Pens, C. Smith.—(*J. F. S. Wallace, China.*)
15,935. Boots, G. A. Kelly, London.
15,936. Window Fasteners, C. Parsons, London.
15,937. Locking Railway Carriages, W. McKenna, London.
15,938. Grinding Scissors or Knives, J. E. Smith, London.
15,939. Garters, M. Chalcroft, London.
15,940. Wooden Wheel Rims, H. H. Leigh. — (*The Indiana Novelty Manufacturing Company, United States.*)
15,941. Manufacture of Cyanides, J. E. Chaster, London.
15 942. Manufacture of Cyanides, J. E. Chaster, London.
15,943. Printing, J. H. Corthésy, Richmond.
15,944. Pressing Bricks and Tiles, J. and B. Craven, London.
15,945. Making Ethylene, J. Y. Johnson. — (*J. E Pellegrini, Spain.*)

22*nd August*, 1894.

15,946. Sluice Gate, R. G. Kennedy, London.
15,947. Pneumatic Tires for Cycles, A. Black, Glasgow.
15,948. Mathematical Instruments, P. J. Wilson and W. E. Wright, Sheffield.
15,949. Acquiring the Art of Telegraphy, J. Cocking, Sheffield.
15,950. Pneumatic Tires, J. W. Brown and T. Buckton, Halifax.
15,951. Mattresses, Chairs, and Seats, W. M. Jones, London.
15,952. Distributing Steam, W. Osborne, Gateshead-on-Tyne.
15,953. Syphons, J. Davey, Hitchin.
15,954. Receptacles for Holding Coin, J. Walker, Birmingham.
15,955. Horseshoe, W. Birch, Hatfield.
15,956. Fixing Screen Bars for Disintegrators, G. P. Wallis, Leeds.
15,957. Cutting Circular Holes in Iron, A. Trickett, Sheffield.
15,958. Devices for Holding Cords, &c., G. Glasson, Derby.
15,959. Photographic Cameras, W. E. Hickling, Leicester.
15,960. Collar Stud and Tie Fastener, J. R Forsyth, Glasgow.
15,961. Ascertaining the Depth of Liquids, T. Bassnett, Liverpool.
15,962. Carriage Lock, R. M. Fenn, Nottingham.
15,963. Economising Household Fuel, J. I. Cooper, Sheffield.
15,964. Machines for Separation of Metals, A. E. Old, Birmingham.
15,965. Manufacture of Creels for Fishermen, M. H. Todd, Bradford.
15,966. Velocipedes, T. P. Wood, Bristol.
15,967. Mounting Bicycle Seats, J. J. Atkinson, Cosgrove Priory.
15,968. Non-return Valves and Cocks, T. W. Moon, Brighton.
15,969. Apparatus for Fastening Envelopes, F. C. Lynde, Manchester.
15,970. Hearth Brooms and Brushes, G. Roberts, London.
15,971. Night Commodes, H. Edwards, Portsmouth.
15,972. Flower-pot Stands, D. O. Bagg, Birmingham.
15,973. Identifying Hats, R. J. Bellamy and T. Morton, Birmingham.
15,974. Children's Mail-carts, E. J. Humphry, Birmingham.
15,975. Adjusting the Seats of Dog-carts, H. Alderton, Birmingham.
15,976. Manufacturing Confectionery, P. S. Alexander, Glasgow.
15,977. Igniting Matches, R. W. Anderson, Liverpool.
15,978. Electro-medical Appliances, A. I. Grabham, Leeds.
15,979. Flyers for Spinning Machines, E. Perks and H. Fernie, Birmingham.
15,980. Keys for Chairs for Railways, &c , E. Jones, Sheffield.
15,981. Operating the Blast Pipe of Furnaces, T. Langer, London.
15,982. Paint, D. Williams, Liverpool.
15,983. Apparatus for Cutting Stone, A. McGugan, Manchester.
15,984. Cultivation of Asparagus, B. von Maltzahn, Manchester.
15,985. Electric Arc Lamps, W. H. Akester and H. H. Price, London.
15,986. Collapsible Dog Kennels, G. W. Green, Laleham, near Staines.
15,987. Appliances for Treating Crushed Mineral Ores, L. F. Gowans and E. G. Appleby, Manchester.
15,988. Drop Keels for Yachts, W. B. Powell, London.
15,989. Wheels for Cycles, &c., B. L. Watkinson, London.
15,990. Testing the Nature of Sub-soils, J. L. Wood, Whetstone.
15,991. Boxes, Show Cases, and the like, C. Clifford, London.
15,992. Ink-pots, A. E. Rice and C. R. Parker, London.
15,993. Sun Blinds and the like, J. Woodger, London.
15,994 Construction of Boats, &c., J. C. Martin, London.
15,995. Storing Stamped Envelopes, J. Mccredy, London.
15,996. Bat Handle, C. H. Bull, London.
15,997. Eye-glass Frames, R. B. Fowler, London.
15,998. Impressing Advertisements, A. Pontefract, London.
15,999. Invalid Bedsteads, G. E. Gorham, London.
16,000. Bucket for Pumps, R. F. Hall, London.
16,001. Material for Protecting Clothing, P. Mercier, London.
16,002. Refining Metal, H. A. House, H. A. House, jun., and R. R. Symon, London.
16,003. Umbrella Frames, H. Ellis and B. G. Coleby, London.
16,004. Securing Trousers, I. Levy, London.
16,005. Air-tight Coverings for Jars, F. E. Hollyer, Brentford.
16,006. Cover for Pickle Bottles, H. S. T. Biscoe, London.
16,007. Coin-freed Mechanism, G. F. Gale and A. B. Holmes, London.
16,008. Umbrella and Parasol Frames, S. Learoyd, London.
16,009. Tie and Cuff Clip, M. Pelegrin, London.
16,010. Window Sash Fastener, C. L. Polden, London.
16,011. Gates, F. L. Godfrey, London.
16,012. Rowing Apparatus, E. Pink, London.
16,013. Ruling Device, A. R. Phillips, London.
16,014. Producing Solid Persulphate of Sodium, R. Loewenherz, London.
16,015. Tool for Cutting Chips, K. A. Seifert, London.
16,016. Velocipedes, E. C. F. Otto, London.
16,017. Envelopes, S. W. Pedley, London.
16,018. A Clip for Securing the Ends of Bags, J. A. Jacobs, London.
16,019. Pull-out Drawers, C. Hass, London.
16,020. Appliance to Issue Disinfecting Paper, H. S. T. Biscoe, London.

23*rd August*, 1894.

16,021. Pivot Sash, C. Buchanan and J. Barr, Glasgow.
16,022. Apparatus for Securing the Doors of Hoists, B. Wright, London.
16,023. Ceiling Decoration, M. Smith, Liverpool.
16,024. Machines for Cleaning Boots, F. W. Follows, Manchester.
16 025. Bag Blue, R. Ripley, Liverpool.
16,026. Joining Earthenware and Metal Pipes, J. M. Ball, Manchester.
16,027. Steel Wire Winding Ropes, W. B. Brown, Liverpool.
16,028. Apparatus for Ice-making, &c., A. Glasson, London.
16,029. Drawing of Circular Arcs, T. Clarkson, Sutton.
16,030. Button-holes, A. M. Heath, London.
16,031. Window Sashes, J. P. Sinclair, Glasgow.
16,032. Flour Reduction Machine, A. R. Tattersall, London.
16,033. Covers to Tobacco Pipes, R. W. Tayler, Bury St. Edmund's.
16,034. Hair Crimpers, H. Maudsley, Accrington.
16,035 Cycles, D. P. Schloss and C. S. Madan, Manchester.
16.036. Lamp-globe Holders, D. H. Croll and C. de'Vere Grant, Hertford.
16,037. Method of Fastening Hampers, T. Reed, London.
16,038. Cabin Trunk, H. A. Norman, Liverpool.
16,039. Illuminating Designs for Leather, W. Evans, Walsall.
16.040. Manufacture of Fluorescent Soaps, S. Neumann, Manchester.
16,041. Coating of Metals, W. K. Greenway, Birmingham.
16,042. Fire-arms, W. Mitchell, Southampton.
16,043. Kilns for Burning Limestone, W. Spencer, Keighley.
16,044. Drawing-off Water from Ships' Decks, W. Collinson, Stockton-on-Tees.
16,045. Device for Holding Food, H. Thompson, London.
16.046. Raising Weights, H. Clark, Stockton-on-Tees.
16,047. Burners for Gas Fires, H. Darwin, Glasgow.
16,048. Sewing Machines, J. Fletcher and C. Brown, Halifax.
16,049. Spring Tongues for Bottle Necks, C. H. Fernley, Manchester.
16,050. Hooks for Securing Boot-laces, F. J. Commin, Exeter.
16,051. Disinfecting Public Buildings, G. Bullock, London.
16,052. Window Sash Fastener, R. Whitehead, Sheffield.
16.053. An Improved Candlestick, S. L. Jones, Bristol.
16,054. Cycle Saddle Attachments, D. A. Martin, Birmingham.
16,055. Extracting Juice from Canes, A. G. Berry, Glasgow.
16,056. Covering Ricks of Hay, &c., S. Harding, Bristol.
16,057. Hairpins, C. Crowther, Manchester.
16,058. Water Heaters, J. Yates and W. Yates, Manchester.
16,059. Coin-freed Apparatus, R. Massow, Manchester.
16,060. Driving Gear for Cycles, J. J. Raggett, Birmingham.
16,061. Adjusting Cycle Handles, G. Patterson, Birmingham.
16,062. Domestic Boilers, T. and W. Slater, and W. Crumblehulme, London.
16.063. Cases for Medicine Bottles, W. Oppenheimer, London.
16,064. Blankets, R. M. Bell, Llanidloes.
16,065. Tobacco Pouch, J. H. Edgar, Droylsden, near Manchester.
16,066. Fishing Lines, C. W. Aitken and A. Kay, Edinburgh.
16,067. Making Hydrosulphurous Acid, J. Grossmann, Manchester.
16,068. Making Hydrosulphurous Acid, J. Grossmann, Manchester.
16,069. Roller Blind Furniture, G. Burn, Birmingham.
16,070. Combined Letter Sheet and Envelope, D. McIntyre, Glasgow.
16,071. Extraction of Gold and Silver, H. R. Angel, London.
16,072. Tramcars and similar Vehicles, E. Böhm, London.
16,073. Decoration of Glass, E. Böhm, London.
16,074. Fastening Wire, T. Pike and S. Payne, London.
16,075. Appliances for Branding Animals, G. Daws, London.
16,076. Double Cock for Beer Engines, J. Systermans, London.
16,077. Air Valve, J. Schiönning and J. P. Möller, London.
16,078. Relief Stamping Machines, T. B. Kendell, London.
16,079. Casks, R. Perron, London.
16,080. Fare Indicators for Vehicles, O. Schneider, London.
16,081. Steam Engines, B. Lebrun, London.
16,082. Velocipedes, O. Wartmann, London.
16,083. Ethenyldiphenylamidines, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
16,084. Rolling Mills, A. Thomas, London.
16,085. Paper Boxes, H. H. Lake.—(*E. H. Taylor, United States.*)
16,086. Surgical Trusses, &c., F. T. Simmons, London.
16,087. Artificial Fuel, G. S. Cory and C. Cory, London.
16,088. Postal Envelopes, E. Guesdon, London.
16,089. Travelling Boxes, &c., A. M. Jones, London.

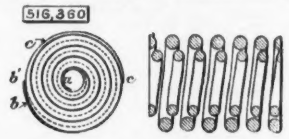
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**516,360.** Spring, *G. Turton, Sheffield, England.—Filed March 16th*, 1893.

*Claim.*—(1) A compound or multiple spring consisting of inner and outer coils connected or united at one point in their length substantially as described, and formed of bars of such relative length that they terminate at diametrically opposite points in the spring, as and for the purposes above specified. (2) A volute spring consisting of inner and outer coils formed of bars tapered at both ends, which bars are connected or united at one end, and are of such relative length that they terminate at diametrically opposite points in the spring, and thus form a stable base therefor, substantially as and for the purpose above specified. (3) A compound or multiple spring consisting of the coils *b c* connected or united at *a*, and terminating at diametrically opposite points *b' c'*, substantially as and for the purposes above specified. (4) A spring consisting of inner and outer coils united at one point in their length, and having a conical or taper portion A—B and a parallel or cylindrical portion A—C at the smaller end thereof, substantially as hereinbefore described

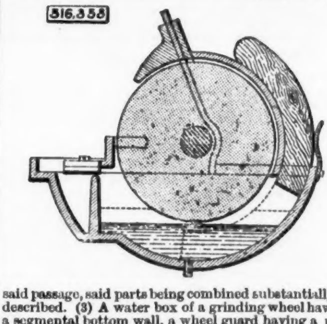
516,360



**516,353.** Water Box of Grinding Wheels, *F. M. King, Philadelphia, Pa. — Filed September 19th*, 1893.

*Claim.*—(1) A water box of a grinding wheel having a wheel guard with a rear wall forming a passage between it and the bottom wall of the box, a plug movable in said passage, and means for retaining said plug in place, said parts being combined substantially as described. (2) A water box of a grinding wheel, a wheel guard having a rear wall forming a passage with the bottom wall of the said box, and a plug fitting in said passage, said parts being combined substantially as described. (3) A water box of a grinding wheel having a segmental bottom wall, a wheel guard having a rear wall forming a passage-way with said segmental bottom wall, a movable plug fitting in said passage-way, and a catch bearing against said plug, said parts being combined substantially as described.

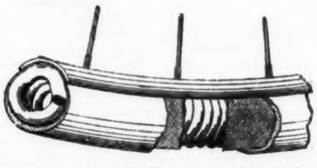
516,353



**516,201.** Wheel Tire, *E. Grenet, Paris, France.—Filed July 7th*, 1893.

*Claim.*—A tire consisting of an outer casing of flexible material and a continuous coil of rubber spirally arranged within the casing, substantially as described.

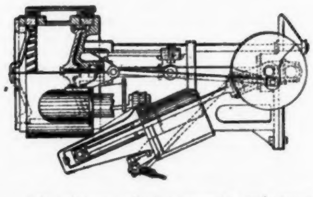
516,201



**516,442.** Blowing Engine, *C. A. Klotz, Vallejo, Cal.—Filed May 22nd*, 1893.

*Claim.*—The inverted vertically acting air compression cylinder provided with admission and discharge ports, an inclined steam cylinder in the same plane, with the axis converging to the centre of the common crank shaft, with which both pistons are connected by approximately oppositely fixed cranks, counterbalance weights on said crank shaft, a cylindrical valve surrounding the air cylinder, excentric rods connecting with pins projecting from the outer faces of the counterbalance weights, whereby the air valve is reciprocated and counterbalanced, and a connection between said excentric rod and the rocker arm of the steam cylinder valve, whereby the latter is actuated simultaneously and from the same excentric, substantially as herein described.

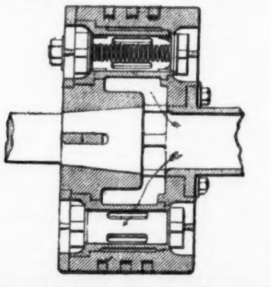
516,442



**516,594.** Fluid Pressure Engine, *G. Dixon, Bolton.—Filed August 16th*, 1893.

*Claim.*—The combination of an engine cylinder provided at each end with a port or ports serving alternately as a steam port and as an exhaust port, valves for controlling the admission of steam and exhaust of motive fluid, a hollow piston formed at its respective sides with ports controlled by non-return valves, springs that normally hold said valves against their seats but each adapted to permit the appropriate valv or valves to automatically open when the pressure at either side of said engine piston falls below that of the hot gases supplied to the interior of said piston, a pump cylinder provided at its ends with inlets for hot gases controlled by non-return valves, a hollow pump piston formed at its respective sides with inlet ports fitted with non-return valves opening inward, springs adapted to hold said valve against their seats at each suction stroke of the pump piston and to permit said valves to open during each compression stroke, and a hollow rod connecting the engine and pump pistons and serving to place the interior of the one in communication with that of the other substantially as described.

516,594



# NOTES ON THE STRENGTH OF FRAMED STRUCTURES AS AFFECTED BY ELASTICITY.

By C. F. FINDLAY, M.A., M. INST. C.E.

(*Concluded from page* 118.)

## SECTION II.—SECONDARY BRACING.

BY this term we mean the bracing by which the main elements of a built-up tie or strut are connected together, in order to enable it to resist stresses of various kinds other than the primary stress, and also in order to check vibration. In regard to the latter, it need only be said that however desirable it may be to avoid the use of long, unsupported, light ties which vibrate freely under moving loads, there is no reason to suppose that such transverse vibrations give rise to appreciable stresses, or are any direct source of weakness. They may be *indications*, but they are not causes of variations of stress with moving loads. The vibration of a bridge—*as a whole*—in the vertical plane is, on the other hand, some sort of measure of the variations of stress due to the impacts of a moving load. It is accompanied by variations of stress in each member of the bridge, and the secondary bracing does nothing to check those variations.

The purposes which secondary bracing serves directly are (1) in struts or columns to resist distortion by flexure; and (2) to give the transverse strength necessary to prevent the weight of the link itself from causing appreciable flexure. As regards the latter purpose, where the weight and length of the link are considerable, its effects can be calculated and allowed for in the scantlings; and, when this is done, it may be desirable to give the link an upward camber, such that its own weight will bring its axis into a straight line, or nearly so. For secondary bracing in general, it seems to be commonly supposed that it takes no share in the primary stress, and that, so long as it is sufficient in amount, the disposition of it is a matter of no consequence. As soon as the deformation begins to be considered, however, it is clear that the primary stress must necessarily be shared by the bracing. The fact that it has been allotted a separate *rôle* by the designer will not prevent it from taking such stress as its place in the structure assigns to it. Consider, for instance, a strut braced as in Fig. 8, all the bracings making the same angle $\alpha$ with the main ribs of the strut. Let S be the section of the main ribs 1, 2, 3, &c., and $m$ S the section of the bracings 5, 6, &c. Let W be the load on the strut. Then

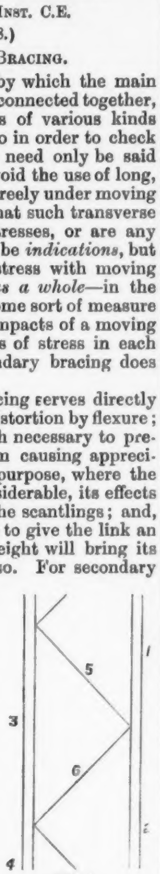


FIG. 8

$$\left.\begin{aligned} -\mathrm{W} &= \mathrm{S}\,(t_1 + t_3 + m\,t_5 \cos\alpha) \\ &= \mathrm{S}\,(t_3 + t_2 + m\,t_6 \cos\alpha) \\ \text{and}\qquad m\,\mathrm{S}\,(t_5 \sin\alpha + t_6 \sin\alpha) &= 0 \end{aligned}\right\}$$

$$\left.\begin{aligned} \text{whence}\qquad t_5 &= -\,t_6 \\ \text{and}\qquad t_1 - t_2 &= 2\,m\,t_6 \cos\alpha \end{aligned}\right\}$$

These equations indicate two possible conditions of equilibrium. Either the strut may widen out, as it shortens under stress, to such an extent that the bracing bars remain of the same length as before and are not strained at all, or it may take a definite flexure by which alternate bars will be in tension and compression. The former would be an unstable condition, which could scarcely occur in practice. In the latter condition, which would in practice be the only possible one, we see that there would be a constant transfer of the load from one side of the column to the other throughout its whole length. The bracing itself, therefore, causes a flexure, such as is shown exaggerated in Fig. 9, to occur.

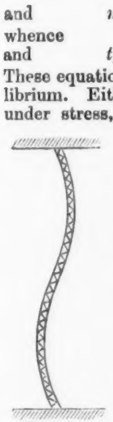


FIG. 9

It is only where the bracing is of the symmetrical character shown in Fig. 10, that the column can contract without flexure. Let $\alpha$ be the angle made by the diagonals with the main ribs, and $S_1$, $S_2$, $S_3$, the cross-sectional areas of the members denoted by these figures.

By static resolution

$$\left.\begin{aligned} -\mathrm{W} &= 2\,t_1\,\mathrm{S}_1 + 2\,t_2\,\mathrm{S}_2 \cos\alpha \\ t_3\,\mathrm{S}_3 + 2\,t_2\,\mathrm{S}_2 \sin\alpha &= o \end{aligned}\right\} \quad \begin{aligned} &\ldots\ (\mathrm{I.}) \\ &\ldots\ (\mathrm{II.}) \end{aligned}$$

The condition that there is no flexure is, that the angle between 1 and 3 remains at a right angle. From the formula in section (I.) this condition is expressed by the equation :—

$$(t_2 - t_1) \cot\alpha + (t_2 - t_3) \tan\alpha = o$$
$$\text{or } t_1 \cos^2\alpha = t_2 - t_3 \sin^2\alpha \quad \ldots\ (\mathrm{III.})$$

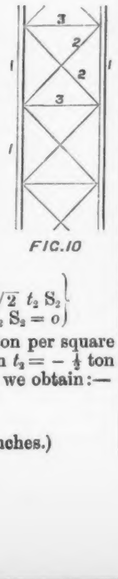


FIG. 10

Now, $t_1$ is negative, and by Equation II., $t_2$ and $t_3$ are of opposite signs; therefore $t_2$ is negative, and $t_3$ is positive. That is to say, $t_2$—by Equation I.—shares in supporting the load in a degree depending on the section given to the diagonals and main ribs respectively, and $t_3$ is a tension, sufficient to resist the outward thrust tending to widen the column. Clearly for economy it is desirable to reduce $S_2$ and $S_3$ as low as possible. At the same time $t_3$ should be small, in order that the column should spread very little, and so the secondary stress be small.

$$\text{Suppose } \alpha = 45 \text{ deg.}\quad \text{Then } \left.\begin{aligned} t_1 &= 2\,t_2 - t_3 \\ -\mathrm{W} &= 2\,t_1\,\mathrm{S}_1 + \sqrt{2}\;t_2\,\mathrm{S}_2 \\ t_3\,\mathrm{S}_3 + \sqrt{2}\;t_2\,\mathrm{S}_2 &= o \end{aligned}\right\}$$

If we allow, for example, $t_3$ to be one ton per square inch, and $t_1 = -\,2$ tons per square inch, then $t_2 = -\,\frac{1}{2}$ ton per square inch. Substituting these values we obtain :—

$$\left.\begin{aligned} \mathrm{S}_3 &= 0{\cdot}7\ \mathrm{S}_2 \\ \text{and } 4\,\mathrm{S}_1 + \mathrm{S}_3 &= \mathrm{W} \end{aligned}\right\}$$

(W being in tons, and S in square inches.)

In order that $t_1$ and $t_3$ may have the assumed values, it is sufficient, therefore, that the sections be chosen making $\mathrm{S}_3 = \frac{7}{10}\,\mathrm{S}_2$ and $\mathrm{S}_1 = \frac{\mathrm{W} - \mathrm{S}_3}{4}$. It is clear that the smaller $S_2$ and $S_3$ are, the smaller is the amount of material used in the column, and that increase of section in the bracings does not necessarily imply greater strength.

On what principle, then, can we determine what strength of bracing should be used for a given column? Practice at present varies exceedingly and capriciously. A rational basis may be found as follows:—Suppose it is decided, according to any column formula adopted, that the proper mean stress for a given column is $t$ tons per square inch, while the safe load for a short specimen of the same material is $t^1$ tons per square inch—*i.e.*, let it be assumed that the stress in the innermost or most strained fibres may safely amount to $t^1$. The width of the column is supposed to be so fixed that when the stress $t^1$ in the extreme fibres is reached, the flexure of the column will not exceed the small limits consistent with the safety of other members of the structure.

The stress in the outermost fibres would be $2\,t - t^1$, if the column is symmetrical, when that on the innermost fibres is $t^1$. It follows that the column has been designed to resist safely a bending moment amounting to

$$\frac{2\,(t^1 - t)}{d} \times \mathrm{I},$$

in addition to the uniformly distributed stress of $t$ tons per square inch, where $d$ is the total width of the column and I the moment of inertia of cross-section. Now, it can be shown by the method of investigation in the appendix to Section I., that the transverse shearing stress on the column will have a maximum value of nearly $\frac{2\,\mathrm{M}}{l}$, where M is the maximum bending moment.

$S_1$, the transverse shearing stress in the column to be provided against, is therefore $\frac{4\,\mathrm{I}}{l\,d}\,(t^1 - t)$. Since $\mathrm{I} = \frac{\mathrm{P}\,\rho^2}{t}$, where $\rho$ is the radius of gyration, and P the load on the strut, this expression may be written

$$\mathrm{P} \times \frac{4\,\rho^2}{l\,d}\left(\frac{t^1}{t} - 1\right).$$

Take the case of a latticed strut in the American truss bridge referred to above. It is 25ft. long between bearings, 1ft. wide, with a radius of gyration of 4in., and a total stress of 21 tons. Suppose $t^1 = 5$ tons per square inch, $t = 1{\cdot}5$ (see Table III., page 162),

$$\text{shearing stress} = 21 \times \frac{4}{9 \times 25} \times \frac{7}{3} = 0{\cdot}9 \text{ tons nearly.}$$

It may at first sight seem contradictory to establish relations between the sections on the supposition that no flexure occurs, and then to determine the strength of the bracing on the assumption of flexure. There is really no contradiction, however. The desirable condition is that of no flexure, and the column should be so designed that such a condition should be possible. We may fulfil that condition, and still the scantlings necessary for the bracings are indeterminate, though the ratios of one to another can be settled. Having thus made the best condition for the column a *possible* one, we turn to another view of the case and make the worst condition a *safe* one.

## SECTION III.—RESISTANCE AT BEARINGS.

As pointed out at the outset, it is assumed in the usual methods of calculating frames that one point of the frame is fixed and another free to move without resistance on a given straight line, while otherwise the frame is free from all constraint. In the case of bridges of large size, the usual method by which it is attempted to realise this condition is that of supporting the main girders on curved bearing blocks, which leave the girders free to change their inclinations at the bearings, while the blocks at one end rest on rollers placed upon a level bed-plate, which is supposed to provide the means of longitudinal expansion. This apparatus, as usually constructed, is very far from realising the ideal condition contemplated by the calculations.

With small bridges and with roof trusses, it is usual to provide for expansion by leaving one end free to slide on a horizontal plate. There are many other cases of frames where no provision for expansion is made at all, and where, nevertheless, the calculations are made as if there was no constraint, as, for instance, in the frequent case of the purlins of an iron roof.

Where provision is made for expansion, it is usually regarded as being required on account of changes of temperature only. Very little consideration, however, is needed to show that, generally speaking, the same provision is equally essential to the theory, on account of the deformations of the frame when strained. In a girder, it is only the points lying on the neutral axis which do not change their horizontal distances from each other under strain, and the bearings of a girder are rarely placed on the line of the neutral axis. The horizontal movement on the expansion bearing of a bridge, which would take place from this cause if no resistance were offered, is quite comparable with the expansion from rise of temperature. If $t_1$ and $t_2$ be the stresses per square inch caused in the booms by certain loads—of which $t_2$ is negative—$t_1$ and $t_2$ being supposed constant throughout the girder, then the spread of the supports owing to deformation by these loads is approximately $\frac{l}{d} \times \frac{t_1 - t_2}{\mathrm{E}} \times a$, where $l$ is the span, $d$ the depth, and $a$ the distance below the neutral axis at which the girder is supported. When, as is usually nearly the case, the supports are in the line of the axis of one of the booms, this expression becomes $\frac{t_1}{\mathrm{E}}\,l$, or $\frac{t_2}{\mathrm{E}}\,l$, as the case may be. In the illustrations already used in Section (I). both bridges are supported somewhat below the axis of the lower boom. For the English bridge $t_1$—from live load only—is about 2·2, and in the American bridge 2·9, so that the horizontal movement at the bearing, taking $l$ as 150ft. and E as 11,000 tons, due to the imposition of the full moving load, is in the one case $\frac{2{\cdot}2 \times 1800}{11{,}000}$, and in the other $\frac{2{\cdot}9 \times 1800}{11{,}000}$, measured in inches, or in one case 0·33in. and in the other 0·47in. These amounts are equal respectively to the expansion due to a rise of temperature of 27 deg. Fah. in one case and 39 deg. in the other.

With a rapidly moving load, the frictional resistances that arise at the bearings must not only modify the stresses in the bridge, but also give rise to vibrations. As the load enters on the bridge no expansion will take place till the frictional resistance reaches its limiting value: when that limit is reached a very small expansion will instantaneously take place till a fresh position of equilibrium is reached, which will again be destroyed in the same way, as soon as it is established; and thus a series of longitudinal vibrations must be produced which will be more violent as the speed of the load crossing the bridge is greater.

As regards the actual stresses caused by the resistance to expansion, the first question to decide is what the frictional resistance may be expected to be for a given bearing; and the second question is what stresses that resistance would give rise to in the frame.

The rollers which are inserted under bridge bearings, to reduce the resistance, are often inoperative after a few years' exposure to weather and to the accumulation of dirt about them. They are usually difficult of access and the maintenance necessary to their efficiency is neglected, as we have verified by examination of several cases where it was clear that the expansion took place, so far as it took place at all, by sliding of the upper casting on the top of the rollers. It is a matter for the judgment of the engineer in each case as to whether the expense of providing apparatus which may possibly be worse than useless—for if it should do no good it will do harm—is justified, and whether the same money might not be better expended in securing the bridge and its piers from any injury that could be caused by the maximum frictional resistance which could occur with plane sliding surfaces. Where a sliding expansion joint is provided, the coefficient of friction, for the usual condition in which the bed plates of bridges are to be found after many years' use, and seeing the impossibility of securing a perfect adjustment, cannot safely be assumed at less than 0·5. For a freely supported girder with a total load of W, we should therefore in ordinary cases expect that the horizontal forces at the bearings resisting movement would have a limiting value of $\frac{\mathrm{W}}{4}$, the vertical reaction being $\frac{\mathrm{W}}{2}$. Leaving out of consideration all secondary stress, equal and opposite horizontal forces applied at the bearings will produce a stress of the same amount in the boom to which the bearing is attached, and will not affect the other members of the girder. Thus, if the horizontal resistance be $\frac{\mathrm{W}}{4}$, the reaction at the abutment will be inclined at an angle of 27 deg. to the vertical, and will be the resultant of the vertical force $\frac{\mathrm{W}}{2}$ and the horizontal force $\frac{\mathrm{W}}{4}$.

Suppose the girder to be of the type shown in Fig. 11, with diagonals at 45 deg. The primary stress in the end member of the lower boom is $\frac{\mathrm{W}}{2}$, which may by reason of the frictional resistance be diminished to $\frac{\mathrm{W}}{4}$ or increased to $\frac{3\,\mathrm{W}}{4}$. A small change of temperature is sufficient to bring this about. Suppose $t$ tons per square inch to be the stress in this link due to the dead load W alone, and S the sectional area in square inches. Then $t\,\mathrm{S} = \frac{\mathrm{W}}{2}$ and $\frac{t}{2}\,\mathrm{S} = \frac{\mathrm{W}}{4}$. Therefore $\frac{t}{2}$ is the stress caused by the resistance $\frac{\mathrm{W}}{4}$. Now a bar of wrought iron extends under a stress of one ton per square inch by about the same amount as for a rise of temperature of 13½ deg. Fah. Therefore a change of temperature of $\frac{27\,t \text{ deg.}}{4}$ will produce a stress of $\frac{\mathrm{W}}{4}$ in the bar. In the English bridge used as an illustration in Section (I.), $t = 2$—nearly—and in the American bridge $t = 1{\cdot}3$. Therefore in the former case a change of temperature of 14 deg., and in the latter case a change of 9 deg., will give rise to the maximum frictional resistance with a coefficient of ½. To state the case more generally, let W be the total dead load and $\mathrm{W}^1$ the total live load on a girder, both symmetrically distributed on the span. Then the maximum stress arising from change of temperature in the boom to which the bearings are attached is $\pm\frac{\mu\mathrm{W}}{2}$, where $\mu$ is the coefficient of friction.

Turning to the resistance offered by the bearings to the deformation of the girder from live load only, we see that this will give rise to a maximum stress amounting to $\frac{\mu\mathrm{W}^1}{2}$ (for the numerical calculation given above for a hypothetical case shows that the deformation may call into play the full amount of friction). Now this latter stress is always opposite in sign to the primary stress in the boom affected by it, and relieves the boom to that extent. Therefore the net effect of these two causes, when a rise or fall of temperature occurs, is to *diminish* the maximum stress in the boom affected by an amount varying between $\frac{\mu (W^1 + W)}{2}$ and $\frac{\mu (W^1 - W)}{2}$. With the type of girder shown in Fig. 11, the maximum primary stress in the end length of lower boom is $\frac{W + W^1}{2}$, which becomes therefore, when the frictional resistance is considered, a quantity varying between $(1 - \mu)\frac{W + W^1}{2}$ and $(1 - \mu)\frac{W^1}{2} + (1 + \mu)\frac{W}{2}$. The stress in the same link when the bridge is unloaded will vary between $\frac{W}{2}(1 \pm\ )$. We therefore see that, when a girder of this kind is supported near the line of one of its booms, the stress in the boom will be diminished and not increased by friction at the bearings unless W is $> W^1$.

---

* See also on this point Stoney on "Theory of Stresses in Girders," new edition, p. 493.

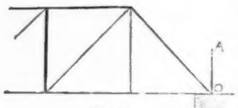


FIG 11

This condition of the dead load being greater than the maximum permissible live load is not reached in railway bridges except in spans of 200ft. and over, unless a heavy system of flooring be adopted. Even when the dead load exceeds the live load allowed for, the increased stress from temperature will be small except for very large spans. Expressed as a fraction of the primary stress, it is

$$\frac{\mu (W - W^1)}{(W + W)}.$$

The stress will not be reversed by temperature in the lower boom of a girder of type of Fig. 11, unless $\mu$ is $> 1$. But with a girder of the type of Fig. 12 there must of course be compression in the end length of the lower boom, and it should always be built as a compression member.

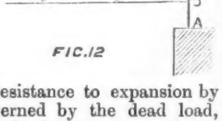


FIG. 12

The general conclusion to be drawn is that, as far as the bridge is concerned, there is in most cases nothing to be gained by reducing the coefficient of frictional resistance to expansion below the usual value for sliding, where the moving load is a large proportion of the total load provided for. The limiting resistance to expansion by change of temperature is governed by the dead load, and the frictional resistance to the deformation produced by the live load goes to relieve one boom or the other of the bridge at the expense of the abutment or pier. It is, however, of great importance to provide by rockers or otherwise for the angular deformation of a girder at its bearings, because otherwise heavy secondary stresses would be produced in the members meeting at the abutment.

The real advantage gained by the use of expansion rollers, when they are effective, is that the load on the piers or abutments is vertical or nearly so, and that advantage may be taken of this to reduce their dimensions below what would be necessary with an oblique load. We do not find, however, that engineers have had the courage to carry the use of rollers to this logical issue, because the piers of bridges show no weakness where the rollers have ceased to act; nor indeed would it be safe to design a bridge pier without a large provision for obliquity of the load, such as might arise from various contingencies. One important and inexpensive protection to a pier on which two adjoining spans rest is often neglected, viz., to connect firmly together, or to make in one piece the bed plates of the two spans. The frictional resistances of the two spans will rarely be equal, but are nearly always opposite; and the horizontal thrust or pull of one against the other should not be transmitted through the masonry.

If it be desired to reduce the possible obliquity of the load on a pier or abutment—an object in some cases of great importance—a much more reliable though less common plan than that of using expansion rollers is to suspend the bearing of the bridge from a centre fixed to the pier, or to use the same arrangement inverted. Let A O be the link by which the bridge is supported from the fixed point A, in Fig. 11 or Fig. 12, and $b$ inches its length between centres. Let $r$ be the radius of the pin or knuckle at each end of the link, and tan $\phi$ the coefficient of friction for the link A O at its bearings. The extreme obliquity of the line A O will be the angle whose sine is $\frac{c}{b}$, where $c$ is the extreme movement of O from the vertical through A. If $b$ be of sufficient length to answer the intended purpose, the expansion may be considered to be practically free; $c$ may amount at the most to about 2in. for each 100ft. of span, and will be much less if the position of A is fixed with care. The obliquity of the line of pressure at A to the vertical will then be $\sin^{-1}\frac{c}{b} + \sin^{-1}\frac{2r \sin \phi}{b}$. Sin $\phi$ will not be far from the value $\frac{1}{2}$: $\frac{c}{b}$ and $\frac{r}{b}$ should both be small. The maximum obliquity of pressure will, in that case, be an angle with the vertical whose circular measure is, roughly, $\frac{c + r}{b}$. We see, therefore, that to be of practical service, the pendulum must be of considerable length. Suppose we desire to limit the obliquity of the pressure to the angle $\frac{1}{10}$, for a 100ft. span resting on a 4in pin: $b$ would be determined by the equation $\frac{4}{b} = \frac{1}{10}$ or $b = 40$in. Short cast iron knuckles with large radii to their curved ends, such as have been proposed for this purpose, may give a larger resistance to expansion than a sliding bed-plate.

It is probable that the success which in practice has attended the use of expansion apparatus of both types, is due largely to its having failed to fulfil the purpose for which it was designed. If the condition be pictured to one's mind of a bridge which responded instantly and without resistance to the smallest longitudinal effort, it would probably be too lively under a rapidly moving load to give satisfaction. It would be more satisfactory, from the mechanical point of view, if the bearings could be placed near the line of the neutral axis; but this condition cannot generally be realised without undesirable complications.

---

## THE IRON AND STEEL INSTITUTE.

The largest party for the excursions on Thursday morning visited the Mariemont and Bascoup Collieries, leaving Brussels by a train starting ten minutes later than that conveying the visitors to Haine St. Pierre for the engineering and glass works in the same neighbourhood. These collieries, which rank high among the most important enterprises in the country, have been formed by the consolidation of two older concessions, and, taken together, cover about fourteen square miles of the coalfield of Hainault, the area included in Mariemont being 4065 acres, and that in Bascoup 4720 acres, of which nearly a quarter—2127 acres—represent freehold lands, woods, farms, and other buildings. The surface is formed by secondary strata covering a ridge in the older rocks known as the Comble du Nord, which render the lower coal measures accessible within moderate depths—from 130 to 650 yards in Mariemont, and from 260 to 660 yards in Bascoup, the latter division having seventeen and the former twenty-five workable seams, varying in thickness from 14in. to 41in. The total output of 1,100,000 tons per annum, divided in the proportion of five to six between the two concessions, is supplied by ten pits which are connected on the surface by a system of endless chain roads about six miles in length, with central, screening, picking, and washing works in each division, the same system of traction being applied on about 7½ miles of roads underground. The most important centre of production, the No. 5 Bascoup pit at Trazegnies, was selected for inspection by the nstitute. This includes in the same buildings the winding, pumping, and ventilating machinery for a pair of pits, together with the screens, picking tables, and washing machinery for small coal, the whole being covered by corrugated iron roofs of sufficient height in the centre to enclose the pit frame, a substantial iron structure with tubular standards and back legs, about 80ft. high. The winding is done in three-decked cages, each carrying two tubs with 9 cwt. of coal, making a useful load of 54 cwt. for each lift, which is drawn from a depth of 266 yards in 32 seconds; the landing of the full tubs and caging the empty ones taking 30 seconds more — corresponding to 150 tons drawn per hour when the engines are fully employed. The landing arrangements in strong contrast to the large amount of refined machinery about the pit top, are of a decidedly primitive character. A line of six or eight women standing close to the pit-brow join hands when the cage arrives at the surface, and pull the tub out, giving it sufficient impetus to run to the tippler, where it is emptied on to the first screen, which takes out the largest lumps. The different sizes of cobbles, large and small nuts, the latter locally known as *têtes de moineaux*, or sparrow heads, and slack being separated in other screens combined with rotating picking tables, where the shale and dirt are sorted out by hand, the finest sizes being purified by washing in Luhrig Coppée jigging machines. Owing to the friable character of the coal, very great care is taken to prevent breakage, the screens being laid at as low an angle as possible, the delivery being assisted by the oscillating tail bars invented by Mr. A. Briart, the chief engineer of the company. Travelling belts formed of old aloe fibre pit ropes are also largely used for intermediate transmission of the coal between the screens and the points of final delivery.

The coal produced is in considerable demand for household use and boiler firing, being comparatively low in volatile matter, but coking coals are also raised in several of the company's pits.

The main winding engines are of the vertical direct-acting class, with cylinders 32in. in diameter and 5ft. stroke, bringing the cage to the surface in $13\frac{1}{8}$ revolutions, which corresponds to a diameter of about 21ft. in the drum. The engineman is placed on a platform at a level of the axis of the drum, having the winding, indicator, reversing, and brake gear at hand, but out of sight of the main engines. The initial steam pressure is 86 lb. atmospheres in the boilers and nearly 85 lb. at the engines, which are provided with the well-known expansion gear due to Mr. L. Guinotte, the general manager of the company. The same gear is attached to the engines working in the second pit, which is enclosed in the same building. These are devoted to pumping, ventilating, and the Warocquére or man engine, so named from the inventor, the late M. A. Warocqué, the former general manager of the company. These engines, which are used in several of the mines of the group, there being two in Mariemont and three in Bascoup, are of a more elaborate construction than the main engines of metalliferous mines, the reciprocating rods being driven by water circulating under pressure instead of the older system of bell cranks and sweep rods—the effective lift per stroke being about 16ft. The relative position of the platforms can be seen at any moment by a large indicator at the surface, divided into ten equal parts, each about 20in. long. The water is circulated by a pair of single-acting plunger pumps, of larger diameter and correspondingly shorter stroke than the rods, driven by a small vertical engine, the necessary change in speed being obtained by a somewhat complicated train of bevel and spur gearing wheels. For pumping, two unequal armed beam engines, exactly similar in dimensions and construction, are provided, but only one is kept at work at a time. These are of the Seraing pattern, with Guinotte slide valves and connecting-rods and fly-wheels on the steam side, the cylinder is 54in. diameter and 11½ft. stroke, reduced to 8ft. 2in. in the pumps. The total lift of 266 yards is divided over three sets of pumps, having an effective area of 2·15 square feet, and delivering 500 litres—110 gallons—of water per stroke. Engines for the ventilating fans, which, like the pumps, are provided in duplicate, and for electric lighting, complete the contents of this spacious machinery hall. Owing to the large size of the party it was difficult for their guides to give verbal explanations as to details except to a limited extent; but considerable assistance was afforded to the visitors by a series of working drawings of the engines placed upon the walls, and indicator diagrams both for the winding and pumping engines were freely distributed among them. There was so much to be seen at this pit that the hour for departure was reached without its being possible to carry out the proposed inspection of the workmen's dwellings adjoining, a further obstacle being presented by the heavy rain which fell persistently during the morning. The party therefore assembled at the Chateau of Trazegnies, a picturesque seventeenth century house which has been acquired as a headquarters for the associated companies, where refreshments were served, and after an appropriate acknowledgment by the president of the kindness of their entertainers, the return to Charleroi was made by train.

In the afternoon a smaller number of the visitors went by steam tram to Marchiennes and Dampremy to examine the method of winding from great depths in ten and twelve-decked cages adopted by M. Soupart. The arrangements at these pits were described in M. Briart's paper on "Coal Mining in Belgium," read on the first day of the meeting, and will be found in our report on page 163. A model of the large cage at Marchiennes is shown in the Antwerp Exhibition, where there is also a very fine one of the surface arrangements of No. 5 Bascoup pit.

The principal feature of the forenoon excursion on Friday was the inspection of the Angleur Company's steel works at Sclessin, a smaller detachment of the party visiting the adjoining collieries at Horloz. This company, whose original seat is at Angleur—a short distance from Liége, in the direction of Verviers—purchased the Sclessin works, situated on the left bank of the Meuse opposite to Seraing, in 1892, and has re-arranged them for working the basic Bessemer process, with pig iron smelted from the oolitic ores of Audun le Tiche, in Lorraine. There are two blast furnaces 65½ft. high and 21ft. 4in. diameter in the boshes, supplied with hot blast by four Cowper stoves, of the modified Seraing pattern. The tunnel head gas is taken off by a central tube, and cleaned by passing through large dust catchers before it is admitted to the stoves and boilers. Coke for smelting is made on the ground from the small coal of the neighbouring collieries, partly washed and partly in the rough state, in a battery of 100 Coppée Menier ovens about 30ft. long, 4½ft. high and 17in. wide. The use of such very narrow ovens is rendered necessary by the deficient binding properties of the coal owing to the low proportion of volatile matters present, so that a high heat quickly applied is required to produce a coherent coke. The surplus heat of the ovens is utilised in the firing of seven De Nayer boilers of 200-horse power each, which together with a similar series of Galloway boilers with outside combustion chambers fired by blast furnace gas, supply the whole of the steam for the blast furnace and Bessemer blowing engines. The furnaces are blown by five tuyeres with outside water cooling on the hearth; the principal novelty in their working being the granulation of the cinder which runs continuously into a tank where it meets a current of water flowing in the opposite direction, and is converted into a coarse-grained glassy sand that can be more conveniently lifted by a bucket elevator and loaded on to ordinary railway trucks for removal than the heavy balls or blocks of the ordinary cinder-tub, besides being of a certain value for ballast, building sand, and concrete making. The Bessemer plant, which is very similar in character to that of the newer Westphalian works, comprises three 10-ton basic converters with intermediate transfer and casting ladle cranes, the latter being placed in the centre of a casting pit of large diameter, nearly the whole of which is available for placing ingot moulds, and provided with five ingot cranes. When the visitors arrived the dephosphorising blow of a charge was just completed, and the converter, turned down for sampling the metal, made a very liberal distribution of the slag over the spectators, although separated from them by more than the breadth of the two ladle pits. The slag was received at one end of the transfer crane in a bogie upon a narrow-gauge railway truck, which, when filled, was lifted on to the line by one of the cranes, and drawn away by a locomotive. The finished charge was poured into a ladle on the opposite end of the crane and pushed over to the crane in the casting pit by a horizontal ram in the ordinary way. The ingots, when reheated, were converted into railway sleepers, being rolled down to bars in a three-high mill, cut and stamped in a hydraulic press to a dish shape at one heat, the subsequent operations of bending to gauge and punching the holes for the fang-bolt attachments being done cold. In the latter part of the work a considerable amount of hand labour is required, and in this respect the method of manufacture is in strong contrast to that seen last year at Darlington, where ingots are converted into sleepers, and delivered blacked and finished for shipment with scarcely any intermediate handling. A large and well-arranged puddling forge adjoins the steelworks. This was employed in the production of merchant bar iron, mostly of small sizes. The method of driving the small mills by a belt from the engine, which is directly attached to the roughing train, seems to be very generally adopted. Want of time, however, prevented a fuller investigation of this part of the works, as the hour for the return to Liége had arrived before we were able to reach the furnaces.

On the arrival of the party at Liége they were received at the station by several members of the Société John Cockerill, and proceeded to the Jardin d'Acclimatisation, where luncheon was provided for about 500 guests by the Société. There is in the gardens a great glass pavilion, with one side open to the gardens, and in this the guests were seated, while the Société Royale des Fanfares de Seraing's excellent band, composed exclusively of workmen, played at a little distance among the trees. Nothing was left undone by the hosts to make the luncheon a complete success. At its close a few speeches were made, short and to the point, and then the visitors proceeded to the railway station, where a train was in waiting to convey them to the works. Arrived there, they were divided into separate parties and conveyed from one department to another by carriages and engines borrowed for the purpose from the Liége Steam Tramway Company. Each engine drew one large car, and some amusement was caused by the circumstance that the curves at Seraing being too sharp for the rolling stock, the cars every now and then got off the road; all the passengers turned out, and then six or eight labourers quietly going to one corner first, and then to the other, they lifted the car on to the rails again. The passengers entered and steamed away merrily until the next crossing was reached, when the operation had to be repeated. While on the subject of rolling stock it may be worth while to say that to the train proceeding from Brussels to Liége in the morning an accident occurred precisely similar to that which had happened the day but one before between Brussels and Antwerp. Between Louvain and Tirlemont the train was checked by signals, the driver applied the brake incautiously, and immediatly afterwards the engine and the leading brake van broke away from the rest of the train. No one was hurt on this occasion, and a spare draw-bar being at hand, the delay was brief.

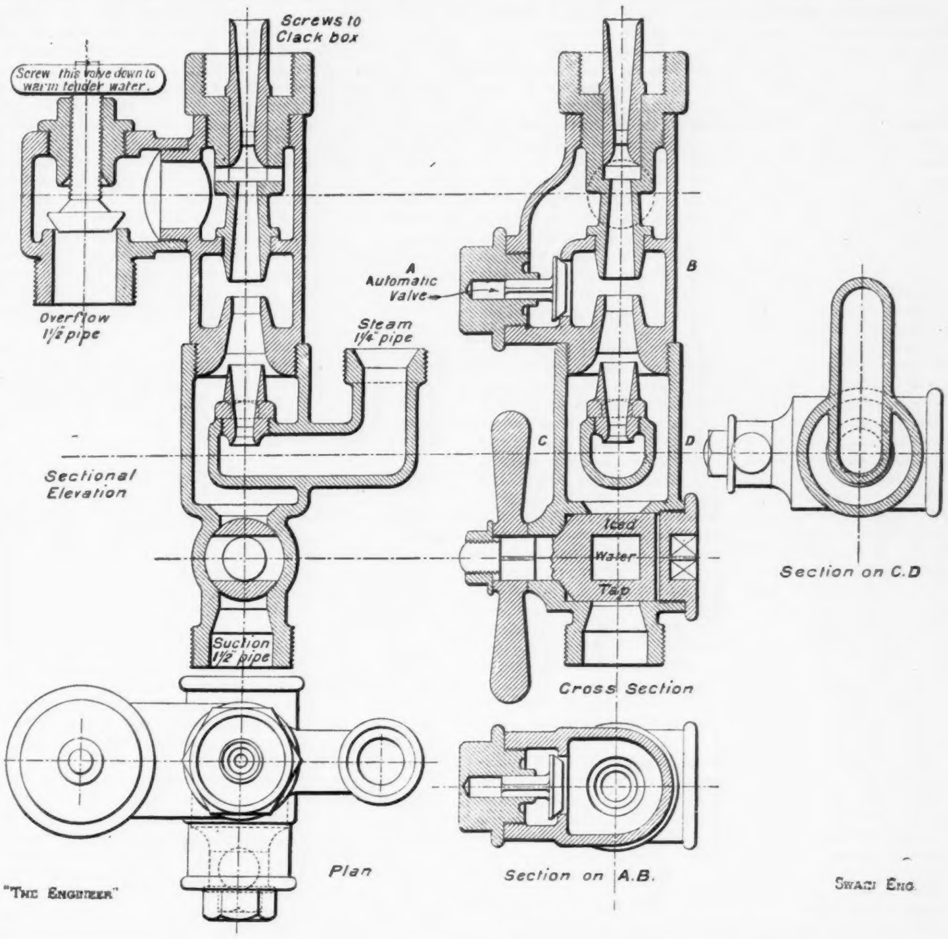
At 2.30 p.m. the inspection of the works began. As the return train for Brussels was to leave at 6 p.m., there was not much time available, and as a matter of fact, the visitors wisely concluding that it would be impossible to see everything, contented themselves with seeing what they could, and found time before the train started to return to the old chateâu, once the palace of the Prince Bishop of Liége. In the gardens they were once more entertained by the Société, and returned to Brussels at a much later hour than was intended, perfectly contented with the day's work.

It would be quite out of the question to attempt to give here any detailed description of these renowned works. It will suffice to say a few words concerning them for the benefit of such of our readers as may not be familiar with the reputation of Seraing. The works were founded by John Cockerill in 1817. They supplied between 1818 and 1823 the first steam engines ever built on the Continent. Between 1823 and 1830 they constructed the first blast engines for ironworks; and in 1824 engines of 160 and 240-horse power for the Royal Marine of the Netherlands. About the same time they made the first exaust fan for a mine, constructed a steamboat for service on the Rhine. In 1835 they made the first locomotive and the first rails produced on the Continent. In 1845 they made the pumping engines for the Paris and St. Germain atmospheric railway. In 1848 they built and engined the first steamboats to ply between Dover and Ostend. In 1854 and 1856 they built three large transatlantic steamships, the Leopold the First, the Duc de Brabant, and the Congres. In 1858 they commenced the construction of the immense plant used in making the Mont Cenis Tunnel. Of their recent work it is unnecessary to speak. It is impossible to overrate the importance of the part which Seraing has played in the development of engineering in all its forms on the Continent; and with engineering the industrial development of the Belgian nation. The progress of the works may be divided into three epochs. The first from 1817 to 1840 when John Cockerill died. The second, the period from the formation of the Société in April, 1842, to 1864. The third period extends from that year to the present time. The first workers with Cockerill were Martin Poncelet, and afterwards Pierre Wery, mechanical engineer. Gustave Pastor in 1817 was director of the Metallurgical Department, and in 1829 he became director of the entire establishment. His connection with the works terminated on the 30th of June, 1866, after thirty-seven years devoted to the extension of the vast concern. From 1866 to the end of October, 1886, Baron Eugene Sadoine was the head of the establishment. From November, 1886, to the 30th June, 1887, the works were managed by M. Delloye-Matthieu, since which time M. Adolphe Grenier has been the head.

The works now cover an area of 267 acres. The nominal capital is 15 millions of francs, or £600,000. About 10,000 hands are employed. The annual wages bill is 9,000,000 francs, or £360,000. There are 355 steam engines developing 19,000-horse power. The coal consumed per day is 1400 tons. The annual output of the establishment is estimated to be worth 35,000,000 francs, or £1,400,000; up to the present Seraing and Hoboken have turned out 69,280 engines and machines, and over 459 ships and steam vessels of various kinds. They can produce each year 100 locomotives, 70 steam engines, 1500 machines more or less heavy; 10,000 tons of bridges, roofs, and boilers; 14 steamships for sea and river traffic, to say nothing of guns, turrets, cranes, and hydraulic machinery. In the shops there are 528 machine tools, many of them of great size and power. The transport service is carried on by eight steamers, of 1400 to 3500 tons, two steam barges, and four barges of 300 tons each, 27 locomotives, 450 wagons. There are thirty-six miles of permanent way. The Société maintains an hospital with 300 beds, and an orphanage, besides schools and gardens, and other institutions calculated to be of benefit to their employés.

The end of the visit to Seraing was also the end of the annual meeting of the Iron and Steel Institute. It was in every respect a great success, and reflects the utmost credit on Mr. Brough, the secretary, and his staff, who indeed worked night and day. The welcome offered by the Belgian ironmasters was extremely cordial. Nothing was lacking indeed but better weather, and that would certainly have been provided by our hosts could it have been obtained by money or solicitation.

## INJECTORS FOR THE L. & N.W.R. LOCOMOTIVE GREATER BRITAIN



"THE ENGINEER" SWAIN ENG

---

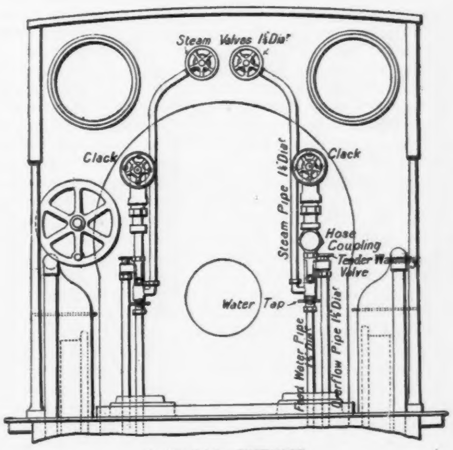
## IRON AND METAL WORK IN WESTERN INDIA.

ACCORDING to a recent report of the United States Consul at Bombay upon "Manufactures of Western India," during the last twenty years the number of ironfoundries and machine shops has greatly increased, and the country is less dependent on Europe for general ironwork. Imports of wrought iron and steel in bars are yearly increasing. Such structures of iron and steel as are made in India comprise:—Barges, bridges, buildings, cotton presses, coasting steamers, grinding mills, hay and other presses, jetties, launches, oil mills, piers, river steamers, sluice gates, small engines, both compound and single, steam boilers, steam pumps, sugar-crushing machinery, tanks, turbines. Railways make their rolling stock, but import axles, tires, wheels, and other ironwork. Rails and steel sleepers, the latter being much in vogue in place of wood, are all imported. Bolt, chain, and rivet making are not yet separate industries. Wire working, being readily taken up by the natives, is steadily increasing. Machine tools are made but in small quantities, most of the tools are imported. Textile machinery is entirely made in England. Agricultural implements are in small demand on account of the ignorance and poverty of the cultivators. Cultivation as practised in Egypt, the grain districts of Southern Europe, and the United States, has not yet commenced in India. The inauguration of systematic cultivation awaits an impulse either from the commercial community, which suffers much from the present degradation of produce, or from the educated native princes, whose revenues would be greatly benefitted thereby. Until this is done agricultural implements can have only a very limited use. The rich native planters recognise that there must soon be a change, and many of them are introducing modern implements. Locks of fairly good quality are made in Bombay and Calcutta, but none of the manufacturers possess a key-cutting machine or a good set of machine tools; their tools are very primitive. Padlocks are the only class of European ironmongery found throughout India; they are used in preference to locks, even on safes and strong boxes. On account of national and religious customs, brass and copper vessels for cooking, drinking, and eating are to be found in every house, and the workers in these metals are more numerous than those in iron. Hollow ware is made of imported sheets hammered into shape, and vessels used for cooking are tinned inside. Brass hinges are made and much used here on account of the destructive effects of the monsoon rains on iron hinges. The whole of the work is done by hand labour without the assistance of a press or stamp. Machinery was tried in a Bombay workshop, but the inferior sheets used would not bear the process and it was consequently abandoned, the experimenter not knowing that better sheets were needed for stamping than for hand work.

## INJECTORS FOR THE GREATER BRITAIN.

THE accompanying engravings illustrate the injectors of Mr. Webb's celebrated locomotive, the Greater Britain, illustrated in our impression for November 20th, 1891. They were made by Messrs. E. H. Birley and Co., Queen's Chambers, Manchester. These injectors are absolutely automatic in re-starting. They have no moving or sliding piece in the nozzles to wear out or stick. They will work in any position, either as lifters or non-lifters. They have a very large range of working pressure; will work hot, and take feed-water when lifting, at over 100 deg. Fah.

The injectors are each No. 8 mm., and at 175 lb. pressure one threw about 1500 gallons per hour into the boiler, being almost sufficient alone to maintain the feed-water at the highest speed of the engine. The injectors were designed to suit the previous standard arrangement of valves, clack boxes &c., on the engines, and have given such satisfaction that this patent is now adopted as the standard injector for the London and North-Western Railway Company's system.



INJECTOR FITTINGS

The modern re-starting automatic injector is now a necessity on locomotives, saving the drivers and stokers endless trouble and worry, as compared with the old Giffard non-automatic injector, which had to be stopped and re-started by hand each time the jet of water was interrupted. Injectors on this patent are made without valves attached, in a simpler form for the ordinary market. The steam pipes for the injectors of the Great Britain are 1¼in. diameter, the overflow 1½in. diameter, the feed suction 1½in. diameter. The valves for warming the tender water are attached—they were made on White's patent.

---

THE Cunard line steamer Lucania passed Daunt's Rock, arrived at Sandy Hook lightship, New York, at 4.59 on the 31st ultimo, having made the passage in 5 days 8 hours 38 minutes, or 51 minutes better than the previous record of the Campania. The average speed of the passage, which was protracted by fog and stormy weather, was 21·65 knots.

## THE FEDERATED INSTITUTION OF MINING ENGINEERS—NEWCASTLE MEETING.

THE annual general meeting of the Federated Institution of Mining Engineers referred to in our issue of the 24th ult. took place in the Wood Memorial Hall of the North of England Institute of Mining and Mechanical Engineers, Newcastle-upon-Tyne, on Wednesday of this week. The continued popularity and appreciation of the Federation was well exhibited by the fact that over 200 members were present at this meeting, in spite of troubled times in certain districts. The first business was the vacation of the chair by the outgoing president, Mr. Arthur Sopwith, and the assumption of the office by the new president, Mr. W. N. Atkinson, one of H.M. Inspectors of Mines. A vote of thanks having been accorded to Mr. Sopwith, the report of the Council was read, in which the increased prosperity of the Institution was alluded to; the membership now being 2068, and the Federation including six societies. The report contained a suggestion that it would be desirable to extend the Federation to all mining and metallurgical societies in the empire, inasmuch as judging from the success of the present Federation of British societies, the suggested Federation could not be otherwise than very advantageous. The papers received during the year included many dealing with geology, mining engineering, mechanical engineering, ventilation, illumination and gas testing, the preparation of minerals, electricity, explosives, and miscellaneous matters. Prizes were awarded to Messrs. Bertrand, Charlton, and Redmayne respectively, for their individual contributions to the Institution's "Transactions," which, owing to their rapid growth, have now to be published in two volumes annually. The first paper read was a contribution from Professor Edward Hull, "On the Discovery of a Concealed Ridge of Supposed Cambrian Rocks under the New Red Sandstone of Netherseal, near Ashby-de-la-Zouch, Leicester." The author based this supposition on the examination of a core obtained in borings recently put down by the Netherseal Colliery Company, and in discussion this occurrence of Cambrian rocks was confirmed by members who had made observations on the surface.

C. A. Stetefeldt, in the second paper considered by the meeting, on "THE STETEFELDT FURNACE," contributed an account of the origin and development of that furnace, which is so well known and largely employed in the Western States. A Gerstenhöfer furnace was started in Austin, Nevada, U.S.A., in 1867, but the shelves proved an obstacle to the roasting of the sticky ores of the district, and, as a result, the author erected a furnace with a plain shaft 25ft. high. With this, however, the Gerstenhöfer feeder—consisting of fluted rollers and an iron plate with narrow slits—proved inefficient for distributing the ore in the furnace, and consequently the author's rocking sieve feeder was devised. Then it was found that much dust escaped from the flue imperfectly roasted, and this led to the introduction of the second fireplace for heating the flue, and known as the auxiliary fireplace. The furnace has from time to time undergone modifications to suit local circumstances, but the main features have always been maintained. A tall, square, tapering shaft, with a descending flue alongside leading to a series of chambers, the last of which connects with a chimney, either direct, or preferably with an intermediate flue following the slope of a hill, where circumstances permit. In the most recent furnaces the shaft is 48ft. long and 4ft. square at the top, 37ft. being the active falling distance. At that distance down the heat is applied, and the furnace is 6ft. square. Some 6ft. lower down there is a hopper, closed by a swing door, in which the falling material is arrested and accumulates; whilst beneath the hopper there is space to permit of a truck running underneath to receive a charge of treated material. The flue commences at the top of the shaft, and descends at an incline alongside of it. Being heated at the same level as the shaft, the chambers and chimney call for no special comment. The Stetefeldt feeder consists of a cast iron grate covered with a steel sheet punched with $\frac{1}{8}$in. holes, through which the ore-pulp, mixed with salt, is fed by the oscillating motion of a wrought iron rocker having a No. 4 wire screen stretched over the frame, the necessary friction being created by stationary blades. The rocker is now suspended by adjustable flexible steel bands instead of being supported on friction rollers as hitherto. The distance of the rocker from the punched plate, and of the fixed blades from the rocking sieve, and the rate of rocking, can be regulated so as to adjust the feed as required. By means of a damper situated below the grating, the feeding appliances can be shut off from the furnace for repairs or other purposes. A bucket elevator conveys the mixture of ore and salt to the top of the furnace. The mixture falls from the feeder down the heated shaft, and in its descent becomes partially roasted and chlorodised; only about 32 per cent. of the roasted ore, however, reaches the hopper, the rest passes into the flue, where it is subjected to a second roasting, and about 55 per cent. of the roasted ore is caught in the hopper below the flue, of the remaining 13 per cent. eleven is caught in the first six chambers and one in the last six. There are various ports placed at convenient spots for inspecting and cleaning any part of the furnace where lodgments may be expected. The firing has until recently been done with solid fuel, but to ensure greater uniformity of temperature, gaseous fuel from a Taylor gas-producer has been applied with great success. For this purpose a spiral-weld steel tube, provided with expansion joints, supplies the gas to cast iron burners, which have openings with covers in the front for cleaning out soot and tar. The gas escapes from the burners through square holes at the top, provided with cast iron slides to regulate the supply of gas, which escapes into the combustion chamber through suitable openings, from which soot can be removed, if it accumulates, through pipes that are ordinarily plugged. Air for combustion ascends through special channels, the supply being regulated by sheet iron slides. It is not necessary to give other details of the furnace. The introduction of gas has effected a saving of 2s. 4d. in one case, and 1s. $8\frac{1}{2}$d. in another case in the cost of fuel for working per ton. The new furnaces have an output of from 70 to 90 tons a day, whilst the output from the old ones rarely exceeded 30 tons. These furnaces are stated to work ore without having it very finely crushed, to occasion very little loss of silver and gold, to consume comparatively little fuel, and to require little labour, only one man per eight-hour shift. Their use has, however, practically been restricted to the chlorodising roasting of ores of the Western States, which consist of galena, zinc blende, fotlore, a little iron pyrites, and a clayey quartz gangue. It is interesting to note that copper, zinc, and aluminium are found chiefly as chlorides, in the roasted ore, in the shaft hopper, but as sulphates in the flue; lead and sodium as sulphates in both cases, but more abundant in the flue. The retaining of the hot ore in the hoppers is very advantageous to the chloridising, the amount of silver converted to chloride produced being largely increased by such treatment.

In discussion it was pointed out that this paper was of value as the only exact account of this furnace. The advantage of using gaseous fuel was also enlarged upon; but the use of this furnace for roasting pyrites was questioned.

John Morison's paper on

"WALLING AND SINKING SIMULTANEOUSLY WITH THE GALLOWAY SCAFFOLD"

deals with an instance where this has been successfully achieved at Newbattle colliery. The success depended largely on the cradle designed and used by the author. It consisted of a working floor and a protecting roof with a central opening admitting of the passage of two kibbles, the opening being fenced by sheet iron $\frac{1}{4}$in. thick and $6\frac{1}{2}$ft. high, bolted to the six upright angle bars and hangers. The floor stage was formed by a 4in. by 4in. by $\frac{1}{2}$in. mild steel angle bar turned to a true circle, supported on and fastened to a bottom framing of 5 by 5 by $\frac{3}{8}$in. steel angle bars. Hinged hatchways, recessed for passing pipes, &c., were provided in the floor so as to permit of passing obstructions and allowing brick kibbles to be lowered if required.

The floor was covered with planking 5in. thick. The roof was formed of 5in. by 5in. by $\frac{3}{8}$in. steel angle bars, covered with $\frac{3}{8}$in. sheet iron plates. The framing of the roof where the suspending wheels carry the whole of the cradle is constructed of double 5in. by 5in. by $\frac{3}{8}$in. steel angle bars riveted together. The bottom and top of the scaffold were connected together by four corner steel angle bars, 5in. by 5in. by $\frac{3}{4}$in., bolted to the top and bottom framing; four stays being placed to the four upright corner angle bars for the purpose of supporting and stiffening the top or roof framing. Two $1\frac{1}{2}$in. tension-rods were secured to the double angle bars and to the outer ring of the floor, for the purpose of strengthening and carrying the floor. A sheet iron ring, formed of $\frac{3}{16}$in. sheet iron, was bolted to the circular framing and formed a fence round the scaffold 18in. high. The difference between the diameter of the pit and the upper side of this ring was about $1\frac{1}{2}$in., or an opening of $\frac{3}{4}$in. existed between the brickwork and the fence. Fending plates were bolted to the bottom of the scaffold, to guide a swinging kibble through the opening in case of accident. The weight of the scaffold was about $8\frac{1}{2}$ tons; and when loaded with bricks, lime, and workmen, the working load was about twenty tons.

The cradle was hung by four 5in. ropes in double purchase, and proper guides and suitable winding arrangements enabled the engines to wind the kibble even 1650ft. in fifty-five seconds. Pulsometers delivered water from the sump to a tank furnished with valves and boggers for running the water into barrels; these arrangements obviated any necessity for baling, and 200 gallons could be wound per minute from a depth of 900ft. while sinking progressed and pumps were fixed.

In walling, a roll of canvas or brattice cloth was packed between the outer ring on the scaffold and the shaft side, so that there was absolutely no opening. The hatch or doorway, where it closed against the air boxes, pipes, &c., was also carefully packed with canvas before commencing to build the walling. Sheet iron plates where laid over the hatchway where the brick kibble was tipped. The bricks and lime were sent down in kibbles provided with trunnions, and the material was tipped without detaching the kibble from the rope. At the top of the pit the empty kibble was landed on to a bogey, detached from the rope, and a full kibble hung on in its place. When walling, three bricklayers with three labourers and a sinker in charge was the most convenient number to work on the scaffold, and in ordinary work these would build a 5ft. length complete. The scaffold was considered safe from damage by shots in the pit bottom when at a distance of 60ft. from the bottom. Crib-beds were laid as the foundation was found suitable, and lifts were taken varying from 90ft. to 240ft.

Pump-rooms and lodgments in the side of the shaft could be formed by taking the scaffold to the point required, without any interruption of the sinking. A lift of concrete coffering, 90ft. high and 28in. thick, was put in from the scaffold very conveniently. The ordinary brickwork was $10\frac{1}{2}$in. thick, and the shaft 20ft. in diameter, and 1650ft. deep, was lined from top to bottom, with the exception of small projections of hard stones under several of the walling crib foundations; in forming a crib bed the sinkers left the stone rough hewn out, leaving the levelling and dressing to be done off the cradle. The advantages observed by the author in the use of the cradle are:—(1) It permits of quick winding with double kibbles with great safety. (2) No time is lost through the sinkers being withdrawn to wall. (3) The brickwork can be better done by skilled bricklayers and at a less cost than by sinkers. (4) In forming any necessary recesses or roads off the shaft side, no delay in sinking need be incurred. (5) The suspension of a substantial structure on the shaft affords a considerable protection to the men working in the pit bottom. With reference to the latter advantage, upon several occasions when material has dropped accidentally down the shaft, it has landed on the roof of the scaffold and caused no damage; and especially when working within a moderate distance from the bottom the protection is of great advantage.

Some members present pointed out that the information in the paper was not as perfect as it should be, the saving in time as compared with the ordinary method of working not being noted; moreover, no note as to the method of ventilating beneath the cradle was supplied, and some other technical points were defectively set forth.

This paper was followed by the discussion of papers announced to be discussed, in which it was incidentally remarked that underground photography had progressed so far, that stereoscopic views of underground workings were now to be obtained. The ever debatable subject of gob-fires also attracted attention. The chief point at issue being whether the moistness of a coal had anything to do with its liability to spontaneous ignition, which seems a point that still remains to be decided; it was suggested that to avoid gob-fires, the best practice was to pack well and remove all slack.

The meeting then adjourned, leaving the following papers to be considered on the reassembling: "Timber Bridges and Viaducts," by Mr. Morgan W. Davies. "Explosions in Novia Scotian Coal Mines," by Edwin Gilpin, jun. "The Shaw Gas Tester for Detecting the Presence and Percentages of Fire-Damp and Choke-Damp in Coal Mines," &c., by Mr. Joseph R. Wilson. Various excursions were arranged for Thursday and Friday, and will receive any notice required subsequently, when the unread papers enumerated above are considered.

## THE CHILIAN CRUISER BLANCO ENCALADA.

As a supplement this week we give an illustration of the powerful Chilian cruiser, Blanco Encalada, built at the Elswick shipyard of Messrs. Sir W. G. Armstrong, Mitchell and Co. In our issue of June 1st and 15th we gave accounts of her gunnery and speed trials, at which she attained such excellent results. Her principal dimensions are as follows:—Length, 370ft.; breadth, 46ft. 6in.; mean draught, 18ft. 6in., and her displacement is 4500 tons. Our illustration is from a photograph taken during the gunnery trials of the vessel.

The armament of the vessel consists of two 8in. breech-loading guns, two 6in. quick-firing guns, twelve 3-pounder quick-fire guns, twelve 1-pounder guns, two Gatling guns, and five torpedo tubes. At the trials all of these guns and torpedo tubes were discharged in various directions, and the guns at extreme elevation and depression, in order to test the structure of the ship, with the result that all the fittings and other parts were shown to be of ample strength and able to stand all the strains to which they might be subject by the firing of the guns in action. The steam trials showed that the vessel could run with forced draught at a speed of 22·78 knots, and that she could run as long as her coal supply lasted, with natural draught, at a speed of 21·75 knots. Her normal supply of coal is 350 tons, but she can carry 900 tons. With her bunkers full, the above speeds would be somewhat reduced; but starting with her full coal supply she could steam at, say, the mean speed, $21\frac{1}{2}$ knots, for eighty-four hours, and would cover a distance of 1800 knots, while at the economical speed of 12 knots she could steam for twenty-eight days, and cover a distance of 8000 knots.

The vessel is sheathed with wood and coppered. She has an inner bottom throughout. She carries the very powerful armament above enumerated. She is one of the fastest cruisers afloat, and these splendid results have been obtained on a displacement of only 4500 tons.

The engines and boilers are by Messrs. Humphrys, of Deptford.

## THE CORROSION OF BOILERS.

IN the *Goldsmith's Journal* has been published a very lucid paper on "The Corrosion of Ships and Boilers," by Mr. Ward. Speaking of zinc, the author says that the proper way to use zinc consists in placing a number of studs in the sides of furnaces and combustion chambers, bolting on to these studs the zinc slabs, which should be about 10in. by 6in. by 1in. It is important to see that the contact surfaces are clean and smooth, and that the nut is screwed up tight to exclude the water. When so applied the protection against corrosion is perfect. He concludes his paper by drawing attention to the chief points which should be attended to by those who have charge of steamships or steam boilers:—

"As to the hull.—If of iron, see that all blisters and rust are removed by chipping, and if of steel the magnetic oxide or mill scale should have been removed before applying the paint. Use paint of a good quality, one that consists of a compound of zinc or lead will be best, because it will be more readily oxidised. See that the surfaces are thoroughly dry before painting, as it is quite usual to see paint put upon ships' hulls when wet.

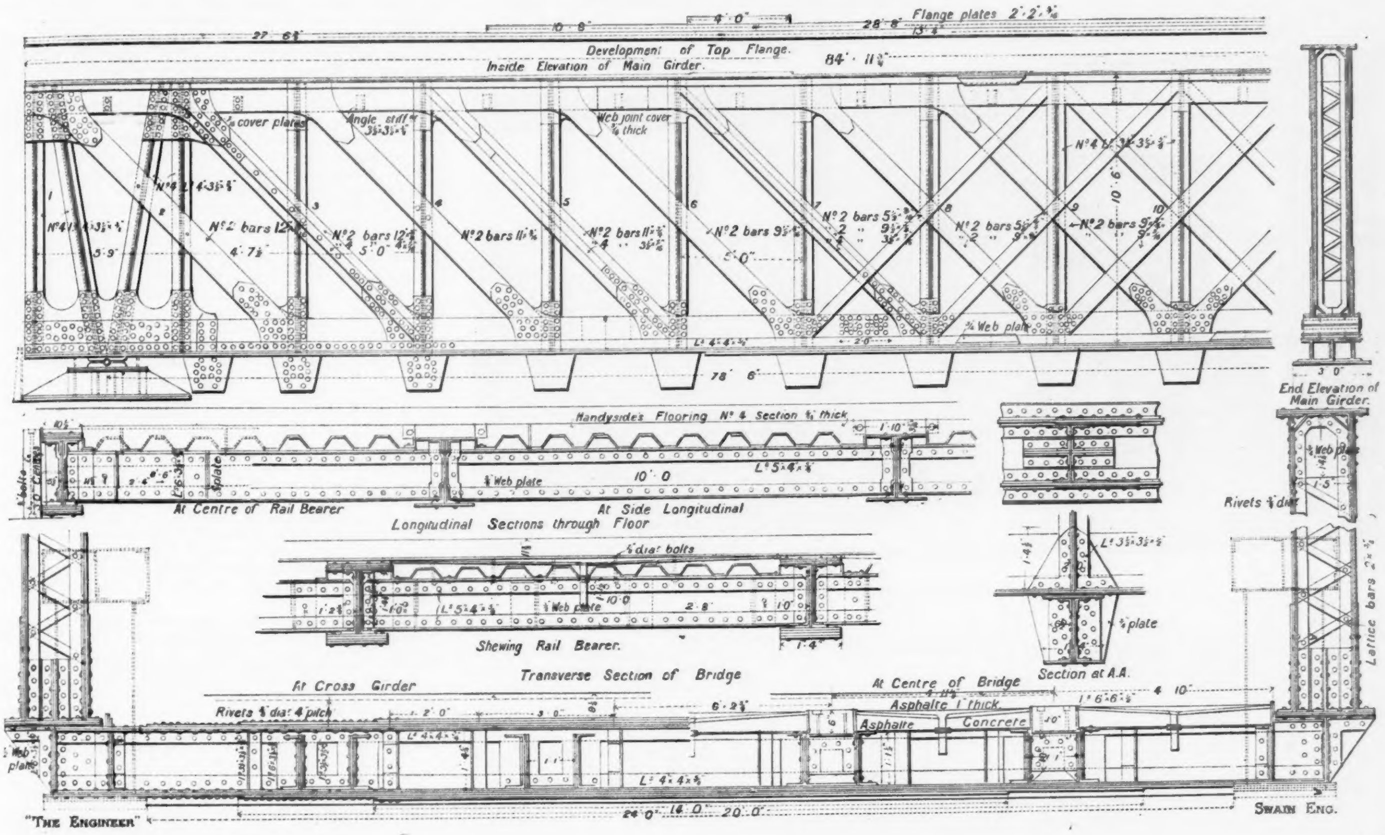
"As to the boiler (externally).—(1) Keep all seams, joints, and rivets tight and free from leakage. (2) Prevent as far as possible all moisture getting in contact with the plates. (3) At least once a year apply a coat of good paint: red lead and linseed oil being the best for this purpose. (Internally.)—Firstly, select a good cylinder oil where it is impossible to work without one, and only use such as have a vaporising point at a higher temperature than the temperature of the steam at the pressure at which the boiler is to be worked. Do not take the statement given of the vaporising points of these oils for granted, even though it may be a standard brand or make, but see that each particular lot as supplied is equal to the sample which influenced the purchase, as it may be taken for granted that the lowest quality that will be accepted without complaint will be about the highest quality supplied. Under any condition endeavour to keep your boiler water as fresh as possible, and where a fresh water supply cannot be obtained it is desirable to fix some contrivance such as an evaporator to obtain the same; and, lastly, if it is impossible to dispense with the use of sea water, means must be taken to counteract its evil effects, such as those I have endeavoured to show in this paper.

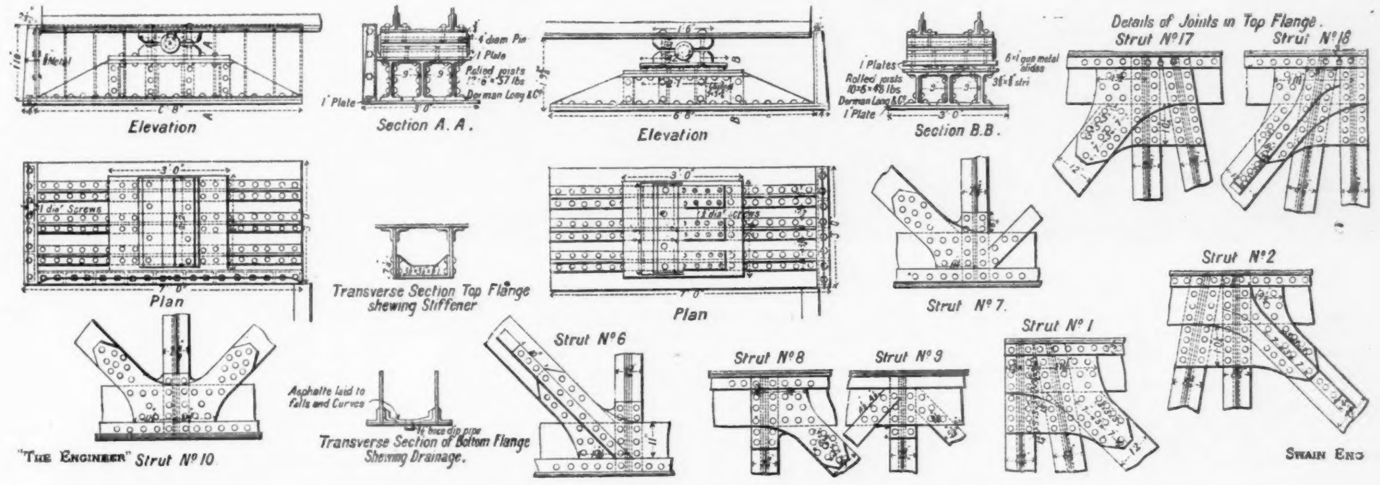
"Under these conditions we should be rewarded by our boilers not being cut off in their prime, but dying of old age."

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Engineers: Mr. Frank C. Allen, to the Haughty; Frederick M. D. Spry, to the Rocket; Thomas S. Guyer, to the Starfish; and John W. Ham to the Achilles; to date September 30th.

## GREAT NORTHERN RAILWAY—RE-CONSTRUCTION OF BRIDGE OVER THE DON—DETAILS

MESSRS. ANDREW HANDYSIDE AND CO., DERBY, CONSTRUCTORS


Flange plates 2'.2".
Development of Top Flange.
Inside Elevation of Main Girder.
84'. 11"
cover plates
Angle stiff
Web joint cover ⅝ thick
N°2 bars
⅞ Web plate
78'. 6"
End Elevation of Main Girder.
3' 0"
Handyside's Flooring N° 4 Section ⅝ thick
½ Web plate
10'. 0
At Centre of Rail Bearer
At Side Longitudinal
Longitudinal Sections through Floor
⅞ dia. bolts
Shewing Rail Bearer.
Transverse Section of Bridge
At Cross Girder
At Centre of Bridge
Section at A.A.
½ plate
Rivets ⅞ dia.
Lattice bars
Rivets ⅞ dia. 4 pitch
Asphalte 1" thick
Asphalte
Concrete
Web plate
24' 0"
14' 0"
20' 0"
"THE ENGINEER"
SWAIN ENG.


Elevation
I Plate
Section A. A.
Rolled joists Dorman Long & C°
Elevation
I Plates
Rolled joists
Dorman Long & C°
I Plate
Section B.B.
Details of Joints in Top Flange.
Strut N° 17
Strut N° 18
1" dia. Screws
7' 0"
Plan
Transverse Section Top Flange shewing Stiffener
3' 0"
1" dia. Screws
Plan
Strut N° 7.
Strut N° 2
Strut N° 6
Strut N° 8
Strut N° 9
Strut N° 1
Asphalte laid to falls and Curves
Transverse Section of Bottom Flange Shewing Drainage.
"THE ENGINEER" Strut N° 10
SWAIN ENG.

### GREAT NORTHERN RAILWAY.—RE-CONSTRUCTION OF A BRIDGE OVER THE DON.

IN our last impression we published four views of the work performed in renewing a Great Northern Railway bridge over the Don, and gave some preliminary particulars. We now complete our illustrations of the works.

The bridge being over a navigable branch of the river Don, there was also the canal traffic to provide for. On account of the limited height from water to rail level, no staging could be erected over the canal. To meet the several requirements of the railway and canal traffic, the following method was adopted. A row of piles 9ft. apart, as shown by the engravings of details on page 211, were driven on each side of the canal and parallel with the face of the two abutments, each pile being driven until it set ½in. under a blow of the ram weighing one ton and falling a height of 12ft.—each pile having a working load of 27 tons. On the head of each pile was fixed a crosshead 4ft. by 14in. square; the crosshead being steadied with brackets placed on each side of the pile head, and all bolted together with 1in. diameter bolts. On these crossheads were placed two longitudinal timbers 14in. square, with bridge rails laid and fixed on the upper surface.

On these rails were placed eight special steel trollys of the pattern shown by detail on page 211 and Fig. 3, four to carry the new bridge, and four for the old one; two hydraulic jacks being carried on each trolly, as no staging could be placed over the canal other than that described. The main girders were put together near the site, and when completed were loaded on two trucks and taken to the site, and there unloaded—Figs. 2, and 4, page 194, and in general arrangement on the plan, and placed on two of the trolleys and moved out to the proper width. This being done, an overhead traveller was fixed on the top of the new main girders, and used for erecting the new cross girders and flooring. When the whole of the new structure was nearly completed, the old girders were temporarily supported as shown on page 211. The bedstones were taken out, redressed, and reset, as owing to the lightness of the original girders, the stones were damaged and loose on their beds from excess of vibration. The ballast for a width of 20ft. sufficient to clear the ends of the new bridge was removed, and the permanent way carried on longitudinal timbers and packings, to enable the space to be cleared quickly during final operations. The hydraulic jacks were then connected in sets of four by tubing, each set being actuated from a pump fixed on trolleys, and shown in Fig. 6. When the work was complete and ready for moving into position, all the apparatus was carefully examined, and the lifting power tested. This proving satisfactory, the day for slewing was appointed; the time being as mentioned above.

At the stated time the rails at the ends of the old girders were removed, and the pressure applied to the pumps, and when lifted a sufficient height, wood blocks were then inserted between the main girders and frame of trolleys, and the whole bridge hauled out by means of two crabs, four men to each crab. This occupied from start to finish twenty-five minutes—Fig. 1.

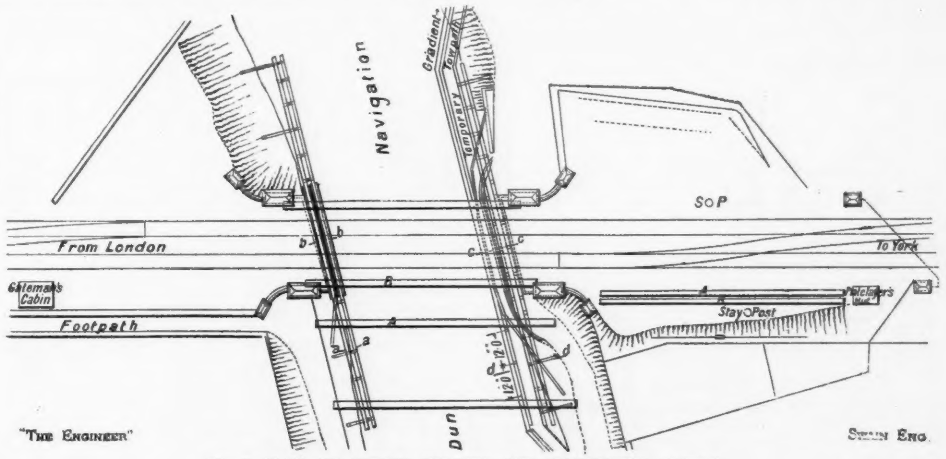

Navigation
Gradient
Towpath
Temporary
SOP
From London
To York
b
b
c
c
B
Gateman's Cabin
Footpath
A
A
Platelayers' Hut
Stay Post
a
a
d
d
12'0"
12'0"
Dun
"THE ENGINEER"
SWAIN ENG.

Fig. 5—PLAN OF BRIDGE STAGING AND TRAVERSING TACKLE

While the old bridge was being moved out the new one was being moved in, also by means of two crabs. As the new one was considerably heavier, the operation was ten minutes longer, or thirty-five minutes. The new bridge was then lowered on to its final bed, the ends ballasted and the rails joined up with those on the new bridge, which had already been laid before

# GREAT NORTHERN RAILWAY BRIDGE OVER THE DON

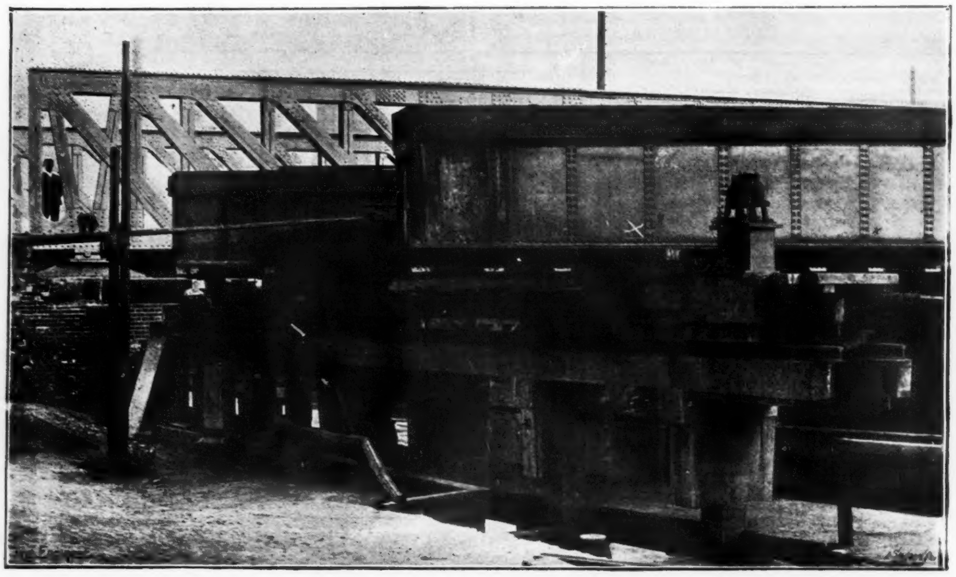


Fig. 6—DETAIL OF STAGING AND PRESSURE PUMPS.

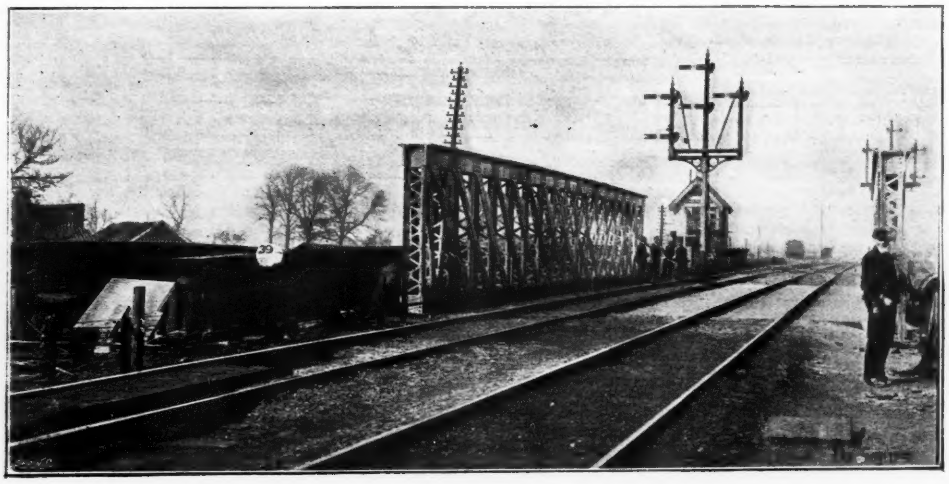
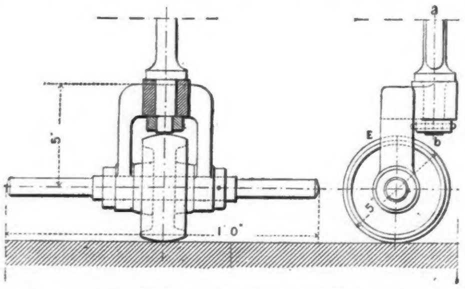


Fig. 7—THE NEW BRIDGE IN WORKING ORDER

it had been moved—Fig. 5. The whole of the operation, from the breaking of connection until the line was ready for resumption of traffic, was sixty-five minutes, or thirty minutes within the allotted time. The main girders are of the Whipple-Murphy type, and constructed to carry four lines of way. Working details are given by the engravings on page 209, which will explain themselves. The total cost, including taking away the old structure, erection and removal of staging, was £22 per ton of new structure.

## TWO-TON TROLLEY CRANE.

EVERY railway terminal or intermediate station of importance possesses warehouses, stores, or covered sheds for the reception and subsequent delivery or transference of goods, wares, and merchandise. The general arrangement of premises of this description is familiar to most people. A small branch line, or "turn out," enables the wagons to come alongside of the platform or floor of the goods sheds, the level of which is usually so placed as to range flush, or nearly flush, with the bottom of the trucks. In order to facilitate the unloading, reloading, and necessary sorting and shifting about of the different descriptions of goods, cranes fixed and movable, of many various types, are employed. We extract from the "Portefeuille économique des Machines de l'Outillage et des Matériaux" the description and illustration of the most recent form of trolley crane adopted by the Western Railway Company of France. A reference to the accompanying drawing will serve to indicate the general character of this handy little machine. It consists essentially of an inclined beam or jib, which is suspended from a small four-wheel car or trolley at the upper end, and rest at the lower extremity on a small upright post carried by a castor which is free to move in any direction over the floor of the goods shed. The car or trolley runs forwards and backwards between a pair of overhead plate girders, and a lever-arm with a balance weight is attached to the point of suspension or pivot, so as to enable the whole crane to be easily lifted when it becomes necessary to clear bales, packages, or parcels, which always more or less encumber the floor of all warehouses.



TWO-TON CRANE—HEEL CASTOR

*The car or trolley.*—A pair of plate girders shown in elevation in Figs. 1 and 5, and in cross section in Figs. 2 and 6, form the roller path for the car which travels upon the horizontal ribs of the lower angle-irons of the two girders. Each plate girder is built up of a vertical plate web $\frac{3}{16}$in. thick, and an upper and lower angle-iron forming the flanges, 2½in. by 2½in. by ¼in. Inside the web plates the clear width is 9in., and the total breadth over both girders over all, at top, 1ft. 4in. At intervals of every 4ft., the twin girders, which are 1ft. 2in. in total depth, are braced together across the upper flanges by strips of angle-iron 1ft. 11in. long, which together with cranked gusset pieces, also of angle-iron, fasten them to the wooden joists of the building, Figs. 1 and 2. The car itself consists of two pairs of cast iron flanged wheels 10in. in diameter, joined together by a strong bent wrought iron bar or crosshead—Figs. 1, 5, and 6—upon each end of which is fixed the axle of each corresponding pair of wheels. Over the bearings of the crosshead is placed a cup, from which two bent copper tubes supply oil for the lubrication of the journals. Between the pair of wheels of the car, the crane is suspended by an iron rod 1½in. in diameter, turning in the central part of the crosshead B, shown in Figs. 1, 2, 5, and 6. A screw, prevented from becoming loose by two small pins, holds the rod in its place, and two steel washers are placed between the screw and the crosshead, which are capable of sliding slightly upon one another, so as to take the wear off other parts of the machine when it is shifted about. The lower end of the suspension rod is furnished with a staple keyed on to it, and to which is attached the pulley C, carrying the hoisting chain.

*The jib.*—To the jib—which is a "sandwich" beam of timber and iron—is fixed the axis of suspension which passes completely through it. A plank 2½in. thick, secured to two iron plates—4in. by ⅜in.—by bolts, ¾in. diameter and 14in. apart, forms the jib, which carries at the upper end a lever-arm 6ft. in length, supporting at its free extremity a balance weight or cast iron ball 1ft. 2in. in diameter. Two 1in. holes are bored in the ball, through which melted lead can be poured to adjust it when required. Near the top of the jib the timber plank is cut off at K in Fig. 5, and is also discontinued just above the pinion connected with the winch in Fig. 7. The lower part of the jib carrying the hoisting gear is composed of two plates ¼in. in thickness, bolted to the flitch-plates, and also to a stirrup of wrought iron, which latter serves to secure the foot of the crane. In this space of 6in. are placed the principal parts of the hoisting gear, and over all is fixed a covering of sheet iron to protect those working the machine from accidental injury. An iron leg provided with a terminal castor 5in. in diameter, E—Figs. 1 and 2—helps to support the crane in its normal position, and the method of articulation adopted permits the crane to move about freely in every direction. A detail of the arrangement is shown in Figs. 9 and 10, in which the axle of the castor is formed of a wrought iron cross piece 1ft. in total length. Upon the projecting ends of this cross piece, the men working the crane place their feet when turning the handles, so as to keep the jib firm in its place when the crane is under a load. Two iron check plates are attached by bolts ⅜in. in diameter to the lower part of the jib, to guide the hoisting chain and throw it into gear with the pinion—Figs. 7 and 8. There are two axles in the hoisting winch, one carrying the handles or the driving axle, and the other the large wheel which gears into the spur-wheel actuating the chain.

*Power required to work the crane.*—Put P to represent the power, W equal to the weight to be lifted, and T equal to the tension on the chain $= \frac{W}{2}$ all in pounds. Let D = the diameter of the circle described by the two handles of the winch, $D_1$ that of the large wheel, $d$ that of the driving pinion, and $d_1$ that of the spur-wheel carrying the chain, then we shall have the following general equation:—

$$P \times D \times D_1 = T \times d \times d_1$$

or

$$P = \frac{T \times d \times d_1}{D \times D_1}$$

To apply this to the example before us, we have merely to insert the actual values of the quantities. Although the dimensions on the drawings are given in feet and inches, it will be more convenient to use feet and decimals of a foot in calculation. Hence we have for the maximum working load, $W = 2$ tons, $T = \frac{W}{2} = 2240$ lb., $D = 2{\cdot}296$, $D_1 = 0{\cdot}896$, $d = 0{\cdot}232$ and $d_1 = 0{\cdot}273$, and our equation becomes

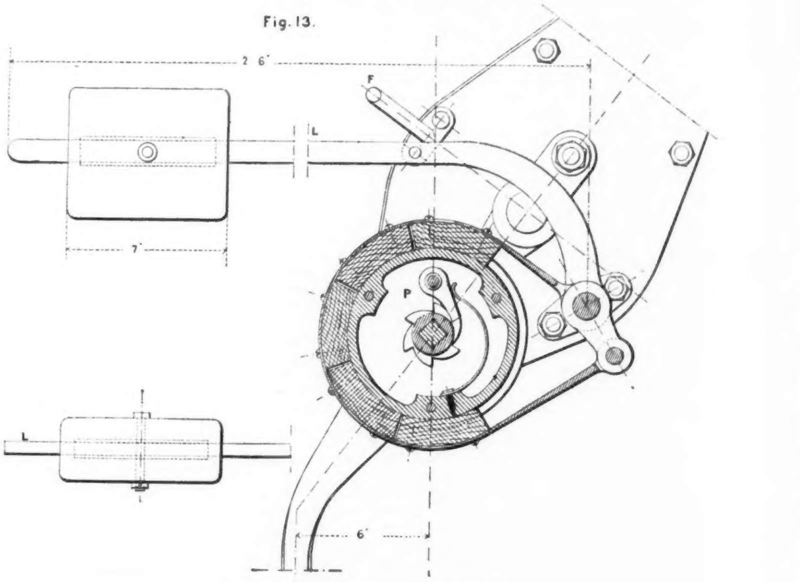
$$P = \frac{2240 \times 0{\cdot}232 \times 0{\cdot}273}{2{\cdot}296 \times 0{\cdot}896} = 68{\cdot}5 \text{ lb.}$$

If we suppose two men to each handle, more particularly as the labour is of a very intermitting character, the effort exerted by each will be 17 lb. The two axles of the winch are supported by bronze sockets fixed to the flitch-plates of the jib by three bolts ¾in. in diameter. Upon the one carrying the chain spur-wheel is keyed the large gear wheel, which has a diameter over all of 1ft., and the other pinion is forged on the axle of the handles—Figs. 7 and 8. In the accompanying table are given particulars, in decimals of a foot, relating to the details of the toothing of the wheel gear:—

| Particulars. | Wheel. | Pinion. |
|---|---|---|
| Diameter at contact .. .. .. | 0·896 .. .. | 0·232 |
| Pitch .. .. .. .. .. .. | 0·103 .. .. | 0·103 |
| Thickness of teeth .. .. .. | 0·049 .. .. | 0·049 |
| Number of teeth .. .. .. | 27 .. .. | 7 |
| Depth of teeth .. .. .. .. | 0·067 .. .. | 0·067 |
| Maximum stress on teeth .. | 682 lb. .. .. | 682 lb. |

The pinion carrying the chain has eight teeth with an external diameter of nearly 4in. and a pitch of 1in., corresponding to that of the hoisting chain. At the end the teeth, which are ¾in. in breadth, are slightly reduced in order to catch the better in between the links of the chain.

Fig. 13.



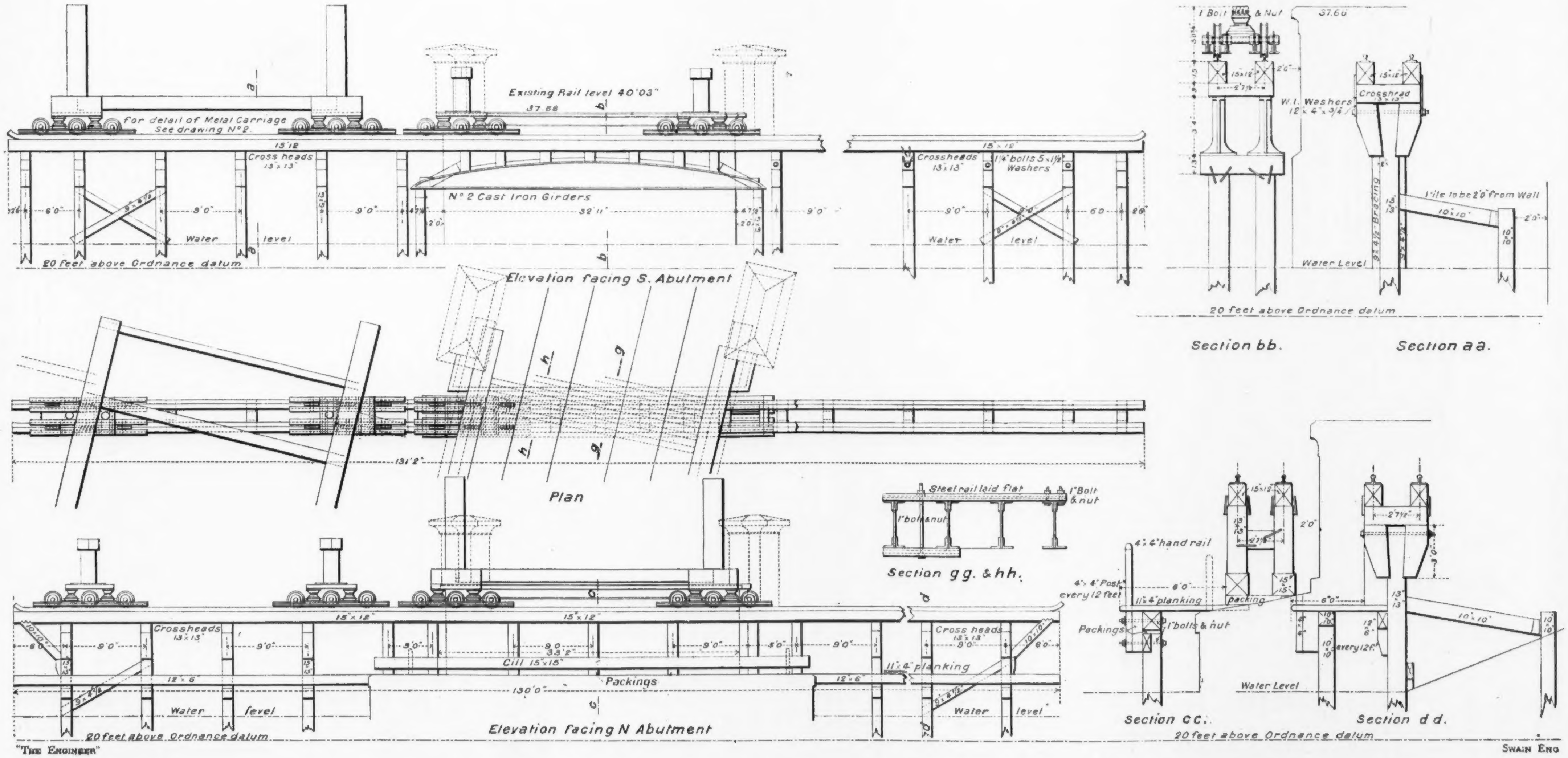
TWO-TON CRANE—DETAIL OF BRAKE

*Hoisting chain.*—In Figs. 11 and 12 are shown an elevation and section of the hoisting chain belonging to the Galle type, which is composed of links of flat iron 1in. wide and ⅛in. thick, fastened together by pins ⅜in. in diameter, upon which they are articulated. Four links on each side of the chain are held together by the pins, and are kept apart at a uni-

# GREAT NORTHERN RAILWAY—RECONSTRUCTION OF BRIDGE OVER THE DON—STAGING AND TRAVERSING TRUCKS

MR. RICHARD JOHNSON M. INST. C.E., ENGINEER

*(For description see page 209)*


Existing Rail level 40'03"
37.66
For detail of Metal Carriage See drawing No. 2
Cross heads 13 x 13"
No. 2 Cast Iron Girders
Water level
20 feet above Ordnance datum
Elevation facing S. Abutment
Crossheads 13 x 13"
1¼" bolts 5 x 1½" Washers
Plan
131'2"
Section gg. & hh.
Steel rail laid flat
1" Bolt & nut
1" bolt & nut
Crossheads 13 x 13"
Cill 15 x 15"
Packings
130'0"
11" 4" planking
Elevation facing N Abutment
1 Bolt & Nut
W.I. Washers 12 x 4 x ¾
Crosshead
Bracing
Pile to be 2'0" from Wall
Water Level
Section bb.
Section aa.
4" x 4" hand rail
4" x 4" Post every 12 feet
11" 4" planking
Packings
1" bolt & nut
packing
every 12 ft
Water Level
Section cc.
Section dd.

"THE ENGINEER"

SWAIN ENG

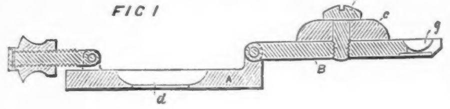
form distance of ⅜in. by a kind of shoulder which slightly increases the thickness of the central part of the pins. A hook attaches the chain at one end to the suspension shackle D—Figs. 1, 4, and 5—and small iron wedges at the other prevent it from becoming disengaged from the small pinion while running out, while the free end runs through a case or box, G, fixed to the under surface of the jib—Figs. 1 and 3. These wedges are held by screws at the end of the chain after its passage over the pulleys, the Galle pinion, and through the box, Figs. 11 and 12. The pulley blocks, including the one C at the top of the jib, are furnished with a central flange ⅝in. wide, to keep the chain in its place. When passing over the top of the pulley C, Figs. 1, 5, and 6, the play of the pins is reduced to ⅛in. by means of a small stud or stop terminating the suspension rod. By this arrangement the chain is prevented from falling in the event of any sudden shock or accident. Both pulley blocks are connected to the hooks by shackles of the same size and shape, and are also both provided with small steel washers to avoid wear between the shackle and the screw nut. Upon the upper surface of the jib is fixed a covering plate K, Fig. 3, of wrought iron, ¼in. in thickness, over which runs the hoisting chain. It is fixed by screws to the timber plank, and the box G consists of wrought iron of the same thickness, bent into the rectangular form shown in the cut. Cast iron sockets M, Figs. 1 and 3, bolted to straps of wrought iron, which are riveted to the iron flitches of the jib, carry the chain box, and the strap N, in the middle of the jib, passes over the chain to keep it in line. A cast iron box, into which is inserted the end of the chain box, protects the lower part of the chain together with the Galle pinion. It also serves as a guide to the chain, and is fixed to the iron plates of the winch by bolts ⅜in. in diameter, in the same manner as the two checks of iron already described.

*Automatic brake.*—An automatic brake, shown in Figs. 1 and 2, and in detail in Figs. 8 and 13, completes the mechanical construction of the trolley crane. It is sufficiently powerful to arrest the fall of the load without requiring any assistance from the handles of the winch. In order to lower the load, all that is necessary to do is to release, by slightly raising it, the lever of the brake L, so as to diminish the friction on the pulley P, and cause the load to descend with the velocity required. If, by any accident, those working the crane are obliged to abandon their hold, the automatic brake will come into play, and maintain the load suspended in the air. It consists essentially of a cast iron pulley P, fixed on the axle of the handles, and a lever counterweight L, actuating a band of iron, upon which are screwed the wedge-shaped pieces of wood which constitute a rim or tyre, nearly surrounding the whole circumference of the pulley, Fig. 13. The lever itself works on a fulcrum, attached to an oval-shaped strap, and the band of the brake terminates in a couple of similar fastenings, one of which is attached to the articulating shaft of the lever and the other to its extremity. The tension on the band is regulated by the cast iron weight situated at the other end of the lever L. It will be seen from Fig. 13 that the brake pulley is composed of two halves, between which is placed a rack to prevent the load from touching the ground, by stopping the revolution of the axle to which the handles are attached. The rack is mounted on the axle, and is furnished with a wheel having six teeth, in which a catch of wrought iron constantly works. This catch is pivoted on a small axle carried by the brake pulley, and is maintained in contact with the teeth of the rack by the pressure of a bent spring, which also prevents it from turning, so as to lower away so long as the pulley is held tight by the action of the balance weight. Three screws, ⅜in. diameter, secure the cover plate over the pulley, and the spring pressing against the catch is fastened to the pulley by a square-headed screw, having a diameter of ¼in. Omitting the plate beams forming the roller path, the total weight of the crane is as follows:—Cast iron, 564 lb.; bronze, 20 lb.; lead, 88 lb.; wrought iron, 598 lb.; steel, 1 lb.; timber, 33 lb.; total, 1304 lb. From the floor level to the soffit of the plate girders is 13ft. 6in., the length of the jib of the crane is 12ft. 7in., and the horizontal radius, or the throw of the jib, 8ft. All these dimensions can be altered to suit the requirements of any particular store or warehouse.

## SWORN'S BOAT PLUG.

The above illustrations show a boat's plug, the patent of Mr. Vincent W. Sworn, of Tunbridge Wells, and which, we think, possesses features which will commend it for adoption for users of boats. Fig. 1 is a sectional elevation when the plug is opened out, and Fig. 2 shows the plug in plan. The plates A and B are made in hard gun-metal, while the actual plug C is made of vulcanised india-rubber secured to the top plate B by means of screw E. The mode of fitting is simply to screw the plate A to bottom plank of boat, which, for this purpose, should be strengthened by fitting the usual thin wood plug cap on the outside of boat. To render the drain-hole D water-tight it is only necessary to turn the top plate B over on to the lower plate A, pass the hinged screw-bolt L into the recess G, and screw the butterfly-nut F down on the top plate B. The plug C thus covers the drain-hole D, and is pressed into same by screwing the butterfly-nut down on to the top plate, thus securing perfect water-tightness of hole; the whole operation taking only a few seconds. To relieve the boat from any accumulation of water when on shore, hanging in the davits, or stowed on a ship's deck, it will be seen that it is only necessary to reverse the operation described. The plugs are used in H.M. Navy, and by many private boat builders, and they are made in three sizes.

FIG 1



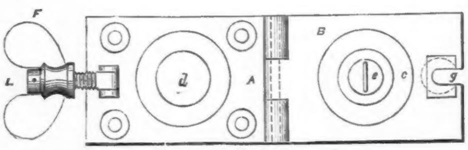
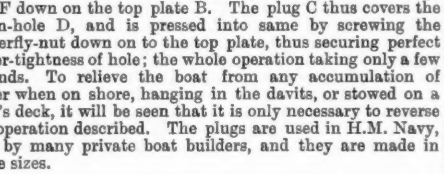


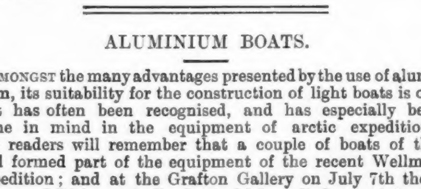
FIG 2

## ALUMINIUM BOATS.

Amongst the many advantages presented by the use of aluminium, its suitability for the construction of light boats is one that has often been recognised, and has especially been borne in mind in the equipment of arctic expeditions. Our readers will remember that a couple of boats of this kind formed part of the equipment of the recent Wellman Expedition; and at the Grafton Gallery on July 7th there was on exhibition a similar boat which excited some interest.

The boat which is shown, holding twelve men, is 18ft. long, 5ft. beam, 2ft. deep, and can carry two tons; and with sails and masts weighs 192 lb. It is built in three sections, as shown. The two end sections are interchangeable, so that the boat may be sailed either way; or if desired the end sections form a complete boat, as shown, in which form, filled with stores, it is designed for their conveyance on sledges across the ice. The whole is covered inside and out with Messrs. Docker Brothers' non-corrosive paint, which is impervious to the action of seawater.





Each section has a waterproof canvas covering stretched tightly over the top, perforated with holes with bag-like fittings for the rowers to draw tightly under their arms, each section thus forming an absolutely watertight compartment. All the metal fittings and wire ropes are of aluminium, and the basketwork fenders, which keep off the floating ice, when not in use fold in the bottom of the boat, are to be used to sleep on, and whilst the middle section forms one sleeping compartment, the others when placed on end and facing one another make a small tent. The bamboo mast is also in two parts, so that it can be stored away when not in use. The cooking utensils are also made of aluminium. The makers are Messrs. Swain and Kirby, of Birmingham.

The new bilge keels which are being fitted to the vessels of the Royal Sovereign class weigh some fifty tons. The fitting of these to each vessel takes about a month to complete. The Repulse has already been dealt with, the Resolution being now in hand.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### OSCILLATING v. INCLINED PADDLE ENGINES.

Sir,—In reply to "Voyager" I say that in all respects the oscillating paddle engine is superior to the inclined engine. Its weight is less, and in simplicity and cost of upkeep it is much superior. But it has the drawback that it requires a deep boat. The Belgian steamers only draw 8ft. or 9ft. They could not get into Ostend at low water if they were deeper, and oscillating engines cannot be got into this depth without sacrificing all their advantages. The great difficulty of the oscillating engine is the central crank for the air pump. This can be got rid of in various ways. In the Dutch boats there is a large excentric close to the high-pressure cylinder. This works two levers, driving the air, bilge, and feed pumps. The circulating water is provided by a centrifugal. Engines of this type have given every satisfaction. For triple-expansion work the oscillating system does not answer, and nothing better has been devised than Laird's arrangement used in the London and North-Western boats. J. S.

Birkenhead, September 3rd.

### APPROXIMATE CALCULATIONS.

Sir,—How annoying it must be for M. Normand to find British naval architects persistently ignoring his treatise on "Approximate Calculation," published about thirty years ago, and to see some one continually trotting out a formula which is either not as good as his or else exactly the same. The latest sinner in this respect is Mr. Archibald Denny, who at the summer meeting of the Institution of Naval Architects gives a rapid method of calculating wetted surfaces as follows:—$S = L\left\{(D \times 1{\cdot}7) + (B \times C)\right\}$ If in this formula we substitute $(D \times 1{\cdot}5)$ for $(D \times 1{\cdot}7)$ and $C + 0{\cdot}09$ for C we find that it is M. Normand's formula for an approximation to wetted surface, and that it is perfectly unjust to rechristen it Mumford's in 1894.

A perusal of M. Normand's valuable work will evidently be very useful reading for Messrs. Denny's tank staff, as all that can be said on approximate calculation has pretty well been said in it.

Foreigner.

### A NEGLECTED FIELD FOR INVENTORS.

Sir,—The following extract from a letter just received from a friend in Spain may interest your readers:—

"I do not understand why foreign inventors take out so few patents in this country. Spain is not alone the land of wine, fruits, and cigarettes; for with reference to objects manufactured, other articles are used here besides guitars, swords, sashes, arms, and fancy headgears. Not only in Catalonia, that eminently commercial and industrial province, whose inhabitants, exceptionally intelligent and laborious, willingly adopt new systems and apparata as soon as the example is given them, but also in districts such as Bilbao, Valencia, Savilla, Antequera, Bejar, and Alcoy, Spain possesses very important industrial centres. A number of different industries exist in Madrid and its vicinity—the chemical and agricultural enterprises, railways, tramways, electric light, &c., all offer a wide field for inventors. Transactions, they say, are difficult in Spain, and are not well paid, but these difficulties are greatly exaggerated, and as influential English and French agents are to be found in the principal cities of the country, foreign manufacturers can fully ensure protection of their interests. If more attention is paid to this country, I am sure that it will be done at a profit."

Any further information I shall be pleased to supply.

Nottingham, September 5th. H. Walker Hill.

### CUIRASSES.

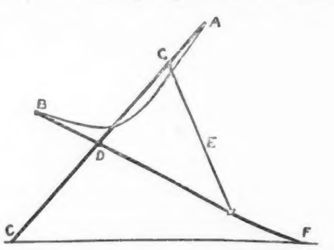
Sir,—I was labouring under the delusion that the cuirass humbug was dead and buried. It seems, however, that I was mistaken. I attempted to show that a piece of good steel accounted for all the phenomena. If the public did not understand me, it certainly was not my fault. I demonstrated that a steel plate weighing no more than 10 lb. to the square foot would stop a Lee-Metford projectile every time with a considerable margin for safety. After this, one would suppose that the cuirass makers would have to beat these figures in order to get any notoriety in the newspapers. The test is an exceedingly easy one. Let the cuirass exhibitor fire a dozen shots at his cuirass; then the area of the field containing these twelve shots could be measured and the cuirass weighed. All the instruments necessary are a carpenter's rule and grocer's scales. Then we should see whether these gentlemen would be able to beat the sheet of steel or not.

The fact is, however, that all these so-called cuirasses are nothing more or less than a piece of armour-plate sewed up in a bag, except those which are made for daggers, when a piece of dried rhinoceros hide answers the purpose admirably.

Bexley, September 5th. Hiram S. Maxim.

### THE GRAPHIC STATICS OF A DECK CHAIR.

Sir,—Just at this season deck chairs form a not inconspicuous object of attention. They are in many ways comforting and restful. But they are more than this, they supply, properly used, a most interesting, instructive, and perplexing subject for the study of the composition and resolution of forces. I give a diagrammatic sketch of one, and I ask any of your readers to determine the stresses at the various joints when a man weighing, say, 160 lb. is seated on the canvas. It will be found that the problem is about as difficult of solution as can be imagined. To begin with, what is the pull of the canvas at the points A and B? Again, A C tends to turn on D as a fulcrum; it is prevented by E, which tends to force F downwards, but the effort at B tends to compensate for this. What is the stress at G? What is the longitudinal or compressive stress in B F tending to cause it to slide back along the floor, and due to the pull of the canvas at B?



I could add half-a-dozen questions, but I think I have said enough to show that this affords a far better example of complicated stresses than did the camp stool, round which raged such a combat a few years ago in the correspondence pages of The Engineer.

Dunoon, September 3rd. Canvas Back.

### LOCOMOTIVE ENGINE BOWS.

Sir,—In dealing with the problem of reducing the air friction and resistance of trains, the experiment of placing "bows" in the front of a locomotive is only a fractional part of a very extensive problem. It has always seemed to me that there must be a great waste of power in creating the draught that is felt when sitting in a railway carriage with one's face to the engine, and travelling at, say, forty miles an hour. Supposing there are eighteen carriages in a train, and each is divided into six compartments, we have 108, into which stationary air is being forced and propelled at the speed of the train.

Again, our English carriages are built with narrow windows, which necessitate numerous projections, which although small when taken in the aggregate, must consume a considerable amount of power to propel them through the air. The underframes of the carriages are constructed in a way that form almost an ideal air trap. The above may seem mere trifles, but Mr. Maxim has just pointed out by his wonderful experiments in connection with mechanical flight, that projections—mere trifles—on the aëroplane of his flying machine meant all the difference between success and failure. The resistance of these is insignificant compared with those in connection with a railway train.

Can the power required to overcome these resistances account for the discrepancies which you have so often pointed out between the theoretical power of a locomotive to haul a given weight of train and that required in actual practice? W. P. Walker.

Beckenham, August 31st.

### THE THEORY OF THE STEAM ENGINE.

Sir,—Mr. Donkin's paper read before the British Association is full of interest. It might have been rendered more valuable, however, by a fuller enunciation of Mr. Donkin's own views. May I ask him to tell me and your readers in general, how he explains such performances as that of the well-known Pawtucket pumping engine, in which admitting steam to the jackets did no good but rather harm. There are dozens of such cases available with all kinds of engines. It is quite clear, indeed, that the factor of condensation in various engines is very different. In fact, in no two engines is it alike. Some light on this point is urgently needed. It would seem, indeed, that we are standing on the very verge of a notable discovery. Why cannot all engines be built so that, like the Pawtucket engine, they can be extremely economical and have no jackets? While I am on the subject I would like, with your permission, to direct attention to another point which wants clearing up. When a gas expands without doing work, its temperature does not fall; were it otherwise the fall in temperature could not be precisely proportional to the amount of work done. The fall in temperature is a result of the doing of work, not of the expansion of the gas, and, accordingly, we can say that $\frac{T - t}{T}$ represents efficiency.

Now, it is also said that in the steam engine its efficiency is to be measured as in any other heat engine, and that the amount of work to be got out of a given weight of steam depends on the difference in its initial and terminal temperatures. This seems to me to be all wrong, save in one sense; that is to say, it is right if we compare one steam engine with another, but it is all wrong if we compare a steam engine with a hot air or gas engine; and for this reason, steam cannot be expanded without falling in temperature, whether it does work during expansion or not. As expansion takes place part of the sensible heat becomes latent; that is to say, it is expended in doing internal work. The external work is done in the case of saturated steam, not by the sensible heat, as is the case with a gas, but by the latent heat. Condensation takes place by the performance of work; but whether little or much steam remains at the end of the stroke, it will have the temperature due to its pressure, no more and no less. The difference then between the action of steam and air or gas is radical, but the fact seems to be constantly overlooked. Until it is fully recognised there will be no good and adequate theory of the steam engine available.

Oldham, Sept. 3rd Maurice Cross.

### THE RAIYAN RESERVOIR AND DRAINAGE CANAL.

Sir,—Although, as was stated in your issue of July 27th, the three Commissioners appointed by the Egyptian Government to advise on the proposals for the regulation of the Nile were unanimous in rejecting the Wadi Raiyan project, this decision is not in any way to be regarded as final. The session of the Commission held on March 27th, 1894, was devoted to the examination of my views. I was asked to explain to the Commissioners the plans which I had recommended for the utilisation of the Wadi Raiyan, to state in what they differed from those submitted by the Department of Public Works, and the objections which, in my opinion, might be made to those presented for the consideration of the Commission. I proceeded to give a summary of my discovery of this depression, citing documentary evidence as to the origin of my own inquiries and the state of the reservoir question from the time of Mehemet Ali down to 1882. I showed that on May 16th, 1881, I had published the expression of a hope that the explorations which I was about to undertake in the Fayoum and adjacent desert, during the following winter, would not only lead to a more intelligent conception of the system of irrigation in force in the brilliant days of Egyptian prosperity, two thousand years ago, but that practical results might also be achieved, and that if this proved to be the case, these researches would "enormously increase the population of Egypt and redeem a large area of so-called desert." The value of a reservoir is now acknowledged. Its annual returns are estimated at between £7,000,000 and £12,000,000.

How is it possible that this immense addition to the wealth of Egypt should have been ignored during that half-century of progress, since the conversion of the Delta from inundated land into irrigated fields under Mehemet Ali, to the arrival in Egypt of the Anglo-Indian engineers? The answer is given in the "Memoires des Principaux Travaux en Egypte," published by Linant de Bellefonds in 1872-3. This great French engineer recognised the value of a reservoir, but the objections to ponding up the water in the valley itself seemed to him insuperable. No dam, of course, could be constructed to the north of the rock, which crops out for the first time across the river bed at Silsileh. Here the sandstone was too unsatisfactory, in his opinion, to permit of more than an elevating dam or barrage, sufficient to raise the low Nile about 20ft. This view was shared by all the European and American engineers in the service of Ismail Pasha, as well as by those who visited Egypt. Their name is legion, and they included the most eminent engineers and contractors in the world. The difficulties were not simply of an engineering character. The problem was for many reasons one of great complexity. Absolute safety, whether from the normal pressure of the water, and the scouring of the silt-charged current, or the exceptional but possible chances of war, anarchy, or earthquake, had to be attained. Such a dam must be as firm as the everlasting hills, and in appearance as well as reality, when the susceptibilities of five million inhabitants have to be considered. The Channel Tunnel is an illustration of the weight of popular apprehension, even when excited by a remote and contingent danger.

In 1881-2 there was a movement in the direction of a reservoir at Silsileh, but it is noteworthy that it was due to a physician—not an engineer—a M. La Motte. It was skilfully used for political purposes by the French Colony; precisely as the abortive scheme of M. Roudaire was countenanced by M. de Lesseps and the French Government, to secure a hold upon Tunis by planning an engineering work which, by flooding the Shotts, would detach Tunis from the African continent and facilitate its annexation to Algeria.

Linant de Bellefonds, having thus rejected a valley reservoir, proposed the construction—or, as he maintained, the re-construction—of a lake on the upper eastern plateau of the Fayoum. It was to contain 2915 million cubic metres of water, and thus be of the same capacity as that now projected at Assouan. Nothing, however, was done by him from 1842 onwards to work out a detailed scheme, and in 1871-2 he obviously considered it as impracticable. Doubtless mature reflection had led him to the conclusions so lucidly stated by Major Brown, Inspector-Genera for Upper Egypt, that such a reservoir would endanger th

Fayoum. I therefore claim that the Silsileh episode would have been long since forgotten had it not been for my persistent and continuous efforts. The acknowledgment, made first in official publications in 1887, and in the Parliamentary Reports of 1890, that the Raiyan depression was a feasible and innocuous mode of draining the basins of Middle Egypt, reducing the danger to the Delta of an excessive flood, and storing a supply sufficient to double the low Nile for the three months of water famine, revived the hopes of the shareholders in the moribund Société du Nil. It is obvious that nothing has occurred to diminish the danger to Egypt from the accidental or wilful destruction of a reservoir dam at any point between Assouan and Halfa. Nor is the sanitary objection to ponding-up the water other than it was in the days of Linant. The control of the whole country is unquestionably given to the masters of the gates through which the river would pass. A section of the river would be depopulated for a hundred miles. It may be argued that these objections are not fatal, and do not justify Linant's conclusion. They have been considered with care by the Reservoir Department, and an opinion expressed. It is certain, however, that a widespread feeling exists—fostered, no doubt with an evident animus, by the archæologists and the native Press—that the military, social, sanitary, and engineering difficulties have been unduly minimised by the English officials in the Public Works Department. It is pointed out that had the Technical Commission authorised the Assouan dam as proposed by Mr. Willcocks, the piers would, according to Sir B. Baker, have been destroyed by erosion; and that the addition of £400,000 worth of cast-iron tubing completely changes the structure in an essential feature. The deposit of silt, also, in the river bed, would commence where the current entered the still reach of the reservoir. When the gates were first lowered, in December or January, the sand would drop just above the sills; but as the river current was checked at a point steadily advancing for three months southward, the deposits would retreat, to advance northward as the lake was lowered. The bed would thus be raised for a hundred miles. The bar formed by the Barrage is noticeable at Roda, south of Cairo. The Philæ bar would extend to Korosko. In order to keep the flood channel clear, the river would be required to take up this matter in addition to what the current already carried in suspension in the flood, and shoot it into the Mediterranean, some 750 miles distant. The scouring of a channel has often disappointed expectations founded on careful observations. Water in movement readily takes up silt, but drops it on the least excuse. In this case it would be difficult to predict with certainty the effect on the flood-Nile. It would make the current at the cataract more impetuous, although some deposit might reduce the strain upon the foundations of the dam. It would level up the floor of the river in the cataracts, and make a bar a short distance below the dam.

It has been calculated that if the dam yielded to a strain, when full, the river bed would carry off the water without endangering the country. The more dangerous moment, however, would seem to be in October. If even a small number of the gates were lowered, or obstructed by floating trees or other material thrown into the river with malicious design, the dam would be overtopped by the flood in a week, even though a relatively large discharge were passing through some of the sluices. As the Nile flows in a deep bed by the side of a long plain which tilts towards the west, any body of water, diverted by a temporary obstruction in its normal course, would never return to the river. It would pursue its destructive career across the fields and villages and be deepest under the foot of the desert hills. Over the sanitary question the doctors differ. I go too far, in the opinion of Rogers Pasha, in considering this alone sufficient to ensure the rejection of a tropical tank, however long, filled with water from the White Nile. Nor does the present chief sanitary official attach importance to the danger of local pollution by cholera or similar disease from the Nubian villages. These are points, nevertheless, that are still being urged with some success, and with a certain amount of support, largely, no doubt, personal, political, and sentimental. On the other hand, confronting all objections to a reservoir, we have a glittering pile of gold in the tempting prospect of immensely increased revenue. As I have elsewhere said, this increase of the summer supply of the Nile is a work which the amelioration of the millions of inhabitants of Egypt demands. It is impossible for England now, with due regard to her Imperial interests and her prestige, to allow those to triumph, whether political rivals or honest but misguided sentimentalists, who are trying with energy and ingenuity to shelve the whole subject.

The archæologists seem to favour a Kalabaha dam, but the Kaibar site has its advocates, especially in military circles, while I am in no way willing to abate my advocacy of my Raiyan scheme. In the last number of the Journal of the Royal Institute of British Architects, I bring the question up again, because no authoritative decision has been reached by Sir B. Baker, M. Boulé, and Sig. Torricelli. There is ample measure of justification for this contention in what took place in the session of the Commission to which I have referred. It will be observed that the technical commissioners were selected by the reservoir department. They were a purely advisory body. They had no authority delegated to them by her Majesty's Government or the other Powers. They were not "International" in any other sense than that of being of three different nationalities. I denied any jurisdiction over me or my scheme. It is evident from the form of the question put to me that this was admitted, and that the Raiyan plans submitted for the consideration of the Commissioners were not mine.

"M. Cope Whitehouse fait remarquer à la Commission que le projet nommé 'The Raiyan Project,' dressé par la direction des Reservoirs, est nullement acceptable. Il la prie de le rejeter comme inadmissible. Il caracterise la carte et la section comme non seulement incompletes, mais aussi pleines de deceptions." Thus I not only denied the competence of the tribunal to sit in judgment on my Raiyan project, but invited the Commissioners to reject that form of the Raiyan project which had been prepared by the Department of reservoir studies, and challenged the accuracy of the map and the alleged facts submitted to them for their guidance. The Commissioners conceded that "le projet de M. Cope Whitehouse est tout-à-fait différent de celui qui a été soumis à la Commission, et qui'il faudrait d'abord en faire l'étude et l'estimation." Thus it must be admitted that so far as my own Raiyan plans are concerned, I have saved my rights whatever they may be.

The Raiyan project submitted to the Commission was disavowed by me, and this was distinctly recognised. My plans were not examined, and no opinion was expressed.

There is one use of the Raiyan depression on which all parties might be disposed to agree. In the volume entitled "The Fayoum and Lake Moeris," Major Brown discusses my proposal to utilise the basin as a waste-weir for the drainage waters of Middle Egypt. "The last use to which the Wadi Raiyan might be put is to adapt it for the reception of the drainage waters of the Nile Valley, after the basin area of Middle Egypt has been converted into Sefi—summer—irrigation by means of the increased supply provided by the assumed existence of reservoirs in the Upper Nile Valley, and a regulating dam at Asyut. When all these basin lands are converted into tracts under perennial irrigation, there will be a great difficulty in the disposal of their drainage water during the time of high flood, and the Wadi Raiyan affords a possible means of solving this problem. Even though the drainage might gain on evaporation, and the Wadi Raiyan become eventually full, its water-surface would be annually so far lowered, by allowing a flow out into the Nile during the summer months, as to prepare the basin for the reception of all the drainage it would be called upon to receive during the next flood season." The drainage level of the cultivated land opposite the proposed cutting into the Raiyan basin is about 26 metres above sea level. The high Nile maximum is officially given at 33 metres. It may be calculated that the Department must provide for drainage into some other channel than the Nile for at least three months. This drainage must provide for the maximum duration of the Nile above R. L. 24·5 at Beni-Suef. The alternative proposed is a drain prolongation of the Bahr Jusuf, 110 kilos. in length, 40 metres bed width, and 4 metres deep, discharging into the Rosetta branch. Its excavation, the syphon under the Rayah Behera, and the improvement of the Bahr Jusuf are estimated by Major Brown to cost £600,000.

It would, however, be a distinct advantage if, during the continuance of the present inundation system, even a part of the water standing in the basins could be let off into the desert to the west. The cutting through the isthmus would be 11½ kilos. in length, with the excavation of 7,592,000 cubic metres of marl, and about 2,486,000 cubic metres of rock, for a canal with a bed width of 40 metres. The total cost would be £E379,000 for the marl, and apparently about £E196,880 for rock, or a total of £600,000. An interest and maintenance charge of even £25,000 per annum would be further reduced, or rather covered, many times over, by the use of this water, in the coarse but valuable crops which could be obtained within the Raiyan area, and the utilisation of my Wadi Lulu as a reservoir for the Gharaq and Western Fayoum districts, and the fisheries.

I have, as is well known, repeatedly offered to purchase the Raiyan depression and cut the isthmus at personal risk, under such conditions of repurchase by the Egyptian Government as would leave those in the construction syndicate reasonable profits. It is difficult to see how there could be any very wide fluctuation in cost, now that the principal facts have been admitted by the Public Works Department. Egypt is an ideal land for excavation. Its equable climate and absence of rainfall reduce the rate of excavation to a certainty. If the benefits of such a canal were fixed at only £300,000 per annum, and responsible English contractors agreed to execute the works, with a right of acquisition by the Egyptian Government at any time, on payment of cost and a fair bonus, it seems as if no tangible reason existed for obstructing, actively or passively, a work which would be a great public benefit, and give profitable employment to British capital.

The reproduction of a portion of Plate XVI. enables any engineer to determine for himself whether the plans, submitted by Mr. Willcocks for the consideration of the Technical Commission conform to the ordinary laws of hydraulics. If it had been desirable to attach the Raiyan reservoir to the low-Nile bed of the river by a single intake-and-discharge canal, it would still be incredible that the best line should not be the shortest distance. The intake, however, is designed to serve as a flood relief. It is to receive a large volume of water of at least 100 million cubic metres daily in the critical fortnight, at the second rise of the Nile in October, when the banks of the Damietta and Rosetta branches of the Nile have been weakened. In every year some 60,000 to 90,000 men are taken from their own fields in the Delta by the so-called Corvée. The repairs of the Barrage largely diminished the clearance of silt from the deep summer canals. It consequently diminished their carrying capacity in flood, and increased the danger of bursting banks during the inundation. Yet this proposed flood intake runs southward against the stream! As an outlet it might be of a reduced capacity. For its discharge would be little more than one-fifth, in any given day, of its maximum intake. Besides this, as I had explained a hundred times to the Ministry of Public Works, the quality and head of the water to be discharged are factors of such great sanitary and commercial value that no one could seriously contemplate running the pure Abyssinian rainfall back into the fetid pool formed by the Barrage in June and July.

The section shows that the maximum high Nile is at reduced level 33. Why was not this line carried across the intervening isthmus into the Raiyan depression? Why is not the minimum level of the outlet similarly marked? As the canal works both ways, why should there be a slope to the west of 1 in 20,000? If the bed is dropped to obtain the required section with less excavation, this reason ceases as soon as the water reaches the depression. The section of a canal is merged in a lake. The Wadi, discovered and surveyed by me in 1886-7, and shown upon my maps of 1887-8 as the Wadi Lulu, would necessarily be filled first. By what possible reasoning was Mr. Wilcocks led to assume that water would not find its own level, and that the surface of this considerable sheet of water would always tilt towards the west? Presumably he imagines that this inclination would persist even during the outflow eastward! The "canal" is elsewhere depicted as a thick black line running down, like a pipe, the sides of this depression and running up again on the western slope. It is not even carried straight across. It meanders like a huge snake, when clearly the distance ought to be measured in a direct line on the surface of the water. But why indicate any canal at all after the contours 33—25 have been reached? This is not a case of rival navigation schemes, in which a lake is to be included, as in the Nicaraguan route as against the Panama. Not only is the canal prolonged for 26 kiloms., but one notes with dismay that the "slope" reappears on the other side of this so-called Wadi "Liernur," as if the discharge from the isthmus canal was comparable to a shot from a gun. Its direction once established the way is to be cleared to the 57th kilometre, where its force is spent. But when the Raiyan Reservoir is discharging water back into the Nile Valley at the 20th kilometre at a reduced level of 24, what will it avail to have the mouth of the canal at R.L. 12?

The isthmus canal is the essential feature in my scheme. It is plain that the geological statement of the existence of "Epsom salts" and "Parisian" limestone is absurd. It is inexplicable that no single boring was carried down to R.L. 25, if there was a sincere desire to place before Sir B. Baker, M. Boulé, and Sig. Torricelli well-established facts. It would have added nothing to the outlay. The mere clerical work involved in these conjectures and inferences as to cost of excavation, slope of sides, and pitching, represents an expenditure far in excess of the few pounds required to take out a proper core. Nor would even this sum have been added to the heavy charges needlessly inflicted upon the Egyptian taxpayers by Mr. Willcocks. I offered to make these borings, and permission was refused. I then offered to pay the Government for any extra work deemed expedient by me, but not considered necessary by its officials. This offer was also rejected.

The Raiyan Project was approved by Colonel Western. It was declared to be feasible by Sir C. Scott-Moncrieff. This was communicated to her Majesty's Government, and to all those interested in Egypt, by Lord Cromer, and the Foreign-office, in numerous official utterances, covering several years of repeated examination and mature consideration. There is no evidence to show why the Public Works Ministry in 1894 reverses decisions of its highest officials arrived at in 1887-8. Something has been said of the material to be excavated on a northern line as softer than that on the southern. No doubt it is frequently better to carry water through a more refractory material, but the "marl" would not change in the distance of a few miles.

A discussion of this point would require a resort to facts not disclosed on Plate XVI. It is my object to show that these plans stand self-condemned. In the technical language of the law I moved the Technical Commission to reject the Raiyan project, as presented by Mr. Willcocks, on his own papers. It was an erroneous and incomplete presentation of the case.

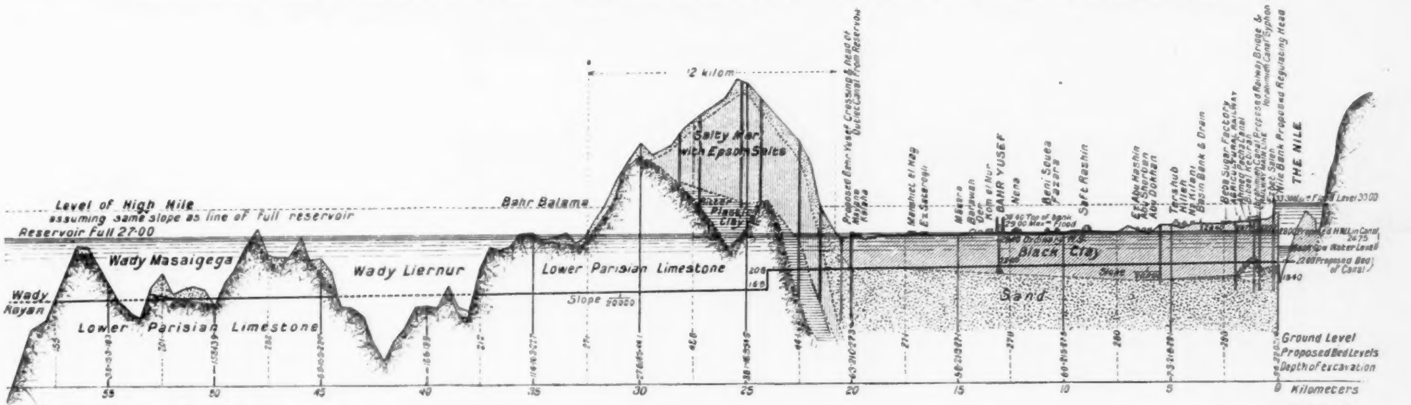
The plate shows that the inundation floods the valley to the West of the Bahr Jusuf. It is of such width as to be readily convertible into a relatively vast flood-feeder of the Raiyan isthmus canal. The Bahr Jusuf itself delivers a perennial supply, with a summer minimum of 1 to 1½ million cubic metres—409 to 713 cubic feet per second. In flood, however, it carries 6½ to 7 million cubic metres—2658 to 2863 cubic feet. It is therefore available as a feeder. Each great basin has its own flood canal, by which immense bodies of water are drawn from the Nile into the enclosed area which it covers. By simple and inexpensive means each of these could be made to do its share of the duty imposed upon the flood-escape and reservoir canal. They would be the natural feeders of the Raiyan Canal.

The total estimate of £1,500,000 being reduced by about £350,000 by the suppression of the inlet canal, and cancelling the absurd charges for a western prolongation beyond contour R.L. 25, the total is less than £700,000, even based upon a compact limestone of Paris, instead of the horizontal strata of the easily worked Egyptian stone. In 1887 I offered to deliver the completed works for £1,000,000. The Public Works Ministry concede that Sir C. Scott-Moncrieff by his ill-omened opposition has cost Egypt upwards of twenty million pounds.

**Cope Whitehouse.**

8, Cleveland-row, St. James's,
September 1st.

LONGITUDINAL SECTION OF PROPOSED INLET AND OUTLET CANALS FROM PLATE XVI. OF THE PLANS OF THE RESERVOIR DEPARTMENT, EGYPT



"The Engineer"

Swain Eng.

*Official Estimates of Excavation in cubic metres.*

| | | | | | |
|---|---|---|---|---|---|
| Sand | 602,000 | Marl | 7,592,000 | Clay | 6,996,000 |
| Rock | 3,792,000 | Rock | 4,582,000 | | |
| Cost | £303,360 | Cost | £746,160 | Cost | £379,200 |

Note.—The double vertical lines represent borings. The dotted horizontal line has been added to the original plate.

Surface of reservoir at R.L. 30, 727,000 000 square metres.
at R.L. 23, 607,000,000 " "

Volume between R.L. 23 and R L. 30, 4,711,000,000 cubic metres.
Estimated volume of Assouan Reservoir 3,733,000,100 " "

Cost of Assouan Reservoir (as amended), £2,000,000

---

H.M. Battleship Audacious, which was launched in 1869, is to be again fitted for further service, having since her first cost had expended upon her some £200,000 in alterations.

# TWO-TON TROLLEY CRANE, WESTERN RAILWAY OF FRANCE

*(For description see page 210)*

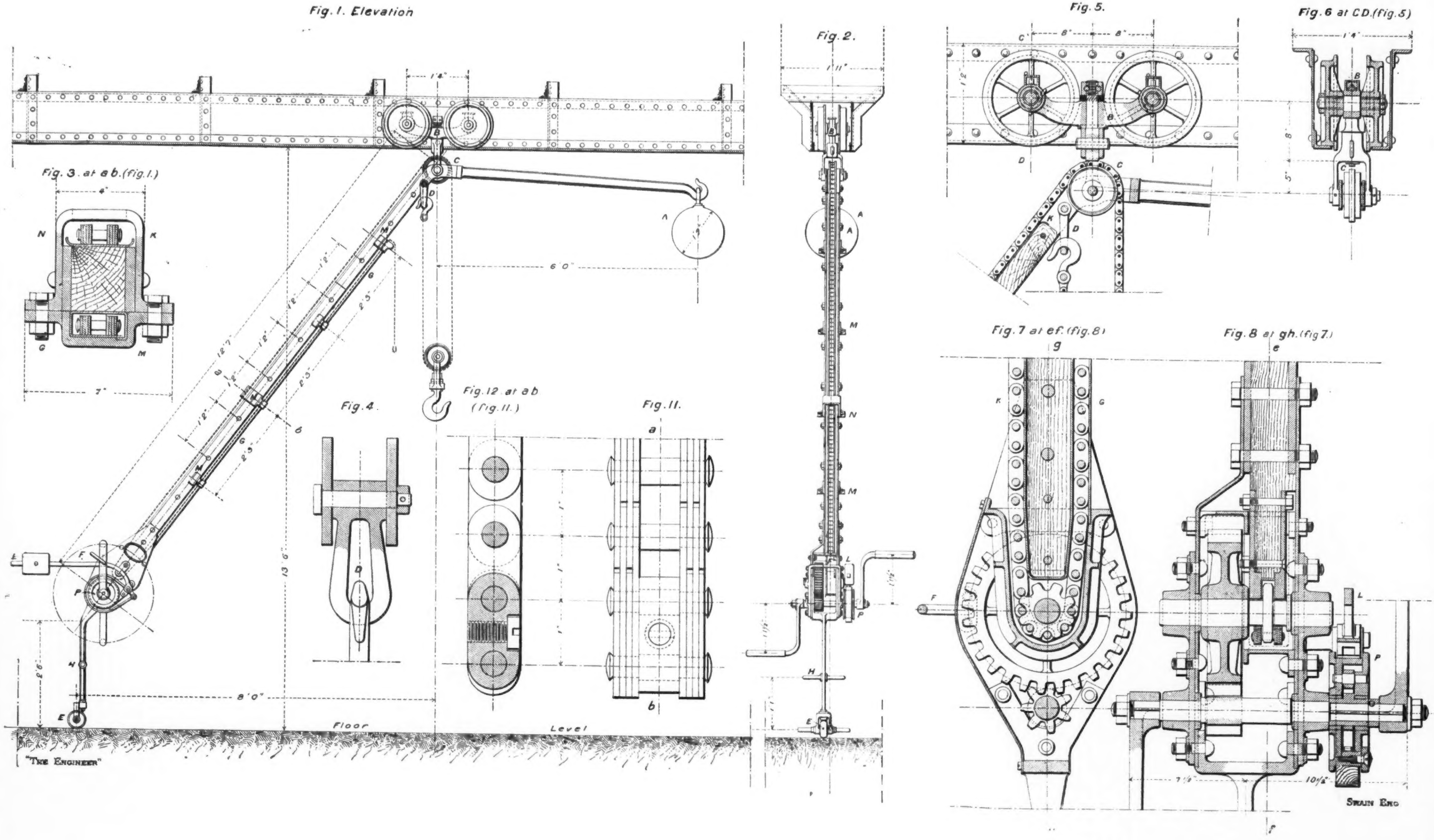
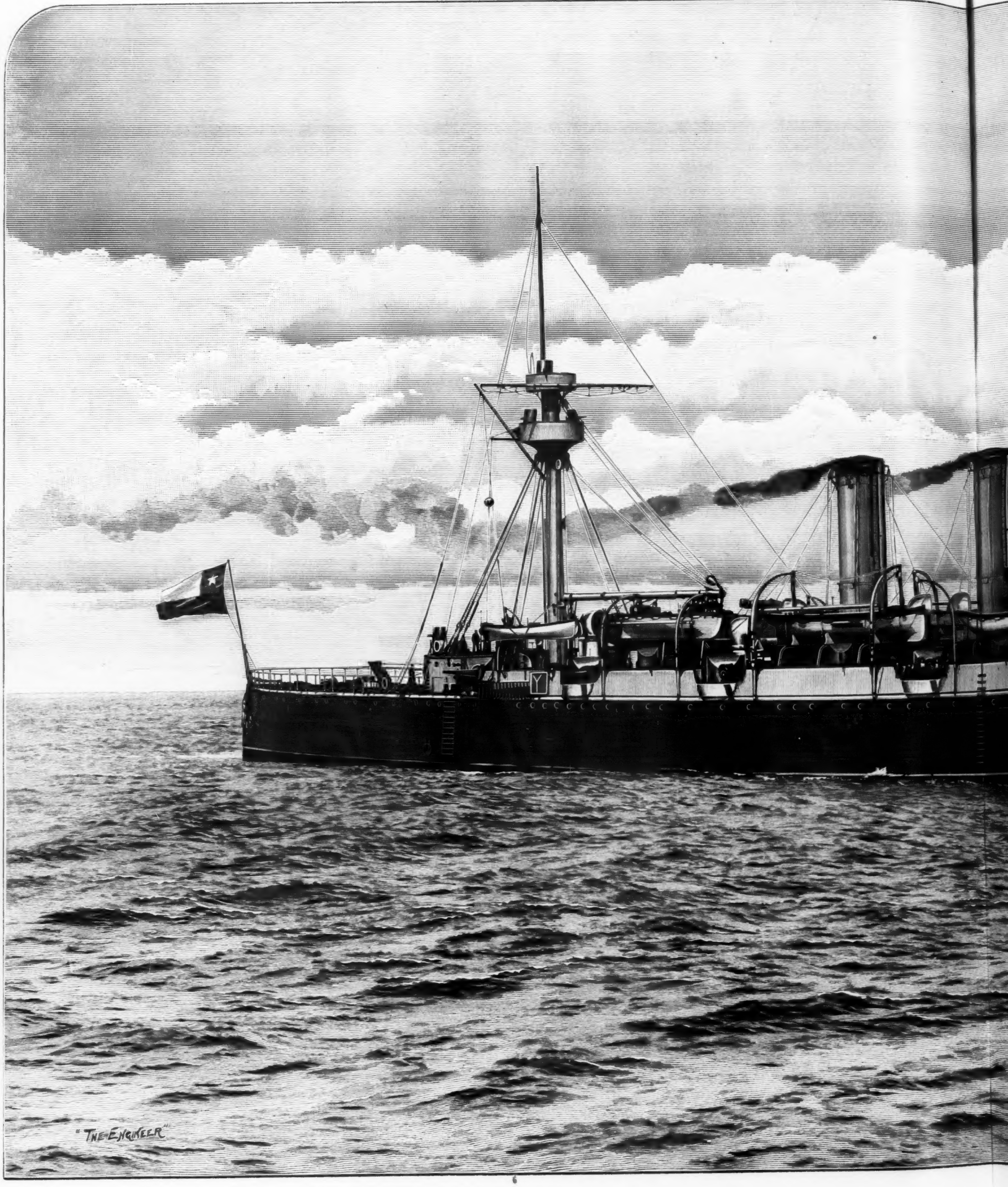


Fig. 1. Elevation
Fig. 2.
Fig. 3. at a b. (Fig. 1.)
Fig. 4.
Fig. 5.
Fig. 6 at C D. (Fig. 5)
Fig. 7 at e f. (Fig. 8)
Fig. 8 at g h. (Fig. 7.)
Fig. 11.
Fig. 12. at a b (Fig. 11.)
6' 0"
13' 6"
8' 0"
Floor
Level
"The Engineer"
Swain Eng.

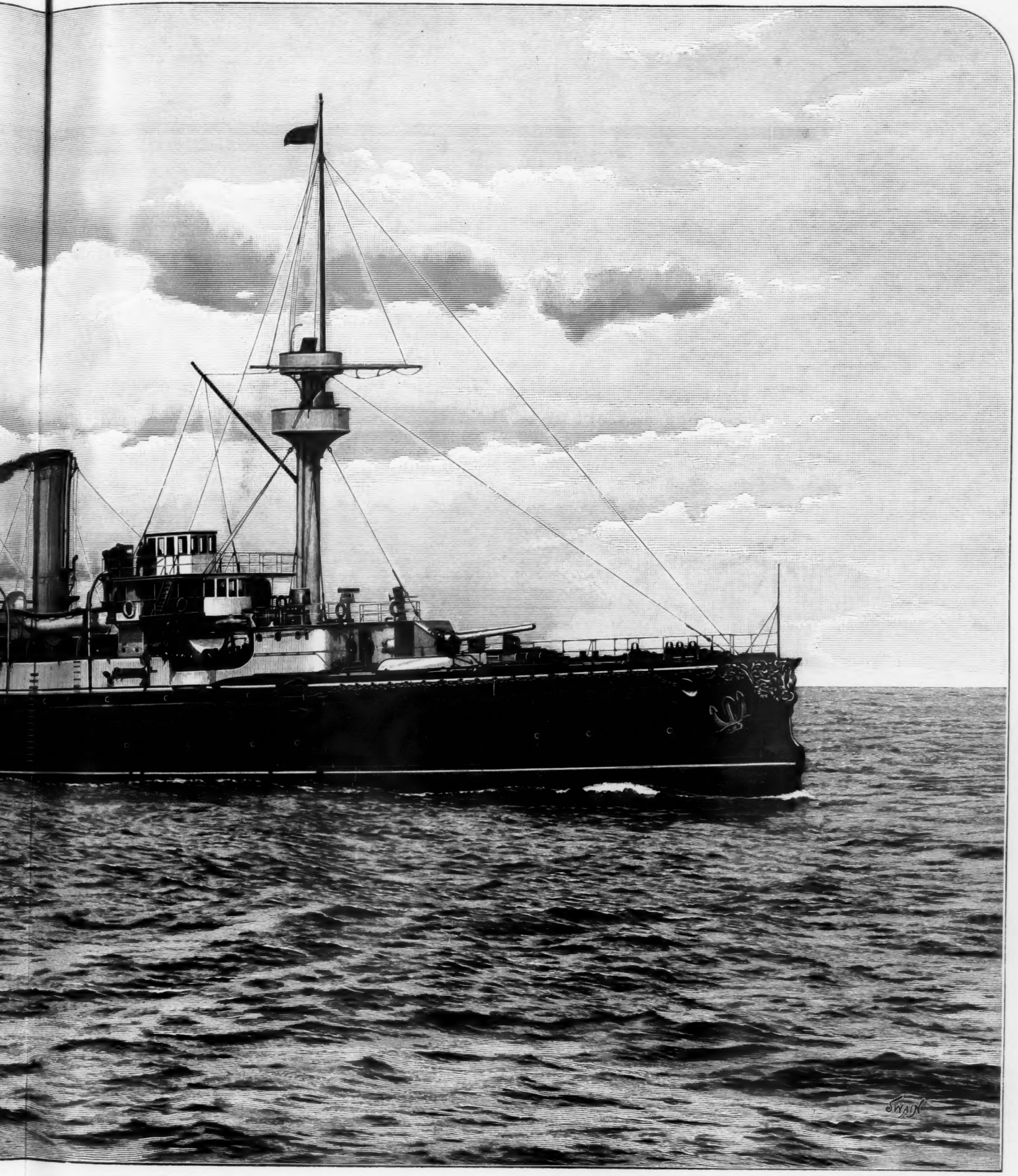
# THE CHILIAN CRUISER B

MESSRS. SIR W. G. ARMSTRONG, MITCHELL AND CO


"THE ENGINEER"

# ISER BLANCO ENCALADA.

MITCHELL AND CO., NEWCASTLE-ON-TYNE, BUILDERS



## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** With this week's number is issued as a Supplement a Two-page Engraving of the Chilian Cruiser Blanco Encalada. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it.*

## CONTENTS.

THE ENGINEER, September 7th, 1894. PAGE
NOTES ON THE STRENGTH OF FRAMED STRUCTURES AS AFFECTED BY ELASTICITY .. .. .. .. .. .. .. .. .. .. .. .. .. 205
THE IRON AND STEEL INSTITUTE .. .. .. .. .. .. .. .. .. .. 206
IRON AND METAL WORK IN WESTERN INDIA .. .. .. .. .. .. 207
INJECTORS FOR THE GREATER BRITAIN. (Illustrated.) .. .. .. .. 207
FEDERATED INSTITUTION OF MINING ENGINEERS—NEWCASTLE MEETING 208
THE CHILIAN CRUISER BLANCO ENCALADA.. .. .. .. .. .. .. 208
THE CORROSION OF BOILERS .. .. .. .. .. .. .. .. .. .. .. 208
GREAT NORTHERN RAILWAY—RECONSTRUCTION OF BRIDGE OVER DON 209
TWO-TON TROLLEY CRANE .. .. .. .. .. .. .. .. .. .. .. .. 210
SWORN'S BOAT PLUG. (Illustrated.) .. .. .. .. .. .. .. .. .. 212
ALUMINIUM BOATS. (Illustrated.) .. .. .. .. .. .. .. .. .. .. 212
LETTERS TO THE EDITOR—Oscillating *v.* Inclined Paddle Engines—Approximate Calculations—A Neglected Field for Inventors—Cuirasses—The Graphic Statics of a Deck Chair—Locomotive Engine Bows—The Theory of the Steam Engine—The Raiyan Reservoir and Drainage Canal .. .. .. .. .. .. .. .. .. 212
LEADING ARTICLES—Labour and Wages in Belgium .. .. .. .. .. 215
The Supersaturation of Sewage Farms—Scotch Railways and the Strike—Conciliation at Work .. .. .. .. .. .. .. .. .. 216
LITERATURE—BOOKS RECEIVED .. .. .. .. .. .. .. .. .. .. 216
RAILWAY MATTERS NOTES AND MEMORANDA—MISCELLANEA .. .. 217
THE TORPEDO BOAT DESTROYERS FERRET AND LYNX .. .. .. .. 218
BRITISH ENTERPRISE IN PARAGUAY .. .. .. .. .. .. .. .. 218
HYDRAULIC TURNTABLE, ANTWERP EXHIBITION. (Illustrated.) .. .. 219
METHODS OF DETERMINING DRYNESS OF STEAM .. .. .. .. .. 219
AUSTRALIAN ENGINEERING NOTES—AMERICAN ENGINEERING NEWS .. 221
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire—The Sheffield District .. .. .. .. .. .. .. .. .. 221
The North of England—Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. 222
AMERICAN NOTES—RAILWAY CONNECTION WITH MANSFIELD .. .. 223
ELECTRIC GENERATING STATION OF BAZACLE, TOULOUSE .. .. .. 223
THE PATENT JOURNAL .. .. .. .. .. .. .. .. .. .. .. .. .. 223
SELECTED AMERICAN PATENTS .. .. .. .. .. .. .. .. .. .. .. 224
TWO-PAGE SUPPLEMENT—CHILIAN CRUISER BLANCO ENCALADA.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

F. B. (Hull).—*From seventy to ninety revolutions per minute.*

W. J. M. (Walsall).—*We cannot answer the first part of your question. As to the second we do not think that much is to be gained just now by emigrating.*

H. W. H. (Larne).—*Rous-Marten's work cannot be obtained now. We hope to inform you with regard to the Midland locomotives in our next issue.*

### HAUSALTER'S TRAIN SPEED INDICATOR.

*To the Editor of The Engineer.)*

SIR,—Will any reader tell us who are the makers of this apparatus?

September 3rd. G. AND H.

### FRUIT EVAPORATORS.

*(To the Editor of The Engineer.)*

SIR,—I shall be obliged by the address of the makers of evaporators for fruit drying. CHELSTON.

September 3rd.

### COCOANUT MACHINERY.

*(To the Editor of The Engineer.)*

SIR,—I shall be obliged to anyone who will give me the address of a firm making machinery for husking and cutting cocoanuts by manual labour or by steam. KERNEL.

September 4th.

### CANDLE-MAKING MACHINERY.

*(To the Editor of The Engineer.)*

SIR,—Can any of your readers oblige me with the name and address of makers of candle-making machinery for making, say, 5000 to 10,000 candles daily from animal fat? VIADUCT.

September 4th.

### HELICAL *versus* STRAIGHT GEAR.

*(To the Editor of The Engineer.)*

SIR,—We have a rolling mill with straight gear, 1¼in. pitch, 4in. wide, but owing to complaints of lines showing across the paper after being rolled we substituted machine-cut helical gear, 1in. pitch, 4in. wide, and these do the work splendidly, but we have broken them twice in a very short time. Is the failure due to reducing the pitch from 1¼in. to 1in., or do helical wheels require to be so much wider and stronger to do the same work as straight gear, owing to the side thrust on them; and about how much greater is the loss of power in helical gear than straight gear?

September 4th. F. G. W.

### SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)* .. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| THIN PAPER COPIES— | |
| *Half-yearly* | £0 18s. 0d. |
| *Yearly* | £1 16s. 0d. |
| THICK PAPER COPIES— | |
| *Half-yearly* | £1 0s. 3d. |
| *Yearly* | £2 0s. 6d. |

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

# THE ENGINEER.

*SEPTEMBER* 7, 1894.

### LABOUR AND WAGES IN BELGIUM.

IN our last impression we reproduced certain opinions expressed by an influential member of the Iron and Steel Institute who had visited Belgium last month. It will be remembered that he named the low wages paid to Belgian workmen as a noteworthy factor in the competition of that country with this. The proposition is one of such transcendant importance that it deserves very careful examination. We may, to consolidate ideas, put it into the shape of two questions. In the first place, Is the Belgian iron trade a greater success than the English iron trade? In the second place, assuming that the answer is in the affirmative, is its success due to difference in wages paid in this country and in Belgium?

If our readers will turn week by week to the "Notes from Germany," published with our other trade letters, they will find much valuable information as to the position and prospects of the Belgian iron and steel trade; and they will also find that it rises and falls, is good and bad, very much as our own trade fluctuates. They have in Belgium slack times and periods of hardship just as we have; and we venture to think that no one in this country will say that in Belgium trade is very much better than it is here. If we look for the fortunes made by individual Belgian ironmasters we find that they are few and far between; and in scarcely any case will they compare favourably with those which have been made in this country by such men, for example, as the late Earl Dudley. The great companies do not pay their shareholders any extraordinary dividends. Indeed, taking all the circumstances into consideration, we are disposed to say that making iron and steel in Belgium is not on the whole so profitable a business as making them in Great Britain. Indeed, the conditions of trade are so much alike in the two countries that if an English and Belgian company exchanged mills and furnaces, the change would scarcely be felt as far as buying and selling are concerned. Dowlais, for example, has no more to fear from the competition of Angleur, let us say, than it has from that of Consett. Probably not so much.

But for the sake of argument let us take it for granted that the Belgian ironmaster does make more money than his English competitor, and proceed to consider how far the question of wages affects this. Again, for argument sake, we shall assume that Belgian wages are two-thirds of English wages; or allowing for longer hours, then they are nominally one-half. In dealing with this question, the proper way to proceed is not to consider what the wages paid per man per day may be, but what is the sum represented by each ton of steel or iron turned out. In a word, what is the cost in wages of a ton of metal? Of course it is not necessary as we are considering wages only, to enter upon any discussion of the relative merits of Belgian coal and coke and ore, and methods of working as compared with the same things English. We are discussing wages, or, to speak more accurately, the cost of labour. Now, in order that the contention that labour is cheaper in Belgium than it is in this country may be proved, it is essential that the work done in return for 4s. in Belgium shall be about equal to the work done in this country for 6s. Here, we believe, the whole theory breaks down. Not so much because the Belgian workman is inferior in skill to the English workman, as because more hands are employed. Machinery is not used to save labour to the same extent as it is in this country; a notable illustration of this is supplied by the manufacture of sleepers, referred to in another page. We have very good reason to believe that the actual sum disbursed in wages, or its equivalent, per ton of finished iron or steel is not much less in Belgium than it is here. That it is a little less is certain; but if it were not so it would be impossible for the Belgian or, indeed, the French or German ironmaster to live. In this country we have to pay a very small sum for the support of our army and navy as compared with the national income. On the Continent, as is well known, enormous armies are kept up, and these are paid for by correspondingly heavy taxes—taxes heavy to a degree of which the Englishman has no adequate conception. But besides these, it must always be borne in mind that the great iron and steel works of Belgium do a great deal more for their hands than pay them wages. Nominally the wages are very small, but let us consider all that goes with them. Let us take, for example, the works of Marcinelle and Couillet, of which we gave a brief description in our last issue. As far back as 1836 the company began to build houses for its workmen. There are in all now six groups comprising 160 houses. Each is let separately to one family, and contains all the rooms and offices considered in Belgium as necessary to one family. The rent is 16f. or 17f. a month, or £8 a year. The rent is deducted from the wages paid to the men. The taxes are paid by the company, by which also the houses are whitewashed and kept in excellent repair. In order to encourage the men to save, in 1866 the company began building houses, at a cost of 1734f., or nearly £70 each. These cottages have each a plot of land attached costing 300f. This house can be brought outright in eight years, with its plot of land, by paying down when the contract is signed 407f., and each fortnight in the first year 11·19f., in the second year 10·85f., in the third 10·51f., and so on a descending scale until the eighth year, when the payment is 8 81f. per fortnight. In the same way a better class of house can be had for a little less than 3000f., or £120. The house of the type of 2034·90f. is composed:—(1) Of a cellar 1·90 metres high, divided into two compartments. (2) Of a ground floor divided into two rooms, 5 metres long by 2·90 metres wide, the other 5 metres long by 4·40 metres. (3) A large box room. The house of the type of 2998·80f. is composed of:—(1) A cellar 1·90 metres high, divided into two compartments. (2) A ground floor divided into two rooms, measuring the one 4·60 metres long by 4·40 metres wide, the other 4 40 metres by 3·50 metres. (3) A first floor of three rooms measuring respectively—4·40 metres by 3 metres; 3·20 metres by 2·30 metres; 3·20 metres by 2·80 metres. (4) A large lumber or box room. These houses are very highly prized by the workmen, and only those who know the perfection to which farming is carried in Belgium can realise how great a boon is the plot of land. It is much more than doubtful if the company realises a farthing of profit, although nominally a profit of 4 per cent. seems to be charged. Then there are the schools, which are of three kinds, the infant, the elementary, and the adult. There are, besides, a music school, a drawing school, a school for apprentices, and a housewifery school. All these are free, the cost being defrayed by the company. The housewifery school deserves special mention. It was established in 1871, and gives the girls all the necessary instructions to make good housekeepers. In order to be admitted to the school they must pass an examination in writing, reading, and arithmetic. They are taught sewing by hand and by machine, mending, washing, ironing, cleaning kitchen utensils, cooking vegetables and meat, making soups, making bread and butter—in fact, they are initiated into all the cares and occupations which are necessary in a well-kept household. At the same time they receive a sound and moral education. They become women of order, and will be able to educate their families in the sentiments of duty and principles of economy. More than five hundred pupils have been educated at this school. The Société also subsidises a similar school in Marcinelle.

In 1867 the company decided to come to the assistance of its workpeople by buying flour wholesale and selling it cost price to the men in advance of their wages. In this country such a transaction would be a breach of the Truck Act, but in Belgium it has worked with the utmost success. The regulations are very strict, and no man is compelled to take flour instead of wages. The price is advertised every fortnight when the distribution takes place. The price is generally 3f. to 5f. per 100 kilos. below the retail or shop price. The quantity sold to each family must not be more than it can consume to prevent reselling. The distribution of flour began on the 1st of February, 1867, and up to the 30th of June in the present year 3020 tons had been sold at an average of 4f. per 100 kilos. under shop rates. The workmen have thus derived an advantage of 1,200,000f., or about £48,000. There is also a public bakery, whence the unmarried hands can obtain all the bread they need at cost price. In winter excellent soup is distributed. Again, there is an insurance fund against accident and old age, largely subsidised by the company. The coal mines of Marcinelle are aided by the Provident Fund of Charleroi. No deduction is made from the wages of the men, but the company pays 1½ per cent. on the paid wages into this fund. The coal mines have besides a special accident fund, to which the company as well as the employés and men contribute. This fund provides gratuitous medical assistance to the employés, men and their families, within a certain distance. In 1847 the company erected a hospital in Couillet to receive workmen who have been wounded in the metallurgical works or the coal mines. The hospital is attended to by Sisters of Charity. There are two wards, one for men, containing fourteen beds, one for women, containing three beds, a refectory, bath room, gardens, &c. A surgery and dispensary adjoin the hospital. Every day from 10 to 11 o'clock a.m. the workmen and their families, as well as the workmen who have been slightly wounded and live at home, receive the advice and care of the doctors attached to the company. The workmen who are ill, and the members of their families who cannot come to the surgery, are visited at their homes by the doctors, and receive gratuitous advice and medicine. The sanitary service is divided into nine circumscriptions, each attended to by a doctor residing in the locality. Each circumscription has a radius of about two miles round the respective works.

In endeavouring to form an idea of the relative cost of wages in different countries it is important to take such facts as those we have given into consideration. It is evident that the workmen at Couillet—and Couillet is by no means exceptional—possess advantages of various types, which represent the value of a considerable addition to their wages. No doubt they are really better off in some respects at 4s. a day than the English workman at 6s. a day. It is only necessary to see the men, their wives, and children to realise this; and, furthermore, it must not be forgotten that the drink bill of the Belgian workman is very much smaller than that of his English competitor. But all this does not directly affect the cost of iron or steel, although indirectly it has a very considerable influence. In this country strikes are constantly taking place. Now, like everything else, a strike represents a pecuniary value. The cost of a strike it can very easily be shown must always in the long run be charged against the product. Thus the strike going on in Scotland must affect the value of coal for a long time to come. In the case of a blast furnace, for example, it is evident that the cost of producing a ton of iron, if we take three years into consideration, will be less if the furnace runs continuously than it will be if strikes interrupt operations for a greater or shorter time. In this country there is an idea that the beginning and end of all things with the working man is to pay him money for work done. It is here that Belgium has the advantage. All the employés are given an interest, not in the profits—profit-sharing, often tried in this country, is a hopeless failure—but in their position. They get more than money. The result is that strikes have hitherto been few and far between, and that the strikes which have upset the Belgian coalfields have occurred at places where only money is given, and they have been largely political in their nature. The lesson, we think, to be learned from Belgium, is that the employers in this country should not rest content with paying money, but should give their hands besides solid advantages which will bind them to the place of their employment. In our own Government factories we seldom, if ever, hear of a strike. What may be termed the local advantages are too obvious to be lightly sacrificed. We do not think that we have any reason to dread Belgian competition on the score of wages. The Belgian workman does not turn out as much as the Englishman, but there is none the less much to be learned by those who choose concerning the harmonious relations which should exist between labour and capital. Monometallism is held to be a good thing in coinage; but in the conduct of business between capital and labour it is a mistake to assume that the only means of trading is gold.

### THE SUPER-SATURATION OF SEWAGE FARMS.

THE subject above named was warmly discussed in our columns some fourteen years back. What then gave rise to its ventilation was the death of a gentleman, the brother of a well-known M.P., that was alleged to have been due to the inhalation of noxious vapour arising from a sewage farm across which he had been shooting. The contention of that correspondence was that when sewage is applied to soil in excess of the power of the vegetation upon it, and of the soil itself, healthily to absorb it, the surplus constituents passed off into the atmosphere in a form analogous to sewer gas, and with an effect as likely to prove as deleterious as is that gas when confined in a sewer.

We refer again to this subject because statements recently made in the House of Commons with regard to the condition of the sewage farm at Aldershot would seem to bear out the contention to which we have above referred. We are not aware if any deaths that may have taken place in our great military camp have been traced to the effects of the state of things described as existing; but it must be evident, if this be as bad as has been officially admitted, it will be singular indeed if some mortality among our soldiers might not be traceable to it. Reference may be usefully made here to the description given in the House of Commons of the present condition of this sewage farm at Aldershot. The detail is derived, it appears, from a report made by the medical officer of Surrey. It describes the so-called farm as being more properly to be termed a "sewage marsh." Pools of stagnant, putrid sewage are said in this report to give rise to poisonous exhalations, and we can readily understand why, upon the basis of that report, the War-office has under consideration the future disposal of this sewage at a place sufficiently remote from habitations. For many years past the erection of these in the vicinity of the camp has been steadily increasing, and no doubt the aggregation of population, apart from the military denizens of the camp itself, has become too much for the capacity of the farm, as originally calculated upon, to bear. It has become, in the words of one of our former correspondents, super-saturated. The area of vegetation is now too limited fully to take up the constituents of the sewage discharged upon the land, and the noxious surplus remains unassimilated either by the soil or by the vegetation. It produces in the "pools of stagnant, putrid sewage" remarked upon in the report. One of those who at the time of the correspondence named favoured us with their views, seemed to contend that it was impossible to pass the boundary of assimilative power. It is evident, however, from the facts now made known to us, that the capacity for this has been passed in the case of this Aldershot sewage farm. The correspondent referred to seemed to hold the opinion that excess of sewage would soon find its way, either downwards or laterally, and must so obtain the required deoderisation. Evidently he was mistaken as to this. Once a certain degree of saturation is obtained, fluidities can no longer maintain their flow. The soil becomes waterproofed, so to speak, after it has absorbed a fixed standard of moisture, and holds further additions to this upon its surface in a liquid state until it is evaporated by atmospheric operations. It is on this principle, no doubt, that the advocates of the dry earth system insist so strongly on the necessity for the employment of absolutely dry material. We presume that it is now fully acknowledged that plant life can only absorb the constituents of sewage up to the point at which the healthiness of its development can be maintained. Fourteen years back, when the correspondence we have named appeared in this journal, this conclusion was disputed. It seemed to be then thought that the vitality of vegetable growths could be stimulated until these assumed almost Brobdignagian proportions. We know that, relatively speaking, this has been attained with the production on certain sewage farms; but it has become also evident that this development cannot be urged beyond certain limits. The plants, it is now known, cannot attain growth in full proportion to the amount of stimulant applied to them. When that is in excess of that power, assimilation ceases and rejection begins. Necessarily, therefore, if the already saturated soil in which these plants have their growth cannot, for the reasons above stated, allow the excess to flow into and through it to fresh and virgin soil, the impurities must remain upon the surface after the fashion indicated in the report from which we have quoted.

We should presume, from the intention expressed by the War-office authorities to remove the sewage farm to some more distant locality, that no land remains available near the site of the existing farm for the extension of its area. This is the danger that we think must attend all endeavours to apply this system of sewage disposal. It must always be difficult—sometimes, we should think, wholly impossible—to provide in advance against the increase of population and the corresponding requirements in the extent of the lands for treating the sewage arising from it. Experience has not yet been had as to the length of time that would be required in the case of a super-saturated farm to restore its absorbent power by abstention from sewage treatment. If this could be estimated, it would seem desirable to provide two disposing grounds, each of an area and capacity to serve while one of them might be undergoing the necessary period of rest. This point, so far as is known to us, has never yet been considered, or the dual system involved under it adopted. The disposal of sewage by these farms is, however, too valuable in principle to be lightly abandoned; and the difficulties and dangers which we fear must be admitted to attend it might be obviated could provision be made in all cases of its adoption for the period of rest and de-saturation we have suggested. But we certainly should deprecate any experimenting with such a course in the near neighbourhood of so densely-populated an area as is the Aldershot Camp and its environs. The sooner the possible plague spot is wholly abandoned the better it will be for the health of our valued soldiery.

◆

### SCOTCH RAILWAYS AND THE STRIKE.

THE effect of the strike of the Scotch miners is only partly shown in the accounts of the railway companies for the last half-year. But on the Glasgow and South-Western it was marked by a decrease of some £5181 in the receipts from minerals, though that is, as far as the gross traffic is concerned, more than made up for by increased passenger revenue. On the other hand, there is a decrease in the expenditure, as was to have been expected, though it does not appear in all departments. The train mileage run shows a considerable decrease in that of the goods and mineral trains; but although this is the case, the expenditure for coal and coke for locomotive power is greatly increased—the sum paid being £9000 more—but whether this is due to any stocking of coal, or to the paying of a higher price, remains to be told at the annual meeting. In other items, such as that of repairs and renewals of carriages and wagons, there is a decrease; there are savings in compensation also, but the general charges are again increased. On the whole the position may be best put thus:—Despite the savings we have spoken of and slight increase in the receipts, the proportion of the expenditure to the receipts rose from 51·48 per cent. in the corresponding half of the past year to 52·12 per cent. for the half-year now being reported on. The chief item causing that increase was that of locomotive power, which took a year ago 13·99 per cent. of the gross receipts, and has for the past half-year taken 14·91 per cent. In another way it may be put that a year ago the cost of locomotive power was 7·32d. per train mile, whilst this year it is reported as 8·08d. per train mile. In neither half-year are the working expenses of the steamboats owned by the company included in either the percentage statement or the mileage cost. Already, therefore, the cost of the strike has been in part felt on the railways, and looking at the fact that there is now a daily increase in the number of the miners at work, it may be hoped that its fullest effects are now experienced. It is evident that the railway companies suffer most keenly by these strikes; their earnings are reduced, and their expenses for fuel are increased, for the diminution in the mileage run is not sufficient to counterbalance the additional expenses incurred in bringing coal from other coalfields; whilst the lessened earnings of the workmen are speedily reflected in reduced takings both for goods and passengers, and the purchasing power of the affected district is made less for some considerable time. Possibly the wants of the district may have accumulated in the period of the strike, and thus its conclusion may be followed by a period of greater activity in the autumn and winter than might have otherwise been the case; but the general results of the stoppage are most hurtful to the railway companies.

### CONCILIATION AT WORK.

THE Coal Trade Conciliation Board is slowly but surely justifying its creation. One difficulty after another is being met and overcome. The latest was that caused by the action of the pit lads and surface men. It was not unreasonably urged by the youths employed in the workings, as well as by the adults engaged on the banks, that it was unreasonable to ask them to concede a ten per cent. reduction. Their argument was the strong one that they could not return that which they had never got. The reasonableness of this view appears to have struck both sides of the Board, the members of which, after a long discussion, arrived at an agreement which has an equitable look commending itself to impartial spectators. The substance of the settlement is that the topmen who have received the same advances as the miners are to submit to the same reduction—10 per cent. At the collieries, where the advances have not been so great, the reduction is to be one-fourth *pro rata* on the advances received since 1888. No more satisfactory arrangement could have been made. It means, in brief, that where no benefit was obtained no sacrifice is required, and where benefit *was* obtained the concession is to be restricted to the fourth part of that enjoyed. That is a fair and common-sense arrangement, and should lead to an immediate termination of the strife at the collieries where the practical protests of boys and banksmen have caused work to cease. It is clear that the Conciliation Board, if loyally and firmly conducted as in this instance, is bound to be a power for years in the coal industry of England.

## LITERATURE.

*The Centrifugal Pump. Turbines and Water Motors, including the Theory and Practice of Hydraulics.* By CHAS. H. INNES, M.A. Manchester: The Technical Publishing Company; and London, John Heywood. 1894.

THE latter part of the title of this little book is too broad, as the theory and practice of hydraulics as herein treated relate only to pumps and water motors, while this title would cover the branches of hydraulic engineering which are as far removed from the construction of pumps and motors as the latter is from the work of the master plumber who styles himself hydraulic engineer. It is a useful little book, which sticks to its text, and commences with the simple parts of the theory of hydraulics, as far as is necessary in the problems which present themselves in the construction and designs of different forms of apparatus worked by water under pressure, which lift water by means of pressure artificially created. Commencing with motion of water under pressure, the measurement of flow and power of a stream, loss of energy by friction and change of direction, the author deals with hydraulic engines. These various questions are treated almost entirely by means of simple equations and arithmetic, without in any way lessening the value of the book as a guide on its subjects.

The engines are illustrated by sectional drawings, more of the diagram order than the finished drawing. But there are some forms of hydraulic motors which he has not noticed, such as Rigg's high-speed water engines. In his treatment of the turbines of various kinds he has omitted to mention one of the most important, namely, the Pelton wheel. Those who have wanted a simple treatment of the theory of design of centrifugal pumps and turbines will welcome this little book, and we can recommend it, although there are several subjects and examples of each of the classes of apparatus which should be included to make it complete, and could be incorporated without adding many pages to it. In some respects the book is up-to-date, as, for instance, it gives drawings and plans of the turbine wheels designed for the Niagara water-power works. The cuts might be better, and an index would be useful. There is what is nominally an index.

---

*Yof-Dakar Underground Cables. Report on Repairs.* By CHARLES BRIGHT, Assoc. Memb. Inst. C.E., M.I.E.E. 1893.

THIS is a little book of 108 pages, illustrated by maps and diagrams. It is a somewhat wordy account of certain repairs carried out in a tropical climate, and the edges are gilt. Mr. Bright is very careful to tell us that he taught his subordinates at the outset to be as polite as possible "to all Frenchmen and French-speaking niggers," but to "carefully avoid being too friendly with English-speaking niggers." The book is largely taken up with criticisms on the methods of those who laid the cables. These people would, no doubt, have something to say on their side of the question.

The general scientific value of the work may be summed up by saying that gutta-percha seems to be a bad insulator in hot climates, and that when it is used the cables should be buried pretty deep; that white ants eat wooden things, and that it is not advisable to go out in the sun without a helmet.

The most useful portion of the book is the summary beginning on page 69. This contains a good many recommendations which are apparently the result of Mr. Bright's experiences with the Yof-Dakar cables. As, for example, "A cable with a first-class vulcanised india-rubber core is, as a rule, on the whole more suitable for land line work than a cable insulated with gutta-percha, unless it has to pass through a permanently wet ground, below the surface of which the cable is sure always to remain." No doubt many men employed in tropical cable laying will find much in the book to interest them. It is to be regretted that no light whatever is thrown on the causes which led up to the defects which Mr. Bright had to make good. Were they due to incompetence on the part of those who laid the cables in the first instance or to want of money? Mr. Bright is not to blame for his silence on this point, because he seems to have been told nothing about the history of the line, and did not know whether it was an old cable relaid or a new cable.

---

*Metal Working for Amateurs.* "Amateur Practical Aid" Series. "Brazing and Soldering," by G. EDWINSON; "Gas-fitting," by E. W. DENNISS; and "Brass Casting at Home," by F. J. DURRANCE. London: Ward, Lock, and Bowden. 1894.

THERE are not very many of the numerous books avowedly written for amateurs which are of much use to them, but they may try this little book, and learn from it how to do many of the things that are useful and necessary in model making and other work.

## *BOOKS RECEIVED.*

*Transactions of the Institution of Naval Architects, vol. xxxv.* Edited by George Holmes. London: Office, 5, Adelphi-terrace, W.C. Sold by Henry Sotheran and Company.

*Transactions of the Society of Naval Architects and Marine Engineers, vol. i.*, 1893. Edited by the Secretary. New York, U.S.A.: 12, West 31st-street. London: The International News Company.

*The Sanitary Arrangement of Dwelling-houses.* A handbook for householders and owners of houses. By A. J. Wallis-Tayler, C.E., Assoc. M. Inst. C.E. London: Crosby Lockwood and Son. 1894.

*Coal Dust an Explosive Agent, as shown by an Examination of the Camerton Explosion.* With seven plates. By Donald M. D. Stuart, F.G.S. London: Office of the *Colliery Manager*; E. and F. N. Spon.

*Modern Methods of Sewage Disposal for Towns, Public Institutions, and Isolated Houses.* By Geo. E. Waring, jun., M. Inst. C.E. New York: D. van Nostrand Co. London: Sampson, Low, Marston, and Company. 1894.

*Encyclopédie des Travaux Publics, Architecture et Constructions Civiles, Charpenterie, Métallique Menuiserie en fer et Serrurerie.* Par J. Denfer. Tome premier. Paris: Gauthier, Villars, et Fils, Quai des Grands-Augustins, 55. 1894.

*An Introduction to the Differential and Integral Calculus.* For the use of students reading without the aid of a tutor. By Matthew Wyatt, F.R.G.S., F.I.I. London: Whittaker and Company. Rugby: George E. Over, the Rugby Press. 1894.

*Turning Lathes.* A manual for technical schools and apprentices. A guide to turning, screw-cutting, metal spinning, ornamental turning, &c., with 225 illustrations. Edited by James Lukin, B.A. Fourth edition. Colchester: Britannia Company. 1894.

*City and Guilds of London Institute for the Advancement of Technical Education. Programme of Technological Examinations, including Regulations for the Registration and Inspection of Classes in Technology and Manual Training, Session* 1894-95. London: Whittaker and Company.

*A Practical Treatise on Patents, Trade Marks, and Designs, with a Digest of Colonial and Foreign Patent Laws, the Text of the Patents, Designs, and Trade Marks' Acts,* 1883 *to* 1888 *(consolidated), &c. &c.* By David Fulton, A.M.I.C.E., Barrister-at-law. London: Jordan and Sons. 1894.

## RAILWAY MATTERS.

Five thousand of Mr. Adler's patent axle-box dust-shields have been ordered for use on the Rajputana-Malwa Railway.

The Tramways Committee of Glasgow have decided to erect half-mile stations on all the routes, to be distinguished after dark by a coloured lamp.

The Indian Railway administrations have been asked by Government to furnish all possible information for the projected International Railway Congress to be held in London in June, 1895.

A contract was recently obtained for locomotives for the Egyptian State Railroad, in which the tenders were made by weight, by the Société Franco-Belge. At the rate named the price of a 40-ton locomotive would be a little over £1600.

The survey of the proposed railway between Newcastle and Glasgow is expected to be commenced immediately by Messrs. Foreman and McCall, of Glasgow, who are also the engineers for the Glasgow Central and the Lanarkshire and Dumbartonshire Railways, presently under construction.

Among the railway projects that will be shortly decided by the Indian Government are the Chittagong-Akyab and Minhla Railway, about 420 miles in length; Delhi-Bhatinda-Bhawalpur Railway, about 400 miles in length; and the Rutlam-Muttra and Ujjain branch, about 460 miles in length.

At a meeting of the directors of the Highland Railway Company on Wednesday, it was resolved to make application in the ensuing Session of Parliament for powers to construct a line of railway from Inverness to Spean-bridge and Fort William. The new line, which will be fifty-eight miles in length, will cross the Caledonian Canal at Bona Ferry.

We read that the Bombay, Baroda and Central India Railway Company is desirous of effecting a direct junction between its metre gauge system and that at Cawnpore of the Oudh and Rohilkhund Railway Company. The Government of India do not wish to consider the question before the larger project for connecting the metre gauge lines in the North-West Provinces and Oudh is settled.

Messrs. R. Schram and Co. have recently executed two tunnelling plants to the order of the Assam-Bengal Railway Company, consisting of four air compressors, four boilers, and sixteen rock-boring machines, and accessories for driving the advance heading, &c. This plant is similar to that supplied by Messrs. Schram to the Indian Government in 1888, for constructing the Khojak Tunnel on the Chaman Extension Railway in Central Asia.

According to a recent report issued by the United States Department of Agriculture, the length of railway line in Mexico is 7297 miles. The report further states that about twenty miles of the railway across the Isthmus of Tehauntepec from Coatzacoalcos, on the Gulf, to Salina Cruz, on the Pacific, remain to be built at the centre of the isthmus. About 8 per cent. per annum will fairly represent the increase of railway movement in the territory.

A new railway from Ismailia to Port Said, a Decauville line, 2ft. 6½in. gauge, was opened in December last. The trains are well appointed, and shorten the journey to and from Ismailia by about an hour. The British Consul at Port Said observes:—"The line is only adapted for passenger traffic, but should it prove the precursor of a serious railway adapted for goods as well as passenger traffic, a considerable impetus to the trade of this place will be the result. As it is it will prove a convenience to passengers between this and other parts of Egypt."

The Expropriation Bill for constructing a railway between the station in the north part of Rotterdam and that at the eastern extremity has passed the Dutch Legislative Chambers. The necessity for such a line is proved by the extreme difficulty that large steamers have to reach the eastern—formerly the Rhenish—railway station, owing to their having to pass two bridges, whilst it is of the utmost importance that on the right bank of the river there should be harbours and quays in direct communication with the existing railway system. These works will entail a very large expenditure on the part of the town. Towards the completion of the connecting link by the Dutch Railway Company, the cost of which is estimated at £160,000, the State will contribute £100,000.

An accident occurred on the Midland Railway at Irchester Junction on Saturday night last. The driver of an express goods train from London made a mistake as to his signal, with the result that his engine struck the catch points, and his train, which consisted of 27 wagons, was thrown off the line and wrecked, many of the wagons being broken to atoms, and only the wheels left whole. The engine was much knocked about, and a signal-box standing at the junction was partially demolished by a truck being hurled against it, the signalman narrowly escaping serious injury. A passenger train narrowly escaped disaster, thanks to the presence of mind of the signalman, who jumped from the window of his box, and running down the line with his hand lamp managed to stop the incoming train within a few yards of the wreckage. Much damage was done to the rolling stock and permanent way. No one was seriously injured.

The floods in India are considerably interfering with railway traffic. The Rewari-Ferozepur Railway has been breached near Ferozepur Cantonments. The floods at Ruk have also spread, and passengers have now to tranship over a mile. In the course of transhipment the other day, two boats capsized and four men were drowned. Passengers to Chaman have to walk over the Khojak tunnel, about four miles, to get to the other side, making their own arrangements for the transport of their baggage. It appears that the floods on the Great Indian Peninsula Railway are almost beyond parallel in the history of the line. The *Indian Engineer* says that in one place the progress of a train was obstructed by a slip in the embankment, while its retreat was cut off by a mass of earth, estimated at several thousand tons, that had fallen over the line at a point which it had safely passed a few minutes earlier. The train appears to have been imprisoned for over sixty hours, and two other trains are reported to be blocked in a similar manner. Fortunately there has been no loss of life.

Major Marindin, in reporting to the Board of Trade the result of his inquiry into the recent collision at St. Pancras terminus, says that this collision, the serious consequences of which, as regards the leading vehicles in the train, and the passengers in them, were due, probably, to the effect of the great weight on the momentum of the train, rather than to the speed at which the train was running when it struck the buffer-stop, presents all the usual features of collisions of this class, except that there is more validity than usual in the excuse of the driver that the greasy state of the rails prevented the action of his brakes from taking proper effect in pulling up the train. As both brakes were in working order, he considers that the driver must therefore be held to have committed a technical breach of the rules in entering the station at a speed higher than a hand-brake speed, having miscalculated the speed at which he was running, but nevertheless, inasmuch as the rule quoted above may be fairly said to be never observed by any driver entering the station, and is allowed to be broken with impunity many times every day, this driver, who was only running at the usual speed, or very little more, and would probably have been able to stop his train by the use of his continuous brake, if it had not been for the greasy condition of the rails, cannot be considered to have been guilty of a serious offence.

## NOTES AND MEMORANDA.

The German output of pig iron for the six months ending June 30th was 2,649,071 tons, an increase of 247,131 tons on that of the first half of the year 1893.

The new cable recently laid by the Anglo-American Telegraph Company makes the eighth Atlantic cable connected with New York. It was laid in twelve days by the cable ship Scotia, and contains 600 lb. of copper to the nautical mile, being the largest conductor laid hitherto.

In London last week 2704 births and 1193 deaths were registered. Allowing for increase of population, the births were 86 above, and the deaths 272 below, the average numbers in the corresponding weeks of the last ten years. The annual death rate per 1000 from all causes, which was 15·4 in the preceding week, fell to 14·4.

At a recent meeting of the Paris Academy of Sciences a paper was read on "Electricity Considered as a Vortical Movement" by M. Ch. V. Zenger. The author showed that an electrical discharge produces a whirling movement in the gas through which it is discharged, which may be said to be a cyclone on a small scale, so completely are the phenomena of cyclones reproduced. The particles appear to describe a trajectory which may be represented by a screw of variable pitch traced on a conical surface.

At the annual meeting of the Federated Institution of Mining Engineers, held at Newcastle-on-Tyne on Wednesday, a paper was contributed by Mr. Edwin Gilpin, jun., on "Explosions in Nova Scotian Coal Mines," in which the writer expressed the opinion that although in no instance in Nova Scotia had coal dust caused an explosion, yet the presence of coal dust added to the area and destructiveness of the explosions. Mr. Joseph R. Wilson, of Philadelphia, contributed a paper describing the Shaw gas tester for indicating the presence and percentage of fire-damp and choke-damp in coal mines. It is a mechanical instrument, and although in the discussion exception was taken to its cumbersome character, its accuracy and usefulness were admitted. The next meeting will be held in Staffordshire in February.

The possibilities of natural gas evidently have not yet been exhausted, according to *Cassier's Magazine*. The latest use which would seem to have been found for it is the making of ice, the idea being to simply expand the gas from its usually high initial pressure down to or near that of the atmosphere, Nature having done all the preliminary work of compression and cooling, making the gas ready to absorb heat from its surroundings immediately upon being released from confinement. All that would be necessary, it is said, would be suitable coils or chambers into which the gas could be allowed to expand, but here it is evident that an important thermodynamic fact has been overlooked. It has been calculated that with an ordinary gas well, furnishing 1,500,000 cubic feet per day, something like fifty tons of ice could be turned out daily at an expense of about 50 cents a ton. The gas loses nothing but its pressure, retaining all its calorific value, and hence all its virtue, for rolling-mill and glassworks use, for heating brick, lime, and pottery kilns, and the endless number of other furnaces to which it is adapted. In a certain way, therefore, the gas may be regarded as affording something for nothing—a desideratum to which many in this world are constantly looking forward.

At a recent meeting of the Royal Society a paper was read "On the Viscosity of Water as Determined by Mr. J. B. Hannay, by Means of his Microrheometer," by Robert E. Barnett. In a paper entitled "On the Microrheometer," published in the *Phil. Trans.* for 1879, Mr. Hannay described an apparatus which he devised for measuring the rate of flow of liquids through a capillary tube, and gave the times of flow of water at various temperatures, and of certain aqueous salt-solutions which he had observed by its means. The capillary was 21 mm. long, and 0·0938 mm. in diameter; the bulb had a capacity of 4·053 c.c., and the pressure employed was that of 1 metre of water at 20 deg. In order to compare the results with those of other observers, the author has converted the measurements of time of flow recorded by Mr. Hannay for water into viscosity-coefficients by means of the formula:—

$$\eta = [(\pi r^4 p t) \div 8 V l] - V \rho \div 8 \pi l t.$$

The figures thus obtained are given in tabular form, and on comparison with the results given by Poiseuille, Slotte, Sprung, and Thorpe and Rodger, are seen to yield discordant values for the viscosity of water. Not only is the value at 0 deg. far below that of any known liquid, but it diminishes so rapidly that at 6 deg. and above it is a minus quantity. This paradoxical result is due to the fact that Mr. Hannay's experimental figures are inconsistent. It is physically impossible to pass such a volume of water under the stated pressure through a capillary tube of the dimensions given, in the times recorded. At 20 deg. for instance, the time of flow required under these conditions would be about 4600 seconds, instead of 131·3 seconds, as stated. The author has attempted in several ways to account for the discrepancy, but without success.

Professor Dewar, in his account of his researches in connection with phosphorescence, gives in explanation of its existence in many bodies, of which, however, phosphorus is not one, the following facts:—He found that photographic action does not cease at low temperatures, though it is diminished by 80 per cent. or more. While investigating this he noticed that the apparatus with which he was working was phosphorescing brightly, and he was thus induced to study phosphorescence itself at low temperatures. Beginning with gelatine and celluloid—substances which he was using in his photographic experiments—he found them to be very luminous when cooled to − 180 deg. and exposed for a second to the beam of a strong electric light. In the same way phosphorescence was produced in numerous other organic substances, such as ivory, bone, india-rubber, egg shell, feathers, cotton wool, linen, leather, blossoms of flowers, &c. Naturally the question presented itself of the relation of phosphorescence to structure. Professor Dewar therefore experimented with various definite organic compounds and found that one of the most beautiful phosphorescing bodies was the complex salt, the platino-cyanide of ammonium, which shone with a splendid green light. White of egg was brighter than the yolk, while albumen frozen on the outside of a tube and exposed to a light coming through a quartz lens, so that there was no glass to obstruct the ultra-violet rays, phosphoresced with a bright and blue light. From these and other experiments Professor Dewar is led to the provisional generalisation that the more complex a body is in structure, the more likely it is to phosphoresce, perhaps because in some way its structure enables it to take up the light vibrations with the more facility. A very curious point is the enormous effect of the presence of an almost infinitesimal quantity of organic matter. Pure water is weakly phosphorescent, but if it is very slightly impure it becomes strongly so. A perfectly clean plate of metal does not phosphoresce, but the merest trace of grease—such as is left by a touch of the hand—will make it brightly luminous. The differences which may be caused in the physical behaviour of substances by the addition of other substances in infinitesimal quantities is attracting a good deal of attention at the present time. The capability of oxygen for phosphorescing is another curious fact. In the gaseous state it can be made to glow if exposed to an electric spark while rushing into a large vacuum tube. This property is shared by its compounds, but is not possessed by hydrogen or any other gas. Here, strange to say, the presence of a trace of organic matter destroys the effect. Professor Dewar stated that a drop or two of ether or of scent in the room would make the experiment impossible for hours. That the phosphorescence is due to some kind of molecular change in the oxygen is indicated by the fact that ozone, among other products, is formed during the process.

## MISCELLANEA.

The Hampstead Electric Light Supply will come into use on October 1st.

Mr. J. Evelyn Williams, M. Inst. C.E., has removed to 57, Charing Cross, S.W.

An Exhibition of all matters connected with Optics and Photography will be held at the Royal Aquarium, from September 11th to October 6th.

The Red Star Line, of Antwerp, has concluded a contract with the Charleroi United Collieries Company for 12,000 tons of coal briquettes for use on its vessels.

A stone monument in memory of the late Sir Joseph Whitworth has been presented to Lady Whitworth by the inhabitants of Darley, Matlock, at which place the eminent engineer resided.

The Thames Ironworks and Shipbuilding Company has just constructed two dry docks 475ft. by 65ft. by 25ft., and 335ft. by 46ft. by 20ft. respectively, for facilitating the repairing of large vessels.

Herr Dowe has been officially informed that the cuirasses submitted by him for test to the committee of the Prussian War-office were worthless, as on each occasion of firing the bullets traversed the shield.

The sale of the electrical engineering plant of Messrs. Latimer Clark, Muirhead, and Co., of Regency-street, Westminster, by Messrs. Fuller, Horsey and Co. commenced on Tuesday continuing throughout the week.

The *Marine Review*, in its double issue of June 30th, gives, with a most complete description of the steamship North-West, seven plate-supplements, showing that ship at different stages of her construction and views of her machinery and interior.

The Laing, Wharton, and Down Construction Syndicate have acquired for the United Kingdom the patent rights of the Thomson-Houston systems, and they will in future carry on business under the title of "The British Thomson-Houston, Limited."

The London and India Docks Joint Committee have acquired land in the vicinity of Smithfield for the erection of extensive freezing chambers. Messrs. J. and E. Hall, of Dartford, have contracted for the refrigerating machinery, which will be of their hydro-carbonic acid type.

The Rockingham Railway and Jarrahdale Timber Company desires it to be known that the wood laid recently by the Paris authorities, and described in several papers as Brazilian mahogany, is really West Australian hardwood. This wood, "Jarrahdale Jarrah," has now been laid in the Rue Lafayette, Rue de Rivoli, Carrousel Arcades, and Boulevard Sébastopol.

Messrs. Maudslay, Sons and Field, London, have secured the contract for the construction of the triple-expansion engines and boilers for the battleship Cæsar, to be built at Plymouth. The engines are to indicate 12,000 horse-power under forced draught, giving a speed of 17½ knots, and under natural draught 10,000 indicated horse-power, with a speed of 16½ knots.

Messrs. Witty and Wyatt, of Leadenhall-street, have sent us a specimen of a patent asbestos and metal jointing for pipes which, they say, commands a considerable sale. It consists of a metal disc to which are affixed circles of asbestos cord, so arranged that the disc on being screwed up in the joint becomes corrugated. They are made in all sizes, and seem worthy of trial.

The Peninsular and Oriental Company's new steamer Caledonia is now lying in the Royal Albert Docks, opposite the Central Station. The public will have an opportunity of inspecting the vessel on Friday and Saturday, the 7th and 8th inst., when tickets to view will be obtainable at the docks. The proceeds will be devoted to the Seamen's and Dock Hospitals. We hope next week to give a full-page illustration of this, the finest vessel in the Peninsular and Oriental fleet.

A general meeting of Birmingham brass manufacturers has been held to consider the new regulations issued under the Factories Act, in regard to unhealthy occupations. The regulations provide that during the process of mixing metals the men shall be furnished with respirators, that suitable beverages shall be provided, and that the workshops shall be whitewashed every six months. It is understood that the meeting decided to memorialise the Home-office against some of the regulations. A meeting of operative brassfounders was subsequently held in support of the regulations.

The water in the Gohna Lake reached the top of the dam in the early morning of August 25th, and commenced to overflow in a small stream during the afternoon. About 320ft. of water escaped, and the lake afterwards commenced to settle down. It was then about two and a-half miles long, and quarter of a mile wide, with 400ft. maximum depth, which means a reduction of 260ft. in width and 375ft. in depth. Further accounts state that the water escaped with a tremendous roar, at an average rate of twenty-two miles an hour, carrying all before it, and in some gorges the water rose to a height of 160ft. No lives have been lost.

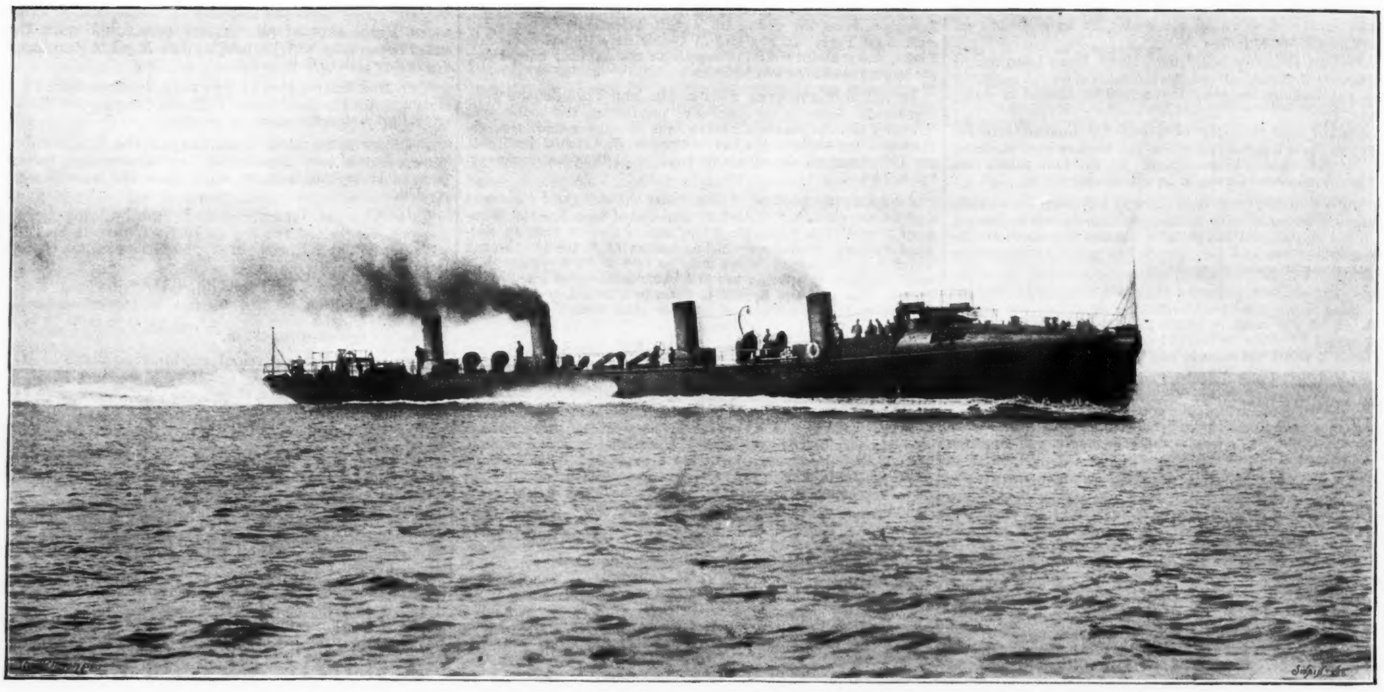
The Local Authority of Crewkerne, Somerset—the Chard Union—have at length determined to deal with the sewage difficulty in which the town has been for some years placed owing to the pollution of the river Parrett, and have instructed Mr. E. Bailey Denton, M.A., M. Inst. C.E.—Bailey Denton, Son, and North—of Palace-chambers, Westminster, to prepare plans for the purification of the sewage. The system to be adopted will be the screening by means of tanks placed at the mouth of the outfall sewer of the coarser matters contained in suspension, and the subsequent utilisation of the liquid upon land by means of intermittent filtration and wide irrigation.

The Italian Government being desirous of encouraging the preparation in Sicily of citric and tartaric acids, especially the former, has issued a decree offering prizes to persons who shall open factories for the preparation of these acids in Sicily. The first prize is to be one of £500, the second of £350, and the third of £175 sterling. To obtain the first prize both citric and tartaric acid must be made, the former in a quantity of at least ½ ton a day. Applications for the prizes must be made on Italian stamped paper not later than December 31st, 1895, and the works must be in operation not later than February, 1896, in which year the prizes will be distributed by the Minister of Agriculture. There are already two works in operation in the island.

An occurrence partaking of the nature of the Franklin experiment is reported from Aldershot. A captive balloon was held by a wire cable about 200ft. long. Suddenly it was struck by lightning, which ignited the gas, the balloon falling to earth amid a loud peal of thunder. Three of the sappers at the winch below were seen rolling on the ground, apparently in intense pain. This is attributed to their connection to the wire cable through the brass handles of the winch. One, a bugler, had the inside of his hand rather badly burnt, but the worst case of the three showed no external signs of injury. The car of the balloon fell without doing any damage. On examination it was found that all the upper part had been burnt away, though the metal valve was almost uninjured. Had anyone been in the car, even if he had escaped uninjured from the electric shock, he would have had a terrible fall. None of the sufferers were very seriously injured.

# H. M. S. LYNX AT FULL SPEED

MESSRS. LAIRD BROS., BIRKENHEAD, BUILDERS & ENGINEERS



## THE TORPEDO DESTROYERS, FERRET AND LYNX.

During the past month Messrs. Laird Brothers have had several successful trial trips of vessels on the Clyde. The necessity for going so far away arises from the fact that the measured mile at Liverpool is unsuited for these high-speed vessels. The trials of No. 97 First-class Torpedo Boat and the destroyer Ferret have already been reported on in our columns, and on Thursday week the Lynx destroyer, duplicate of the Ferret, completed her runs, and on Friday the Argentine Cruiser Patria.

The design of these destroyers, which Messrs. Laird submitted, was approved by the Admiralty in August, 1892, although for financial reasons the contract for construction was only placed in January, 1893, so that in comparison with other similar boats they have been promptly completed and tried. The engines differ from those of other Destroyers, but with slight modification are the same as those made by same builders for H.M.S. Rattlesnake in 1886, and the Argentine boats Espora and Rosales in 1890. The boilers, however, are of the Normand water-tube type.

The trial of the Lynx on Thursday week gave the following results:—Speed on measured mile, 27·15 knots; mean speed for three hours, 27·01 knots; the contract speed being 27 knots. The circle turning, starting, and stopping trials were subsequently gone through, each stage being entirely satisfactory. The instantaneous photograph which we reproduce, by Messrs. Adamson and Son, of Rothsay, represents the Ferret when she was going 27·61 knots.

The Admiralty were represented by Mr. Pledge and Mr. Ellis, also by Mr. Hobbs and Mr. Hocken, of Devonport Yard; the contractors by Mr. John Laird and Mr. Bevis.

## BRITISH ENTERPRISE IN PARAGUAY.

A recent report of the second secretary to the British Legation at Buenos Ayres, upon the Paraguay Central Railway, and its proposed extension to Encarnacion, is well worth the attention of intending investors in, and those who wish to form some idea of Paraguay.

Although the country offers many advantages as a field for colonisation, and the present Government is most anxious to attract immigration, there is a great drawback in the geographical situation of Paraguay, which renders it dependent on its neighbours for markets for its produce. The scarcity and uncertainty of these markets is a great obstacle to any rapid progress, and unless the Argentine and Umguyan markets are assured by treaty or otherwise, or new routes are opened to Brazil and the Atlantic, no sudden return of prosperity can be looked for.

There is plenty of room for legitimate enterprise in South America, and if the investing public would look more to the intrinsic paying powers of enterprises to which they are asked to subscribe, and less to the possible prices at which their shares may be quoted on the Stock Exchange, they would think less bitterly of South America. The causes of failure in railways, the principle enterprise in South America, are usually the large price paid for concessions; the culpable carelessness with which concessions are taken up in London for the sake of the commission they bring in, without sufficient trouble being taken to ensure accurate information about the country to be traversed; the carelessness with which concessions are drawn up, and the consequent legal difficulties which eat up profits; the line of country chosen, often with some object quite different from the ultimate success of the enterprise, or the development of the country; the scamped work of contractors, which in some cases has necessitated much expenditure on maintenance and renewal of the line.

The principal British enterprise in Paraguay is the Paraguay Central Railway, from Asuncion to Villa Encarnacion, on the river Paraná, a distance of 244 miles, of which the part from Asuncion to Pirapó, 154 miles long, has been completed, and works in three sections, Asuncion to Paraguari, 45 miles; Paraguari to Villa Rica, 47 miles; Villa Rica to Pirapó, 62 miles.

The capital of the company is £1,396,930, divided into 5 per cent. perpetual debenture stock £914,000, and share capital £482,930, the latter comprising 21,000 preference shares of £10 at 6 per cent., issued as fully paid to the Government, as part payment for portions of the line from Asuncion to Villa Rica, and 27,293 ordinary shares of £10.

According to the concession, the undertaking is entitled to a guarantee of interest from the Government of Paraguay for twenty years, at 6 per cent. per annum, upon £420,000, as to the railway from Asuncion to Villa Rica, and upon £3728 8s. per mile upon the line from the latter place to Encarnacion, being a total of £104,040 per annum. The Government complied with its obligations up to 1890, since when the guarantee has fallen into arrear. In September last an arrangement between the Government and the company for the payment of the guarantee was thrown out by the Senate, but the obligation was fully recognised, and proposals made for increased taxation on the export of Yerba to raise the required sum.

The gross receipts for the year ending 30th April, 1893, were £121,848, and the working expenses £115,888, as against £86,593, and £86,084 respectively in the previous year. The net profit rose from £509 to £5960. The proportion of working expenses to receipts fell from 99·53 to 95·74 per cent. The improvement would have been greater yet had it not been necessary to expend so much money on maintenance of permanent way, and renewal of bridges and sleepers. During the past year several stations were repaired on the Villa Rica-Paripó section—that last open to traffic—and the maintenance of which has lately been taken over by the company from the contractors. Twenty-seven bridges were renewed to original dimensions, three were renewed to increased dimensions, and four others repaired. On the Villa Rica-Pirapó section, most of the sleepers require renewal; the old ones, which have been only laid two years, are completely rotten, being made of soft wood, and a kick knocks a hole in them. "That this should be the case in a country where the hardest woods, and the best suited for railway sleepers are growing almost on the edge of the embankments is a scandal, and reflects discredit both on the constructors of the line and the engineer who passed the work. It is such scamped work which brings British contractors into discredit, and there are some almost incredible specimens of it in Missiones and Paraguay. In the old Jesuit town of Santa Maria, Missiones, the lintels of the doors are made of these hard woods, and although exposed to wind and weather for considerably over a century are perfectly sound. The work done by Guayrá Indians for the Jesuits contrasts most favourably with that done by British contractors for British companies." Much of the expenditure lately incurred has been rendered necessary by the bad management and misfortunes of former years. The improvement which has begun ought to continue, but the energies of those in charge should be entirely devoted to developing the traffic, with an intelligent knowledge of the country. The timber trade may be greatly increased, and agriculture much improved and extended. If the various colonies springing up along the line are carefully encouraged, they will soon have a considerable effect upon the traffic returns. Although the company is bound to extend the line to Villa Encarnacion, it is doubtful whether this would be advisable. Although the country between Pirapó and San Antonio, a distance of twenty-five miles, is very fertile, and contains considerable scattered population, the rivers Pirapó, Tébicuari-Guazú, and Tacúari, would require much expenditure on bridges. There are also two large streams near Encarnacion, and several large tracts of swampy land—flooded after rain—to be traversed, over which it would be very difficult to carry a line. Encarnacion is a small town on the Paraná, and the principal port of Paraguay, on the eastern side. It is far from flourishing, and there are numbers of deserted houses, the Argentine duties on tobacco, and the stringent measures against smuggling having paralysed trade in the Eastern part of Paraguay. In view of these facts an extension to Encarnacion could not possibly pay, unless in connection with an extensive scheme of colonisation.

One object of the extension is to place the Paraguayan railway in connection with the proposed line from Posadas—on the Argentine bank of the Paraná—to Monte Caseros. This line was begun in 1889, and several sections were constructed, but the bursting of the boom in the River Plate, and the failure of the contractors, brought the enterprise to an abrupt termination. There is some talk of proceeding with the construction of the Argentine North-Eastern Railway, but it is doubtful whether at present it would be a success. Frequent revolutions in the neighbouring province of Corrientes, and desultory fighting on the Brazilian bank of the Uruguay having so unsettled the country that even the industrious cannot live. In addition to this, the route might have to compete with two others which are in a more advanced state of construction, viz., Resistencia—Santa Fé—Rosario, Corrientes—Mercedes—Concordia, but these routes would not open up any new market. A proposal is said to have been made by Mr. C. R. Thursby to the Paraguay Central Railway Company, to study another route, viz., Villa Rica to a point on the Paraná, north of the Rio Mondáy, and opposite the mouth of the Rio Iguazú de Curitiba, and that the line should be continued to Paranaguá or some Brazilian port on the Atlantic. This route, by following the water shed to the north of the Tebicuari, would avoid the heavy expenditure on bridges entailed by the construction of the other line. Such a line would have the immense advantage of opening the Brazilian market to Paraguayan produce, and bringing Rio Janeiro within nearly the same distance from Asuncion as Buenos Ayres. Little is accurately known of the country in question, but it is said to have a considerable population, both on the Paraguayan and Brazilian side.

A scheme has been proposed by La Compagniè Francaise des Chemins de Fer Brésiliens to construct a railway from Paranaguá on the Atlantic to the mouth of the Ignazú de Curitiba, and that part of the line from Paranaguá to the town of Curitiba has been constructed. In addition to these routes there is the river route, *viâ* the rivers Paraguay and Paraná, which, if properly taken advantage of, would compete with the railways, both in passengers and goods traffic, with every chance of success.

Nothing has been done on the Paraguayan section of the proposed line from Asuncion to Villa Igà timi with a branch to Tacúrupúcú on the Upper Paranà, and which was to form part of a trans-continental railway to the Atlantic.

This report, No. 1357, Annual Series, contains details of the trade routes and a map of the proposed railways.

An interesting feature of the report is the description of a visit to the "New Australian Co-operative Settlement Association" in the department of Caagúazu, near Villa Rica, for the purpose of inquiring into the causes of the expulsion of three members, and the secession of about one-third of the colony. The community was founded on co-operative principles, with the object of "putting into practice upon a voluntary basis, and under the most favourable conditions available, that form of industrial association which will secure justice for all." The dispute began in personal differences, aggravated by the intrigues of two or three men. An agreement had been signed binding the colonists to total abstinence until preliminary difficulties had been overcome—a space of three years. The agreement was broken by the three men expelled. The ladies joined in the quarrel, strong language was used, threats exchanged, and eighty-five men, women, and children left the colony, sacrificing their stake in the Association, which amounts to a minimum of £60.

A few more such secessions will ruin the movement, disgust the Paraguayan Government, and give the British colonists a bad name in South America.[*] Under good management and on reasonable lines, the colony should be a success, but it is probable that the chairman's views are too straight and his administration too strict for ordinary men.

The colonists started with everything in their favour—free land, immunity from taxation, a good climate, and the command of a certain amount of capital. They are a fine class of men, and if they were less disposed to stand on the letter of their rights, and took a more reasonable view of the feelings of their fellows, they would be sure to succeed. As it is, they came to found Utopia, and in a few weeks created—as they said—"a hell upon earth."

---

[*] Later information states the colony to be rapidly disintegrating.

# ANTWERP EXHIBITION—HYDRAULIC TURNTABLE

M. G. FRANCOIS, BOUFFIOULX ENGINEER

Fig I.

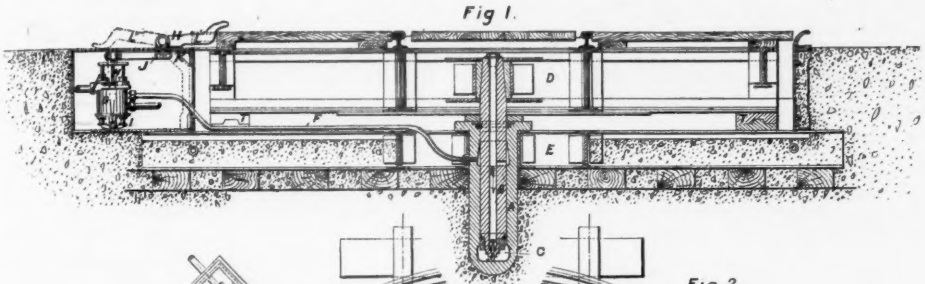


Fig 2.

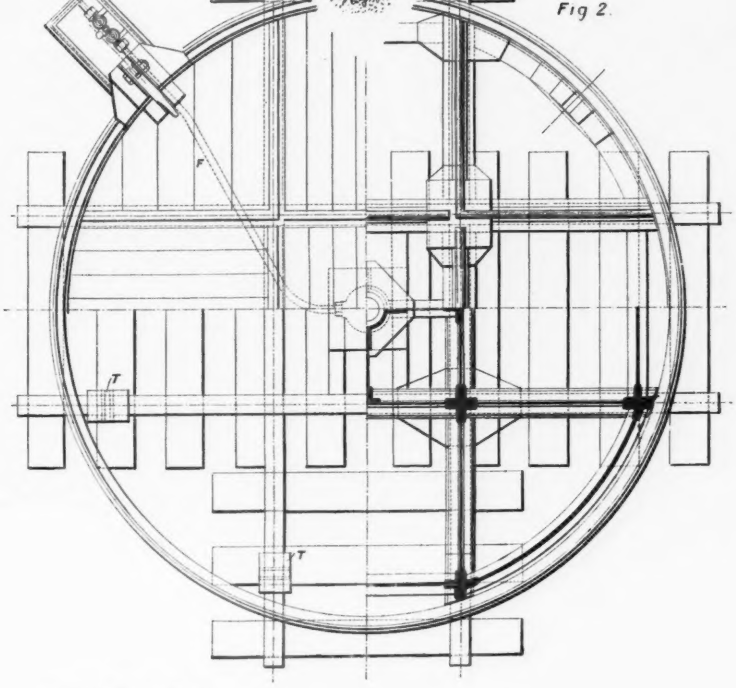
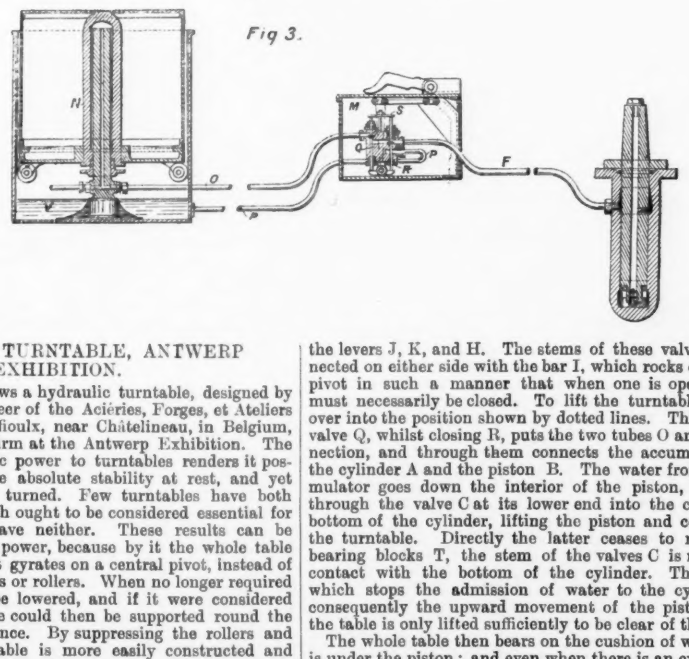


Fig 3.



## HYDRAULIC TURNTABLE, ANTWERP EXHIBITION.

Our illustration shows a hydraulic turntable, designed by M. G. François, engineer of the Aciéries, Forges, et Ateliers de la Biesme, of Bouffioulx, near Châtelineau, in Belgium, and exhibited by that firm at the Antwerp Exhibition. The application of hydraulic power to turntables renders it possible for them to have absolute stability at rest, and yet for them to be easily turned. Few turntables have both of these qualities, which ought to be considered essential for them, whilst many have neither. These results can be obtained by hydraulic power, because by it the whole table can be lifted, so that it gyrates on a central pivot, instead of having to run on wheels or rollers. When no longer required to turn, the pivot can be lowered, and if it were considered necessary, the turntable could then be supported round the whole of its circumference. By suppressing the rollers and roller path, the turntable is more easily constructed and erected, and less likely to get out of order, and there are several minor advantages—for instance, less lubrication is required, and the pit is less likely to fill with water during heavy rains.

Fig. 1 is a cross section of the turntable; Fig. 2 is a plan, with the flooring partly removed, and Fig. 3 is a section showing the connection of the hydraulic valves with the accumulator on one hand, and with the cylinder under the centre of the turntable on the other. This hydraulic cylinder, marked A in Fig. 1, is suspended from a steel frame E, carried by wooden sleepers which rest on the ground. This frame is preferably made in the form of a cross; and it supports at its ends the bearing blocks T, on which the turntable D usually rests. The hollow piston B, which is turned conically at its upper end, is firmly secured to the table D, whilst its lower end is inserted into the cylinder A. At the foot of the piston is a small valve C, whose stem rests on the bottom of the cylinder. The valve is thus kept open as long as the turntable is at rest. A tube F connects the space inside the piston, and the cavity at the bottom of the cylinder, with the valves Q and R, which are also placed in communication with the accumulator N, by means of the tube O. The construction of the accumulator will be clearly seen from the drawing.

When the turntable is at rest, the handle L fits into a groove in its rim, and serves to lock it in position. It also serves to open and shut the valves Q and R, by means of the levers J, K, and H. The stems of these valves are connected on either side with the bar I, which rocks on a central pivot in such a manner that when one is open the other must necessarily be closed. To lift the turntable, L is put over into the position shown by dotted lines. This opens the valve Q, whilst closing R, puts the two tubes O and F in connection, and through them connects the accumulator with the cylinder A and the piston B. The water from the accumulator goes down the interior of the piston, and passes through the valve C at its lower end into the cavity at the bottom of the cylinder, lifting the piston and consequently the turntable. Directly the latter ceases to rest on the bearing blocks T, the stem of the valves C is no longer in contact with the bottom of the cylinder. This closes C, which stops the admission of water to the cylinder, and consequently the upward movement of the piston, so that the table is only lifted sufficiently to be clear of the blocks T.

The whole table then bears on the cushion of water which is under the piston; and even when there is an exceptionally heavy wagon on it, a man can easily turn it with one hand. As soon as the table has been turned to the desired position, the handle L is put back. This opens the valve R, which allows the water to escape from the cavity at the bottom of the cylinder, and to flow through the pipe P into the receptacle V. The removal of the water allows the table to descend, and again to bear on the supports T. As the quantity of water used is very trifling, the raising and lowering of the table is almost instantaneous. In the Exhibition a hand pump is attached to the accumulator; and as the liquid is used over and over again, a mixture of water and glycerine, or any other fluid, may be substituted for water, if considered preferable.

---

**Death of Mr. Charles Wood.**—It is with much regret that we have to record the death of Mr. Charles Wood, late chief of the mechanical engineering department at the Silvertown Works. He was only 55 years at the time of his death on the 30th ult., but had done 23 years useful work for the Silvertown Company. Previous to this he had worked for the Basin Foundry Company at Glasgow, where he had been originally apprenticed. Whilst at Silvertown Mr. Wood was largely responsible for the construction of the Company's cable machinery and electric lighting machines up to the time of his much-regretted death; he will be difficult to replace. Charles Wood was admired and respected by all who knew him. He well earned the reputation of an industrious, painstaking, and very able engineer.

---

# METHODS OF DETERMINING THE DRYNESS OF STEAM.*

By W. C. Unwin, F.R.S., M. Inst. C.E.

(*Concluded from page* 200)

### Tests to Determine the Relative Trustworthiness of Different Methods.

*Test of the wire-drawing calorimeter.*—The instrument tried was one received direct from Mr. Barrus. It seemed extremely desirable to get some kind of absolute test of the trustworthiness of this instrument, as it is much the simplest to use for nearly dry steam. Especially it seemed desirable to ascertain whether any correction for radiation or other loss of heat would be necessary. This can only be tested by using steam of known condition. The direction given in the instructions accompanying the instrument is to test it with the steam from a boiler not doing much work, the steam being then *assumed* to be dry saturated steam. But this is inconclusive. To test this instrument a small superheater was constructed, heated by a row of gas jets. Then there is definitely superheated steam in both chambers of the instrument. Let $t_1'$ be the temperature in the first chamber, $t_2'$ the temperature in the second chamber after wire-drawing. Apart from any loss by radiation, and assuming that the kinetic energy due to passage through the orifice is reconverted by friction into heat, the difference of temperature in the two chambers can be calculated. Let $p_1$ be the pressure in the first chamber, and $t_1$ the corresponding temperature of saturated steam; $p_2$ the pressure in the second chamber, and $t_2$ the corresponding temperature. Since the total heat per pound is the same in both chambers,

$$1082 + 0{\cdot}305\, t_1 + 0{\cdot}48\, (t_1' - t_1) = 1082 + 0{\cdot}305\, t_2 + 0{\cdot}48$$
$$(t_2' - t_2)\quad t_1' - t_2' = 0{\cdot}3646\, (t_1 - t_2).$$

In the following experiment the pressure in the second chamber was slightly greater than atmospheric pressure, and the corresponding temperature was 215 deg. Putting in this value—

$$t_1' - t_2' = 0{\cdot}3646\, t_1 - 78{\cdot}4.$$

*Test of the Barrus wire-drawing calorimeter at the Central Technical College with superheated steam.*—The steam was taken from a Babcock-Wilcox boiler, and the engine was running. Steam valve opened at 2 h. 49 min., and gas jets of superheater lighted at 3 h. 1 min. Barometer 30·02 = 14·75 lb. per square inch. Pressures taken by a Schaffer and Budenberg gauge.

| Time. | Pressure by gauge—lbs. per sq. in. | Absolute pressure—lbs. per sq. in. | Saturation temperature due to pressure in 1st chamber | Observed temperature in first chamber. | Observed temp'rature in second chamber. | Observed $t_1' - t_2'$ | Calculated $t_1' - t_2'$ |
|---|---|---|---|---|---|---|---|
| h. m. | | | $t_1$ | $t_1'$ | $t_2'$ | | |
| 3 32½ | 54 | 68·75 | 301·5 | 324 | 292 | 32 | 31·6 |
| 3 35 | 54 | 68·75 | 301·5 | 323·5 | 292 | 31·5 | 31·6 |
| 3 37½ | 54·5 | 69·25 | 302·0 | 324 | 292 | 32 | 31·7 |
| 3 40 | 54·5 | 69·25 | 302·0 | 325 | 294 | 31 | 31·7 |
| 3 45 | 54 | 68·75 | 301·5 | 324·5 | 295 | 29·5 | 31·6 |
| 3 47½ | 54 | 68·75 | 301·5 | 324 | 295 | 29 | 31·6 |
| 3 50 | 54·5 | 69·25 | 302·0 | 325·5 | 296 | 29·5 | 31·7 |
| 3 52½ | 54 | 68·75 | 301·5 | 325·5 | 296·5 | 29 | 31·6 |
| 3 55 | 53·5 | 68·25 | 301·0 | 326 | 297 | 29 | 31·4 |
| 3 57½ | 54 | 68·75 | 301·5 | 327 | 298 | 29 | 31·6 |
| 4 0 | 56 | 70·75 | 303·4 | 323 | 291 | 32 | 32·2 |
| 4 2½ | 56·5 | 71·25 | 303·9 | 322 | 288 | 34 | 32·4 |
| 4 5 | 54·5 | 69·25 | 302·0 | 325 | 291 | 34 | 31·7 |
| 4 7½ | 54·5 | 69·25 | 302·0 | 329·5 | 298 | 31·5 | 31·7 |
| 4 10 | 54 | 68·75 | 301·5 | 332 | 302 | 30 | 31·6 |
| 4 12½ | 54 | 68·75 | 301·5 | 334 | 304·5 | 29·5 | 31·6 |
| Means .. | — | — | 301·9 | 325·9 | 295·1 | 30·78 | 31·45 |

The mean superheat in the first chamber was 24 deg., that in the second chamber 80·1 deg. There could be no doubt, therefore, as to the quality of the steam. The observed difference of temperature $t_1' - t_2'$ was remarkably constant, and the differences from the calculated values are not great. The mean difference of the observed and calculated values of $t_1' - t_2'$ is only 0·67. Necessarily the common pressure gauge readings are only approximate, and the difference is less than that which may be due to unavoidable inaccuracy in reading the pressure gauge. Since in ordinary use about 20 deg. fall of the temperature $t_2'$ corresponds to 1 per cent. of moisture in the steam, it appears that the calculated value of $t_2'$ for dry steam is practically exact. Other experiments—though not over any great range of pressures—have been made. So far as they have gone, they confirm this result. Hence it appears that no correction of the theoretical calculation is necessary to obtain practical accuracy, and that the assumption that all the kinetic energy at the orifice reappears as heat is practically true. In Fig. 6 the temperature curves for the experiment above have been plotted. The saturation temperature $t_1$, due to the steam pressure, calculated from the pressure gauge readings, and the actual temperature of the superheated steam $t_{s1}$, are shown by the two upper lines. The temperature of the superheated steam in the second chamber $t_{s2}$ is shown by a full line, and the calculated value of $t_{s2}$ by a dotted line. The thermometer being in an iron tube necessarily lags a little behind the temperature in the chamber.

*Test of a combined separating and wire-drawing calorimeter by Mr. Barrus.*—A very careful test is given by Mr. Barrus in his paper,[18] in which the steam passing through the instrument was condensed in a surface condenser and measured. Pairs of trials were made under identical conditions; in one the separator was in use, and in the other the separator was shut off. Each trial lasted usually an hour, sometimes two hours.

*Pairs of Trials in one of which most of the Moisture was Trapped in the Separator, and in the other the whole Measured by Wire-drawing or Heat Gauge.*

| No. | Temperature by upper thermometer. | Temperature by lower thermometer. | Weight of steam condensed in surface condenser per hour. | Weight of water from separator per hour. | Total weight of steam used per hour. | Moisture calculated from separator, per cent. | Moisture calculated from heat gauge, per cent. | Dryness of steam. | Total moisture, per cent. |
|---|---|---|---|---|---|---|---|---|---|
| | $t_1$ | $t_2$ | lbs. | lbs. | lbs. | | | $x$ | |
| 1 | 312·4<br>312·2 | 265·4<br>239·6 | 53·87<br>53·89 | 0·644 | 54·51<br>53·89 | 1·18 | 0·40<br>1·80 | ·984<br>·982 | 1·58<br>1·80 |
| 2 | 312·5<br>313·8 | 267·0<br>241·4 | 53·58<br>54·97 | 0·684 | 54·26<br>54·97 | 1·26 | 0·30<br>1·70 | ·984<br>·983 | 1·56<br>1·70 |
| 3 | 313·6<br>313·1 | 266·4<br>225·0 | 53·91<br>54·40 | 1·284 | 55·19<br>54·40 | 2·33 | 0·40<br>2·60 | ·973<br>·974 | 2·73<br>2·60 |
| 4 | 314·1<br>314·1 | 267·2<br>223·9 | 54·50<br>55·32 | 1·350 | 55·85<br>55·32 | 2·42 | 0·40<br>2·80 | ·972<br>·972 | 2·82<br>2·80 |
| 5 | 314·3<br>314·3 | 267·9<br>227·1 | 55·00<br>55·82 | 1·309 | 56·31<br>55·82 | 2·33 | 0·40<br>2·60 | ·973<br>·974 | 2·73<br>2·60 |

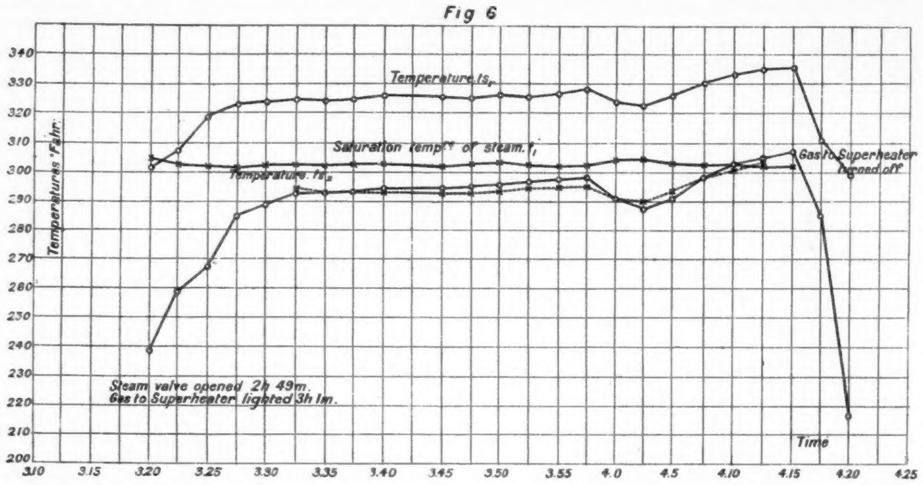
Mr. Barrus has used these results in an attempt to calculate a value for the specific heat of superheated steam, and gets values ranging from 0·415 to 0 519, the mean value being 0·475, almost exactly the value generally assumed. It is hardly to be expected that experiments of this kind are accurate enough to prove that the specific heat varies. On the other hand, Mr. Barrus has neglected to calculate the dryness fraction of the steam, and so has missed the striking evidence these results afford to the general accuracy of the instrument. The separator was not a very perfect one, and allowed about 0·4 per cent. of moisture to pass. But the separator results cannot be much wrong, for they are measured results depending on no assumed constants. The error in calculating the 0·4 per cent. passing the separator cannot be large enough to much affect the total result. On the other hand, the calculation from the heat gauge when the separator was cut out, which depends on the assumed value 0 48 of the specific heat and on the theory of the instrument, agrees strikingly with the separator results.

---

* Report of the Committee, consisting of Sir F. J. Bramwell, Bart. (chairman), Professor T. H. Beare, Mr. Jeremiah Head, Professor A. B. W. Kennedy, Professor Osborne Reynolds, Mr. Mair Rumley, Mr. C. I. Wilson, and Professor W. C. Unwin (secretary).

[18] Amer. Soc. Mechan. Engineers, 1890.

Fig 6



*Test of wire-drawing and separating calorimeter combined.*—The following tests have been arranged to determine how far it is true, as stated by Carpenter, that a separator traps the whole of the moisture, even with very moist steam. The Barrus calorimeter was used with its drip box or separator. The amount of water deposited in the drip box was measured. Observations also were taken of the temperatures in the two chambers of the wire-drawing part of the instrument. Let $t_1$ $t_2$ be the temperatures in the first and second chambers of the wire-drawing part, $t_3$ the saturation temperature of steam in the second chamber calculated from the pressure. Then, from the formula given above,

$$x = \frac{1116 - t_1 - 0{\cdot}19t_3 + 0{\cdot}48t_2}{1116 - 0{\cdot}71t_1}.$$

The dryness in each experiment has been calculated by this formula for the steam passing from the drip box into the wire-drawing part.

*Tests of Barrus Calorimeter with Separator attached at the Central Technical College.*

| Date. | Time. | $t_1$ | $t_2$ | $t_3$ | $x$ | Per cent. of moisture trapped in separator. |
|---|---|---|---|---|---|---|
| | H. M. S. | | | | | |
| Nov. 27, 1893.. | 4 23 30<br>4 27 45 | 294·5 | 256·2 | 215 | ·996 | 9 |
| | 4 27 45<br>4 32 15 | 292·5 | 257·0 | 215 | ·998 | 9 |
| | 4 32 15<br>4 37 15 | 289·0 | 257·0 | 215 | ·998 | 9 |
| Mar. 15, 1894.. | 11 9 0<br>11 37 30 | 290·5 | 254·9 | 215 | ·997 | 5 |
| | 11 51 0<br>12 21 0 | 286·4 | 251·5 | 215 | ·996 | 5·7 |
| Mar. 28 .. .. | 1 2 40<br>1 11 52 | 298·0 | 262·0 | 215 | ·997 | 4·4 |
| Mean .. | — | — | — | — | ·997 | — |

It will be seen that, although the steam entered the separator with more than 4·4 per cent. to 9 per cent. of moisture, the steam passing through the wire-drawing part has only from 0·4 per cent. to 0·2 per cent. of moisture. The mean dryness fraction of the steam passing to the second chamber in the six tests was 0·997, so that the error of using the separator without the wire-drawing part would generally, for practical purposes, lead to an error of no great importance, at any rate, when the steam had initially more than 1 per cent. of moisture. Further, the separator on the Barrus calorimeter is not quite so well arranged as that of the Carpenter calorimeter. The steam leaving the latter is no doubt drier than that leaving the separator of the Barrus calorimeter.

*Test of a Carpenter separating calorimeter showing the influence of radiation from the steam pipe in producing moisture in steam.*—The Barrus calorimeter and Carpenter calorimeter were fixed side by by side for comparative tests. A branch pipe 30ft. long brought the steam from the main steam pipe, which delivered steam to the engine. This pipe was well clothed with Keenan's composition. The engine was running, so that there was a considerable flow of steam along the main steam pipe. Two pairs of tests were made. In one the Carpenter calorimeter alone was used, and the flow of steam along the 30ft. branch pipe was comparatively slow. In the other pair, steam was flowing through the Barrus calorimeter also. As this uses twice as much steam as the Carpenter, the rate of flow was about three times greater than in the first pair of tests.

*Test with Carpenter separating Calorimeter at the Central Technical College, March 28th, 1894.*

| No. | Duration Mins. | Rise of temperature of condenser. | Steam condensed in lb. | Water tapped in separator. | Per cent. of moisture in steam. | Absolute steam pressure, lb. per sq. in. | |
|---|---|---|---|---|---|---|---|
| 1 | 4·833 | 21·7° | 1·15 | 0·20 | 14·82 | 67 | No steam flowing through Barrus |
| 2 | 5·217 | 25·8° | 1·36 | 0 20 | 12·82 | 72 | |
| | | | | Mean | 13·82 | | |
| 3 | 6·60 | 32·6° | 1·77 | 0·08 | 4·33 | 72 | Steam flowing through Barrus |
| 4 | 8·80 | 39·5° | 2·19 | 0·08 | 3·52 | 68 | |
| | | | | Mean | 3·93 | | |

The only difference in these two sets of experiments was that the rate of flow along the branch steam pipe was different. In the first set the mean moisture was 13·82 per cent., in the second set 3·93 per cent., being greater when the steam current was slower. The difference is due to condensation in the steam pipe. The result is important as showing how large the proportionate condensation may be, even in a well-clothed steam pipe, when the rate of flow is small, and also how important it is, in using calorimeters of this kind which take only a small quantity of steam, to place them closely adjacent to the engine or boiler tested.

*Simultaneous wire-drawing and salt test on a Babcock boiler at the Central Technical College.*—Steam was taken by a short pipe clothed with felt from the casting carrying the safety valve at the top of the boiler. This pipe branched to the Barrus calorimeter and to a worm in a cold water tank, closely adjacent to each other. The following table gives the Barrus calorimeter results in full to show the consistency of the determinations :—

*Test with a Barrus Wire-drawing Calorimeter, June 5th,* 1894.

Steam valve opened at 11h. 25m. a.m. Barometer, 29·88in. = 14·68 lb. per sq. inch. Pressure in second chamber, about 4in of water, or ·14 lb. per sq. inch. Temperature of saturated steam corresponding to pressure in second chamber taken at $t_3$ = 213 deg.

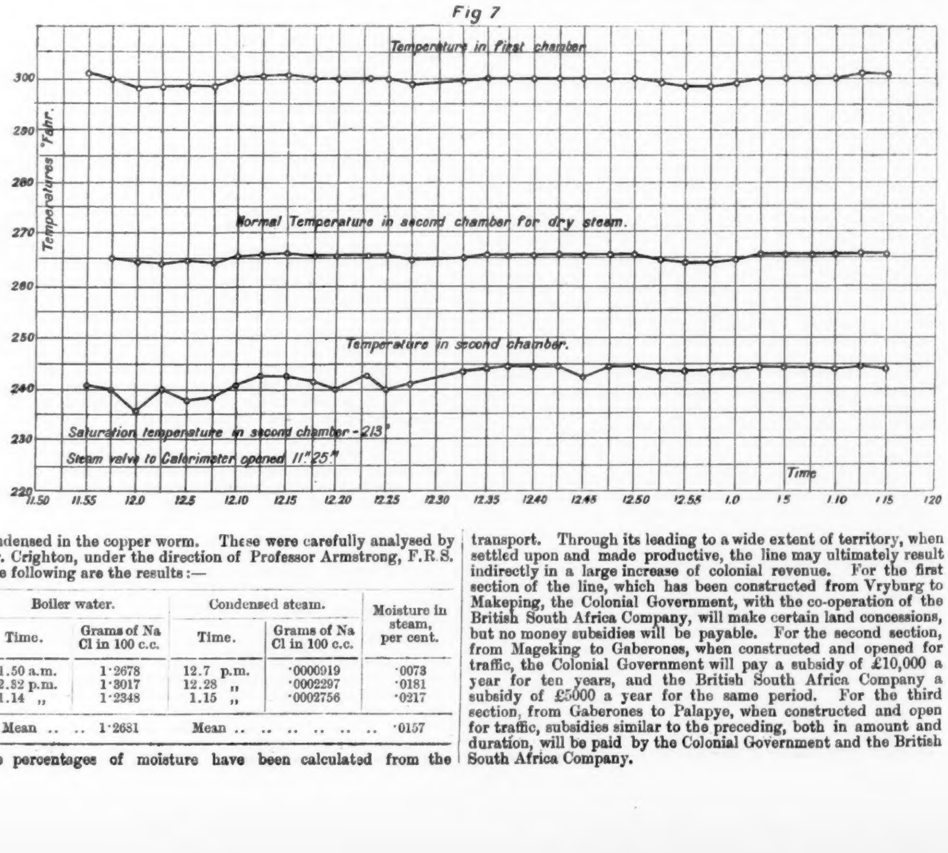
| Time. | Pressure by gauge on boiler, lb. per sq. in | Temperature of steam, $t_1$. | Temperature after wire-drawing, $t_2$. | Dryness fraction of steam, $x$. | Per cent. of moisture in steam. |
|---|---|---|---|---|---|
| 11.55 a.m. | 58 | 301 | 241 | ·986 | 1·4 |
| 57½ | 56 | 300 | 240 | ·986 | 1·4 |
| 12.0 | 56 | 298 | 236 | ·985 | 1·5 |
| 2½ p.m. | 56 | 298 | 240 | ·987 | 1·3 |
| 5 | 57 | 298·5 | 237·5 | ·986 | 1·4 |
| 7½ | 59 | 298 | 238 | ·986 | 1·4 |
| 10 | 59 | 300 | 240·5 | ·987 | 1·3 |
| 12½ | 60 | 300·5 | 242 | ·987 | 1·3 |
| 15 | 60 | 300·5 | 242 | ·987 | 1·3 |
| 17½ | 59 | 200 | 241 | ·987 | 1·3 |
| 20 | 58·5 | 300 | 240 | ·987 | 1·3 |
| 23 | 58 | 300 | 242 | ·988 | 1·2 |
| 25 | 57·5 | 300 | 240 | ·987 | 1·3 |
| 27½ | 57·5 | 299 | 241 | ·987 | 1·3 |
| 32½ | 59 | 299·5 | 242·5 | ·988 | 1·2 |
| 35 | 59 | 300 | 243·5 | ·989 | 1·1 |
| 37½ | 59 | 300 | 244 | ·989 | 1·1 |
| 40 | 59 | 300 | 244 | ·989 | 1·1 |
| 42½ | 59 | 300 | 244 | ·989 | 1·1 |
| 45 | 58 | 300 | 242 | ·988 | 1·2 |
| 47½ | 59 | 300 | 244 | ·989 | 1·1 |
| 50 | 57·5 | 300 | 244 | ·989 | 1·1 |
| 52½ | 56 | 299 | 243 | ·988 | 1·2 |
| 55 | 56 | 298 | 243 | ·988 | 1·2 |
| 57½ | 56 | 298 | 243 | ·988 | 1·2 |
| 1.0 | 57·5 | 299 | 243·5 | ·988 | 1·2 |
| 2½ | 59 | 200 | 244 | ·989 | 1·1 |
| 5 | 58 | 300 | 244 | .989 | 1·1 |
| 7½ | 59 | 300 | 244 | ·989 | 1·1 |
| 10 | 60 | 300 | 244 | ·989 | 1·1 |
| 12½ | 60 | 301 | 244·5 | ·988 | 1·2 |
| 15 | 60 | 301 | 244 | ·988 | 1·2 |
| Means .. .. .. .. .. .. .. .. .. .. | | | | 0·9877 | 1·23 |

While these calorimeter tests were made, three samples of boiler water were taken from the gauge cock and three samples of steam condensed in the copper worm. These were carefully analysed by Mr. Crighton, under the direction of Professor Armstrong, F.R.S. The following are the results :—

| Boiler water. | | Condensed steam. | | Moisture in steam, per cent. |
|---|---|---|---|---|
| Time. | Grams of Na Cl in 100 c.c. | Time. | Grams of Na Cl in 100 c.c. | |
| 11.50 a.m. | 1·2678 | 12.7 p.m. | ·0000919 | ·0073 |
| 12.32 p.m. | 1·3017 | 12.28 ,, | ·0002297 | ·0181 |
| 1.14 ,, | 1·2348 | 1.15 ,, | ·0002756 | ·0217 |
| Mean .. .. | 1·2631 | Mean .. .. .. .. .. .. | | ·0157 |

The percentages of moisture have been calculated from the mean saltness of the boiler water. It will be seen they vary considerably. Further, the moistness from the salt test is only one-hundredth as great as that shown by the wire-drawing calorimeter. The temperatures for the Barrus calorimeter are plotted in Fig. 7, in order to show how remarkably regular and consistent the observations with a wire-drawing calorimeter are.

Fig 7



*Simultaneous wire-drawing and salt test.*—In the following test the Barrus wire-drawing calorimeter was used, the observations being taken by Professor Unwin. Simultaneously Professor Kennedy took samples of the condensed steam and boiler water, and determined the moisture in the steam by the salt test.

*Test of water tube boiler, using wire-drawing calorimeter, April 11th,* 1894.—The temperatures of the calorimeter thermometers given are the means of two to five observations at intervals of about one minute, taken after steam had been flowing through calorimeter for about twenty minutes. They were taken as soon as the temperatures had become steady. Barometer 29 936in. = 14 70 lb. per square inch. Temperature of saturated steam corresponding to pressure in second chamber assumed 214 deg.

| — | Time. | Pressure by gauge on boiler, lb. per sq. in. | Temperature in first chamber, $t_1$ | Temperature in second chamber, $t_2$ | Dryness fraction of steam, $x$ | Moisture in steam per cent. |
|---|---|---|---|---|---|---|
| | h. m. | | | | | |
| Apr. 11 | 10 14 a.m.<br>10 20 ,, | 160·5 | 360 25 | 281·75 | ·990 | 1 0 |
| | 10 17 ,,<br>10 19 ,, | 158 0 | 359 75 | 283·0 | ·989 | 1 1 |
| | 12 14 p m.<br>12 18 ,, | 160·0 | 361 0 | 284·0 | ·990 | 1·0 |
| | 2 20 ,,<br>2 25 ,, | 157 4 | 360·8 | 284 3 | ·990 | 1·0 |
| | 3 16 ,,<br>3 18 ,, | 158 3 | 360 3 | 284·5 | ·991 | ·9 |
| Means . | — | — | — | — | ·990 | 1·0 |
| Apr. 10 | 10 3 a.m<br>10 5 ,, | 161·6 | 357·0 | 279·3 | ·988 | 1·2 |
| | 11 12 ,,<br>11 20 ,, | 161 0 | 357 5 | 280·6 | ·989 | 1·1 |
| | 12 17 p.m.<br>12 21 ,, | 160·8 | 359·6 | 282 8 | ·989 | 1·1 |
| | 2 52 ,,<br>2 55 ,, | 149 0 | 354 0 | 281·3 | ·990 | 1·0 |
| Means .. | — | — | — | — | ·989 | 1·1 |

It is obvious that the salt test shows much less moisture than the calorimeter, the mean moisture by the former being 1 per cent., and by the latter only about one-tenth as much. Naturally the salt test which shows only mechanical priming should give a lower result than the calorimeter. But the salt tests are so irregular that it is impossible not to doubt a little the accuracy of the method.

The moisture found by condensing some steam and determining the amount of salt during the same trials was as follows :—

| — | Sample. | Time. | Dryness fraction. | Moisture per cent. |
|---|---|---|---|---|
| | | h. m. | | |
| April 10 .. .. | 1 | 10.30 a m. | [·9997] | less than 0 03 |
| | 2 | 11.38 ,, | ·9965 | 0·35 |
| | 3 | 12 34 p.m. | [·9997] | less than 0 03 |
| | 4 | 1 51 ,, | [·9997] | ,, |
| | 5 | 3.40 ,, | [·9997] | ,, |
| Mean .. .. .. | — | — | ·9991 | 0·094 |
| April 11 . .. | 1 | 10 35 a.m. | [·9997] | less than 0 03 |
| | 2 | 11.47 ,, | ·9957 | 0·43 |
| | 3 | 1.40 p.m. | ·9990 | 0·10 |
| | 4 | 3.42 ,, | [·9997] | less than 0 03 |
| Means .. .. | — | — | ·9985 | 0·147 |

Vryburg to Palapye Railway, British Bechuanaland.—According to a Treasury Minute, the leading features of the agreement between the Government of British Bechuanaland, the British South Africa Company, and the Bechuanaland Railway Company, for the extension and working of the Vryburg-Mageking Railway—gauge 3ft. 6in.—to Palapye, are :—The revenues of British Bechuanaland will be changed with a subsidy to the railway company, amounting in time to £20,000 a year for a period of years, but by means of the new railway the Colonial Government expects to effect an at least equal saving in the cost of police and transport. Through its leading to a wide extent of territory, when settled upon and made productive, the line may ultimately result indirectly in a large increase of colonial revenue. For the first section of the line, which has been constructed from Vryburg to Makeping, the Colonial Government, with the co-operation of the British South Africa Company, will make certain land concessions, but no money subsidies will be payable. For the second section, from Mageking to Gaberones, when constructed and opened for traffic, the Colonial Government will pay a subsidy of £10,000 a year for ten years, and the British South Africa Company a subsidy of £5000 a year for the same period. For the third section, from Gaberones to Palapye, when constructed and open for traffic, subsidies similar to the preceding, both in amount and duration, will be paid by the Colonial Government and the British South Africa Company.

## AUSTRALIAN ENGINEERING NOTES.

(*From our own Correspondent.*)

THE annual report of the New Zealand railways for the year ending 31st March, 1894, has just been published. The result of the year's working shows an increase under all heads of revenue excepting the carriage of grain and merchandise, under which there was a reduction of 112,446 tons of grain and 20,295 of merchandise traffic, the total revenue being decreased by £8729 on last year's figures. The expenditure has increased £3217. Sixty-one miles of new lines were added during the year. The fruit industry is stated to be attaining considerable dimensions, 900 tons being carried to Dunedin and Auckland—no less than 326 tons of this was carried forty to fifty miles by road on horse wagons to the railway stations. The permanent way has been well looked after; 19,303 rails have been renewed, 82 per cent. being 53 lb. steel rails. About 155,502 sleepers were laid for ordinary renewals and about 22,000 laid to increase the number per rail length.

Rates have been reduced in almost all classes of goods, and passenger fares have been reduced in several instances. There is plenty of room for reductions in freights and fares, as the rates are considerably higher than what prevails in the other colonies. The following is a summary of the principal particulars:—

| | Year 1894. | Year 1893. |
|---|---|---|
| Miles open | 1,948 | 1,886 |
| Train mileage | 3,113,231 | 3,002,174 |
| Gross earnings | £1,172,793 | £1,181,522 |
| Gross earnings per mile of line | £618 | £631 |
| Gross earnings per train mile | 7s. 6½d. | 7s. 10½d. |
| Total working expenses | £735,359 | £732,142 |
| Total working expenses per mile of line | £384 | £391 |
| Total working expenses per train mile | 4s. 8¾d. | 4s. 10½d. |
| Net earnings | £437,434 | £449,380 |
| Net earnings per mile of line | £229 | £240 |
| Net earnings per train mile | 2s. 9¾d. | 3s. |
| Working expenses to gross earnings, per cent. | 62·70 | 61·97 |

The report of the Tasmanian Government railways is always very late in appearing, but this year it is earlier than usual. The report is for the year ending 31st December, 1893, and the following summary gives the position of these railways at that date:—

| | |
|---|---|
| Capital cost of lines open | £3,510,196 |
| Total miles open for traffic | 419·75 |
| Gross revenue | £152,083 |
| Working expenditure | £136,468 |
| Net earnings | £15,615 |
| Working expenses to revenue, per cent. | 89·73 |
| Train mileage | 799,823 |

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Fire hydrant.*—In the new Eddy hydrant the vertical stem or rod carrying the valve extends through the valve, and has a threaded end entering a bushed nut carried in the bottom of the casing. By this arrangement the valve is held in place from the bottom, and cannot lift in case the upper part of the casting or rod is broken. The valve is made with a cylindrical piece of smaller section on the lower side, and as this enters the seat it gradually reduces the flow of water before the valve comes upon the seat, thus avoiding any "water hammer." A collar on the stem prevents the rod being screwed out of the bottom bushing. A drip plug at the valve seat is automatically opened when the valve is shut, thus allowing the water in the casing above the valve to escape, while the plug is closed when the valve is opened. The valve is rubber faced, but does not revolve on its seat, as the stem revolves in the centre of the valve.

*Narrow gauge railways.*—The narrow gauge craze which obtained in the United States some years ago has long since died out, and enormous sums of money have been spent in widening the gauge of hundred of miles of track to allow of through traffic and connections. Some few roads of respectable length still retain the 3ft. or 3½ft. gauge, but their change is only a question of time and financial conditions. The East and West Texas Railway is about to change 230 miles of 3ft. to the standard gauge, as it has standard gauge roads at each end of its line. A similar fate has attended the old southern gauge of 5ft., and the Erie Railroad gauge of 6ft., some thousands of miles of track being removed to the standard gauge, on account of the difficulty and expense of through carriage of freight. A fifty mile branch of the Nashville and Chattanooga Railway is also to be changed. There are certain conditions under which a narrow gauge is admissible, as for short isolated lines, and some of the curious little 24in. railways have been very satisfactory, but some of these little branches have been absorbed and changed by standard gauge roads. With proper care in locating and laying out a railway for ordinary traffic, there are few cases where a standard gauge road cannot be as well and as cheaply built as a road of anything over 3ft. gauge. There are two 3ft. roads in Iowa, which are said to carry the same loads and at the same speeds as the standard gauge, trains running steadily and easily at fifty miles per hour, but it is probable that no increase in cost need have been required for the wider gauge, while the expense of widening must be incurred sooner or later.

*Gas engines for electric plant.*—The electric light plant at Danbury is driven by three Otto gas engines of 100 horse power each. Each engine has two horizontal cylinders 14½in. by 24in., placed one above the other, with both connecting rods driving the same crank pin, the main shaft being midway between the centre lines of the cylinders. The belt fly-wheels are 6ft. in diameter, and run at 165 revolutions per minute. The engines are placed side by side, with the crank shafts in line and connected by flexible couplings, so that one, two, or three engines can be run at a time. A small 15-horse power Westinghouse steam engine is used to start the gas engines by driving the driven shaft, and thus revolving the fly-wheels. The engines are coupled up with the cranks 180 or 120 deg. apart, according whether two or three engines are in operation. The governors are also connected up so that the plant acts as one engine with four or six cylinders. The cylinders are water jacketed, the water of circulation being taken from the gas-holder. The boiler for the starting engine is used also in making the producer gas and for heating the power station. The exhaust pipes have enlarged pockets to deaden the noise, and these pipes lead to a small brick chimney. The plant has been so successful that the former steam plant has been abandoned. Either illuminating or producer gas can be used. The electrical plant includes two Westinghouse alternating dynamos of 1500 and 1750 lights capacity, with separate exciters; three 45-light Schuyler arc-machines, and two Schuyler 40-light commercial machines.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

LL probability of the Congreaves Ironworks and the New British ron Company being restarted—at least as regards the manufactured iron and steel plant—seem to be dissipated by the sale which has this week begun of the extensive plant and stock in lots under the hammer. The attendance, which was large, included buyers from Manchester, Sheffield, and other distant centres, and some fair prices were realised. The average price for job lots of iron was, it is suggestive, £4 per ton, and for scrap £2 2s. A large quantity of steel ingots were disposed of at prices ranging from £2 2s. 6d. to £2 7s. 6d. per ton. It is intended to continue the sale at intervals during the autumn, when the mills, forges, steelworks, blast furnaces, chain works, colliery plant, &c., will be sold without reserve. A rumour has been afloat this week that the blast furnaces had been purchased by a syndicate and were to be restarted, but I fear that the report is without foundation.

Business in the iron trade is this week assisted by the continued firmness of the Scotch and Cleveland markets, and by the increased demand which has appeared in some departments of the manufactured iron trade. The sheet iron makers are busier, and so, too, are the galvanisers. The bar makers are doing rather more, and thin hoops and strips are understood to be exceedingly firm. Prices are upheld on the improved basis lately ruling, namely, £6 10s. to £6 12s. 6d. and £6 15s. for black sheets—doubles; £7 5s. for trebles, and £7 to £7 10s. for common plates. Galvanised sheets are £9 12s. 6d. to £9 15s. and £10, f.o.b. Liverpool or equal, and common bars £5 10s., while good merchant bars are £6, and marked bars £7 10s.

The sheet iron works at Walsall of Messrs. Walker, which have been closed since the spring of last year, were re-opened this week—an indication of revived trade of a very favourable sort. Pig iron keeps strong in price for all descriptions, and demand is good.

The declaration of a reduction in colliers' wages of 4d. per day, or stint, by the Coal Trade Wages Board, has led to a strike since last report, at some of the West Bromwich collieries, including the important Sandwell Park Company's concern. Some 8000 colliers are affected by the reduction all over the district, but fortunately not much more than 1000 of these came out, and the strike was of very short duration. The men protested that they should have received a fortnight's notice on Wednesday, but under the rules of the Wages Board this is not so. The men's leaders of the Board did their utmost to persuade the men to return to work, but until Tuesday in vain. On that day, however, the men agreed to descend the pits again on Wednesday, and most of them did so. But it is understood that the advisability of giving notice for a termination of the Wages Board will be discussed in the ensuing few weeks, and instead of joining the National Federation. The experience is a repetition of the old trouble of the difficulty of getting miners to adhere to a sliding scale in a falling market, and is an evidence of the increasing favour which the National Federation is meeting with in Staffordshire. Already 2000 miners here are affiliated with the organisation, and it is probable that before a very great while all will be.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—The probability to which I previously referred, that the increased weight of buying recently going on in the iron market might prove to be no more than the result of a very general conviction on the part of consumers and merchants that prices had touched the bottom, and that it was therefore prudent to place out the orders and contracts they had been holding back, seems now to be recognised. There is nothing to indicate that users have been buying more iron because they have secured a correspondingly increased weight of work, and I hear of no reports of appreciably increased activity in any of the principal iron-using industries. Merchants who have been buying to cover and consumers who have supplied their present requirements are now holding back from placing further orders at the advanced rates quoted by makers, whilst, on the other hand, makers who are mostly now tolerably well sold for the next two or three months are indifferent about booking orders, except they can get their present rates. The result will probably be another lull in the market until present contracts are to some extent worked off; but the general opinion is that prices are not likely to come back to the exceedingly low figures recently ruling, and with the excessive lowness of stocks, should there be any real revival in the iron using industries which would bring about an enlarged demand on account of actually increased consumption, a considerable further rise in prices is not at all improbable.

About a fair average attendance was brought together at the Manchester ironmarket on Tuesday, but a quieter tone prevailed generally as compared with the last fortnight or so. Prices for pig iron, however, were very strong, makers of some brands holding out for further advances upon the quotations of last week, but there was a disinclination on the part of buyers to follow this further upward move, and any transactions put through at the full quoted prices were for the most part only of small weight. Lancashire makers, who have not advanced their list quotations at all during the recent upward move, report a moderate business, and they are very firm at about 40s. for forge to 42s. for foundry, less 2½ at the works, or equal to about 42s. 6d. for forge to 44s. 6d. and 45s. for foundry delivered equal to Manchester. Lincolnshire makers, who have been selling pretty freely, were asking quite 6d. per ton above last week's prices, but only occasional transactions, and these of no weight, were reported at what may be termed the maximum figures. In forge iron some business has been put through at about 39s. 6d., and in foundry at about 40s. 6d. and even 41s., net cash, delivered Manchester, whilst there have been a good many inquiries within about 6d. of the figures makers have been asking. Makers are now holding out for about 39s. 6d. to 40s. for forge, up to 41s. for foundry, net cash delivered Manchester, and although these figures seem to have checked further buying, makers are not at present at least at all disposed to give way, preferring to work on with the contracts they have secured rather than come down under the maximum quoted rates. In Derbyshire iron there has been a fair amount of business doing recently, and foundry qualities are now quoted about 45s. to 46s., net cash, delivered Manchester. Middlesbrough iron continues very firm at about 45s. to 45s. 4d., net cash, for good foundry brands, delivered Manchester, and a tolerable weight of business is being put through at something like these figures. In Scotch iron quotations are little more than nominal, some brands are altogether out of the market, but in Eglinton business has been readily done at about 48s. 6d., net prompt cash, delivered Lancashire ports.

The manufactured iron trade still shows no really appreciable improvement. Here and there orders have perhaps been coming forward rather more freely during the past week or so, but not sufficient to give anything like activity to forges, which are mostly still short of work, and any stiffening up in prices has been due almost entirely to the increased cost of raw material, which has compelled makers to withdraw from the concessions they were previously disposed to offer buyers where business could be secured. Delivered Manchester district, Lancashire and Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths.

Nut and bolt makers report rather more business doing, but no really better prices are obtainable.

The steel trade generally continues only quiet. Good ordinary foundry hematites can still be readily bought at 53s., less 2½, delivered Manchester, which is only about 6d. above recent minimum quotations, and even under this figure has been taken upon special sales, but makers in one or two cases are quoting 54s. to 54s. 6d., less 2½, delivered. Ordinary basic billets are still readily obtainable about £4 net cash, and although makers of steel boiler-plates, owing to the stoppage of production in Scotland, are not quoting under £6 7s. 6d. to £6 10s. for delivery in this district, merchants are prepared to book forward orders at about £6 5s.

In the metal market a moderate business is coming forward at the recent advance in list rates for manufactured goods.

A rather more hopeful tone seems to prevail in some branches of the engineering trades, and here and there a little more activity is reported, chiefly amongst machinists and some of the special machine tool makers; generally, however, there is no real improvement, and for the most part establishments continue but moderately off for work, with new orders still coming forward but slowly.

A very handy portable furnace, specially designed for melting magnolia metal, is being introduced by the Magnolia Anti-friction Metal Company, of Manchester. This furnace has been designed with the object of removing all risk of overheating, which s injuriously affects the chemical composition of this metal, and thi is accomplished in a very simple manner. The furnace is heated by gas, through burners so arranged that seven different powers or grades of heat can be obtained by simply opening or closing one or other of three regulating cocks which are provided for this purpose. This enables the metal to be melted in the furnace in from eight to ten minutes if required, by using the whole of the burners, or it may be kept fluid all day by using the smallest burner alone. The top of the furnace is arranged on one side in the form of a wide shelf, underneath which pass the waste gases, and the mandrils, bearings, bushings, &c., can be laid upon this shelf for heating to the proper temperature before the metal is run into them. The furnace, which is made in two sizes, one to hold about 1 cwt., and the other to melt any quantity of metal up to 3 cwt., is light and portable, so that it can be moved to any convenient place in the works, and, by means of a rubber tube, connected up to the nearest gas pipe. By this means there is no risk of the metal cooling down during conveyance from the furnace to the bearing that is being cast, and any ordinary workman can run the furnace without difficulty or danger, whilst he has ample time to get ready the bearings, &c., into which the metal has to be poured.

The coal trade still shows no appreciable improvement, except perhaps rather more inquiry for the better qualities. Pits, however—except where they are in a position to secure shipping orders—are still scarcely working four days per week, whilst stocks are still accumulating. As regards manufacturing classes of fuel, the local demand continues to be restricted by the holiday stoppages in various manufacturing centres; and engine fuel is still more of a drug upon the market, with very low-priced supplies coming in from other districts. At the pit mouth best Wigan Arley coals do not average more than 11s.; seconds, 10s.; common house-coals, 8s.; and steam and forge coals about 7s. to 7s. 6d. per ton, with engine fuel ranging from about 3s. 9d. to 4s. for common, to 4s. 6d. and 5s. for medium, up to 5s. 9d. and 6s. for the best descriptions.

In the shipping trade a fair amount of activity is still reported, with considerable quantities of steam coal and engine fuel going away to Scotland; but no better prices are obtainable, ordinary steam coal not averaging more than 8s. 9d. to 9s., and engine fuel 5s. 6d. to 5s. 9d., delivered at the Garston Docks or the High Level, Liverpool.

For some time past it has been evident that the Lancashire Coal Sales Association, which was established just after the close of the coal strike, with a view of preventing undue competition in the market, had only a very precarious prospect of continued existence, there being strong complaints on the part of some of the leading colliery owners connected with the Association, that not a few of the members in one way or another were underselling the prices agreed to at the meetings; and the withdrawal of several of the largest colliery concerns in Lancashire, at a meeting held in Wigan last Monday, may be said to have brought about the final break-up of the Association, as the other members considered it useless attempting to further carry it on. Whether this break-up of the attempted combination on the part of the coalowners to regulate prices will result in any weakening in the market remains to be seen; those firms who have complained that they have been undersold, and, whilst bound by the official list rates, unable to compete, will of course now be at liberty to take such action as they think best in their own interests, but probably the near approach of winter may tend to remove underselling and give a steadier tone to prices.

*Barrow.*—Another quiet week's business has been done in the hematite pig iron trade. Orders for foreign and continental users are especially few, and prospects of any improvement in trade are remote. Business in Bessemer iron is chiefly confined to local users, and the general home demand is very quiet. Forge and foundry qualities of metal are in very quiet demand. Only thirty-three furnaces are in blast. Prices are steady at 44s. 7½d. net cash sellers, and 44s. 6½d. buyers. Makers are quoting 45s. to 45s. 6d. per ton net f.o.b. for parcels of Mixed Bessemer Nos.

Iron ore has but a very poor market. Locally there is but a small consumption. Less is being sent away by shipping, and the amount used in different parts of the country has been sensibly minimised by the keen competition on the part of Spanish raisers of ore. Native qualities are quoted at 8s. 6d. per ton net at mines, and best samples are in small sale at 12s. to 14s. per ton.

Steelmakers report no further improvement in the state of business. Orders are very scarce for rails, tin-plate bars, hoops, slabs, wire rods, and billets, and there is also a good trade doing in steel shipbuilding material, orders for which are fairly well held. There is not much prospect of new orders at present.

Shipbuilders and engineers report that a few inquiries for new tonnage have come to hand, some of them of an important character. At Barrow during the week two trading steamers, each of about 4000 tons, have been launched, the Axim for the British and African Company, and the Clan Campbell for the Clan Line. Last week the newly-tripled steamer Xema, belonging to the Cork Steampacket Company, made her trial from Barrow, which was very satisfactory.

The coal and coke trades are very quiet, and sales are exceedingly few of late, as well on manufacturing as on shipping account.

It is stated that in the West Cumberland district some marked developments are taking place in the manufacture of coke, which it is expected will tend to place makers of pig iron in a better position than at present, when they are using such a large amount of Durham coke.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IN the South Yorkshire coalfield the large collieries producing steam coal are working four to six days a-week, and firmness is generally reported. The owners of house-coal pits, however, are not so well off, the demand exhibiting no autumnal influence of any importance, and the tendency of prices being downward. The wages difficulty, as revived by the lads and banksmen, has not yet closed with the suggestion of the South Yorkshire Joint Board—as confirmed even by the Conciliation Board—but is certain to do so. At one large colliery, the New Oaks, the miners' leaders have found that the lads decline to follow their counsel. The surfacemen also express strong dissatisfaction, although they appear to submit for the present to bear grievances quietly. It is admitted that their position is a hard one.

House coal continues in small demand, considering the season is now on when householders lay in stocks for winter. To London the tonnage is not quite up to the average of former years. Buyers evidently expect that values will be lower, and hold off purchasing to any extent on that account. Agents, therefore, find it hard to make sales at current rates. Several of the West Riding towns are securing supplies, it is said, at prices considerably below the average. If there is to be a reduction before October, the existing condition of trade will accelerate the concession by the keen competition for orders. Quotations are now as follow:—Silkstones, 9s. 6d. to 11s. per ton; Barnsley house, 8s. 6d. to 10s. per ton; other qualities, 1s. 6d. to 2s. per ton lower. For steam coal prices appear hardening. Having regard to the advanced season, the trade with the Humber ports is well maintained. The railway companies are also taking a full average. Barnsley hards are 7s. 9d. to 8s. 6d. per ton; lower grades from 7s. per ton. The gas companies no longer hold their hands, there being a decidedly brisker demand at 7s. to 8s. per ton. In manufacturing fuel there is much less demand than supply, prices being weak and tending downward. Supplies are easily secured at exceptionally low rates, good slacks not making more than from 4s. to 5s. per ton; ordinary slack and smudge abundant, and realising about 2s. per ton. Coke remains at 9s. to 11s. per ton.

The steel manufacturers are already feeling the benefit of the new tariff arrangements in the United States, and energetic efforts are being made to recover much of what has been lost in that market. The new duties, however, are not operating altogether as expected, the broad effect being that cheap manufactures benefit by the change from the specific to the *ad valorem* system, but with regard to the higher-priced productions the very opposite is the case. Several articles which are not made in the States, and could be successfully imported from Sheffield, are hindered rather than helped by the new scale, owing to these articles, being high-priced, having now to pay a heavier amount, the *ad valorem* duty being more than the specific duty per pound weight. The cutlery trades are generally benefitting by the change.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

It is satisfactory to be able to announce the removal of one obstacle which has done very much to retard business in this district for weeks past, in fact it has paralysed operations at many works. The strike of moulders is at last at an end, the men resuming work on Monday wherever the employers were in a position to find it for them, but in a large number of cases the men will have to remain idle for an indefinite period because work has had to be sent elsewhere during the strike, and orders which would have been executed in this district have had to be completed in other parts of the country and even abroad, the consumers being unable to wait the convenience of manufacturers in the North of England. Thus when the men are anxious to work and have given in, they in many cases find there is no work to do, business being driven away by their action. The men have not abandoned their claim to advanced wages, but they have agreed to the proposals of the employers that they should go back to work at the old rate of wages, and submit their claims to an Arbitration Court which is to be established. The men have been on strike twenty-four weeks, and their first claim was for an advance of 3s. per week in time wages, and 10 per cent. in piece prices, but they modified their claims to 2s. and 5 per cent. respectively, before the strike actually commenced on March 11th, and that they still claim. But recently the employers have found it necessary on account of the increased dulness and unprofitableness of trade caused by the men's action, to put in a claim for a reduction of wages, and the arbitrators will be called upon to adjudicate upon that claim as well as upon the claim of the men for an advance. The dispute would have been ended before, but the men objected to anything but their own claim being considered. It is also provided that a Conciliation Board shall be formed in order to adjust all future labour disputes. The patternmakers have not abandoned their strike, but they are comparatively few in number, and it is expected that they will quickly follow the example of the moulders. They adhere to their original demand for 3s. 6d. per week on weekly wages and 10 per cent. on piece prices. This strike of moulders has done a great deal of harm to the trade of the district, for though 1500 men only were directly involved in it, their action threw out of employment nearly 20,000 other operatives, who cannot meet with full work for some weeks yet. The cessation of this strike has had a very favourable influence upon the market generally, and has allowed of consumers ordering more freely than for a long time past, the demand being best for steel plates and angles, and it is reported that several good orders for steamers have been concluded in this district this week.

Manufacturers of finished iron and steel have had their position so much improved by the termination of the moulders' strike, that they have been able to advance their prices, and competition among them is less keen. They have for some weeks had to seek for orders to replace those the execution of which was suspended owing to the strike. But now they can resume work on these old contracts, and thus are under less necessity to look out for others, and accordingly have raised their prices. Steel plates and angles have this week been raised another 2s. 6d., and thus are 5s. above the recent minimum. Makers expect to be able to realise still better prices, as the shipyards get more fully to work and can take more of their iron. Steel ship plates are now £5 2s. 6d.; steel ship angles, £4 17s. 6d.; steel boiler plates, £6 2s. 6d.; and steel engineering angles, £5, all less 2½ per cent., and f.o.t. Iron plates and angles are in rather better request, and are quoted at somewhat higher figures. Iron ship plates are at £4 17s. 6d., and iron angles at £4 15s., both less 2½ per cent., and f.o.t. In consequence of the improvement in the steel plate and angle trade, the consumption of hematite pig iron, which has for a long time past been poor, has increased, and makers will now be able to reduce the heavy stocks they are said to hold. They have kept up their make while the consumption declined, through the stoppage of local steel works and the smaller requirements of Scotland. Thus the stock accumulated, and on this account they have not been in a position to advance their quotations so much as have the producers of ordinary Cleveland pig; in fact, the advance in Middlesbrough hematite pig has only been 3d. from the minimum, whereas for No. 3 Cleveland pig it has been 1s. Mixed numbers of East Coast hematite pig can yet be bought at 43s. per ton for early delivery. Last month the closing of local steelworks caused the stock of hematite pig in Connal's public warrant stores to increase 12,441 tons, the quantity held at 31st ult. being 55,758 tons. No particulars are available as to the quantity the producers have in their own yards, as the ironmasters do not give the stocks of hematite and basic iron, though they have for years published the stocks of Cleveland iron.

The August statistics of the Cleveland Ironmasters' Association were unsatisfactory, but not more so than was expected, seeing that the moulders' strike in this district and the miners' strike in Scotland have greatly reduced the consumption of Cleveland iron. It was calculated that the stocks would show an increase of 10,000 to 12,000 tons, and the actual increase was 13,298 tons, making an increase of over 30,000 tons in the last three months, a period when there should have been as large a decrease, but the situation has been exceptional because of the strikes, and an improvement may now be expected. That the trade do not look upon the statistics unfavourably is seen by their having no influence on the market; they relate, however, to the past, and a new order of things has been inaugurated this month. The returns show that there were no changes in the furnaces last month, 51 making Cleveland iron, and 43 hematite, &c., total 94 blowing out of 142 erected as in July. The production showed a decrease of 8260 tons from July, which may be accounted for by the holiday which the blast furnacemen took on August 11th. Of Cleveland pig 116,985 tons were made—6129 tons decrease from July—and of hematite, basic, and spiegel iron 127,386 tons—2131 tons decrease—total 244,371 tons—decrease 8260 tons. The total stock of Cleveland pig iron held on 31st ult. was 186,709 tons, of which 91,055 tons was held unsold by makers — increase 14,266 tons, and 90,389 tons in Connal's warrant stores—decrease 5003 tons. The pig iron shipments were poor, reaching from Middlesbrough only 75,723 tons, this being 10,805 tons less than in July, 1894, and 13,575 tons less than in August, 1893. The exports oversea were up to the average, and the falling off was entirely due to the strike in Scotland, which led to a great decrease in the Scotch consumption of Cleveland iron.

The prospects of the Cleveland pig iron trade are more satisfactory, and prices continue to improve. No. 3 G.M.B. has been quoted and sold this week at 36s. 4½d. for early f.o.b. delivery, but the best brands have not been under 36s. 6d. Some No. 3 has been sold for delivery up to the end of the year at 36s. 6d., but not many producers will accept that under present circumstances. Cleveland warrants have not fluctuated much this week, sellers keeping about 36s. 4d. The lower qualities of Cleveland pig iron are creeping up in value, as there is more demand for them now that the moulders' strike has ended, and the Scotch strike is in a fair way for collapsing. No. 4 foundry is at 35s. 3d., and grey forge at 34s. 6d., but notwithstanding the advance they are still relatively cheaper than No. 3.

The rail trade is very quiet yet, though it is, perhaps, a little better than it was. For heavy steel rails £3 10s. net at works is quoted. Common iron bars are at £4 17s. 6d., less 2½ per cent., f.o.t., and thus have improved very little in value for weeks. Engineering establishments will now be able to work more fully, because there will no longer be any stoppages owing to the difficulty of getting castings, now that the moulders have gone in. The marine engineers, it will be remembered, struck work at the same time as the moulders, and for a similar advance, but they abandoned their claim before long. That, however, has not availed them much, because their employers could not set many to work as long as there was a dearth of castings. Some masters nevertheless, in spite of the opposition of the moulders, have been able to procure castings from other districts, and considerable quantities have been obtained from abroad. Increased activity cannot but follow, in the engineering industry, the settlement of the difficulty in the ironfounding trade.

The coal trade continues very active, and both Durham and Northumberland are profiting considerably by the Scotch miners' strike, as from these districts a good deal of fuel is sent to Scotland itself, and more is forwarded to consumers abroad, who have hitherto bought largely from Scotland. Best Northumberland steam coal is at 10s. 9d. to 11s., f.o.b. Coke is in good request at 12s. 6d. per ton, delivered on Tees-side.

The colliery mechanics of Northumberland have voted against the acceptance of a reduction of 2d. per day in their wages, unless it were accompanied by the 53 hours per week. The coalowners are not likely to grant this concession, though the Durham coalowners gave it to their mechanics three years ago. The Durham miners have voted against the rules which the masters and their own executive propose for governing the Conciliation Board which is to be established, and the question is to be further considered.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron market has been comparatively active, a large quantity of warrants changing hands in the course of the week. The prices have fluctuated somewhat, but the general tendency is upwards. The Scotch warrants have sold from 43s. 6d. to 43s. 7d. cash. There has been little doing in hematite iron, the local consumers still having their works closed, and Cleveland is only in small request from the same cause.

Two furnaces have been put out of blast at Shotts, leaving two in operation there, and two at Coltness, these four now being all that are at work in Scotland. Special brands are becoming scarce, some of the makers having nothing to offer. Both Gartsherrie and Clyde have disappeared from the market lists.

The makers' quotations are therefore very firm:—G.M.B. f.o.b. at Glasgow, No. 1, is quoted 45s. per ton; No. 3, 44s.; Monkland, No. 1, 48s. 6d.; No. 3, 44s.; Carnbroe, No. 1, 48s. 6d.; No. 3, 46s. 6d.; Calder, No. 1, 58s.; No. 3, 50s.; Summerlee, No. 1, 56s.; No. 3, 50s.; Coltness, No. 1, 59s.; No. 3, 52s. 6d.; Glengarnock at Ardrossan, No. 1, 56s.; No. 3, 50s.; Eglinton, No. 1, 54s.; No. 3, 47s. 6d.; Dalmellington at Ayr, No. 1, 52s.; No. 3, 47s. 6d.; Shotts at Leith, No. 1, 56s. 6d.; No. 3, 50s. 6d.

The stocks of pig iron in the Glasgow warrant stores have been steadily decreasing, and now amount in the aggregate to 302,000 tons, being 34,000 less than at this time last year.

The shipments of pig iron in the past week have been 2978 compared with 5123 tons same week last year. There was sent to Canada 250 tons, India 209, Australia 210, France 10, Germany 129, Holland 815, Spain and Portugal 266, China and Japan 100, other countries 160; the coastwise shipments being 839,000, compared with 2283 in the corresponding week.

The manufactured iron and steel trades are still very dull.

The position of the coal trade shows little change.

The result of the ballot of miners taken towards the close of last week gave a majority in favour of what are known as the Federation terms, viz., an advance of 6d. per day, with wages guaranteed for two years. This resolution was carried against another proposing to adhere to the demand for 1s. per day, and is therefore a modification of the miners' original demand. The employers are not, however, disposed to make any concessions whatever.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Last week the sailors' strike was to the front at Cardiff, Newport, and Barry, and some believed that a great time of excitement and of trade blocking was at hand. So far there has been very little hindrance to business, and several cases have occurred of steamships and sailers getting crews at union rates. The fact would seem to be that, where freights have sanctioned it, shipowners have given way. The coal trade has been vigorous of late, and prices have been sustained. Had it been on the down grade, as was anticipated, it is not likely that any shipowners would have yielded, but would have resolutely abided by their determination to put their vessels by rather than give way. If, as some contend, the rate of wages is really lower in Cardiff and Newport than at Swansea, where there is no dispute, no doubt an investigation will be made, and matters remedied as much as possible. But it is here where the union and shipowners are at variance. The union demands a fancy wage; the coalowners and shipowners contend that the wage must be governed by the freight they are able to get.

For the Mediterranean, freights at Cardiff this week showed a slight hardening tendency; those for France are unaltered.

Coal shipments at all ports have kept up well.

Closing prices at Cardiff remain as follows:—For best steam, 11s. 3d. to 11s. 6d.; seconds, 11s.; dry sorts, 9s. 9d. to 10s. 3d.; small, 5s. 3d. to 6s.; according to quality. The slight droop in house coal has been regained, and best house commanded 11s. No. 3 Rhondda is selling at 10s. 6d.; brush 8s. 6d.; small, 6s. 6d. No. 2 Rhondda is at 8s. 6d. to 8s. 9d.; through, 7s.; small, 4s. 6d. to 5s.

The improvement which has been manifested in the coal trade has had the usual improving influence all round. Markets are much more buoyant, and a good deal of business has been done in coal and iron shares, the prominent ones in demand being Albions, Norths, Penrhiwkiber, and Rhymney coal. In railway stock, Taff Vales are brisk, and business has been done at 83. Debenture stock, up 1½. Rhymney Railway rise strongly maintained; present figures, 202. Barrys remain 230. Vale of Glamorgan shares are at 18s. premium.

Patent fuel is in improved demand, especially at Swansea, which exported over 10,000 tons last week. At Cardiff prices are maintained 11s. to 11s. 6d. Coke also remains firm, furnace selling at 15s. to 16s.; good foundry, 17s. to 17s. 6d.; and special, 20s. to 20s. 6d. Pitwood, 15s. 6d.

On 'Change, Cardiff, this week there was an improved tone for foreign ore, and the following prices were quoted:—Best Rubio, 11s. to 11s. 3d.; Tafna, 10s. 6d. to 10s. 9d.; Garucha, 10s. 6d.; Perman, 9s. 6d. to 10s.; and Almeria Campanil, 14s. 3d. per ton, c.i.f. Newport or Cardiff.

A little more activity is reported from the principal iron and steel works.

Cardiff Exchange tin-plate quotations this week were:—Steel cokes, J.B. brand, 10s. 9d. to 11s.; B.V. grade, 10s. 6d. to 10s. 9d.; Bessemer cokes, 10s. 6d. to 10s. 9d.; Siemens coke, 10s. 9d. to 11s. Siemens cokes, squares and odd sizes, 11s. 3d. to 11s. 9d. Siemens charcoals, upper forest grade, 11s. 6d. to 11s. 9d. Siemens charcoals, 12s. 3d. to 12s. 9d. Siemens best charcoals, 13s. 3d. to 13s. 9d. Worcester grade Siemens ternes, 28 by 20, 23s. 6d.; Dean grade ternes, 28 by 20, 22s. to 23s. The above quotations are all I.C. 95 lb. to 100 lb.; cokes, 3 lb. less than I.C., and 90 lb. cokes 4 lb. less than I.C. all delivered f.o.b. Wales.

Swansea Exchange quotations mid-week were: Glasgow warrants, 43s. 6d. cash; Middlesbrough, No. 3, 36s. 3d.; Welsh bars, £5 to £5 2s. 6d.; sheet iron and steel quotations unchanged; heavy rails from £3 17s. 6d.; light, from £4; Bessemer bars, from £4 2s. 6d.; Siemens, from £4 5s.; Bessemer tin-plate cokes from 10s. 6d. to 10s. 9d.; Siemens, 10s. 9d. to 11s.; ternes, from 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; wasters, 6d. to 1s. less than primes; odd sizes, usual extras.

It is again affirmed, with some show of official authority, that an agreement is on the point of being signed between the Great Western Railway and the Swansea Harbour Trust, by which the railway rates to that port will be materially reduced. It is stated that the arrangement will come into force in a very short time.

The No. 2 Rhondda seam has just been struck at the Glyncymmer Colliery, Maesteg. It is 3ft. thick and of good quality. Mr. T. G. Davis, M.E., conducted the operations.

The Junior Engineering Society were much gratified by their inspection of the Taff Vale locomotive works Cardiff, the Alexandra Docks, Newport, the Lloyd's proving house, Cardiff, and various places of interest.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

The iron markets over here continue remarkably quiet. So far as both makers and consumers are concerned, a general want of confidence in the future in most cases operates against entering into forward engagements of any moment, and until the outlook becomes more settled business is likely to remain of a hand-to-mouth sort.

There is still an absence of improvement in the Silesian iron trade, and if there is any change noticeable it is rather in the direction of a weaker tone in the market, both for crude and for manufactured iron. The wire and nail-shops are comparatively well employed. List quotations do not show a change since former letters, being in the same depressed condition as before; there have even been symptoms of a downward inclination in some instances.

Though there is not much animation noticeable on the Austro-Hungarian iron market just at present, business transactions are nevertheless considered as fairly satisfactory. Bars, girders and all sorts of plates are in quiet but regular call. In Bohemia English plates are being offered at very low rates, and inland firms find it extremely difficult to compete with their foreign rivals.

The French iron market is still rather uncertain, but, on the whole, better this week than last. In pig iron there is not much doing, but quotations are tolerably well maintained for most sorts. Manufactured iron makers remain fairly satisfactorily employed; there is a considerable amount of new work coming forward in the girder line, and a firm tone is to be perceived in the prices for that article. Bars are still offered at 155f. p.t.; while girders continue to be sold at 165f. p.t.

In Belgium the iron industry remains very dull, but there is, nevertheless, a slightly improving tendency to be noticed in some branches. Plates and steel girders, for instance, have experienced quite a fair request upon the week. The prices obtainable leave much, or rather everything to be desired; even the smallest export orders cannot be got unless large reductions are agreed to. Demand and sale remain limited on the Rhenish-Westphalian iron market, and the general tone is altogether very sensitive and uncertain, so that even the most experienced member of the trade would hardly be able to form an opinion as to the future development of the iron business. Iron ore is in moderate request, and the prices paid for spathose iron ore, are M. 7·40 to 7·90 p.t.; roasted do., fetching M. 11 to 11·50 p.t. at mines. Inferior qualities are paid with M. 9·80 to 11 p.t. Luxemberg-Lorraine minette is in tolerably good demand, and quotations are, with few exceptions, pretty firm, ranging from M. 2·50 to 3·20 p.t. net at mines. Spanish ore has improved in demand. In the Rhenish-Westphalian district the quietness in the pig iron trade is as great as ever, while from the Siegerland rather more cheering reports come in. Spiegeleisen is sold at the old price of M. 52 p.t., while Rhenish-Westphalian forge pig No. 1 continues to be quoted M. 46, No. 3 M. 40 p.t. at works. For hematite M. 63 is given; foundry pig No. 1 stands at M. 63 p.t., while No. 3 costs M. 54 p.t. Basic is noted at M. 45 p.t. Luxemburg forge pig continues to be offered at 48f. per ton free Luxemburg. The demand on the malleable iron market has been irregular, some mills being well off for new work, while others hardly know how to keep their concerns going. Stocks are, on the whole, decreasing rather than otherwise; quotations remain low. Orders for sectional iron are pretty numerous, and hoops have likewise been in good demand, but for both articles prices remain depressed. Concerning the plate and sheet trade there is still nothing of importance to notice; for export extremely little has been doing, and unless foreign trade becomes more lively there is not much to be expected with regard to higher prices. For the present very low rates are the rule. The majority of the foundries and machine factories are well employed, and the wagon factories are looking forward to a time of vigorous activity, an order for 354 passenger cars and 220 load wagons having just been given out by the Elberfeld Railway Administration.

Latest list quotations per ton at works are as under:—Good merchants bars, M. 110; angles, M. 120; girders, M. 95; hoops, M. 110 to 115; billets, in basic and Bessemer, M. 81; heavy plates, for boiler-making purposes, M. 150; tank ditto, M. 130 to 135; steel plates, M. 125; sheets, M. 140; Siegen thin sheets, M. 125 to 130. Iron wire rods, common quality, M. 115; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

At a Vienna workshop an iron church is being constructed for the Bulgarian colony at Constantinople. The basis of the church, which is to hold 500 persons, measures about 55 metres; the iron used weighs 400 t., while nearly four million rivets and screws are required. Sixty-four pillars bear the roof. It was first intended to have the inside of the church covered with fayence and marble plates, but that plan has been abandoned, and bronze-gilt iron has been chosen instead. The total cost of the church is estimated at 250,000f.

The Explosion in the Solent.—Colonel Ford, her Majesty's Inspector of Explosives, in reporting upon the explosion of tonite or cotton powder, which resulted in the loss of seven lives on a boat in the Solent on July 19th, considers that the explosion was caused either by Alfred Rennie, a seaman apprentice, attempting to remove the detonator from a 20lb. charge which had failed to explode, or by the charge being knocked off the thwart by one of the men, the latter cause being the less probable. Further, the successive steps leading up to the accident appear to have been all more or less blameworthy or open to criticism. In the first place, Mr. Gaster, over-estimating his knowledge of blasting operations, proposed that he should conduct the work, and incorrectly reported that he had all that was necessary for carrying it out. Then, the Trinity House, accepting his rating of his qualifications, authorised him to conduct it without being satisfied that he was competent to do so. Colonel Ford adds that in the course of his inquiry it came to light that the Trinity House had habitually stored tonite in lightships without any licence, this being a practice not in accordance with the Explosives Act.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 30th.

American markets are slightly stronger in all lines. Stocks of goods of all kinds, including raw material for manufactures, have been allowed to run very low. Throughout the Western and Southern sections of the country a demand for prompt shipment of seasonable goods is made. Bank loans also indicate the moderate improvement in progress. Jobbers report encouraging inquiries. Money is in good supply. No gold exports for a week. Manufacturers have not bought freely yet. In the iron trade orders were placed for 20,000 billets, 6000 tons rails, and quite a number of small orders for plate and structural material. There is confidence in further improvement. Agricultural works, foundries, wire mills and rolling mills are more fully engaged than for many months. Blooms are 19 dols., girder rails 23 dols. to 25 dols. The trade is ready for a sudden demand, and it is a widespread belief that an improvement will soon show itself. Prices have never been as low. Labour strikes are threatened in three or four leading industries, involving 50,000 hands, because of reductions made necessary by tariff reductions.

## LAUNCHES AND TRIAL TRIPS.

A new twin-screw steamer, the Columbia, built by Messrs. James and George Thomson, Clydebank, to the order of the London and South-Western Railway Company, for their fast passenger and mail service between Southampton and Havre, was launched on Tuesday, the 4th inst. The length of the vessel is 270ft. between perpendiculars, and the breadth 34ft., the gross tonnage being about 1100 tons. In the design of the vessel the first care has been to provide exceptionally comfortable accommodation for passengers during the night service across Channel, and the first-class passengers will have separate staterooms similar to those in ocean-going steamers. One hundred passengers can be accommodated in this way, chiefly in state-rooms containing two berths, while there is accommodation in large cabins for fifty second-class at the other end of the vessel. The machinery is so arranged that the majority of the first-class state-rooms are situated as nearly as possible in the centre of the vessel, where the pitching motion is least, and bilge keels have been fitted in order, as far as possible, to prevent rolling. The steamer will be propelled by two sets of four-cylinder triple-expansion engines, and a high rate of speed is expected.

Messrs. Napier, Shanks, and Bell, Yoker, Glasgow, launched, on Monday, the steel screw steamer, Independencia, built to the order of Messrs. Frame, Alston, and Co., of London, for the Government of San Domingo. The vessel, which has yacht lines and cutwater stem, has been designed by the builders, and constructed to Lloyd's 100 A1 class, to meet the views of the President as a means of coast defence along the shores of San Domingo. To meet this requirement, the vessel will be fitted with seven Hotchkiss guns placed at convenient positions around the deck. Her dimensions are: Length, 170ft.; breadth, 25ft.; depth, 12ft. 6in. The entire space aft of machinery is set apart for the President's suite of rooms, which will be furnished in first-class style, the furniture being in walnut. At the forward end of the machinery space the officers and artillerymen are berthed in rooms branching off a well-arranged mess room; while the crew are housed in a good-sized forecastle. The Independencia throughout will be fitted with a complete installation of electric light, including a powerful search light, and, in addition, supplementary candle lamps will be supplied to the rooms. The deck gear consists of steam windlass, steam steering gear on bridge, and screw gear and capstan aft. Double awnings will be provided right fore and aft, and over bridge. The vessel has been constructed under the supervision of Mr. George McFarlane and Mr. Nicol MacNicoll, of Glasgow.

On Saturday, September 1st, the pleasure steamer Duke of York was successfully launched from the Thames Electric and Steam Launch Works, Eel Pie Island, Twickenham. Miss Victoria Grant Duff, daughter of Sir Mount Stuart Grant Duff performed the ceremony of naming the boat. The principal dimensions of this vessel are as follows:—Length from stem to taffrail, 80ft.; beam, 14ft.; depth, moulded, 7ft.; draught aft, 3ft. 6in. There is a promenade deck the whole length between the fore and after decks, supported at each end by ornamental steel columns, the side being of teak down to the covering board, and glazed with bevel-edged plate glass. The top of promenade deck is covered with corticine, and the skylights form seats. Galvanised stanchions and steel rails are fixed round. The main saloon is artistically decorated, brass electroliers being fitted for the incandescent lamps. The electric light is also fitted throughout the vessel, the current being obtained from a 50 volt circuit, other lamps being arranged in the port, starboard, and mast head lights. The vessel is propelled by a three-bladed screw, made of Bull's metal, supplied by the Phosphor Bronze Company, and the engines are compound surface-condensing, manufactured in the company's engineering shops. The boiler is of the return tube type, working at a pressure of 140 lb. to the square inch. This vessel has been designed by Mr. W. I. Sargeant, to give a speed of nine knots an hour, for passenger service between the new lock at Richmond and Hampton Court Palace, being the largest launch running on the Thames above lock. There is accommodation for 300 passengers. After the ceremony of launching, the new vessel, with a company of over 200 people, was towed round Eel Pie Island by the electric launch Glow-worm.

Rolling mills and arsenals are being built at Hanyan, China, which will cover seventy acres. Native iron will be used and rails and small arms made on large scale. The rails will be used for local railways.

## RAILWAY CONNECTION WITH MANSFIELD.

Mansfield, a thriving town in Nottinghamshire, is near the line of the Lancashire, Derbyshire, and East Coast Railway, but is not touched by it. The inhabitants, with the people of Mansfield, Woodhouse, and other villages, are anxious to be connected with the main line by a branch, and at a meeting held last Friday night, presided over by the Mayor of Mansfield, a resolution to that effect was passed and a petition adopted for presentation to the directors.

On Monday the Midland Railway Company opened its new warehouses and stores at the Wicker, Sheffield. In 1875 the company laid down at Wincobank, near Sheffield, 3¾ miles of sidings on the down line and 2½ miles on the up line at Grimesthorpe. There, too, was built an engine shed capable of accommodating some forty-eight engines, and a large warehouse of four floors was erected in the Wicker at a cost of £30,000.

The two upper floors of this warehouse, which are used for the storage of grain, sustain a weight of 3000 tons, and hold on each floor 25,000 full sacks. This warehouse, which is fitted with hydraulic machinery, is the only building connected with the old Wicker Station that has been left. In 1892 it was found necessary to make further provision, and the directors decided to spend about £120,000 in the erection of new offices, warehouses, &c. They front Savile-street, cover an area of 650 square yards, are built of red brick, relieved with terra-cotta, and consist of three separate floors, for correspondence and other offices, all lit by the electric light.

The new warehouse, which is connected with the offices by balcony and bridge, consists of basement, ground floor, and upper floor. The basement is used for the storage of wines and spirits under bond, and ale in casks. It has an area of 5500 square yards. There are three large vats for blending spirits. In the two floors there is a total area available for general storage of about 8200 square yards. About 2000 tons of iron, all of English make, has been used.

The electric light installation consists of three single-cylinder horizontal engines, by Messrs. Marshall and Sons, Gainsbrough, two indicating 80-horse power each, and one 30-horse power, four 35-light arc dynamos of the Thompson-Houston pattern, and one incandescent dynamo for 300 16-candle power lamps, by Mather and Platt. The incandescent lamps are for the offices, and in the Wicker warehouses and yard of the engine shed, Cardigan and Grimesthorpe sidings, will be over 110 arc lamps, each of 2000-candle power.

## ELECTRIC GENERATING STATION AT BAZACLE, TOULOUSE.*

By P. Juppout.

The Garonne at Toulouse crosses two weirs, the second and more important of which provides the power made use of in the new generating station here described, which is a central station distributing current both for lighting and for motive power. The head of water is 14ft. 9in., and the hydraulic installation had to be so arranged as not to interfere with the mills already using the water power of the fall. Four turbines of the Girard type were erected, each being able under the full head to develope 320-horse power. The power is under control by means of cast iron valves sliding across the fourteen orifices on each turbine; these are worked either by hand or from two auxiliary turbines provided for the purpose. The turbine shaft is vertical, and drives by bevel gearing—wood and iron—a horizontal shaft, from which a belt is taken to the dynamo.

The demands for power have so much increased that steam engines have had to be provided also, which can be coupled at will to the same dynamos. Soapy water is used for lubricating the footsteps of the turbines, and gives satisfaction.

The dynamos are six in number, made by Messrs. Guénod and Sautter, of Geneva. The current is continuous. At a speed of 380 revolutions each developes a current of 700 ampères at 150 volts. Each turbine, with its two dynamos, will supply twelve thousand lamps. The three-wire system of distribution is used.

In order to maintain a constant electromotive force at the end of the line, the speed of the turbines is regulated to suit the consumption, and the moving masses being large, this method avoids any sudden change, such as might be a danger in directly varying the magnetic field for the purpose of regulation. The entire control of both mechanical and electrical apparatus is concentrated at one point under the eye of the electrician in charge. Eight feeders have been established, all overhead lines, with a development of thirteen miles, and within a radius of 1300 yards from the station.

In order to cope with the increased demand, which went very soon beyond the amount of current originally provided for, two accumulator stations have been established, and a third is projected. These are charged by isolating one of the feeders from the general system at a time when the demand is slack.

The municipality have adopted the company's current for street lighting, there being now two hundred and eight arc lamps in use. They are suspended over the centre of the street from a pair of posts in the line of the kerbs. The motors supplied by the current vary from ½-horse power to 4-horse power, and the price paid is £20 per horse-power per annum. 125-horse power in all is supplied. The total receipts for light and power in 1892 amounted to nearly £24,000.

The s.s. Islam.—The s.s. Islam, which was recently seized on a warrant issued by the British Government, has been fitted by Baird, Thompson, and Co. with a ventilating system which is capable of changing the whole atmosphere of the ship once every minute, if necessary. It can be used with closed hatches and when everything is battened down.

---

* "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*23rd August*, 1894.

16,090. Calculating Steam Diagrams, G. G. Pryce-Brown.—(*P. Pryce-Brown, Straits Settlements.*)
16,091. Photographic Cameras, H. Smyth, London.
16,092. Boots and Shoes, E Allen, London.
16,093. Hair-pins or Coiffure-pins, J. Wedderburn, London.
16,094. Chatelaines, I. A. Margesson, London.
16,095. Belt Fastener, D. Honeywood and E. L. Austin, London.
16,096. Pneumatic Tire for Wheels, E. M. Doman, London.
16,097. Electric Fuse Heads, T. Malson, London.
16,098. Piston Packings, J. W. Peelle and A. C. Latimer, London.
16,099. Snow-cleaning Attachment, M. F. Mauden, London.
16,100. Electrolysis of Chlorides, H. Auer and F. Hurter, London.
16,101. Apparatus for Feeding Sieves, L. Turner, London.
16,102. Coin-freed Machine for the Sale of Cigars, S. T. C. Brukewich and S. W. Allen, London.
16,103. Cutting Paper, A. Thrower, J. Joyce, and Mansell, Hunt, Catty, and Co., Ld., London.
16,104. Umbrella Rims, F. G. Lloyd.—(*E. H. Falkner, New Zealand.*)
16,105. Electrical Disposition of Zinc, R. Heathfield and W. S. Rawson, London.

*24th August*, 1894.

16,106. Galvanometers, A. Ford-Lloyd, London.
16,107. Saving Fuel in Household Fires, J. I. Cooper and G. H. Matthewman, Sheffield.
16,108. Medicine Bottles and Receptacles, J. Stephens, Bristol.
16,109. Window Sash, E. W. Sheldrick, Barnes.
16,110. Preventing Colliery Cages Falling, J. Stirland and W. Cottrill, Derby.
16,111. Cocks, J. Dewrance, London.
16,112. Electric Contact for Doors, F. C. Geary, Burton-on-Trent.
16,113. Railway Wheels, J. Baker, Rotherham.
16,114. Bearings, J. W. Sheard and J. Done, Blackpool.
16,115. Cycle Lamps, H. Browne, Birmingham.
16,116. Bird Trap, J. Jackson and W. Alexander, London.
16,117. Flexible Metallic Heald Strap, W. E. Goldthorpe, Huddersfield.
16,118. Steaming Carpets, G. W. Grosvenor and S. S. Partridge, Kidderminster.
16,119. Self-righting Cricket Stumps, J. Akers, Sheffield.
16,120. Box, A. A Govan, Glasgow.
16,121. Folding Stools or Chairs, L. M. Lewis, Birmingham.
16,122. Stoppers for Flasks, &c., J. C. Eddison, Bradford.
16,123. Tread Blocks for Stairs, J. Lauder, Glasgow.
16,124. Braces, D. R. Steers, Glasgow.
16,125. Chimney Flue for Cottages, J. Earnshaw, Halifax.
16,126. Scouring Machines, J. H. and I. Mitchell, Huddersfield.
16,127. Structures for Storing Grain, R. A. Wilkinson, London.
16,128. Producing Patterns on Cotton Fabrics, J. A. O'Loughlin, Glasgow.
16,129. Screw Bolts and Nuts, I. Jackson, Manchester.
16,130. Belt Fasteners, I. Jackson, Manchester.
16,131. Electric Signs, W. D. Hawksley and I. M. Lamb, Manchester.
16,132. Manufacture of Can-openers, B. Marsland, Birmingham.
16,133. Razors, I. Waine, Birmingham.
16,134. Match-boxes, &c., M. and A. Jacob, Birmingham.
16,135. Padlocks, J. Frakes, Birmingham.
16,136. Cartridges for Working Coal, M. Settle, Manchester.
16,137. Manufacture of Waterproof Fabrics, C. H. Arnold, Manchester.
16,138. Transparent Cask, J. W. Mellor, Oldham.
16,139. Water Cycle, R. and A. J. Brown, Newport.
16,140. Football, J. McGregor, Lancashire.
16,141. Construction of Vehicles, P. Alderson, London.
16,142. Horse-clipping Machine, J. Y. Johnson.—(*D. Little, New Zealand.*)
16,143. Boots and Shoes, W. Gibbin, London.
16,144. Boot Lace, J. L. Hart, Eastbourne.
16,145. Apparatus for Electrolytic Process, C. Hessel, London.
16,146. Picture Suspenders, H. Munslow, London.
16,147. Indicators for Lamps, G. H. Randall, London.
16,148. Seat Pillars for Cycles, G. Chamberlain and L. Castiglione, London.
16,149. Obtaining Cyanogen from Gases, H. Drehschmidt, London.
16,150. Construction of Coats, A. R. Dagg, London.
16,151. Walking Sticks, E. R. Jeschke, London.
16,152. Fireproof Floors, E. T. Hughes.—(*J. Seipel, United States.*)
16,153. Driving-gear for Cycles, G. White, London.
16,154. Cycle Lamp and Bracket, R. W. Smith, Birmingham.
16,155. Steering Heads of Bicycles, R. W. Smith, Birmingham.
16,156. Electric Winding Engines, &c., B. Lebrun, London.
16,157. Toy Canals or Waterways, F. D. C. Strettell, London.
16,158. Machine for Digging Potatoes, A. J. Keeble, London.
16,159. Golf Clubs, The Hon. R. T. D. Brougham, London
16,160. Range-finders, J. R. Oastler, London.
16,161. Antiseptic Compounds, Sir W. G. M. Call, London
16,162. Accumulators or Secondary Batteries, M. Engel, London.
16,163. Controlling the Working of Cranes, J. A. Essberger and A. W. Geyer, London.
16,164. Firing Apparatus for Ordnance, A. J. H. Wyatt and W. H. Stentiford, London.
16,165. Book Cover, W. Rutty, London.
16,166. Vehicles, A. Schroeder, London.
16,167. Locks, J. V. Martin, London.
16,168. Recreation Apparatus, E. J. Clubbe and A. W. Southey, London.
16,169. Boilers, J. J. Brown, London.
16,170. Marking Patterns on Cloth, E. Quennoy, London.
16,171. Manufacture of Knitted Fabrics, H. Wildt, London.
16,172. Card Clothing, L. Jansen, London
16,173. Obtaining Zinc from Ore, F. L. Lesage and A. F. Breuillaud, Liverpool.
16,174. Finishing Boots, F. W. Warburton and A. Pochin, London.
16,175. Carding Machines, O. Bartholemy, London.
16,176. Rebating and Chamfering Machines, A. Slater, London.
16,177. Apparatus for Teaching Arithmetic, W. E. Smith, London.
16,178. Cinder Sifter, J. T. Evans, London.
16,179. Sash Fasteners, B. W. Dallyn, London.
16,180. Hair-pins, D. R. Moody, London.
16,181. Sash Fasteners, S. Gurd, London.
16,182. Fastening Appliances for Doors, D. R Moody, London.
16,183. Sash Fasteners, T. Holmes, London.
16,184. Sash Fasteners, H. O. Tucker, London.
16,185. Sash Fasteners, W. R. Yates, London.
16,186. Curtain Rods and Blind Rollers, D. R. Moody, London.
16,187. Construction of Bedsteads, F. W. Gould, London.
16,188. Studs, D. R. Moody, London.
16,189. Music Desks, S. F. Read, London.
16,190. Making Wire Chains, F. W. Smith, jun., London.
16,191. Electric Bells, S. Quincey, P. Benns, and H. Belham, London.
16,192 Electric Bells and other Devices, S Quincey, London.

*25th August*, 1894.

16,193. The Printers' Metal Quoin, A. J. Carter, London.
16,194. Venetian Blinds, H. Luke, Manchester.
16,195. Camera, T. Cook, Manchester.
16,196. Polishing, &c., Machinery, F. C. Askham, Sheffield.
16,197. Utilising the Tide in Rivers, &c., W. Bill, Longport.
16,198. Vertical Steam Boilers, I. Morris Walsall.
16,199. Supplying Air to Furnaces, J. J., T. F., and J. W. Meldrum, Liverpool.
16,200. Ladies' Dress Fastening, F. Wolstenholme, Sheffield.
16,201. Deep-sea Lightships, W. M. Walters, Liverpool.
16,202. Firelighters, Liver Resin Firelight Company, Liverpool.
16,203. Brooms and Brushes, A. and V. McGrath, Huddersfield.
16,204. Feed-water Filtering Apparatus, H. Hocking, Liverpool
16,205. Magazine Rifles, R. J. Urquhart.—(*A. H. Russell and W. R. Livermore, United States.*)
16,206. Carriage Lock Striking Plates, J. Latham, London.
16,207. Metal Circular Disc Cutter, A. E. R. Bottone, Wallington.
16,208. Camera Backs, A. Riddell and J. Sinclair, Glasgow.
16,209. Sand-moulding Machines, A. Murray and W. Fairweather, Glasgow.
16,210. Window Stand for Drapery, J. Bromilow, London.
16,211. Boiler Tube Closing Device, H. Matheson, London.
16,212. Blacking and Blacklead Brushes, G. Pickup, Accrington.
16,213. Boot Fastening, J. Stirling and A. Dagnall, Glasgow.
16,214. Cycle and Vehicle Tires, R. A and L. P. Vogt, Glasgow.
16,215. Cartridges, D. Nickie and G. F. Beutler, London.
16,216. Pocket Knives, D. W. Ireland, Glasgow.
16,217. Floor Coverings, D. W. Ireland, Glasgow.
16,218. Driving, &c., Gear of Cycles, G. Denlalt, London.
16,219. Fixing Corrugated Iron Sheets, J. Cruddas, London.
16,220. Armour-plating Vessels, J. Beatty and R. F. Eadon, Sheffield.
16,221. Reversible Screw Propellers, R. Powell, London.
16,222. Embossing Paper and Calico, J. Hofmeier, London.
16,223. Wagon Coupling Apparatus, T. D. Swift, Liverpool.
16,224. Cigarette-making Machines, R. Bowes, Liverpool.
16,225. Syphon Heads, J. Y. Johnson.—(*La Société Durafort et fils, France.*)
16,226. Boots, H. S. Cole, London.
16,227. Production of Hydrochloric Acid, P. R. J. Krause, Birmingham.
16,228. Sheaves, Wheels, and Pulleys, G. H. Wise, London.
16,229. Opening Fanlights, G. Darrah and J. Renshaw, Manchester.
16,230. Igniting Device for Engines, A. S. Hauser, London.
16,231. Producing Designs on Paper, G. R. Hildyard, London.
16,232. Preventing Ingress of Insects, H. Meynell, London.
16,233. Rugs, Mats, and the like, G. F. Wilsor, London.
16,234. Boxes for Containing Dubbin, F. S. Lees, London.
16,235. Evaporating Saccharine, A. Crerar.—(*W. R. Boon and E. A. Hancock, West Indies.*)
16,236. Feeding Thrashing Machines, R. R. Holben, London.
16,237. Preventing Tire Punctures, P. A. Nix, London.
16,238. Projecting Mechanism for Pencils, W. Hood, London
16,239. Stand for Wigs, S. Lichtenfeld and W. Kluge, London.
16,240. Syringe for Medical Purposes, C. A. Cope, London.
16,241. Combined Slop-pail and Commode, T. J. Shaw, London.
16,242. Stoppering or Closing Bottles, P. Philip, London.
16,243. Electric Propulsion of Cars, A. H. Brindell, London.
16,244. Velocipede Wheels and Tires, H. Zanella, London.
16,245. Chimney Top Mounting, G. Vogt, London.
16,246. Cooling Apparatus for Breweries, H. Clark, London.
16,247. Assisting Passengers to Enter Railway Carriages, C. W. Martindale and S. Handscombe, London.
16,248. Dinner and other Plates, M. A. Thomas, London.
16,249. Displays for Shop Windows, H. T. Wagner, London.
16,250. Brickmaking Machinery, &c., J. Bond, London.
16,251. Hinges, J. Bond London.
16,252. Indigo Dyeing Apparatus, J. W. Sanderson, London.
16,253. Cycle Saddles, J. A. and H. A. Lamplugh, London.
16,254. Aerated Lemonade and Beverages, A. Mitchell, London.
16,255. Flexible Pipes and Tubes, &c., S. Frank, London.
16,256. Taps, H. B. Merton, London.
16,257. Billiard Chalks, A. Nikolay, London.
16,258. Formates, H. H. Lake.—(*J. H. C. Behnke and The Chemische Fabrik in Billwärder vorm. Hell and Sthamer, A. G., Germany.*)
16,259. Bottles, H. Wenning, London.
16,260. Machine Guns, H. S. Maxim and L. Silverman, London.
16,261. Sash Fastener, W. Hemmings, London.
16,262. Fasteners for Window Sashes, G. B. Austin, London.
16,263. Hat Pins, D. R. Moody, London.
16,264. Fasteners for Cupboard Doors, D. R. Moody, London.
16,265. Puzzle Purse, W. G. Winslet, London.
16,266. Window Sash Fasteners, W. Carter, London.
16,267. New Game, J. J. Jackson and A. Horbury, London.
16,268. Window Sash Fastener, E. Blunden, London.
16,269. Parcel Labels, W. T. Burall and H. C. Burall, London.
16,270. Clinical Thermometers, H. H. Lake.—(*F. Pinchetti, Italy.*)
16,271. Slates for Schools, C Huelser.—(*F. Schaefer, Germany.*)

27th *August*, 1894.

16,272. Breech-loading, &c., Fire-arms, C. Ricci, London.
16,273. Joining Pneumatic Tire Air Tubes, P. Mercier, London.
16,274. Preventing Tents Blowing Inside Out, T. G. Harvey, London.
16,275. Cycle Rims, J. Hargreaves, Manchester.
16,276. Propelling Railways by Wind, F. P. E. Potter, Skibbereen, Co. Cork.
16,277. Pumps for Compressing Air, B. J. Hall, Workington.
16,278. Electrical Measuring Instruments, J. Swinburne, Teddington.
16,279. Cycle Frames, J. T. Clarke and F. Williamson, Swanley.
16,280. Utilising Rise and Fall of Tides, R. M. Craig, London.
16,281. Prepayment Fluid Meters, &c, D. Orme, Manchester.
16,282. Spherometer, W. G. Heys.—(*J. Heilmann and R. Simon, France.*)
16 283. Guiding and Steering Cycles, J. Shakespeare, Dudley.
16,284. Spring Attachment for Keys, B. Shorthouse, Birmingham.
16,285. Double and Single Bust, T. H. Withers, Manchester.
16 286. Poison Bottle Indicator, W. Cuthbertson, Edinburgh.
16,287. Umbrellas, Parasols, &c., E. Slade, Liverpool.
16,288. Joint for Folding Shafts, W. E. Goodwin, Longport.
16,289. Game of Skill and Apparatus, J. F. Parsons, Bristol.
16,290. Face-plate for Tiring Wheels, H. and C Atkinson, Castleford.
16,291. China Pianoforte Keys, E. P. Hutchinson, London.
16,292. Lubricating Hydraulic Rams, W. Entwistle, Manchester.
16,293. Cycles, R. M. McDonald and A. McDonald, Glasgow.
16,294. Frost Hobnail for Roughing Boots, J. Hill, Stourbridge.
16,295. Gas Burners, G. Bray, Bradford.
16,296. Solking and Heeling Boots, T. McCulloch, Bradford.
16,297. Reflecting Gaslights, G. Bray, Bradford.
16,298. Reaping Machine Conveyor, W. Anderson, Glasgow.
16,299. Preventing Air Escaping from Tires, T. Coppock, jun., Manchester.
16,300. Anti-nicotine Plug for Pipes, J. J. Duffy, Dublin.
16,301. Metallic Socket for Picks, G. S. Waterfall, Sheffield.
16,302. Wall and other Decoration, W. A. Ebel, London.
16,303. Pouring Liquids into Vessels, H. Child, London.
16,304. Plummet and Ground-bait Box, W. Wilcox, Wolverhampton.
16,305. Veneer Barrels, C. Wittkowsky, London.
16,306. Bodice Steels, W. Higgs, London.
16,307. Food Safe, E. Paul, London.
16,308. Combination Revolver and Dagger, E. Paul, London.
16,309. Cycle Mudguards, H. Davis and P. Byrne, London.
16,310. Apparatus for Lighting Matches, H. Thurlow, London.
16,311. Oil Stove Flues, J. Harper and Co. and C. Retallack, London.
16,312. Mortising and Routing Machines, A. Slater, London.
16,313. Protecting Cyclists from Dogs, S. Franken, jun., London.
16,314. Railway Carriage Coupling, L. F. D. Saget, London.
16,315. Commode, F. J. Mockler, London.
16,316. Spiked Heel Plates for Boots, H. A. Dightam, London.
16,317. Blackboards for Schools, &c., P. Kohler, London.
16,318. Blind Rack, H. Micklefield, London.
16,319. Construction of Elastic Tires, A. Grupe, London.
16,320. Process for Manufacturing Chlorine, E. Bückse, London.
16,321. Corsets, E. W. Butler, London.
16,322. Portfolios for Binding Periodicals, S. Honeyman, London.
16,323. Game and Apparatus Therefor, W. H. Keene, London.
16,324. Yarn Winding Machines, H. L. Pratt and C. T. Upton, London.
16,325. Cushions of Billiard Tables, W. E. Bartlett, London.
16,326. Construction of Panoramic Scenes, J. Train, London.
16,327. Sanitary Pails, V. E. Poppens, London.
16,328. Combination Apparatus, G. H. Conroy, London.
16,329. Enabling Doors of Hansom Cabs to be Opened and Closed by the Driver, J. G. Price, London.
16,330. Scissors, B. Amsberg, London.
16,331. Electric Organs, P. R. Harrison, London.
16,332. Roofing and Wall Tiles, W. W. Morris, London.
16,333. Velocipedes, A. F. Spencer and A. H. Spencer, London.
16,334. Cleaning Device for Fire-arms, W. Wesenkoff, London.
16,335. Pneumatic Tires, R. Pritt, London.
16,336. Pneumatic Tires, J. H. Price, London.
16,337. Adjustable Slide Rest Attachment for Lathes, H. B. Newbold, Manchester.
16,338. Parcel Carriers, H. A. Dale, London.
16,339. Means for Teaching Music, A. J. Pratt, London.
16,340. Means for Teaching Music, A. J. Pratt, London.
16,341. Beer Engines, W. F. P. Clayton, London.
16,342. Production of Metallic Carbides, G. B. Ellis.—(*T. L. Willson, United States.*)
16,343. Edging for Lace, S. Borton, London.
16,344. Fastenings for Window Sashes, A. E. Dawes, London.
16,345. Window Sash Fasteners, F. W. Cashmore, London.
16,346. Lamp Chimneys, A. L. and G. Ollendorff, London.

28th *August*, 1894.

16,347. Chairs, A. J. Boult.—(*J. Bergmann, Germany.*)
16,348. Machines for Milling, H., S. and B. Preston, London.
16,349 Troughs of Doubling Frames, T. Guest and T. Brookes, Manchester.
16,350. Stiffening for Coat Fronts, T. H. Brown, Manchester.
16,351. Pants, T. H. Brown, Manchester.
16,352. Air-pumps, E. Lyons, London.
16,353. Bonnet Fasteners, A. Smith, Reading.
16 354. Sewing-machine Attachments, J. Knox, Manchester.
16,355. Lighters, R. Neuss, Manchester.
16,356. Tipping Machinery for Trams, B. Nicholas, Pontypool.
16 357. Bed Guard, E. E. Meade and F. W. Gallagher, Ramsgate.
16,358. Hand-lever Lifting-jacks, G. R. Postlethwaite, Birmingham.
16,359. Tie-holder, A. Taylor, London.
16,360. Angle Plate Chuck, H. Venables, Burton-on-Trent.
16,361. Gun and Rifle Slings, C. E. Greener, Birmingham.
16,362. Knife Apparatus, J. E Hayward and J. B. Lowe, Birmingham.
16,363. Producing Patterns on Wood, A. E. Frisby, Nottingham.
16,364 Dress Holders, R. Rees, London.
16,365. Props for Mines, W. W. Barnes, Cumberland.
16,366. Heat Electric Alarm, R. Brown. Preston.
16,367. Window Clip, A. Mokaiesh, Manchester.
16,368. Table Lamps, C. Meason, Birmingham.
16,369. Hanging Lamps, C. Meason, Birmingham.
16,370. Apparatus for Stamping "Set Pots," J. Shepherd, Bradford.
16,371. Corliss Valves, G. N. and A. Brearley, Bradford.
16,372. Stoppers for Bottles, F. A. Walton, Birmingham.
16,373. Lamp Stoves, G. Salter, Birmingham.
16,374. Securing Labels, W. Holland, jun., Birmingham.
16,375. Quick-firing Guns, A. and H. Normanton, Manchester.
16,376. Manufacture of Inlaid Linoleum, D. E. Thomson, Glasgow.
16,377. Coating of Metals, W. T. Leyshon, Birmingham.
16,378 Ventilating Fans, H. T. Johnson, Manchester.
16,379. Apparatus for Cutting Fabrics, J. J. Mann, Manchester.
16,380. Droppers for Wire Fencing, J. T. Rae, Glasgow.
16,381. Quick-drying Paint, J. McLintock, Barnsley.
16,382. Dry-sand Moulding, W. C. Wood, London.
16,383. Operating Vehicle Hoods, H. Golbransen, London.
16 384. Apparatus for Extracting Corks, F. Jorgensen, London.
16,385. Thread-cutters for Sewing Machines, J. Y Johnson.—(*The Willcox and Gibbs Sewing Machine Company, United States.*)
16,386. Automatic Locking Gear, F. H. Nalder and A. Soames, London.
16,387. Smoothing Irons, T. Smith, London.
16,388. Machine for Carving a Fowl, G. C. Nobile, London.
16,389. Grapnels for Lifting Cables, J. Skinner, London.
16,390. Umbrellas, &c., J. P. O'Donnell.—(*F. Giles, Australia.*)
16,391. Electrical Switches, W. P. Theermann and G. C. Elliott, Manchester.
16,392 Movable Roofs or Coverings, A. J. Simpson, London.
16,393. Valves for Steam Engines, J. Pollit and E. Wigzell, London.
16,394. Game of Skill, W. and J. King, London.
16,395. Manufacture of Gas, W. F. Browne, London.
16,396. Observation Tower, M. F. Smith and H. Pettit, London.
16,397. Apparatus for Windows for Exclusion of Flies, &c., A. L. Isaacs, London.
16,398. Rock and Ore Breakers, R. D Gates, London.
16,399. Lacing Studs, F. B. Manville and A. Mathison, London.
16,400. Applying Electricity to the Human Body, W. J. Newton, H. J. Purbrook, and H. de C. Hudson, London.
16,401. Rope Driving Mechanism, J. H. W. Hoadley, London.
16,402. Shop Saws, W. W. Holmes and C. F. Quincy, London.
16,403. Utensil for Culinary Purposes, C. E. Davey, London.
16,404. Sealing Wax, S. Estcourt, London.
16,405. Protecting Shops from Burglars, W. Whiffin, London.
16,406. Appliances for Cutting Hair, J. G. Dodd, London.
16,407. Railway Brakes, T. F. Portnell, London.
16,408. Printing Telegraphs, &c., R. A. Fowden, London.
16,409. Larding Knife, T. Rudolph, London.
16,410. Photographic Cameras, J. Tascher, London.
16,411. Oil Lamps, C. Quitmann.—(*V. R. Glashütten, Germany.*)
16,412. Hoeing Machines Steering Gear, P. Tidick, London.
16,413. Trouser Braces or Suspenders, W. Varney, London.
16,414. Disinfecting or Deodorising, M. S. Sharp, London.
16,415. Clip or Holder for Neckties, C. W. Higgs, London.
16,416. Fish Oils, S. Rosenblum and F. L. Bartelt, London.
16,417. Fish Oil, S. Rosenblum and F. L. Bartelt, London.
16,418. Telephonic Apparatus, J. Cerpaux and G. de l'Escaille, London.
16,419. Kettles, R. A. Briggs, London.
16,420. Smoke Enema Apparatus, H. H. Burckhardt, London.
16,421. Umbrella Boxes or Receptacles, Holyman and Co., London.
16,422. Manufacture of Disinfectants, R. England, London.
16,423. Electric Lamps, R. J. Rae, London.
16,424. Elastic Tires, P. Amjörn, Comte de Sparre, London.
16,425. Storage Batteries. D. Young.—(*The Hess Storage Battery Company, United States.*)
16,426. Governing Apparatus for Engines, G. H. J. van Amstel, London.
16,427. Couplings for Boring Rods, R. W. Taynton, Richmond.
16,428. Decorative Show Cards, &c, A. Tuck, London.
16,429. Cutting and Moulding Machines, C. G. Fisher, London.
16,430. Pulleys, D. Levack, A. Walker, and V. Jones, London.
16,431. Head Locks for Cycles, M. D. Rucker, London.
16,432. Shovel and Spade Handles, G. Walters, London.
16,433. Plate Holder or Carrier, E. Drechsler, London.
16,434. Regulators for Engines, H. A. House, H. A. House, jun., and R. R. Symon, London.
16,435. Cycle Saddles, J. Harrington and T. Middlemore, London.
16,436. Toys, J. Empson and J. Hewitt, London.
16,437. Bonnet Pins, J. Empson and J. Hewitt, London.
16,438. Soda-water Bottle Openers, W. F. Lovell and W. H. Janes, India.

29th *August*, 1894.

16,439. Springs for Vehicles, E. J. O'Malley and C. P. J. Fitzsimon, Drumcondra.
16,440. Chain Brake for Cycles, M. Mitchell, Stafford.
16,441. Fastening Handles to Tea-pots, T. Weir, Dublin.
16,442. Orthoptics, H. Faulkner, Leeds.
16,443. Clips or Bosses for Cycles, &c., R. Mason, Birmingham.
16,444. Bearings of Shafts or Axles, B. U. Moore, Bradford.
16,445. New Hair Fastening, E. Moore, Birmingham.
16,446. Tires for Vehicles, W. Rowland and L. B. McCulloch, Crewe.
16,447. Fire-places and Flues, E. Taylor, Blackburn.
16,448. Manufacture of Insecticide Material, J. Taylor, Liverpool.
16,449. Target Mantelets, J. Taylor, Manchester.
16,450. Wax Heater, H. S. Goodman and H. J. Newman, Northampton.
16,451. Crank-pedals for Cycles, G. Pirnie, Dundee.
16.452. Shirt Collar Studs, H. F. Talbot.—(*S. Fader, British Columbia.*)
16.453. Jacquard Carpet Apparatus, S. Holdsworth, Kidderminster.
16,454. Wedge-shaped Valve, R. M. O. Tillmann, Berlin.
16,455. Apron File and Calendar, W. D. Clemitson, London.
16,456. Horse Collars, C. McCallum, Glasgow.
16,457. Ranges, Firegrates, and the like, W. Couper, Glasgow.
16,458. Opening Sash Windows, R. Frame, Glasgow.
16,459. Safety Appliances for Elevators, B. Jones, Manchester.
16,460. Stretching Carpets, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
16,461. Lock and Seal for Boxes, &c., H. Smith, Leeds.
16,462. Construction of Water-closets, W. Hodgson. London.
16,463. Obtaining Motive Power from Tides, E. Davies, London.
16,464. Lids or Covers for Bottles, &c. J. Banbury, Oxon.
16,465. An Armoured Rim Sole, H. W. Barfoot, Mayfield.
16,466. Safety Apparatus for Hoists, W. Walker, London.
16,467. Riveting Machines, J. Leveque, London.
16,468. Camp Stools, W. F. Timm, London.
16,469. Gearing and Brakes for Bicycles, S. Ward, London.
16,470. Breech-loading Rifles, A. G. Dougherty and T. B. Buskirk, London.
16,471. Folding Bed and Crib, D. Froehlich, London.
16,472. Feeding Water to Steam Boilers, J. and A. Niclausse, London.
16,473. Method of Arranging Telephones, G. Ritter, London.
16,474. Polishing Sheet Metal, &c., F. W. Koffler London.
16,475. Golf Clubs, J. G. E. H. D. S. Campbell, London.
16,476. Making Wire Fabric, T. E., W. H., and A. E. Wale and F. C. Adie.—(*White Manufacturing Company, United States.*)
16,477. Combination Corkscrew, J. Elser and E. Blass, London.
16,478. Plaiting Wire Springs, B. Cockin and G. E. Stringer, London.
16,479. Postal Wrappers, J. Fletcher, London.
16,480. Sash Fasteners, J. Halse and O. Reece, London.
16,481. Boots, F. Kennell, London.
16,482. Tea-cosy, E. W. Crebbin and J. W. S. Holt, Liverpool.
16,483. Purifiers for Seed or Grain, W. H. Price, Liverpool.
16,484. Moulding or Printing Starch, D. M. Holmes, London.
16,485. Moulding Cream Fondants, D. M. Holmes, London.
16,486. Chucks, C. F. Lorch, London.

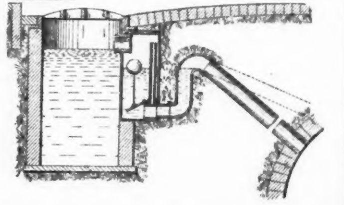
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**520,146.** Drainage System, *P. Scanlon, Chicago, Ill.—Filed March 27th*, 1893

*Claim.*—The combination with a tank, of a syphonic discharge pipe communicating therewith and having its bend or highest point at a level below the level of the top of the tank, so that the water may rise up in the tank and discharge pipe to such a height that it flows from the short to the long leg of said pipe, whereby, when the flow is sufficient, syphoning is automatically started, and a valve for closing the inlet end of said pipe when the water reaches a given level, the pipe being provided with a vent for permitting the water within in it to regain its equilibrium after the inlet end of the pipe is closed, substantially as set forth.

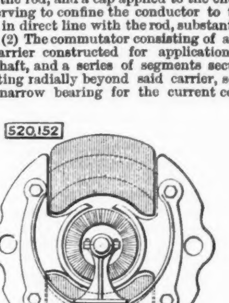
520,146



**520,152.** Dynamo-electric Machine or Electric Motor, *R. K. Welch, Philadelphia, Pa.—Filed June 24th*, 1894.

*Claim.*—(1) The combination of the commutator with the current collector, consisting of an anti-friction roller, a forked rod carrying the same, a spring for projecting the rod, and a cap applied to the end of the rod, and serving to confine the conductor to the end of the rod, in direct line with the rod, substantially as specified. (2) The commutator consisting of a central disc-like carrier constructed for application to the armature shaft, and a series of segments secured to and projecting radially beyond said carrier, so as to provide a narrow bearing for the current collector, substantially as specified. (3) The commutator consisting of a central disc-like carrier constructed for application to the armature shaft, and a series of segments secured to and projecting radially beyond said carrier, and each having a stud and binding screw for the reception of wires of the armature wind, substantially as specified. (4) The commutator consisting of a central disc, constructed for application to the armature shaft, and having a projecting flange, and segments each having a stem passing through an opening in said flange, and having a confining nut and means for insulating the said stem from the flange, substantially as specified.

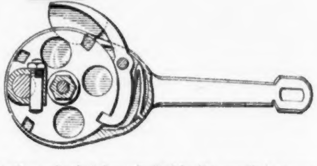
520,152



**520,157.** Variable Crank, *C. H. Davids, Brooklyn.—Filed November 1st*, 1893.

*Claim.*—(1) The combination with a velocipede crank, of a circular bearing, on the axial line of which the crank is pivoted, the said bearing being provided with a plurality of notches along its periphery a spring-actuated locking dog pivoted to the crank with its operating arm accessible to the foot of the rider, the locking dog having an engagement with the notches on the said bearing to lock the crank positively to the bearing, and means for securing the bearing excentrically to the drive shaft of a velocipede, substantially as set forth. (2) The combination with a crank provided with a recess, of a circular bearing adapted to seat within said recess, means for pivoting the crank to the bearing on the axial line of the latter, a spring-actuated dog pivoted to the crank in position to engage the bearing, the said dog having an operating arm extended to the exterior of the crank and means for securing the bearing to a shaft, substantially as set forth.

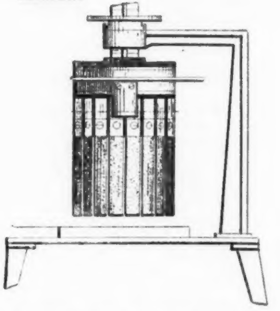
520,157



**520,300.** Method of Heating, Welding, or Working Metals Electrically, *C. L. Coffin, Detroit, Mich.—Filed October 7th*, 1893.

*Claim.*—The herein-described method of heating metal, consisting in subjecting the metal to the influence of a moving voltaic arc while simultaneously heated by radiation from incandescent electrodes in proximity to, but not in contact with the metal.

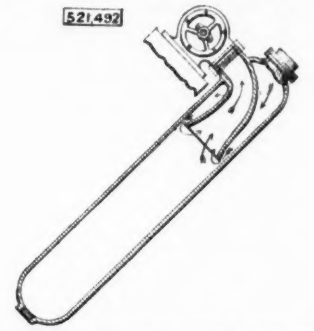
520,300



**521,492.** Steam Separator, *G. W. Aulmann and W. R. Harris, Des Moines, Iowa.—Filed February 23rd*, 1894.

*Claim.*—In a steam separator, a separator chamber having an open top adapted to be connected with a steam supply pipe and an opening in its bottom to discharge water, and a steam conductor extending outward from the top of said chamber and adapted to be connected with a valve chamber and extending downward in the separator chamber and terminating in an open bell-shaped mouth, as and for the purposes stated.

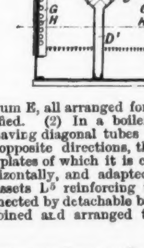
521,492



**521,532.** Steam Boiler, *D. Ahern, New York, N.Y.—Filed September 26th*, 1893.

*Claim.*—(1) In a boiler, the rectangular chamber D, and diagonal tubes $C^1C^2$ traversing it, arranged diamond-wise, as shown, in combination with the continuous water leg $D^1$ extending downward from its lower angle, the series of pipes G, headers H and connecting pipes I, serving as water legs at the sides, with the connections $D^3$ to the upper angle of the chamber and separating drum E, all arranged for joint operation as herein specified. (2) In a boiler, the rectangular chamber D, having diagonal tubes $C^1$ $C^2$ traversing it obliquely in opposite directions, the flanged lips or edges of the plates of which it is composed extended outward horizontally, and adapted to serve as supports, the gussets $L^5$ reinforcing the joint, and the panels W connected by detachable bolts to said flanged lips, all combined and arranged to serve as herein specified.

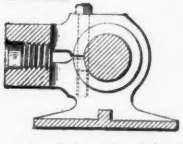
521,532



**521,695.** Device for Securing Piston-rods to Cross-heads, *E. J. Armstrong, Oswego, N. Y.—Filed Feb. 12th*, 1894.

*Claim.*—The combination, with a crosshead having an opening therethrough formed with screw threads, a bevelled mouth or seat at the end of said opening and a blank or unthreaded portion intermediate said bevelled mouth and the screw-threaded portion of the opening, of a piston rod having a screw-threaded end, and a nut having a bevelled face adapted to fit the bevelled mouth of the opening, substantially as described.

521,695



## THE DECENNIAL PROGRAMME FOR NAVAL CONSTRUCTION IN FRANCE.

As soon as the Naval Defence Act of Great Britain was passed in 1889, France, realising her inferiority as a maritime Power, and the difficult position that she must occupy in the future unless she raised herself to the level of the efforts which were being made in other countries, determined also to have a distinct programme issued for new naval construction. With this object in view, a campaign was actively opened in maritime centres, in Parliament, and amongst the people themselves. But it was not until the end of 1891 that the Admiralty Board of France set forth the programme that we give below in tabulated form, which was to last a period of ten years:—

| | | | | | |
|---|---|---|---|---|---|
| Sea-going battleships | | | | | 10 |
| Coast-defence ironclads | | | | | 1 |
| Cruisers | 1st class | Sheathed | 8 | 9 | 45 |
| | | Unsheathed | 1 | | |
| | 2nd class | Sheathed | 12 | 19 | |
| | | Unsheathed | 7 | | |
| | 3rd class | Sheathed | 12 | 17 | |
| | | Unsheathed | 5 | | |
| Torpedo depôt ships | | | | | 4 |
| Floating workshops | | | | | 2 |
| Torpedo gunboats | | | | | 5 |
| Torpedo boats, first-class | | | | | 8 |
| Gunboats | | | | | 7 |
| Total | | | | | 82 vessels |

Thus the decennial programme, passed by the Admiralty Board, provided that within ten years after the commencement of the year 1892 the naval arsenals and the trade should build the eighty-two vessels of which we have just given the detail; the work then was to be completed at the expiration of 1901.

The total cost for thirteen representative vessels out of each of the thirteen classes enumerated may be estimated at £4,768,000, giving an average of £366,769 for each ship. This average, multiplied by eighty-two, gives a total of thirty millions sterling in round numbers, or, in other words, the Admiralty Board decided upon a naval budget, as regarded new shipbuilding, amounting to thirty millions sterling extending over a period of ten years. From 1889 to the end of 1899, that is to say, for an equivalent period, England will have reached a figure representing nearly the double of this.

Once the decennial programme of 1891 was voted in Parliament, the Admiralty Board deemed it necessary to begin in good time the eighty-two ships, in order that they might be completed at the end of the year 1901. Now, for the first three years—1892, 1893, and 1894—the numbers laid down should have amounted to 29, viz., sea-going battleships, 6; first-class cruisers, sheathed, 2; unsheathed, 1; second-class cruisers, sheathed, 2; unsheathed, 4; third-class cruisers, sheathed, 4; unsheathed, 3; torpedo-depôt ships, 2; floating workshops, 1; torpedo gunboat, 1; gunboats, 3; total, 29.

Has this programme been carried out? This is the point to be determined. We will see first what provision was made for each of the years alluded to, then we will ascertain how these anticipations have been verified. Lastly we will make a total of all the new ships which have been laid down during these three years, a total that we will compare with the total as above, anticipated by the Admiralty Board. We shall not be long in seeing that the decennial programme has been more and more departed from; indeed, that it is on the point of being completely abandoned. The provision for 1895 will afford us proof of this fact.

What were the ships to be laid down in 1892? The Bouvet and Masséna, battleships; the Pothuau, first-class cruiser, unsheathed; the Descartes and Pascal, second-class cruisers, sheathed; the Linois, third-class cruiser, sheathed; the Foudre, torpedo depôt; the Cassini, torpedo-gunboat. Upon this estimate six vessels only out of eight were laid down, two were set aside, a cruiser of the first-class, sheathed, the Pothuau, and a second-class cruiser, sheathed, the Pascal. Already, so early as the first year, 1892, the programme anticipated failed in its execution; we shall see later on that this process will be accentuated more and more.

Before passing on to the Estimates for 1893, we think that it may be interesting to give the principal characteristics of these ships, which are not yet in the service.

The Bouvet, battleship, was laid down at Lorient. She will have three screws, worked by three independent sets of vertical engines. Total horse power, 14,000; speed, 17 knots with natural and 17·5 with forced draught. Dimensions: Length, 382ft. 3in.; beam, 70ft. 3in.; draught, 27ft. 7in.; displacement, 12,205 tons. For protection, an armoured belt 8in. to 16in. thick, and an armoured deck of 3½in. maximum thickness. Armament: Two guns, 11¾in. calibre, forward, and two, 10½in. calibre, aft, in closed turrets; eight quick-firing 4in. guns with shields upon the superstructure; twelve guns of 47 mm., and twenty of 37 mm.; five torpedo tubes. Cost about £1,080,000.

The Masséna, battleship, building at St. Nazaire, Les Ateliers et Chantiers de la Loire. Dimensions: Length, 368ft. 6in.; beam, 66ft. 6in.; draught, 26ft. 3in.; displacement, 11,730 tons. Speed, 17 knots with natural, and 17·5 with forced draught. Three independent sets of engines, developing a total of 12,600-horse power, and triple screws. Protection will be distributed as follows: At the water-line a steel belt from 10in. to 17¾in. thick; upon the turning portions of the great turrets, 13¾in., and upon the fixed parts 15¾in. of steel; upon the small turrets, 4in. to 5½in.; shields of steel for the minor artillery. The armoured deck, 3½in. The armament will consist of two guns, 11¾in. calibre, in revolving turrets, one forward, the other aft; two guns of 10½in. calibre in turrets on the broadsides; eight quick-firing guns of 5½in. calibre, also in turrets; eight quick-firing guns of 4in. calibre upon the superstructure, with hardened steel shields; thirty-two smaller quick-firers or machine guns of 47 mm. and 37 mm.; and five torpedo tubes. There will be twenty-four boilers upon the Lagrafel and d'Allest system. Cost, about £1,080,000.

The Descartes, second-class cruiser, sheathed, building also at St. Nazaire. Length, 315ft. 6in.; beam, 42ft. 4in.; depth, 30ft. 7in.; draught, 19ft. 9in.; displacement, 3888 tons; horse-power, 9000; speed, 18 and 19 knots. A protective deck, sloped at edges. Armament: Four 6¼in. quick-firing guns in sponson ports on the bows and quarters; ten 4in. quick-firing guns, four pointing ahead and astern, six raised upon the shelter deck and forecastle; fourteen of 47 mm.; eight of 37 mm.; and two torpedo tubes ahead. Cost, a little more than £320,000.

The Linois, third-class cruiser, building at La Seyne, Forges et Chantiers de la Méditerranée:—Length, 321ft. 6in.; beam, 34ft. 6in.; draught, 17ft. 5in.; depth, 22ft. 5in.; displacement, 2270 tons; horse-power, 6600; speed, 19 and 20 knots, with natural and forced draught respectively. A protective armoured deck of 1½in. in thickness. Armament: two quick-firing guns, 4in. calibre, forward and aft; four quick-firing guns, 4in. calibre, sponsoned out on the broadside; eight quick-firing guns of 47 mm.; four quick-firing guns of 37 mm.; four revolving guns of 37 mm., and four torpedo tubes, two ahead, two pointing laterally. An armoured hardened steel conning tower of 4in. thick for the captain. Cost about £200,000.

The Foudre, torpedo depôt ship, building at Bordeaux, Chantiers de la Gironde. Torpedo depôt ships are intended to accompany squadrons of armoured vessels, and to place at the disposal of admirals a certain number of torpedo boats, which will arrive in good condition, because they will not have made the passage by their own efforts. But this type is a subject of sharp controversy amongst French sailors; some deem that it is useless, each battleship being able to carry similar torpedo boats to those which are found upon the Foudre. Others believe that this class of ship is destined to render great service, being a valuable attribute to a squadron, as a sailing torpedo depôt and workshop. The Foudre has a length of 370ft. 6in.; beam, 51ft. 3in.; draught, 20ft. 2in.; displacement, 5970 tons; horse-power, 11,000; speed, ordinary draught, 18·5 knots; forced, 19 knots. An armoured protective deck, 2in. thick in the centre, 4in. thick on the sides. The armament comprises eight guns, quick-firing, of 4in. calibre; four of 65 mm.; four of 47 mm. and five torpedo tubes. This cruiser will carry upon the deck eight 14-ton torpedo boats, of a speed of 16·5 knots, that she can embark and disembark by means of derricks. Moreover, she will have special machinery that will enable her, during the course of a campaign, to repair torpedoes and their gear. The Foudre is a natural sequence of the Hecla and Vulcan, British torpedo vessels. The cost will be £400,000.

The Cassini, torpedo gunboat, building at Graville, near Havre, by the Forges et Chantiers de la Méditerranée. Length, 262ft. 6in.; beam, 27ft. 4in.; draught, 11ft. 6in.; depth, 17ft. 4in.; displacement, 943 tons; horse-power, 5000; maximum speed, 21 knots. The motive power will consist of two sets of vertical triple-expansion engines, making 266 revolutions per minute. The armament will comprise one quick-firing 4in. gun; three of 65 mm. and four of 37 mm., with three torpedo tubes. Cost nearly £120,000.

Let us pass now to the year 1893, and see what was to be laid down for that year. The d'Entrecasteaux and Jeanne d'Arc, first-class cruisers, sheathed; the Pascal, second-class cruiser, sheathed; the Duchayla, d'Assas, and Catinat, second-class cruisers, unsheathed; the Galilée, third-class cruiser, unsheathed; Casabianca, torpedo gunboat; Surprise gunboat. Out of this estimate of nine vessels, seven only were laid down; two were set aside, the Jeanne d'Arc and the Catinat. On the other hand, the Pothuau was, in addition to the estimate, reinstated from the estimate for 1892 and laid down, making eight in all. Let us look at the characteristics of these eight vessels laid down in 1893.

The d'Entrecasteaux, sheathed cruiser of the first class, intended for distant stations, building at La Seyne:—Length, 384ft.; beam, 58½ft.; draught, 23ft. 6in.; water-line area, loaded, 1534 square metres; displacement, 8144 tons; horse-power, 14,000; estimated speed, 19 knots, with moderate forced draught, and burning 130 kilos. of fuel for each square metre of grate surface. The steam will be supplied by five cylindrical boilers of return draught pattern, placed, four in front of the engines, and the fifth behind, between the screw shafts, a disposition which will admit of bringing the engines near the centre of the ship, and of giving them more room. The boilers will be tested to 10 kilogs. Protection will be afforded by an armoured deck with sloping edges, 4in. thick, plating included, at the sides, and by another horizontal deck ⅞in. thick above; the space between these two decks will form an immense cellular caisson, which will contain reserve fuel and stores. The hull will be entirely devoted to the engines, the boilers, and the magazines, which will be very numerous, each gun having its own separate ammunition trunk. All the auxiliary apparatus, steering engines, electric engines for lighting and for the distribution of power to the helm, and for the working of the guns, such as the ammunition hoists, turret gear, &c., will be under the shelter of the armoured deck. All will be actuated by electricity. The armament will include two 9½in. guns of 40 calibres, in closed balanced turrets fore and aft, protected by 10in. of steel, and trained by electricity. Twelve quick-firing 5½in. guns will be distributed as follows:—Four upon the spar deck, bearing ahead and astern, placed in the centre of the ship, and protected by 2¾in. shields of hardened steel and by the bulwarks; eight in a redoubt upon the upper battery, protected as the others, and all firing axially, thanks to their disposal *en échelon*. Each of the 5½in. guns will have its magazine and its rack for projectiles. Twelve quick-firing guns of 47 mm., and four of 37 mm., will be distributed upon the superstructure and in the tops; these will have regular platforms. Two torpedo tubes below and five above the water-line. There will be two military masts, with interior staircases. The d'Entrecasteaux will be very solidly constructed. The weight of the hull amounts to 2989 tons, that is to say, 36 per cent of the displacement; the armour will weigh 1670 tons, the armament 482 tons, the motive apparatus 1395 tons, and at normal draught the ship will carry 650 tons of coal—but with the reserve supply, this quantity will increase to about 1000 tons, which will give a good radius of action. The d'Entrecasteaux will be the largest of the French cruisers. Like all modern vessels, she will be complicated. However, it may be said that the autonomy of and the protection afforded to each of the guns will be complete, and that great care has been taken to localise possible damages caused by the fire of the enemy. Besides the armoured conning-tower, several protected positions have been arranged for the captain. The ship will cost about £680,000.

The Pothuau, first-class cruiser, building at Havre by the Forges et Chantier de la Méditerranée, is a Latouche-Tréville, enlarged and more powerfully armed. She will cost a little more than £440,000.

The Pascal, second-class cruiser, sheathed, building in the arsenal at Toulon. Similar to the Descartes, described above. Cost, about £320,000.

The d'Assas, second-class cruiser, building at St. Nazaire. Length, 325¼ft.; beam, 44ft. 11in.; draught, 19ft.; depth, 29ft. 9in.; displacement, 3952 tons. Protective deck on the flat, 1¼in.; on the sloping sides, 3⅛in. Two vertical triple-expansion engines, developing a normal horse-power of 6000; maximum horse-power, 9500. Steam supplied by twenty d'Allest boilers, tested to 20 kilogrammes to the centimetre; speed, 19 knots. Armament: Six 6¼in. quick-firing guns, four 4in., twelve of 47 mm., sixteen revolving guns of 37 mm., and six torpedo tubes. Cost, £300,000.

The Duchayla, second-class cruiser, building at Cherbourg. Similar to the d'Assas, just described.

The Galilée, third-class cruiser, building at the arsenal, Rochefort. Length, 321½ft.; beam, 35ft. 1in.; draught, 14ft. 7in.; depth, 23ft. 2in.; displacement, 2317 tons; horse-power, 6500; speed, 19 and 20 knots with natural and forced draught respectively. A protective armoured deck with sloping edges. Armament similar to that of the Linois, already described; a conning-tower for the captain, 4in. thick, of hardened steel. Cost, £200,000.

The Casabianca, torpedo gunboat, building at Bordeaux, Chantiers de la Gironde. Length, 262ft. 6in.; beam, 27ft. 4in.; draught, 10ft. 3in.; displacement, 943 tons. The strength of the hull is reinforced, and it is of hardened steel in the vicinity of the engines and boilers. Two vertical four-cylindered engines will give her a speed of 21½ knots, with the maximum power of 5000 horses. The boilers, upon the d'Allest system, will be tested to 15 kilos. to the centimetre. They will be arranged in four groups, each with two furnaces. Armament: One quick-firing gun of 4in. calibre, three of 65 mm., five of 47 mm., four of 37 mm. Cost, £100,000. She is a sister-ship to the Cassini.

The Surprise, gunboat, designed by M. Normand, who is building her at Havre. Length, 183ft. 9in.; beam, 24ft. 7in.; draught, mean, 10ft. 2in.; depth, 14ft.; displacement, 626 tons. The Surprise will be of steel, sheathed, and will have one propeller. A vertical engine and four cylinders will develope 650 and 850-horse power with natural and forced draught respectively; maximum speed, 13 knots. Boilers tested to 11·25 kilos. to the centimetre. Armament: Two quick-firing guns of 4in. calibre, four of 65 mm., four of 47 mm. This gunboat will have three masts—two masts barque-rigged, the foremast square-rigged. The total sail surface will be 344·93 square metres. Cost, £48,000.

Let us now pass along to 1894, and see what ships were estimated to be laid down this year:—The Henry IV., Charlemagne, and Saint Louis, battleships; $E^4$, $E^5$, $E^6$, second-class sheathed cruisers; $G^3$ and Cassard, second-class unsheathed cruisers; Lavoisier, third-class unsheathed cruiser.

Out of these nine estimated units, *four only* have been laid down—the Charlemagne, the Saint Louis, the Cassard, and the Lavoisier. All the other units have been relegated to 1898, or even to a more distant date; but it is only fair to say that two units not estimated for in 1894 have been laid down this year—the Jeanne d'Arc and Catinat, reinstated from 1893. It is thus shown that, in 1894, six ships will be laid down instead of nine.

The Charlemagne, battleship, building at Brest Arsenal. Length, 385ft.; beam, 66ft. 7in.; draught, 25ft. 10in.; displacement, 11,232 tons. The height of the freeboard guarantees her being a good sea boat. The subdivision of the hull has been specially studied, with a view of reducing as much as possible the danger caused by the inrush of water upon the main deck and into the compartments alongside. In order to minimise the effects of a blow from a ram, or of the explosion of a torpedo, the designer has multiplied the compartments of the hull, especially alongside. With a view of increasing the protection against projectiles striking the armour on the main deck, he has adopted two armoured decks—one, 2½in. thick, situated, as in all other ironclads, at the level of the upper edge of the armoured belt; the other, 1½in. thick, situated at the level of the lower edge. Below this second deck will be placed all the vitals of the ship, engines, boilers, apparatus for training the turrets, magazines, &c. The space between the two decks is, properly speaking, an enormous cofferdam. It is extensively subdivided, so as to stop the inrush of water. The armoured belt which surrounds the ship is 6ft. 6¾in. in width; its upper edge rises to 19½in. above the water-line. In the middle of the ship the thickness of this belt is 15¾in., over a depth of 2ft. 3½in., measuring from the upper edge. The belt decreases from this downwards to the lower edge, where it is only 10in. thick. Armour, 3in. thick, which goes completely round the ship, secures the foot of the upper works from the destructive effect of lighter ordnance. Behind the light armour runs along a cofferdam, one metre in height, which rests upon the main deck, and goes round the ship. The divisions, in sheet steel, of this feature complete the subdivision of the space situated above the main deck. The getting rid of the water which reaches the main deck, by possible damages of the outer skin, is effected by means of large pipes, which expel the water at once, without the necessity of discharging it at first into the hold, or into a drain. A battery, composed of eight quick-firing guns of 5½in. calibre, is placed under the shelter deck, which extends to the forecastle. It is protected by exterior steel armour, 3in. thick, including the plating, and by a traverse similarly armoured forward, which descends to the main deck. In order to provide that a projectile bursting in the battery shall not disable all the guns at once, each of them is enclosed in a drum of plate steel, which isolates it from its neighbours. The superstructure is less developed than upon the earlier ironclads. The conning tower, placed before the foremast, is armoured with 4in. steel. Beside this conning tower there are two other armoured cylinders from which the captain can transmit his orders to the engines and to the helm. These three protected posts are connected with another post situated upon the lower deck, at the foot of the armoured trunk which connects the principal conning tower with the interior of the ship, and from thence orders can radiate to the boiler-rooms, engine-rooms, turrets, &c. The military masts have double staircases inside; besides two tops at their highest part, they carry a shield at a certain height above the bridge. Anchors will be supplied upon the Manel system.

The motive power will embrace three triple-expansion engines, with four cylinders to each, of which two can be detached. Each of these engines will work a screw. One of the screw-shaft beds will be placed in the longitudinal axis of the ship, the two others will be alongside, and the screws will be distributed over a frontage of very considerable extent. Each engine will be placed in a water-tight compartment. They will communicate with one another, and with the boiler-room compartments, by means of water-tight doors situated upon the upper floors. Twenty boilers upon the Belleville system will supply steam. The engines are calculated to develope 14,000-horse power with forced draught. Estimated maximum speed, 18 knots; with natural draught the speed should be 17 knots. The supply of coal, sufficing to steam 4000 knots at a speed of 10 knots, will be about 600 tons; but the bunkers are calculated to receive a much more considerable quantity—about 1100 tons.

The armament will comprise four guns of 11¾in. calibre, of the 1891 model, mounted in pairs in two closed turrets placed at the ends of the ship; ten 5½in. quick-firing guns, eight in the battery before alluded to, two upon the shelter deck; six 4in. quick-firing guns upon the shelter deck; sixteen of 47 mm.; eighteen of 37 mm.; four submarine torpedo tubes, two ahead on the bows and two astern, bearing on the quarters; and six torpedo-tubes above the water-line. The forward turret has a command of 27ft. 10in., and the aft turret a command of 21ft. 4in. We have already indicated the means adopted for protecting the guns mounted in the secondary battery. Upon the shelter deck, the 5½in. guns will have a revolving shield, but those of 4in. calibre will be without any protection. The disposition of the ammunition magazines will be especially convenient. All the magazines will be found directly beneath the guns which they supply. Speaking generally, all applications of power will be effected by means of apparatus moved by steam, hydraulic force, or electricity. The ship will be completely lighted by electricity, and will have six projectors.

The Saint Louis, battleship, building at the Arsenal at Lorient, will have similar characteristics to those which we have noted in the Charlemagne. Each of them will cost about £1,080,000.

The Jean d'Arc, first-class cruiser, sheathed, estimated to be laid down in the year 1893, was provisionally laid aside. The anticipated expenditure on her for 1894 will be £6440.

The Catinat, second-class cruiser, will be sheathed with wood and coppered, which shows that she is intended for distant stations. Building at Graville, near Havre, by the Forges et Chantiers de la Méditerranée. Length, 328ft. 9in.; beam, 41ft. 4in.; draught, 19ft. 8in.; depth, 30ft. 6in.; displacement, 3998 tons. Protection, an armoured deck of 1⅛in. on the flat, of 1⅝in. upon the glacis. This deck will be laid upon plating ⅜in. thick. A cellular band will run along above the armoured deck, over which will be a splinter deck. Horse-power of engines 7000 with natural draught, 9000 with forced. Maximum speed 19 knots. The boilers will be upon the Belleville system. Armament, four 6¼in. quick-firing guns; ten 4in.; fourteen 47 mm.; four 37 mm., and six torpedo tubes of 13¾in. calibre. The 6¼in. guns will be in sponsons upon the deck; four 4in. guns will be under the forecastle, and two upon it; four distributed upon and under the poop. A portion of the 47 mm. guns will be in the lower tops, the 37 mm. guns in the upper tops. She will have six electric projectors, two military masts, and two tops on each. The conning tower for the captain will be of 4in. steel armour. The cost will be a little over £320,000. The Cassard, second-class cruiser, unsheathed, building at Cherbourg Arsenal, will be similar to the Duchayla and the d'Assas, which we have already described. The Lavoisier, third-class cruiser, not sheathed, building at Rochefort, similar to the Galilée.

We have seen at the outset of this brief survey that the number of ships laid down in 1892, 1893, and 1894, should amount to 29 units; in reality they only compute to 20, of which the following is the detail:—

| | | | 1892. | 1893. | 1894. | Total. |
|---|---|---|---|---|---|---|
| Battleships | | | 2 | — | 2 | 4 |
| Cruisers | 1st class | sheathed | — | 1 | 1 | 2 |
| | | unsheathed | — | 1 | — | 1 |
| | 2nd class | sheathed | 1 | 1 | 1 | 3 |
| | | unsheathed | — | 2 | 1 | 3 |
| | 3rd class, unsheathed | | 1 | 1 | 1 | 3 |
| Torpedo depôt ship | | | 1 | — | — | 1 |
| Torpedo gunboats | | | 1 | 1 | — | 2 |
| Gunboats | | | — | 1 | — | 1 |
| Total | | | 6 | 8 | 6 | 20 |

There will only have been laid down, therefore, during the three years, four battleships instead of six; three second-class cruisers unsheathed instead of four; one torpedo depôt ship instead of two, and one gunboat instead of three. The programme for first-class cruisers will, however, have been accomplished, and it will be exceeded by one second-class cruiser sheathed, and one torpedo gunboat. But nothing will have been done for the four sheathed third-class cruisers, or for the two floating workshops.

To sum up, we repeat that, instead of twenty-nine units, we shall only find at the expiration of the year 1894 twenty units upon the stocks—nine will be wanting at the roll-call. For 1895, the scheme presented to the Chamber of Deputies has only anticipated the laying down of two ships—a battleship, $A^7$, and a second-class cruiser, $E^4$. As for the Henry IV., the sheathed second-class cruisers $E^5$, $E^6$, and a second-class cruiser, unsheathed, $C^2$, they are relegated to a date more or less distant.

We were right, then, in saying, at the commencement of this paper, that the decennial programme for naval construction in France had not been verified. This is what we wished to prove.

## THE DECADENCE OF SHIPBUILDING ON THE MERSEY.

The present condition of Mersey shipbuilding affords distinct evidence that the industry, so far as some of the yards are concerned, is in a moribund state. Time-honoured firms, which have turned out their 16,000 or 17,000 tons in a year, are now doing absolutely nothing. Their yards are completely idle; nor is there at present any prospect of improvement. The brisker demand for new vessels which marked the closing months of 1893 failed to influence the Mersey outlook. It is regrettable that such should be the case, for Liverpool's shipbuilding associations are quite historical. During the latter half of last century, Liverpool builders were in great demand as constructors of war vessels. In 1758 the Venus frigate was launched. The slip on which she was built has long been absorbed by the Mersey Dock estate, a similar fate having overtaken many of the older shipbuilding yards. In 1777 his Majesty's ship Harpy, twenty guns, was launched, and she was followed in the next year by the Penelope, twenty-eight guns. In 1779 the Ulysses, forty-four guns, was launched; while during the next three years no fewer than twelve vessels, carrying in all 380 guns, were built to the order of the Government. It is difficult to convey any idea of the activity among Liverpool shipbuilders in those warlike days. The Mersey port in 1779 boasted a fleet of 120 privateers, many of them expressly built for belligerent purposes. Repairs and refits were frequently necessary, as well to them as merchant vessels; and there was besides the steady demand for Liverpool-built merchantmen.

Liverpool's early shipbuilders established, and their successors have maintained, a well-deserved reputation for good work. In the strength of their craft they must have had every confidence, for in 1763 one firm of builders launched a vessel, the snow Happy, which modern phraseology would dub a small barque, completely rigged and laden. The launching over, the vessel proceeded at once on a voyage to Africa. In 1773, the Kent, of 1100 tons, was launched, she being the largest vessel built in the North of England up to that date. Two years later a Greenlandman was first built on the banks of the Mersey. She was named the William, and a staunch craft she proved herself, for after close upon half a century of hard service she was used as a floating chapel, and was finally broken up in 1850.

There is no need to follow the progress of Liverpool's shipbuilding through the long roll of merchant vessels, Indiamen, and war vessels. The Mersey port had a very considerable share of the trade in those days, and among the more interesting vessels which the Mersey yards have constructed during more recent years may be mentioned the steamship United States (1840), afterwards the Oriental, the Hindostan (1842), a steamer of 2017 tons, built for the Peninsular and Oriental Company, the steam frigate, Birkenhead (1845). Coming to more modern history still, we have the Alabama, the ill-fated Captain, the Agincourt, and foremost among a fleet of steam and sail, the flyer Columbia. Nor must the last famous production of Messrs. Laird's yards, the Royal Oak, be omitted.

It seems hard that a river which has such an illustrious record should fail to be patronised by those who have orders to place.

So far as the river itself is concerned, there could not be a better for shipbuilding purposes. It is not the river but its position which is partly responsible for the decadence of this industry. The Thames at one time shared with the Mersey the foremost position among shipbuilding rivers. The decline of each seems to be proceeding on somewhat parallel lines. Both turn out a certain amount of Government work. Apart from this, the Thames produces little but barges, and it is quite possible, in view of Manchester Ship Canal potentialities, that the Lancashire estuary may develope a building business in a similar direction. During the last seven years the output of tonnage on the Mersey has been as under:—

| Year. | Mersey Tonnage. | Total British Tonnage. |
|---|---|---|
| 1887 | 10,664 | 585,430 |
| 1888 | 22,538 | 912,299 |
| 1889 | 35,773 | 1,317,033 |
| 1890 | 30,577 | 1,291,090 |
| 1891 | 23,736 | 1,293,560 |
| 1892 | 39,330 | 1,280,989 |
| 1893 | 9,071 | 917,166 |

The drop from close upon 40,000 tons to a little over 9000 is a very serious matter; but in the matter of work really done, the falling-off is not so great as it appears at first sight. In 1892 Messrs Laird launched the twin-screw gunboats Onyx and Renard, and floated from their constructing-dock the first-class battleship Royal Oak. The total tonnage of these vessels is over 15,000. During 1893 a great deal of work was done to these craft before they were finally completed and handed over to the Admiralty. In addition to this, Messrs. Laird contributed about half the tonnage turned out from Mersey yards, their principal item being the Vanderbilt yacht Valiant, of 1828 tons, and engines of 4500 indicated-horse power. Of the remaining tonnage, Messrs. Royden were responsible for a steel sailer of 2846 tons, and Messrs. Potter for four vessels with an aggregate tonnage of 548. Messrs. Jones launched the St. Brieuc, a steamer of 400 tons; and the remaining tonnage is composed of wood and steel barges built by Messrs. Cochrane and Messrs. Gilchrist.

The outlook for 1894 is bad, decidedly worse, in fact, than it was during 1893. The old-established yards of Messrs. Roydon and Messrs. Potter are doing nothing, although, together, they are capable of turning out 30,000 tons in a year. Messrs. Evans had in February a sailing vessel of 2500 tons almost ready for launching, but up to the present little in the shape of orders has turned up to take its place. No prospect of improvement is the verdict from the Liverpool yards; and where a few years ago business and activity reigned, one sees deserted yards and closed gates labelled with the significant notice, "To Let."

The causes of this condition of things are after all not far to seek. First and foremost is the fact that the Mersey is removed from the coal and iron centres, more especially the latter. When every ton of iron or steel has to bear an extra impost of ten or twelve, or even more, shillings for carriage, plus a further charge of one shilling and sixpence per ton cartage from the nearest railway depôt, it will be readily admitted that the Liverpool shipbuilder labours under an enormous disadvantage. In these days of keen competition it cannot be expected that any industry can flourish under such drawbacks. The Liverpool builders, however, still receive inquiries, but as one of them remarked to the writer, "They only aggravate us; we cannot touch them." Shipowners who in the past have derived every satisfaction from their Mersey-built vessels confess that it is with a certain amount of pain they place their orders elsewhere. The work, they admit, is excellent; but they cannot, in a depressed state of trade, shut their eyes to the fact that other yards are considerably cheaper.

There is another factor that operates against the success of the Liverpool yards. The trading tendency of the present day is opposed to the Mersey shipbuilders. The private yard, so potent in the past, is clearly doomed. The big companies in ship construction, as in other businesses, must sooner or later swamp private enterprise.

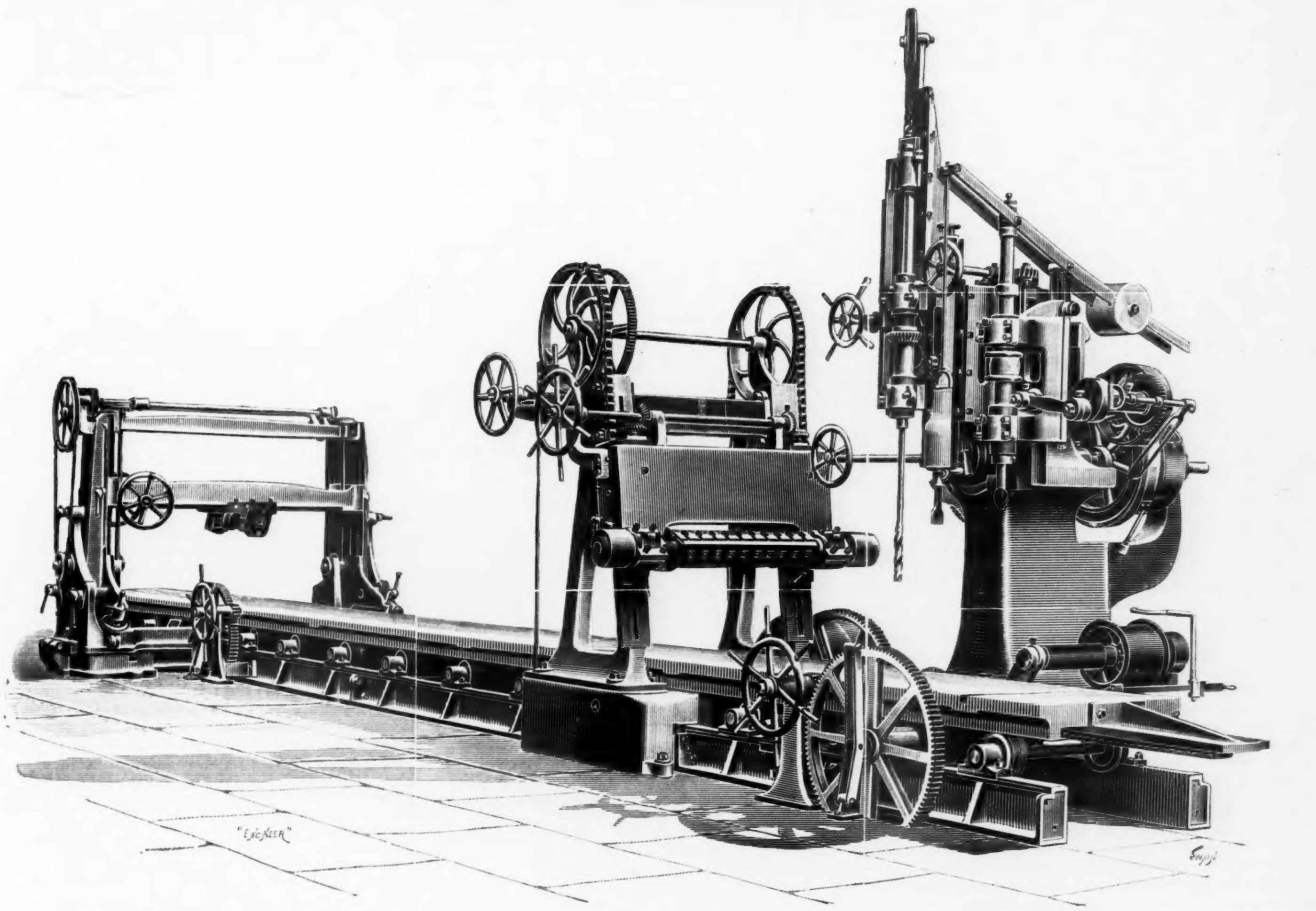
The two causes mentioned above would militate against the success of similarly circumstanced yards anywhere. But the Liverpool yards—that is those on the Lancashire side of the Mersey—have a still further adverse force to battle. They are under and form part of the Mersey Dock Estate, and consequently fall under the jurisdiction of the Mersey Docks and Harbour Board. The policy which these managers of the Port of Liverpool adopt towards shipbuilders is one of repression, or at best mere toleration. To begin with, the rents charged for shipbuilding sites are extremely high. Few builders can afford at the present day to pay a rental of 1s. 6d. per yard, with rates and taxes in addition. Such a burden as this may not be seriously felt in good times when work is brisk, but when the rent has practically to fall upon one or two vessels the margin of profit must be a very narrow one indeed. The Dock Board again will not lease their yards. Those to whom they are let are six-monthly tenants, and though it cannot be contended that occupiers of yards might be turned out of their holdings without due consideration to their contract obligations, &c., yet it is a well-known fact that sooner or later the yards will be wanted for dock sites. At present the Liverpool yards of Messrs. Jones, Evans, Potter and Royden have docks on all sides of them except the westward, on which lies their river frontage. The Dock Board, too, make no efforts to cater for the shipbuilding industry. From their point of view, the revenue from the yards is a mere bagatelle. For the year ending July, 1893, it stood at £3953 5s. 3d., a small item among aggregate rents of close upon £120,000, and total receipts of £1,330,336. According to the Dock Board, too, these rents must be considered irreducible, so that taken altogether, the Liverpool shipbuilder has a hard time of it. He complains, too, of the cost of unskilled labour, which is doubtless owing to the constant employment that offers at the docks to the better classes of unskilled labourers.

There is at Liverpool, too, a lack of such facilities as are necessary for shipbuilders in these days of quick despatch. The masting of vessels is usually performed in a dock close to the four yards mentioned above. Here the Dock Board have provided a crane capable of lifting twenty tons, but *the motive power is hand*. To put the lower sticks into an average sailer is thus made an operation both tedious and costly, the crane generally employing twenty-two men at least a couple of days during the process.

Years ago, in describing the industries of Liverpool, it used to be shipbuilding and ship repairing. Now this is reversed, it is ship repairing first, and shipbuilding afterwards. This is not very gratifying to those who are interested in this long-established Mersey industry, and it is still less pleasing to learn that the progress of degeneration is not yet complete, that the repairing business labours under such disabilities as frequently drive owners to send their vessels to other ports. Vessels entering Liverpool docks for repairs are charged dues just as if they came to discharge or load cargo. The graving dock rates of course cannot be grumbled at, but owners can hardly be expected to saddle themselves with heavy dues by sending their vessel to Liverpool to be repaired. If

# DOCK GATE MAKING MACHINERY FOR THE MERSEY DOCKS AND HARBOUR BOARD

MESSRS THOMAS ROBINSON AND CO., ROCHDALE, ENGINEERS



she has brought cargo to the port it is of course another matter. This grievance of ship repairers—and the repairers are the builders as well—is felt to be a serious one. The opening of the Ship Canal might, under other conditions, have brought business to Liverpool; but as things are at present, the Liverpool builders and repairers cannot compete for the repairs to vessels injured in the Manchester waterway. It may be thought that the question of ship repairing is hardly relevant to the discussion of Mersey shipbuilding, but in a great port like Liverpool the two industries go hand-in-hand.

That Liverpool's shipbuilding is doomed there can be no doubt. The very fact that of the 725,532 tons built for British firms during 1893, something like 110,000 tons was for Liverpool owners, is eloquent testimony as to the lower rates of other builders. At the beginning of the present year, when quotations for new tonnage were on the rise, it was hoped that past history would repeat itself, and that Liverpool builders would benefit. Though the outlook was thus a little brighter, it must be admitted that material betterment is as far off as ever. Possibly the Dock Board, now that the opposition to the port has led them to undertake the redress of grievances, may be induced to deal a little more tenderly with the shipbuilding fraternity, and this may doubtless tend to postpone the evil day when Liverpool will cease to be counted among the shipbuilding centres.

## IMPROVED WOOD-WORKING MACHINE FOR THE MANUFACTURE OF DOCK GATES.

Those of the members of the Institution of Mechanical Engineers who paid a visit to the works of Messrs. Thomas Robinson and Son, Rochdale, during the recent summer meeting, had an opportunity of inspecting a new machine, or rather combination of machines, which had just been completed by this firm for the Mersey Docks and Harbour Board, and which is intended for preparing the timber required in the construction of the ten pairs of gates which will be necessitated by the extensive alterations and improvements at the north end of the Liverpool Docks. This machine, which we are now enabled to illustrate, is intended to perform the operations of planing, shaping, tusking, tenoning, morticing, and boring baulks of greenheart timber up to 60ft. long by 3ft. square, without the necessity of moving them from one machine to another, and with this object in view, one long travelling table serves for the whole of the operations.

The operations of planing and shaping the baulks of timber are performed by means of revolving cutters attached to a horizontal cutter block driven at high speed by two belts. It is mounted on the slide plate of a vertical headstock, and spans the travelling bed which carries the timber. The cutter block slide plate is in two parts; the front portion which carries the cutter block is made to slide on the back portion so that the cutter block can be raised or lowered through a short distance by means of screws for the purpose of adjusting the depth of cut. The whole slide plate is capable of moving up and down freely on the face of the headstock, its weight being counterbalanced by means of weights suspended by chains below the floor. A friction roller is attached to the slide plate, which, when allowed to rest on a curved template fixed on the travelling table, will cause the cutter block to rise and fall with the curve, and so shape the timber on which it is operating to the form of the template. This arrangement is for the purpose of shaping one side of the timbers which form the ribs of the gates to the required curvilinear form. When required to plane a level surface the slide plate is cramped fast to the headstock at the required height above the table, and the depth of cut is adjusted by raising and lowering the cutter block by means of the screws and slide on the back slide plate provided for the purpose. For the operation of morticing and boring there are provided two machines, one fixed on each side of the travelling table, so that one cuts the mortices and bores the holes along one edge of the timber, and the second performs a similar operation along the other edge. This arrangement permits the work to be done where required on the timbers without having to traverse the tools completely across the timbers, and so cause them to be unduly overhung from the standard on which they are carried. The mortice holes are first cut out to the required depth by means of a revolving routing tool, and the ends are squared by means of a reciprocating chisel. Holes to a depth of 30in. are bored by means of a spindle driven by bevel gearing, and attached to the same headstock as the morticing tools. The headstock which carries these tools is arranged to slide in a lateral direction across the bed, so as to enable the work to be done on different portions of the timber without its being necessary to move the latter in any but a forward direction.

The operation of tusking consists in cutting a series of bevelled seatings across the face of the timbers which form the upright posts of the gates. These seatings form beds on which rest the shoulders of the tenoned ends of the transverse ribs. The appliance for tusking has been made from the designs of Mr. Thomas Owen, one of the employés of the Mersey Dock Estate. It consists of a pair of cast iron standards between which the table carrying the timber travels. A sliding carriage, on which is mounted a horizontal cutter spindle with a cutter block on each end, is carried on these standards, and is raised or lowered or traversed in a lateral direction across the timber by means of screws turned by hand-wheels. The standards are supported on trunnions, on which they can be canted forward or backward to any desired angle, and the trunnions are mounted on a swivelling bed, which can be turned on a centre pin so that the cutter blocks may operate on the timber at different angles. By this arrangement of canting and swivelling the standards on which the cutter blocks are carried, the machine is enabled to cut the tuskings and tenon the ends of the timbers at any required angle. It should be stated that Mr. A. G. Lyster, M. Inst. C.E., is the engineer for the above-mentioned undertaking.

## RAILWAYS IN INDO-CHINA.

So rapid has been the commercial development of the French possessions in Indo-China during the past two or three years, that the authorities have found it necessary to propose a vast scheme of railway construction, of which the details have already been thoroughly worked out. Up to the present moment Tonkin has only possessed a single line, of comparatively small importance, connecting Hanoi with Lang-Son, and though it was laid down for strategical reasons, it has yet proved to be of great service in directing a large current of trade to the Red River. It is with a view of opening up new territories that the Governor-General, M. de Lanessan, has made concessions for the laying down of lines to French engineers, and these concessions are now only awaiting the sanction of the Chamber of Deputies. It is thought to be practically certain that the Chamber will unanimously favour the project, as it will entail no expense whatever on the mother country, and all the charges incidental to this enterprise will be borne by the colony, whose budget shows a large excess of receipts over expenditure. One line of 700 kiloms. from Hanoi to Hué and Tourane has been conceded to a syndicate represented by MM. Vézin and Raveau, of the Compagnie de Fives-Lille. The cutting and banking for this line have already been partly carried out, and the rest will be done by the Annamite villages through which the railway will pass. Other lines conceded to M. Soupe and Raveau, of the Fives-Lille and the Cie. des Messageries fluviales de Cochinchine, are one from Saigon to Touraine and Hué, a distance of 800 kiloms., and a steam tramway intended to connect the capital of Tonkin with the new railway which they are themselves constructing from Phu-Lang-Thuong to Lang-Son. This railway is to be further extended as far as Binh-hi. Concessions have also been made to M. Portal, the director of the Kébao mines, who is acting for the Cie. Commerciale et Industrielle du Tonkin, and for a syndicate of Parisian capitalists. These concessions include a line from Kébao to Laokay, a distance of 450 kiloms.; from Kébao to Lang-Son, from Haiphong to Sontay, from Hanoi to Chai-Ngngen, and from Kébao to Moncay. The length of lines thus conceded to M. Portal is 1100 kiloms., all of which is to be constructed in Tonkin. The estimated cost of the entire system is £8,400,000. In Indo-China, as elsewhere, the 0·60 metre gauge has entirely gone out of favour, and all the new lines will be constructed with a metre gauge, which thus becomes the standard gauge in the colony. It is urged that while the metre gauge only entails a very little extra expenditure, the line is much more flexible than if constructed with the narrower gauge, and has a capacity not much inferior to that of the larger lines. This has been proved—in Tonkin, at least—by the working of the lines at the Kébao and Hongay collieries. It has been decided that all the material required in the construction of these 3000 kiloms. of railway shall be supplied from France, and that the locomotives shall only consume fuel mined in Tonkin. Besides this work, the Kébao Colliery Company is engaged in the construction of a port at the termini of the lines conceded to the Cie. Commerciale et Industrielle du Tonkin. This port will be in a very sheltered position at Tien-Yen, and will allow of vessels drawing eight metres of water entering at all tides. Entrance to the port will be further facilitated by the erection of three lighthouses, and the whole undertaking will cost something like half-a-million sterling. It is expected that this port will become the depôt for supplying the whole of the Eastern markets with the coal mined in Tonkin, and it is further hoped that this great industrial movement will result in the establishment of manufactories in the different mining centres. At present it is impossible to develope the industrial resources of Tonkin to anything like their full extent, owing to the disinclination of French capitalists to put their money in colonial enterprises, and it was found necessary to work the coal mines in that country with capital belonging to British merchants in Hong Kong, who are thus certain to be among the first to benefit from this creation of a railway system.

## FRENCH MACHINERY AT ANTWERP EXHIBITION.

(*From our Special Commissioner.*)

IN the main building of the Exhibition French exhibits occupy an important place; in fact, there are some branches of industry in which France is better represented than even Belgium. But this is not the case in the Machinery Hall, where the French display is even smaller than the English.

In these days of international industrial enterprises, it is not always easy to divide exhibits according to their nationality. Last week, under the head of Belgian Machinery, I spoke of an exhibit which would have equal right to be called German, and the machine tools shown by Le Progrès Industriel, of Paris and Brussels, are even more cosmopolitan in their character, as this company, which manufactures in France as well as in Belgium, exhibits chiefly examples of "Pittler's Universal Lathe," and tools which are practically adaptations of it. This lathe is the invention of Herr W. v. Pittler, of Leipzig, and of High Holborn, so that it might equally well have been classed with German mechanical inventions. It has recently undergone several modifications in minor details, and the subjoined illustration will show its most recent arrangement. It will be seen that the lathe bed is in the form of a trapeze, or truncated triangle in section. On this bed, and bearing on the three upper sides, is the saddle, which is circular, and upon it the tool holder revolves. This tool holder is split at one side, and can be tightened up by a screw, so that it can either revolve freely round the saddle, or can by tightening the set screw, be securely fixed in any position. The leading screw is fitted underneath inside the lathe bed, which it traverses from end to end, so that by it the saddle, and consequently the tool holder, can be moved backwards and forwards, either by hand from the back end, or automatically, by means of small change wheels in the head. In some of these lathes, instead of a single tool there is a capstan bearing a set of tools. In others, a separate apparatus is put into the tool holder, with automatic milling cutters; these are driven from a small side wheel on the lathe, which turns a rod with a universal joint at each end. An excentric on the continuation of this rod moves the wheel to be cut, up and down; a lever on the side of the excentric turning a disc, according to the distance set. Another arrangement has a pulley at the end of the lathe, which moves a revolving cutter forward; this is used for turning spirals. Again, another modification converts this tool into a sort of copying lathe; a plate, with a slot in it is placed in the machine, and this guides the tool-holder according to the shape of the article required. One of the lathes shown is especially intended for worm wheels, another is an automatic ball-turner.

Besides lathes, the exhibitors show several varieties of milling machines. One of these can either be arranged for horizontal or vertical milling. When the vertical milling head is used, it can be turned 45 deg.; and when required it can quickly be removed, and another head with horizontal motion put in. A milling machine designed especially for making gimblets, augers, &c., has a very ingenious arrangement. It is driven by a worm, and the worm wheel is set excentrically, so that the spiral should gradually flatten.

In the illustrations, Fig. 1 is a section of the gearing of a screw-cutting lathe, through the worm-wheel shaft, at the back of the head-stock, the shaft *r* being made to pivot, so that the worm-wheel *f*, which may vary in diameter, can always be brought close up to the worm, Fig. 2 is a section through lathe bed, saddle, and tool-holder. In this, *n* is the lathe bed, *l* the circular piece which slides on it, and *a b* the tool-holder.

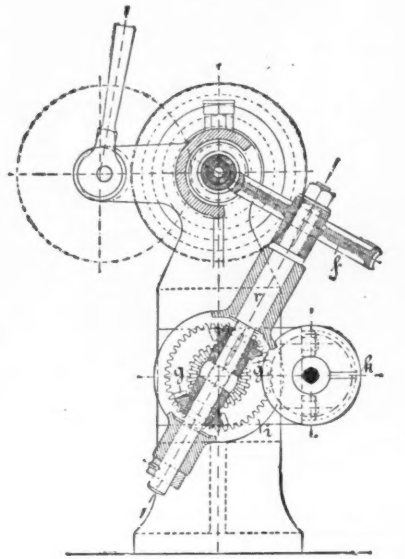
Those who are desirous of comparing the leading types of water-tube boilers have a good opportunity of doing so at Antwerp. The Babcock and Wilcox, De Naeyer, and Dürr boilers have all been mentioned in previous letters, and the list would not be complete without the Belleville. Unfortunately the De Naeyer is the only one of these which is shown at work. Messrs. Delaunay, Belleville and Co. have made no change in their standard type since 1889; they still consider that large receptacles above the tubes, whether intended for steam or water, are a mistake, and that they diminish the security against explosion, which should be considered one of the chief merits of a water-tube boiler. They also maintain that by the use of an automatic feed-regulator, these reservoirs are rendered unnecessary. Their principal exhibit is a group of four boilers, which form one-eighth part of the total boiler power of the French ironclad battleship Bouvet, 14,400-horse power. Their test pressure is 1000 lb. on the square inch. In a list of the boilers recently manufactured by this firm, I observe that they have supplied those for H.M.S. Powerful and Terrible, each of 25,000-horse power, and also of the Sharpshooter, 3500-horse power.

Amongst their other exhibits are a small boiler with thirty-six tubes, working at 225 lb. pressure, for boats 33ft. long in the French Navy. They also show an eight-horse power portable engine, of which they are supplying a good many to Africa and to the mountainous parts of Italy. It has thirty tubes, and can be taken to pieces for mule transport, the heaviest piece only weighing 264 lb. It is put together entirely with bolts.

The machine tools, and especially the milling machinery made in different countries, do not differ so much as the water-tube boilers. Still, there are little variations between them, and each one has something worthy of notice. Only one French firm exhibits heavy machinery of this description—viz., the Usines Bouhey of Paris. In one of their machines, a vertical miller, they say that the tool revolves 195 times a second. The table in this is in three pieces, of which the middle part can be made to revolve separately, or the whole table can be set to travel automatically in any direction. In another vertical miller, weighing 15 tons, the whole of the front part carrying the tool bearer is movable. It weighs 50 cwt., but can easily be lifted by hand, by means of a lever with a ratchet wheel. The arrangement of the bed plate is the same as with the former one. They also show a machine for cutting or sharpening milling tools. In this there is a conical cutter which can be turned to any angle, and can be set exactly by means of a scale on the side. They have a large display of other tools similar to those described as being exhibited by Belgian makers of this class of machinery.

Another branch of engineering industry in which French manufacturers are making at least as much progress as those of other countries, is the production of special descriptions of bronze. In the attractively arranged stand of Messrs. Mathelin and Garnier, of Paris, some samples of bronze are shown, which seem to possess nearly all the qualifications required in good steel, with several others in which steel is wanting. This firm seem to have been experimenting in the same direction as Professor Roberts Austen, by examining the effect of the addition of minute quantities of manganese, aluminium, &c., to different descriptions of gun metal. More particularly they have been trying the effects of the introduction of phosphorus to an ordinary bronze in a state of fusion. For instance, they took two samples containing 88 parts of copper, 12 of tin, and 2 of zinc, a proportion regularly used in French arsenals. One of these samples on being tested showed a breaking strain of 11 tons, and an extension of 5 to 7 per cent. The same metal phosphorised by their process had a breaking strain of 17 tons, and an extension of 14 per cent.

Fig. 1



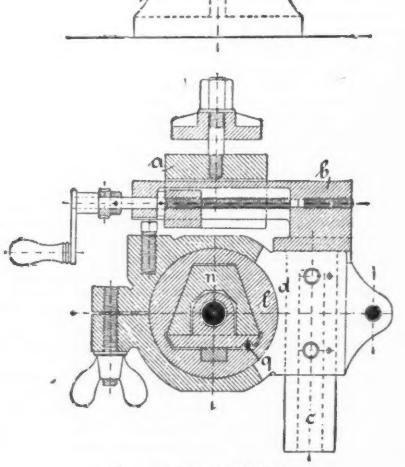


Fig. 2 - PITTLER LATHE

But their latest achievement, to which they have given the name of "Roma," from the Greek ρομα, "strength" is much superior to the manganese bronze, and phosphor bronze which they have shown at previous exhibitions. They do not give the exact constituents of this metal, but state that it contains copper, phosphorus, tin, aluminium, and manganese. Specimens of it are exhibited cast in various forms, rolled into bars and sheets, and drawn into boiler tubes or wires, as well as forgings which have been made from it. Roma is a pale yellow, has a specific gravity of 8·5, and melts at a temperature of about 1000 deg. C. As it does not corrode in sea water, and is not magnetic, it is preferable to steel for the hulls of steamers, &c. A set of test bars are shown which have given the following results:—

No. 1 Ordinary gun-metal, 10 to 13 tons per square inch breaking strain, 7 to 10 per cent. extension.
No. 2 Phosphor bronze, 17 tons per square inch breaking strain, 8½ tons elastic limit, 15 per cent. extension.
No. 3 Roma, cast in sand, 22 tons per square inch breaking strain, 16½ tons elastic limit, 43 per cent. extension.
No. 4 Roma, cast in sand, 24½ tons per square inch breaking strain, 19½ tons elastic limit, 21½ per cent. extension.
No. 5 Roma, cast in a mould, 28 tons per square inch breaking strain, 20 tons elastic limit, 40 per cent. extension.
No. 6 Roma forged, 31 tons per square inch breaking strain, 22½ tons elastic limit, 35 per cent. extension.
No. 7 Roma rolled, 35 tons per square inch breaking strain, 26 tons elastic limit, 7½ per cent. extension.

The exhibitors state that with drawn tubes they have had 37 tons breaking strain, 24½ tons elastic limit, and 16 per cent. extension; and with wire 62 tons breaking strain, 49 tons elastic limit, and 16 per cent. extension. Messrs. Mathelin and Garnier also exhibit a very pretty model of a torpedo boat, entirely constructed in Roma metal, and some photographs of screw propellers and other castings for naval construction. To one of these—the photograph of the screw for the Jaureguiberry, a casting weighing nine tone—is attached a copy of the official test made in May, 1893, showing a breaking strain of 24 tons, an elastic limit of 13 tons, and an extension of 21 per cent.

Messrs. Morane and Co., of Paris, show a number of hydraulic presses for different purposes. They have presses for making gas retorts, bricks, and cartridges, but their speciality is machinery for stearine. The first apparatus shown is a double hydraulic press for separating the stearine from the oleine. In this machine the engine is on one side of the press, and there is an automatic arrangement which, when the pressure is too strong, releases the water. The material is first pressed cold and then hot, the heat being applied by means of steam passing through thirty small plates in the press. There are several machines for making stearine candles, some of which are solid and of the ordinary shape, others have three oval holes about ¼in. by ⅛in. cast in them through their entire length. This arrangement is made in order to prevent guttering. The machine will cast a hundred candles at a time, and works continuously, as the wick is coiled on drums underneath the machine. They also show a very large press for stamping steel pans, &c., having a pump which will exert a pressure of fourteen tons on the square inch.

M. Leon Droux, of Paris, exhibits a complete set of apparatus for the manufacture of glycerine. This consists of an open pan in which the fat is melted, a steel retort, a set of six copper condensers, and a spiral cooler. A syphon connects the pan with the retort, and a vacuum being created, the melted fat is drawn into the latter. Superheated steam at a temperature of 190 deg. to 200 deg. Centigrade is then injected into the retort, and heat is also applied underneath. The products of distillation are drawn through the six condensers, passing from the top of one to the bottom of the next, any glycerine vapour remaining after the sixth is liquefied in the spiral cooler. The glycerine from the condensers falls into copper receptacles underneath; that in the first ones is usually of bad colour, and requires to be redistilled. The residues are drawn off into a separate receptacle, which is also in connection with the retort, so that they can be pneumatically returned to it, and redistilled if necessary. M. Droux also exhibits a copper retort for the distillation of fatty acids, produced by the decomposition of fatty materials. A novelty in connection with this still is that the residue is received in a specially designed airtight vessel, which prevents any risk of its catching fire.

M. E. Wauquier, of Lille, exhibits two descriptions of pumps, centrifugal and direct double-acting steam force pumps. The centrifugal pumps are specially designed to raise water to the height of 100ft. in one lift. In the double-acting pumps there are two pump barrels, with direct double-acting pistons, each worked by a steam cylinder with an ordinary slide valve. They are so arranged that the valve rod of one steam cylinder is driven from the rod of the opposite pump. By this means there is always an opening for the admission of steam, and consequently no dead point. There is the further advantage that the speed of the pump may be diminished considerably without fear of its stoppage. One pump exhibited, intended for feeding marine boilers, will work against a pressure of 140 lb.

At the same stand there is shown a model of an interesting invention by M. P. Walraf, for taking up the *vis viva* of a tramcar when the brake is put on, and causing the wheels to revolve and to start the car directly the brake is removed. It consists principally of an intermediate shaft, on which a strong spiral spring is coiled. The shafts carrying the front and back wheels gear by means of intermediate pinions into a wheel on this shaft. Directly the brake is applied, it causes the spring on the intermediate shaft to tighten, and as long as the brake is on, it prevents the spring from uncoiling. Directly the pressure of the brake is removed, the spring causes the intermediate, and consequently the main wheels, to revolve, and thus starts the car. The extra weight of this apparatus is about 3 cwt.; but the inventor is endeavouring to simplify it, and thus make it lighter.

## THE FEDERATED INSTITUTION OF MINING ENGINEERS.—NEWCASTLE MEETING.

AT the resumed meeting, Mr. Morgan W. Davies' paper on "Timber Bridges and Viaducts," Mr. Edwin Gilpin's paper on "Explosions in Nova Scotian Coal Mines," and Mr. J. R. Wilson's paper on "The Shaw Gas Tester for Detecting the Presence and Percentages of Fire-damp and Choke-damp in Coal Mines, &c.," were considered. The first paper dealt with the characters of the various kinds of timber suitable for bridge construction at the disposal of the British mining engineer; with methods of making tests and computations to ascertain the suitability of such timber for the purpose; and with various modes of bridge construction, and the points and calculations that should be contemplated before deciding on the mode of construction to be adopted in any particular case.

In his paper, Mr. Edwin Gilpin, who is a deputy commissioner and inspector of mines, pointed out that there are three widely separated coal-mining districts in Nova Scotia, but that the geological horizon of each is the middle carboniferous. The Cape Breton coals are almost invariably coking and adapted for gas-making, whilst the Pictou and Cumberland coals are more or less free-burning; the latter two are associated with beds of shale, the former with a larger proportion of beds of sandstone.

The following average analytical numbers give a general indication of the differences of these coals:—

| | Cape Breton. | Pictou. | Cumberland. |
|---|---|---|---|
| Moisture | ·75 | 1·19 | 1·46 |
| Volatile combustible matter | 37·26 | 29·10 | 33·69 |
| Fixed carbon | 58·74 | 60·63 | 59·35 |
| Ash | 3·25 | 9·34 | 5·50 |

The author then proceeded briefly to enumerate, with more or less important and interesting detail as to localisation and prevailing conditions, the principal explosions that have occurred in these districts, from about the beginning of this century to the present time. In Cape Breton district there have been a number of cases of ignition of gas, of which one only—in 1878—is classed as an explosion, and in no case is dust considered to have played an active part. In the Pictou district, which is very gasey, fifteen fires and explosions are recorded, and a copy of the special rules in force in 1840 is appended to the paper. The rules, curiously, are the same as those in vogue in South Hetton Colliery at the same period, and show that then, as now, the use of gunpowder was intimately connected with fire. One explosion in the Cumberland district is chronicled. It is noteworthy that in the author's experience no explosion in Nova Scotia can be attributed to coal dust alone, but a number of them have had their area and their destructiveness to life materially increased by coal dust.

The apparatus described by Mr. Wilson appears to be well known and highly appreciated in the United States. It is made of iron and brass, measures about 2ft. square, weighs 90 lb., and costs £100. It consists of a pair of air pumps, one with a stationary cylinder and constant stroke of piston, the other with a movable cylinder that can be set between two graduated bars, so as to pump any desired percentage of gas. Both pumps are operated by the same swinging arm, which is also one of the graduated bars, and the sum of the volumes of gas pumped from the two cylinders always equals 100. The stationary cylinder serves for the gas to be tested, the movable one for the standard gas. When the pistons are operated the product of the two cylinders, in testing for fire-damp, is pumped through a mixer into an igniting chamber, which is provided with an orifice on one side in front of a gas jet. If the mixture pumped in is ignitable, the expansion induced by the heat of ignition propels a loose piston-head, held in place by a bowstring against a gong at the end of the chamber, and an addition or subtraction of 0·1 per cent. will cause this gong to ring or remain silent. The sample of gas from the mine is taken with a diaphragm pump, and stored in a six-gallon rubber bag; to make a test the bag is attached to the stationary cylinder, and the movable cylinder is adjusted to deliver an explosive proportion of standard inflammable gas, then if the detonation is too loud, or there are other indications of the presence of much gas in the mine air, the proportion of standard gas is reduced until a normal ring of the gong is obtained, and the percentage of gas is then ascertained by noting the position of the movable cylinder by means of the graduations on the bars.

It is claimed that with this apparatus even an unskilled operator can estimate, within a minute or so, whether a gas is wholly fire-damp or only carries 0·1 per cent. of that gas, that is, can obtain results accurate to the 0·001 part. With it, too, mixtures might be accurately prepared to test the sensitiveness of safety lamps, and the noxious proportions of sulphuretted hydrogen, carbonic anhydride, carbonic oxide, &c. Whilst by the same process of admixture, and by means of suitable indicators, the proportion of any of these gases in an atmosphere can be, it is said, accurately ascertained. Professor Bedson, in absence of any practical knowledge of the apparatus, had misgivings as to the delicacy claimed. Mr. Ashworth and others commented on the cumbersomeness and unwieldly character, moreover disapproved, of testing by firing, and drew attention to well-known appliances which could do most—as regards fire-damp and choke-damp—of what was claimed for this apparatus. Mr. H. G. Graves drew attention to the fact that M. Le Chatelier had obtained results with the Shaw apparatus which were as accurate and as constant as the results obtained with the Le Chatelier endiometric apparatus, which is in use both in France and Belgium, and depends, like the Shaw tester, on the ignition of mixtures of known volumes of mine gas with known volumes of inflammable gas.

The excursions included a sail, on the Wednesday afternoon, up and down the Tyne, and permitted of the examination and admiration of the vast operations of the Tyne Commissioners, and a cursory but interesting view of the general industries on the river banks. The striking features of the river were the high-level and swing bridges, the great grain stores, the extent of many of the works operated by individual corporations, the numerous coal staiths and spouts, and the large number of steamers laying up. On the Thursday opportunity was given the visitors to examine the Northumbrian methods of winning and shipping coal, the North Seaton, Cambois, Ashington, New Hartley and Seghill Collieries, and Blyth Harbour being thrown open for inspection. At North Seaton the yard seam, 2¼ft. to 3ft. in thickness, at a depth of 558ft., and the low main seam, 4ft. to 5ft. thick, at a depth of 750ft., are worked, the former on long wall, the latter on the board-and-pillar system; the output is 1100 tons a day. The winding engine is vertical and condensing, with cylinders 60in. diameter and 7ft. stroke, and a drum of 22ft. diameter; it draws four tubs of 21 cwt. gross weight at a time; an endless rope counterbalance is used under the cages. The haulage is the main-and-tail system in the low main seam and the endless rope system in the yard seam. For pumping there are a compound condensing Worthington engine underground, with high-pressure cylinders 18in. diameter, and low-pressure cylinders 30in. diameter, and rams 9in. diameter with 30in. stroke, which forces 750 gallons of water a vertical height of 800ft. through a 10in. wrought iron main; a vertical beam engine, cylinder 78in. diameter and 6in. stroke, held in reserve; and an electric pumping plant, with an engine at bank with cylinder 13in. diameter and 10in. stroke, driving a Tyne dynamo connected to an underground three-throw pump 8000ft. distant. The pump is worked by worm gearing, has rams 9in. diameter and 15in. stroke, and pumps 250 gallons of water a minute. The screening plant comprises jigging screens, picking belts, mechanical tipplers, 200-ton Robinson coal washer, &c. There is also an electric light plant. At the Cambois Colliery the low-main seam, 4½ft. to 5ft. thick, is worked on the board-and-pillar system, with main-and-tail haulage, at a depth of 630ft., and mainly under the sea; the output is 1200 tons per diem. The winding engine is vertical and condensing; cylinder, 65in. diameter and 7ft. stroke, with a drum 22ft. diameter, draws the same load of tubs as the North Seaton engine. The underground pumping engine has two cylinders 22in. diameter, with 5ft. stroke and rams 9in. diameter and forces 400 gallons of water a minute to a vertical height of 650ft. through 13in. pipes; whilst the electric pumping plant at bank consists of a Robey trip-gear engine and a 40-unit Tyne dynamo, which drives six underground pumps at distances varying from 3600ft. to 6900ft., necessitating the use of nearly eight miles of cable. There is an electric lighting plant and a 250-ton Robinson coal washer. The colliery is connected by a private line with the company's shipping ports at North Blyth.

At Ashington Colliery the low main seam is at a depth of 540ft., and in spite of some rather ancient engines, 4300 tons of coal are drawn from three shafts daily. The haulage is on the endless-rope system, and the underground pumping is done partly by compressed air, partly by endless ropes, the feeders being raised to the surface by pumps 25in. in diameter. Mechanical bars and forced draught are used under the boilers. Jigging screws and travelling belts and a Bell and Ramsay washer are employed in preparing the coal. Electric light is supplied in many departments. A feature of this colliery, which, by-the-bye, is one of the most successful in the district, is the model village attached to it, consisting of long rows of neat cottages, mostly built of fire-brick made at the colliery by the semi-dry process. A narrow gauge railway runs at the back of each row of cottages, and serves for running a locomotive and trains of tubs, for the distribution of coal to the workmen and others, and also for the scavenging of the village. At the New Hartley Colliery one was struck by the neat housing and the well planned arrangement of the various departments on the surface, and the attention paid to the maintenance of pumps, &c., in good condition. The yard coal is worked from the Hastings pit at a depth of 330ft. on the longwall system, with an endless chain haulage; all waste obtained in the mine is used as stowage, so that no spoil heaps appear on the surface. The winding engine is horizontal, with two cylinders, each 28in. diameter and 54in. stroke, with a drum 14ft. 4½in. in diameter. The cages are two-decked, carrying four tubs, each containing 8½ cwt. of coal. A compound differential pumping engine on the surface, with cylinders 24in. and 44in. respectively in diameter, and 7ft. stroke, works two 17½in. rams the same stroke at the pit bottom, by means of quadrants and spears, and forces about 500 gallons a minute a vertical height of 384ft., but it has pumped 1570 gallons per minute. A 30ft. Guibal fan is used for ventilation, and produces 108,000 cubic feet of air per minute under a water gauge of 1·30in. Electric light is supplied on the surface and underground. The Melton pit, tapping the yard seam at 336ft., is being sunk to the low main seam. At Seghill the Blake, yard, and low main seams are worked; the output is 1200 tons a day from two shafts. The ventilating, pumping, and haulage engines are of special interest. The ventilation was until recently done with furnaces, but now it is effected by an open-running fan 35ft. in diameter driven by a Corliss engine, described in vol. vi., page 48, of the Institution's "Transactions." It has one steam cylinder, 16in. in diameter and 3ft. stroke, with sugar-tongs trip valve gear. The engine is controlled by a governor which automatically varies the cut-off and maintains a regular speed, even when the steam pressure varies 20 lb. per square inch. The speed is readily varied by altering weights placed on the governor, and can be effected while the engine is running.

For pumping, a vertical engine, with a cylinder 9½in. in diameter, 9in. stroke, running at 200 revolutions per minute, drives a 15-horse power dynamo producing a current of 460 volts. The electric energy is transmitted through a $\frac{7}{16}$in. insulated cable to a 10-horse power motor placed in the low main seam, nearly a mile distant from the shaft. This motor drives a three-throw ram pump delivering 100 gallons of water per minute to a vertical height of 120ft. through two pipes 4in. in diameter. The useful effect is 32 per cent. A few electric incandescent lights are attached to this dynamo. The haulage, on the main-and-tail-rope system, is worked by a horizontal engine, with a cylinder 13½in. in diameter and 30in. stroke; steam jacketed, and fitted with valve gear controlled by a governor, which automatically varies the cut-off, and maintains a constant speed of engine. The speed may be varied from 70 to 100 revolutions per minute by altering a spring attached to the governor, even while the engine is in motion. When not hauling, the tail-rope drum can be put out of gear, and a clip wheel put into gear, and the power transmitted by an endless wire rope to the main pumping-engine in the low main seam. This engine, when running at 70 revolutions per minute, indicates 66-horse power, and pumps 200 gallons of water per minute from a depth of 510ft. A similar engine works the endless rope haulage in the yard seam with over two miles of rope. A smaller engine, with a cylinder 10½in. in diameter and 22in. stroke, works the endless-rope haulage in the Blake seam with over six miles of rope. All these engines work by steam at a pressure of 100 lb. per square inch, and the steam for the whole collieries is generated by four Lancashire boilers, fired by hand with small coal.

A good general idea of the extent, capacity, working, and equipment of the Northumbrian collieries was obtained from these visits, whilst a visit to Blyth Harbour, round which the members were taken in steamers, showed what enterprise and engineering ability had done to facilitate the shipment of the vast output. From a comparatively insignificant sea port, Blyth has grown to be one of the most important coaling ports on the North-East Coast, and ships, it is said, more coal than Hull, Grimsby, and Goole put together. It is situated at about the centre—measuring north and south—of the Northumberland coalfield, and about eight miles north of the river Tyne. There are upwards of twenty collieries within a radius of four miles, and about twenty others in the neighbourhood, for which Blyth Harbour is the natural port of shipment. There are fourteen coaling-spouts at the harbour, most of them being upon the most improved principles, and adapted to load into two hatchways of a vessel at one time, and having a depth of water alongside of 29ft. to 34ft. at high water. The entrance channel from the sea has a depth of 28ft. at high water. By the continuous improvement of the harbour, trade has developed so rapidly that it has been found necessary to provide further accommodation for vessels and greater facilities for shipping coal. The Harbour Commissioners are now increasing the deep-water area of the harbour to the extent of thirty-five acres, and are providing new coaling staiths capable of shipping 2,000,000 tons of coal per annum, and deep-water import and export wharves with railway sidings and connections. There are quays for the discharge of timber, ballast, and general goods; five graving docks for the repair of vessels, and land available for factories, shipbuilding yards, &c. Both sides of the harbour are connected with the North-Eastern Railway system, and by it with all parts of the country. The remarkable growth of this port will be gathered from the fact that in 1883 the shipment from the harbour for the year was 146,264 tons, whilst the shipment last year was 2,342,020 tons. It may be mentioned that the party were enabled to make this large round of visits through the liberality of the directors of the North-Eastern Railway, who provided a special train for the purpose.

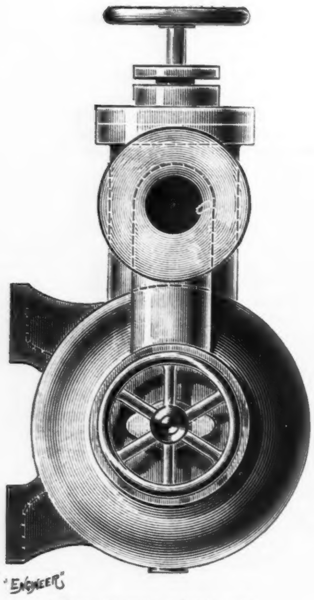
It is a well-known fact that the North of England Institute of Mining and Mechanical Engineers have been conducting, at their own expense, important experiments on flameless high explosives. The labours of the committee, so far, and of which a report is now in the press, have been directed to the behaviour of carbonite, ammonite, securite, bellite, westphalite, roburite, and Ardeer powder, also gunpowder, when fired into atmospheres under atmospheric pressure, containing from 1 to 6 per cent. of mine gas or coal gas. In order to give the engineers assembled in Newcastle an opportunity of judging the character of the methods of investigation, invitations from the Flameless Explosives Committee were issued for last Friday to view the appliances and witness some experiments. It is not our intention to anticipate the report in any way; we shall therefore restrict our remarks to some of the interesting operations and arrangements we observed. The scene of the experiments is a disused brickworks, and its general appearance of dilapidation gives it an air singularly appropriate to the purpose to which it has now been applied.

The firing chamber consists of a cylindrical tube, 100ft. long and 3ft. in diameter, made of boiler plates, and a cannon, mounted on a carriage and capable of being brought close up to one end of the chamber, serves for holding and firing the charge of explosive. The chamber has safety vents at intervals along the top, which are closed by wooden plugs loosely knocked in, whilst, in addition to these, several ports glazed with thick glass extend along the side, for observing the interior from an adjoining dark room, the parting brick wall having holes in it corresponding with the glazed ports. There are other arrangements: for ensuring the delivery of a measured volume of gas into a definite volume of air; for effecting the perfect admixture of the gaseous mixture; for warming the gaseous mixture; for taking samples of the mixture before or after explosion; for taking its temperature; for providing for the presence of dust of any kind in suspension, or *in situ*, and for other purposes, all of which will be duly described in the report, and all of which indicate how carefully and thoroughly the investigations have been planned and executed.

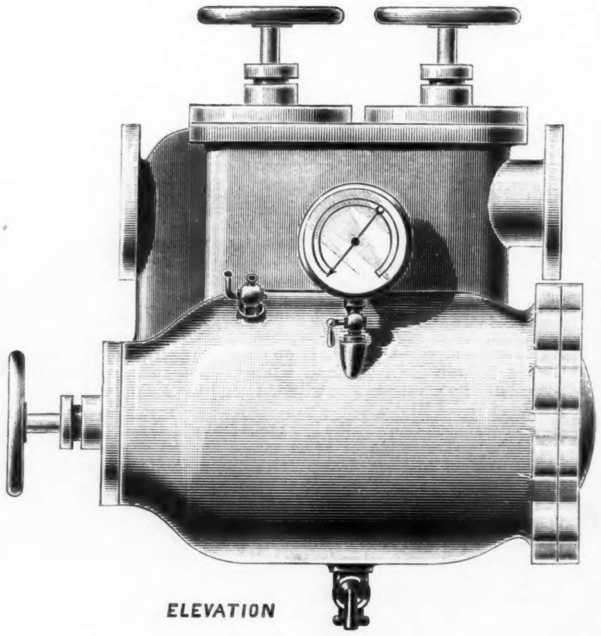
On Friday experiments were performed with the firing of gunpowder into the ordinary air; into an inflammable mixture of mine gas, direct from Hebburn Colliery, and air; into ordinary air with coal dust in suspension; into ordinary air with coal dust *in situ;* the last three being done in duplicate to enable the visitors to view the effect both in the inside of the firing chamber and outside it. Before commencing any experiment, the far end or mouth of the firing chamber was covered up with a sheet of brown paper. In the air, with gunpowder alone a bright flash was observed in the chamber, and the brown paper was blown off the end; when dust was present, whether in suspension or *in situ*, the flash was considerably brightened and lengthened, and not only was the brown paper blown off the end, but a huge cloud of smoke was propelled for more than thirty yards from the mouth of the chamber, and many of the plugs were forcibly projected from the safety vents, being followed by rushing columns of thick black smoke, and in some instances flame; very suggestive of the explosiveness of mixtures of coal dust and air. The force of the explosion of the fire-damp and air was equally well exhibited, and in this case two flashes were observable, the first being due to the ignition of the gunpowder, the second to the ignition of the gaseous mixture. The experiments were very successful; moreover, all points were well explained, and the apparatus lucidly described by Mr. J. L. Hedley, H.M. Inspector of Mines. All present were much gratified, and have had their appetites sharpened for the speedy devouring of the report when it appears. This was an interesting and fitting termination to the agreeable and instructive visit of the Federated Institution to Newcastle-upon-Tyne. The next meeting of the Institution is to take place in February, in South Staffordshire.

# RANKINE'S MARINE FILTER

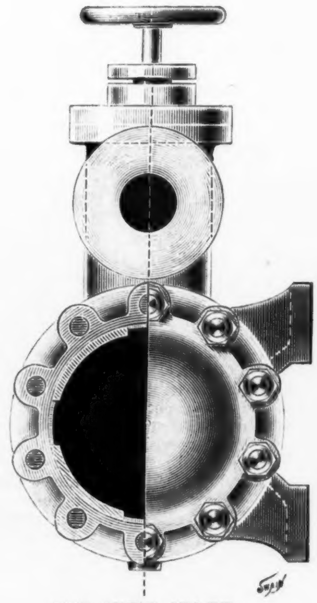
MR. D. RANKINE, WATER-STREET, LIVERPOOL, ENGINEER



END VIEW OUTLET



ELEVATION



END VIEW INLET

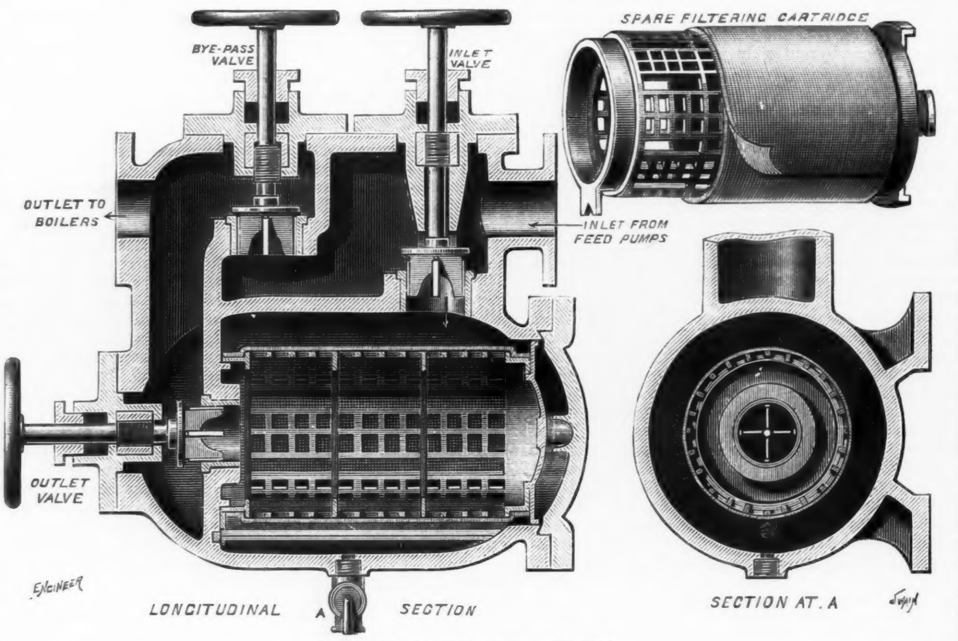
## RANKINE'S MARINE FILTER.

RANKINE's marine filter, which we illustrate by the accompanying engravings, is an apparatus for separating and extracting air, oil, and greasy deposit from the feed-water before entering the boilers, and is fitted on the delivery side of the feed-pump, between the feed-pump and the feed-water heater or boilers, but may be fitted on the suction if necessary. The apparatus consists of a cylindrical gun-metal or cast iron filtering box divided into two compartments, having in the outlet compartment a diaphragm bored out to fit the tapered ring of the filtering cartridge, and a seat at the inlet end into which the cartridge fits. It is also fitted with a steel manhole door for cleaning purposes and two drain cocks. An arrangement of inlet, outlet, and bye-pass valves is fitted, the latter being so arranged that the feed-water may be passed at any time into the boilers when necessary to clean the filter.

The internal arrangement is a portable cartridge, and is made as follows: — A strong perforated tube is fitted into a tapered ring at one end, and at the other end closed by a turned washer of malleable iron; these are mounted on a spindle and firmly fixed together. This forms the cartridge proper. Two or more turns of the filtering cloth, usually Turkish towelling, are wound round the perforated tube and further secured by a steel strip, hinged at one end and buttoned at the other. The cartridge is now ready for shipping into place. A packing ring is put under the collar to prevent water passing through the hole for the spindle in the external casing, and the cartridge is drawn tight to its seat by the handle.

On leaving port the inlet and outlet valves are open and the bye-pass valve closed. The feed-water will then pass through the inlet valve into the annular space around the cartridge, and freely through the filtering cloth and holes of the iron tube, and so out at the base of the cartridge to the outlet valve and on to the boilers. The pressure gauge will register at the commencement simply the boiler pressure, but as the filtering cloth becomes charged with grease the pressure gauge will indicate the extra pressure set up by the filtering cloth, and when it shows 15 lb. above the boiler pressure it will indicate that the cartridge is foul and requires changing. To clean the filter the bye-pass valve is opened, and the outlet and inlet valve shut down. The feed-water will then pass freely into the boilers. The manhole door is then taken off and the handle at the inlet end is turned; the cartridge then travels out with the screw.

The linen cloth coverings are thus easily removed and replaced. They are of large area, and thus do not sensibly increase the pressure against which the pumps have to work.



SPARE FILTERING CARTRIDGE

LONGITUDINAL SECTION

SECTION AT A

RANKINE'S MARINE FILTER—SECTION

## ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

*France: British goods in Nantes.*—It is surprising that so few English commercial houses send representatives to this part of the country. English cutlery and hardware are highly esteemed, and would find a ready sale if properly brought to the notice of the public by such channels as commercial travellers. English goods are imitated in France with a certain degree of success, but the prices are not much lower, and the quality in most cases is vastly inferior. It is only the better class of goods which would find a market here. The cheap kinds would not be able to stand the high protective duty.

*France: Canals of.*—In 1879 a law was passed by which the State was authorised to purchase all the larger canals of the country, so that the traffic upon them, most of which at that time was still in private hands, should gradually be freed from all charges. Whilst the provisions of this law were carried out in most parts of the country, and the traffic on seven-eighths of French canals became free from dues, a different course has been adopted by the Government in south-western France. Here, instead of taking into its own hands the rather important canal traversing the country from west to east—the western portion being called "Canal Latéral à la Garonne," and the eastern the "Canal du Midi"—the Government made an arrangement with the South of France Railway Company, by which the latter, instead of receiving a certain sum granted by the State as a subvention to all the large French railway companies, became proprietor of the western portion, and the eastern portion was left in the hands of another private company. This canal is 60ft. wide, with an average depth of from 6ft. to 7ft. It connects Bordeaux with Cette, but is consequently entirely used by barges and vessels of a very small class. The traffic on both portions of this canal has continued to be subject to certain charges, and the South of France Railway Company is considered to have systematically favoured the traffic on the railway to the detriment of that on the canal, which, according to the prevalent opinion of the agricultural, commercial, and industrial classes in the Bordeaux district, has become useless to them. These classes have for some years demanded that the Government should take the canals of Southern France into its own hands, and that the traffic thereon should be freed.

The project of connecting the Atlantic and the Mediterranean by a ship canal of sufficient dimensions to afford a passage to the largest merchant vessels, and the largest war vessels of the French navy, has assumed a more definite shape, through the formation of a French company, with the intention of constructing and maintaining such a canal without any guarantee or pecuniary aid from the French Government, if the public will provide the money for the work. The company has invited French engineers to compete in drawing up plans and estimates of the projected canal, and proposes that none but French engineers, contractors, workmen, and materials shall be employed in the work, which, if it could be carried out at a reasonable cost, the "Canal des Deux Mers" would, especially for French interests, be a very useful undertaking, apart from its importance in time of war, as it would give a very great impulse to the development of the agricultural, commercial, and industrial interests of the fertile districts of Southern France, besides offering certain advantages to shipping, both of France and other countries. It is questionable whether the cost of the undertaking would not be out of all proportion to the advantages expected from it, and if sufficient money to carry the enterprise into effect can be raised. At a meeting held at Toulouse in the early part of the year, and attended by numerous senators, deputies, and delegates from commercial and other public bodies of South-Western France, it was resolved that until the question of the redemption of the existing canals of Southern France shall have been satisfactorily settled, that of the proposed construction of the "Canal des Deux Mers" can not be considered. At Bordeaux the opinions of the leading classes are not favourable to the project, it being thought that the undertaking, if carried out, which is unlikely, would be a financial failure.

The idea of constructing a maritime canal between Dieppe and Paris has again been mooted by those who cite the Manchester Ship Canal as an example of what courage and perseverance can effect. A summary report on the proposal of M. Jacques, describing the project of a maritime canal from Paris to Rouen to be one of public "utility," was recently laid upon the table of the Chamber of Deputies; but the Chambers of Commerce both of Dieppe and Rouen wrote to the Deputies and Senators of the Department, reminding them of the energetic protest they made against the scheme some years ago, and declaring that the arguments then adduced are still in force, and begging them to use their influence so that the scheme may again be negatived by Government.

The deepening and widening of the canal from Ouistreham to Caen, so that larger vessels may come to the latter place, has not been commenced, but good progress has been made with the preliminary formalities, and it is expected that this important undertaking will be begun this year.

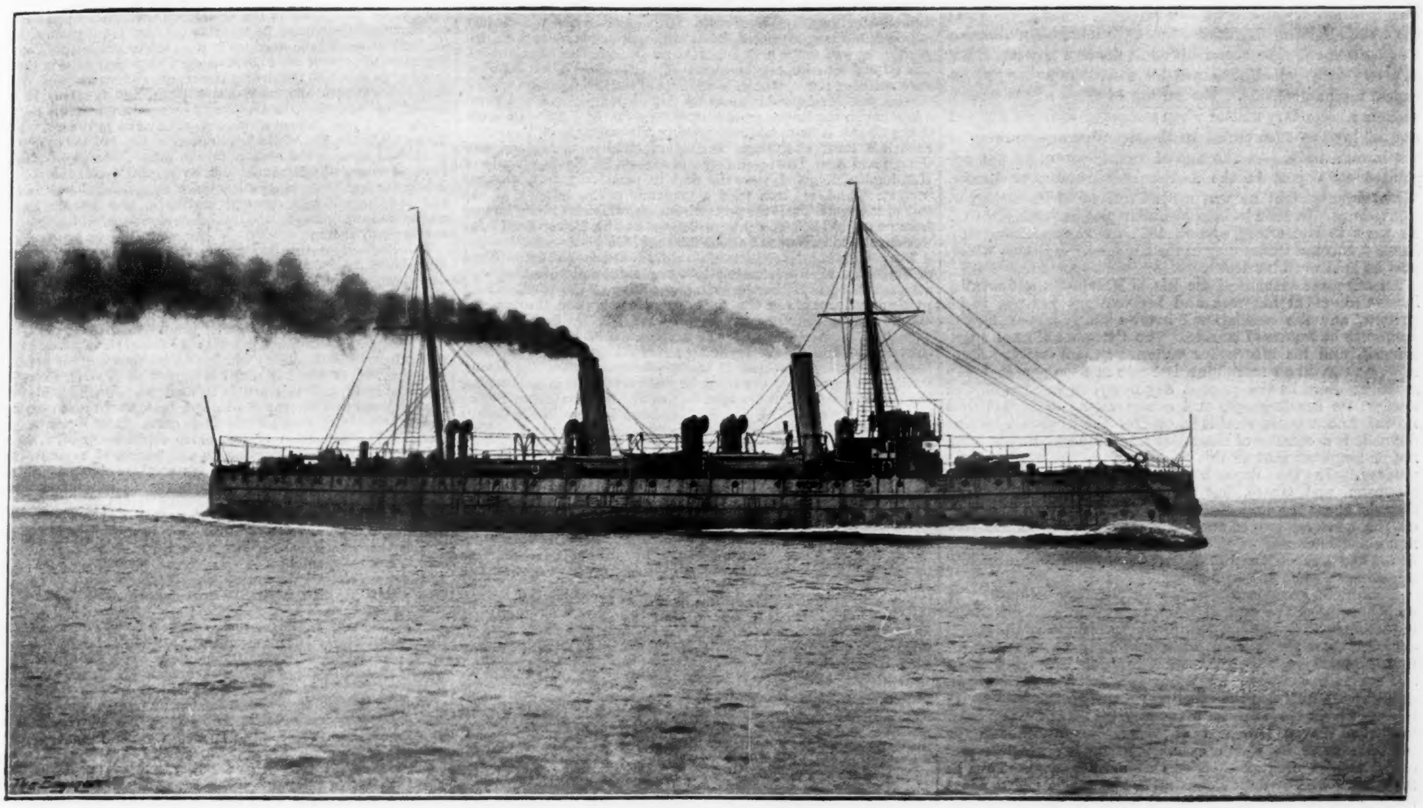
The traffic on the Tancarville Lateral Canal, which fell from 440,330 tons in 1891 to 373,096 tons in 1892, last year rose to 445,978 tons.

Since the opening of the Maritime Canal de la Basse Loire, a great number of large sailing vessels and steamers have passed through it, and it is generally considered by those interested in the trade of Nantes that the success of the canal is assured, and that Nantes will recover its former position as a busy port. The increase in shipping entered last year was 113,935 tons, or 130·17 per cent. over the figures of 1892. The increase in sailing vessels was 2818 tons, or 8·54 per cent., and the steamers 111,117 tons, or 195 per cent.

THE re-construction of H.M.S. Monarch is approaching completion, and she will be ready for commissioning in a week or two. An examination of her hull showed that it was in a remarkably sound condition, but her engine and boilers were worn out. These have now been replaced by new ones, and she has been thoroughly repaired at a comparatively small cost, with the result that she is now an efficient battleship.

# THE ARGENTINE CRUISER PATRIA

MESSRS. LAIRD BROS. BIRKENHEAD, BUILDERS AND ENGINEERS



## THE ARGENTINE CRUISER PATRIA.

The Argentine cruiser Patria, built and engined by Messrs. Laird Bros., of Birkenhead, has been put through her official speed trials with eminently successful results, the procedure of the trials being similar to that laid down by the British Admiralty, armament and all normal weights on board.

The full power forced draught trial of three hours' duration was made on the Clyde last Friday week, six runs over the Skelmorlie mile giving a mean speed of 20 575 knots, with a mean of 233·4 revolutions per minute, whilst the record for the three hours' continuous running was 20 56 knots, with a mean of 233·5 revolutions—this exceeding by one knot the guaranteed speed of 19·5 knots. Nothing could have been more satisfactory than the working of the engines and boilers, and the almost entire absence of vibration of machinery and in the ship.

The official natural draught trial was made in Liverpool Bay the week before, during boisterous weather and with a heavy cross sea, when, during eight hours' continuous steaming, 17·6 knots, and with 201 revolutions, during six consecutive runs over the base between the outer lightships, 17·915 knots was recorded. The ships are 8·1 knots apart, in exposed positions, and form necessarily a difficult course to steer accurately; the speed, however, was one quarter knot over contract. In order to test this a further natural draught trial was made on Friday last, when four runs were made over the Skelmorlie mile at 190 revolutions—which it was estimated would give 17·5 knots, the contract speed—with the result that 17·772 knots was recorded, with 11 revolutions per minute less than when running the trial in Liverpool Bay.

The Patria is a cruiser similar to the Halcyon and Harrier class, of which some half-dozen are being added to the British Navy, but, on the recommendation of Messrs. Laird, the Argentine Government decided to have the poop and forecastle joined, forming a complete spar deck, which adds much to the general comfort and seaworthiness, makes it possible to place the broadside guns fully 7ft. higher above water, and affords accommodation available for the carrying of troops or reliefs when required, whilst the larger engine power gives a knot per hour greater speed. The principal dimensions are:—Length, 250ft.; beam, 31ft. 6in.; draught of water, with armament and all normal weights on boards, 10ft.—the screws do not project below the line of keel—bunker capacity for 250 tons of coal, or 4000 knots range of action.

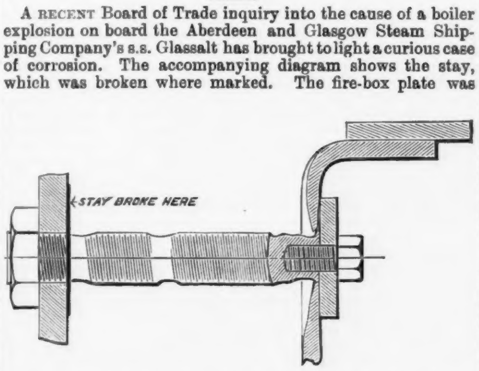
The machinery consists of two sets of tri-compound engines. The main condensers, evaporators, and distillers are of brass, and the auxiliary machinery and general arrangements are similar to the builders' well-known type of high-speed engine, of which the Rattlesnake was the original. The boilers are four in number, of the dry bottom locomotive type, worked on the closed stokehold system, the air pressure for full power not exceeding 2½in. Each pair of boilers and each set of engines are in separate compartments.

The armament is of the best and newest type. The guns are two 4·7in. of Armstrong's make, the four 8-pounder and two 3-pounders being Maxim-Nordenfeldt, carried on the spar deck, and two 1in. machine guns on the bridge, whilst the torpedo equipment consists of one bow tube and four broadside tubes carried on the main deck, worked through specially designed ports, the torpedoes being made by Whitehead, of Fiume, of the latest 18in. pattern. The completion of every detail of arrangement for the efficient and convenient working of this small but powerful cruiser reflects great credit on the builders, who designed all the details of the vessel and machinery, and adds another success to their well-earned and leading position as naval ship constructors.

There were on board during the trial Captain Manuel Barraza, Captain Diaz and Captain Lagos, and Mr. T. W. R. Hughes, representing the Argentine Naval Commission, Mr. John Laird, Mr. Bevis, and Mr. Bevis, jun., representing the builders, Mr. F. D. Hobbs, R.N., and Mr. W. T. Hocken, R.N., of Devonport Dockyard, and Mr. C. C. Scott, of Greenock.

## BOILER EXPLOSION.

A recent Board of Trade inquiry into the cause of a boiler explosion on board the Aberdeen and Glasgow Steam Shipping Company's s.s. Glassalt has brought to light a curious case of corrosion. The accompanying diagram shows the stay, which was broken where marked. The fire-box plate was also so corroded that the stay had no hold on it, and was consequently blown out, scalding the chief engineer, who was in the combustion chamber at the time, so severely that he died two days afterwards. The report says:—"As to the failure of the stay, it had much the appearance of having been cut at one time until nearly severed, and very little of the metal remained." "From evidence obtained," the report goes on, "it appears that on the passage to St. Malo there was a leakage from the centre fire-box of the boiler. On the vessel's arrival at her destination it was discovered that the leakage was coming from the stay second row from the bottom; this they repaired, in order to stop the leakage, by fitting a ⅝in. pin into centre of stay, and making a joint with a small plate or washer. On the morning of 29th March, while raising steam, water was observed coming from the centre fire-box. The chief engineer, when the pressure was about 45 lb. per square inch, went into the back in order to ascertain where the boiler was leaking, taking with him a hammer and two caulking tools. It is stated that he could not have been in over a minute when the explosion occurred. Whether he had been working at the stay or not, the fireman who was in attendance cannot say, as he states he did not hear him using the hammer."



No one connected with the ship seems to have been aware of the previous condition of the stay, and no evidence was obtained regarding its condition when it was first fitted. The boiler was built by Messrs. Hall, Russell, and Co., engineers and shipbuilders, Aberdeen, in the year 1883, under the inspection of Lloyd's Registry, and was last inspected in Elsinore, in May, 1893, by one of the Registry's surveyors.

## THE ARMOUR-PLATE SCANDAL.

Last week the Chairman of the House Committee on Naval Affairs submitted a preliminary report on the alleged frauds in the manufacture of armour-plates by the Carnegie Company. The charges are summarised thus:—"The plates did not receive the uniform treatment required by the specifications of the contract; that false reports of the treatment of plates were systematically made to Government inspectors; that bolts did not receive double treatment required; that specimens taken from the plates, both before and after treatment, to ascertain the tensile strength of each plate, were stretched, without the knowledge of the Government inspectors, so as to increase their apparent tensile strength when actually tested; that false specimens, taken from other plates, were substituted for specimens selected by Government inspectors; that the testing machine was manipulated by the order of the superintendent of the armour-plate mill so as to increase the apparent strength of the specimens; specimens selected by the inspectors were re-treated before being submitted to test; plates selected by inspectors for ballistic test were re-treated with the intention of improving their ballistic resistance, without the knowledge of the Government inspectors; that in violation of the contract, pipes or shrinking cavities, erroneously called blow-holes in plates, were plugged by the contractors and the defects concealed from the Government inspectors; that the Government inspectors' stamp was either duplicated or stolen and used without the knowledge of the inspectors, and that the Government inspector, in inspecting bolts, was deceived by means of false templets or gauges."

Concerning these the report states that the first charge, that the plates did not receive uniform treatment, is admitted, the explanation being that what was wanted was uniform *results.* The second charge, that of false reports, is held to be proved by the rough records of the company itself of over 700 plates and lots of bolts. Over 95 per cent. of the records examined show changes of the reports to be made to the inspectors, evidently for the purpose of deceiving the inspectors. The third charge as to the double treatment of the bolts is held to be proved. The fourth charge, as to preliminary pulling of the tensile systems, is admitted, but Superintendent Schwab says that it was done without his knowledge or sanction, although he would not have objected to it had he known it. The charge that false specimens were substituted is practically admitted, but held by Superintendent Corey to have been of small importance. The charge that the testing machine was "jockeyed" is also admitted, but it is claimed that the manipulation was legitimate. The charge of re-treatment of specimens is held to have been proved. Superintendent Corey admits that plates selected for ballistic test were re-treated without the knowledge of the inspectors, but says that this was done, not for the purpose of improving them, but as an experiment. The charge of plugging blow-holes is admitted, but it is claimed that the plates would pass the requirements of the ballistic test. The charge that the inspector's stamp was duplicated or stolen is not sustained, nor is the charge that the inspectors were deceived by false templets or gauges. The committee considers the Government inspectors to have been negligent in their duty, but not corrupt. It was recommended that the Secretary of the Navy be directed to remove certain specified plates now in place on various vessels and submit them to ballistic test, and that he be authorised to pay the costs of such tests from money heretofore appropriated for the increase of the navy. The resolution covering this point was adopted by the House.—*Railroad Gazette.*

Dividends in the Birmingham District.—A return which has been prepared of the dividends of public companies in the Birmingham district in respect of each half-year during the past two years is interesting reading. It shows that on the whole, though dividends have decreased, our local companies have stood their ground fairly well, and better than in some instances might have been expected, remembering that the period was one of constantly declining trade. Collieries have improved their position. The tube and metal rolling companies have fared badly. On the other hand, Muntz's Metal Company and the Mint maintain their distributions—the former at 10 per cent., and the latter at 7 per cent. The cycle manufacturing concerns, which formerly paid such handsome dividends, are nearly all down, the result of the excessive competition. Steel making and constructional engineering establishments also mostly tell an adverse tale. But the Horsely Engineering Company, Tipton, is a noteworthy exception. This firm has augmented its dividends of late years from 5 and 6 to 7 per cent. The principal changes in the railway rolling stock group are in a downward direction, but the Patent Nut and Bolt Company, Smethwick, maintains its reputation as one of the most wonderfully prosperous manufacturing concerns, not only in the Birmingham district, but in the whole country, by still declaring 10 per cent. dividends.

## HERMAN LUDWIG FERDINAND HELMHOLTZ.

On the 8th inst. died at Charlottenburg, Professor Helmholtz, in the seventy-fourth year of his age. The mere list of the papers which he has written would suffice to fill a page of THE ENGINEER. His reputation extended to every portion of the civilised globe. His father was a German, his mother an Englishwoman. He began his adult life as a physician, but at a very early period he turned his attention to the physiological mechanical side. The curing of those who were sick became a secondary matter when compared with the study of natural laws as exemplified in the structure and working of the human body. At the age of twenty-seven, he was appointed to a post in the Anatomical Museum of Berlin. When twenty-eight he was made Professor of Physiology at Konigsburg. In 1856 he held a similar post at Bonn. In 1859 he went to Heidelberg, and in 1871 he was appointed Professor of Natural Philosophy in the University of Berlin, which post he held until his death.

An adequate account of the life of Helmholtz and a satisfactory *résumé* of his work and his writings has yet to be written, and the writing will involve much labour, for the ground to be traversed is wide. The Professor did not spare himself, and his biographer will not get off easily. Here, now, we can do no more than indicate in a very general way what he did. In the present day everyone speaks glibly of energy, its development, and conservation. The fact that no one knows quite what it is, or how the word can be best defined, is a matter of secondary importance. But it must not be forgotten that all this popular use of the word is quite modern. In the days before Faraday, Tyndall, Joule, Thomson, and Grove, but little was known or taught or thought about the subject. Helmholtz wrote a short paper on the conservation of energy, which was one of the very first clear enunciations of the theory, and that paper beyond doubt had a most important effect in shaping and moulding scientific thought subsequently.

Helmholtz, above and beyond any physicist before him or with him, used the animal machine as a subject for study, induction, and deduction. While others dealt with the steam engine, he dealt with man, and accordingly we find that his inventions all took their direction from his bent of thought and specialised work. He wrote two remarkable treatises, one on "Optics" and the other on "Tone," but he dealt with both not from the abstract mathematical point of view only, but from the physiological as well; showing, indeed, the intimate relations which exist between physiological processes and the unalterable truths of mathematics. Thus he it was who first made it clear that the organism had to adapt itself to the laws of light, which it could in no way modify. He was the inventor of the ophthalmoscope, which materially modified ophthalmic surgery, and his studies in acoustics are almost monumental.

Helmholtz was appreciated, and honours were awarded him. The Copley medal of the Royal Society was awarded him in 1873, and in 1883 the German Emperor gave him a title of nobility. The proximate cause of his death was apoplexy. He had a preliminary attack some months ago, from the effects of which he only partially recovered, and he readily succumbed to the second. His temperament was calm, his method of thought wide and precise. He was a man of many friends and few enemies, respecting and respected. Emphatically a great man in the world of science, and one whose name will endure.

## LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.

The first meeting of this Association after the recess was held as usual in the Cannon-street Hotel, on Saturday, the 1st inst., at 7 p.m., when the President, Mr. Wm. H. Bale, and the Vice-President, Mr. R. J. Cook, occupied the chairs, and there was a good attendance of members.

After the general business was over, a paper was read by Mr. Jas. J. Pike, on "A Visit to the Scotch Coal Shale Mines." Mr. Pike briefly sketched the rise and progress of the American mineral oil trade from its first annual output of 2000 barrels to the present time, when the production is about 100,000 barrels per day. About the beginning of this period, say, in 1850, when the natural oil was beginning to flow freely from the American wells, Mr. Young, a Scotch chemist, was devising a method of distilling it from coal, and with other gentlemen established works at Bathgate, in the centre of the Torbanehill coalfield, for the manufacture of oil, &c., from cannel coal. Afterwards shale which had been often met with, but was looked upon as a mineral of no value, was used instead of coal, and with so much success that the oil industry developed at a rate almost unparalleled in the history of British manufactures, and although American competition in recent years has contracted it materially, the trade still survives, and is fuller of hope than at any time since 1885. There are at present in Scotland about sixty to seventy paraffin oil works in operation, and as in the case of the gas manufacture, the by-products are of as much if not more value than the oil.

Mr. Pike stated that the shale is found in seams like coal, and described the system of mining and bringing it to the surface, and then described the process of conversion, illustrating his remarks by a large assortment of samples of the various products. The shale is first crushed between rollers, then put into cast iron retorts and distilled at a low heat, somewhere about the melting point of plumbers' solder, when it evolves oil and ammonia vapours, which are collected and condensed separately into crude oil and ammonia water, which latter is converted into sulphate of ammonia and largely used as a valuable manure. The crude oil is re-distilled, washed with oil of vitriol and caustic soda, again distilled, when the lighter portion condenses into crude burning oil and the heavier into a heavy oil containing solid paraffin scale. The scale is cooled, pressed, placed on sloping shelves and heated nearly to the softening point. The softer portion gradually melts out and runs away, carrying with it the colouring matter and leaving nearly pure white wax. The heavy oil, after the hard scale has been extracted, is washed again with vitriol and soda and separated into different qualities of lubricating oils, which after further cooling to remove all the soft scale of low melting point, are finally washed again with chemicals, and so finished. The lighter portion of the crude oil, after several chemical washings and distillations, yields the finished burning oils of different grades.

Mr. Pike stated that the great chemist Liebig once said that it would be esteemed one of the greatest discoveries of the age if anyone could succeed in condensing coal gas into a white, dry, solid, and odourless substance, portable and capable of being placed in a candlestick and burned in a lamp, and it seemed as if this had now been attained in the production of the paraffin wax which is turned out by the ton and made into candles, &c. He also mentioned that it is largely used for preserving eggs, as having a low melting-point they are easily dipped into it, and when cold forms a thin air-tight coating round them which delays decomposition for a considerable time. A vote of thanks was given to Mr. Pike for his interesting description, and the meeting closed,

## RUSTLESS COATINGS FOR IRON AND STEEL.*

By M. P. WOOD, New York City, Member of the Society.

THE protection of iron and steel used in engineering, structural, and art work from the corrosive action of the atmosphere, as well as from air charged with the fumes of many industrial and chemical pursuits, and the fact that the usual coating with paint proves so ineffectual to guard from rapid decay, even when periodically renewed, has long attracted the attention of inventors and experimenters as well as the best efforts of many chemists and scientists. The latter, with all the resources of well-equipped laboratories, have not been much, if any, in advance of the less favoured experimenter who developes his ideas by main strength and awkwardness, though the fact or process once brought to light, the work of the savant is acceptable in proving the *rationale* of the same. Fredric S. Barff, of Kilburn, County of Middlesex, England, and George and A. S. Bower—father and son—of St. Neots, County of Huntingdon, England, were the first to practically coat wrought iron, steel, and cast iron with a magnetic oxide, forming at the cost of the metal itself the protective layer, which is usually formed from paint. This is the process known as the Bower-Barff that was developed in England about the year 1875.†

The process in brief consists of placing the articles to be coated in a muffle heated to approximately 1000 deg. Fah., and when they have attained this heat, either by extraneous firing of the muffle or by passing producer gas or the products of combustion through the muffle and amidst the articles contained, or by both methods named, steam superheated to the temperature of 1000 deg. Fah. is then admitted to the muffle, and the formation of magnetic oxide begins at once. The heat of the muffle decomposes the steam, setting hydrogen free, which can be utilised to assist in maintaining the heat of the muffle, the oxygen uniting with the iron to form $Fe_3O_4$, or magnetic oxide. The period of exposure is from five to twenty hours, according to the size of the articles and depth of coating required, which varies from $\frac{1}{100}$ to $\frac{1}{10}$ of an inch, and can be continued almost indefinitely, or until all moderate thicknesses of iron are resolved wholly into oxide. A very able presentation of the full process was made to this Society in a paper read by Mr. George W. Maynard, and found in "Transactions," American Society Mechanical Engineers, 1884, vol. iv., page 351. The colour of the magnetic oxide so formed is a dull blue-black: the coating is tenacious, though when broken through by drilling, shearing, or mechanical injury, oxidation of the injured surface proceeds more rapidly than in untreated articles.

The high heat and intermittent character of the process is destructive to the retorts or muffles, and the process is necessarily prohibitory to all articles requiring cutting qualities. Its application to fire-arms instead of the customary blueing or browning by acid was not a success, too much attention being required to prevent the springing or distortion of the barrels, and removing the deposit formed in the bore, though it has been employed to some extent in the fittings of fire-arms. Articles distorted in process can be reheated to a low red or black heat and re-straightened without injury to the coating. The process materially weakens the iron or steel articles coated, not only by the amount of material changed from a metal to a metallic oxide or metalloid, but suffers a further loss of strength, particularly in wrought iron, by the burning out of the cinder in articles long exposed to the heat, making what rollers and forgers call "dry iron." A further difficulty appeared in structural work held in place by rivets; the heat necessary to form the oxide caused the loss of set in the rivet. If riveted together after oxidising the parts, the rivet had no protection from corrosion, and Muntz or gun-metal connections became necessary. The coefficient of elasticity between the oxide and the metal from which it is formed, is so nearly the same, that railway bridge members and car truck frames are comparatively unaffected by long periods of service under compression, tension, and vibratory strains. The process applied to the pipes and iron work exposed to the action of mine, sulphurous, or acidulated and sea water, appears to give that protection from rapid decay so long desired by those who "churn" those liquids. The data concerning the cost of application of the process are very unsatisfactory. So much depends upon the size of the articles, depth of coating, whether the furnace or muffle is operated continuously or not; but it must be an expensive process per pound or square foot on account of the skilled labour and superintendence required, setting aside the expense of superheating the steam required to the necessary temperature of 1000 deg. Fah. None of the parties using the process appear to be at all anxious to recommend the adoption of their steam superheating device, or to flit their tales of woe about the same. Costs given range from 5 dols. to 20 dols. per ton of articles treated, but there are many situations in which the protection given by this process would bear an addition to these figures. The amount of steam required if used alone for the oxidising element and for coatings of a moderate thickness, is determined to be: for each pound avoirdupois gain in weight of iron oxidised to form the magnetic oxide, 232·9 cubic feet of hydrogen weighing 2 lb. was set free, making 3 lb. of steam or 75 cubic feet at or slightly above atmospheric pressure.

The above is the theoretical amount needed to furnish the oxygen; in practice from 25 to 33 per cent. more was passed through the superheater and muffle to get results. The deeper the coating the more steam was required. If 1000 square feet of surface was exposed for oxidation only $\frac{1}{64}$in. thick, it equalled 625 lb. of magnetic oxide, and would require at least 2500 lb. or 62,500 cubic feet of steam to be furnished in about six hours, or approximately 17-horse power per hour. The patents for the process, if not expired by limitation or by the non-use requirements of foreign patent laws, are rendered of small value except in special cases, by more recent improvements in the art by several inventors, one of which is a matter of record in this Society; and is of interest aside from its cheap and effective application by not being patented, the inventor by publication having given its use to the public.

The paper No. 180 presented to this Society by Wm. H. Weightman, "Transactions," A.S.M.E., 1886, vol. vi., page 351, embraces a report by Lieut.-Col. A. R. Buffington, Ordnance Department, National Armoury, Springfield, Mass., to the Chief of Ordnance, U.S.A., Washington, D.C., fully describes the process, which is peculiarly applicable to finished surfaces of iron and steel, notably fire-arms and kindred work; the process being conducted at so low a degree of heat as to not affect tempered parts of the arm. Finished surfaces of cast iron are given a bronze-coloured coating which sustains mechanical injury, such as a blow, without cracking the coating or affecting its protective power. The apparatus for armoury work consists of a common cast iron vessel or open-mouthed pot, deep enough to receive the longest piece to be treated—a gun barrel immersed vertically—and large enough in diameter to contain a dozen or more barrels arranged on a movable rack capable of being raised and lowered into the bath of melted nitre, which contains a small percentage of peroxide of manganese. A brick furnace is built around the nitre pot and a coal fire maintains the heat of the mixture, which is hot enough to ignite and maintain combustion in a pinch of sawdust scattered over the surface, or about 650 deg. Fah. The articles polished but not burnished or unduly raised in lustre are simply immersed and moved about in the bath for a given time or until the requisite colour is obtained, which can be ascertained by raising the articles out of the bath and re-immersing them any number of times until the colour is right; then they are removed, cooled in the open air to about the temperature of boiling water, then plunged into hot water to remove the nitre, and then into a sperm oil bath to complete the process. The nitre used must be refined, the commercial article not giving uniform results. Articles not taking the desired colour on the first application, or which bear a streaked or spotted appearance from some peculiarity in the metal, are corrected upon a second application. Care must be taken to prevent the introduction into the bath of water, oil, wood, or any carbon or combustible matter. The nitre mixture is not explosive, even when poured into the open fire, but in this case the arising fumes are suffocating and dangerous. The simple and inexpensive plant, the economy of time, labour, and material, the uniformity of product, and the beautiful colour mark this process an important advance in the art. I have been unable to learn of the application of the process to any large unfinished members of architecture or other structural bodies, but I see no reason why it should not be as effective in these cases as it is in the hundreds of small articles comprising horse furniture and saddlery fittings, general hardware, and articles made of malleable iron, wrought iron, and drop forgings, which are on sale nearly everywhere.

The *Journal* of the Society of Arts has a translation by Mr. Fredric W. North of a paper read before the Paris Société d'Encouragement, by M. Octave de Rochefort-Lucay, on the new Bertrand processes for coating with magnetic oxide, and enamelling iron and iron carburets, and on a new process of tinning for cast iron, that are of interest as being possibly more simple and effective than the Bower-Barff process, and are evidently based upon a new discovery in chemistry which may be thus stated. If a thin adhesive film of another metal is formed on a steel, wrought, or cast iron body, and this article be then heated to 1000 deg. Fah., and exposed to a current of oxidising gas, the oxygen penetrates through the film, oxidises the body metal, and forms magnetic oxide. The formation of this oxide continues indefinitely, the thickness increasing according to the period of exposure to the oxidising current, provided the temperature remains at about 1000 deg. Fah. The film of metal deposited in the first instance disappears in some obscure way, forming oxides which mingle with the magnetic oxide or volatilise according to the nature of the metal of which they are composed. M. Bertrand's experiments to find the best metal for depositing the primary coating led him to select bronze—a mixture of copper and tin—which gave perfect satisfaction, and for depositing it upon the articles to be coated with oxide, he uses electricity or wet baths, and sulphophenolic acid.

The following is the method adopted by M. Bertrand for an oxidation. The article cleansed—which is indispensable—is dipped a few moments in a bath containing a solution of sulphophenate of copper and tin, a slight coating of bronze is formed, the article is immediately washed in cold water and dried with sawdust, then placed in the furnace. Oxide forms, and at the end of fifteen or thirty minutes—according to the size of the article—it is sufficiently oxidised, the coating formed varying from one-tenth to one-fifth of a millimetre for these exposures; longer periods give thicker coating to any desired extent. M. Bertrand uses an electrical current to determine if the coating is of uniform and sufficient thickness. The wires leading from the poles of an ordinary galvanic battery are fitted with a bell arranged to ring when in circuit. If on application of the wires to the article being coated the bell rings, the current passes, showing the oxidation is insufficient; if the bell is silent, the oxide is of sufficient thickness to insulate the object and to practically protect it.

*Process for tinning cast iron.*—The coating of cast iron surfaces with tin is one of the most unsatisfactory processes connected with the mechanical arts. M. Bertrand also uses sulphophenolic acid to obtain a durable coating of tin on cast iron. A bath is formed of water and the acid, in which salts of tin is dissolved in the ratio of 1 per cent. of tin salt and 5 per cent. of the acid. The article to be tinned, previously cleaned, is dipped into this mixture, and is at once covered with an adherent coating of tin, which can be afterwards polished on ordinary buffing wheels of wire and cloth, and a result obtained which is at once cheap and effective.

(*To be continued.*)

---

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

† See the United States patents—To Fredric S. Barff, No. 182,148, September 12th, 1876, protecting iron surfaces. Described in the *Official Gazette*, vol. x., page 443. To George and A. S. Bower, No. 234.524, November 16th, 1880, coating iron with oxide. Described in the *Official Gazette*, vol. xviii., page 1147. No. 270,004, January 2nd, 1883, depositing metals upon the surface of iron and steel coated with magnetic oxide. See *Official Gazette*, vol. xxiii., page 440. No. 270,005, same parties, same date, for a furnace used in connection with the process.

---

MORE MIDLAND CATS.—At the engine shed, Buxton, the men make a pet of a fine cat. On August 13th, it being known that the cat had a family somewhere around, search was made. *On the Line* says it was not until Wednesday afternoon that the kittens, five in number, were found in the trailing drag box, directly under the driver's footplate on goods engine No. 915. That day this engine had made a trip to Rowsley and back, thirty-two miles, besides shunting in the yard for several hours. The kittens were dry and warm, and as lively as could be.

DOVER HARBOUR.—After some little delays in the erection of the temporary timber staging at the new harbour at Dover, the first large submarine concrete block was satisfactorily set in position at the East Pier last week. The estimated cost of the East Pier and approach viaduct alone is some half-million sterling, and no doubt, when the whole scheme for the new harbour is completed, something over a million will have been laid out. The engineers for the work are Messrs. Coode and Matthews, the contractor for the whole of the work being Mr. John Jackson, of Westminster.

DEATH OF MR. JAMES TAYLOR.—We regret to announce the death of Mr. James Taylor, of Birkenhead, who was for nearly forty years one of the leading contractors for the Admiralty and other Government Departments. A native of Glasgow, where he was born in 1817, he became connected with Fox, Henderson, and Co, London and Birmingham, and in 1852 established the Britannia Engineering Works at Birkenhead. He was the inventor of the floating graving dock, and the inventor and builder of some of the largest steam cranes in the kingdom. Many of his inventions have been used in Her Majesty's dockyards.

A SUBSTITUTE FOR THE COMPASS.—The "Solarometer," invented by Lieutenant W. H. Beecher, U.S.N., is intended to supplant the compass, especially on iron and steel vessels, on which vessels the compasses would become practically useless if not frequently compared with some standard, owing to the deviation or variation due to the influence of the metal of the ship. Only one of these devices has yet been made—except the models—and this is to be tried on an ocean steamer by permission of the Secretary of the Navy. The instrument is floated in quicksilver contained in a vessel floated in the same material, and this latter vessel is hung in gimbals, so that the instrument will remain practically level in spite of the motion of the ship. A company has been organised to manufacture these instruments for naval and merchant vessels.

LABOUR AND WAGES IN BELGIUM.—THE ENGINEER ought to be accepted as an authority on the subject, and it roundly declares that the prevailing ideas as to the prosperity of the iron trade in Belgium are decided misconceptions. If we look for the fortunes made by individual Belgian ironmasters, it observes, we find that they are few and far between, and in scarcely any case will they compare favourably with those which have been made in this country by such men, for example, as the late Earl Dudley. The great companies do not pay their shareholders any extraordinary dividends. Indeed, taking all the circumstances into consideration, THE ENGINEER is disposed to say that making iron and steel in Belgium is not on the whole so profitable a business as making them in Great Britain. This is a strong statement, no doubt, but there is even more decided evidence on the subject. A representative of the American Government has conducted a comprehensive inquiry into the relative cost of production in the iron and steel trade in different countries. It was proved that the production of a ton of steel costs less in England than either in America—with its boundless iron ore and coal in close proximity, and its natural gas ready to be tapped for its blast furnaces—or in Belgium with its low wages and its long hours.—*Newcastle Leader.*

## RAILWAY MATTERS.

The Rhondda and Swansea Bay line is to be completed in about five weeks.

It is stated that the Russian Government has resolved upon the construction of a railway from Samarcand to the frontier of the Pamir region.

An application has been made to the Mayor of Palermo for a concession for the construction of four tram lines in that town to be worked by electric cars. It is proposed to erect the power station in the Piazza Ucciardone.

The report of the Statistician of the Interstate Commerce Commission for the year ended June 30, 1893, which has just been published, gives the railway mileage of the United States on June 30, 1893, as 176,461 miles. This shows an increase during the year of 4897 miles, being a gain of 2·80 per cent.

The Russian Government has recently received applications from several large foreign manufacturing firms for permission to build workshops in Russia, for the manufacture of rails and locomotives. It is represented that the establishment of foreign factories will obviate the paying, by the railway companies in Russia, of the existing high prices for home material.

The Illinois Central Railroad has been experimenting recently with a device for killing grass and other vegetation on the roadbed by electricity. The electric current was delivered from the generator through the blades of grass to the earth. The rate of movement of the outfit was about five miles an hour. The vegetation that was killed showed signs of distress at once, but it was found that some stalks escaped. On going over the same section a second time the remaining grass was killed, and that which had been killed at the previous passage was fired by the current. The experiments were so far satisfactory that it is probable that a new machine will be designed.

From the returns of Indian railways for the current financial year it appears that from April 1st to July 14th the increase in traffic, as compared with the similar period of last year, is most encouraging. The gross earnings have risen by nearly 34½ lakhs of rupees, and this in spite of a decrease on the Great Indian Peninsular system of close upon 14 lakhs. The East Indian, as usual, heads the list with over 10 lakhs; the Rajputana-Malwa is close on its heels with nearly 9½ lakhs; and the North-Western is a good third with 9¼ lakhs. The Oudh and Rohilkhund line has forged ahead with 5⅓ lakhs; the Eastern Bengal shows a welcome improvement of over 3⅓; and the Bombay-Baroda is 2,40,000 rupees to the good.

The signalmen employed on the passenger and goods stations of the Midland Railway between Millers Dale and New Wells, Derbyshire, have forwarded to Mr. W. L. Mugliston, the traffic superintendent, a petition for a reduction of hours of duty at the busiest boxes. They point out that some of the boxes in the district with fifty trains in twenty-four hours have recently been made second-class with ten hours, whilst on the main lines at the Junction station and intermediate boxes with two hundred trains passing in twenty-four hours still remain third and second-class ten hours. Mr. Mugliston has notified that their memorial is under his consideration. The traffic in this part of Derbyshire has greatly increased since the opening of the Dore and Chinley line.

The tenders for the work in connection with the construction of the Manchester, Sheffield, and Lincolnshire Railway Company's extension from Chesterfield to London have been given as follows:—To Messrs. Logan and Hemmingway, the first twenty miles from Chesterfield towards the south; to Mr. Lovatt, of Wolverhampton, the section from Loughborough to Aylestone, Leicester; and to Messrs. Topham and Co., of London, the section from Aylestone to Rugby; the fourth, between Rugby and Charwelton, is let to Mr. Thomas Oliver, of Horsham, while another London firm has secured the fifth and sixth sections from Charwelton to Brackley, and Brackley to Quainton, the firm being Messrs. J. T. Firbank and Co., of 15, Railway-road, London Bridge. The work will be at once proceeded with, and is expected to be finished in 2½ years. The total length of the railway is 112 miles, and the estimated cost 6½ millions sterling.

On Monday morning two goods trains came into collision outside Knottingley Station about nine o'clock. A Knottingley shunting engine in charge of a number of trucks while proceeding from the station to the depôt, ran into a special butter train on the Hull and Barnsley line, which was approaching on its way to Manchester. While crossing the upper south line to the down north line the butter train caught the trucks of the pilot engine, cutting its way through them, smashing up six wagons and strewing the line with *débris*. The driver and stoker of the butter train stuck to their engine and escaped uninjured, the wheels of the trucks through which their engines passed being piled on the top. The driver and fireman of the Knottingley engine contrived to keep their locomotive clear of the approaching train. Considerable damage was done to the permanent way, as well as to rolling stock, and it was afternoon before the line was again cleared.

The Godhra-Rutlam Line extension to Rutlam has been completed. Of the many extensions of this line which have been proposed, only one is in a somewhat forward state; this is the extension from Rutlam to Ujjain, where the broad gauge would meet the Indian Midland Railway. *Indian Engineering* says there is considerable probability of this extension being made at an early date. The project is now being considered by the Bombay Government, and will shortly go up to the Government of India, on whose behalf Mr. R. J. Bell, the new consulting engineer for State Railways, while in Bombay on his way to Simla, discussed the details of the scheme with the officers of the Bombay, Baroda and Central India Railway Company. That company's large scheme for connecting Bombay with the north without break of gauge is thus likely to be realised in a way. The company's proposals include also the construction of a loop line from Baroda to Godhra, which would shorten the through distance to Bombay by about twenty-five miles. As it is rumoured that the Secretary of State may be disposed to allow some portion of the accumulated cash balances in the Indian treasuries to be expended on remunerative public works, the extensions referred to will probably receive early attention.

While the discussion on the subject of "Light Railways" waxes merry, Mr. A. P. Heywood demonstrates the possibility of their construction in this country, even under the Board of Trade regulations at present existing, by exhibiting a 15in. gauge railway at Duffield Bank, near Derby. The line runs up a gradient varying from 1 in 10 to 1 in 12, about a quarter of a mile long, to a level 80ft. above, where the experimental course is laid out in the shape of a figure 8, so as to admit of continuous runs. This part, somewhat more than half a mile in length, has a level stretch of a quarter of a mile, the remainder consisting of gradients, of which 1 in 25 is the most severe. The minimum curve on the main line is 25ft. radius, but in the sidings some occur as sharp as 15ft. radius. The line is properly equipped with interlocked signals and points on a very simple plan, into the details of which it is hardly necessary to enter. There are on the railway three tunnels, two bridges, and a viaduct 90ft. in length and 20ft. high. At the exhibition two small locomotives, coupled all round, with flexible wheel-base and other improvements, were shown in steam; and closed and open bogie carriages conveyed visitors over the line. Dining and sleeping cars, together with goods wagons, vans, &c., conveying various loads, were shown at work; and also a dynamometer car, fitted with instruments to indicate the power and speed of the engines.

## NOTES AND MEMORANDA.

M. Le Chatelier, who has been making experiments concerning the magnetic properties of Hadfield's manganese steel, finds that the temperature of annealing should be about 1020 deg. Fah., and that from one to two hours suffices to effect the change.

A new photographic telescope with six cameras has recently been completed for the Yale Observatory. One of its applications will be for the purpose of taking six simultaneous photographs of meteors by closing electrical circuits at different points where single telescopes are erected.

The deaths registered last week in thirty-three great towns in England and Wales corresponded to an annual rate of 15·3 per 1000 of their aggregate population, which is estimated at 10,458,442 persons in the middle of this year. Huddersfield and West Ham were lowest with 10·1 and 10 5 respectively, and Liverpool again worst with 24 0.

In London 2369 births and 1175 deaths were registered, 275 births and 255 deaths below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 17·1, 15·4, and 14·4 in the preceding three weeks, further fell last week to 14·1. In Greater London 3224 births and 1511 deaths were registered.

Out of an area of 768,800 square miles in the French penal colony of New Caledonia there are, according to the report of the Belgian consul at Noumea, 307,500 square miles in which nickel ore is found, and one-tenth of this last-named area has been conceded to mining companies, who are now actively working 7688 square miles. The *American Manufacturer* says the ore occurs in the state of hydrated silicate of nickel and manganese, without the slightest trace of arsenic, and contains from 8 to 10 per cent. of metal, while some samples contain as much as 16 per cent. The mean value of the ore delivered at the port of shipment is about £4 per ton.

In a paper in the *Comptes Rendus* entitled "New Researches on Chromium," by M. Henri Moissan, the author states that chromium has been prepared in large quantity by means of the electric furnace. Pure chromium has the density of 6·92 at 20 deg. C. It is more infusible than platinum, and has, apparently, no action on a magnetic needle. It is practically unacted on in moist air, but burns at 2000 deg. C. in oxygen. It readily combines with silicon and carbon, to form very hard compounds; the silicide scratches the ruby. The pure metal is not nearly so hard, and readily takes a fine polish. It is hardly attacked by acids, resisting aqua regia, and is not acted on by fused potash, though oxidised by fused potassium nitrate, or chlorate.

A new solder for aluminium is being introduced by the Alsite Aluminium Company, 106, Liberty-street, New York. The surfaces to be soldered are cleaned by dipping in a hot solution of soda or potash, then dipped into nitric acid, rinsed in hot water, and dried. Sometimes the surfaces are cleaned by filing the edges to be joined. The parts to be soldered are heated as hot as can safely be done without melting, and a small portion of the solder is spread over the edges by means of a soldering brush, which should be kept heated during the process. The edges are then joined, and more solder is applied and spread evenly over with the brush. During the entire operation the metal is kept as hot as possible, and it is completed when the solder becomes distinctly white or the aluminium assumes a reddish hue.

An essential feature in the employment of aluminium for various industries is the power of that metal to resist the corrosive action of water. *Dingler's Polytechnisches Journal* recently chronicled experiments made on this subject at the Physical Institute of Berlin, which were attended with the following results:—A tube of aluminium was taken, found on analysis to contain ·58 per cent. of silicon and ·32 per cent. of iron, without a trace of lead or copper, also an aluminium plate containing 72 per cent. of silicon, ·50 per cent. of iron, and ·25 per cent. of copper. The experiments showed that aluminium, after immersion for 120 hours in water of varied composition, was corroded, this corrosion being strongest with hot water obtained from the town supply, and least with cold distilled water. The corrosion extended uniformly with the interior of the metal. Brass behaved much better. Although these trials show that the use of aluminium, from a chemical point of view, should only be resorted to under exceptional circumstances, they are none the less instructive with regard to the many other uses to which the new metal can be devoted.

At a recent meeting of the Vienna Academy of Science, Herr Bruno Piesch gave an account of his recent work on the change in the electrical resistance of aqueous solutions, and of the electric polarisation with change of pressure. The author has examined a large number of liquids, both acids and salt solutions. The apparatus—*Nature* says—was so arranged that the resistance and polarisation would be simultaneously measured. The high pressures used were obtained by means of a Cailletet's compression apparatus, and experiments were carried on up to a pressure of 600 atmospheres. The vessel in which the liquid to be experimented upon was placed was enclosed in the iron receptacle of the pump, being insulated by means of an ebonite plug. The following results have been obtained:—A change in pressure is always accompanied by a change in the electrical resistance, the resistance decreasing with increase of pressure. No definite connection is observable between the amount of the pressure change and the concentrate of the solution, but in the case of most of the substances investigated the change was greater in the case of very dilute solutions than in more concentrated ones. The magnitude of the change in resistance with change in pressure is very small, as is also the case with the change in the polarisation. In most cases an increase of the polarisation with increase of pressure was observed, but the irregularities were in this case greater than those observed in the resistance measurements. In conclusion, the author examined a solution of ammonium nitrate in alcohol, when he obtained changes in the same sense as in the case of aqueous solutions.

The photometry of arc lamps is a most unsatisfactory subject, more so, perhaps, even than of most lighting apparatus. Scientific determinations of the candle-power of arc-lamps are now generally made by measuring the mean spherical candle-power; and in instituting comparisons between the candle-power of arc lamps on alternate current circuits and on direct current circuits, to judge from the reports of experts, it is generally considered that this is the only fair method of making the measurement. As a matter of fact, however, so far as the commercial value of the light is concerned, this method is a somewhat misleading one, as in an alternating arc the rays are thrown as much upwards as downwards, and this distribution of light for illuminating a roadway, even where reflectors are used, is not so valuable as the downwardly directed rays from a direct current lamp. *Electrical Plant* says, recent determinations of the candle-power of arc lamps seem to go to prove, also, that there exists an enormous difference between different kinds of arc lamp carbons employed. Measurements of two 450-wall arc lamps, using different kinds of carbons, showed in one case—taking the mean spherical candle-power and employing direct current—only 500 candle-power, and in another, 1200 candle-power Mushrooming carbons with iron and other impurities have, we hope, long been discarded by practical men. It would seem, however, from the above determinations, that a regularity in burning and slow consumption are not only the only things to be thought of, and that carbons ought also to be tested for their illuminating capacity.

## MISCELLANEA.

Kingstown Harbour will shortly be deepened, to enable first-class battleships to anchor at low-water.

The Brighton Town Council have resolved to spend £47,000 in improving the sea front and in protecting the shore from the encroachments of the sea.

The Scarborough Town Council have voted for an expenditure of £70,000 for the construction of a new marine drive and sea wall round the castle foot.

The Mersey Docks and Harbour Board intend to erect a large new shed on the site of the central dockyard, Great Howard-street, supplying it with the requisite hydraulic machinery, roadways.

Messrs. Francis Morton and Co., Liverpool, have contracted for the supply and erection of the whole of the wrought ironwork in the extensive sheds at Hornby Dock, for the Mersey Dock and Harbour Board.

A boiler explosion on the French torpedo boat No. 120 at Toulon has resulted in the deaths of two sailors. An investigation has shown that the accident was caused through a leakage between the boiler and the furnace.

The Local Government Board have sanctioned the loan applied for by the Melton Mowbray Local Board, and approved of the scheme for improvements at the sewage works. The necessary additions include candy tanks, clarifiers, and polarite filters, and the work is to be proceeded with at once.

The Battersea Polytechnic has just issued its prospectus for the second session which opens for day classes on the 17th inst., and for evening classes on the 24th instant. The prospectus offers classes for both men and women in technical science, art, and commercial and general subjects, the number of classes being 133 in 71 different subjects.

The scheme proposed by Mr. J. F. Reade, A.M.I.C.E., London, for the supply of water to Kilkenny, has been selected by the Corporation of that city. Fourteen schemes were submitted, but the names of the other competitors have not been published, as the terms of the competition were strictly secret. It is estimated that the scheme selected will cost £21,500.

At the metallurgical works of Messrs. D. Cattro and Co., Italy, a firm giving constant employment to over 200 hands, although wages have increased by about 10 per cent. in the last three years, the average rates paid per day of 10½ hours are: To boilermakers, 2s. 3d.; ironfounders, 2s. 11d.; riveters, 2s. 11d.; turners, 3s. 2d. This is another striking instance of the lowness of Italian wages.

A correspondent of the *Echo de Paris* reports the invention of another new cuirass or breastplate, this time of hardened leather. It is said to resist absolutely sword and bayonet thrusts, and even a shot from the old-style revolver at 150ft. Another merit is its extreme lightness. A Mr. Lennard, of Brooklyn, has invented a bullet-proof shield, which measures 17in. by 13in., and is 1¾in. in thickness. At a trial of this cuirass held last month at Governor's Island, none of the shots fired succeeded in piercing the shield.

The chrome steel Chase-Gantt armour plate was subjected to a test at Sandy Hook proving grounds on August 24th, in the presence of a number of distinguished visitors. The plate was 5ft. by 6ft. and 10½in. thick, supported against a solid oak backing 36in. thick. The projectiles used were 300 lb. Midvale-Holtzer 8in. calibre. The first shot fired broke the plate in three pieces, some of which were badly cracked. A second shot was fired which broke the top section of the plate in several pieces and went into the sand butt.

Experiments with a new form of torpedo-net cutter are being carried out at the submarine mine station of Bramsnäs by order of the Danish Minister of Marine. The "torpedo scissors," as the appliance is called, are the invention of a Danish naval officer. They are fixed at the head of the torpedo, and their action depends upon its speed. Having effected a breach in the net the scissors fall aside and allow the torpedo to pass on and strike a ship's side. The *Times* says the experiments are so far successful, and the invention is regarded as hopeful.

Much trouble has recently been experienced with the underwater fittings in connection with the auxiliary circulating engine of H.M.S. Æolus, second-class cruiser. The vessel has since been docked at Malta, when it was discovered that the inlet and discharge valves had been fitted the wrong way, and that as a result both spindles were badly bent, and some of the fittings much corroded, while the valves, instead of being water-tight, have been leaking during the whole commission. As this work was done at Devonport, the Admiralty have instructed the officials at that port to ascertain who was responsible for this blunder.

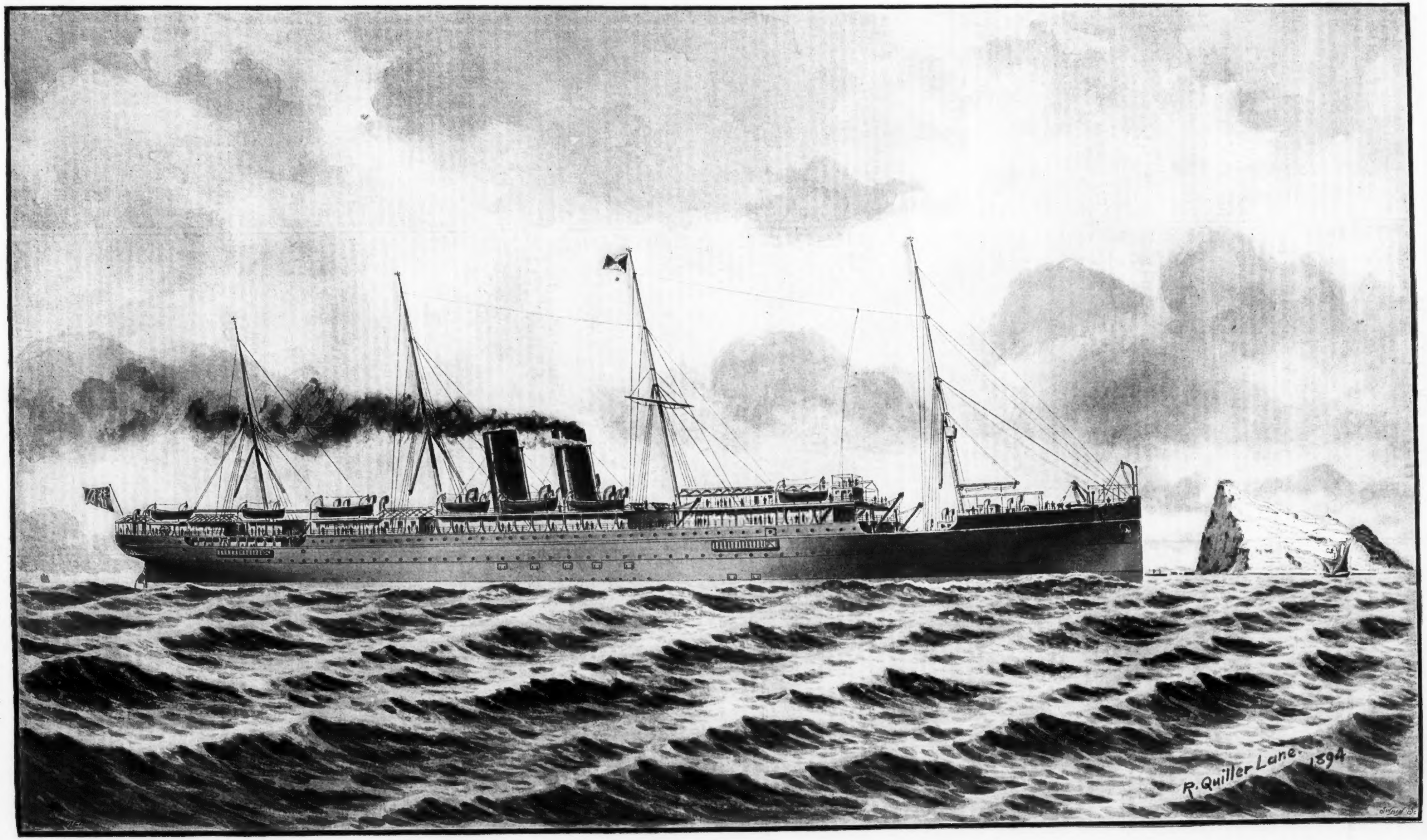
There is to be an electrical exhibition at Ealing which will be opened on Wednesday, October 3rd. There will be, besides the exhibits of leading electrical firms, a loan exhibition, in which will be included many of the latest improvements in electrical science. Almost every known system of telegraphic and telephonic manufacture and manipulation will be shown. There will be delivered during the ten days that the exhibition is open lectures by men of eminence in the scientific world. Sir Frederick Bramwell, for instance, has undertaken to lecture on "Elementary Electricity;" Mr. H. Graham Harris will explain the exhibits and their application to various purposes; and Mr. William Lind will lecture on "Edison and his Inventions." All the public thoroughfares within the district of the Ealing Local Board are to be lighted with electricity. The cost of the installation has been about £30,000.

The following is the report as to the progress of the Manchester Ship Canal works made by Mr. E. Leader Williams, chief engineer of the company, for the half-year ending June 30th, 1894:—"The dredging of the canal to the full depth of 26ft. has been actively carried on and will soon be completed. Eight dredgers have been employed, working day and night. The deposit caused by sewage brought down into the canal by the rivers Irwell and Mersey has materially increased the amount of work to be done. The dock sheds that were in progress early in the year have all been completed. Three additional large three-storey sheds are now being erected, and will be completed this year. A 30-ton crane is now at work, and twenty additional hydraulic cranes are being constructed and will shortly be ready for work. The roads at the docks are in good working order, with the exception of those recently ordered and only now under construction. Good progress has been made with facing the slopes of the canal with stone. The construction of the Walton lock and the dredging of the river Mersey between that point and the Iron and Chemical Works, near Bank Quay, Warrington, are still in progress. The dredging is a troublesome matter, owing to the continued silting. These works had to be carried out in pursuance of clauses inserted in the Act of 1885, to enable large barges from Bank Quay and Warrington to use the Ship Canal during low tides when they could not pass down the river Mersey to Liverpool. The Ship Canal Company will receive a small toll on the cargo in these barges when the work is completed. Notwithstanding the fact that nearly all the steamers using the canal have not previously navigated a similar channel, the trade has been carried on in a satisfactory manner, steamers using the canal regularly by day and night. The hydraulic machinery at the docks, swing aqueduct, bridges, and locks, continue to work in a satisfactory manner."

THE PENINSULAR AND ORIENTAL STEAMSHIP COMPANY'S S.S. CALEDONIA

MESSRS. CAIRD AND CO., GREENOCK, BUILDERS AND ENGINEERS

(*For description see page* 238)


R. Quiller Lane. 1894

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, September 14th, 1894. Page

The Decennial Programme for Naval Construction in France 225
The Decadence of Shipbuilding on the Mersey.. .. .. .. .. .. 226
Improved Wood-working Machines for the Manufacture of Lock Gates. (Illustrated.) .. .. .. .. .. .. .. .. .. .. .. 227
Railways in Indo-China .. .. .. .. .. .. .. .. .. .. .. .. 227
French Machinery at Antwerp Exhibition. (Illustrated.) .. .. 228
Federated Institution of Mining Engineers—Newcastle Meeting 228
Rankine's Marine Filter. (Illustrated.).. .. .. .. .. .. 230
The Argentine Cruiser Patria. (Illustrated.) .. .. .. .. .. 231
Boiler Explosion. (Illustrated.).. .. .. .. .. .. .. .. .. 231
The Armour-plate Scandal .. .. .. .. .. .. .. .. .. .. 231
Herman Ludwig Ferdinand Helmholtz .. .. .. .. .. .. .. .. 232
London Association of Foremen Engineers and Draughtsmen .. 232
Rustless Coatings for Iron and Steel .. .. .. .. .. .. .. 232
Railway Matters—Notes and Memoranda—Miscellanea .. .. 233
Leading Articles—Report of the Waltham Abbey Explosion—Liquefaction in Steam Cylinders .. .. .. .. .. .. .. .. 235
A Question of Value—Clyde Measured Mile and High-speed Steamers—Clyde Shipbuilding .. .. .. .. .. .. .. .. .. 236
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. 236
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 237
Centrifugal Circulating Steam Pumps. (Illustrated.) .. .. .. 234
The Peninsular and Oriental Steamship Caledonia. (Illustrated.) 238
Catalogues .. .. .. .. .. .. .. .. .. .. .. .. .. .. 238
Improved Multiple Drilling Machine. (Illustrated.) .. .. .. 239
Progress at the Cessness Docks, Glasgow .. .. .. .. .. .. 239
Universal Milling Machine. (Illustrated.).. .. .. .. .. .. 239
Letters to the Editor—Values of $\gamma$ and J .. .. .. .. .. .. 240
The Graphic Statics of a Deck Chair—The Theory of the Steam Engine .. .. .. .. .. .. .. .. .. .. .. .. .. .. 241
Trade Marks in Germany—House Coal in London—Fortifying Portsmouth—Aluminium Boats .. .. .. .. .. .. .. .. .. 242
American Engineering News .. .. .. .. .. .. .. .. .. .. 242
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. .. .. .. .. .. .. .. .. .. .. .. .. 242
The Sheffield District—The North of England .. .. .. .. .. 243
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. .. 244
American Notes .. .. .. .. .. .. .. .. .. .. .. .. .. 244
Launches and Trial Trips .. .. .. .. .. .. .. .. .. .. .. 245
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. 245
Selected American Patents .. .. .. .. .. .. .. .. .. .. .. 246

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

F. G. W. (Helical Gear).—*A letter lies at our office for this correspondent.*

Kernel (Cocoanut Husking Machines).—*Letters lie at our office for this correspondent.*

A. W.—*We are unable to give you the information you require. You might perhaps obtain it by applying to the Chinese Embassy, 49, Portland-place, London, W.*

S. D.—*So far as we can see there is nothing particularly new about your diving apparatus. The use of water-tight sleeves protruded through the side of a diving bell has often been proposed, and, we believe, actually used.*

G. H. T. (Mildura).—*The only illustrated article on colonial pumping engines which appeared in our volumes in 1888 referred to engines made by Messrs. Allen and Co., Lambeth. We cannot call to mind any article which answers to your description.*

S. W. S. (Ampthill).—*The proportions vary with different engines, say about one of oil in 30,000. The temperature of ignition varies with the oil used, and with the same oil it varies with the compression. Ignition tubes are kept at a dull red heat in most cases, but for some oils and in some engines must be kept at a bright red.*

J. C. (Whitehaven).—*It is impossible for us to answer your first question in the absence of all information as to what you know already. As to the second question there are plenty of "grinders" and "coaches" who will give you information by correspondence. But we very much fear that you will not win a Whitworth Scholarship in that way. If you will state your age and give us some idea of what you know now, we shall be in a position to advise you further.*

## SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)*.. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| **Thin Paper Copies—** | |
| *Half-yearly* .. .. .. .. .. .. .. .. .. | £0 18s. 0d. |
| *Yearly* .. .. .. .. .. .. .. .. .. .. | £1 16s. 0d. |
| **Thick Paper Copies—** | |
| *Half-yearly* .. .. .. .. .. .. .. .. .. | £1 0s. 3d. |
| *Yearly* .. .. .. .. .. .. .. .. .. .. | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

## ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## DEATHS.

On the 30th ult., at Summerseat, near Philadelphia, John Humfrey Osborne, C.E.

On the 9th inst., George Cole Baker, C.E., drowned at Rossbehy, Co. Kerry.

On the 12th inst., in his 78th year, James Taylor, of the Brittannia Engineering Works, Birkenhead.

# THE ENGINEER.

*SEPTEMBER* 14, 1894.

### REPORT ON THE WALTHAM ABBEY EXPLOSION.

The Committee appointed to investigate the circumstances of the explosion at Waltham Abbey have now issued their report. The Committee consisted of Lord Sandhurst, Sir Frederick Abel, Colonel Majendie, and Major-General Lloyd. The chief interest that attaches to the question now is the light that it throws on the manufacture and use of cordite. Before dealing briefly with the report, then, we would point out the bearing and significance of the features brought out. An explosive may be dangerous in two distinctly different ways; it may be unsafe to use or unsafe to manufacture. Clearly the former is by far the more important matter, because danger attendant on the use of an explosive pursues it through its entire life, jeopardises the safety of every person and thing with which it is brought in contact, and the evil becomes aggravated whenever less care than usual is taken. On active service, in tropical climates, and in the hands of inexperienced men, any danger becomes specially formidable. On the other hand, a measure of risk attending manufacture may be grappled with. It is limited in time and confined to a certain spot, and concerns only a particular body of trained workers; nor should there be any liability to the accidents and irregularities that, in the nature of things, must arise on service. The first object, then, with an explosive is that it should be trustworthy and reasonably safe when issued for actual use. Safety in manufacture is quite a secondary question; but one to be duly considered in its place.

Naturally the repeated explosions which have occurred at Waltham Abbey have brought the character of cordite into question. Consisting as it does of nitro-glycerine and gun-cotton, compounds which have each caused death in notable instances, distinct assurance is needed to establish confidence in it. This assurance was obtained at the time of its adoption, and was based on thorough experimental investigation; but the question arises whether accidents, which in the nature of things show mistake or serious fault, upset the conclusions formed. It will be seen from the report before us that the safety of cordite as a fully manufactured article is not only not assailed by any evidence, but, on the contrary, is confirmed. There was a large store of 3000 lb. of cordite drying by hot air in a building only eighty-five yards from the spot where the explosion occurred. This cordite was actually injured by falling *débris* and fragments of the building which was crushed by the explosion, yet none of the cordite was either exploded or ignited, so that in fact it compared very favourably with either gunpowder or gun-cotton. As, then, no cordite was fired at all, and as the only part played by it in the occurrence was to resist explosion under severe trial, we may dismiss the more serious branch of inquiry, and pass on to that only concerned—namely, the danger attending the processes of manufacture of cordite, a question which is certainly a most interesting one to those concerned in the work and those living in the neighbourhood of a cordite factory.

It appears that the explosion took place at 4.8 p.m. on May 7th last, in the washing house and in the "nitro-glycerine store" of the Quinton Hill Factory. These buildings were sixty-one yards apart, and one explosion followed so quickly on the other that there was some difficulty in discovering which took place first. The bulk of evidence, however, went to establish the fact that the washing house was the point where explosion commenced, and that the store followed so rapidly that the effect must be ascribed to the actual shock or air wave of the first explosion. The Committee consider that the second action was far too rapid to be attributed to the effect of falling *débris*, and that there is evidence that the actual flash was not capable of such a result, certain buildings, "nitrating houses," and persons who were actually more exposed to the flash, not suffering from it. The superintendent suggested foul play; but the Committee, while admitting that the buildings were exposed far too much to public approach, cannot find any evidence to justify the idea of foul play. Concluding that the explosion began in the "washing house," it remains to see by what means it might have been brought about, and this, as in similar cases, resolves itself into a surmise as to which of certain unlikely but possible contingencies took place. The explosion was simply a double explosion of nitro-glycerine—that is, of about 1500 lb. in the process of washing, and 2200 lb. of stored nitro-glycerine.

The process of washing is that which has been followed for seven years at least at Nobel's factory at Ardeer. Two lead tanks, 39in. in diameter and 35in. deep, are used. The wash water consisted of a succession of warm soda solutions which were floated on the top of the nitro-glycerine, and ultimately drawn off by a lead skimmer suspended from the ceiling by a pulley and with an india-rubber pipe leading from its bottom to an earthenware tap at the bottom of the tank, the washing being effected by air agitation by means of a lead pipe. Here, then, must be sought the elements of danger. It appears that the soda solution was used at a temperature of 50 deg. Cent.—122 deg. Fah.—which is sufficiently high to render the nitro-glycerine sensitive and reduce the margin of safety in an undesirable way. This was done to facilitate and accelerate the purification of the nitro-glycerine to the rigorous standard required by the Government. Temperatures as high, or even higher, have been maintained in other factories, and the Committee do not think that blame is to be attributed on this account, but they recommend that a lower temperature be maintained in future. This element, then, undoubtedly favoured the explosion, while it could not in itself produce it. The actual provoking cause must be looked for in the handling of the articles mentioned above. The lead skimmer, if dropped on a film of nitro-glycerine on a hard surface, would explode it. It is difficult to see quite how this condition could here be produced, but the skimmer has been known to run down more rapidly than was intended, and if the pulley broke, or some accidental swing struck the skimmer against the side of the tank, an explosion is quite conceivable. Next earthenware cocks have been known to stick, and the application of force might then explode the nitro-glycerine. So the lead pipes and other loose articles might by their fall cause the accident. Further, the precaution necessary to prevent the carriage of grit into the houses on the boots of the men was not as strictly enforced as desirable. Consequently, the Committee see the most probable cause of explosion in the above elements. The accident occurred while the process of washing was in progress, and those engaged were killed, and everything happened, as unfortunately was to be expected, under such conditions that no further evidence is available. While attaching no blame to any of the staff of the factory, the Committee recommend that the buildings be divided and reconstructed in a different way. They consider that the premises and ground at Quinton Hill only afford scope for half the factory now existing; consequently they recommend that duplicate factories be established—one on Quinton Hill and one elsewhere. Further, they suggest that the nitro-glycerine be absorbed into gun-cotton, forming cordite, as fast as it is made, and that no store of nitro-glycerine should be kept. Finally, they recommend that the actual operations should be under the constant and immediate supervision of "a chemist of high standing and of long special experience in these departments of chemical industry." Taking it altogether, it may be said that the report is as satisfactory as could well be under the circumstances.

### LIQUEFACTION IN STEAM CYLINDERS.

Mr. Donkin's able paper read before the British Association and reproduced in our columns, supplies, when taken with correlative facts, an excellent illustration of the difficulties encountered in endeavouring to give shape and coherence to a theory of the steam engine. A correspondent last week asked Mr. Donkin for further information. It is more than doubtful if any one can supply what is wanted. Mr. Donkin has carried out with much care and skill a very elaborate series of experiments. He started with the thesis that the metal with which steam comes in contact at each stroke of the piston liquefies a portion of that steam; and he proceeded to ascertain how much liquefaction took place under various conditions, and what relation the liquefaction bore to the quantity of metal heated. The most important of his deductions, however, is that, by jacketing the cylinder liquefaction is very much diminished, and the economy of steam largely promoted. All this is quite clear, and sufficiently demonstrated. Again, everyone knows that steam is condensed in the jacket, giving up its heat to prevent liquefaction in the cylinder; and it is also pretty well understood that the principal reason why condensation in the jacket is not so wasteful as condensation in the cylinder, is that all the water formed in the cylinder must be re-evaporated therein, while that condensed in the jacket is discharged from it as water. In the first case every pound of water formed in the cylinder is evaporated twice at the expense of the fuel—once in the boiler and once in the cylinder, while steam condensed in the jacket produces water which has only been evaporated once in the boiler. So far all is clear.

The value of a theory lies principally in its capacity for practical use. If the theory does not work in practice it may be interesting, or amusing, or scientific, but its commercial value is necessarily very small. Applying this test to Mr. Donkin's investigations, it is easy to see that their pecuniary value is next to nothing. If they prove anything it is that jacketing is essential to economy in the use of steam. But there are plenty of examples available which prove quite as conclusively that exceedingly economical engines are at work which are not jacketed, and furthermore, that in these engines, turning steam into the jackets did not make them more economical but less so. How can this be? What is the explanation of the fact? There is no satisfactory explanation available, and yet the circumstance is one of value and importance. It affects every theory of the steam engine; it is radical; it goes to the very root of the whole matter. Until a satisfactory explanation is forthcoming there can be no theory of the steam engine framed which is worth the paper on which it is written. We have more than once called attention to the only fact which appears to be able to help in any way to a right conclusion. It is that in all the highly economical engines in which a jacket does no good, there is next to no compression in the cylinder, the leading corner of the diagram being almost a right angle. But this really enlightens us very little, and as we have of course not seen all the diagrams that have been taken from economical unjacketed engines, it is impossible for us to assert that they all have square admission corners. We can only give the results of our own experience; but it is at all events worthy of note that no one has contradicted our statement, or sent us diagrams proving it to be erroneous.

As matters stand at present, we have a very consistent theory of the steam engine, which is that a certain proportion of the steam admitted per stroke is expended in heating up the cylinder in the first instance during the admission period, and is subsequently re-evaporated mainly during the exhaust period, and never does any work whatever on the piston, or, at all events, very little. Mr. Donkin reduces this theory to particulars, and shows how much metal is concerned in doing mischief. There is no question of Mr. Donkin's accuracy; but it is impossible to accept his conclusions as universally applicable to the steam engine, because there are so many steam engines at work, which contradict them. Why do the exceptions exist? This is *the* question to which engineers and physicists should direct their attention. In what direction are we to search for the solution of the problem? The first point to be considered is this: On what does the power of the metal to condense steam depend? Obviously, on its capacity for taking up heat. Can it be shown that two different pieces of cast iron vary in this respect? Has the nature of the surface of the metal any influence? It was suggested not long since in our pages that a surface of metal dead smooth would be a worse absorber of heat than a rough surface. We have made some inquiries on this point, with wholly negative results. In highly economical engines no attempt has been made to polish the insides of cylinder covers or piston faces; indeed, in all cases it is known that these parts soon become dull, and coated with a thin layer of grease and dirt brought over by the steam. On the other hand, Mr. Donkin has proved that by putting plenty of oil into a cylinder condensation is diminished, just as it is by a jacket; and also that a thin coat of varnish has the same effect. The quantity of metal affected and affecting is in any case so very thin that it is nearly, so to speak, all surface, and it would almost appear that it is to some relation between the character of the surface and the steam that we must look ultimately for the solution of the problem; but when we have reached this conclusion we have advanced but a very little way. Then we have the remarkable fact that the efficiency of cylinder metal as a condenser is appallingly phenomenal. It is far superior in this respect to the brass tubes of a surface condenser through which cold water is flowing. Furthermore, it appears to be largely independent of difference in temperature. At all events, whether the range of temperature within a cylinder is large or small, the condensation seems to be about the same. This truth is beginning now to be accepted by those who for years strenuously opposed us when we directed attention to the results obtained in actual practice with triple, compound, and single-cylinder engines.

One point claims further investigation. What is the relation existing between the quality of the steam used and the amount of cylinder condensation? It will be remembered that the late Mr. Willans showed that most disastrous results as regards economy were obtained by permitting a tablespoonful or so of water to remain in a cylinder. It is well known that under certain circumstances pumping engines will not "come indoors" to the full length of the stroke if any water is allowed to remain in the cylinder. The views of Professor Zeuner and his disciples on the effect of water are too familiar to need reproduction here. Now, is it not possible that the key to the anomalies presented by steam engines in practice is to be found in the dryness or wetness of the steam? Is it not possible that much of the water said to enter the cylinder in the form of steam really enters it as water? We commend to our readers, as bearing on the subject, Professor Unwin's most valuable paper on priming which we have recently published. It was time that the subject was handled by a competent unprejudiced authority. We rise from the perusal of the paper with the conviction that a great deal of so-called dry steam is not dry at all, and that the much-vaunted salt test is of no value whatever. Not long since a case came under our notice in which the traps on a row of steam pipes delivered enormous quantities of water. These pipes were very carefully clothed. According to all existing data on the subject, the condensation due to radiation could not have produced one-tenth of the water coming from the traps. It amounted to from 12 to 14 per cent. of the feed-water. Tests were made in the usual way with the balanced water barrel, hose, and thermometer. These over and over again gave 10 to 12 per cent. of water in the steam. Then the salt test was tried, and it showed that the amount of priming was less than a fraction of one per cent. Here we have a case confirming the accuracy of Professor Unwin's conclusions. The first thing, it seems to us, to be done in all engine trials, of whatever kind, is to ascertain the percentage of water entering the engine with the steam. It would also be useful to ascertain the percentage of water in the exhaust steam, on its way to the condenser. As we have repeatedly pointed out, any water received from the boiler as such will find its way to the condenser as water. It will be augmented in quantity by the liquefaction due to the performance of work and to radiation, but the results obtained from the exhaust pipe would serve as a very useful check on those got from the steam pipe.

### A QUESTION OF VALUE.

SOME rather amusing reading is to be found in a printed document where it might be least looked for. The publication to which we refer is a Parliamentary Return just issued, showing the districts in England and Wales in which systems for treating sewage by precipitation are in operation, and stating "whether in such cases the precipitate is of a saleable value." Almost first on the list we meet with Aylesbury, where the sewage is dealt with according to "an expired patent of the Native Guano Company," and where the sludge is sold for a shilling a cartload. When the sewage was treated by the Company, the sludge was dried and ground, and was sold at £3 10s. per ton. Of course, unpressed sludge is nine-tenths water, but the Local Board appear content with a shilling for the sludge, and indisposed to seek the larger sum by the complete A B C process. At Kingston-on-Thames the process is in full working order, the sewage being treated by the Native Guano Company as lessees and contractors under the Corporation. The Company are described as disposing of the treated precipitate on their own account, the material being sold "under the name of native guano, and in the form of a dry powder." The Surbiton Commissioners have arranged "temporarily" for the transfer of their sewage to Kingston, whither that of Hampton Wick also goes, both to be merged in the A B C treatment. The Native Guano Company have fought a brave and prolonged battle on behalf of precipitation, yet the Parliamentary Return now before us lends little support to the idea that a chemical process can extract anything very valuable from sewage. If the Native Guano Company can achieve such a result, it would seem that nobody else can. A general abandonment of hope characterises the reports from the various localities where methods of precipitation have been brought into use. Buxton treats its sewage with "chalybeate water and lime," and passes the sludge through air compressers. Sometimes the farmers cart the product away, and sometimes, being busy, they leave the Local Board to cart it on to their own farm. The Buxton report concludes by saying, with respect to the sludge: "At present, however, it has no saleable value."

At Wolborough, in Devonshire, an alumino-ferric is used, and the sludge is dried in open bays, afterwards selling at half-a-crown per load, "which is about the cost of the forming the bay and drying the sludge." The Prestwich authorities consider "there is a distinct manurial value in the sludge, but hitherto the Board have not sold any." The farmers are good enough to take possession of the stuff, and the Board are willing to let it go. At Melton Mowbray, where lime is employed, the precipitated material "cannot even be given away." What becomes of it we are not told. At Sheffield, the question whether the precipitate from the sewage is of any value meets with the reply: "Not to the Corporation, as they are put to a large expense in disposing of it." At Golcar, it is said: "The Board have not been able to find a purchaser, but there can be no doubt that the product is of some value." In proof that the sludge possesses fertilising properties, it is mentioned that "trees and bushes planted therein have thriven well." At Ealing, in Middlesex, most of the precipitate is used for getting up steam, being burned with the house refuse in the destructor. If we remember rightly, the late General Scott used part of the Ealing sludge for fuel, in order to make cement of the rest. The Finchley report enters rather fully into detail, but acknowledges "there is no sale for the precipitate." It is found to be of some service on heavy land by disintegrating the soil and increasing its porosity, so that the land has absorbed quite 10 per cent. more sewage than before, without in any way affecting the quality of the effluent. At Taunton a sodium process is employed, and there is said to be a "great demand for the sludge in the district, for agricultural purposes." But we are not informed that the Corporation get a single penny in return. All through the list of towns there is the same failure to gain any commercial advantage by the chemical treatment of sewage. Not only so, but the receipts are so ridiculously small, where any are obtained, that the pecuniary result is practically nil. The Native Guano Company may get a price, but it has to spend largely in order to get it, and the system only operates in very few cases. Simpler methods yield an infinitesimal revenue.

The sewage from the district of Polegate, in East Sussex, is treated on what is known as the "Taunton system" of precipitation. The population of Polegate is doubtless small, and so indeed is the receipt from the sale of the precipitate, the sum total in about six years being one pound sterling. At Esher and Ditton, in Surrey, sometimes a little of the precipitate is sold at a shilling per load, but the greater part is "gladly given away." A curious report from Pontefract states that precipitation is effected by "lime and salt water and filtration," and that the product "finds very ready sale;" but the price is not named. Ambleside is happier than Polegate, for it has sold a year's precipitate by tender for £9 5s. But this is only about a penny per head on the population. South Crosland, in Yorkshire, "cannot say" whether the precipitate is worth anything or not. This they know. "No person has been willing to purchase," and the Board are said to be glad to get the article removed without receiving anything "therefor." In the Birmingham, Tame, and Rea drainage district there is partial treatment of the sewage by precipitation with lime in tanks, but the product has no saleable value. Coventry sold 4367 tons of its sewage product for £188 "only," being a little more than 10d. per ton. Stoke-upon-Trent obtained 1s., but there was not a ready sale "even at that price." Lichfield could get little or nothing. Manchester, recently making use of lime and sulphate of alumina, has "not yet had much experience as to the disposal of the precipitate." Salford treats its sewage with a mixture of lime and chemicals, and has many thousand tons of wet sludge, concerning the disposal of which "the Corporation are about to establish a system." Atherton is peculiarly unlucky, having sometimes to bear part of the cost of carting the sludge "in order to induce farmers to take it away." Burnley gets 10d. per ton "after treatment by filter presses and disintegration." Bolton, Blackburn, and Rochdale declare that they find no value in the precipitate obtained from the sewage; Leeds and Bradford announce the same.

While it is evident that the precipitated product of sewage, unless under the auspices of the Native Guano Company, is practically a drug in the market, yet there is some variety in the scale of prices, though the range is limited. Zero obtains in several cases, and something below zero, where money has to be paid to get rid of the "fertiliser." But why should Uxbridge, in Middlesex, get 3s. per ton, and yet be so dissatisfied that "a new system is about to be inaugurated." Hitchin, treating its sewage with sulphate of alumina, gets 2s. 6d. per load. Hereford, by a method not specified, gets the same price. At Leyton, in Essex, the sludge is pressed, which is so much in its favour, yet the Board must needs pay for its removal. Pressing is adopted at Colchester, reducing nearly 18,000 tons of liquid to a little more than 3500; but the average price obtained is only 1s. 6d. per ton, though a return of £260 seems exceptionally good. At Saffron Walden sludge-pressing machinery is employed, but the article produced has hitherto proved unsaleable, though it is thought quite possible that when the product has been tried for a longer period, "some one may consider it worth buying." At Adlington, in Lancashire, the alumino-ferric treatment has been tried, the precipitate selling at 8d. per ton. The system introduced by the International Water and Sewage Precipitation Company is at work in some places, or about to be commenced. At Daventry the sewage is treated by this system, and the results are said to be satisfactory, but the price obtained is only 1s. 6d. per load. The method pursued consists in the use of ferrozine and polarite. But at the root of all the various methods there is this consideration, that sewage has to be treated so as not to be a nuisance; and the pecuniary result, so far as the public are concerned, is altogether a subordinate question. There was a time when sewage was considered capable of yielding a handsome revenue. Irrigation was entered upon with the most sanguine expectations, and precipitation followed suit. But irrigation has its difficulties, though decidedly of service in the raising of certain crops. Precipitation offers a more facile, and a less expensive system, but it is burdened with sludge, and it throws away in the effluent the most valuable of the manurial properties which sewage contains. How to get rid of the sewage at the least cost seems to be the practical question. How to get any money out of it remains an unsolved problem. London is content to let its effluent go into the river, while the sludge is cast into the German Ocean, thus affording the most gigantic example of seeming waste to avoid a greater loss.

◆

### THE CLYDE MEASURED MILE.

THE Clyde "measured mile" at Skelmorlie promises to become more and more the area over which high-speed steamers of all classes, emanating from shipyards all over the kingdom, and even on the Continent, must show their paces and satisfy contractors' stipulations as to speed, turning power, &c. The Naval Construction and Armaments Company of Barrow has just received permission from the Admiralty to run the official trials of the torpedo boat destroyer Sturgeon, launched July 21st, on the Skelmorlie course; while during the past month or six weeks as many as four vessels, built by Messrs. Laird and Company, of Birkenhead—No. 97 first-class torpedo boat; the torpedo cruisers Ferret and Lynx, and the Argentine cruiser Patria—were tested for speed, &c., on the Skelmorlie mile. At Liverpool the measured mile is unsuited for these high-speed vessels; the Lynx, for example, having attained a maximum speed, for some distance, of 27·61 knots. The course at Skelmorlie is well sheltered and exceptionally well suited for securing trustworthy and uniform results. The water is deep—about forty fathoms, and the depth of water, it is generally conceded by experts, should not be less than from ten to fifteen times the draught of the vessel. If less than this the speed will be seriously interfered with. The Admiralty knot at Stokes Bay, from this cause, is almost totally useless for vessels of deep draught or high speed. Attention having been drawn to this subject by Dr. W. H. White at the Institution of Naval Architects two years ago, it is not surprising, therefore, that the Admiralty should readily agree to the trials of vessels built north of the Thames taking place at Skelmorlie, and it may even become the standard testing ground for most of the naval vessels produced in the dockyards of the south. Both the Leopold II., built by Messrs. Denny and Brothers, of Dumbarton, and the Marie Henriette, by the Cockerill Company, now running on the Ostend and Dover route, were tried on the Skelmorlie measured mile, and it is a condition of the contract for a new channel boat now building by the Cockerill Company at Antwerp that it shall try the vessel, when completed, on the Clyde.

### CLYDE SHIPBUILDING.

THE cessation of new orders which has marked the record of Clyde shipbuilding during the past month or five weeks has been agreeably broken in upon—so far, at least, as the artisans of Greenock and Port Glasgow are concerned—by the announcement of fresh orders from the P. and O. Company and others. It has been known for some little time that this enterprising company was in the market for four new steamships, and Messrs. Caird and Co., who have already built very largely for the company, have been entrusted with the building of two of these, the most costly. Messrs. A. Stephen and Son, of Linthouse, and a North of England firm—Messrs. Raylton Dixon and Co., of Middlesbrough—have each received an order to build one of the remaining vessels. The latter are stated to be two passenger and cargo or "intermediate" steamers similar to those on the stocks in Messrs. Caird's yard. The two vessels to be built by the latter firm consist of a first-class passenger steamer of 7500 tons, a duplicate of the Caledonia, also another first-class passenger steamer, 20ft. longer than the Caledonia, which is at present the largest of the company's numerous fleet. This latter vessel, it is also believed, is to be of the twin-screw type. Messrs. Murdoch and Murray, Port Glasgow, who have at present in course of construction three steamers for the Amazon passenger river traffic, have just booked an order for a fourth of similar dimensions.

## LITERATURE.

*The Theory and Practice of Modern Framed Structures.* By J. B. JOHNSON, C. W. BRYAN, and F. E. TURNEAURE. J. Wiley and Sons, New York; and Kegan Paul, Trench, Trübner and Co., London. 1893.

THIS book constitutes the most serious and elaborate attempt yet made and published in the English language to treat completely the subject of bridges, roofs, and kindred structures. It professes to be suitable for the use of students in the technical colleges and of practical engineers as well. In England of late years there has been a veritable flood poured out continuously from our chief publishing sources of so-called technical literature intended to assist in the development of instruction in our new technical schools. To a large extent these schools are misnamed, because their operations are mainly confined to the teaching of very elementary pure science, and venture a very few steps indeed into the domain of real technics. But everything must have an historical beginning, and it may very reasonably be hoped that before another decade has passed, these schools will have so far developed that a commencement to real technical education will have been made.

But this cannot be done generally until the pupils and teachers of these schools have abandoned their present apparent appetite for untruthful and slovenly translations into bad grammar of misunderstood passages culled from the classics of natural philosophy and accepted blindly without personal experimental test and without any effort of mental assimilation except of the most fantastic and careless description. All these must be swept into the rubbish destructor, and for them must be substituted more genuine guides written and taught by men who possess both real knowledge of things and also the power of accurately and clearly imparting their knowledge in intelligible language. There exist already a few such books of the most excellent kind for the use of the advanced students of our technical colleges. The one at present under review is an example of this class. It is written by a combination of men who have experience in what they write about, who are fairly familiar with the experimental facts and with the details of actual professional practice, and who are too well educated in reasoning power and in mathematical facility to be at all blind to the current mistakes in contemporary practice, or afraid to expose them and to recommend improvements deduced by more complete and careful theoretic investigation. It is not intended to assert that the book is without faults, and contains no errors; but it covers a very large range of subject with both theoretical and practical treatment, it goes into a perfectly sufficient amount of detail, and throughout it bears evidence of very honest and laborious endeavour to discover and describe what is true and best. It also proves the authors to possess quite an extensive acquaintance with the special literature in various languages bearing on their subject. Another merit deserves to be noticed—namely, the foot-notes, &c., in which very complete and frank acknowledgments are made of the sources from which theoretic and practical information has been derived.

The book consists of over 500 quarto pages. It is in good print, and is abundantly illustrated by clearly-engraved diagrams. It is divided into two main parts, in accordance with its title. The first part is mainly theoretic; the second mainly descriptive of practice. It is distinctly an American book; the practice described is American, and the theory expounded bears chiefly on American practice. Its distinctive origin is somewhat amusingly illustrated by the extreme brevity of its only allusion to the Forth Bridge, namely, one of half a line's length. In fairness it should be stated that similarly brief reference is made to several important American bridges.

The first ten chapters of Part I. deal with the "historical development" of the truss, general statics of frame structures, roofs, bridges under uniform loads and under wheel loads, conventional loadings used for purposes of design, cross-bracings, beams and girders, struts, and secondary stresses. Then comes a chapter on the statical analysis of suspension bridges; another on swing bridges, two more on cantilever and arch bridges, and the last, or fifteenth chapter, deals with deflections and with the distribution of stresses in redundant structures.

Part II. contains fourteen chapters and three lengthy appendices. These deal with style, choice of site, and the fulfilment of the conditions imposed by site; with fatigue in metals; with general constructive details; details of plate girders, roof trusses, railway and highway bridges, the design of a single-line railway bridge being worked through in full detail; the Howe truss, swing bridges, elevated railroads, æsthetic design, standpipes and tanks; and a chapter on iron and steel mill buildings. The appendices contain examples of detailed specifications, and a description of American methods of erection which will be interesting and instructive reading to those English engineers not already acquainted with these methods.

This statement of the contents shows that the work covers nearly all, if not quite all, the ground indicated by its title. The title-page bears the names of the three leading authors, but the work is really the production of ten different writers. The extensive treatment given to swing bridges is due to Mr. J. W. Schaub, a pupil of C. Shaler Smith. The two lengthy chapters on this subject form an excellent special treatise, but viewed simply as an item in a book upon bridges and roofs generally, they certainly seem to give this part of the whole an altogether undue relative importance. The chapter on æsthetic design, of which more will be said below, is by Mr. D. A. Molitor. It is refreshing to have testimony that the æsthetics of engineering receiving from some Americans that attention which they deserve, and which they do not get in any fair measure in any quarter of the globe.

It might have been advantageous if the first few pages of Chapter I., devoted to elementary explanations, had been written more carefully. Thus the first sentence is ungrammatical; lower down it is stated, somewhat incomprehensibly, that the external forces "are always concentrated or applied at the joints before they can come on the structure as a whole;" also that stress "can only exist in solid or plastic bodies when *unconfined*," and that "the external forces and internal stresses stand in the relation to each other of action and reaction in mechanics." This last statement is made quite generally, not confined to cases of static equilibrium, whereas it is strictly untrue during the oncoming of a load and the consequent generation of vibration, and also during the breakage or collapse of a structure. Again in a work devoted to the use of structural iron and steel, it is surely a superfluous inaccuracy to assert that the limit of constant proportionality between stress and strain is coincident with the limit below which no plasticity appears, *i.e.*, the limit beyond which permanent set begins.

The sketch of the historical development of lattice bridges is meagre in the extreme. The idea given to the reader is, that no one except Palladio, an Italian of the sixteenth century, and certain Americans, ever attempted anything in the way of bridge building. Whether this is intended as a display of American humour, or is meant seriously, it is impossible for an English critic to determine.

Chapter II., dealing with the statistics of equilibrium by the algebraic method, shows less of the above faults; but here again we find it stated that the mechanical conditions of equilibrium "in general fully determine the external forces, provided not more than three are unknown." This is just three times as much as these same conditions are really capable of determining. Each force requires three elements to determine it, and of the nine elements wanted for the full determination of the above three external forces, the conditions of equilibrium supply only three. It is a pity that careless statements of the most important fundamental propositions should appear in a work of this merit and completeness; the more so that it is proved to be mere carelessness in writing by the fact that the immediately following examples display as clearly as possible that it is only three out of the six elements needed to determine the ordinary two supporting forces that can be calculated from the mechanics of equilibrium alone. The glaring inconsistency between the examples and the teaching of the general proposition can hardly fail to confuse the student—if, indeed, it does not lead him to put a lower value upon the book as a whole than it deserves. Again, Example 4 in this place, which is not worked out, sets the student to solve a problem which it is impossible to solve without making as many as three perfectly arbitrary assumptions. It seems inadvisable to encourage students at the very outset to form the habit of solving difficult problems by the easy but often entirely misleading process of assuming this, that, and the other. The same mistake is carried forward into the next chapter, which treats the same subject graphically, where, on pages 23 and 24, it is boldly stated twice over that if the two ends of a structure be fixed to the abutments, the abutment reactions must be parallel, a peculiarly unfortunate error to teach to students.

This part contains, on page 24, a very neat solution of the problem "to draw an equilibrium polygon through three given points." Bow's nomenclature of graphic diagrams is mentioned, although without giving Bow the credit of it; but, unfortunately, it is used very little throughout the book. We notice here and there diagrams borrowed without acknowledgment from Bow and others.

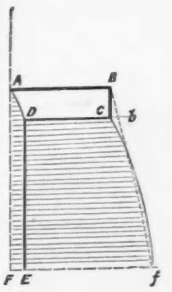
In the next chapter the weight of a roof is estimated as proportional to the square of the span. For railway bridges, in the following chapter, the dead load is taken as the sum of two terms in the first and second power of the span. These rules, although commonly followed, are not at all accurate through any large range of span. It is easy to frame a much more rational formula, which is quite as simple and easy to use. 30 lb. per square foot only is allowed for wind pressure, but on the other hand, on pages 36 and 37, a steep-pitched roof is worked out on the assumption that the *maximum* snow-load is to be *added* to the *maximum* wind-load. In our climate a roof would be cleared of snow by the wind before it rose to hurricane force. We cannot say what would happen in the United States. In Fig. 65 some confusion is produced by the wrong marking of one of the radii of the arch. Several excellent examples of roof stresses are worked out in more or less detail; but we must express our regret that the authors have seen fit throughout the book to give the + sign to compressions, and the − sign to tensions. Since by no conceivable convention is it possible to call the shortening that accompanies compressive stress a positive change of length, or to call the change of length accompanying tension a negative one, it is quite evident that it is inconvenient to adopt the above signs, or rather, the effect is a displeasing want of logical harmony in the nomenclature. Although little practical inconvenience arises, superfluous difficulty is introduced into every theoretical proposition of any considerable generality.

In the two following chapters a careful and able investigation of moments, shears, chord stresses and web stresses, produced by uniform and by rolling wheel loads, is given, the results being explained for a variety of patterns of lattice girder. In considering wheel loads, what are called "influence lines" are extensively and cleverly utilised. These are the invention of Professor G. F. Swain. An "influence line" is a diagram showing the effect produced at one constant section by a passing load of unit magnitude as this load moves from point to point along the bridge. The measure of the effect at the given section produced by the unit load when placed in any position is plotted vertically to scale at this position of the load; and through ordinates thus obtained for all possible positions of the load, the "influence line" or diagram is drawn, the whole of this diagram referring, however, to one particular section. The effect thus plotted may be a bending moment, or a shear, or a stress in one particular bar, &c. This conception is extremely fruitful in useful results, and it is a pity it is not more clearly and simply explained by the author of this part. Many results are obtained, but the obscurity of the method of reasoning leads sometimes to incorrectness in the conclusion, as, for example, in Equation (5), page 76, where a wrong, and, in fact, an unmeaning rule is stated. A capital form of diagram is given on page 85, Fig. 131, to enable the positions to be found for two heavy engines and tenders to give maximum moments and shears.

Chapter VI. is devoted to a discussion of five systems of conventional loading for use in designing, one of which, a new one proposed by the authors, seems to possess considerable advantages over the others.

In discussing the moment strength of beams in Chapter VIII., what is called a "rational formula" for the breaking strength is developed, which no doubt gives a much closer approximation to the real breaking strength than does the ordinary elastic formula. There ought, however, to be now-a-days no risk of the elastic formula being applied without modification to find the breaking strength by any intelligent engineer. Moreover, it ought to be borne in mind more constantly that the calculations of engineers have really seldom anything to do with breaking strengths, but are solely concerned with safe working strengths. For these latter the common elastic formulas for beams are sufficiently accurate. In this chapter again we have to complain of inaccuracy of language. For instance, the author here and elsewhere seems to be haunted by a strange belief that the equations of mechanical equilibrium are applicable only to "*rigid*" bodies. He also says that "within the elastic limit a normal section of a beam which is plane before bending is a plane and nearly normal after bending." Now the actual large variation of shear stress across the section clearly prevents it remaining *plane*, and it also necessarily becomes *not* normal in proportion to the average intensity of shear stress; so that both statements here made are strictly untrue. They are not approximately true because, although the deviations from flatness and normality are small, so also are all other strains considered in the problem, and these deformations are *not* of a minute magnitude compared with the others dealt with. Moreover, it is entirely unnecessary to assume flatness and normality in order to deduce with rigid accuracy the ordinary simple formulas of elastic bending.

The tabular statement of moment quantities contains a very useful column which, although it has been used privately for several decades past, we have not before seen printed in a text-book; the column, namely, of maximum deflections in terms of maximum stresses. The question of variation of shear stress across the section is also more fully treated than is usually seen except in purely scientific treatises. But we cannot agree to the contention that appreciable error is never made by assuming that, in the case of flanged sections, the whole shear load is uniformly distributed over the web section alone, the web receiving no help from the flanges. The numerical example taken to prove this is one of extreme dimensions, the height being 66 times the flange thickness, and the flange width being 32 times the web thickness. "Most economical" values for these ratios can be calculated. This is not done in the book under review, and the above stated ratios are far from being among the most economical. The accompanying diagram shows a very neat and easily drawn, and at same time closely approximative construction showing the variation of shear stress across the section of an equal flanged beam I section. A F and F *f* are centre lines giving the quarter section A B C D E. Set off C $b = \frac{1}{2}$ F E $= \frac{1}{4}$ the web thickness. Draw B *f* straight through *b*. C *f* should be a parabolic arc, which can be well enough approximated to by sketching, and A D is also a parabolic arc, but so nearly straight that a straight line may be drawn for it. The diagram A D C *f* measured from the centre line A F shows the relative variation of shear stress intensity across the section. To the scale of this diagram $\frac{1}{2}$ F E is the average shear stress on the flange, but it must be remembered that this comparatively small stress is exerted over the comparatively large flange section; so that in many cases, at any rate, the flange really bears a very appreciable share of the whole shear load. A rough approximation to this share is a little less than the depth of one flange divided by the depth of the web.



(*To be continued.*)

## BOOKS RECEIVED.

*Department of Science and Art of the Committee of Council on Education, London, S.W., Directory—revised to June,* 1894—*with Regulations for Establishing and Conducting Science and Art Schools and Classes.* London: Printed for her Majesty's Stationery Office by Eyre and Spottiswoode. 1894.

*Stresses in Girder and Roof Trusses for both Dead and Live Loads by Simple Multiplication, with Stress Constants for* 100 *Cases.* For the use of civil and mechanical engineers, architects, and draughtsmen. By F. R. Johnson, Assoc. M. Inst. C.E., civil engineer. Part I., *Girders;* Part II., *Roofs.* London: E. and F. N. Spon. 1894.

*The Water Supply of Towns and the Construction of Waterworks.* A practical treatise for the use of engineers and students of engineering. By W. K. Burton, Assoc. Memb. Inst. C.E. To which is appended a paper on the effects of earthquakes on waterworks. By Prof. John Milne, F.R.S. With numerous plates and other illustrations. London: Crosby Lockwood and Son. 1894.

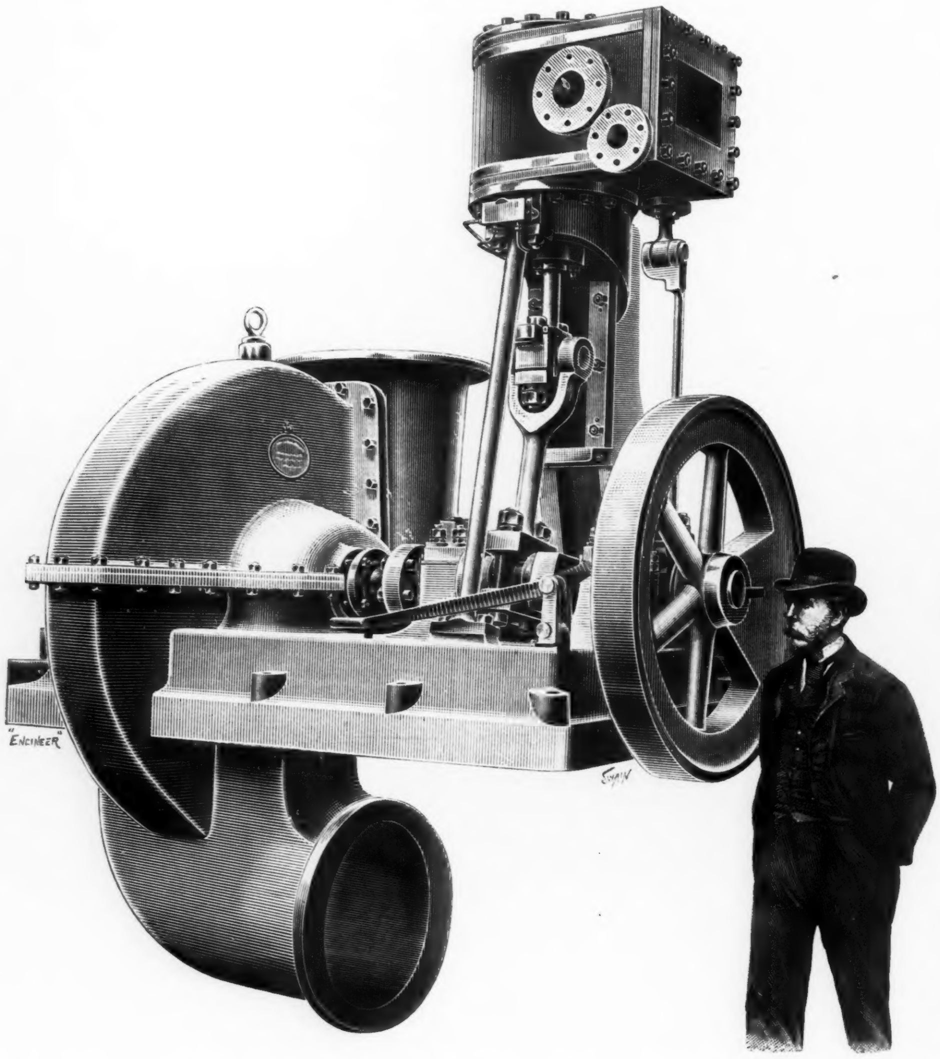
*The Gas, Water, and Electric Lighting Companies' Directory,* 1894. Revised to March 31st, 1894. With a specially written summary of the leading events of the year in the gas, water, and electric-lighting industries, and lists of associations of engineers and managers of gas, water, and electric lighting undertakings in all parts of the world. London: Hazell, Watson, and Viney. 1894.

NAVAL ENGINEER APPOINTMENTS.—Fleet engineers; Peter Colquhoun, to the Achilles, and Edward R. Vine, to the Nile. Engineers: John W. Ham, to the Achilles, and George G. Wright, to the Nile. Acting engineer: Victor de Paris to the Benbow. Assistant-engineers: Alfred T. P. Reed and Arthur Olver, to the Nile. Probationary assistant-engineers: Ernest E. Pethick and Francis Magrath, to the Nile, and G. W. Wooldridge, to the Collingwood.

PROPOSED MEMORIAL TO MR. JOSEPH HALL.—A suggestion has just been put forward that some memorial, either in the shape of a tablet upon the Birmingham Exchange, or some other form of permanent recognition, should be erected to the memory of Mr. Joseph Hall, an early Staffordshire ironmaster of the historic firm of Bradley, Burrows, and Hall, and now deceased some forty years or more. By the invention of the cinder or oxide bottom for puddling furnaces instead of the sand bottom, Mr. Hall is said to have done for iron manufacture what Sir H. Bessemer did for steel. The sand bottom had always been injurious to the making successfully of wrought iron, and the change marked an important era in the improvement of the quality of British iron. Moreover, the invention facilitated the introduction of pig iron made from weaker ores, and thus revolutionised the mixtures of the charges of iron for the puddling process.

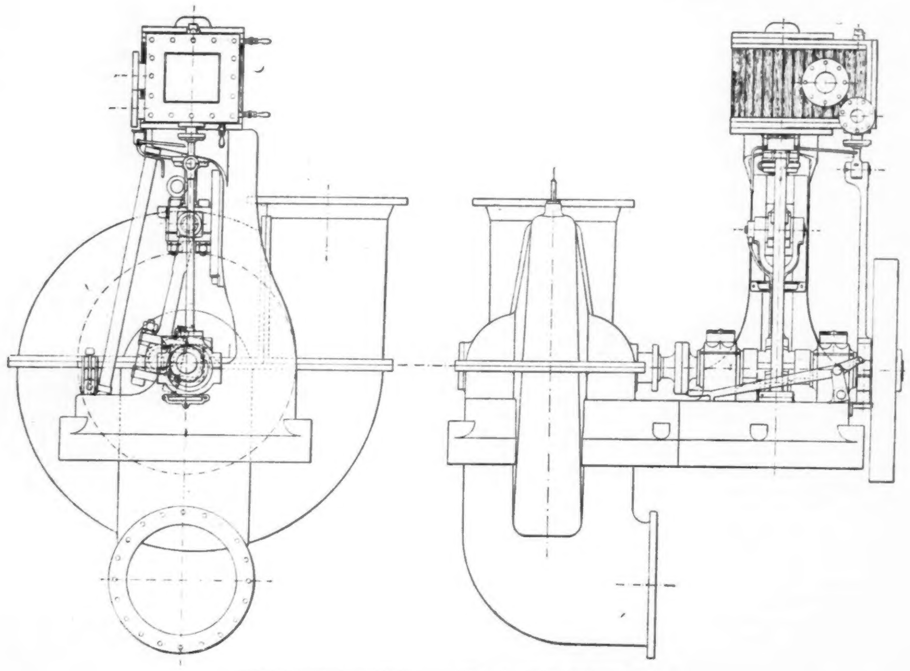
# CIRCULATING PUMPS, P. AND O. S.S. CALEDONIA

MESSRS. GWYNNE AND CO., LONDON, ENGINEERS

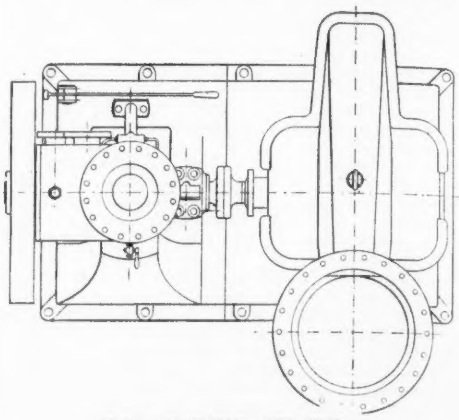


## CENTRIFUGAL CIRCULATING STEAM PUMPS.

Messrs. Gwynne and Co., Brooke-street Works, Holborn, London, E.C., have supplied the circulating centrifugal steam pumps to the Peninsular and Oriental Steamship Company's new vessel Caledonia, built by Messrs. Caird and Co., Greenock. These pumps—one of which is shown in front and side elevation in the accompanying illustrations—are intended for circulating the cooling water through the condensers, and are of large size, having inlet and outlet branches 24in. internal diameter. The pump discs are of gun-metal 4ft. 6in. diameter, keyed on steel spindles cased with gun-metal. The upper portion of the pump casing is made in two parts with flanges for bolting together, with a view to facilitating the removal of the bearings or shaft without disturbing the pipes. The engine cylinder is 15in. diameter by 12in. stroke, has an ordinary D-slide valve, and is bolted to the main casting, the working steam pressure being 170 lb. per square inch. With this pressure, and with a speed of between 180 and 190 revolutions per minute, the output of the plant is 11,000 gallons of water per minute. All the bearings are of special bronze, the working surfaces being of extra large dimensions to minimise wear. The pump bearings are 12in. and 7in. long by 4½in. and 4¾in. diameter respectively; the engine bearings being 10in. long by 4½in. diameter, the crank pin 8in. long by 4¾in. diameter, while that of the crosshead is 6in. by 3in. All the forged parts are of steel, and the construction generally is plain and substantial. The floor space occupied by each unit is 8ft. by 7ft., and the height above the floor 8ft. Special care has been devoted to the continuous automatic lubrication of all parts while the engine is running. A simple barring arrangement is also provided. The engines are made right and left-hand, arranged together compactly on one side of the engine-room. One alone is able to do the work of circulating through the main condenser, the other being a stand-by kept ready for emergency. Each pump and engine weighs about seven tons. They are designed to maintain a vacuum of 28in. when the steamer is going through the hot waters of the Red Sea.



CIRCULATING PUMPS, P. AND O. S.S. CALEDONIA



PLAN OF ENGINE AND PUMP

## THE PENINSULAR AND ORIENTAL STEAMSHIP CALEDONIA.

We illustrate this week the most recent addition to the fleets of the Peninsular and Oriental Steamship Company. We have already given some particulars of this splendid ship in our impression for May 25th of the present year.

She is 486ft. long, 54ft wide, and 37ft. deep, 11,000-horse power, and 7500 tons displacement. She was built and engined by Messrs. Caird and Co., Greenock. She will carry 320 saloon and 150 second cabin passengers, and 1500 tons of cargo. She has a single screw. She will sail on her maiden voyage on October 5th.

## CATALOGUES.

Lumley, Son, and Wood, Limited, West Grove Works, Halifax. Wrought Iron and Steel Welded and Riveted Boilers for Heating Apparatus on the low-pressure hot water, and low-pressure steam systems; Kitchen Range Boilers, Vertical Steam Boilers, and Hot-water Valves. This is a carefully prepared and well executed catalogue of a very large number of different forms and applications of the boilers above mentioned and their applications. The heating power of all the boilers is given in actual quantities of 4in. pipe that they are calculated to heat under average conditions, instead of the maximum quantity which it has been customary to give, based on Hood's rule of 50ft. of pipe for every foot of direct heating surface, from which about 30 per cent. should be made to secure efficiency. The catalogue contains a good index, and useful information on heating. It will be valuable to those who are concerned in the heating of buildings of all kinds.

Lea and Sons, Shrewsbury. Electric Light Fittings. Descriptive and illustrative of artistically designed fittings. This is one of the most artistic catalogues we have ever received. Not only are the designs of the pendants of various forms, and numbers of lights, and the brackets and table lights all of pleasing design, but they are nicely engraved, and every one coloured by hand. Messrs. Lea, Sons, and Co. should have a large demand for their fittings, as they undoubtedly will for this catalogue, although its price accords with the high character of its finish.

Isaac Hill and Son, Derby. Flush Side Cold Sawing Machines for various purposes.

Dewrance and Co., London. Catalogue of Engine and Boiler Fittings, Antifriction Metals, and Bronze. This is a nicely prepared and well executed catalogue of the firm's well-known fittings of various kinds, and illustrations of the application of these metals. It has a very complete index, is bound in cloth, and has the name on the back.

Russell and Co., London. Complete Catalogue of Electrical Engineering Requirements, commencing with steam engines and boilers, combined engines and dynamos, including steam, turbine, and dynamo combinations, machine tools, pumps, fans, &c., worked by electric motors, transformers, accumulators, and electrical fittings generally. A well executed quarto catalogue.

Leeds and London Electrical Engineering Company, Limited, The, Leeds and London. Lowrie-Hall Electric Converter, Station Main Fuse, Converter Fuses, High-pressure Fuse, Station Main Switches, &c.

Leeds Forge Company, Limited, Leeds. Morison Suspension Boiler Furnaces.

Drake and Gorham, Victoria-street, London. Electric Lighting Plant and Accessories.

Fleming, Birkby, and Goodall, Limited, Halifax, Yorks. Belting. A useful catalogue of various kinds of leather and leather link belting, woven beltings, methods of driving, leather ropes for driving of triangular and other sections, cotton driving ropes, belt fasteners and clamps, leather pickers and buffers, shuttles and tongues, canvas and other hose, and rubber mats.

Buchanan and Son, James, Liverpool. Sugar Making Machinery. Brick, Tile, and Pipe Making Machinery, including all the machinery and apparatus necessary for both these industries.

Hayward Tyler and Co., London. Complete Installations for the Electric Lighting of Houses, Factories, Mines, Ships, &c. All fittings amd requisites for electric light work.

Brown and May, Devizes and London. Portable and Semi-portable Steam Engines, High-pressure Undertype Engines, Horizontal, Fixed, and Stationary Engines and Boilers, Pumps, Sluices, Winding Machinery, Gravitation Battery for Wet Crushing and Grinding Mills.

Taylor and Challen, Limited, Birmingham. Shafting, Shaft-fittings, Pulleys, &c.

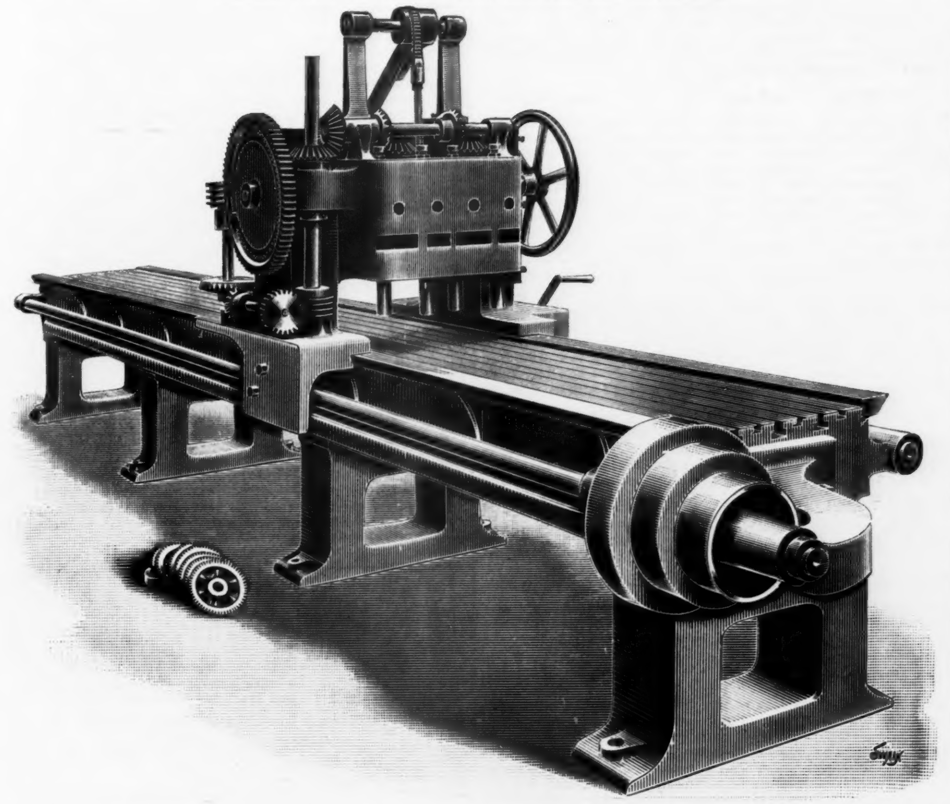
Davies and Son, John, Derby, London, and Cardiff. Mining, Surveying, Engineering, and Mathematical Instruments, Miners' Safety Lamps, Meteorological Instruments, and anemometers.

Cradley Boiler Company, London, and Cradley Heath. Second edition of their second 1894 catalogue of Lancashire, Cornish, Locomotive, Marine and Vertical Type Boilers, Flues, &c.

Ernest Scott and Mountain, Newcastle-on-Tyne. A complete and copiously illustrated catalogue of Electrical Plant and Accessories, Steam Engines, Boilers, Pumping Machinery, &c. Electric Specialities in the shape of Cranes, Capstans, Coal Cutters, Machinery for Electric Welding, &c., all lend to the usefulness of this catalogue.

## MULTIPLE DRILLING MACHINE

MESSRS. CUNLIFFE AND CROOM, MANCHESTER, ENGINEERS



## IMPROVED MULTIPLE DRILLING MACHINE.

WE give an illustration of a four-spindle drilling machine, specially designed and constructed by Messrs. Cunliffe and Croom, of the Broughton Ironworks, Manchester, for drilling spindle rails used in the manufacture of winding frames, in connection with cotton preparation machinery, where it is absolutely necessary that the holes should be drilled exact distances centre to centre, and the rails interchangeable. In this machine, which is of course applicable to many other purposes where accurately pitched holes are required, the drill spindles can be arranged a definite distance centre to centre, as shown in our illustration, or, by the introduction of adjustable quadrant brackets to carry the spindles, the distance can be varied, the driving gear being always in correct pitch in any position of adjustment. The headstock carrying the drill spindles moves in angle bearings vertically, being counterbalanced by a lever and weight, and is provided with self-acting down-feed and automatic disengaging motion to throw out the feed—which is adjustable in any position of the vertical traverse—and return the headstock and drill spindles to the starting position ready for the attendant to traverse the head along the bed for the next series of holes to be drilled. The gear is of sufficient strength to drill four 1in. holes at one operation, and the depth of self-acting feed is variable. The bed is provided with bolt grooves planed from the solid, and also with longitudinal clearance slots to avoid the drill entering and disfiguring the bed after passing through the work when drilling the full depth of the traverse. The illustration shows a machine with a bed 18ft. long to drill four holes at once, 5in. apart centre to centre, transversely in rails up to 15ft. in length—four rails at once—and to clear 20in. between the uprights, to admit and drill rails 8in. deep. The spindles—which never leave their bearings, but descend bodily with the headstock, thus ensuring accurate work—are bored up to receive 1in. taper shank twist drills. The pitch of the holes longitudinally can be varied to anything desired by means of a guide screw, revolving nut, dividing box, and suitable change wheels.

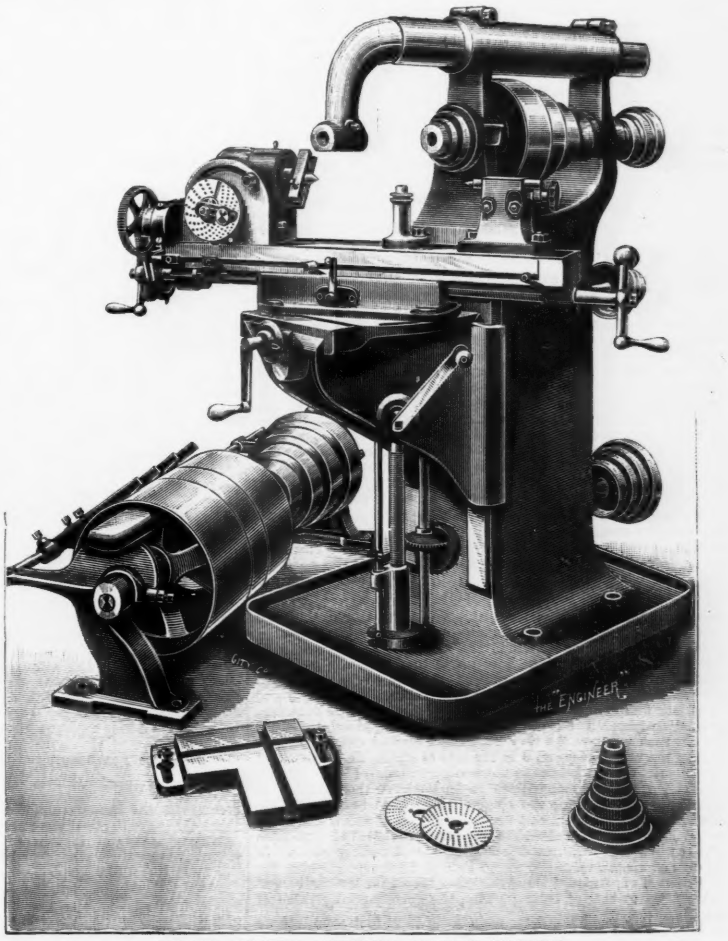
## PROGRESS AT THE CESSNOCK DOCKS, GLASGOW.

THE annual inspection of the harbour of Glasgow by the members of the Clyde Trust took place last week, and in no direction was more satisfaction felt than in connection with the forward state of the Trust's new docks at Cessnock, and the thorough character of the works, in so far as they are completed. Roughly speaking, about three-fourths of the entire undertaking—inaugurated in 1890—have now been accomplished. The scheme, it will be remembered, involves the formation of four basins and a new graving dock, which latter, when finished, will be the largest in the world. The total area occupied by the docks is about seventy-five acres; thirty-five acres being taken up by water space and forty acres by quayage and dry dock. Of the four basins—one an outer canting basin 1100ft. long, and three inner basins, each 1200ft. long—the north basin of the latter group—the basin nearest the river—has been complete for about ten months, and for the greater part of that time has been bringing in a revenue to the Trust. The centre basin will have its quayage complete in about a month's time, and four months subsequently the basin will be dredged out and ready for the reception of shipping. In this way 9000ft. of additional quayage accommodation will be available at the harbour of Glasgow. The quay wall forming the west boundary of the group of basins is now also complete, and sheds are being erected upon it, as well as the foundations for the Trust's new 130-ton crane recently ordered from Messrs. Cowans, Sheldon and Co., of Carlisle. The remaining, or "south," basin has also been begun, and about two years is the period allowed for its completion. The depths of water secured, and being allowed for, in the several basins are likely to be fully adequate to modern requirements either as regards large mail steamers, heavy deadweight carriers, or ships of war. In the completed north basin there is a depth at low water of 20ft., and at high water of 31ft. The centre and south basins are to have a low-water depth of 25ft., and a high-water depth of 36ft. In the outer or canting basin, through which approach is had to the several other basins, the depth is to be as much as 28ft. at low water, and 39ft. at high water, and thus afford ample depth for the clear berthing of the heaviest men-of-war. The several quay walls, which are constructed on the concrete cylinder principle, are founded in sand mostly at a depth of from 55ft. to 58ft. below the cope level. On the top of the concrete cylinders is a superstructure of granite, 20ft. in height, faced with concrete and granolithic. For the working of cranes, capstans, dock gates, &c., a hydraulic power station will be laid down at the east end of the central basin, the contract for the hydraulic machinery involved being in the hands of Messrs. Fullarton, Hodgert and Barclay, of Paisley. Work at the docks has been kept going night and day, the number of men employed being about 600. The plant constantly in use includes four locomotives, twenty steam cranes, ten portable engines of various kinds—for stone breaking, concrete mixing, pumping, &c.—three powerful dredgers, the largest of which has a lifting capacity of 600 tons per hour, and 16 hopper barges employed in conveying the dredged material to Loch Long, the largest of which carries 1200 tons. Since the beginning of operations, two and a-half millions of cubic yards of earth have been dug out, and mostly removed, and it is estimated that three million cubic yards more will have to be dug and removed ere the works are complete. The new graving dock, which is being formed immediately to the south of, and parallel to, the Clyde Trust's present graving docks, is well under way, attention, however, being meantime confined to the entrance end. It is to have a total length of 900ft., a width at the entrance of 83ft., and a depth of water on the sill at high water in spring tides of 27ft. The body of the dock will be 115ft. wide at top, 74ft. wide at bottom, and have a depth of 28ft. from average high-water springs to floor. The length of dock from inside face of caisson will be 880ft., and it is intended to divide this length into two by gates, placed at a suitable point, and with the full width and form of entrance maintained in wake of the masonry at and near the gates. The two present graving docks are only 560ft. and 575ft. in length respectively, and 72ft. and 65ft. across the entrance, with a depth of water of 23ft. The floor of the new dock, being founded on running sand, the laying of a satisfactory foundation is proving a matter of difficulty and painstaking care. To secure a dry bottom for the reception of the concrete, three rows of 9in. fire-clay pipes are laid upon a bed of gravel, and are covered over with a further layer of gravel 1ft. deep. Through the latter the water percolates to the pipes, the joints of which are left open so as to admit the water freely, which then finds its way to the temporary pumps. This was the system adopted with success in the construction of the present adjoining dock, and the concrete foundations being put down after this preparatory process in the case of the new dock promise to be equally successful. The total cost to the Clyde Trustees of the Cessnock Docks works is expected to amount to £1,250,000, which will bring up the total expenditure on the harbour of Glasgow since 1770 to approaching £15,000,000. The constructive and engineering operations at the docks are being carried out by the Clyde Trustees' own workmen, under the able direction of Mr. James Deas, civil engineer to the Trust, and his assistant, Mr. A. Hamilton.

## UNIVERSAL MILLING MACHINE.

THIS machine is an entirely new design, and made from new patterns throughout. The aim has been to embody all the most desirable working features and to make a heavy tool capable of doing the most accurate work as rapidly as possible. It is adapted to a great variety of uses; fluting milling cutters of every description, twist drills, taps and reamers, nut and bolt head finishing, die-sinking, cam cutting, cutting teeth in spur, bevel and worm gears, and automatically cutting spirals.

The column is cast solid with the head and supports for the overhanging arm. It has a flanged base and a cupboard for tools. The spindle is hollow, running in bronze bearings, and is hardened and ground. The outer end is threaded. The bearings are arranged with means for compensation for wear, and are self-oiling. The overhanging arm is in one piece. The table is of extra depth and slides in long bearings. It has a central feed, automatic in both directions and trips at any point. It can be worked automatically at any angle up to 45 deg., and can be operated by hand from either end. The spiral head is designed to be as compact and rigid as possible. It is arranged to take up very little room when being worked in a perpendicular position. Aside from the divisions obtainable through the worm and gears, it has an extra plate on the spindle for indexing directly when fluting taps, twist drills, reamers, &c. The tail stock centre has an angular adjustment. The knee is very stiff and extra strong, and its weight is taken on ball bearings. Its vertical adjustment is operated through a bearing which projects at an angle, so that the traverse and vertical adjustment can be operated simultaneously. Adjustable dials, graduated to $\frac{1}{1000}$in., are provided for both movements.



LUDWIG LOEWE'S UNIVERSAL MILLING MACHINE

The machine is made in four sizes, and is furnished with chuck and vice, set of change gears for cutting different spirals, three index plates, and a double countershaft. In model 1, the table is 33in. long, $6\frac{1}{4}$in. wide, and has a working length of 17in. Adjustment parallel with spindle is $6\frac{3}{4}$in., and vertical adjustment $17\frac{3}{4}$in.; the height of universal centres is $5\frac{5}{16}$in., with a maximum distance of 14⅜in. between them; four grades to cone, $3\frac{5}{16}$in. wide, and weight 1700 lb.

The machine is made by Messrs. Ludwig Loewe and Co., of Berlin, represented in this country by Mr. H. F. Orcutt, of Cannon-street, E.C.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### VALUES OF $\gamma$ AND J.

Sir,—As my letter on the values of $\gamma$ and J was the *fons et origo* of the lengthy correspondence which has, I think, effectually cleared up the fantastic mysteries of *fin de siècle* thermodynamics, and by so doing conferred an inestimable boon on engineering students, it is the most fitting title to my valedictory contribution to the discussion on thermodynamics. I wish to make a summary of, and advance a few more arguments in favour of, the views I have advocated. I must begin by acknowledging that in my criticism of the law of Boyle and Marriotte I committed the error of mixing together the scale in which equal differences of temperature correspond with equal differences of volume with the scale in which the coefficient of expansion per degree of temperature is constant. In the tables the value of a constant coefficient of expansion is given, which is equal to the total expansion between the thermal states of melting ice and boiling water, divided by the difference between the number of degrees which denote these two temperatures. This coefficient, therefore, only gives the correct expansion per degree of temperature on the Boyle and Marriotte scale at the temperature of melting ice. In the equation $p\,v = a\,(k + t)$ the value of $k$ is constant for all ranges of temperature, and represents the temperature on the Boyle and Marriotte rate of the zero of the scale to which it refers. On a Boyle and Marriotte scale equal increments of volume correspond with equal increments of temperature, so that the value of $a$ is constant. If, therefore, equal increments of volume correspond with equal increments of heat the value of $\gamma$ is constant and the correct equation of relation between the temperatures and pressures is

$$k + t_2 = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}} (k + t_1)$$

The correct value of the work done in adiabatic compression is also $\frac{p_2\,v_2 - p_1\,v_1}{\gamma - 1}$. If the value of $\gamma$ is not constant these formulas are only approximately true, and the value of $\gamma$ corresponding to the mean between the two temperatures ought to be used. The coefficient of expansion is equal to $\frac{1}{T}$, where $T = k + t$. If the coefficient of expansion per degree of temperature is constant, the equation of relation between pressures, volumes, and temperatures is

$$p\,v = p_0\,v_0\,(1 + a)^t$$

where $v_0$ represents the volume at pressure $p_0$ when $t = 0$. The zero of the scale may refer to any assigned thermal state. If equal increments of heat correspond with equal increments of volume, the value of $\gamma$ on this scale is also constant, and the same as that on the Boyle and Marriotte scale. The equation of relation between the temperatures and pressures is

$$\left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}} = e^{(t_2 - t_1)\log.(1 + a)}$$

If the coefficient of expansion per increment of unit of heat is constant, the value of $\gamma$ increases as the temperature increases.

Whether equal increments of volume correspond with equal increments of heat or the coefficient of expansion per increment of unit of heat is constant, can be set at rest by a very simple experiment. The apparatus consists of a receiver fitted with an air-tight piston, which can be moved freely up and down, so as to keep the pressure constant when the temperature of the air in the receiver varies, and a heating apparatus capable of giving out constant quantities of heat per unit of time. If the temperatures of the contained air are carefully noted by an ordinary thermometer graduated with equal intervals, and the times at which the observations are taken carefully noted, the differences between the temperatures will be found to vary very nearly with the differences between the times, if equal increments of heat correspond with equal increments of volume. If they are not found to do so, the temperatures on a scale on which the coefficient of expansion per degree of temperature is constant can be calculated from the observed temperatures, and their differences compared with the differences of the times. Theoretically the differences in the temperatures on a Boyle and Marriotte scale ought to vary exactly as the times, but not exactly on a scale in which the coefficient of expansion is constant, because the specific heat at constant pressure increases as the temperature rises.

The zero of the Boyle and Marriotte scale has nothing to do with the zero of the absolute scale. The zero of the Boyle and Marriotte scale corresponds with the total disappearance of the operative substance of the thermometer. If, therefore, this coincided with the zero of the absolute scale, total deprivation of heat would mean total annihilation of matter, but the mass of a body is unaffected by changes of temperature. Its physical form only suffers change. The difference between the zero of indicated and absolute temperatures must be less than $k$. It has yet to be proved that a body can be totally deprived of heat.

In a former letter I determined the values of J, on the assumption that the specific heat of steam is equal to that of water, by calculating the work done by the expansion of 1 lb. of steam, on the basis that it is equal to the work done in adiabatic compression. For this purpose I used the tabular values of the temperatures, pressures, and volumes of saturated steam, and the value of $\gamma$ from the formula $p\,v^\gamma$ = constant. To justify this method it is necessary to prove that the relations between the temperatures, pressures, and volumes given in the tables agree approximately with the adiabatic relations between them. If it can be shown that when the volume of dry steam is substituted for that of the saturated steam, the absolute pressure, volume, and Boyle and Marriotte temperatures are connected by the adiabatic equations of relation founded on the law of Boyle and Marriotte, it is evident that we have the very best experimental data for determining the values of $\gamma$ and J in the case of steam, since in making the experiments only simultaneous observations of the volume, pressure, and temperature have to be made, without having to make any allowance for the conduction of heat to and from the steam. Air, hydrogen, and probably all gases which obey the law of Boyle and Marriotte have the same coefficient of expansion between the temperatures of melting ice and boiling water. In the case of air the value 460·6 deg. Fah. of $k$ corresponds with the coefficient of expansion ·3654 of the volume from the temperature of melting ice to that of boiling water, the corresponding value of $\frac{p\,v}{t}$ on the Boyle and Marriotte scale being 53·21 foot-pounds if we adopt Regnault's value of $p\,v$ for 1 lb. of air at 32 deg. temperature and 14·7 lb. pressure, viz., 26,214 foot-pounds, for which value the volume of 1 lb. of air at the same temperature and pressure is 12·383 cubic feet. This is the value adopted by Rankine; Maxwell—"Theory of Heat," pages 49, 50—states that this coefficient is probably a little less than ·3665, but probably not less than ·366. Corresponding to ·3665 the value of $k$ is 459·13 deg. Fah., and of $\frac{p\,v}{t}$ is 53·38. If $a$ is the coefficient of expansion per deg. Fah. corresponding to the coefficient ·3665, we have

$$(1 + a)^{180} = \cdot3665 \quad a = \cdot001736.$$

If $t$, $\theta$, represent temperatures indicated by an air thermometer graduated with equal intervals, and an air thermometer in which the coefficient of expansion per degree is constant respectively, and the freezing temperature is in each case indicated by 32 deg., $t$ and $\theta$ will be connected by the equation

$$(1\cdot001736)^{\theta - 32} - 1 = \frac{\cdot3665\,(t - 32)}{180} = \cdot00204\,(t - 32).$$

In calculating the volume of dry steam corresponding to the volume of saturated steam, the coefficient of expansion for dry steam has been taken to be the same as that for air, and the tabular volume of saturated steam at 212 deg. Fah. to be equal to the volume of the same weight of dry steam. It certainly seems reasonable to assume that the weight of the moisture contained in a pound of newly generated steam is independent of the pressure. If this be so the ratio of the volume of the moisture to the combined volume of the moisture and steam must increase as the pressure increases. Thus if R be the ratio for newly generated steam at a pressure of 14·7 lb., its value for steam at 45 lb. will be about 3 R, and at 150 lb. about 10 R. Since the volume of saturated steam at 14·7 lb. pressure is about 1600 times the volume of an equal weight of water, calculations based on the assumption that the tabular volume is equal to the volume of the same weight of dry steam cannot be appreciably affected by the difference between the values. If then $v$ is the volume at 212 deg. Fah., the volume at any other tabular temperature $t$ will be equal to $(1\cdot001736)\,v^{\theta - 212 \text{ deg.}}$ multiplied by 14 7 lb., and divided by the tabular pressure corresponding to $t$. The following table gives the tabular values of the temperatures and volumes corresponding to the pressures 14·7 lb., 45 lb., 150 lb., and 200 lb., and the corresponding values of $\theta$ and of the volumes of dry steam. The values of $\gamma$ from the equations $p\,v^\gamma$ = constant and $k + t_2 = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}} (k + t_1)$, of $k$ from the equation $p\,v = a\,(k + t)$, and of the expression $\frac{p_2\,v_2 - p_1\,v_1}{\gamma - 1}$ given in column I. are calculated from the tabular temperatures, pressures, and volumes of dry steam given in columns I. and II. Those in column II. from the same data in columns II. and III., and those in column III. from the same data in columns III. and IV. The value of $J_1$ is equal to the value of the expression $\frac{p_2\,v_2 - p_1\,v_1}{\gamma-1}$, divided by the difference between the tabular values of the temperature $t_1$ the value of $\gamma$ used being constant and equal to the value at 212 deg., viz , 1·087, so that it is the value of J on a scale graduated with equal intervals, if the specific heat of steam is equal to the specific heat of water, on the assumption that equal increments of heat correspond with equal increments of volume. The value of $J_2$ is equal to the value of the expression $\frac{p_2\,v_2 - p_1\,v_1}{\gamma-1}$, divided by the difference between the value of $\theta$, the value of $\gamma$ used being that in the same column, so that $J_2$ is the value of J on a scale in which the coefficient of expansion per increment of unit of heat is constant. Columns V. and VI. give the values deduced from Mr. Harrison's data.

| | I. | II. | III. | IV. | V. | VI. |
|---|---|---|---|---|---|---|
| Tabular value of pressure in pounds .. .. .. .. .. .. .. .. .. | 14·7 | 45 | 150 | 200 | 45 | 150 |
| Tabular value of temperature $t$ .. .. .. .. .. .. .. .. .. .. | 212° | 274·4° | 358·3° | 381·7° | 276·3° | 362·7° |
| Corresponding value of temperature $\theta$ .. .. .. .. .. .. .. .. .. | 212° | 263·3° | 325·7° | 342° | 264·7° | 329·1° |
| Tabular volume in cubic feet of 1 lb. of saturated steam . .. .. .. .. | 26·27 | 9·15 | 2·95 | 2·25 | 9 | 3 |
| Calculated volume in cubic feet of 1 lb. of dry steam .. .. .. .. .. | 26·27 | 9·38 | 3·14 | 2·42 | 9·4 | 3·15 |
| Value of $k$ from $p\,v = a\,(k + t)$ .. .. .. .. .. .. .. .. .. .. | 458 | 360 | 433 | — | — | — |
| Value of $\gamma$ from $p\,v^\gamma$ = constant .. .. .. .. .. .. .. .. .. .. | 1·086 | 1·102 | 1·105 | — | 1·102 | — |
| Value of $\frac{p_2\,v_2 - p_1\,v_1}{\gamma - 1}$ in foot pounds $\gamma = 1\cdot087$ .. .. .. .. .. .. .. | 64,210 | 81·884 | 21,756 | — | — | — |
| Value of $J_1$ .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. | 1,030 | 973 | 930 | — | — | — |
| Value of $\frac{p_2\,v_2 - p_1\,v_1}{\gamma - 1}$ in foot-pounds, $\gamma$ varying with $\theta$ .. .. .. .. .. | 64,210 | 69,137 | 17,819 | — | 70,588 | — |
| Value of $J_2$ .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. | 1,232 | 1,107 | 1,094 | — | 1,096 | — |
| Value of $\gamma$ from $k + t_2 = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma-1}{\gamma}} (k + t_1)$ .. .. .. .. .. .. .. | 1·087 | 1·096 | 1·11 | — | 1·088 | — |
| Value of $p\,v\,a$ in foot-pounds .. .. .. .. .. .. .. .. .. .. .. | 96·54 | 105·52 | 117·74 | 121 | — | — |
| Value of $\gamma$ from $\gamma = \frac{1132 + p\,v\,a}{1132}$ .. .. .. .. .. .. .. .. .. .. | 1·085 | 1·093 | 1·104 | 1·11 | — | — |

The calculated volume of dry steam at 45 lb. pressure is about 2½ per cent. greater than that of saturated steam, at 150 lb. about 6½ per cent., and at 200 lb. about 8 per cent. A result which proves that the coefficient of expansion for dry steam is the same as that for air, and that the weight of water in a pound of saturated steam is about the same *cæteris paribus* at all pressures. A very slight alteration in the volume, pressure, and temperature would make the calculated value of $k$ agree with that for air. In calculating the value of $\gamma$, the value $k = 459$ has been used. The values of $\gamma$, calculated from the equations $p\,v^\gamma$ = constant and $t_2 + k = \left(\frac{p_2}{p_1}\right)^{\frac{\gamma - 1}{\gamma}} (t_1 + k)$, are so nearly equal, and the values of $J_1$ so nearly constant, that it is clear that the relations between the tabular pressures and temperatures and the calculated volume of dry steam agree with the adiabatic equations of relation founded on the law of Boyle and Marriotte. I have already pointed out that if equal increments of heat correspond with equal increments of volume, the value of $\gamma$ is constant, both on the scale graduated with equal intervals and the scale in which the coefficient of expansion per degree of temperature is constant, but that it is not in either case if the coefficient of expansion per increment of unit of heat is constant. Corresponding to a rise in the value of $\theta$ from 125 deg. to 126 deg., and of $t$ from 118 deg. to 119 deg., the increment of volume is the same on both scales, and therefore the specific heat and the value of $\gamma$ the same, whether equal increments of heat correspond with equal increments of volume or the coefficient of expansion per increment of unit of heat is constant. If this coefficient is constant the specific heat at constant volume on the Boyle and Marriotte scale decreases as the temperature rises above and increases as the temperature falls below that value. Since the value of $\frac{p\,v}{t}$ is constant therefore the value of $\gamma$ increases as the temperature rises. Although in both scales the value of $\gamma$ rises if equal increments of heat do not correspond with equal increments of volume, as the temperature rises for other thermal states than that represented by the value 124 deg. of $\theta$, the value of $\gamma$ will not be the same on both scales, but within the limits of temperatures selected the difference between the two will not be appreciable. The gradual increase, therefore, in the values of $\gamma$ derived from both the adiabatic formulas proves that equal increments of heat do not correspond with equal increments of volume.

The mean of the four values of $J_2$ is 1132. If the pressures in II., III., and IV. are altered to 44·75, 149·21, and 199·11 lb. respectively, the value of $J_2$ will be equal to about 1132 foot-pounds in each case. The mean value of $J_1$ is 978 foot-pounds. Now the value of $J_1$ is the actual quantity of heat required to raise the temperature of one pound of steam one degree on the scale of Boyle and Marriotte, on the assumption that equal increments of volume correspond with equal increments of heat, and $J_2$ is the actual quantity of heat required to raise the temperature of one pound of dry steam one degree on the constant coefficient scale, if the coefficient of expansion per increment of unit of heat is constant. If, then, the specific heat of steam is less than the specific heat of water, the value of J must be greater than $J_1$ if the first assumption is true, and greater than $J_2$ if the second assumption is true. But the value of $J_1$ is greater than the highest of the values of J obtained by experiments to ascertain the heat required to raise the temperature of one pound of water one degree. If, then, the result of these last experiments is to be relied upon, the specific heat of steam is greater than the specific heat of water. If the results obtained from experiments to determine the specific heat of steam can be relied on to prove that the specific heat of steam is not greater than that of water, and the results of the experiments to determine the specific heat of water that it is not less, it follows that the specific heat of steam must be equal to that of water. The close agreement of the values of $\gamma$ obtained on the assumption that the coefficient of expansion per increment of unit of heat is constant, that the specific heat of steam is equal to the specific heat of water, and that J is equal to 1132 foot-pounds, with the values determined from the adiabatic equations, must be regarded as a proof that the two first assumptions are true, and that the true value of J must be about 1132 foot-pounds. The results of direct experiments like those performed by Joule cannot be relied upon for these reasons. It is necessary to know the exact specific heats of the various substances of which the apparatus is composed, which we do not know, and to allow for heat dispersed into the air, which can only be guessed at. An excessive amount must have been allowed under these heads. In the case of Regnault's experiments to ascertain the temperatures, pressures, and volumes, no allowance of any kind had to be made.

We have now to examine whether the results arrived at in the case of steam are confirmed by dealing in the same way with the data in the case of air. Now the heat required to raise the temperature of 1 lb. of any gas 1 deg. is equal to the work done in adiabatic compression when the temperature is raised 1 deg. If equal increments of heat correspond with equal increments of volume, this is equal to

$$\frac{p_2\,v_2 - p_1\,v_1}{\gamma - 1} = \frac{p_1\,v_1}{t_1\,(\gamma - 1)} \text{ on the Boyle and Marriotte scale,}$$

$$= \frac{p_1\,v_1\,a}{\gamma - 1} \text{ on the constant coefficient scale,}$$

where $v_2\,v_1$ represent the volumes of 1 lb. of the gas at the pressures $p_2\,p_1$, and the temperatures $t_2\,t_1$ on one scale and $\theta_2\,\theta_1$ on the other. If $v$, V, represent the volumes of 1 lb. of air and 1 lb. of steam respectively at the same pressure and at the same temperature on either the Boyle and Marriotte or constant coefficient scale, the ratio $\frac{v}{V}$ is constant for all temperatures so long as the pressure remains constant. If then the specific heat of steam is equal to the specific heat of water, and $S_v$ represents the specific heat of air at constant volume, and $\gamma_a\,\gamma_s$ the values of $\gamma$ in the case of air and steam, we shall have the following equation of relation:—

$$\frac{(\gamma_s - 1)\,v}{(\gamma_a - 1)\,V} = S_v \;.\;.\;.\;.\;.\;.\; (1).$$

Now for the temperature of 212 deg. and pressure 14·7 lb., $v$ = 16 93 cubic feet, V = 26 27 cubic feet. If, therefore, we put $\gamma_s = 1\cdot086$, its value for 212 deg., we get

$$(\gamma_a - 1)\,S_v = \cdot0554 \;.\;.\;.\;.\;.\;.\;.\; (2).$$

Since the difference between the specific heats at constant pressure and constant volume multiplied by J are equal to the work done in expansion by 1 lb. of air when its temperature is raised 1 deg., we have

$$(\gamma_a - 1)\,S_v\,J = \cdot0554\,J = p\,v\,a \text{ on the constant coefficient scale.}$$

$$= \frac{p\,v}{t} \text{ on the Boyle and Marriotte scale.}$$

The following table gives the values of $v$ and of $p\,v\,a$ for the temperatures $\theta$ = 125 deg., for which $\frac{p\,v}{t} = p\,v\,a$ and the temperature 212 deg. and the corresponding value of J in foot-pounds.

| | | | | |
|---|---|---|---|---|
| Temperatures .. .. .. .. .. .. .. .. | 125 deg. | .. | 212 deg. |
| Volume of 1 lb. of air in cubic feet at 14·7 lb. pressure .. .. .. .. .. .. | 14·53 | .. | 16·93 |
| Value of $p\,v\,a$ in foot-pounds .. .. .. .. | 53·38 | .. | 62·2 |
| „ J „ „ .. .. .. .. | 964 | .. | 1123 |

Since the value of J has been determined by the same value of $\gamma_s$ as $J_1$ and $J_2$ in the table for steam, viz , its value at 212 deg., the value of J from this table at the temperature 125 deg. should be equal to that of $J_1$ and at 212 deg. to that of $J_2$. The slight differences are clearly due to errors in experimental data. If we use the value of $\gamma_s$ for steam at 118 deg. tabular temperature, the value of J at 125 deg. should agree with the value of $J_2$. It does so, if we put $\gamma_s = 1\cdot074$. Corresponding to this value we get for the value of $p$, the pressure at 118 deg. from the formula

$$(k + 212°) = \left(\frac{14\,7}{p}\right)^{\frac{\gamma-1}{\gamma}} (k + 118)$$

$p = 1\cdot7$ lb., which agrees with the value in the steam tables. Can any candid man doubt the truth of the conclusions at which I have arrived?

It is stated in the "Encylopædia Metropolitana," that Laplace demonstrated that the ratio of the adiabatic electricity of a perfect gas to its isothermal electricity is equal to the ratio of the specific heat at constant pressure to the specific heat at constant volume, but the demonstration itself is not given. Maxwell—"Theory of Heat," Chapter. IX—attempts to prove that these ratios are equal, but he commits errors identical with those I pointed out in his attempts to prove the truth of the four thermodynamic relations alleged by Clausius to exist, but which do not exist, between the pressure, volume, temperature, and entropy. The error committed in one step is counteracted by another in the next. For the proof of this I must refer your readers to my letter on "The Four Thermodynamic Relations of Clausius," in your issue of June 27th, 1893. That these two ratios are equal may be demonstrated in a very simple way. The elasticity of a given weight of gas is equal to the product of its volume multiplied by an indefinitely small increment of pressure and divided by the corresponding indefinitely small decrement in volume. Let $v$ represent the volume of a given weight of gas subject to the pressure $p$ at any assigned temperature, $\delta p$ an indefinitely small increment of pressure, and $\delta v$ the corresponding indefinitely small decrement in volume. If the changes are isothermal, and we neglect squares and products of $\delta p$ and $\delta v$, we get

$$p\,v=(p+\delta p)(v-\delta v) \qquad \frac{v\,\delta p}{\delta v}=p.$$

If the changes are adiabatic we have

$$p\,v^{\gamma}=(p\,t\,\delta p)(v-\delta v)^{\gamma} \qquad \frac{v\,\delta p}{\delta v}=\gamma\,p\;.\;.\quad (B)$$

We have therefore

$$\frac{\text{Adiabatic elasticity}}{\text{Isothermal elasticity}}=\gamma=\frac{\text{Specific heat at constant pressure}}{\text{Specific heat at constant volume}}.$$

Equation B is only true if $\gamma$ is constant, which it is not, if equal increments of volume do not correspond with equal increments of heat. For indefinitely small changes of volume and pressure its value may, however, be regarded as constant, and therefore this proof of the equality of the ratios for the same temperature of the gas as strictly true. We have then a means of determining a value of $\gamma$ without reference to the specific heats of the gases. Rankine attempted to do so from the approximate formula $v^2=\gamma g h$ for determining the velocity of sound worked out by Laplace, in which Laplace attempted to make allowances for the changes of temperature in the wave of sound, based on the assumption that the value of $\gamma$ is independent of the temperature. The terms and factors which he had to leave out in order to arrive at this simple equation are, however, of such importance that the formula is of no use for determining the values of $\gamma$ from observed velocities of sound; although subject to the assumptions as to the intensity of the sound, &c., on which it is based, it gives values of the velocities approximately equal to the observed velocities. Rankine has, however, given a demonstration of the exactness of this formula, which has received the approval of Maxwell and is given at length in his work on heat, Chapter XV., "On the Propagation of Waves." In a letter published in your correspondence columns, dated May 16th, 1891, I analysed Rankine's demonstration, and proved that it is full of errors. As none of my opponents attempted to find any flaw in my proof of the utter worthlessness of Rankine's demonstrations, I am justified in regarding their silence as an acknowledgment of their inability to do so. Corresponding to Regnault's values of $h$, at 32 deg. and 14·7 lb. pressure, when $g=32{\cdot}2$ft., and the velocity of 1090ft. per second of sound at this temperature, deduced from observed velocities of sound at other temperatures, we get $\gamma=1{\cdot}408$. Rankine adopted this as the constant value of $\gamma$ on the Boyle and Marriotte scale, and with the value 53·21 foot-pounds of $\frac{p\,v}{t}$, we have

$$S_v\,J=\frac{53{\cdot}21}{{\cdot}408}=130{\cdot}4 \text{ foot-pounds, and } S_p\,J=183{\cdot}6 \text{ foot-pounds.}$$

Adopting 772 foot-pounds as the value of J, Rankine obtained $S_p={\cdot}2378$. This calculation was published by Rankine in 1850. The value of the specific heat of air at constant pressure, determined by direct experiments on air by Regnault, and published in 1853, is ·2379—Maxwell's "Theory of Heat," Chapter XI. If in equation (2) we put $\gamma=1{\cdot}408$ we get $S_v={\cdot}1358$, $S_p={\cdot}1912$. Now, in accordance with the assumptions on which Rankine's own calculations are based, equation (2) is stictly true, and therefore Rankine's value of $\gamma$ does not agree with Regnault's value of $S_p$. If we adopt Regnault's value of $S_p$ we have from equation (2) $S_v={\cdot}1825$ $\gamma=1{\cdot}304$. If in equation (1) we put $\gamma_s=1{\cdot}074$ its value for $\theta=125$ deg. we get

$$(\gamma_a-1)\,S_v={\cdot}0472\;.\;.\;.\;.\;.\;.\;.\;.\quad (3)$$

With Regnault's value of $S_p$ we get from this $S_v={\cdot}1907$, $\gamma=1\,243$. As the temperature of the air during Regnault's experiments was probably on an average not very different from 118 deg., this may be regarded as a nearer approximation to Regnault's value of $\gamma$. According to Berard and Laroche $S_p={\cdot}256$, and we get from (3) $S_v={\cdot}2088$, $\gamma=1{\cdot}226$.

Subsequent to the publication of Laplace's formula, Clement and Desormes experimentally determined the ratio of the adiabatic elasticity of the air to its isothermal elasticity to be equal to 1·3492. This result was published in 1819 in the *Journal de Physique*. A full account of the method adopted is given in the "Encyclopædia Metropolitana." The formula velocity for this value is 1064ft., or less than the accepted observed velocity by only 27ft. Laplace, calculating from the experiments of Messrs. Walter and Gay Lussac, subsequently obtained a still nearer approximation to the observed velocity, the difference amounting to less than 10ft. On the results of these experiments, Herschel, the writer of the article, makes the following grave comment—a comment which ought to be read, marked, learned, and inwardly digested by all who may have placed confidence in the "joiner's fits" of the *fin de siècle* scientists: "In inquiries of such delicacy, and where *the effects of minute errors become so much magnified*, it seems hardly candid to desire a more perfect coincidence." As Clement and Desormes' experiments were made to test the approximate truth of Laplace's formula, we shall not be showing any disrespect to those gentlemen in assuming that the value 1·3492 was in their opinion a maximum value. With the lowest value, $\gamma=1{\cdot}243$, deduced from Regnault's value of $S_p$, the calculated velocity is 922ft., sufficiently near to prevent us from concluding that $\gamma=1{\cdot}243$ is wrong. If we put Clement and Desormes' value of $\gamma$ in Equation (3), we get—

$$S\,v={\cdot}1323,\quad S\,p={\cdot}1795.$$

In my criticism of "Student's" letter, which contained a demonstration of the truth of the formula on which Professor Alexander based his demonstration that the scale of the constant pressure air thermometer graduated with equal intervals is the same as Thomson's absolute scale, I simply pointed out that the equation on which he based his proof, $J\,d\,Q=d\,E+d\,W$, is wrong. If heat and work are convertible, the correct equation is—

$$d\,Q=d\,E+d\,W.$$

In accordance with Carnot's theory of heat, the correct equation is

$$\frac{J\,d\,Q\,(T_2-T_1)}{T}=d\,E+d\,W,$$

in which $d\,Q$ represents a quantity of this heat substance, each unit of which at temperature T possesses one J, and $T_2-T_1$ represents the fall in temperature corresponding to the work $d\,E+d\,W$. I have since carefully investigated his demonstration and give you the results, which are well worthy the careful study of all who are called in the jargon of the day technical students. "Student" states that in the mechanical theory of heat we have as characteristic equation of a body $F\,(p\,v\,t)=0$. He next states that we may select any two as independent variables, and selects $v$ and $t$. The first three equations, of which I need quote only one,

$$dQ=\frac{d\,Q}{d\,v}\,.\,d\,v+\frac{d\,Q}{d\,t}\,.\,d\,t$$

affirm that $d\,Q$, $d\,E$, $d\,W$, are each equal to the double of itself. If "Student" had written the equation $J\,d\,Q=d\,E+d\,W$, in the form

$$J\,Q=E+W \qquad (1)$$

he would have escaped making an egregious blunder, and could have obtained at once by differentiation the equations

$$J\,\frac{d\,Q}{d}=\frac{d\,E}{d\,v}+\frac{d\,W}{d\,v} \qquad (2)$$

$$J\,\frac{d\,Q}{d}=\frac{d\,E}{d\,T}+\frac{d\,W}{d\,t} \qquad (3)$$

By differentiating (2) with respect to $t$, and (3) with respect to $v$ and subtracting, "Student" arrives at the following equation:—

$$J\left\{\left(\frac{d}{d\,t}\right)_v\left(\frac{d\,Q}{d\,v}\right)_t-\left(\frac{d}{d\,v}\right)_t\left(\frac{d\,Q}{d\,t}\right)_v\right\}=\left(\frac{d}{d\,t}\right)_v\left(\frac{d\,W}{d\,v}\right)_t-\left(\frac{d}{d\,v}\right)_t\left(\frac{d\,W}{d\,t}\right)_v \qquad (4)$$

"Student" then puts $d\,W=p\,d\,v$ and arrives at the equation—

$$J\left\{\left(\frac{d}{d\,t}\right)_v\cdot\left(\frac{d\,Q}{a\,c}\right)_t-\left(\frac{d}{d\,v}\right)_t\cdot\left(\frac{d\,Q}{d\,t}\right)_v\right\}=\left(\frac{d\,p}{d\,t}\right)_v \qquad (5)$$

which is supposed to be identical with the equation.

$$J\left\{\left(\frac{d\,M}{d\,t}\right)-\left(\frac{d\,N}{d\,v}\right)_t\right\}=\left(\frac{d\,p}{d\,t}\right)_v \qquad (6)$$

accepted by Professor Alexander and believed by him to be accepted by all scientists as true. If N, the specific heat at constant volume is independent of the temperature, $\frac{d\,Q}{d\,t}=N$, but otherwise not. If therefore $\frac{dQ}{d\,t}=N$ we have $\frac{d\,N}{d\,v}=0$. If M is the heat absorbed per increment of unit of volume by unit of mass during isothermal expansion, $\frac{d\,Q}{d\,v}$ is not equal to M, because the so-called latent heat of expansion does not vary as the increment of volume. M, $d\,Q$, and $d\,v$ are connected by the equation

$$d\,Q=\frac{M\,[\log.\,(v+\delta v)-\log.\,v]}{\log.\,(v+1)-\log.\,v}$$

Since Q may be represented by the product $p\,v$, $\frac{dQ}{d\,v}=p+v\,\frac{d\,p}{d\,v}$ and therefore $\frac{d\,Q}{d\,v}$ represents a pressure, not a quantity of heat. Now "Student" obtained equation (4) by putting $\left(\frac{d}{d\,t}\right)_v\left(\frac{d\,E}{d\,v}\right)_t=\left(\frac{d}{d\,v}\right)_t\left(\frac{d\,E}{d\,t}\right)_v$ which is quite right, but how is it that "Student" has overlooked the fact that the same differential coefficients of Q and W are also respectively equal to each other? If we put $d\,W=p\,d\,v$, the first term of the right-hand member of equation (4) is equal to $\left(\frac{d\,p}{d\,t}\right)_v$, but it is beyond my capacity to differentiate $d\,v\,\frac{d\,p}{d\,t}$ with reference to $v$. If "Student" had put $W=p\,v$, he would have found that the right-hand member of equation (4) is equal to zero. Equation (4) is of the form $0=0$.

I have demonstrated that the equations of relation alleged by Clausius to exist between the temperature, pressure, volume, and entropy do not exist; that in fact, whether the zero of the Boyle and Marriotte scale does or does not refer to the same thermal state as the zero of the absolute scale, entropy has nothing to do with the thermal state of the body, and therefore nothing to do with the science of thermodynamics; that the second law of Clausian thermodynamics is not true, and that the formula—which is evidently regarded by Professor Alexander, and all fashionable *fin de siècle* thermodynamicians as one of the groundworks of the science—is not only based on a false assumption, but is arrived at by calculations full of errors of analysis. What more is needed to prove the utter falsity of the whole system of *fin de siècle* thermodynamics?

When I adopted the profession of engineer, I at once commenced to study Rankine's "Applied Mechanics" and "Prime Movers." I found, however, that I could not make head or tail of either; and, as I found at the same time the contents were not likely to be of much use in my profession, I threw the books aside. Having subsequently to carry out an installation of turbines, I again tackled the subject of water power, and soon found the reason why I could not understand one section of Rankine's work on "Prime Movers," the validity of which has been admitted by Professor Alexander. About eight years ago it became necessary for me to thoroughly investigate the question of transmission of power by compressed air and high-pressure water; and, in the course of my study calculated the value of J by means of the adiabatic formula and experimental data in the case of air. The result obtained was within a few decimals of a foot-pound equal to 772 foot-pounds, the hitherto accepted value of J. This result would not have been obtained if all the data had been arrived at by independent experiment, but it was not till some time after that I found out that the value of the specific heat of air at constant volume had been calculated from Regnault's value of the specific heat of air at constant pressure by means of the value 772 foot-pounds of J!! This discovery caused me again to study the question of heat, and to try to get at the root of *fin de siècle* thermodynamics. This time I took up Maxwell's work on heat. To my surprise I found therein the same difficulty that I had found in the case of Rankine's works. I could not understand Maxwell. After repeated attempts to overcome the difficulty I met with, especially on the subject of entropy, persevered in from belief that the University of Cambridge would not lend the sanction of her authority to a work full of errors, in what may be regarded as mere matters of analysis, however patronising or tolerant she may deem it advisable to be of the advocacy of fantastic untenable theories, I came to the conclusion that Maxwell must be wrong, and set about finding out the errors. The result of my investigations have already been published in your correspondence columns. Your readers must judge for themselves the measure of the success I have obtained by adopting this method of getting to understand *fin de siècle* scientist writings. It is abundantly clear that the passing of examinations with glowing honours affords no proof that the successful examinees understand the subjects in which they have been examined. Such could not be the case if the examiners themselves were masters of the subjects in which they have to examine. The modern system of education is rotten from its rind to it core. It has been developed by teachers, who have utterly ignored the only sound principles of education. *Non multa, sed multum. Non omnes omnia possumus.*

During an epoch of crazes in scientific and literary life, which happily appears to have reached its climax and to be on the wane, of geniuses in research and hunters of all types after ephemeral notoriety, the quickest and easiest way to achieve success has been proved to be, to write either catching trivialities or oracular absurdities, which neither the writers themselves nor anybody else can understand. Some writers have the faculty of describing correctly, parrot fashion, scientific processes, which they are themselves quite incapable of understanding. For a period of more than forty years, poor Bacon's spirit must have suffered tortures at the outset unspeakable, and of ever increasing intensity. Star-eyed science indeed! How copiously during all those years must the grove of Academus have been watered with the tears of its nymphs.

WILLIAM DONALDSON.

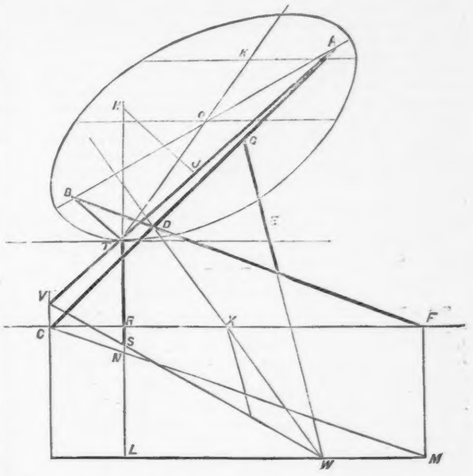
August 25th.

## THE GRAPHIC STATICS OF A DECK CHAIR.

SIR,—By a very curious coincidence I have this week been working out for my own amusement the very interesting problem which "Canvas Back" propounds for your readers' benefit. The solution I arrived at is as follows:—It is first necessary to know the directions along which the forces exerted by the canvas on the cross-pieces act. These would be easily found by graphic construction if (1) we knew the precise distribution of pressure on the canvas; (2) we could be sure that the whole weight of the sitter came on the canvas. Neither of these conditions, however, can in practice be fulfilled. With regard to (2) it is obvious that a considerable and variable portion of the weight is taken directly by the bar B, and is not transmitted by the canvas at all; also that the pressure of the sitter's feet on the ground cannot possibly be estimated. Without further data, therefore, the problem is quite indeterminate. In order to arrive at any definite result it is therefore necessary to make some assumptions with regard to the distribution of the weight.

If the whole of the sitter's weight is taken by the canvas it is obvious that the resultant of the two end-tensions must be vertical, and that therefore given their directions and their resultant—*i.e.*, the weight of the man—they can be completely determined by the parallelogram method, and this quite independently of variations of local pressure on the canvas. These latter are integrated, as it were, by the canvas, and are completely taken account of by the direction which the ends of the canvas take up. If, therefore, we are given these directions, we have all we require, and can find the line of action of the weight on the chair.

The simplest assumption of all is to imagine that the sitter is a very good business man, that is to say, he must be very acute and very slippery, so that he may be replaced by a very small roller of his own weight placed transversely on the canvas. It remains to determine graphically the position taken up by the "acute" portion or roller. This is shown in the diagram. Describe an ellipse with foci A and B, whose major axis = length of canvas. Draw a horizontal tangent at T, and determine the precise point of contact by means of the conjugate diameter K O T. T B and T A are then equally inclined to the vertical T R through the point T. (The *rationale* of this construction will be obvious to anyone who knows the elements of co-ordinate geometry.) T will therefore be the position taken up by the roller. Of course the two tensions T B T A must be equal, since our sitter is slippery. These tensions can be found by setting off T H = 160 units, and drawing H J parallel to B T. T J is then the tension in the canvas.



The pressures at C and F must now be found. This may be done by setting off R L = 160, and completing the parallelogram C M as shown. R N is then the pressure at F, and N L that at C. All the remaining stresses, *i.e.*, the shear at D and the compression in E, may now be found in one operation, *i.e.*, by considering the equilibrium of either the piece B D F or A D C. Both give the same result, as may be proved.

It is now to be noted that the strut E can only exert a definite force in the direction of its length, and that the pin D can only exert a "force of constraint" in a definite direction at present unknown. We have therefore the body A D C acted on by four forces—(i.) The tension along A T known in magnitude and direction; (ii.) an upward force at C likewise completely known; (iii.) a force along E G whose direction is known; (iv.) an unknown force through D. Of these (i.) and (ii.) being produced meet in V and have a resultant = S V in magnitude and direction. We know, therefore, since the body is in equilibrium, that the resultant of S V and the force along E must pass through the point D. These forces meet in W. The resultant, *i.e.*, the upward pressure on D, is in direction W D and of magnitude W X.

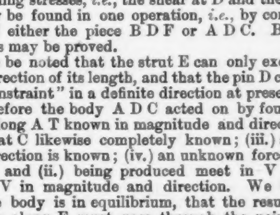
This completely determines all the doubtful stresses. The bending moments, &c., in the members can easily be found by applying the ordinary rules.

ARTHUR H. BARKER.

Norwood, Pontefract, September 7th.

SIR,—In the ingenious problem set by "Canvas Back," a great difficulty is introduced by supposing a person to sit in the chair. He will assume various positions. To simplify matters I suggest that instead of a man we suppose that a small cask, say a foot in diameter, be placed in the chair.

I have been working at the question, but I am puzzled to find that there is no vertical component of the load at the forward end of the canvas. In a chair in which I have tried the experiment, I find that the pull of the canvas lifts the front end of the seat up, tending to cause it to turn round A in the direction of the arrow. How is this to be dealt with?



L. B.

September 11th.

## THE THEORY OF THE STEAM ENGINE.

SIR,—With reference to Mr. Maurice Cross's letter in your last issue, his remarks as to a supposed difference between saturated steam and other gases in their behaviour under free expansion are either obscure or absolutely invalid. A comparison of the behaviour of saturated steam and air when near its point of liquefaction has, so far as I am aware, never been attempted, and it is at this point that the comparison must be made, if it is to have any direct force.

As a matter of fact, we know that the temperature of saturated steam is not lowered below that corresponding to its terminal pressure after free expansion. On the contrary, steam is superheated by free expansion—that is, expansion taking place absolutely without the performance of external work. The free expansion of ordinary nearly perfectly gaseous air results in the lowering of the temperature—small in amount, but still sufficient to be clearly obvious when a proper amount of experimental skill and knowledge are brought to bear in carrying out the operation. Joule and Thompson's experiments in this direction are now historical and quite conclusive.

On those experiments I based the statement I made in your columns some years back, that "the energy of a pound of air is slightly increased by a reduction of pressure, provided its temperature remain unaltered." For this statement I was assailed by several of your correspondents, notably Dr. Lodge—*ex cathedrâ*, as usual. He, however, was finally compelled to admit, somewhat ungraciously, the accuracy of my statements. Experiments on air at ordinary temperatures and pressures, however, are not to be taken as applying to air when so near its point of liquefaction as is saturated steam. Henry Cherry.

21, Festing-road, Putney, S.W., September 11th.

Sir,—Mr. Donkin in his most interesting paper does not appear to have worked out any law of condensation in relation to the difference in temperature between the cylinder and the steam. May I ask him if he thinks that such a law exists and can be worked out? Thus, for example, will the condensation per square foot of surface be greater in the high than in the low-pressure cylinder of a triple-expansion engine? J. P.

Doncaster, September 11th.

### TRADE MARKS IN GERMANY.

Sir,—It may interest your readers to know that a new German Trade Mark Law comes into operation on October 1st next. According to the present law British marks are registered at Leipzig, but under the new law all previously recorded marks must be entered on the Imperial Register at Berlin. The sooner this is done the better, as the first applicant secures priority, and marks previously registered at Leipzig, unless re-registered, will be disregarded by the Berlin officials when dealing with new applications. Owners of trade marks entered on the Imperial Register will be officially informed of any applications for similar marks for the same goods. Infringers of registered marks will be liable to fine and imprisonment, and also to pay an indemnity to the registered proprietor.

Any further information respecting the above can be supplied by this office. Reginald W. Barker, F.I. Inst. F.S P.A.

British Trade Protection Office, Monument-chambers, E.C.
September 7th.

### HOUSE COAL IN LONDON.

Sir,—The following figures may interest many of your readers:—Good to best house coal at the pits, 11s. to 13s. 6d.; railway to London, north of the Thames, 8s. 9d. per ton; railway to London, south of the Thames, 10s. 3d. per ton; wagon hire, 1s. per ton, north or south; total cost of a ton of coal, 20 cwt., in the truck at the coal merchant's siding, best coal, North London, 23s. 3d. per ton; South London, 24s. 9d. There is little or no profit on this class of coal. The competition among coal merchants is now very keen, and if it were not that they can make favourable contracts, and get the long ton of 22 cwt., they could not make a living. Seaborne coal is nominally much cheaper, but there is 30 to 40 per cent. of small, which keeps it level with railway carriage. If the breakage could be reduced, the price of coal in London would fall. A Consumer.

Clapham, September 11th.

### FORTIFYING PORTSMOUTH.

Sir,—My excuse for troubling you is my country's need, and sometimes simple ideas are overlooked. There is a scheme for fortifying Portsmouth. I think that the best plan may be to build on each side of the fairway towers, with engines in them; so that cables may be hung across the fairway and stretched or lowered, as the case may require. The engines could light the towers.

Gong Gong, Ballarat, Victoria, Australia. John Liddes.
August 4th.

### ALUMINIUM BOATS.

Sir,—Seeing an account of aluminium boats in your issue for 7th inst., where allusion is made to one exhibited recently at the Grafton Gallery, perhaps I may be allowed to point out that the framework was made by this company, and that Messrs. Swain and Kirby, who are represented as being the makers, merely covered it with aluminium for the Berthon Boat Co., Ltd.

Romsey, Sept. 11th. E. P. Berthon, Manager.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Tramcar fenders.*—The increased speed of street cars, due to the widely increasing use of cable and electric motive power, has led to so many accidents that numerous devices are being tried to prevent people when struck from falling under the car and being run over. Many of these work well with stuffed figures, bundles of hay, &c., in experiments, but fail in actual service, for while an inanimate object will always fall in a certain way when struck in a certain way, there is no knowing how a man may fall, according to his position when struck and his endeavours to avoid a fall. Owing to the oscillations of the car, fenders projecting beyond the ends must be placed so high that they may easily pass over a child or even a man lying on the track.

*Sea channel and breakwater.*—At Block Island, R.I., a channel is to be made to connect Great Salt Pond with the ocean, the channel being dredged through a sandy strip of land, and the ocean end protected by sand-tight breakwaters. The mean rise and fall of tide is $2\frac{1}{2}$ft. in the sea and 6in. in the pond. The channel will be 300ft. wide at the top, 250ft. wide on the bottom, with a depth of 15ft. of water at mean low tide. The breakwater jetties will consist of a row of piles 12ft. apart, driven 10ft. deep, connected by two stringers or waling pieces, and sheathed on one side with grooved oak planks 3in. by 10in., driven 3ft. deep, with the top 5ft. above low water and fastened by 6in. galvanised spikes, making a sand-tight barrier. These will be carried out to 11ft. of water. The piles will be of white or yellow oak with the bark left on, at least 12in. diameter at the butt and 7in. at the top, inside the bark. On each side of the barrier will be deposited a core of broken stone or "rip-rap," consisting of chip stones 3ft. wide placed 18in. on each side of the planks. The foundation of the breakwater will be a single layer of stones 2ft. thick, and not less than half a ton in weight, laid on the largest surface and placed as close together as possible, the spaces between them being filled by smaller stones. The stone used must be of angular shape—not boulders—weighing at least 140 lb. per cubic foot. Excavated material will be measured in the scows or barges, the capacity of each scow or barge being determined beforehand; and in making deductions for deficiencies in loading, or for dredging below the specified depth, four yards *in situ* will be taken as equivalent to five yards in the scow.

*Notes on permanent way.*—Some extracts from notes made during a recent professional trip may be of interest to railway readers of The Engineer. The Lehigh Valley Railroad is an important line with an enormous coal traffic. It is double line all the way from New York to Buffalo, 458 miles, this being its main line or "backbone," and the main tracks are laid with 80 lb. rails, spliced by heavy 30in. angle fish-plates of the Sayre pattern, with six bolts spaced 5in., 4in., 4in., 4in., and 5in. centre to centre. The bolts have button heads outside the rail and hexagon nuts and spring nutlocks inside. The rail ends are cut at an angle of 45 deg., this being about the only road which now follows this practice to any extent, and while the track rides easily and the rail ends show an even wear, these results are almost certainly due to the stiff and heavy joint fastenings rather than to the angle-cutting of the rail ends. The rails are laid with broken suspended joints, and there are 16 ties to a rail length of 30ft. The joint spacing of the rail ends is irregular, and during the hot weather of June, while many of the joints were quite closed, others had a space or $\frac{1}{2}$in. to $\frac{5}{8}$in. measured on the square. There are very heavy grades on the mountain division crossing the Alleghanies. The Western New York and Pennsylvania Railroad has a network of main and branch lines aggregating about 640 miles. The main line is laid with 67 lb. steel rails, and while English-made rails of this weight lasted well for twelve years' service without battering of the ends, the newer American rails have been much less satisfactory. This has been the experience of several railways, and while no doubt due in part to the increased wheel loads and increased traffic, it is certain that the average steel rails to-day are of decidedly inferior quality to those made more carefully at a time when higher prices prevailed and more care was taken in the manufacture. There is no trouble in making good rails in the United States now if only the railways will insist upon getting them, and will recognise the economy of a good price for a good article, as some railways have already done. The rails are $4\frac{1}{2}$in. high and $4\frac{1}{2}$in. width of base, with flaring sides to the head, $\frac{11}{32}$in. top corner radius, and 11in. top radius. They are laid with broken suspended joints, spliced by 26in. angle fish-plates with four $\frac{3}{4}$in. bolts spaced 6in., $6\frac{1}{4}$in., and 6in. centre to centre. The plates weigh $42\frac{1}{2}$ lb. per pair, the bolts and nuts $87\frac{1}{2}$ lb. per 100, and the Goldie sharp pointed spikes 60 lb. per 100. The bolts have square nuts $\frac{3}{4}$in. by $1\frac{1}{4}$in. The ties are mainly of white oak, costing about 60 cents each, and are spread only just far enough apart for shovel tamping, giving generally sixteen ties to a rail, with the joint ties spaced 10in. between the edges of the top faces. The ballast is of coarse and rather dirty gravel, with a considerable admixture of large rounded pebbles. Bridge sleepers are 6in. by 8in. section and 10ft. long, spaced 4in. apart, and the bridge floors have outside wooden guard rails and inside iron guard rails, the latter being brought to a point on the approaches. One large iron bridge has a solid floor of built-up rectangular troughs, with sleepers 8in. by 11in., and no ballast, as it is considered better to keep the ironwork free for inspection and painting. The Buffalo and Susquehanna Railroad is principally a lumber line, tapping the timber resources of the Alleghanies. There are five or six "switchbacks" or "reversing stations," and the maximum grades are $2\frac{1}{2}$ per cent. in getting through the mountains by a steep and winding location. The permanent way is of 60 lb. and 70 lb. steel rails, spliced generally with 24in. four-bolt angle fish-plates, but in some places larger six-bolt angle fish-plates are used. On the older rails the 24in. plates have bolts spaced 5in., 8in., and 5in. centre to centre, while the bolts of the heavier rails are spaced 6in. centre to centre. There are plenty of ties, and the ties are of ample width, but not stripped of bark as they should be. On heavy curves bridle rods are sometimes used, three rods being used to a rail length. This is on account of the great strain due to the heavy engines.

*Tramway track.*—A committee appointed to report upon the best type of rail for the street railways of Detroit recommended the use of either girder or grooved girder rails. The former should weigh at least 60 lb. to 70 lb. per yard, and be $5\frac{3}{4}$in. high, with the paving bricks or blocks—shaped to fit the web of the rail—level with the top of rail head on the outside and $\frac{1}{2}$in. below it at the inside of the track. The grooved rail should weigh not less than 70 lb. to 80 lb. per yard. The city of Port Huron uses ordinary flange rails of 45 lb., laid on pine stringers 5in. by 5in., which rest on cross sleepers 3ft. centre to centre. Oak or pine strips 2in. by 2in. fill the space under the rail head. The grooved girder rails used in Detroit weigh $77\frac{1}{2}$ lb. per yard, with the guard side of groove not more than $\frac{1}{4}$in. below the running side. The rail is $6\frac{1}{4}$in. high and 4in. wide, spiked to white oak ties, 3ft. centre to centre, the gauge being maintained by tie-bars 1in. by $1\frac{1}{2}$in. at intervals of 8ft. The paving—asphalte, granite, brick, and wood—is laid close against the rail head, and the space against the rail web filled with cement grouting. At Toledo the old flat side-bearing rail is used, with paving level with top of rail, so that there is a groove $1\frac{1}{2}$in. wide and 1in. deep, which is very objectionable. At Chicago the rail specified by the Public Works Department is a girder rail 5in. to 6in. high, with a running head 3in. wide, so as to carry wagon wheels and avoid rents alongside the rail head. At Columbus, flange rails, 62 lb. per yard, are used, and have electrically-welded joints.

*Mails and goods on electric railways.*—The advantages derived by country electric railways in carrying goods and parcels traffic has more than once been referred to, and the latest example is at Brooklyn, N.Y., where mail cars have been put on to run to Coney Island, a summer resort about ten miles distant from the post-office and situated on the Atlantic coast. The electric railway in connection with the post-office department has put on two mail cars, having the forward part fitted up with pouches and pigeon holes for letter sorting, while at the rear end is a passenger compartment for smokers only. The cars are 28ft. long, painted white with gilt lettering, like the standard U.S. railway mail cars, and cost 2000 dols. each. Several stops are made and pouches delivered and taken on along the route. The first stop is at Fifth-avenue and Twelfth-street, where a pouch is delivered to a collector for Station V and mail is received. At Fifth-avenue and Thirty-sixth-street the mail is transferred to another car, which runs over the Brooklyn, Bath, and West End route to Coney Island. Mail is delivered and received at West Brooklyn, Blythebourne, Bath Beach, Van Pelt Manor, Unionville, and Coney Island, and sorted on the way. The trip from the post-office to the West End station in Coney Island is made in sixty-six minutes, and the return trip in sixty-two minutes, the same stops being made. When the system is in complete operation four daily trips will be made. Considerable saving, both in time and money, is effected by the new system. The electric railway is proving a great factor in opening up suburban districts—as people do not have to live up to a time table as they do if they take the steam railway—and in connecting country towns; but in some states the charters only give the right to carry passengers. If this is changed to allow baggage, parcels, and freight to be carried, such electric railways will become even more valuable properties, as proved by experience on roads where such traffic is carried. Suburban roads generally follow the roads—but not always, especially on long lines—but country lines are very generally located and built on their own land like ordinary railways. The cost of construction and equipment is, of course, very much less than where steam locomotives have to be carried.

*Irrigation.*—A proposition has been made by a California irrigation company for irrigating the Pecan Valley, Texas. It is proposed to construct a system of ditches, for the sum of 3·30 dols. per acre for ten years, if the people will take up 50,000 acres of irrigated land. The Mitchell Canal in Nebraska is to be extended about fifteen miles, crossing the "bad lands," and will be enlarged to greater capacity. The canal will then be nearly fifty miles long. The Saticoy Irrigation Company, in California, is having surveys made for a pipe line thirty miles long, to bring water from the Santa Clara River. Perkins County, Nebraska, has voted to issue bonds for 90,000 dols., to assist in the construction of a canal sixty-five miles long, which will cross that country.

*Railways.*—No large projects are under way, but there is some activity in small line, particularly in lumber districts. In Maine the Wiscasset and Quebec, 24in. gauge, has twenty miles of grading completed, forty miles under way, and fifteen miles not yet cleared. The reason for adopting this gauge is not clear, as the road bed is of standard width, and the line crosses two standard gauge roads, with which connection will sooner or later be required. When completed there will be about 150 miles of 24in. gauge road in this state. In Canada the Canada Atlantic Railway is pushing work vigorously on its line west from Ottawa to Parry Sound, a port on Georgian Bay, and this line is all the way through a timbered country. A large number of subsidies has been granted by the Dominion Government. The Coast Railway of Nova Scotia has let contracts for a line ninety miles long, extending from Yarmouth to Lockport. The Port Arthur, Duluth, and Western Railway will extend its line in Canada to the recently-discovered gold mines of the Rainy Lake region. A new and important route between Buffalo and Pittsburg will be effected by the construction of seventy-five to one hundred miles of connecting links between the lines of three companies, and a double-track line into the city.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

Business in the manufactured iron and steel trades maintains the improvement recently noticeable, and prices of sheet and bar iron are kept fully up to the quotations given last week. The general attention which is being paid just now to the subject of Belgian competition has led to the disclosure of some remarkable instances. Certain classes of steel hoops are being landed in London from Antwerp at £1 per ton less than Staffordshire makers are quoting; and in some sorts of girders for contractors' purposes, both steel and iron, the difference is even greater than this.

Gasholder engineers are among the latest sections of the community in this district to benefit by Belgian cheap labour and long hours. For in addition to rolling, as they have long done, iron and steel girders and joists for building, the Belgian ironmasters have now begun the manufacture of sectional steel for gasholder engineers. Midland buyers who have given Belgium a trial state that the particular sections of steel they have ordered successfully bear all tests, and that the material is far cheaper than that of British make. By laying down special rolls the Belgians are indeed beginning to cultivate a trade in this and somewhat similar classes of steel which they are likely to find decidedly lucrative. This further information as to Belgian competition enforces the lessons which iron and steel masters, returned from the meeting of the Iron and Steel Institute at Brussels, bring, of the necessity for increased vigilance by our own manufacturers, if we are to keep pace with Belgium. The opinions of these authorities, which have been expressed this week and last, have occasioned great interest among iron and steel masters in this district.

It is matter for satisfaction that though the total exports of galvanised sheet iron from this district to foreign markets are not just now much increasing, yet as regards Australia and the Cape, the purchases of both these colonies are steadily going up. In the past month the buying by Australia was of the value of £46,612, against £41,455 this time last year; and the purchases of the Cape were worth £24,445, against £18,174 a year ago. The other chief customers of this district were India, the Argentine, and miscellaneous markets. The total exports to all markets for this year, so far as it has run, are of the value of £1,293,223, against £1,356,847 in the first eight months of 1893.

American orders have been received in this district since the passing of the tariff for special qualities of tinned sheets worth £24 10s. per ton. Midland makers doubtless contributed to some extent to produce the improvement of 3341 tons of tin-plates which went to the States last month in excess of the same month a year ago; the newest total being 19,123 tons. Most of the Midland manufacture lies, however, in best sheets for deep stamping purposes rather than the ordinary run of tin-plates for transatlantic canning services.

The steelmasters are better employed than for a long time past. Orders are arriving from both British and foreign customers, and the converters and cogging and rolling mills are decidedly busy. Prices are strengthening. Bessemer tin-plate bars are quoted £4 2s. 6d.; boiler tube strip, £6 10s. to £6 15s.; bridge plates, £6 15s.; boiler plates, £6 5s.; and plating bars, £5 2s. 6d.

Pig iron rules firm at 38s. 6d. for Staffordshire cinder sorts; 41s. 6d. to 42s. for Northamptons; 42s. to 43s. Leicestershire and Wiltshire; and 51s. to 52s. 6d. for Welsh hematites.

The bridge and roofing makers have a good deal of home railway work in hand just now; one of the most recent contracts received being for as much as 16,000 tons of ironwork. Steel bridge work is also under execution for Japan, India, and other Eastern markets. Hot water engineers are busier than recently upon the manufacture of heating apparatus for public institutions.

The mechanical engineers and locomotive builders of the Midlands are gratified to find that the British export trade, though apparently on a retrograde plane as regards most of the industries of the country, is yet still progressing in the great departments in which they are chiefly interested. They are glad to see an advance in the value of steam engines of 14 per cent. for the month, and 2 per cent. for the eight months; and in machinery of 10 per cent. and 5 per cent. respectively. Our August exports of steam engines were of the value of £316,729, as against £275,525; and those for the eight months were worth £2,090,807, compared with £2,048,120. Machinery for August rose from £875,620 to £971,347, and for the longer period from £6,931,174 to £7,344,756.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester.*—Although a quieter tone has come over the iron trade so far as further buying of any weight is concerned, the recent spurt of business has left behind it a better feeling in the market, and the advance in prices has been maintained. The position, however, as regards the large iron-using industries, still shows no really appreciable improvement. In this direction no materially increased activity is reported, nor does the present outlook indicate any large volume of trade coming forward in the immediate future.

Only a moderate business was being put through on Tuesday's Manchester Iron Exchange, but prices were firm at the full rates quoted last week. Lancashire makers, who have not moved at all in the way of advancing their list rates, still report a moderate business doing at about 40s. for forge, to 42s. for foundry, less $2\frac{1}{2}$ at the works, representing about 42s. 6d. for forge, to 44s. 6d. and 45s. for foundry, delivered Manchester or district. In some of the district brands where makers have not put up their prices to quite the same extent as those who are so fully sold that they are indifferent about booking further orders, some fair transactions are being put through at about 39s. 6d. for forge, to 40s. 6d. for foundry, net cash delivered Manchester; in other cases, however, 40s. for forge to 41s. for foundry, net cash, is being held for, but these prices check further buying, consumers, who have satisfied present requirements, preferring to wait. For Derbyshire foundry iron quotations remain at about 45s. to 46s. net cash, delivered Manchester, but no business of any moment is reported. For outside brands offering here prices continue exceedingly firm at, if anything, slightly above last week's quotations. Good-named foundry brands of Middlesbrough are scarcely obtainable under 45s. 4d. net cash, delivered Manchester, whilst for the very small quantities of Scotch iron now in the market prices continue to harden, and it would be difficult to buy Eglinton under 49s., whilst 51s. has been paid for Glengarnock, net prompt cash, delivered at the Lancashire ports.

Finished ironmakers still report no appreciable improvement in this branch of trade. Some of them are perhaps rather better off for orders than they have been recently, but they are still short of work to keep forges anything like fully going, and the only extent to which they are in any really better position is that buyers are not pressing for such excessively low prices, and makers are able to maintain something like their quoted rates. Lancashire and North Staffordshire bars are firm at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Nut and bolt makers report business coming forward rather more freely, but no better prices ruling.

A considerably increased weight of business is reported in some quarters as being put through in the steel trade during the past week or so, and for hematites better prices have been obtainable, ranging from 53s. to 53s. 6d., less $2\frac{1}{2}$, for good foundry qualities, delivered Manchester. Ordinary basic billets are still obtainable about £4 net cash delivered here. With regard to manufactured material, bars are quoted at £6 and steel boiler plates at £6 7s. 6d. to £6 10s. delivered in the Manchester district, but these figures are not at all readily obtainable.

In the metal market the downward tendency in raw material has quite put a check on further buying in manufactured goods at the recent advance on list rates, but these remain without change.

Here and there rather more work is reported to be stirring amongst engineers, but the position generally does not show any real improvement, and for the most part establishments continue but moderately supplied with orders with low cutting in prices to secure any business coming forward. The reports issued by the engineering trades union organisations also show no material change in the position. The Amalgamated Society of Engineers return a slightly lessened number of out-of-work members on the books, but this still remains at nearly 10 per cent. of the total membership. In the Manchester district, owing chiefly to suspensions at one of the large engineering establishments, there has been a further increase of unemployed members during the month, and there are now about 9½ per cent. of the local membership in receipt of donation benefit. The reports from the various districts connected with the Association show no improvement in the outlook as regards industrial prospects, but it is hoped that the settlement of the strike of moulders on the north-east coast, which has not yet made itself felt as regards the present returns, will tend to improve the position of the society, and that the report for the next month may show a considerable decrease in the number of out-of-work members. The returns issued by the Steam Engine Makers' Society show no appreciable change as regards the number of out-of-work members, which still represents more than 5 per cent. of the total membership on donation benefit, whilst the reports as to the condition of trade show no improvement.

The quarterly meeting of the Manchester Association of Engineers was held on Saturday, Mr. T. Daniels, the President, in the chair. The business was entirely of a formal character, relating chiefly to financial matters, and the nomination and election of members. Messrs. A. J. Bailey, of Sir Wm. H. Bailey and Co., Salford; J. E. Hobson, of the Engine, Boiler, and Employers Liability Insurance Company, Manchester, were elected honorary members; and Mr. J. R. Ingham, of Kendall and Gent, Salford, an ordinary member of the Association. Arrangements have been made for opening the ensuing session on Saturday, October 13th, on the afternoon of which day there is to be an inspection of the Manchester hydraulic and electric installations.

The considerably increased pressure at which boilers have now to be worked, as compared with what was considered requisite or possible a few years back, has of necessity compelled special attention to improvements in steam fittings, and it will be interesting to notice several new designs in this direction recently introduced by Messrs. Fletcher Bros., of Ashton-under-Lyne. One of these is a patent blow-off cock, specially designed for high-pressure. Hitherto the method of compressing the plugs and packing has been to first compress the packing, which in turn compresses the plug. As the compression of a mass of packing is objectionable in large cocks, Messrs. Fletcher have introduced a new arrangement with a patent cover gland, which, upon compression, acts directly upon the plug, metal to metal, and also compresses a loose ring, which acts upon the vertical and horizontal slots of asbestos, so that by screwing the bolts the four slots and the top and bottom packing, along with the plug, all become compressed. A patent triple safety valve is another improved fitting specially adapted for Lancashire boilers working at 200 lb. pressure. In this valve, instead of having one hanger, as usual, for the low-water arrangement, the boiler-plate is cut to a special plan, and two bolts are hung from the boiler shell. This arrangement brings the action of the valve much closer to the fulcrum, so that a dead load of 7 cwt. can be raised. Another important feature is that all the valves are mounted on one riveting base, thus saving extra holes in the boiler. In the old easing gear, when loaded up for 200 lb., the difficulty has been that with the boiler pressure low it has been found almost impossible to move the easing lever, but in Messrs. Fletcher's design this difficulty is avoided by mounting the valves with loops or stirrups and the easing valve with excentrics, so that the easing can now be done with two fingers of the hand, although there may be no assisting pressure in the boiler. The two high steam valves and the low-water valve are all mounted on the one casing, and the steam issuing from the low-water valve is conducted away by a separate branch. Amongst other new designs which the firm are introducing is a patent steam-reducing valve. In the old system of lever and weight good results could not possibly be obtained when reducing from 200 lb. to 17 lb. with one valve. The cut-off ports in the old valves were always placed closed to the corresponding ports for receiving the pressures, so that at the slightest motion the valve was open and passing steam, but in the new deadweight system designed by the firm the inner ports are carried a considerable height up the casing away from the ports taking in the pressure, so that plenty of lap or bearing is obtained when the reducing valve is required to cut off steam. This valve, which is very simple in construction, having no levers, links, or pins, has a piston packed with asbestos, and waste condensation water is entirely dispensed with. For marine purposes a spring takes the place of the deadweight.

The coal trade still shows no appreciable improvement, except, perhaps, some increasing inquiry for the better qualities, which of course is looked forward to at this season of the year. Common round coals, however, continue in very limited local request for iron-making, steam, and general manufacturing purposes, and engine classes of fuel remain quite a drug in the market, with prices, if anything, a trifle easier since the break-up of the Coal Sales Association, and excessively cheap supplies still come in from other districts. Pits for the most part are not working more than four days per week, and supplies of all descriptions of fuel are in excess of requirements. The average market rates remain at about 11s. for best Wigan Arley, 10s. for Pemberton four-foot and seconds Arley, 8s. for common house coal, 7s. to 7s. 6d. for steam and forge coal, and from 3s. 6d. to 4s. for common slack to 4s. 6d. and 5s. for medium up to 5s. 6d. and 5s. for the best qualities.

There is still a fair amount of activity in the shipping trade, but with the prospects of an early settlement of the Scotch strike buyers are more cautious about placing orders, and there is some pressure for lower prices than have been ruling. There is, however, no quotable change, and delivered at the Garston Docks, or the High Level, Liverpool, ordinary Lancashire steam coal remains at about 8s. 9d. to 9s., and engine fuel at about 5s. 6d. to 5s. 9d. per ton.

*Barrow.*—There is a very quiet trade doing in hematite qualities of pig iron, and the week's business has not been an improvement in any sense on recent experiences. Makers are booking but few new orders either for Bessemer or ordinary hematite, and the foreign and continental demand is exceptionally quiet. On home account very little is being done, and were it not for the pig iron which is used in the district for steel-making purposes, very little business would be done. Prices are rather higher at 44s. 11d. buyers of warrant iron net cash, and makers are asking 45s. to 46s. for parcels of mixed Bessemer numbers net f.o.b. There are only thirty-three furnaces in blast, compared with thirty-four in the corresponding week of last year. Stocks of pig iron have been reduced during the week 257 tons, and now stand at 158,066 tons, being an increase since the beginning of the year of 63,443 tons.

Iron ore is selling very badly. The Scotch trade, owing to the strike, has been reduced to a minimum, and very little ore is at present being shipped out of the district. Local smelters are not using much. Prices are steady at 8s. 6d. for ordinary, and 12s. to 14s. for best sorts, net at mines.

Steel makers report a slight improvement in tin-plate bars, but a quiet tone in all other branches of trade except that of steel plates for shipbuilding purposes. Makers are fairly off for orders in this department. Steel rails are especially quiet, and very small parcels only are inquired for. The winter's outlook in nearly every department of the steel trade is cheerless. Prospects do not improve as the season proceeds.

Shipbuilders and engineers do not report any new orders, but several good inquiries have recently come to hand which it is hoped will lead to business. Some preliminary trials have been made this week with H.M. ship Sturgeon, one of the three torpedo boat destroyers building here for the Admiralty, and very satisfactory results are reported. The new sand dredger built at Barrow for Kingstown Harbour has been completed and delivered to her owners at Dublin. Satisfactory trials of her working capacity have been made.

The coal and coke trades are very quiet, and deliveries are necessarily small. Prices are steady at 17s. for East Coast coke delivered at West Coast furnaces.

Shipping is still indifferently employed. During last week the exports of pig iron from West Coast ports represented 3513 tons, and of steel 6605 tons, compared with 2110 tons of pig iron and 8636 tons of steel in the corresponding week of last year, an increase of 1403 tons of pig iron and a decrease of 2031 tons of steel. The aggregate shipments for the year so far have been 254,061 tons of pig iron and 283,343 tons of steel, compared with 190,111 tons of pig iron and 355,846 tons of steel in the corresponding period of last year, being an increase of 63,950 tons of pig iron and a decrease of 72,521 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

House coal continues to be in fair demand, and the tonnage forwarded to London is about an average. Although the season is advancing there is no forward buying, merchants apparently still clinging to the belief that there will be a fall in prices. Silkstones at present make from 9s. 9d. to 11s.; Barnsley house coal, 8s. 6d. to 10s. 3d.; lower grades about 1s. to 1s. 6d. cheaper. In steam coal the Humber ports are still taking a good weight, business being up to the average. Barnsley hards are from 7s. 9d. to 8s. 9d. per ton. Secondary qualities from 7s. per ton. Gas coal is in better request at from 7s. to 8s. per ton. The depressed business in wool and cotton manufacturing districts prejudicially affects the demand for slacks, which are easily obtainable at 4s. to 5s. per ton, smaller coal being as low as from 2s. The owners of house coal pits complain of the cost of the carriage of coal to London, the reduction of the railway ton of 21 cwt. to 20 cwt. making an additional cost of fourpence a ton in carriage. The owners say that the consumer is not paying it, and that it was unwarranted at the first; they therefore are agitating to have it removed. It is said that the Coal Trade Association is about to test the right of the railway companies to make this alteration in the rates of carriage for coal, which practically means an advance of 5 per cent. Coke is now making from 8s. 6d. to 10s., which represents an advance of fully threepence per ton on the fortnight. The tone of business is more hopeful.

Messrs. Newton, Chambers, and Co., Thorncliffe collieries, who send an enormous tonnage by rail to London—probably the heaviest weight sent by any English colliery company—are now quoting house coals as follows:—Best Mortomley, 16s. 6d.; Mortomley brights, 13s. 9d.; best Mortomley nuts, 14s. 6d.; seconds do., 11s. 6d.; thin seam, 15s.; brazils, 13s. 6d.; Tankersley house, 12s.; Parkgate softs, 10s. These are the prices at Sheffield per 20 cwt. They are the lowest summer rates, which will be raised, it is expected, 1s. a ton in October, when there is generally an advance made in values. In the iron trade a general improvement is reported. An advance of 2s. per ton in pig iron is encouraging the blowing-in of other furnaces. These, by increasing the output, will probably check an advance in values. Hematite pig iron is now making from 51s. 6d. to 54s. per ton, according to the brand; forge iron from 39s. to 40s., delivered at Sheffield. Iron is being generally stocked in expectation of better business. Bessemer billets are about £5 10s. per ton; bar iron £5 10s. to £5 15s. at makers' works; common wire rods £5 5s.; rope rods and high carbon rods, £8 8s. At present there is no improvement reported in the shipbuilding trade, the moulders' strike in the North interfering very considerably with that important industry. All round, however, there is a more cheerful tone and very considerable accessions to business may shortly be expected.

The official returns of the Hull Chamber of Commerce and Shipping for the month of August exhibits the tonnage of coal imported and exported at the chief Yorkshire port, and is particularly interesting on account of its being the first month in which the coalowners have realised the benefit of the 10 per cent. reduction in wages. August is also the anniversary of the first month of the great struggle of last year. The figures, of course, show a great advance over the trade done twelve months ago, but they still justify the fact that business once lost is difficult to win back. The whole of the Yorkshire collieries sent to Hull last month 181,896 tons of coal, as compared with 83,248 tons in August of 1893. This weight, it will be seen, is more than double the business done twelve months ago, but it is still considerably less than the tonnage of August, 1892, when the weight amounted to 213,672 tons. For the completed period of eight months the weight was 1,328,200 tons, as compared with 1,006,485 tons in the corresponding period of 1893, and 1,520,592 tons for the eight months of 1892. South Yorkshire still holds the first position. Denaby Main continues to head the list with 21,696 tons sent during the month, and 156.664 tons during the eight months. New Sharlston, a West Yorkshire colliery, takes second place for the first time with a weight of 10,560 tons for the past month; Monk Bretton is third with 10,192, and Aldwarke Main fourth with 8744. Five South Yorkshire collieries sent 56,144 tons, or 30 per cent. of the whole. In West, as in South Yorkshire, large collieries also took the trade. Thirteen South Yorkshire collieries sent half of the whole amount, and after them seven collieries in the West accounted for a third of the balance. The exports to foreign countries reached 113,060 tons, against 37,849 tons in the same month of last year, and 99,374 tons in August of 1892.

The manufacture of cotton ties for the United States was for years an important Sheffield industry, from twenty to twenty-two thousand tons being sent annually to that market. The McKinley Act completely killed business, not a single tie having been sent into the States since 1890. Although the duty has been largely reduced by the new tariff, from 100 per cent. to 30 per cent., it is not expected that the relief will be sufficient to revive the trade, the value of the ties having gone down largely of late years. They are now supplied at £6 7s. 6d. free on board at Liverpool, and the duty on that price still remaining at £2, is simply prohibitory. The Americans are making ties of basic steel cheaper than of iron, the cost for puddling iron in America being 16s. 6d. per ton against 7s. 6d. per ton in this country. The American steel ties are now almost universally used by the cotton growers to bind their bales. Petroleum hoops are also affected, but this has been a diminishing business for some time, owing to the freer use of pipes for the conveyance of the oil from the wells to the tank steamers, in which the petroleum is now largely conveyed abroad. Our tie manufacturers are finding the Australian trade considerably better. There the ties are used for binding the bales of wool sent to this and other countries.

The exports of hardware and cutlery for the month of August are somewhat discouraging, there having been a continuous decline during the three years. The value sent last month was £151,178 against £166,983, and £185,326 for the corresponding months of 1893 and 1892. The principal decreasing market has been the United States; but as the settlement of the tariff question has again resulted in the re-opening of business, the exports to the United States from Sheffield having doubled, a marked improvement will be looked for in the official return for September. For the eight months of the year the value of hardware and cutlery exports was £1,197,494, against £1,385,878 and £1,450,641 for the similar period of 1893 and 1892. In steel unwrought there is a gratifying advance to be reported, the value of exports last month having been £183,717, against £157,757 and £149.280 for August of 1893 and 1892. Russia, Germany, and the United States have all taken largely increased values. Russia has risen from £13,934 to £38,219, Germany from £22,776 to £39,548, and the United States from £24,986 to £38,240. Decreases, on the other hand, are reported from Sweden and Norway, Denmark, Holland, British East Indies, and British North America. For the eight months the value is £1,247,403, as compared with £1,158,412 and £1,140,987 for the similar completed periods of the two previous years.

Proof still continues to be afforded of the disastrous effects of the seventeen weeks' stoppage in the coalfield. The Staveley Coal and Iron Co., one of the largest concerns in this district, points to its balance sheet as showing the effect of that calamity on its operations, which reduced the dividend for the year. The Sheepbridge Coal and Iron Company report that its works were suspended for a considerable period during the strike, "which caused a heavy loss to all concerned." The directors report that they have brought into the current account the sum of £11,448, carried last year to the strike reserve fund, and have debited the loss caused by the strike to the profit and loss account of the financial year just closed. The hope is expressed that the newly-formed Conciliation Board will do much to make such trade conflicts impossible in the future.

One of the best of our distant markets at present for Sheffield productions is South Africa, which is taking tools, files, and cutlery in quantities which are continually augmenting every week. There is rather more doing also with the Argentine Republic, while the Australian markets are reported to be recovering so very slowly.

The South Yorkshire Colliery Enginemen's Association, which comprises five branches—Sheffield, Hoyland Common, Swinton, Wombwell, and Barnsley—are resisting the reduction of 10 per cent. decreed by the Conciliation Board. They state that as they were not represented on that Board they decline to be bound by its decisions, and demand that no reduction should be made in their wages. The secretary of the South Yorkshire Colliery Owners' Association has acknowledged receipt of the letter, and the Council of the South Yorkshire Colliery Enginemen have given it to be understood that, unless their demand is complied with, complications and unpleasantness will result.

Mr. Charles Henry Bingham, of the well-known silver-plating and cutlery establishment of Messrs. Walker and Hall, electro works, Howard-street, Sheffield, was duly installed on the 6th inst. as Master Cutler of Sheffield. Mr. Bingham is in partnership with his brother, Lieut.-Colonel J. E. Bingham, J.P., who has twice held that office with equal ability and acceptance. It was during his second tenure of the post that a most successful Handicrafts Exhibition was opened at the Cutlers' Hall by H.R.H. the late Prince Albert Victor, who was the colonel's guest. The other partner in the firm is Captain A. E. Bingham, son of the Master Cutler's brother. The new Master is a gentleman who has taken an active interest in questions affecting the social and material welfare of his native city, and has been a leading member of the Sheffield Smoke Abatement Association, which has already done substantial service in brightening the conditions by cleansing the atmosphere in which some 340,000 people pursue their daily avocations.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A general improvement in the iron and allied industries can fairly be reported, and the tone of manufacturers' forecasts has quite changed from what it was a few weeks ago. They are no longer "down in the dumps," but all speak hopefully of the future, and express belief that the revival of trade, so long looked for, has set in. Consumers are evidently of the same opinion, as they are prepared to buy for delivery over a considerable period at the present prices, which would hardly be the case if they had reason to believe that the current improvement was nothing more than a spurt. Speculators are also taking hold more of pig iron, and have no hesitation in operating, especially in pig iron, as they think that they will be able to speculate profitably, for prices are more likely to advance than to fall back. For some years they have not touched iron, as they could employ their money to better advantage by operating in other metals. People also are inclined to put more faith in an improvement which sets in during the autumn months, for an autumn start has usually meant a revival which has lasted for a considerable period. It is, however, probable that business may not be very lively this year, but still there is much more doing than there has been at any time this year, and better prices are generally being realised, not only in the pig iron but also in the finished iron and steel trades.

As yet the ironfounding and engineering industries have not experienced any of the revival, but both these still feel acutely the effects of the long strike of moulders, and the dulness that continues in the shipbuilding industry. The strike is over, it is true, but comparatively few of the workmen have been able to resume their employment, because the work is not there for them, and it may be weeks before the masters will be in a position to give them work. The cessation of the strike has not meant the simultaneous resumption of employment, except for a very small proportion of the men who were on strike, because their action has driven away to other districts, and even to the Continent, a large proportion of work which would have in all probability been executed in this district if there had not been any strike; and the outlook for the winter for them is not encouraging, because the shipbuilding industry is so depressed, and it is hardly likely that many new orders will be given out, because profitable employment cannot be found for a large number of the steamers that are now running, freights being so low—in fact they are to many ports lower than were ever before known; and many vessels are laid up on our rivers. Thus ordinary shipowners find they have enough to do to manage steamers already running, without ordering more steamers, and thus increase the glut, and the difficulty of making the property pay. Probably never was the difficulty greater of making ends meet in the shipping trade, and it would be better for the owners if more steamers were laid up. Many builders have idle berths, indeed on the Tyne more than half the berths are unoccupied. In face of this it is hardly likely that the moulders can succeed before the Conciliation Board in obtaining any advance of wages such as they have been obtaining during the last six months, and it seems more probable that wages will be reduced. Probably if they had not struck they might have been able by this to secure even more than they asked in March. But their action did much to paralyse business, and it may be some time before a recovery of their trade is experienced. The pattern-makers have not seen their way to follow the example of the moulders, but still remain on strike, and for the original amount, viz., 10 per cent. on piece prices, and 3s. 6d. per week on time wages. Efforts have been made this week to induce them to have the dispute settled, like that of the moulders, by arbitration or conciliation, but the men reject the offer.

The demand for Cleveland pig iron increases, and prices now are better than they were last week. In No. 3 Cleveland G.M.B. a little business was done early in the week at 36s. 3d. per ton for prompt f.o.b. delivery, but the sales were made by second hands, and were practically of odd lots. The producers have generally held out for 36s. 6d., which they have been able to realise; indeed, some firms have obtained 37s. where their brand was particularly needed, and where it could not be bought from merchants or the public warrant stores. As a matter of fact there are several brands of pig iron that never find their way into the public stores, the makers stipulating when they sell the iron that it must not go into the stores, and it is bought on that understanding. Several makers are badly off for No. 3, because their furnaces have not worked well since August 11th, and the roportion of No. 3 made has fallen below the average, so that producers have not in all cases been able to fulfil their orders as promptly as required. Cleveland warrants have been moving upwards this week, and have reached the best price that has been quoted since the improvement commenced. This rise has brought in more speculators, and there is a likelihood of a lively time in the warrant market. On Wednesday the closing price was 36s. 8d., cash. The stock of Cleveland pig held by Messrs. Connal and Co. on Wednesday night was 91,061 tons, or 672 tons increase this month. It might have been expected that as No. 3 is so scarce, the stock in the public stores would be more largely drawn upon. But deliveries are quiet on export account, and the shipments of pig iron from Middlesbrough this month have reached only 25,370 tons, against 27,413 tons last month, 42,965 tons in July, and 34,045 tons in September, 1893, all to 12th.

The lower qualities of Cleveland pig iron are in improving request, and makers look for a large demand when the Scotch miners' strike collapses, as it is expected to do shortly, because the Scotch mills, forges, and foundries will recommence operations directly the strike is over, but will not be able to get supplies of the necessary pig iron from the local works, and will have to procure it from Cleveland. The stoppage of the Scotch furnaces has been very complete, only two remaining in operation. For Cleveland No. 4 foundry pig 35s. 3d. is quoted, and for grey forge 34s. 6d., and there is not much to be had under these figures. East Coast hematite pig has this week at last shown some improvement, and M. Nos. have been put up to 43s. 6d., though in some cases business has been done at 43s. 3d. Foreign ore is somewhat dearer, and as consumers are willing to buy for delivery over the next six months at the present price, it may be inferred that lower rates are not expected.

Business is more active in nearly all branches of the finished iron and steel trades, and the advanced prices are maintained. The steel rail makers have raised their quotation for heavy rails to £3 12s. 6d. net at works, not so much because of a better inquiry as because the cost of production has increased. Still there is more doing, and orders are expected to be more freely distributed this autumn than in any period of this year. The steel plate and angle manufacturers are maintaining their advanced rates, but buyers are chary about paying them, as they can hardly secure a corresponding advance from their customers. Steel ship-plates are at £5 2s. 6d. and angles at £4 17s. 6d., both less 2½ per cent. and f.o.t., but there are sellers at less. Palmer's Shipbuilding and Iron Co., Jarrow-on-Tyne, have secured an order for a 6000-ton steamer for the Peninsular and Oriental Steamship Company. It is only great companies like these that can afford to order new vessels at the present time. Common iron bars are sold at £4 17s. 6d. less 2½ per cent.; they have not moved for months, but there is now some improvement appearing. Bridge builders are somewhat better off, and have more encouraging prospects.

The directors of Bolckow, Vaughan and Co. state that the results of their operations during the first half of the year were fairly satisfactory, but they do not recommend the payment of an interim dividend, preferring to wait until the end of the year, when the results of the full year's working will be known. This was the course they pursued last year.

A committee of the Middlesbrough Town Council have visited the electric lighting works at Newcastle, Leeds, Bradford, Halifax, Huddersfield, and Blackpool, and make a very appreciative report on the subject. They affirmed that the electric light is a paying business, and a profit can be made by its adoption. It is superior to gas and its sanitary effects are in the right direction, and tradesmen's goods are not injured as they are with gas. The committee are of opinion that it would be in the true interests of the borough to proceed forthwith with the laying down of an electric light installation at a cost not exceeding £25,000. They deprecate the proposed spending of a large sum of money on the extension of gas plant. They think it is not desirable that a private company should obtain powers for Middlesbrough to be approached hereafter for purchase—as in the case of Newcastle—but recommend that the Corporation itself should obtain the necessary powers.

The coal trade is very brisk, and deliveries are good both by rail and sea. A large amount of business is coming into the district by reason of the Scotch strike, and prices all round are well maintained. The Elswick Coal Company has applied to the Collieries Committee of the Newcastle Corporation to be allowed to work the coalfield, extending to 350 acres, under the Town Moor. The present workings of the company afford a rent of £200 and 3d. per ton royalty to the Corporation, yielding an average of over £1000 a year. It was agreed to lease the new coalfield on similar terms, the rent being doubled, and the royalty at 3d. a ton increasing in the event of the seams of coal turning out exceptionally good.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

A MODERATE business has been done in the pig iron market in Scotch warrants, which have been firmer in price, selling from 43s. 7½d. to 43s. 9½d. cash. Cleveland iron is in poor request. There has been slightly more inquiry for hematite, Cumberland warrants selling at 44s. 10d. and 44s. 11½d. cash. Scarcely any interest is taken in warrants by the outside public.

The special brands of makers' iron are difficult to obtain, a number of them having indeed temporarily disappeared from the open market. G.M.B. f.o.b. at Glasgow, No. 1, is quoted 45s. 6d. per ton; No. 3, 43s. 6d.; Monkland, No. 1, 48s.; No. 3, 43s. 6d.; Carnbroe, No. 1, 49s.; No. 3, 46s. 6d.; Calder, No. 1, 58s; No. 3, 51s.; Summerlee, No. 1, 59s.; No. 3, 51s. 6d.; Coltness, No. 1, 59s.; No. 3, 52s.; Glengarnock at Ardrossan, No. 1, 54s.; No. 3, 49s. 6d.; Eglinton, No. 1, 54s. 6d.; No. 3, 48s; Dalmellington at Ayr, No. 1, 51s. 6d.; No. 3, 49s.; Shotts at Leith, No. 1, 56s.; No. 3, 51s. 6d.

There are now only two furnaces in blast in Scotland, and these are both at Coltness, producing ordinary iron. Since last week two were put out at Shotts, and the whole of the Scotch blast furnaces with the above exception now stand idle.

The shipments of pig iron from Scottish ports in the past week have been 1623, against 6641 in the corresponding week last year. There was sent to Australia 390 tons; Canada, 16; India, 75; France, 45; Germany, 171; Holland, 60; Belgium, 40; other countries, 10; the coastwise shipments, 818, compared with 3040 in the same week of 1893.

There is as yet no business of any importance in manufactured iron and steel. The annual report of the Steel Company of Scotland is an indication of the unprofitable state of business and of the evil consequences of the miners' strike, and it will be a considerable time before work can be anything like fully resumed. The high cost of fuel makes it impossible to keep the works going at present. One or two firms have made a start, but there is no chance of a general resumption of work until the colliers' strike is at an end.

It need scarcely be said that we are nearer the termination of the strike. The colliers are showing unmistakeable signs of their conviction that they are beaten. In consequence of the unsatisfactory state of trade and the gradual decline in prices, it was and is impossible to give the colliers any permanent advance of wages. At a number of collieries small bodies of men are working, and there are appearances of an early collapse of the strike.

The coal trade is quite disorganised. This week prices have been higher to the household consumer, and the demand for manufacturing purposes is also increasing, although there is still much room for improvement. The past week's coal shipments from all the Scotch ports amounted to only 9963 tons, against 180,467 in the same week of 1893. It will also be of interest to note that the total coal shipments for the current year to date show a decrease of fully 1,000,000 tons, compared with those for the corresponding period of last year.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is certainly more animation in the iron and steel trades of late. In visiting the other day the admirably managed Alexandra dock, Newport, I was impressed with a picture, not seen at any other docks in Wales, of great quantities of rails and sleepers waiting their time for Delagoa Bay. These were principally from the Ebbw Vale Works, though Dowlais-Cardiff does considerably in steel sleepers for foreign destinations. On Tuesday a cargo of rails and sleepers amounting to 3500 tons was despatched. On the same day from Cardiff 600 tons iron went to Bilbao. In Bessemer and Siemens bars the leading works are more busily occupied of late. This week a very large despatch of bars took place from Cyfarthfa, and a good average from Dowlais. Prices are showing a hardening tendency, but in other respects quotations remain unchanged. In iron ore a good deal more business has been done, and numerous consignments have been received. Latest prices show an improvement. Rubio is selling at 11s. to 11s. 3d.; Tafna, 10s. 6d. to 10s. 9d.; Garucha, 10s. 6d.; Porman, 9s. 9d. to 10s.

There has been an increased make and export of tin-plate, and the tone of trade is manifestly improving. Last week the make in the Swansea district totalled 72,328 boxes, and the shipment 72,453 boxes. Stocks are now down to 311,453 boxes. Swansea imported 805 tons of pig iron last week and 490 tons tin bars. The Harbour trade generally was good, and the import and export very satisfactory. The total trade of the last week was 10,000 tons above that of the previous week, and 20,000 tons above that of the corresponding week last year. The prospects of an increased coal trade, by the Great Western Railway reductions from the Aberdare and Ogmore districts, are assured.

The patent fuel trade is fairly active, both at Cardiff and Swansea. From the latter port last week 2260 tons were despatched to France, 680 tons to Spain, 2150 tons to Italy, 1900 tons to Austria, 2840 tons to Algeria. A buoyant tone prevails throughout in connection with the coal trade, and each port records the dispatch of large tonnage. At Cardiff, mid-week, a full attendance again took place on 'Change, and a hopeful condition was noted. Prices showed this conclusively, 12s. again being touched for best steam. The latest quotations were: Best steam, 11s. 6d. to 12s.; seconds, 11s. to 11s. 3d.; best Monmouthshire, 10s. 6d. to 10s. 9d.; dry sorts, 10s. to 10s. 3d.; small, 5s. 6d. to 5s. 9d. f.o.b. Best house coal, 11s.; No. 3 Rhondda, 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 9d.; through, 7s.; small, 4s. 6d.; patent fuel, 11s. to 11s. 6d.; coke, furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; special, 20s. to 21s.

Cardiff Exchange iron and steel quotations for the week have been as follows:—Steel rails, heavy, £3 17s. 6d. to £4; light, £4 10s. to £4 15s.; Bessemer bar, £4 to £4 2s. 6d.: Siemens best, £4 5s. to £4 7s. 6d. Swansea Exchange quotations: Pig iron, Glasgow warrants, 43s. 8½d.; Middlesbrough No. 3, 36s. 5d. prompt; Middlesbrough hematite, 43s. 6d.; Welsh bars, £5 to £5 2s. 6d.; angles, &c., at usual extras f.o.t. at works; sheet iron, £6 to £6 10s.; steel sheets, £6 5s. to £6 10s.; steel bars, Bessemer, £4 to £4 2s. 6d.; Siemens, £4 2s. 6d. to £4 5s.; all delivered in district, cash less 2½; steel rails from £3 15s. to £3 17s. 6d. heavy; light, £4 10s. to £4 15s.; tin-plates, Bessemer's steel cokes, 10s. 6d. to 10s. 9d.; Siemens, 10s. 9d. to 11s.; ternes, 28 + 20, 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; block tin, £71 5s. to £71 7s. 6d. Coke in steady demand at last prices. Pitwood generally improving.

I am glad to be able to report favourably of the South Rhondda colliery. The south crop of the Welsh coal basin has always been regarded as a doubtful area, and though a few have succeeded, the great mass of speculators have come to grief. One mining engineer of eminence described the great tract up towards Swansea as being like a battle ground, from the number of victims who had been sacrificed there. The South Rhondda is on the land of Mr. D. Owen, of Ash Hall, secured by him twelve years ago, and thanks to his knowledge and energy the development has been one of marked success. The yield of best No. 3 Rhondda is now 1000 tons a week, and on one occasion lately the output was 249 tons in one day.

One characteristic of the Welsh collier is extreme hardihood, and, in many cases, recklessness of a most censurable character, in which life is perilled without a thought. This week an Aberdare man, employed in the Treaman Colliery, was summoned for three offences against the special rules—(1) For firing a shot in the mine, (2) for having a match in his possession, and (3) for opening his lamp. The bench leniently let him off for £4 and costs. In consideration of the sacrifice of life which might have resulted, one would have thought that nothing but imprisonment and hard labour would have met the case.

Another step has been taken in the electric lighting of Monmouth. A majority of the Town Council voted at the meeting on Tuesday to appoint Mr. Lailey, C.E., Westminster, to prepare plans and specifications for the combined scheme for drainage and electric light in the borough. The whole of the work connected with the electric installation, as well as the conveyance of the sewage from the pumping station to the purifying tanks, is to be entrusted to Messrs. Bramwell and Harris.

Llanelly is progressing well, and taking its place as the fourth port of Wales. The harbour superintendent has reported successful boring operations carried out on the site of the present scouring reservoir, with the view of finding a good foundation for a new dock. During the half-year ended June 30th Llanelly exported 19,392 tons of tin-plates.

Those conversant with the coal history of Wales will hear with regret that Mr. John Nixon has resigned the post of chairman of the great colliery company of Nixon, Taylor, and Cory. Mr. Nixon remains simply as a shareholder, the retirement being due to his advanced age. He figured amongst the early pioneers of Wales. Locket, Marychurch, and Insole were the first shippers to London of Welsh coal, but John Nixon sent it farther afield, and is even cited as stoking a steamer on the Seine to show the value of the coal. He has rendered great services in the development of the Welsh coal trade, and in connection with the colliery working introduced the long wall system, and in the mechanical arrangements of his three large collieries carried out a perfect system which has been attended with safety from all but an occasional single accident. He is the inventor of the "ventilator," and it is claimed for him that during his career over six millions of men and boys have been up and down his pits without an accident. He was the first to experiment with steam coal in the locomotives of the Taff Vale Railway, in company with the late Mr. George Fisher. The general management of the collieries now devolves upon Major Bell.

There is a strike on at the Phœnix Dry Dock, Swansea. It is stated that the demands of the men for an increased wage are not justified by the state of trade.

I regret to announce the death of Mr. David Davies, principal of the Beaufort Tin-plate Works, Morriston, Swansea. Mr. Davies was a notable instance of industry. He began life as a farm labourer, and next filled a humble position at the Penydarran Works as a roll-cutter. One of the specialities of Penydarran was the nail rod, but at one of the Staffordshire ironworks a burnished one was turned out which was of a superior kind, and David Davies, on his own inspiration, travelled thither and worked in a humble capacity at the works until he learned the process, and, returning, he introduced this and made a fortune. He lived to acquire the ownership of the Penydarran estate, sold this, acquired the College Works, Llandaff, which he again sold, and finally bought the Beaufort Works, near Swansea, and was more successful than the generality in avoiding labour difficulties.

The Dean Forest colliers are agitating about deserting the sliding scale, and adopting the two years' arrangement on the Federated lines.

There are some rumours of discontent amongst the Welsh colliers, though of a slight nature. Federation agents predict that October will see the colliers giving in a notice to abandon the scale. This is, of course, the leading wish of the Federationists, but I question if it will be realised. D. Morgan, miners' agent, at a late meeting, stated that he would abide by the principle of the scale, and only advocate amendments, a statement received with applause.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

BUSINESS transactions on the iron market continue small, but the tendency of prices is tolerably firm. Export trade has been pretty lively, comparatively speaking. There is a specially good business done to Russia, and even the Dutch have come forward with some orders lately, which, though not very important, have been "thankfully received." On the Silesian iron market demand and sale are still exceedingly dull, and almost all the works complain of insufficient employment. This is particularly the case in the bar trade, where the scarcity of fresh orders is more keenly felt from week to week.

The Austro-Hungarian blast furnace works are satisfactorily engaged, chiefly on orders of previous date, and there is a pretty firm tone in prices to be noticed generally. With regard to the business in malleable iron there is not much activity reported in the different branches, orders for bars, plates, and girders coming to hand but slowly. There is, likewise, only a very poor inquiry experienced in the wire trade, while the various sorts of structural iron are in good call. The steel makers are rather badly off for new work just now. There are but very few contracts offering; the requirements for the Austrian State Railways are not likely to be given out this year, as was first intended, which has caused much disappointment. The same is the case with orders for locomotives and wagons, which will be divided over several years, so that prospects for the immediate future are not very favourable. The Rhenish-Westphalian works continue to throw their over production on the Austro-Hungarian market, and have been rather successful of late, especially in Bohemia, where pretty large lots have been sold. The present official quotations are: For common forge pig, 42·50fl.; grey ditto, 48fl.: mixed lots, 43fl. to 45fl.; Bessemer, 48fl. to 50fl., free Vienna; Bessemer ingots, 75fl. to 80fl., free Vienna. Styrian bars, 107 50fl. to 115fl.; girders, 106fl. to 110fl.; heavy plates, 180fl.; tank ditto, 135fl.; sheets, 145fl., all per ton.

On the French iron market business all through continues very quiet, but there is still a regular activity maintained at the works, and makers appear less inclined to go down with their quotations now than in previous months. The articles at present most neglected are plates, for which an exceedingly poor inquiry is coming forward. Much the same is the case with hardware. French business in coal during the first two quarters of present year was as under:—

Import
from Jan. 1st to June 30th.

| Coal from | 1894. t. | 1893. t. | 1892. t. |
|---|---|---|---|
| England | 2,141 520 | 1,993,495 | 2,026,336 |
| Belgium | 1,695,950 | 1,680,482 | 1,732,781 |
| Germany | 321,740 | 303,040 | 277,487 |
| Other countries. | 930 | 1,342 | 1,146 |
| Total | 4,160,140 | 3,978,359 | 4,037,750 |
| Coke from | | | |
| Belgium | 226,870 | 253,565 | 286,679 |
| Germany | 508.080 | 412,007 | 351,124 |
| Other countries. | 7,6[illegible]0 | 24,336 | 11,706 |
| Total | 742,580 | 689,908 | 649,509 |

Export
from Jan 1st to June 30th.

| Coal to | 1894. t | 1893. t | 1892 t. |
|---|---|---|---|
| Belgium | 178 100 | 178,590 | 163,797 |
| Italy | 14,910 | 15,878 | 38,571 |
| Switzerland | 104,020 | 84,338 | 93,023 |
| Turkey | 6,040 | 6,138 | 3,622 |
| Egypt | 290 | 440 | 1.419 |
| Algiers | 6,720 | 1,385 | 3,051 |
| Other countries. | 88,570 | 85,783 | 89,593 |
| Total | 398,650 | 372,552 | 322,876 |
| Coke | 21,660 | 25,038 | 18,247 |

Belgian iron trade does not show much change on the week. Prices for pig iron, especially those for forge pig, show a somewhat weaker tone of late, although inland demand for most sorts of iron and steel has experienced a slight improvement, while export business is as dull as ever. Import of iron in June of present year amounted to 36,898 t., against 15,321 t. for the same period the year before, and against 25,653 t. in 1892. During the first two quarters of 1894 total import of iron was 119,684 t., in the year before it was 58,309 t., and in 1892 it amounted to 68,779 t. Belgian trade in artificial coal—briquettes—has very much improved during the last two years, large quantities being sent to England, Italy, Sweden and Norway, Switzerland, Spain, Egypt, Algiers, Luxemburg, and the United States. Export in artificial coal during the first five months of the year shows an increase of 65,000 t. against the previous year, and 134,000 t. against the corresponding period in 1892. During the first two quarters of the present year 307,919 t. of artificial coal were exported from Belgium, against 230,543 t. for the corresponding period last year. Of these, 2650 t. were sent to Algiers; 9867 t. to Germany, 7805 t. to England, 1150 t. to Columbia, 345 t. to the Congo, 9540 t. to Egypt, 9015 t. to Spain, 34,600 t. to the United States, 114,879 t. to France, 16,440 t. to Luxemburg, 7040 t. to Italy, 6906 t. to the Low Countries, 1550 t. to Russia, 10 t. to Sweden and Norway, 47,436 t. to Switzerland, 1970 t. to Turkey, and 40,316 t. to other countries.

On the whole, the Rhenish-Westphalian iron business remains without improvement; here and there a slightly better tone has been reported; but, taking it all through, the condition of both the crude and the finished ironworks is quite as unfavourable as before, and it is rather astonishing that prices, at least those for raw iron, have been pretty well maintained up to the present. The malleable iron trade is rather slack; very few orders come to market both from inland and abroad, and negotiations remain weak. Girders are in quiet request. The prices for hoops are excessively low just now, owing to insufficient employment of the mills, and there is much the same to be reported of plates and sheets, quotations being now at figures which leave no margin of profit. Drawn wire has been tolerably well inquired for on foreign account lately, while inland demand remains extremely dull. Foundries and machine shops continue in a poor condition, generally, while the wagon shops are reported in regular employment, which is likely to continue for some time ahead.

## AMERICAN NOTES.

NEW YORK, Sept. 5th, 1894.

THE condition of affairs in this country can be best understood by reference to railway earnings for last year. The decrease for first half 1894 in gross earnings was 16½ per cent. on 234 roads, representing 153,355,000 of capital. The estimate of the total gross loss on all roads for the six months is 100,000,000 dols. The decrease in manufacturing is estimated at 20 to 25 per cent. Farm products have declined in value. Building enterprise has been checked. At the same time there is much work in prospect, from railroad building down to house building. The tariff settlement has made no change, and there will be no improvement until after the November elections, when there will be an overwhelming Protectionist victory that will frighten the revenue reformers. Iron and steel quotations are unchanged. Bessemer pig production is increasing. The steel rail mills are booking large orders for delivery in October and November.

## LAUNCHES AND TRIAL TRIPS.

The s.s. South Gwalia is a vessel built by Messrs. Wm. Gray and Co. to the order of Messrs. Evan Jones and Co., and engined at the Central Marine Engine Works. Her dimensions are:—Length over all, 282ft.; breadth, 38ft.; depth, 20ft. 8in. Her engines have cylinders 20in., 31½in., and 53in. in diameter, with a piston stroke of 36in. The boilers are of extra large size, working at 160 lb. per square inch. Having adjusted the compasses, the engines were run full speed ahead for about a couple of hours, and although the very stormy state of the weather caused a great deal of racing, the engines ran in a perfectly satisfactory manner in every respect, and as soon as the trial was over she proceeded on her voyage to London to load. The vessel has been built under the personal supervision of Captain Jones, and the building of her engines has been superintended by Messrs. J. C. Hallett and Co., of Cardiff, whose inspector, Mr. Patterson, accompanied the ship to London.

On the 30th August Messrs. Rickmers and Co. launched from their yard at Bremerhaven the coasting tank steamer Sabine Rickmers, constructed specially for the carriage of petroleum in bulk, and built under the superintendence of Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool. The vessel is 200ft. long, 30ft. 6in. beam, and 20ft. 9in. moulded depth. Her engines are of the direct-acting triple-expansion type, with cylinders 17⅜in. by 28in. by 44½in., with a stroke of 37⅜in., and are supplied by steam at 160 lb. pressure by a circular multitubular boiler 14ft. 6in. extreme diameter, 10ft. 6in. long, fitted with three Purves patent ribbed furnaces, 3ft. 6in. diameter, and about 7ft. long. The oil is carried in three tanks amply stiffened to Bureau-Veritas Surveyor's approval, so that any one tank may be full while others are empty. Ample ventilation is fitted in bunkers and in cargo tanks. Hand-steering gear is fitted amidships to work on pilot bridge. A large donkey boiler capable of making a good head of steam when both cargo pumps are being fully worked is being fitted.

On Monday the s.s. Cierbana left the Cleveland dockyard of Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip, which was very satisfactory. She is a steel screw steamer of the raised quarter deck type, and has been built to the order of Senor Ramon de la Sola, of Bilbao, and takes Lloyd's highest class. The principal dimensions are:—Length, 234ft.; beam, 34ft.; depth moulded, 17ft. 6½in., with a carrying capacity of about 1900 tons at a light draught of water. A very complete outfit of deck machinery is provided for loading and discharging cargoes, working anchors, &c. The decks and deck erections are all of steel and iron, and water ballast will be carried in the cellular double bottom, which extends right fore and aft, and the after peak is also fitted as a ballast tank. The engines are by the North-Eastern Marine Engineering Company, of Sunderland, the cylinders being 16in., 26in., and 43in. by 30in., with one large boiler working at 160 lb. pressure. The construction of the vessel has been carried out under the supervision of Captain Ybarra, and the vessel will be employed in the ore trade between Bilbao and Middlesbrough.

The Lady Gray is the latest addition to the fleet of Messrs. John Coverdale and Son, of West Hartlepool. and has been built by Messrs. Wm. Gray and Co., and engined at the Central Marine Engine Works. She is a vessel taking Lloyd's highest class, and her dimensions are: Length over all, 310ft.; breadth, 40ft.; and depth, 20ft. 10in. Her engines are of the triple-expansion type, having cylinders 22in., 35in., and 59in. diameter, with a piston stroke of 39in. Steam is supplied by two large single-ended boilers working at 160 lb. pressure. The trial trip was made off Hartlepool, the compasses having been adjusted in dock owing to the bad state of the weather. The engines were run full speed for about a couple of hours, everything running perfectly satisfactorily, there being no hitch or trouble of any kind. The Lady Gray is fitted in her engine-room with all the latest improvements developed at the Central Engine Works, including the Mudd and Airey patent metallic packing in all the piston-rods and spindles, which on the trial trip ran perfectly steam-tight and satisfactorily in every respect. Several shareholders and others interested were on board the vessel, including the managing owner, Mr. Robt. Coverdale, Mr. Airey, superintending engineer, Dr. Rawlings, Mr. J. T. Kay, Rev. E. R. Ormesby, Mr. Sanderson, Mr. G. H. Baines, Mr. Geo. Jones and Mr. T. Mudd. Immediately after the trial, the vessel proceeded on her voyage to Cardiff to load for the Mediterranean.

On Thursday morning, the 6th inst., the s.s. Maristow left the Cleveland dockyard of Sir Raylton Dixon and Co., Middlesbrough, for the purpose of testing the machinery and general working of the steamer at sea. She is a steel screw steamer of the partial awning deck type, and takes Lloyd's highest class. This vessel has been built to the order of Messrs. Bellamy and Co., of Plymouth, and is the fourth steamer constructed by these builders for the same owners. She is intended to replace a vessel of similar name which they sold a short time since. The principal dimensions are:—Length, 298ft.; beam, 40ft.; depth moulded, 21ft. 2½in.; and she has a deadweight carrying capacity of over 3600 tons. Shifting boards are fitted throughout for the carrying of grain cargoes. The awning and quarter decks are of iron, the main deck of steel, and the vessel is sub-divided transversely by six water-tight bulkheads. She is rigged as a fore-and-aft schooner, with pole masts of steel, which are fitted with Sidgwick's patent hinge arrangement, by means of which the topmasts can be immediately lowered when the vessel is required to pass under such obstacles to navigation as the permanent bridges on the Manchester Ship Canal, &c. The engines are by Messrs. T. Richardson and Sons, of Hartlepool, the cylinders being 22in., 35in., 59in. by 39in., and steam is supplied by two large steel boilers working at 160 lb. pressure per square inch. The building of the steamer has been under the superintendence of Mr. George Walker, naval architect, of London. The trials were most satisfactory in every sense.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

*20th August*, 1894.

16,487. Hair Comb Binder, P. Shields, Belfast.

16 488. Knitting Machines, J. A. A. Claringburn and A. Banks, Nottingham.

16,489. Blouse or Dress Fastener, H. Munslow, London.

16,490. Rims or Fellows for Wheels, W. Bowden, Manchester.

16,491. Gas Lights, T. Barker, Manchester.

16,492. Wired-on Pneumatic Tires, J. Harrison, Birmingham.

16,493. Looms for Weaving, E. Westwell and J. Mitchell, Halifax.

16,494. Wire-covered Steam Pipes, D. B. Morison, Hartlepool.

16,495. End-warp Leasing Machine, J. Law, Rochdale.

16,496. Handle for Billiard Cue Rest, T. Ritchie, Loughborough.

16,497. Barrels for Containing Liquor, A. E. Allison, Newcastle on-Tyne.

16,498. Motor Engines, J. Southall, Worcester.

16,499. Cuff or Sleeve Links, J. Hopewell, Manchester.

16,500. Securing Glass in Frames, C. Jost, Bradford.

16,501. Attaching Belts to Buckles, M. Winkfield.

16,502. Trace Chains for Horses, D. N. McKelvie, Glasgow.

16,503. Holding Book Rests in Position, B. R. Walker and H. Woodward, Birmingham.

16,504. Cycle Lamps, H. Aulton and R. Merchant, Birmingham.

16,505. Vehicles, A. Fehlen and The Princess Company, Ld , London.

16,506. Coupling Wrench, G. Sheepway and J. Smith, Gloucester.

16,507. Fixing Door Handles on to their Spindles, R. Frame, Glasgow.

16,508. Sign Plates, W. S. Brown and R. Lugton, Glasgow.

16,509. Marine Boiler, L. M. Brayne. Glasgow.

16,510. Fastening Boot Laces, S J. Heinig, London.

16,511. Chair Seat Supporter, T Palmer, Burnley.

16,512. Umbrella Frames, J. P. O'Donnell.—(*F. Giles, Australia*)

16,513. Repair of Pneumatic Tires, C. T. Austen, London.

16,514. Skates, N. Browne.—(*H. Wirths and Sohn, Germany.*)

15,515. Disinfecting Sewer Gulleys, M. and J. Miller. London.

16,516. Meters for Measuring Fluids, J. G. Galley, London.

16,517. Type writing Machines, R. Toepper, London.

16,518. Supports to Hold Stands, N. A. Aubertin, London.

16,519. Pocket for Ladies Dresses, E. Grahame and J. Eddels, London.

16,520. Driving Gear of Velocipedes, F. Russell, London.

16,521. Axle Boxes for Railway Carriages, H. Rees and T. Hulme, London.

16 522. Spring Wheels for Cycles, D. Smith, jun., London.

16 523. Tapes for Curtains, &c, A. E. Fryant, London.

16,524. Tube Pincers, W. Bürkle, Germany.

16,525. Adjustable Garment, C. Thill and H. Puhlmann, Germany.

16.526. Protecting Cases for Matches, H. Klein, Germany.

16,527. Appliances for Sewing Machines, A Bucholz, Germany.

16,528. Cigar and Cigarette Holder, J. Nadler, London.

16,529. Making Potassium Cyanide, G. Kraemer, London.

16,530. Colouring Matters, C. D. Abel.—(*The Actien Gesellschaft fur Anilin Fabrikation, Germany*)

16,531. Steam Heating Apparatus, G. L. Berry, London.

16,532. Electric Lamps, W. E. Conze.—(*F. W. Busch, Germany*)

16,533. Heating Water, J. E. Joselin and J. H. Stevens, London.

16.534. Heating Apparatus, M. A. L. Siffert, London.

16,535. Tea Strainer, G. F. Pierce and F. W. Warrick, London.

16,536. Transporting Corrosive Acids, R. England, London.

16 537. Attaching Pneumatic Tires, P. W. Tillinghast, London.

16,538. Safety Pins, K. E. Winge, London.

16,539. Vessels, C. S. Snell, Saltash.

16,540. Firing Mines Electrically, C. A. Terrey, London.

16,541. Manufacture of Wood Wool, J. M. Webster, London.

16,542. Search-light Projectors, J. B. Furneaux and H. Walker, London.

16,543. Picture Toys, &c., F. Mitchell, Surrey.

16,544. Supporting Persons when Cleaning Windows, H. C. Stanze, London.

16,545. Valve Steam Engines, N. J. Poulsen, London.

16,546. Navigable Vessels, R. Harte, London.

16,547. Propelling Machinery, &c , by Pressure, S. Appleby, Middlesbrough.

16,548. Producing Substitutes for Coffee, R. Haddan.—(*Kathreiner's Malzkaffeefabriken mit beschränkter Haftung, Germany.*)

16.549. Stoneworkers' Gauge Squares, J. H. Gorman, London.

16,550. Match-boxes, &c , C. E. Campbell, London.

16,551. Ferrule for Umbrellas, &c., J. Hurlock and S. Hurlock, London.

16,552. Bunkering or Coaling Steamships, J. Dixon, London.

16,553. Ladies' and Children's Dresses, H. A. Dale, London.

16,554. Nailing Machines, H. Hyde.—(*F. D. Locke, United States*)

16,555. Bicycles, &c., T. Hall and J. Davies, Manchester.

16,556. Fancy or Business Postcards, C. Schell, Liverpool.

16,557. Metal Ingots, W. P. Thompson.—(*Stumm Bros., Germany*)

16,558. Agitating Apparatus for Ice-making Tanks, J. Price, Liverpool.

16,559. Acid Manufacture, G. W. Johnson.—(*Kalle and Co., Germany.*)

16,560. Driving Gear for Tricycles, W. P. Beaver, London.

16,561. Constructing Name-plates, &c., J. B. Adams, London.

15,562. Forming Sheet-metal Boxes, S. B. Stevens, London.

16,563. Firewood Splitting Machines, A. P. Blaxter, sen., and S. O. Holmes, London.

16,564. Sash Fasteners for Sliding Doors, E. Clare, London.

16,565. Postal Wrapper, S. H. Crocker, London.

*31st August*, 1894.

16,566. Safety Air Valve for Cycles, G. Wright, Nottingham.

16,567. Gravitation Motor, J. H. Fitzgerald, Belfast.

16,568. Pleasure Boat, M. Bagnall, Wolverhampton.

16,569. Automatic Delivery Match-box, F. J. Commin, Exeter.

16,570. Adjustable Rack Spanner, E. Barnes, Birmingham.

16,571. Decorative Plates, M. Kohl and E. Kuppert, Manchester.

16,572. Spinning Tops, S. Barnes, Middleton.

16,573. Pneumatic Tires, H. Kesterton, Manchester.

16,574. Furnace and Flue Tubes, E. C. Mills, Manchester.

16,575. Stove, W. Feyton, Halifax.

16,576. Texture Grip, J. A. Riley and E. Tyrrell, London.

16,577. Raising, &c , of Window Sashes, T. Robb, Glasgow.

16,578. Pickers for Over-pick Looms, H. Cruse, Manchester.

16 579. Bobbin Frames, C. Clay and H., T., and J. J. Burgess, Congleton

16,580. Latches, W. H. Wathen. Birmingham.

16,581. Roofing Tiles, H. E. Hayes. Bristol.

16,582. Making Cardboard Boxes, W. Crosland, Manchester.

16,583. Boring Machines, G. S. Waterfall and C. H. Woods, Sheffield.

16,584. Construction of Cycle Handles, J. Brailsford, Sheffield.

16,585. Set-square and Ruler, J. J. Hughes, Carmarthen.

16,586. Photographic Mounts, F. W. Hayward, Norwich.

16,587. Line-throwing Apparatus, J. Griffiths, Swansea.

16,588. Pipe, W. Jones, Cardiganshire.

16,589. Loom Shuttles, H. Cruse, Manchester.

16.590. Pockets for Ladies' Dresses, A. M. Turner, London.

16,591. Deckplate, H. B. and J. S. Watson and M. C. James, Newcastle-on-Tyne.

16,592. Pneumatic Butt End for Guns, W. W. Tonks, Birmingham.

16,593. Heating Dwelling Houses, &c , A. Bruce, Glasgow.

16 594. Cycle Pedals, M. Carswell, jun., Glasgow.

16,595. Compensation Gear, A. E. Beck and W. E. Preston, Birmingham.

16,596. Roving Frame Construction, J. Arrowsmith, London.

16,597. Oil and Gas Heating Apparatus, F. H. Rosher, Kent.

16,598. Vehicle Wheels, J. Bonn, London.

16,599. Regulating Electric Currents, L. B. Miller, London.

16,600. Cycles, T. J. Whiteman, London.

16,601. Holder for Canned Meats, &c., R. F. Mosley, London.

16,602. Gate Spring, C. W. N. Worssam, London.

16,603. Attaching Trade-mark Labels to Frames of Umbrellas, W. A. Bindley, W. J. Gell, and A. F. Boham, London.

16,604. Apparatus for Boring Earth, F. M. McLarty, London.

16,605. Street Sprinkler, H. C. Pollman, London.

16,606. Carbons for Electric Arc Lights, H. C. Barker, jun., London.

16 607. Spring-linked Chain, J. D. Derry, London.

16,608. Plectrums for Mandolines, &c., W. E. Blaker, London.

16,609. Support for Bicycles, C. Pécasse, London.

16,610. Boxes, G. T. Tournier. London.

16,611. Treatment of Fancy Leather, S. H. Epstein, London.

16 612 Manufacture of Paper, P. C. Peebles, London.

16,613. Lamp Glasses, C Quitmann.—(*The Aktien Gesellschaft für Glasindustrie vormals Friedrich Siemens, Germany*)

16,614. Wheel Bearings and Axles, E. Germaine, London.

16,615. Rifle Rest, F. J. Nelson, London.

16,616. Envelope Openers, G. L. Lavington and E. A. Wright, London.

16 617. Clips for Cyclists, A. J. Boult.—(*S. C. Peuchen and P. Clarke, Canada*)

16,618. Motors, A. D. Torre, London.

16,619. Fare-registers, A. J. Boult.—(*A Pfoff, United States.*)

16,620. Valves for Exhaust Pumps, J. W. D. V. Galwey and R. J. Eskrigge, Liverpool.

16,621. Mask Respirator, F. Détourbe, Liverpool.

16 622. Curtains, Pratt, Hurst, and Co., Ld., and T. B. Walker, London.

16,623. Attaching Trade-marks, W. Corder and F. J. Turley, jun., London

16,624. Apparatus for Making Hats, J. Cass, London.

16,625. Process for Engraving Photographs, T. Reich, London.

16,626. Extracting Nibs from Penholders, J. R. Rixen, London.

16,627. Mud-guards for Cycles, H. E. Earl, London.

16 628. Device for Scraping Salt, J. R. Rixen, London.

16,629. Letter Cards, J. Price, London.

16,630. Apparatus for Receiving Coins, E. Edwards.—(*A. Böchsmann, Austria.*)

16,631. Cutter Bars, A. Taylor, London.

16,632. Holder for Hats, W. J. Pendleton, London.

16,633. Tobacco Pipes, W. Shelley, London.

16 634. Calipers, J. Y. Johnson.—(*The Eagle Pencil Company, United States*)

*1st September*, 1894.

16,635. Reducing Vibration in Vehicles, S. H. Stubbs, Manchester.

16,636. Automatic Bicycle, C. Watkin and J. Pickup, Liverpool.

16,637. Socket Castor, J Edwards, London.

16,638. Bottles, J. W. Kilner, Leeds.

16 639. Fire-grate Niggar, E. W. Banner, Southport.

16 640. Rain-guard for Velocipedes, T. Cole, Bournemouth.

16 641. Forks, V. B. Thompson, Sheffield.

16 642. Boiler Furnaces, T. Heppell and R. Auton, Newcastle on-Tyne.

16,643. Match-boxes, J. B. Howard.—(*J. Trendal, Germany.*)

16,644. Dishes, J. Hughes and G. M. Billington, Longport.

16.645. Wheels for Velocipedes, Count C. de Rossetti, London.

16,646. Window Sash Fasteners, S. Daw, Southampton.

16,647. Belt Fasteners, I. Jackson, Manchester.

16,648. Scutching Machines, J. Foulkes, J. E. Park, and G N. Peake, London.

16,649. Clip for Stentering Machines, J. Bridge, Accrington.

16,650. Apparatus for Drying Damp Substances, W. H. Bowers, Manchester.

16,651. Brick-pressing Machines, T. C. Fawcett, Halifax.

16,652. Watchman's Tell-tale Clock, F. Brook, Huddersfield.

16,653. Advertising Sign, D. F. Adamson, F. W. Atterbury, and A. H. Hyslop, London.

16,654. Concrete Structures, J. Sheppard and F. Dashwood, London.

16,655. Machines for Pressing Straw, J. E. S. Perkins, Peterborough.

16,656. Music Stands, J. Jackson, Coventry.

16,657. Rough for Horseshoes, J. Bill, Stourbridge.

16,658. Evaporation Apparatus, &c., J. T. Bottomley, Glasgow.

16,659. Screw Bolts, J. Rankin, E. Beckitt, and J. K White, Glasgow.

16.660. Railway Buffer and Draw Gear, I. A. Timmis, London.

16,661. Covers for Periodicals, C. D. Long, Sheffield.

16,662. Furnaces, G. Clark, Sheffield.

16,663. Hay-cutting Knife, C. Garfitt.—(*The James Russell Barrett Company, United States.*)

16,664. Treating Bully-tree Gum, R. Hutchison, Glasgow.

16,665. Ventilating Casks, A. E. Jolley and J. L. Browning, London.

16,666. Method of Stringing Beads, A. E. Edwards, Manchester.

16,667. Carriage Brake, G. Brendon, Stratton.

16,668. Bed-reader's Safety Lamp, H. J. Newcome, Shenley.

16,669. Eye Protectors, S. S. Hazeland. Cornwall.

16,670. Turkish Bath for the Bedroom, W. S. Walford, Wickham Market.

16,671. Charts for Dress Cutting, S. E. Ramage, Glasgow.

16,672. Privy without Water Flush, K. A. Rudolph, Berlin.

16,673. Weighing Machines, J. Hines, Glasgow.

16,674. Securing and Exhibiting Cards, A. Bissett, Glasgow.

16,675. Steam or Vapour Evaporators, A. Huet, Glasgow.

16,676. Pneumatic Tires, H. Whyte and F. Lewis, London.

16,677. Water-closets, S. Rushton and J. Fletcher, Heywood.

16 678. Valves and Seatings of Cocks, J. Tordoff, Manchester.

16,679. Joint or Coupling for Pipes, H. A. Wassell, Stourbridge.

16,680. Tire Tightener, H. F. Talbot.—(*J. Johnson and J. A. Kenning, British Columbia*)

16,681. Cycle Rims, J. Whitehead and J. Graham Tyrone.

16,682. Game, H. H. Sargent, London.

16,683. Needle Case, J. J. Morrison, London.

16,684. Setting of Arithmetical Tests, C. Rhodes, London.

16,685. Spirit Lamps, G. Herbert, London.

16,686. Construction of Galvanic Cells, C. Vogt, London.

16,687. Electric Alarums, C. Vogt, London.

16,688. Petroleum and Gas Motor, R. Scherfenberg, London.

16,689. Plough and Fillister Planes, W. Kimberley, London.

16,690. Cycle Clips, A. Deck, London.

16,691. Tempered Steel Covering for Pneumatic Tires, J. Bénazet, London.

16,692. Continuous Heating of Water, F. Besin, London.

16,693. Dry Coloured Plaques for Photography, E. de Coninck, London.

16 694. Printing Machines, I. L. Stone.—(*The Duplex Printing Press Company, United States*)

16,695. Electric Lighting, &c., for Gas Lamps, S. Bruck, London.

16,696. Electro-depositing Apparatus, H. Le R. Bridgman, London.

16,697. Electro-depositing Apparatus, H. Le R. Bridgman, London.

16,698. Cold Air Producing Machines, P. Giffard, L. J. M. Boucay, and E. Foucher, Liverpool.

16,699. Hydraulic Motors, A. J. Boult.—(*L. H. Raguet, Belgium*)

16,700. So-called Patent Fuel, G. S. and C. Cory, London.

16,701. So-called Patent Fuel, G. S. and C. Cory, London.

16,702. School Desks, &c , T. Blezard and Sons and T. Blezard, London.

16,703. Spring Gag and Lance Hook Disgorgers, A. Crookes and G. A. Wells, Sheffield.

16,704. Extracting Saccharine Juice from Sugar Cane, G. C. Downing.—(*L. Christ, France*)

16,705. Metallic Carbides, T. L. Willson, London.

16,706. Ink Receptacles and Pens, S. S. Burroughs, London.

16,707. Loom Shuttle Guards, T. Yates, London.

16,708. Device for Holding Pipes, J. D. Roper, London.

16,709 "Combination" Undergarments, F. Penberthy, London.

16,710. Electric Lighting Apparatus, L. Eliasson, London.

16,711. Medicine for Indigestion, L. J. Darby, London.

16,712. Pipes for Conveying Water, S. J. Newman, London.

16,713. Pencils, R Haddan.—(*H. S. Buckland and L. P. Wickland, United States.*)

16,714 Eraser Attachments for Pencils, R. Haddan.—(*C. F. Wickland and H. S. Buckland, United States.*)

16,715. Closet Seat or Cover, K. Hoefelmeyr, London.

16,716. Weighing Machines, E. and J. Böhmer, London.

16,717. Match Holders or Stands, A. Gerken, London.

16,718. Ring for Use as Scarf Ring, &c., A. F. Richter London.

*3rd September*, 1894.

16,719. Target and Pea-shooter, G. H. Goodfellow, Welford.

16,720. Standard for Folding Seat, J. F. Waller, London.

16,721. Heading Tin Canisters, F. W. Durham, London.

16,722. Bungs for Casks, W. P. Thompson.—(*C. Schopf, Germany.*)

16 723. Acrobatic Apparatus, W. Edwards and F. Prince, London.

16,724. Screening and Mixing Chambers, E. W. Ives, Derby.

16,725. Cloth Covered Buttons, W. D. Player, Birmingham.

16,726. Navigable Balloons, W Bell, Glasgow.

16,727. Lace, E. Doughty, H. and A. G. Fleisheim, Nottingham.

16,728. Transferring Heat, F. W. Crossley and J Atkinson, Manchester.

16,729. Filter Apparatus, J. Williamson and R. Rick, Glasgow.

16,730. Sewing Machines, W. Bowden, Manchester.

16,731. Lathes, B. Sutcliffe and E. L. Dutton, Halifax.

16,732. Bicycle and Tricycle Brake, L. O Michael, Birmingham.

16,733. Stone-cutting Machinery, R. Thom, Aberdeen.

16,734. Disengaging Hook, A. J. Kenny and C. James, Newport.

16,735. Drying Knitted Articles, W. Carrick, Edinburgh.

16,736. Cycle Saddles, D. A. Martin, Birmingham.

16,737. Brace or Suspender Ends, A. Tallett, Birmingham.

16,738. Hydraulic Engine, W. Smedley and J. Proctor, Ashover.

16,739. Turning Round Tramcars, F. O'C. Prince, London.

16,740. Machine for Pressing Bricks, S. H. Bromley, Redditch.

16,741. Anchors, C. H. Reed, Sunderland.

16,742. Gas Attachment, W. H. Webb and E. S. Pleasance, Bristol.

16,743. Steam Generators, C. A. Knight and G. W. Thode, Glasgow.

16,744. Applying Heat, R. E. B. Crompton and H. J Dowsing, London.

16,745. Dinner Can, W. H. Stansbury, Marsden.

16,746. Bedsteads, W. A. Beal, Halifax.

16,747. Billiard Tables and Pockets, J. W. Lane, Hounslow.

16,748. Flushing Water-closets, H. I. Sanders and W. Matthews, London.

16,749. Chucks, F. F. Simpson and J. T. Skidmore, Birmingham.

16 750. Water-tube Boilers, G. Richmond.—(*A. Worthington, United States*)

16,751. Folding India-rubber Eraser, W. A. Rees, London.

16,752. Tires, W. Howard, J. F. Sadler, and W. H. Dallimore, London.

16,753. Converting Rotary Motions, A. L. Gravier London.

16,754. Water Heaters, J. G. Smeaton and J. W. Bennett, London.
16,755. Cartridges, F. Brittain, E. L. O'Brien, and the Electrical Installation Co., London.
16,756. Furnaces, F. W. Golby.—(*J. Swiecianowski, Russia.*)
16,757. Tip for Billiard Cues, F. and C. Palfrey, London.
16,758. Utilising Bosh Cinders, &c., W. Roberts, London.
16,759. Treatment of Raw Sugar, C. M. Lafontaine, London.
16,760. Appliance for Beer Engines, S. J. Webster, London.
16,761. Horse Boot, W. Jenkinson, J. W. Squier, and G. E. Jenkinson, London.
16,762. Clay Baths, W. Cliff, London.
16,763. Ironing Stand, T. H. Schooling, London.
16,764. Sash Fasteners, J. Harris, London.
16,765. Sheep-shearing Machines, &c., M. Ford, London.
16,766. Crank shaft Arms of Looms, &c., J. Seed, London.
16,767. Actuating the Healds of Looms, L. Fish, London.
16,768. Saucers and Plates, J. Mohs and E. Zarek, London.
16,769. Thawing Frozen Food, E. M. Nelson, London.
16,770. Tires, S. McCormack, London.
16,771. Boxes, E. Prat, London.
16,772. Mitre Clamps, F. W. Hedgeland, London.
16,773. Apparatus for Aerating Liquids, J. L. Mendl, London.
16,774. Voltaic Batteries, D. G. Fitz-Gerald, London.
16,775. Electrolytic Cells, &c., D. G. Fitz-Gerald, London.
16,776. Tires, J. H. A. and E. T. Woods and W. T. Henley's Telegraph Works Company, London.
16,777. Cork Extractors, R. B. Gilchrist, London.
16,778. Motions for Shuttle-boxes, G. A. Falke, London.
16,779. Mounting or Supporting Labels, E. H. Hardy, London.
16,780. Sewing Machines, H. G. Ashley, London.
16,781. Manufacture of Material similar to Mosaic, R. Haddan.—(*J. Beaudequin, France.*)
16,782. Securing Corks, R. Haddan.—(*L. Murat, France.*)
16,783. Petroleum Lamps or Stoves, J. Hirschhorn, London.
16,784. Chimneys for Petroleum Lamps, J. Hirschhorn, London.
16,785. Making Cellulose Products, G. Jacober and A. Rabourdin, London.
16,786. Shoes, M. Freund, London.

*4th September*, 1894

16,787. Leading Lights for Narrow Channels, E. du Boulay, Isle of Wight.
16,788. Marking Drawing Material, C. W. Bailey, Liverpool.
16,789. Lighting Billiard Tables, W. Carter, Accrington.
16,790. Automatic Hand Camera, A. McLucas, Llanelly.
16,791. Umbrellas and Parasols, W. S. Cole, Bristol.
16,792. Musical Device for Hoop Sticks, W. H. Whitburn.—(*D. Whitburn, New Zealand.*)
16,793. Machine for Sawing Bands, J. Gazzard, Bristol.
16,794. Metallic Hampers, R. Leigh and H. Leigh, Bolton.
16,795. Collapsible Mud Guard, A. W. Penn, Gateshead-on-Tyne.
16,796. Easels, B. H. Heslop, Stockton-on-Tees.
16,797. Cord Fasteners for Parcels, F. E. Hollyer, Brentford.
16,798. Spinning Spindles, B. A. Dobson and G. Skinner, Manchester.
16,799. Adjusting Cycle Saddles, G. P. Mills and F. Easom, Birmingham.
16,800. Dress Clips for Lady Cyclists, A. B. Crowe, Banbury.
16,801. Railway Carriages, J. W. Dougal, Glasgow.
16,802. Fan for Spreading News of Public Interest, A. Lorber, Glasgow.
16,803. Water-proofing Boots, H. Hanson, Huddersfield.
16,804. A Sliding Cylinder, C. Harrison and J. H. Pearson, Peterborough.
16,805. Stud, Collar, and Tie Clips, W. J. Kerslake, Dublin.
16,806. Towing Bollard for Fishing Vessels, J. Norminton, Grimsby.
16,807. Railway Carriage Windows, T. Batty, Bradford.
16,808. Making Coverings for the Feet, T. Gare, Manchester.
16,809. Portable Weighing Machines, J. Holt, Manchester.
16,810. Waste-preventing Cisterns, W. Wheeler, Birmingham.
16,811. Frames for Photographic Pictures, H. Geh, Liverpool.
16,812. French Windows, &c., R. H. W. Rump, Glasgow.
16,813. Show Stand for Shopkeepers, T. R. Waite and H. C. Winham, Norwich.
16,814. Pencil Protector and Manifold Writer, A. Johnston, Glasgow.
16,815. Plates for Fencing Standards, J. Boyd, Glasgow.
16,816. Foundation Cylinders, W. Muirhead, jun., Glasgow.
16,817. Indicating the Weight of Gold, W. Whitehill, London.
16,818. Steering Ships by Hydraulic Power, A. Lafargue, London.
16,819. Front Fork for Velocipedes, E. Lycett, Birmingham.
16,820. Extracting Moisture from Steam, W. Adams, London.
16,821. Girdle, T. Le Beau, London.
16,822. Attaching Bands to Hats, F. W. Franklin, P. E. Taylor, and B. Franklin, Birmingham.
16,823. Expansion Valves of Engines, G. and P. Thornley, London.
16,824. Making Pin Tickets, C. A. Allison.—(*Thomas Manufacturing Company, United States.*)
16,825. Car Brake, R. T. Murray and C. M. Allen, London.
16,826. Automatic Pivot for Shelves, &c., J. Hens, London.
16,827. Advertisements, T. McGrah, London.
16,828. Tires, P. Davies, London.
16,829. Wick Tubes for Paraffin Lamps, J. Hall, London.
16,830. Motor, J. Roxburgh, London.
16,831. Combined Bedstead and Cot, R. Keyte, London.
16,832. Dental Suction Plates, J. Spyer, London.
16,833. Undershirts for Infants, L. Rubens, London.
16,834. Stone Crushers, P. W. Gates and C. L. Carman, London.
16,835. Stoppers for Barrels, H. H. Lake.—(*S. Schlangen and I. Neumann, United States.*)
16,836. Ships, L. M. Lincoln, London.
16,837. Feed-water Heaters, &c., H. G. Keasbey, London.
16,838. Feed-water Heaters, &c., H. G. Keasbey, London.
16,839. Boilers, H. G. Keasbey, London.
16,840. Paper Roll Holder, W. H. Clarke, London.
16,841. Book-rest, E. G. Passmore, London.
16,842. Substitutes for Skittle Balls, H. Oppenheimer, London.
16,843. Stoves, O. Keidel, London.
16,844. Photographic Shutters, W. Oehmke and C. P. Goerz, London.
16,845. Portable Book Rack, W. B. Drabble, London.
16,846. Treatment of Frozen Carcases, J. Atherton, London.
16,847. Tire Protectors, R. P. Majer, H. Mayler, and E. A. Allen, Liverpool.
16,848. Holding Devices for Laces, J. D. Lownsborough, Liverpool.
16,849. Organs, R. Hope-Jones, Liverpool.
16,850. Pill-making Machines, W. P. Thompson.—(*A. Colton, United States.*)
16,851. Underground Electric Railways, W. P. Thompson.—(*O. A. Enholm, United States.*)
16,852. Crushing Stone, W. P. Thompson.—(*Gates Ironworks, United States.*)
16,853. Crushing Stone, W. P. Thompson.—(*Gates Ironworks, United States.*)
16,854. Dynamo-electric Machines, S. H. Blake, London.
16,855. Inhalers, H. H. Lake.—(*F. Forné, France.*)
16,856. Apparatus for Lace Machines, J. Maiden, London.
16,857. Perforating Tapes for Telegraphy, P. B. Delany, London.
16,858. Ornamental Designs on Wood, C. Guattari, London.
16,859. Electrical Distribution, T. C. Coykendall, London.
16,860. Apparatus for Deadening the Shock of Collisions between Railway Vehicles, S. Freeman, London.
16,861. Fire-arms, T. R. R. Ashton and E. J. Kelly, London.
16,862. Magazines for Fire-arms, T. R. R. Ashton and E. J. Kelly, London.
16,863. Measuring Tap for Liquids, C. F. Archer, London.
16,864. Bottle, &c., W. Adams and F. R. Syms, London.
16,865. Pneumatic Tires, W. C. L. Holland, London.

*5th September*, 1894.

16,866. Machines for Knitting, G. F. Sturgess, Leicester.
16,867. Pneumatic Boxing Gloves, H. A. Evans, Birmingham.
16,868. Fixing Labels to Umbrellas, W. Corah, jun., Birmingham.
16,869. Spring Candlestick Socket, W. J. Jones, Glamorganshire.
16,870. Propeller for Torpedoes, J. M. Ross, New Deer.
16,871. Cutting Weft Pile Fabrics, J. Wilkinson, Manchester.
16,872. Transparent Flowers, W. Brierley.—(*F. E. Berta, Germany.*)
16,873. Watch Keys, D. Greenhalgh and W. Stockdale, Halifax.
16,874. Steamer, J. H. Leach, Darwen.
16,875. Forming Rolls of Clay, W. West and O. Y. Rhodes, Leeds.
16,876. Cycles, A. E. Hills, Birmingham.
16,877. Pneumatic Tires, E. H. Seddon, Manchester.
16,878. Way Bars for Phonographs, W. Lacey and A. Lomax, Blackpool.
16,879. Forming Bends or Curves in Tubes, W. Muir, Glasgow.
16,880. Securing Tires to Rims, J. W. O. Walker, W. Stelfox, and A. MacDonald, Glasgow.
16,881. Fastening Envelopes, F. C. Lynde, Manchester.
16,882. Form of Hand Protectors, H. J. Phillips, Ebbw Vale.
16,883. Roving Fibrous Material, C. Brigg, Bradford.
16,884. Chronographic Apparatus, F. J. Smith, Oxford.
16,885. Artificial Flying Birds, J. Harris, Dublin.
16,886. Protection of Lead Piping, J. A. Paskin and W. Ackroyd, Halifax.
16,887. Ships' Telegraphic Apparatus, H. Oliver, Liverpool.
16,888. Chairs for Young Children, T. H. Randolph, London.
16,889. Closing Shot Holes in Ships, E. H. Story, Manchester.
16,890. Textile Printing Machines, J. Wood, Manchester.
16,891. Horse Collars, A. F. McLellan and J. Fairie, Glasgow.
16,892. Cycles, R. Stephen, Glasgow.
16,893. Hair Curling Device, S. C. Russel, Glasgow.
16,894. Hems of Tray Cloths and Covers, J. Ellis, Glasgow.
16,895. Bearing Rein, A. Chopping and E. Pullen, Brighton.
16,896. Bottle Stands, J. E. Bingham, Sheffield.
16,897. Colliery Tub Attaching Gear, T. Archer, Newcastle-on-Tyne.
16,898. Apparatus for Measuring Quantities, H. S. Hele-Shaw, Liverpool.
16,899. Field or Kitchen Cooking Stove, A. C. Strains, Leith.
16,900. Billiard and Bagatelle Cues, R. Wilcox, London.
16,901. Combined Dinner Dish and Plate, H. Harverson, London.
16,902. Liquid Aeration Apparatus, J. T. Clarke, Harrow.
16,903. Elastic Wire Mat, R. Fischer and N. Buehler, London.
16,904. Carding Engines, E. L. Cockrell, R. Thew, and J. E. Stiebel, Manchester.
16,905. Automatic Delivery Machines, W. Oschwald, London.
16,906. Churns, J. Somerville, Glasgow.
16,907. Spikes, Bolts, and Nails, R. Frame, Glasgow.
16,908. Golf Practising Appliance, J. Turnbull, sen., Glasgow.
16,909. Cricket Bats, G. Halsey and W. S. Metcalfe, Enfield.
16,910. Equalising Furnace Draught, R. Gosling and B., H., and F. Hooker, London.
16,911. Combined Pipe and Tobacco Case, H. G. Parkes, London.
16,912. Electrical Insulating Compounds, G. E. Heyl, London.
16,913. Manufacture of Insulating Tapes, G. E. Heyl, London.
16,914. Filtering Apparatus, P. E. Hodgkin, London.
16,915. Folding Cardboard Box, A. Menzel, London.
16,916. Manipulating Electric Light, H. Taylor, London.
16,917. Window Sash Fasteners, G. C. Bullock, London.
16,918. Access Boxes for Electric Conductors, A. Fox, London.
16,919. Plug for Cisterns, F. Coates, Hastings.
16,920. Soap Holders, C. E. Challis, London.
16,921. Cycle Saddles, J. A. and H. A. Lamplugh, London.
16,922. Supporting Curtains, J. Harrington and F. Parker, London.
16,923. Regenerative Air Carboniser, J. F. Coutts, Woolwich.
16,924. Drain-pipe Testing Apparatus, H. E. Burnet, London.
16,925. Gas Lighting, H. Friedlander.—(*C. M. Lungren, United States.*)
16,926. Fasteners for Ladies' Hats, J. Brown, Belfast.
16,927. Gigantic Wheels for Recreation Purposes, J. W. Graydon, London.
16,928. Shoe Bow Grip, J. and H. Dartnall, London.
16,929. Attachment for Umbrellas, H. de Coursey Hamilton, London.
16,930. Elevating and Storing Sea-water, G. W. Blanks, London.
16,931. Door Stop, J. Marshall, London.
16,932. Interment and Disinfection of Corpses, G. Seegers, London.
16,933. Nailing Soles, P. A. Newton.—(*The Keats Maschinen Gesellschaft, Germany.*)
16,934. Coaling Ocean-going Vessels, B. C. T. Boyesen, London.
16,935. Attracting Fishes to the Bait, T. Raaschou, London.
16,936. Dress Preservers, D. R. Harvey, London.
16,937. Hydrocycle, H. Colledge, London.
16,938. Sterilising Water by Ebullition, E. Herscher, Liverpool.
16,939. Recording Electric Currents, H. Aron, Liverpool.
16,940. Attaching Aprons to Garments, F. F. Smith, London.
16,941. Ventilation of Rooms, &c., H. Sandwith, London.
16,942. Metallic Decorative Films, W. H. Coe, London.
16,943. Portable Ladder Platform, T. Langlois, jun., London.
16,944. Miners' Lamps, W. Green and H. Green, London.

*6th September*, 1894.

16,945. Lubricators for Steam Pistons, G. Bentley, Oldham.
16,946. Hair Curlers, H. H. Pearce, Birmingham.
16,947. Machines for Cutting Coal, W. Patterson, Gateshead.
16,948. Provision Knife, C. H. Nassau, Sheffield.
16,949. Curling and Crimping Hair, C. Hide, Worthing.
16,950. Circular Knitting Machines, W. Brown, Leicester.
16,951. Pistons, T. Davies and S. Davies, Liverpool.
16,952. Furnace Fire-bars, T. and S. Davies, Liverpool.
16,953. Inlet and Outlet Valves, J. H. Langlands, Dundee.
16,954. Bakers' and Confectioners' Oven, R. Wray, Bradford.
16,955. Machines for Damping Labels, A. M. Turner, Glasgow.
16,956. Warp Let-off Beams, E. Hollingworth and F. W. Gelder, Halifax.
16,957. Divisible Key Ring, D. Grayl and H. Brookes, Handsworth.
16,958. Pipe Connection, H. Robson and G. J. Calder, London.
16,959. Wheelbarrows, C. E. Edwards and E. Harris, Birmingham.
16,960. Station Indicator, F. H. Angles and J. Ward, Halifax.
16,961. Stock and Dies, W. Ward and T. H. Coles, Bristol.
16,962. Writing, Drawing, or Painting Ring, T. Reeves, Warwickshire.
16,963. Stocks and Dies, W. Ward and T. H. Coles, Bristol.
16,964. Compressed Air Cycle Tires, A. J. Bailey, Birmingham.
16,965. Kiln for Drying Oats, &c., J. Walworth, Bradford.
16,966. Machinery for Potters, E. J. Bradley, Newcastle-on-Tyne.
16,967. Cast Iron Bath and Towel Rail, H. S. Woodward, Falkirk.
16,968. Cultivators, J. Bamford, Birmingham.
16,969. Boots, E. S. Whitby, London.
16,970. Piano Attachment, A. Edwards, Woodford Green.
16,971. Loading Railway Trucks with Coke, A. Jobson, London.
16,972. Window-blind Appliances, A. Gough, London.
16,973. Making Non-conducting Material, J. C. Sewell, London.
16,974. Machinery for Rounding Square Wood, H. Greg, London.

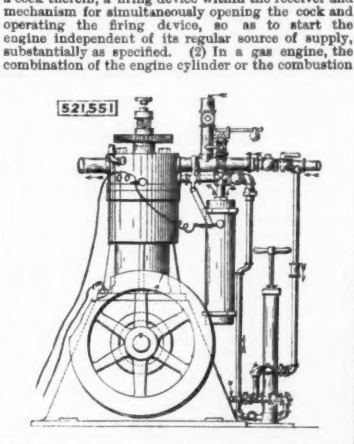
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**521,551.** Apparatus for Starting Gas Engines, *J. W. Raymond, San Francisco, Cal.—Filed April 10th*, 1893.

*Claim.*—(1) In a gas engine, the combination of the engine cylinder or combustion chamber thereof, the supplementary chamber or receiver charged with explosive gas or vapour under pressure, a connecting passage between the cylinder and the receiver, having a cock therein, a firing device within the receiver and mechanism for simultaneously opening the cock and operating the firing device, so as to start the engine independent of its regular source of supply, substantially as specified. (2) In a gas engine, the combination of the engine cylinder or the combustion chamber thereof, a supplementary chamber or receiver charged with explosive gas or vapour under pressure, a connecting passage between the cylinder and the receiver having a discharge cock therein, a compressing pump or other source of supply having a pipe leading to the receiver, and another pipe leading to the engine cylinder, said pump being operated so as to fill the receiver and prepare it between the intervals of starting the engine, a firing device within the receiver and leverage mechanism connected to the discharge cock and to the firing device, so as to operate them both simultaneously, substantially as described.

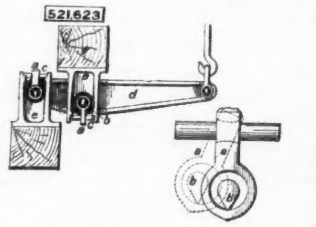
521,551



**521,623.** Weighing Scale, *H. Paddock, St. Johnsbury, Vermont.—Filed October 26th*, 1892.

*Claim.*—(1) In combination with a scale lever, loops having eyes in which the pivots of the lever rest, said loops having openings through them, and rigid horizontals rods *c* passing through said openings and directly supporting said loops, whereby said loops are capable of adjustment on said rods, and means for supporting the rods *c*, substantially as described. (2) In combination with a scale lever, having suitable knife edge pivots, loops *a*, having eyes in which the knife edge pivots rest, said loops having openings near their upper ends, horizontal rods passing through said openings, said openings tapering from both sides of the loops toward the centre, whereby the loops bear upon the rods only at one point, and are permitted sliding and swinging movement thereon, substantially as described. (3) In a railroad scale, in combination with the timbers *f*, the supporting standards *e*, the rods *c*, rigidly supported on said standards, the lever *d*, with pivots *b*, the loops *a*, having eyes in which the pivots rest, and having openings at their opposite ends through which the rods *c* pass, said openings being formed to give the loops a limited sliding movement on said rods, substantially as described.

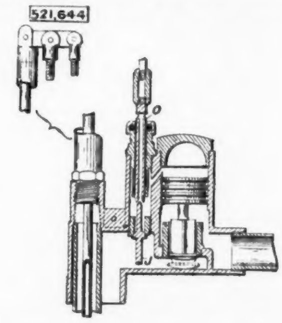
521,623



**521,644.** Automatic Controlling Device for Boiler Feeders, *J. Desmond, Detroit, Mich.—Filed August 26th*, 1893.

*Claim.*—(1) The combination of a steam supply valve, normally closed, a piston for opening said valve, an auxiliary valve for controlling a port supplying steam to the main valve piston, and a thermostat controlled by the height of the water for actuating said auxiliary valve, substantially as described. (2) The combination of the valve casing, the main steam valve therein, the cylinder above said valve, the piston therein, an auxiliary valve for controlling a supply port to said cylinder, the actuating mechanism for said auxiliary valve comprising a thermostatic device controlled by the height of the water, the hollow stem actuated thereby, having the vent O, and conical bearing *b*, on the stem of the valve J, controlling said vent, substantially as described.

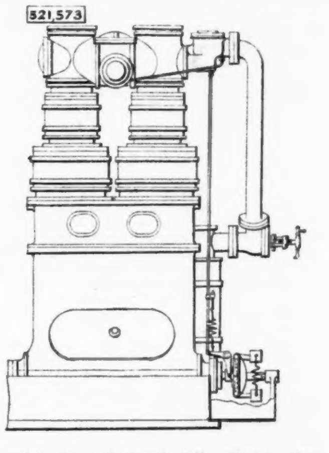
521,644



**521,573.** Expansion-gear for Engines, *M. H. Robinson, Thames Ditton, England.—Filed March 5th*, 1894.

*Claim.*—(1) The combination of a steam—or other fluid—engine cylinder, steam chest—pipe supplying steam thereto, throttle valve and governor acting thereon, hollow piston-rod of piston working in cylinder extending into the steam chest—sleeve in steam chest surrounding the end of the hollow piston-rod—oblique ports in sleeve and in piston rod—a cylinder open at one end to steam chest and at the other to steam supply pipe—a piston working therein and connections from the piston to the sleeve, whereby an inward movement of the piston turns the sleeve in a direction to make the cut-off earlier, and a movement in the opposite direction to make it later, and means for causing any inward movement to take place slowly while the outward movement is left free to take place quickly.

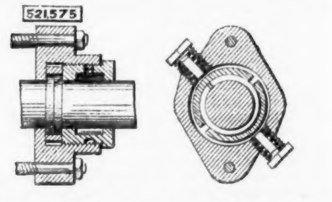
521,573



**521,575.** Rod or Valve Packing Box, *D. Spencer, Shenandoah, Va.—Filed July 22nd*, 1893.

*Claim.*—(1) The combination with a gland or casing, of compressible packing rings, curved jaws engaging opposite sides of the packing rings, adjustable guide-tubes passed from the outside through threaded perforations in the walls of the gland or casing and accessible from the outside thereof, and tension springs coiled within said guide-tubes and bearing at their inner ends against the jaws, substantially as specified. (2) The combination with a gland or casing, of compressible packing rings, approximately semicircular jaws arranged in contact with the outer surfaces of said rings and provided with radially-disposed stems, adjustable guide-tubes threaded in perforations in the walls of the gland or casing, and tension springs arranged within the guide-tubes and embracing said stems, substantially as specified. (3) The combination with a gland or casing, of packing rings arranged therein, a clamping device arranged in operative relation with said rings, and an annular bushing threaded into the outer end of the bore of the gland or casing, provided with an inwardly extending rim or flange to engage said clamping device and packing rings, and having an inner oil chamber communicating by radial perforations with an exterior oil channel, substantially as specified.

521,575



## ANTWERP INTERNATIONAL EXHIBITION.

### THE MARITIME SECTION.—II.

British shipbuilders and shipping companies are so frequently found at international maritime displays, putting themselves in evidence to such an extent as to belittle, if not completely eclipse, the representation made by continental or foreign firms, that an added and very special interest attaches to the maritime section of the Antwerp show through the very full representation and the close juxtaposition of exhibits both by continental and British firms. From this point of view, indeed, the section is not without its element of surprise for those who are ever ready to regard with scepticism or superior indifference the contentions frequently made as to the growth and seriousness of continental competition in shipbuilding. Throughout the section it is made abundantly evident that continental builders are accomplishing a large share of the building required by shipping firms in their own countries, and that even in regard to important work which we have hitherto been rather prone to consider highly specialised and "preserved," there is a distinct and growing competency, if not competition. That this is so in the matter of large powerful ocean mail passenger steamers will have been gathered from our article in our issue for July 6th, where references are made to the splendid exhibits of steamships recently built or now building in Germany, shown at the stands of the North German Lloyds, the Vulcan Shipbuilding Company of Stettin, and the Hamburg American Company. But it is also true as regards fast paddle steamers and the machinery by which they are propelled; a fact strikingly illustrated at the stand of the Société Anonyme John Cockerill in the main buildings, containing the models, plans, and spare shafting of their successful Channel steamer Marie Henriette, and also at their stand in the machinery-in-motion section, where a full-sized set of marine twin-screw engines are seen at work. The latter is one of a set of twin-engines of 1600 indicated horse-power, destined for a cargo boat of 3500 tons now on the stocks at the Société's shipyard at Hoboken, a little way out of Antwerp. The engines are at work driving a length of thrust shafting and a heavy four-bladed propeller. The steamer these engines are destined for forms one of a fleet of ten steamers owned by the Société, and employed in importing ore and exporting manufactures turned out from their great works at Seraing. This fleet, it will be easily understood, enables the company to gain direct experience in marine engine working, and to base designs on the experience thus acquired. Besides the models and plans of the Marie Henriette shown at the stand in the maritime section, there are about a dozen other models of the vessels built at the company's shipyard. These include the p.s. Comte de Flandre, shown as representative of the type of mail steamers of 1868, the sister ships, Prince Albert, Ville de Douvre, and La Flandre, which typify the mail boat of 1888.

The model of the Marie Henriette, of course, exemplifies the mail-boat of the present day; and, in addition to the full models of her shown at the Société's two stands, beautifully finished deck and other plans are ranged round the tables on which the models are placed. As between builders and owners the satisfaction in the Marie Henriette seems to be mutual; and at the present time there is being laid down in the Hoboken yard an additional paddle steamer for the same important Channel service. The new vessel is to be some 40ft. shorter than the Marie Henriette, the reason for this being chiefly concerned with the question of facility of working and movement in approaching and leaving piers.

Belgium's deep interest in the Congo, and the work of colonisation which has been carried on there for years, has necessitated the construction, trans-shipment, and re-erection of many light-draught river paddle steamers, launches, canoes, &c. Most of these have been built by the Cockerill Company, and the conditions as to draught and portability, involving many somewhat nice problems, have been well met by the manager at Hoboken, Mr. Geo. Rickard, M.I.N.A., and his subordinates. A collection of models representing this class of work, also actual steel boats being carried by natives in portable sections, are shown in the Congo Pavilion in the outside grounds.

In the matter of continental competition in building large sailing ships and heavy deadweight carrying steamers, the stand of Messrs. Tecklenborg, shipbuilders, of Bremerhaven, deserves prominent mention. A varied and attractive collection of models is here shown, all of them representing vessels built during the past three and a-half years. The dimension and tonnage of some of these will be evidence enough of the important character of the work carried on by this continental shipbuilding firm. The series includes the s.s. August Korff, built this year, of 5400 tons, and 354ft. long, and the s.s. Placilla, built in 1892, of 4420 tons, and 310ft. long. Besides these there are several others of slightly less tonnage, also models of sailing ships and of various kinds of river paddle steamers. Messrs. Tecklenborg, it will be of interest to state, have lately received an order for a five-masted steel sailing vessel, which, when completed nine months hence, will be the largest sailing vessel ever constructed, being considerably larger than the ill-fated Marie Rickmers, built three years ago by Messrs. Russell and Co., of Port Glasgow, and lost on her first voyage. The new vessel will certainly be the largest sailing ship afloat, her dead-weight carrying capacity being designed at 6150 tons, and register tonnage about 4280 tons. The register tonnage of the Marie Rickmers was 3813 tons, while that of the largest sailing ship now afloat—La France, belonging to the fleet of Messrs. A. D. Bordes and Son, of Bordeaux, and built by Messrs. D. and W. Henderson, Partick—is only 3784 tons. The new vessel, which will be 365ft. in length, is to the order of Messrs. F. Lacisz and Co., of Hamburg.

Mention of the name of Messrs. Bordes suggests some reference to another fact, interesting as showing the growing continental competition in shipbuilding. This enterprising firm, whose ships have hitherto mostly been built on the Clyde, have ordered no fewer than five large four-masted ships, each of 4000 tons deadweight capacity, from French builders. Three are to be built at the Ateliers de la Loire, and two at La Seine by the Forges et Chantiers de la Meditérranee.

The celebrated French firm of Schneider et Cie., Le Creusot, at their interesting stand in the French section, make, in addition to a fine display of artillery, war material, guns, test-plates, &c., an attractive show of photographs, and small working models of marine engines turned out from their works. Photographs are shown of the triple-expansion engines of 13,500 indicated horse-power for the first-class cruiser Charles Martel, and of 8300 indicated horse-power for the cruiser Chanzy. Beautifully constructed small-scale models of torpedo boats, with all internal details in section, also models of torpedo boat engines, and engines for the first-class protected cruiser Alger, of 8000 indicated horse-power, are items exhibited by this firm, of deep interest to all in any way connected with naval design and construction.

Wall and floor space at one side of the Hamburg-American Company's pavilion is occupied with exhibits by the Hamburg shipbuilding firm, not unknown in Britain, of Messrs. Blohm and Voss. They show a full model of s.s. Gintra, built by them in 1889, of 2600 tons, 1600 indicated horse-power; also a half-model of the twin screw Wittekind, of 364ft. in length. From this it may be inferred that the capabilities of their works are of no mean kind; a fact to which further testimony is borne by the display of a series of large photographs showing their shipyard, engine shops, quays, and pontoon dock. One set of photographs illustrates the capabilities of the latter, representing it at a time when it was occupied by the s.s. Bayern, of the North German Lloyd fleet, drawn asunder, and under process of being lengthened 50ft. amidships. The Sachsen, another of the North German Lloyd fleet, was similarly treated by Messrs. Blohm and Voss last year, and now we understand a third steamer, the Preussen, is also being lengthened amidships, the added part in her case being 70ft.

Just outside the Hamburg-American pavilion the Flensburger-Schiffsbau Gesselschaft have an elaborate display of beautifully drawn and coloured plans of the vessels of various kinds they have built, several of these being between 320ft. and 350ft. in length. Included in the collection is a set of photographs, showing the firm's off-shore dock—Clark and Stanfield's patent—with a large screw steamer in place upon it.

Near the above is the stand of the Hansa Shipping Company, of Bremen, at which are shown models of some six or seven of the company's fleet; one being that of the Harsburg and Marienburg, built during the present year by the Flensburg firm. Other models are those of the Rothenfels, Lindenfels, and Stolzenfels, the two former built this year and the latter last year, by Sir Raylton Dixon and Co., of Middlesbrough. These are spar-decked screw steamers of 327ft. in length, fitted with triple-expansion engines by Messrs. Thos. Richardson and Company, West Hartlepool.

Various other continental shipbuilding firms and shipping companies are represented by exhibits, of only a few of which mention need be made. The Koninklyke Maatschappy De Schelde, of Holland, shows an exceedingly varied collection of wall models of vessels built by them, including cargo screw steamers, paddle passenger steamers, sailing ships, and torpedo craft. The Nederlandsche Stoomboat Maalschappy, of Rotterdam, shows half models of s.s. Java built in 1885, also of s.s. Van Dieman, built in 1890 for passenger and cargo service between Holland and her colonies. The Société Anonyme pour l' Importation des Huiles de Graissage show models of several of their boats, including a half model in glass case of the s.s. Erivan, built by the Palmer Company, of Jarrow, last year, and capable of carrying an oil cargo of 2850 tons. A feature of this exhibit is that the back of the model coincident with the centre longitudinal plane of the ship, is all filled in with a linear representation of the structural framework, &c., in an instructive way afterwards to be noticed in connection with a still more interesting model of the same class, shown by Sir William Armstrong, Mitchell and Co.

Mention of this eminent firm reminds us of our having deferred notice of the exhibits from the North-east Coast and other British districts, and this we will proceed to overtake. Firstly, however, we must make reference to the manner in which Lloyd's Register Society is represented in the Exhibition. Indirectly, of course, most of the models sent by British builders and shipping companies, and a goodly proportion of those shown by continental firms, are representative of this great society's operations and scope, as the term "100 A1 at Lloyds" is mostly applicable to them. At former exhibitions Lloyd's Register has put itself more directly in evidence as "guide, councillor, and friend" in the matter of ship construction, by organising a large display of models of vessels built under its rules and survey, selected from the archives of the actual builders, and lent by the latter for the purpose; but, in the present instance this powerful institution has confined itself almost entirely to displaying the literature it has compiled and issued during the whole period of its existence. This includes, of course, the rules for the construction and classification of wood, iron, and steel sailing ships and steamers. Volumes of the register, bearing dates from 1834 to 1894, are on view, and the contrast between the thin and modest-looking volume of the early date and the bulky tome of the latter—comprising, indeed, not only one, but several separate parts—is in itself, sufficiently eloquent testimony to the wonderful growth and development of the Register. The Society's successful yacht register, inaugurated in 1878, is also put in evidence in the shape of the annual volume of rules and the list of yachts afloat classed and unclassed. In glass cases at each side of the bookcase containing this library, is an interesting collection of electro-plated models of anchors of both the stock and stockless kinds. Altogether, some thirty-four examples of anchors, chiefly the stockless patterns, are shown, each bearing the name, if not the "stamp of originality," of the patentee. On the wall above and around the cases are framed diagrams showing the methods approved by the Society of constructing watertight bulkheads, as regards side-framing, stiffening, &c., for ships of various breadths and depths.

Noteworthy as a contribution to the literature of shipping and shipbuilding, and highly appropriate in an international collection of maritime exhibits, is the display made by Captain H. Paasch, Lloyd's surveyor for the Belgian ports, of the new edition of his well-known valuable work, "From Keel to Truck," a marine dictionary in English, French, and German. The present is an extension, revision, and to some extent a blending of his work of that name, published nine years ago, and his subsequently published "Marine Encyclopædia." Within a neat glass case, embellished by medals and badges of honour which have been conferred upon Captain Paasch by various high personages and institutions during a comparatively long and eminently useful lifetime, a number of the volumes are displayed, open at different parts in such a way as to give some idea of the varied and exhaustive contents. Ships and shipping concerns, it need scarcely be remarked, are among the oldest interests in the world, and every important nationality in Europe having a seaboard has supplied, from time to time, some of the terms now in common use; but it is not to be supposed that the birth and growth of terms in this connection has by any means ceased. Not only has the introduction of iron and steel totally overthrown numerous terms formerly in use, but new types of vessels are continually being schemed out and constructed, and new details introduced for their more efficient working. This restless progress, of course, involves the creation of new terms or a modification of the old, rendering it necessary to revise a maritime dictionary at comparatively short intervals, if accuracy and comprehensiveness are desired. The large amount of additional matter and the painstaking accuracy observable in the new edition of Captain Paasch's work, are proofs that he is continuously occupied watching the development of the mercantile marine, and making intelligent note of the constant growth and changes going on. It is not often that a busy and able man connected with the maritime profession is found at the same time combining linguistic and literary capacity, while, as Captain Paasch points out in the preface to his new work, a linguist merely, no matter how capable, if wanting in professional qualifications, is extremely apt to fall into serious error in translating technical terms. Captain Paasch's varied experience places him in a unique position in this respect; and not only as linguist and literary expert, but as seaman, naval architect, and marine engineer he has compiled this most valuable work of reference in the three principal languages—a work which appears to stand alone in the essentials of completeness and trustworthiness. Strongly and handsomely bound, the volume consists of 800 pages of letterpress and illustrations—500 of which pages contain general terms in English, French, and German in parallel columns; 206 pages are occupied by illustrations, with the corresponding explanatory letterpress in the three languages; copious indices, also in triple language, occupying altogether about 70 pages, complete the work.

Sir William Armstrong Mitchell and Co., of Elswick-on-Tyne, occupy a large space with numerous highly attractive exhibits. One in particular is an unfailing source of keen, though somewhat melancholy interest, being a splendidly finished model of the ill-fated warship Victoria. The model proper, which is 30ft. in length, only represents half the ship, but by a mirror-arrangement at the back, the other half is completed by reflection, and from a platform erected in front the whole can be conveniently inspected. The surface of the water in which the vessel is represented as floating, is counterfeited by rippled glass, and extended on booms all along the vessel's length is a protective torpedo netting. The whole exhibit closely counterfeits the warship in every detail, as she lay at sea ready for any surprise from an enemy. Another model of special interest is that representing this firm's conception of a modern Atlantic mail and passenger express steamship. She is a twin-screw vessel, 540ft. by 62ft., designed for a speed of 22 knots. There are two funnels, oval in shape, and two pole-masts with fore and aft canvas only. The model shows the vessel to have three principal decks, with a hurricane or promenade deck almost the full length, from front of poop to front of forecastle decks, both of which are of the turtle-back type. Notable characteristics of the design of the hull are the ease and sweetness of the lines, roundness of bilge, large bilge keels being fitted for half the length, and the sweeping-up of the line of keel, not only at the forefoot, where this has long been the practice for purposes of easy steering, but at the heel or after part of the hull as well. The tendency to lop off needless weight and surface at the heel of fast screw steamers—corresponding to the "deadwood" in the structure of old-time wood vessels—is growing more and more into fashion, as witness the sketches given in our previous article of the new North German Lloyd twin-screw steamers being built by the Vulcan Company, of Stettin, and of the new Union twin-screw liner Norman, built by Messrs. Harland and Wolff, given in our issue of 27th ult. Considerations connected with a free "run" to the propellers and of enabling them to work in undisturbed water as much as possible, would seem largely to account for these modifications. It is noteworthy, at least, that although quite modern, continental builders are not slow to adopt the changes, and even seem to lead the way, by making wider departures from conventional practice than home builders. Alongside the Atlantic Express model is a half model of one of the petroleum tank steamers, in the construction of which Sir William Armstrong, Mitchell and Co. have had large experience. This is a highly instructive exhibit, as the back of the model, coincident with the centre longitudinal plane of the vessel, is all sectioned off to represent the actual construction: floors, beams, frames, pillars, bulkheads, &c., everything in fact connected with the interior structure of the vessel being minutely lined and shaded. The holds are hollowed out as in the actual ship, and linear representation made of side frames, hold-side stringers, tank-top plating, and bulkheads, with the modes adopted of stiffening and rendering them oil and water-tight. On the wall near this model is a set of six half models of petroleum vessels built for service in the Caspian, Azof, and Black seas. The whole of the vessels are fitted with special appliances for burning petroleum as fuel, and several of them have been constructed for the carriage of petroleum in bulk, with powerful pumping appliances, so that the entire cargo can be loaded or discharged in a few hours. Other merchant steamer models shown by Armstrong, Mitchell and Co. are s.s. Roland, s.s. Mark, and the twin screw s.s. H.H. Meier, of 11,000 tons displacement, all built for the North German Lloyd Company. Of Government vessels built by the firm, models are shown of the Argentine cruiser 25 De Mayo, built in 1890 from the designs of Mr. Philip Watts. She is 350ft. in length, 43ft. beam, and 16ft. draught; 3180 tons displacement, and 14,052 indicated horse-power. Under forced draught she attains a speed of 22½ knots, and under natural draught 21¼ knots. There is also a model of the Japanese cruiser Yoshino, built last year, 360ft. in length, 46ft. 6in. beam, and 17ft. draught; 4158 tons displacement, 15,750 indicated horse-power, and 23·03 knots speed on trial. Her radius of action at full speed, with natural draught, is 2000 knots, and at 11 knots speed it is 8000 knots. Both these vessels have been illustrated in our pages.

Facing Sir Wm. Armstrong, Mitchell and Company's exhibits is the pavilion occupied by the Palmer Shipbuilding Company, of Jarrow, which makes a magnificent show with a collection of models, paintings, and photographs of its vessels, as well as a collection of limestone and coke, Cleveland and Spanish ironstone, pig iron of different classes, test bars, and sections of rolled beams. Of warships it shows models of the first-class battleship Resolution, of rolling notoriety, the second-class cruiser Pique, and of the recently completed Spanish cruiser Infanta Maria Teresa, built at Bilbao. An attractive item on the stand is a large marine painting showing, afloat, the various types of war vessels built by the company for the British and other Governments. Besides a further variety of cargo and passenger steamers the stand contains a working model of a triple-expansion engine of 1100 indicated horse-power, to a scale of 3in. per foot. This model—which is nevertheless big enough for a good-sized yacht—is exhibited driving a screw propeller 4ft. in diameter, the diameter of shafting being 2¾in.

Messrs. C. S. Swan and Hunter, of Wallsend-on-Tyne, are represented by a collection of full and half models in glass cases, the vessels chosen for illustration in this way being mostly the large deadweight carriers for trans-ocean service, so many of which the firm are now producing. One of these is the Maori, completed in the autumn of last year for the Shaw, Savill, and Albion Company, built and specially insulated for the carrying of frozen meat between New Zealand and England. The deadweight capacity of the Maori is 7000 tons, and speed 12 knots, the engines having been fitted by the Central Marine Engine Works, West Hartlepool. The firm also show photographs of the exterior and interior of several of their other vessels, and views of the large pontoon dock built by them some two or three years ago for the Tyne Pontoon and Dry Dock Company.

Messrs. Hawthorn, Leslie and Co., both by models and large photographs, convey to visitors some idea of the importance of their productions in the way of marine engines and ships. The models shown include the p.s. Roumiantzeff, built for the Russia Steam Navigation and Trading Company, of Odessa; the s.s. Hevelius, built for the Liverpool, Brazil, and River Plate Steam Navigation Company, Messrs. Lamport and Holt, managers; the twin s.s. Petersburg, built for the Russian Volunteer Fleet; and the s.s. Alagoas, built for Lloyd Brazilliers, Rio de Janeiro. Amongst the photos of engines shown is one of the triple-expansion engines of 10,000 indicated horse-power fitted in the s.s. Sarator and Orel, of the Russian Volunteer Fleet; one of the triple twin-screw engines of 9500 indicated horse-power fitted in H.M. protected cruisers Sybille, Æolus, Brilliant, Bonaventure, and Centurion; and one showing the triple twin-screw engines of 7500 indicated horse-power fitted in H.M. protected cruisers Katoomba, Mildura, Wallaroo, and Pallas.

Sir Raylton Dixon and Co., of Middlesbrough, have an attractive stand, at which they show some ten or a dozen well-finished half models in glass cases. The vessels represented are mostly of recent build, some indeed not yet completed. Notable models are those of the s.s. Ceylon, just completed for the Peninsular and Oriental Company, and designed to carry about 6000 tons deadweight, at a speed of over 13 knots; the s.s. Leopoldville, of 3460 tons, built this year for the African Steamship Company's direct-service between Antwerp and the Congo; and the Hotham-Newton, also built this year for petroleum carrying purposes.

Not a few shipbuilding firms, both on the Clyde and elsewhere in Britain, have contented themselves with sending single models, representative of the class of work undertaken by them. Thus we have Messrs. A. and J. Inglis, of Pointhouse, Glasgow, exhibiting a handsome full model of the large s.s. Taroba, built for the British Indian Association, and fitted by the builders with triple-expansion engines; Messrs. The London and Glasgow Shipbuilding Company, of Govan, showing a half-model in glass case of s.s. Foreland and Goodwin, built for the Clyde Shipping Company, and fitted with engines by the company, having boilers worked under Howden's system of forced draught. Messrs. Blackwood and Gordon, Port Glasgow, showing half model of s.s. Austerland of 950 tons, built in 1886 for Messrs. G. Bethell and Co., and Trinder, Anderson and Co. Messrs. Wigham, Richardson and Co., of Wallsend-on-Tyne exhibiting a well finished model of the s.s. New Londoner, completed by them a few months ago for the Tyne Steam Shipping Company, and Messrs. Joseph L. Thomson and Co., of Sunderland, showing the s.s. Coogee, built for Messrs. Huddert Parker and Co., of Melbourne. To Mr. Jas. Laing, of Deptford Yard, Sunderland, the maritime section is indebted for a model representing what is happily designated "Ye Olde Schoole" of passenger ship, being that of the Vimiera of 1037 tons gross and 841 nett, built at the Deptford Yard in 1850. The presence of this model, typical of the wooden sailing passenger vessels of five decades back, forms a striking contrast to the magnificent steamship Campania, whose splendid model is not far off.

Messrs. R. and H. Green, of Blackwall, in a neat stand, show a model and items of detail of the steam lifeboat Duke of Northumberland, the predecessor of the recent and improved boat of this type, the City of Glasgow, bought by funds subscribed in the Scotch commercial capital, and handed over this year to the National Lifeboat Institution.

Messrs. W. B. Thompson and Co., Dundee, show a model of a pleasure steamer, in all respects to outward appearance typical of the ordinary paddle river passenger steamer. A closer scrutiny, however, discovers that besides being a paddle, she is a twin screw steamer as well, the screw being carried at the end of a long length of outside shafting—long, because of the fine "run" of the hull. The idea of the exhibitors has apparently been to combine the steadiness and comfort usually appertaining to the paddle steamer, with the augmentation of speed due to the twin screws. The model is merely a design, but whether or not an actual vessel is likely to be built does not appear.

Channel passenger steamers, it goes without saying, are plentifully represented by models either at the stands of their owners or builders. The keen interest centring in the models of the Dover and Ostend Packets, Leopold II. and Marie Henriette, has already been commented upon. Scarcely less interest attaches to the models of the Channel twin-screw steamers Chelmsford, Berlin, Amsterdam, and Vienna, built and building by Earle's Shipbuilding Company, Hull, for the Harwich and Hook of Holland service of the Great Eastern Railway Company. The Chelmsford was built last year, and the Berlin, which is a sister ship, with the exception that she has a little more length and beam, was completed in the spring of the present year. The remaining two vessels are nearing completion at the hands of Earle's Company. All the four vessels are slightly over 300ft. long by 36ft. beam, and they measure about 1750 tons. They are fitted with two separate sets of triple compound engines of some 5000 indicated horse-power, the speed attained being over 18 knots.

The London, Chatham, and Dover Railway Company are represented by a model of its swift Dover and Calais Channel steamer Empress, built in 1887, as typical of the consorts in this service, the Invicta, the Victoria, and the Calais-Douvres, the latter a recent addition credited with 21½ knots speed.

At its stand, among the ship models, the Darlington Forge Company makes a most effective display of its manufactures in steel and iron forgings, steel castings, &c., by way of electro-plated models, to scale, of actual items turned out within recent times. These include cast steel stern frames, sterns, propeller and shaft brackets, rudder frames, crank webs and pins, also forged steel crank-shafts, thrust and tail-end shafts, connecting rods, &c. The electro-plating of the models gives them a more toy-like than work-a-day appearance; but that the actual productions which they represent were of the first importance from a scientific and industrial point of view is sufficiently borne out by the mere mention of the vessel's names of which they went to form a part. Amongst the most striking of these items we may note Harland's cast steel hanging stern frame, rudder and shaft brackets, as fitted in the s.s. Civic, of the White Star Line. The actual stern frame weighed 17 tons, rudder, 11½ tons, and brackets 12 tons. Another notable item is that of the model—to ½in. scale—of the cast steel stem of H.M.S. Majestic and Magnificent, the actual stem having weighed 27 tons. The cast steel stern-frames and rudder of the same vessels are represented, also cast steel stern-frame and shaft brackets fitted into s.s. Gaul, Goth, and Greek, of the White Star fleet. The cast steel stern-frame and rudder of the s.s. Australia and Himalaya of the P. and O. fleet, are also shown. Other items are a four-throw crank shaft of the "built" description, of 18¾ tons, cast steel crank webs and pin, and forged steel shaft ends, and forged steel crank shafts of H.M.S. Royal Sovereign, and cast steel balanced rudders for H.M.S. Andromache and Apollo.

## HARBOURS AND WATERWAYS.

*Dock and harbour finances.*—The reports of the two large London dock companies for the past half-year are on the whole satisfactory. The foreign shipping entering the docks in London increased by 370,475 tons, as compared with the corresponding period of 1893; and of this the London and St. Katherine's and East and West India Docks secured 170,907 tons as their share. The net revenue earned by the Joint Committee amounted to £266,396, as compared with £247,738 in the corresponding period of the previous year. The articles handled, it seems, have been of a more paying description, and owing to economy and good management the net revenue has improved by £20,000. It is to be gathered from these reports and the chairman's speech, that, although the tendency for vessels to enter the Port of London with part cargoes is on the increase, and the Thames has lost much of the transhipment trade of former years, yet there is no reason to fear that the great volume of business exhibits any very marked change. The Joint Committee is endeavouring to cultivate trade by providing better accommodation for the Australian meat trade, and by erecting refrigerating meat chambers at the Victoria Docks and at Smithfield. The importation of butter from New Zealand is also a growing trade. An arrangement exists between the dock companies in the Thames by which the various branches of trade are kept more or less to those parts of the port where they have in the course of time found their home, and the agreement relating to this, which has recently expired, has been renewed by the Joint Committee with the Millwall and Surrey Commercial Companies.

At Millwall Docks the report for the half-year shows that the improvement which commenced last half-year has continued. The company's warehouses have been well filled, and the tonnage greater than since 1888. The imports of hay, which had been very large during the winter, had fallen off. One-tenth of all the grain imported into the kingdom passes through these docks, and it is expected that the importation will be heavy this year. The relations of the company with its men continue to be satisfactory, but the effects of the coal strike are still continued to be felt.

At Dundee the condition of affairs has not been prosperous, the deficit on the year's working amounting to over £8000. The revenue is less than was estimated at the beginning of the year by £3738, and the expenditure is greater by £5375. In consequence of this deficiency it has been determined to reduce the expenditure all round; where possible works are to be suspended, and a large number of men will be paid off.

At the Bute Docks the net revenue for the half-year is sufficient to pay a dividend to the ordinary shareholders at the rate of 3 per cent. per annum. At Falmouth the gross revenue for the half-year is £2000 in excess of that for the corresponding half-year of 1893, due to an increased number of vessels putting in for repair and using the graving dock. The general import trade continued to develope.

*Thames Conservancy.*—The annual report for the year 1893, which has recently been issued, shows that forty-one sunken vessels were raised by the Conservators' wreck raising plant, of which five were steam vessels, measuring 2777 tons, and thirty-six were barges of a tonnage of 1376. The annual cost of the wreck service is £2469. The total expenditure for the year amounted to £110,372, the principal items being for interest, £3314; mooring service, £9480; dredging, £13,998; harbour service, £8560; repairs of piers and wages of staff, £10,538; management and engineering staff, £15,729. Amongst the special expenses are for the new offices on the Thames Embankment, £7713; Richmond Lock and Weir, £12,000. The cost of maintaining the upper navigation amounted to £19,710. The receipts in this department include £16,665 paid by the London water companies.

*The Clyde.*—The revenue of the Clyde Trustees for the past year has been £3500 in excess of any previous year. From the report presented to the trustees it appears that the tonnage of vessels has increased from 1,448,869 in 1860 to 3,515,267 in 1893, and of goods from 1,192,475 to 4,879,312. The number of tons of goods discharged for each lineal yard of quay space in 1860 was 322·9 and in 1893 434·4. The returns seem to indicate that the larger vessels now in use discharge a greater quantity of cargo for each yard of quay than was formerly the case. At the present time trade is very disorganised owing to the strike of the Scotch coal miners. Coal has been freely imported from England, but many firms have closed their works on account of the high price which has to be paid. In common with other industries the Clyde Trust has been seriously handicapped by the scarcity of fuel; and English coal has had to be procured to keep the dredgers and ferries going. An idea of the total loss to the Scotch mining industry may be gathered from the fact that in less than eight weeks about 9000 tons were brought from England for this purpose alone. The quantity of material dredged during the past year amounts to 2,310,980 cubic yards, which is about half a million tons more than in the previous year. About half of this was taken from the new Cessnock dock, and the remainder from the channel of the river. The channel is being widened about 70ft. at Newshot Island for about half a mile, the dredged material being placed in the old back channel and the low ground adjoining. Three new hopper barges of 1200 tons each have been added to the dredging fleet. The number of passengers carried by the ferry boats belonging to the Trust in the past year was 12,225,645, and 233,167 vehicles, the revenue derived from this source being £32,803.

*Aberdeen.*—The Harbour Trustees, after receiving a report from Mr. Wake, C.E., of Sunderland, have approved of a scheme of improvement submitted to them by their engineer, Mr. Smith, which includes the widening of Trinity and Regent quays for a length of 400ft. in each case; Victoria Dock quay for a length of 700ft.; and the construction of four new sheds, the total estimated cost being £32,580; also a new swing brdige to replace Trinity Bridge. This bridge is to carry a double line of rails, and it is proposed to work it by hydraulic machinery actuated by a gas engine, the estimated cost being £13,411.

*Peterhead.*—During the past year the breakwater has been extended 105ft., and the foundations of a further length of 40ft. prepared. The foundation work has involved a great deal of rock excavation and levelling under water by divers. Convict labour has been employed in removing about 5400 cubic yards of decomposed rock from the quarry during the winter months. The number of men employed during the past year was: freemen, 133; convicts, 229; warders and guards, 28.

*Bridgwater.*—The Corporation have issued a report with reference to the ship canal which has been projected for the improvement of the port, and have advised that an engineer accustomed to works of this description should be called in to advise on the matter. There are two suggestions which have received consideration: (1) To cut a canal 2½ miles long through the lowlands to the Toven, having a depth of 22ft. (2) To straighten the course of the river by cutting through the existing bends.

*Portsmouth.*—Mr. Kinipple has sent in his report as to the proposed improvements of the Camber for the harbour authority. The report gives three alternative schemes, the cost varying in amount from £30,000 to £77,000, the scheme being so designed that the work may be done in sections, starting with an initial outlay of the smaller amount.

*Barry Dock.*—The contract for the new dock has been let to Messrs. Price and Wills, and operations have been already commenced. It is stated that Lord Windsor intends making considerable improvements for the convenience of summer visitors to Barry Island by improving Whitmore Bay, and making a promenade round the island.

*East Coast shipping disasters.*—The ports on the East Coast seem to have been singularly unfortunate recently. At Lynn the harbour authorities, after the lapse of considerable time and the expenditure of about £18,000, have only recently completed the removal of the steamship Wick Bay, which was wrecked in the Lynn channel about five miles below the dock. In the Humber one of the Wilson liners, the Kelso, grounded on a sand bank near the entrance to the docks and broke her back. The sand banks in the Humber have lately been the cause of considerable anxiety to the authorities. The Edinburgh guardship has recently had to be moved to a fresh berth, as in swinging round she touched a newly-formed sand bank, and narrowly escaped what might have been serious injury. It has also been ascertained that a sand bank has been formed across the entrance to the Saint Andrew's Dock, which is visible at low water or spring tides. It is difficult to say to what this shoaling is due, but it probably arises from the small quantity of fresh water which has come down the river during the past few years. The sand banks in the Humber are notorious for their shifting and dangerous character, and there can be no doubt that the channel could be greatly improved by regulating its width by training walls, as has been done in the Ouse. The Conservancy Board obtained parliamentary powers to carry out works of this description a few years ago, on lines approved by the late Sir John Coode, but very little as yet appears to have been done.

In the Ouse the steamer Lennard, with 600 tons of coal with which she had been loaded in Goole Dock, when about a mile below the dock caught her stern on the ground, and the tide flowing up very strongly carried her bow on to the stone training walls, when she listed over 70 deg. This case unfortunately was attended with loss of life, the second engineer and fireman being unable to escape from below, were drowned. Owing to the strong current running in the river, and the position in which the vessel was laid, considerable difficulty was been found in effecting her removal. A short time after this disaster a train of seventy compartment barges, locally known as "Tom Puddings," each containing about 40 tons of coal which had come into Goole Docks for shipment, was sunk. The accident was due to one of the barges sinking from a leak and dragging the others down with it. At Grimsby the s.s. Kent collided with the steam trawler Regina as she was about to enter the fish dock with a cargo of fish. The trawler sunk within a few minutes. At Boston the s. steamer Ethel of Newcastle with a cargo of about 1200 tons of iron ore from Bilbao, in passing round a bend in the river, a short distance below the dock, ran into the training wall, and her stern being carried by the next tide across the river, the channel was completely blocked. As the tide fell the fore-and-aft ends grounded, leaving the vessel unsupported amidships. Consequently the side plates forward of the engine-room bulkhead buckled, and left an opening 2½ft. wide, the break extending across the deck and down each side below the low-water line. The vessel thus became a wreck, stranded across the bed of the river, the water at high tide coming completely over her decks. This accident was due to the pilot bringing the vessel up too late on the tide and not taking proper precautions when passing round the head. The harbour authorities at once took possession of the vessel and put themselves in communication with several firms of salvors and wreck raisers. From one of these an offer was received to remove the vessel out of the channel for £2000, when the cargo was removed. This offer not being accepted, the commissioners instructed their engineer to take the matter in hand. As similar disasters occasionally occur in other rivers, an account of the method adopted for raising this vessel, as given in the local newspaper, may be useful. About 800 tons of the cargo were removed, the remainder being under water at low water; the forepart of the vessel was prevented from breaking off from the afterpart by wire ropes carried to the afterpart over a bridge of timber constructed in the centre. A platform deck was constructed half way up the forehold above the level of low water, and a vertical bulkhead clear of the breach, the whole being caulked and made water-tight. This deck was well strutted to the upper deck and framing of the vessel. Two heavy baulks of timber were laid across the deck of the vessel, and from these chains carried under the bottom and drawn up tight by screw bolts. In the lower part of the hold about 500 empty petroleum barrels were placed. The engine-room was pumped out by means of an ejector and pulsometer supplied with steam from two boilers placed on deck for the purpose. Access was then obtained to the donkey engines and bilge pumps belonging to the vessel, and the water was pumped out of the engine-room and after hold. Wooden wedges were driven into the openings between the plates where they had bulged and weighted sail cloths dropped over the breach to keep as much water out as possible. When these preparations were complete, as the tide rose sufficiently to float the vessel, she was drawn by chains carried to the shore on to a berth which had been dug away for the purpose at the side of the river and out of the channel. By working both day and night tides the whole was accomplished in a week from the time the order was given for removal, at a cost of less than £500, the channel having only been closed during one set of neap tides.

## BELGIAN STATE RAILWAYS.—BRAKE VAN FOR GOODS TRAINS.

The brake van illustrated on page 256 has just been brought out by M. Leon Bika, M. Inst. Mech. Engineers, Chief Engineer, and Inspector General of the Belgian State Railways. It is not intended to be used for passenger traffic, but is meant for merchandise, and more particularly for coal and mineral trains.

A brake van for a train of this description should be heavy, strong, and cheap both in construction and maintenance. As a light wagon has not sufficient adhesion for a heavy mineral train, additional weight is often given by the insertion of flat plates of cast iron between the floors, and if a collision takes place these plates frequently make the disaster worse by forcing their way through the wooden sides. M. Bika also uses cast iron plates, but makes the lower floor of them, thus securing weight and rigidity. Three castings are used, of which two are off the same pattern; the middle one being necessarily longer, as it must project on either side of the others to leave room for the look-out windows. They are cast from a common quality of pig iron, and are simply bolted together. Holes are cast in them to receive the rails which form the frame. These rails are old ones, and are used just as they have been taken up. In the front and back part of the vehicle, a rail of the current length, 20ft., is used, so that it only needs bending, no cutting being required. Iron plates of a common quality, but $\frac{5}{16}$in. thick, are rivetted to these rails and along the bottom to a ridge on the castings, and the rails are also run into the latter with iron cement. The system of employing cast iron plates for the floors of railway wagons has been in use for the last thirty years on the inclined planes at Liége. It not only renders the wagon very stiff, but it simplifies the construction by doing away with the longitudinal and cross girders, the bracing, gusset plates, &c.

M. Bika considers rigidity of even greater importance than weight. A brake van is more costly than an ordinary truck, and it always contains human beings, whose safety should be studied; and yet in many mineral trains the brake van is the weakest part of the train, and most likely to suffer from telescoping if there is a collision, or to be crushed if overturned on an embankment. In M. Bika's system the brake van is less likely to suffer than the rest of the train, whilst if damaged it is not expensive to repair. Even if there should be a collision of sufficient violence to force in either of the end walls of the car, the men, being in the central portion, would probably not be injured by it.

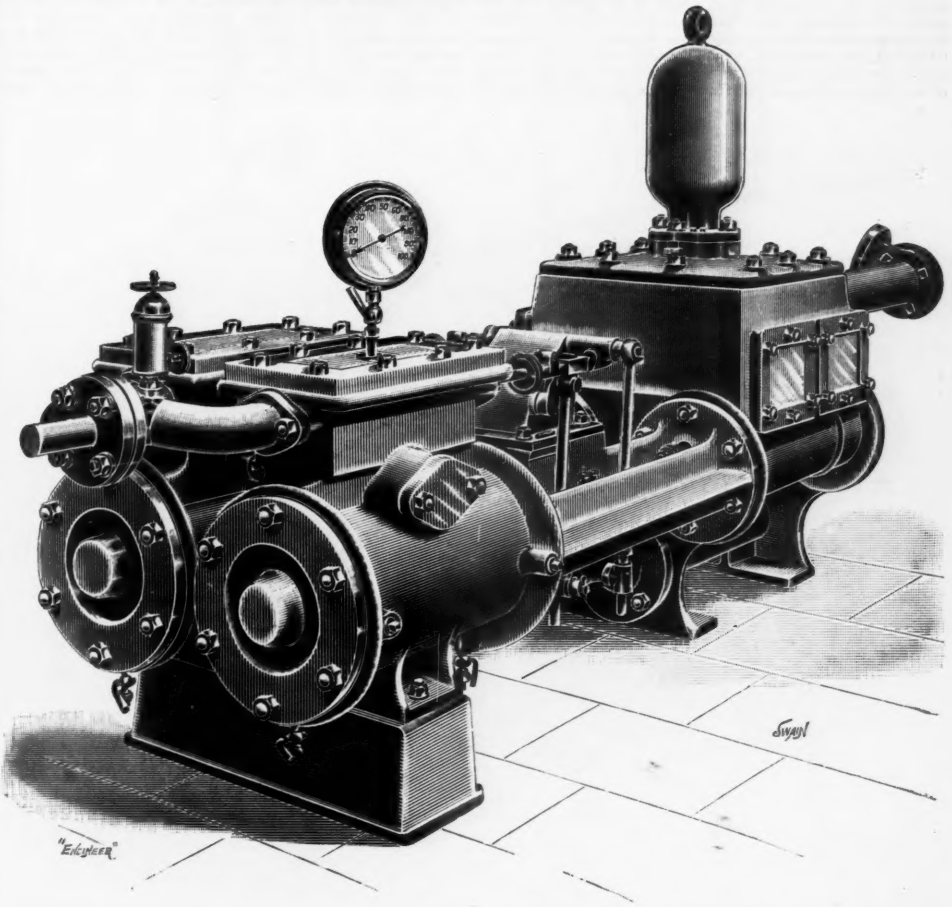
The method of suspension is new in brake vans. The two springs are connected by a balance beam, supported in the middle like the beam of a pair of scales; so that the suspension practically takes place from three points. Besides adopting this method of increasing the stability, the wooden floor of the central compartment, reserved for the brake man, is not connected with the rest of the flooring on either side, but is carried on spiral springs which rest on the cast frame. The interior of the car is lined with match-boarding, an air space being left between the iron and wooden walls. As will be seen on the drawing, there are ventilators in the roof, which communicate with the air-space, whilst inlets have been made through the inner wall near the bottom, so that when the ventilators are open there is always a circulation of air, keeping the inside of the carriage cool, even when the exterior sheet iron is heated by exposure to the sun. When required, the ventilators can be immediately closed, so that there is no need to have them open in the winter.

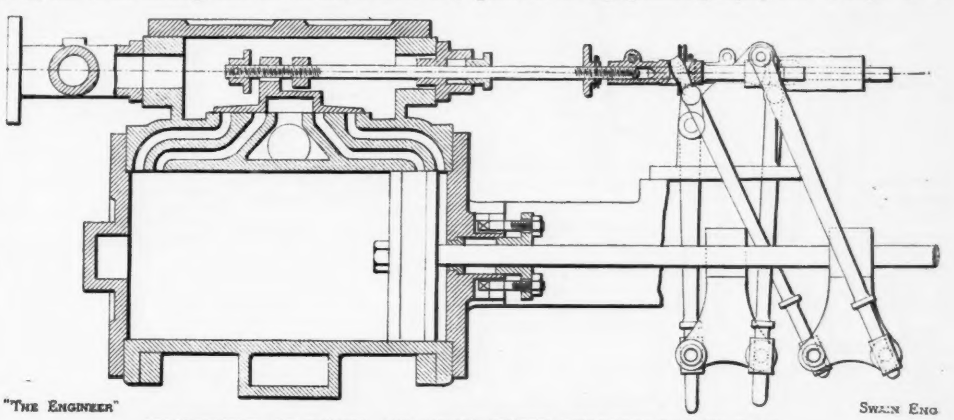
The extreme length of the carriage over the buffers is 21ft. 11in., and the extreme width 9ft. 10in. In the interior, after allowing for the space occupied by the double wall, the central compartment is 8ft. 10in. by 3ft. 8in., and those at either end 6ft. 2in. by 4ft. 10in. The internal height in the middle is 6ft. 5in. The weight is 21 tons. As it is intended to be used for very heavy trains, requiring a powerful brake, the van has intentionally been kept heavy.

In order not to have to introduce new types of wheels, &c., whilst those in use on ordinary brake vans would be too light for one of this weight, the horn plates, springs, axles, wheels, grease boxes, and brake-gear complete, are all those in use on the tenders of the Belgian State Railway. A mistake has been made both in the drawing and in the first van which has been constructed from it, and is now being exhibited at the Antwerp Exhibition. As the doors do not add to the strength of the vehicle to resist crushing, and should be as light as possible, they ought to have been made of wood instead of iron. This will be altered in all others that are made. The part reserved for the men is fitted up very comfortably, and there are many countries besides Belgium where M. Bika's brake van would be most useful.

THE PROSPECT DUPLEX PUMP

MESSRS. COLE, MARCHENT, AND MORLEY, BRADFORD, ENGINEERS





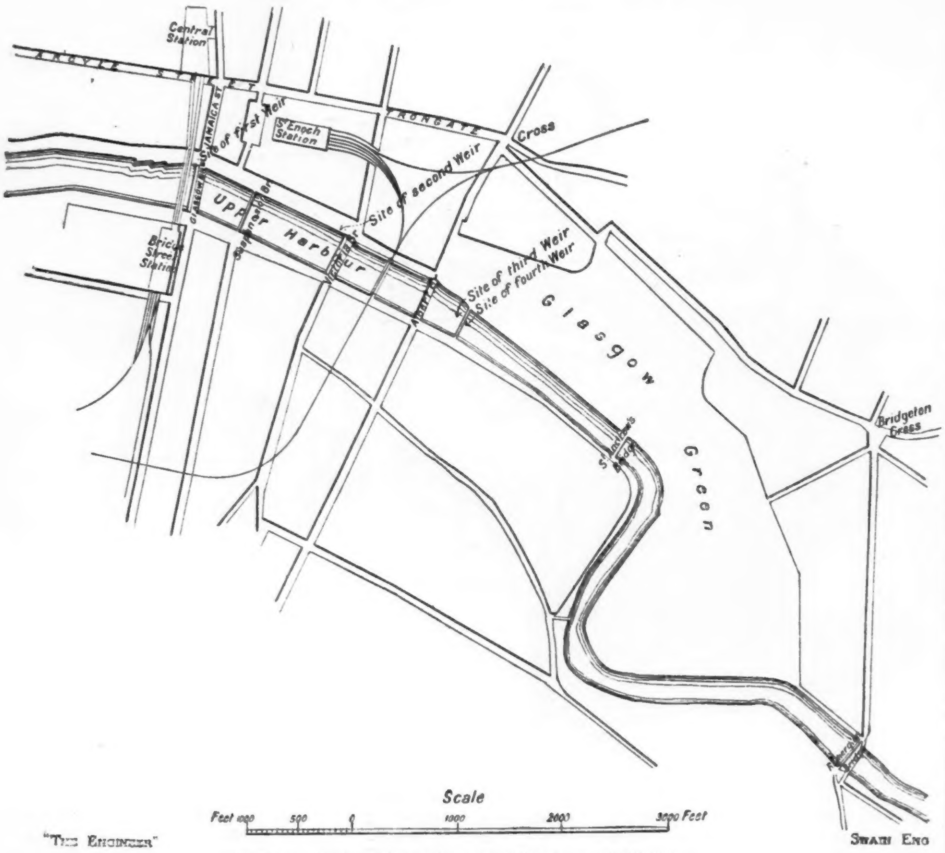
ARRANGEMENT OF VALVES AND VALVE LEVERS, PROSPECT DUPLEX PUMP

## THE PROSPECT DUPLEX PUMP.

In our reports of the machinery exhibited at the Royal Agricultural Show at Cambridge, reference was made to the "Prospect" duplex steam pumps, one of which we illustrate by the accompanying engraving. Both the pumps exhibited had steam cylinders 7in. diameter with 15in. stroke, but one had a 4in. and the other a 6in. pump. Our engraving shows the 6in. pump. The smaller pump is suitable for fire purposes and for high-pressure pumping, and the larger one for irrigation and low service pumping. The makers, Messrs. Cole, Marchent, and Morley, of Bradford, claim for this pump that it is the only general service duplex steam pump in the market which will work expansively, and they send us diagrams taken from a 7in. by 4in. by 15in. pump, which show that they can work expansively, and can vary the expansion in the cylinder, one diagram giving the greatest expansion, and the other a full stroke admission. One diagram was taken at a speed of 160 double strokes per minute, or 400ft. a minute each side. Another diagram, taken at four double strokes per minute, shows that with the same pump the expansion may be adjusted to suit the loads. As regards the water pumped, Messrs. Cole, Marchent, and Morley mention that with a 6in. by 4in. by 6in., and at a piston speed of 220ft. per minute, they have pumped 12,420 gallons in the hour, against a water pressure on the delivery of 4 lb., and a vacuum on the suction of 11in.; the theoretical capacity of the pump was 14,400 gallons, making an efficiency of 86 per cent.

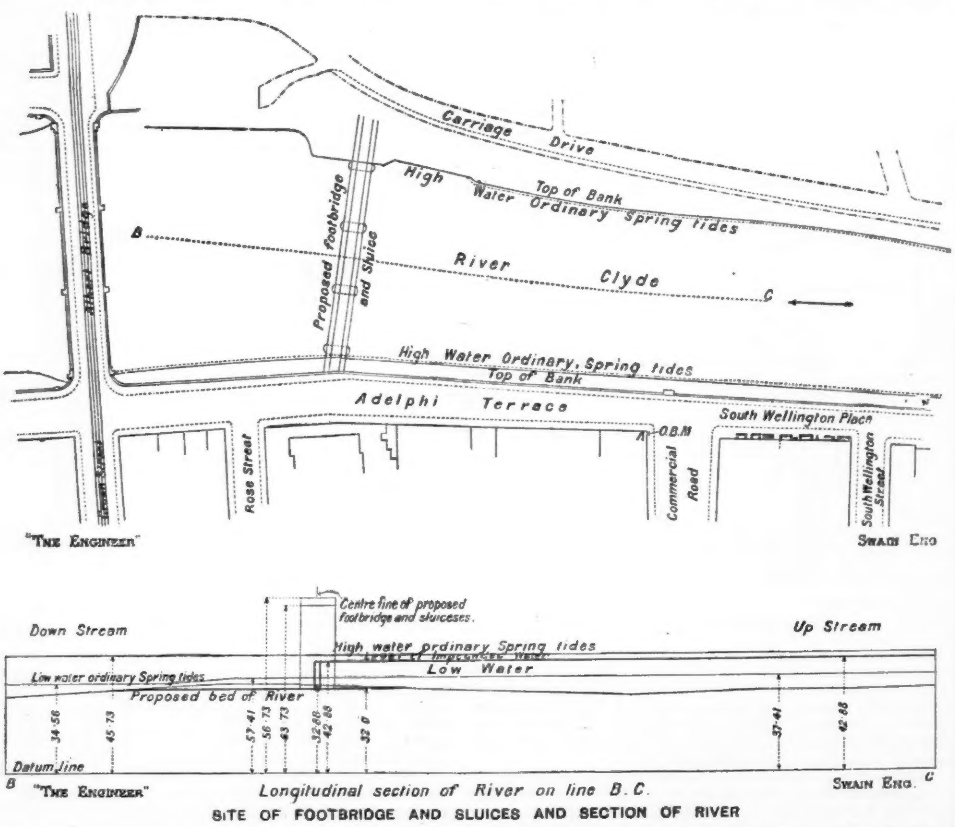
## GLASGOW WEIRS.

THE recent passage through both Houses of Parliament of a Bill enabling the city of Glasgow to construct a weir with movable sluices across the river Clyde at Glasgow Green, calls attention, not only to the work about to be carried out, but also to the attempts which have been made from time to time to grapple with a difficulty which has for more than 100 years confronted the authorities of the commercial capital of Scotland. Apart from the great local interest involved, the history of the weirs of Glasgow carries with it a far more widespread importance in its general aspect as to the engineering difficulties involved in the management of an important tidal river, on whose successful control the welfare of a large industrial city in great measure depends. When it is stated that, in the comparatively brief space of a century, no less than three weirs have been erected across the Clyde within the "ancient royalty" of Glasgow in separate positions and have been removed, and that a fourth weir is about to be commenced, it will be readily understood that no little engineering skill and forethought have been exercised to place the regulation of the Clyde on a sound and satisfactory basis.


Central Station
Argyle Street
Jamaica St
Site of first Weir
St Enoch Station
Trongate
Cross
Site of second Weir
Upper Harbour
Glasgow Br.
Bridge Street Station
Victoria Br.
Albert Br.
Site of third Weir
Site of fourth Weir
Glasgow Green
Bridgeton Cross
St Andrews Bridge
Scale
Feet 1000
500
0
1000
2000
3000 Feet

"THE ENGINEER" SWAIN ENG

WEIRS AND BRIDGES ON THE CLYDE AT GLASGOW


Albert Bridge
Crown Street
Carriage Drive
Top of Bank
High Water Ordinary Spring tides
B
River Clyde
C
Proposed Footbridge and Sluices
Adelphi Terrace
South Wellington Place
O.B.M
Rose Street
Commercial Road
South Wellington Street
Centre line of proposed footbridge and sluices.
Down Stream
Up Stream
High water ordinary Spring tides
Level of impounded water
Low Water
Low water ordinary Spring tides
Proposed bed of River
34·56
45·73
57·41
56·73
43·73
32·88
42·88
32·0
37·41
42·88
Datum line
B
C

"THE ENGINEER" SWAIN ENG

*Longitudinal section of River on line B.C.*

SITE OF FOOTBRIDGE AND SLUICES AND SECTION OF RIVER

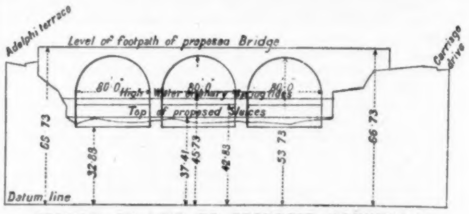
Turning now to consider the different weirs which form the subject of this notice, the earliest weir across the Clyde would appear to have been built about the year 1772, as the following extract from a memorial for the trustees of the Clyde Navigation sets forth:—

"The weir . . . . . had its origin in the magistrates and Council of Glasgow, as then the only trustees on both the Clyde Navigation and on the bridges at Glasgow over the Clyde, situated above the harbour of the Broomielaw, having, in their capacity of Clyde Trustees, about the year 1772 caused a number of large stones to be thrown into the river around the piers of the Jamaica-street Bridge, now called the 'Glasgow Bridge,' in order to strengthen the piers of that bridge, which had shown certain symptoms of instability, arising chiefly from the deepening that had for some time previously been made of the river and harbour by the Clyde Trustees immediately below or to the west of the bridge."

As far back as 1781 John Golborne, in a report dated September 7th of that year, relative to the improvement of the Clyde, gave it as his opinion to the magistrates of Glasgow "that the fall through the new bridge ought to be taken away, by cutting down the piles and removing the other obstructions in the three largest arches."

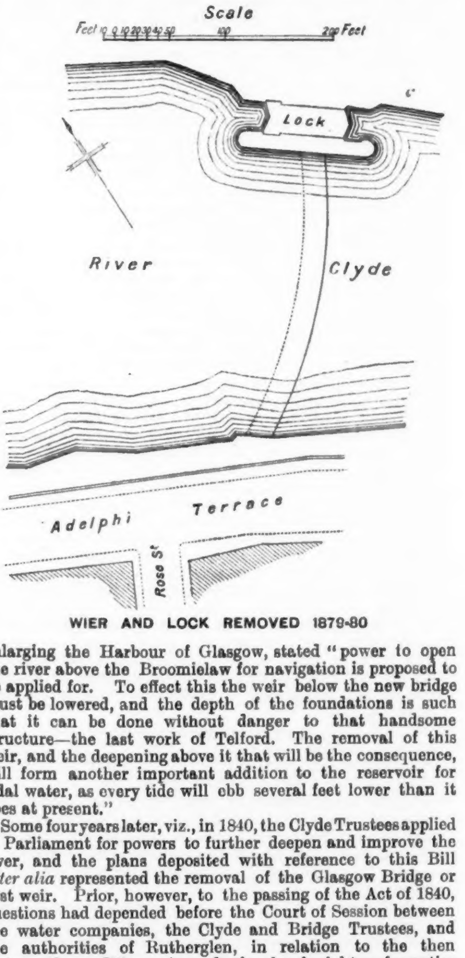
Nothing, however, was done, and the next mention of the first weir is to be found in "A Report by John Rennie, Esq., respecting Obstructions in the River Clyde, near the New Bridge," in which the following interesting passage occurs, which the experience of nearly a century has abundantly verified:—"The second material obstruction is the dyke or weir which has been built across the river, just below the new bridge, to preserve its foundations, the bottom of the navigation below the said dam and along the wharf at the Broomielaw being lower, as I am informed, than the foundations of the piers of the bridge. If therefore this dyke or weir was to be taken entirely away, the stability of the bridge would be endangered. I cannot help expressing my surprise that the foundations were not laid deeper in the original construction of the bridge. . . . . . The weir cannot now be taken away, but as I am informed it is in very bad repair, perhaps it may in rebuilding be so lowered as to afford a considerable addition of section to assist in carrying off the floods, and whenever it is rebuilt it ought to be done on a more permanent construction than it is at present."

The above report bears date August 22nd, 1799. Some eight years later, that is to say, in 1807, Rennie again refers to the weir, and advocates the building of a new one "across the river below the new bridge, and 1ft. lower at its top than the present one." The next point of interest in the history of the first weir was the passing of the Act of 1829, Section II. of which authorised the Bridge Trustees in taking down the old bridge to remove the weir. Section VI. of the same Act required the Clyde Trustees to contribute from the river and harbour duties the sum of £6000, in three instalments, for the "great benefit that would result to the Harbour of Glasgow and the navigation of the river Clyde from the removal of the weir below the bridge, opposite to Jamaica-street, and from sinking the foundations of the piers of the proposed new bridge below the level of the harbour at the Broomielaw as now deepened."


Adelphi terrace
Level of footpath of proposed Bridge
Carriage drive
80 0
80 0
80 0
High Water Ordinary Spring tides
Top of proposed Sluices
65 73
32 88
37·41
45·73
42·83
53 73
66·73
Datum line

SECTION ON LINE OF PROPOSED FOOTBRIDGE

In 1836 Mr. Walker, in his report to the Parliamentary Trustees for improving the navigation of the river Clyde and enlarging the Harbour of Glasgow, stated "power to open the river above the Broomielaw for navigation is proposed to be applied for. To effect this the weir below the new bridge must be lowered, and the depth of the foundations is such that it can be done without danger to that handsome structure—the last work of Telford. The removal of this weir, and the deepening above it that will be the consequence, will form another important addition to the reservoir for tidal water, as every tide will ebb several feet lower than it does at present."


Scale
Feet 10 0 10 20 30 40 50
100
200 Feet
Lock
River Clyde
Adelphi Terrace
Rose St

WIER AND LOCK REMOVED 1879-80

Some four years later, viz., in 1840, the Clyde Trustees applied to Parliament for powers to further deepen and improve the river, and the plans deposited with reference to this Bill *inter alia* represented the removal of the Glasgow Bridge or first weir. Prior, however, to the passing of the Act of 1840, questions had depended before the Court of Session between the water companies, the Clyde and Bridge Trustees, and the authorities of Rutherglen, in relation to the then state and condition of, and the legal rights of parties in reference to the weir. Finally, in 1842, the weir was removed to the under side of Old Stockwell-street Bridge. The second, or Stockwell-street Bridge weir, was not, however, destined to last long, for as early as 1844 Mr. Walker, in reporting to the Committee of Management of the Bridge Trustees of Glasgow, advocated the removal of the weir to a point higher up the river, in order to maintain a sufficiency of water for the water company at this part. In 1845 the rebuilding of the Stockwell-street, or Victoria Bridge, as it became designated, was rendered imperative by the disrepair into which it had fallen, and a Bill was introduced into Parliament to obtain the necessary powers, and as the removal of the old bridge rendered it necessary at the same time to remove the weir, powers were also sought to construct the weir still further up the river, and to place it about 140 yards above the Hutchesontown Bridge, which spanned the Clyde at the foot of the Saltmarket, where the Albert Bridge now stands, the Hutchesontown Bridge having been demolished in 1879. Accordingly, the Act 8 and 9 Victoria cap. 133 (1845) was passed, authorising, by Section 12, the removal of the weir from the Victoria to the Hutchesontown Bridge, and the construction of a lock in its vicinity, the cost of the removal and of the new weir and lock being borne by the Clyde Trustees as connected with and for the improvement of the navigation of the river.

In 1851 the third and last weir was built on the east side of Hutchesontown Bridge, being about 120 yards above that structure—the late Mr. James Walker, of London, acting as engineer both for the weir and for the new Victoria Bridge, which occupied the site of and replaced the Hutchesontown Bridge. The third weir, which was provided with a lock for the passage of barges, consisted of regularly-built masonwork, with rows of sheeting piles on the upper and lower sides. The height of its crest was about 2ft. below average high water of spring tides, or 11ft. below the surface of the coping of the South Quay wall. When unaffected by floods, the surface level of the water passing over the weir was 6ft. 4in. above the average low-water level at the underside of the Hutchesontown Bridge, and 7ft. 11in. above the average low water of the lower harbour, the depth of river water passing over the coping of weir being then about 11in. The lock was 74½ft. long and 25ft. wide, with a double pair of gates, having a depth of 8ft. on the upper sill, and 12ft. on the lower, at high water of average springs. The weir was a tumbling one, and was constructed throughout of solid masonry, the Clyde Trustees contributing upwards of £19,000 towards the sinking of the piers of the bridge and the removal and reconstruction of the weir—the weir and lock alone costing about £65,000.

In 1865 Messrs. James Leslie and Andrew Duncan presented their report on "The Proposed Removal of the Weir at the Hutchesontown Bridge," and "the effect which the removal of the weir may have on the navigation of the river both lower and upper, with the change that may ensue in the upper reaches of the river," in which, after dealing very fully with the data available, they say: "Were the weir removed the floods would doubtless not rise to so high a level as they do now, as the water would be more quickly run off, but the sandy and unprotected river banks which are now suffering seriously in many places from the action of the river, and are much in need of protection, would be liable to be still more acted on by the river, when under the condition of a lowered and consequently contracted channel and an increased velocity, and would therefore stand still more in need of protection than now, while the existing protection would in a great measure become inoperative." The third weir was not, however, destined to remain undisturbed: it formed for several years a topic of fierce contention, both parties—the one advocating its removal, the other its retention—straining every nerve to carry their point. Eventually the advocates for demolition gained the day, and in 1879-80 the third and last weir disappeared. Many reasons had led up to this final end. Amongst others it may be stated that the stability of the weir had become year after year more insecure, and the responsibilities which might have followed its failure while under their charge as maintainers of it being fully appreciated by the Clyde Trustees. In order to rid themselves of such responsibilities that body succeeded in getting Parliament to pass Section XXXII. of their Act of 1873, placing the burden and responsibility of the weir's maintenance and removal on the Water Commissioners after July 7th, 1878. Accordingly, on completion of the works in connection with the conduit under the Clyde by the Water Commissioners, the Clyde Trustees, acting as servants of the Commissioners, removed the weir and lock, and their accounts for the period between July 1st, 1879, and June 30th, 1881, show that they expended £527 2s. 7d. in so doing, while in their accounts for the year ending June, 1884, the following item appears:—"Removal of weir—Water Commissioners, £5000; less amount received, £225; total, £4775."

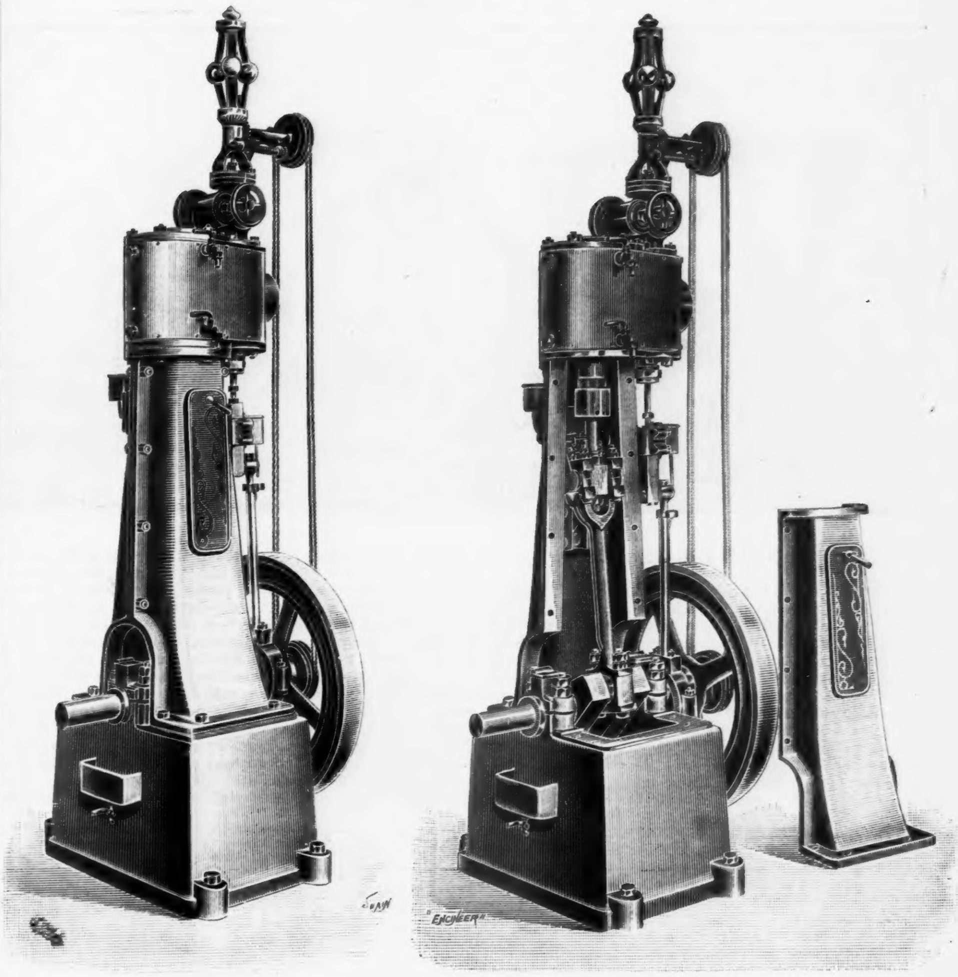
Turning now to consider the effects of the removal of the third weir, no better generalisation can be given than by quoting the words of Mr. James Deas, engineer to the Clyde Trustees, who characterises the demolition as "an unmitigated evil," and goes on to add that as regards the river above the site of the weir, the demolition "has led to the giving way of the banks as far as tidal influence extends, and has already entailed heavy expenditure, probably amounting to £10,000, on the riparian proprietors in the restoration of their banks and the preservation of adjoining property, and has injured the former amenity of the river by carrying up in great volume sewage discharged below the site of the weir, and which the weir formerly prevented ascending. Now immediately after the turn of the tide, the sewage can be traced by its discoloration of the water flowing upwards as far as the tide will carry it, while at low water the bed of the river exposed to view is revealed in all its slimy hideousness. Previous to the removal of the weir there was at all times a stretch several miles in length of slow-flowing river never varying more than a foot or two in level, except when the river was in flood, largely used, especially by the working classes for boating, carried on at all times of the tide throughout the whole day, and in summer evenings crowded with rowing craft. This valuable pastime has been reduced to at least a-half by being made entirely dependent on the tidal ebb and flow."

Whilst in regard to the navigation the same authority states that "the immediate effect of the removal was to bring down hundreds of thousands of tons of material from the bed and banks above the site of the weir, and which the weir kept from moving. During the first four years after the removal of the weir, 1,280,000 cubic yards of deposit required to be dredged out of the harbour and conveyed to Loch Long to retain the former depth of water in the harbour, against 786,000 cubic yards in the previous four years; whilst deep-draughted vessels are kept from half-an-hour to an hour longer waiting on the tide before they can leave, in consequence of the tide, which was formerly impounded by the weir, now flowing unimpeded into the upper reaches of the river. This delay is equivalent to at least a foot of loss of depth all the way to Greenock, vessels being now that time later on the tide of reaching deep water." The rapid erosion of the banks forced on the Improvement Trustees, as owners of property on the river side, an expenditure of no less than £3000 for sheet piling to protect the banks at Oatlands, while both the Suspension Bridge and the Humane Society's house adjoining became endangered by the excessive scour, and had to be upheld by works executed by the Corporation.

In consequence of the rapid destruction of the banks, the Corporation of Glasgow sought and obtained parliamentary powers to lay out a sum of £50,000 in repairing and strengthening the foreshores of the Clyde along the entire extent of the municipal boundaries. A special committee inquired into the whole question, and the late Mr. Carrick, City Architect of Glasgow, spent much time in considering the matter. It is not unlikely, had such a suggestion been practicable, that proposals would have been made at this juncture to replace the weir demolished in 1879-80; but the unwillingness of Parliament to sanction the placing of fixed dams across other tidal and navigable streams indicated the futility of endeavouring to obtain the necessary powers. About this time—1890—the attention of the Corporation of Glasgow was drawn to the action being taked by the Conservators of the river Thames who found themselves confronted by difficulties very similar to those which were being encountered on the Clyde.

HIGH-SPEED CLOSED ENGINE

MESSRS. CHARLESWORTH AND CO., OLDHAM, ENGINEERS



The Thames Conservators were endeavouring to solve the problem by placing a weir with movable sluices across their river at Richmond, and succeeded after a prolonged and exhaustive inquiry in securing the necessary parliamentary sanction, and commenced operations. In view of the interest taken in the Richmond weir, a special committee from the Glasgow Town Council and a deputation from the Clyde Trustees visited the Thames, whilst another joint deputation examined similar sluices on the Manchester Ship Canal, designed to control the flood waters of the river Irwell and to regulate the effluence of the river Weaver, where it unites with the canal and the Mersey below Runcorn. So satisfactory were the reports of the committees in each case, that it was decided to employ analogous means on the Clyde for dealing with similar difficulties—a resolution which has been materially strengthened and justified by the successful inauguration of the Richmond weir by H.R.H. the Duke of York, and by the eminently satisfactory manner in which the sluices have acted.

The new weir for which Glasgow has obtained parliamentary sanction will resemble in appearance an ordinary arch bridge of three spans, the clear opening of each being 80ft., and the headway 18ft. above ordinary high-water level at the centre of each arch. No lock will be provided, the river traffic, which is trifling, passing beneath the sluices, which will be raised altogether out of the water at high tide. The parliamentary estimate for the weir is £45,000, a portion of which will be furnished by the moneys provided for in the River Embankments Act of 1890, of which some £30,000 remains unexpended, and a portion by the Clyde Trustees, who propose to pay £2500 before erection "on being satisfied that the interests of the navigation of the river are likely to be benefited by the erection of the weir or tidal dam," and if they are after its erection that the interests of the navigation of the river have been thereby benefited, then not less than £2500, viz., in all a total contribution of £5000. In this connection it may be recalled that the Clyde Trustees paid £5000 towards the removal of the third weir in 1879-80, and that estimates have placed the total loss incurred through such demolition, by increased dredging necessitated and damage sustained from augmented scour, at no less than £200,000.

Turning now, in conclusion, to the proposed weir, the sluices are designed by Mr. Francis G. M. Stoney, M.I.C.E., whose experience in designing and carrying out similar works is well known, both at Richmond—on the Manchester Ship Canal—on the river Rhone near Geneva, and on the Nile; whilst in Ireland flood sluices were executed on the river Suck and at Belleek, and controlling sluices on the river Shannon, at Lough Allen, and on the Lough Erne drainage works. For the Clyde weir movable sluices are designed in such a manner as to impound the upper waters at a level of 3ft. below high water, whilst mechanism is provided which, so soon as the flood tide raises the lower water to that level, lifts the sluices out of the river, leaving the whole waterway free for navigation. The same appliances lower the sluices when the ebb tide subsides to the level of the impounded water. A wooden float is secured to the top of each sluice, and gives it sufficient automatic buoyancy to allow flood water to pass below independently of the arrangements for dealing with the tidal water. The sluices are provided with counterbalance weights, and are accordingly very easily controlled.

The engineer of the proposed new weir is Mr. Alexander Beith Macdonald, M.I.C.E., city engineer of Glasgow, whose courtesy has placed at our disposal the views we reproduce from the model of the new sluices, and afforded us much information of a valuable nature in dealing with the fourth weir Glasgow is about to erect across her famous river.

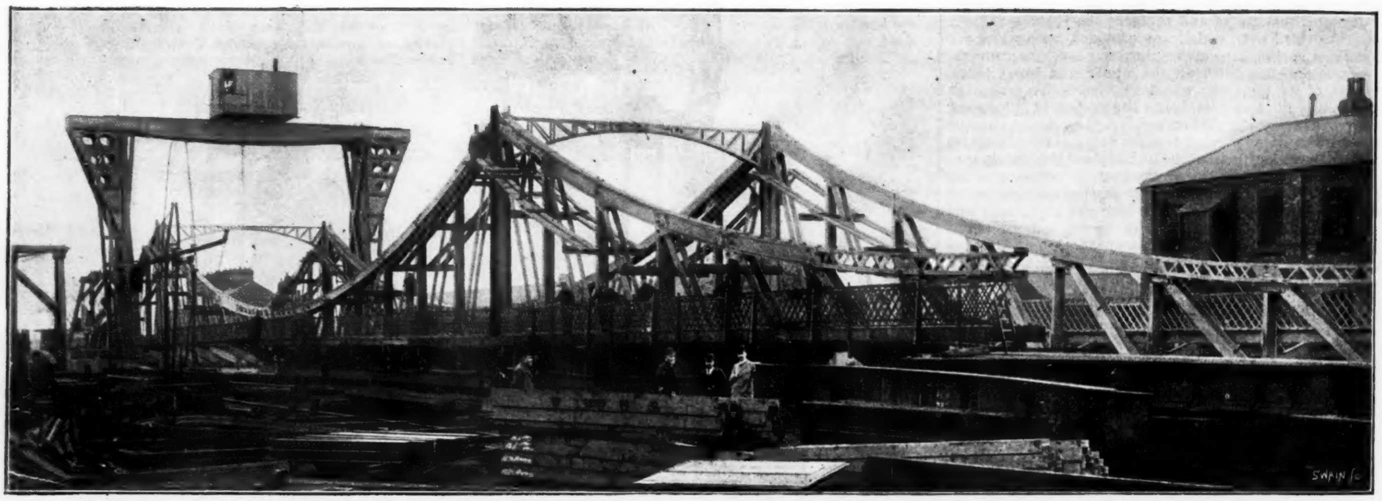
## HIGH SPEED ENGINE.

We illustrate a rather novel high speed engine, which is one of a series recently introduced and manufactured by Messrs. S. Charlesworth and Co., Oldham. It is a double-acting, and of the enclosed type, and is specially designed for driving high speed machinery direct or by belt, or is fitted with a dynamo on one bed-plate for ship and other work. The novelty in design is as seen from the illustrations, the enclosed case being made in two halves, bolted together. The guides and cylinder are permanently carried by the back half. The front half is readily and quickly taken away, and the crank or any other part accessible and removable, thus combining—the makers' claim—the advantages of an enclosed and open type engine. For all ordinary purposes, such as packing the gland and inspecting the crosshead, a door is provided. All parts of the engine are automatically oiled. The strength of the parts has been proportioned for very high boiler pressures. The steel crosshead is easily taken out for examination, and like the other parts has large wearing surfaces. The engine illustrated has a 7in. cylinder, 6in. stroke, 10 brake horse-power, at 350 revolutions, at 60 lb. boiler pressure. It is fitted with a Pickering governor, but is also made with an automatic centrifugal governor, and all the engines are fitted with piston valves.

**Skelton and Brotton Sewage Disposal.**—A Local Government Board inquiry was held on the 12th at the Local Board Offices, Skelton-in-Cleveland, by Mr. W. J. B. Clerke, M. Inst. C.E., engineering inspector. There was a large attendance, including representatives from the Saltburn Local Board, who some time ago obtained an injunction at the county court to prevent the Skelton and Brotton Local Board from polluting with sewage from their district the Skelton Beck, which flows through Saltburn. The inquiry was held to obtain the sanction of the Local Government Board to borrow £14,500 for works of sewerage and sewage disposal which will prevent this pollution. The scheme, which is of a complex and difficult nature, is from the designs of Mr. D. Balfour, M. Inst. C.E., F.G.S., of Newcastle on-Tyne, and comprises about ten miles of 21, 18, 15, 12, and 9in. sanitary and iron pipes, with manhole and lamphole shafts, flushing chambers, iron pipe valley crossings. The work consists of a combined intercepting scheme for conveying the whole of the sewage from the ten villages comprised in the Board's district to a point at the top of cliffs on the coast called Cranedale Spout, where the high cliffs, 200ft. in height, will be bored and lined with iron pipes, which will be jointed at the bottom with iron pipes having easy bends, laid in a heading, driven from the beach; and then by means of cast iron pipes laid in a cutting in the rock, of which the beach is composed, the sewage will be delivered at lowest point of the furthest ebbing tide. The scheme was explained and other evidence given by Mr. D. Balfour, jun., A.M. Inst. C.E., on behalf of the engineer, after which the inspector visited the whole of the district.

# ROAD BRIDGE FOR BRAZIL

MR. MAX AM ENDE, M. INST. C.E., ENGINEER; MESSRS. JOHN BIRCH AND CO., CONTRACTORS



## ROAD BRIDGE FOR BRAZIL.

This bridge, for which the contract was made with Messrs. John Birch and Co., London, and which is being erected by them over the Cachoeira River, is a steel structure, carrying a concrete roadway 32ft. 9½in. wide between the main girders, and two footpaths 4ft. wide outside of them. The length between abutments, 524ft. 1¾in., is divided into five spans, of which the central span is 197ft. 8¾in. between centres of piers. The main girders over the three middle spans, although they resemble a certain system of suspension bridges, are cantilevers, converted into continuous girders by inserting the central piece of the top flange after the completion of the bridge so far. The platform of the bridge is continuous between the abutments, and the structure is fixed only to the second pier, resting on rollers on the three other piers and on the abutments. At the first and fourth piers the continuity of the top flange is interrupted. In consequence of this arrangement the end spans do not affect the stresses in the main structure, except in so far as they furnish the necessary balance weight when the middle span is loaded; in consequence of the temporary omission of the central piece of the top flange, the central span without the live load is accurately balanced by the adjoining spans, and the stresses for this case are calculated in an elementary way. These are stated in the third column of the table of stresses, the figures in the first column identifying the parts in the diagram, Fig. 1. The stress in the top flange and the shearing stress at the centre are known to be nil.

Side Span.

| Number of bar. | $\frac{10{,}000\,l}{E f}$ | Stresses in tons from | | | | Maximum stresses. |
|---|---|---|---|---|---|---|
| | | Dead load. | Live load. | | | |
| | | | Case 1. | Case 2. | Case 3. | Tons. |
| 0 | 4·104 | — | — | — | — | — |
| 1 | 4·122 | + 31·2 | + 4·7 | + 82·0 | - 77·3 | +113·2 |
| 2 | 4·146 | +112·3 | + 35·1 | +145·4 | -110·3 | +257·7 |
| 3 | 2·172 | +116·3 | + 78·9 | +187·0 | -108·1 | +403·3 |
| 4 | 1·476 | +323·2 | +124·8 | +222·6 | - 97·8 | +545·8 |
| 5 | 1·168 | +421·3 | +169·4 | +235·2 | - 65·8 | +656·5 |
| 6 | 1·002 | +497·9 | +205·8 | +231·7 | - 25·9 | +729·6 |
| 7 | 0·888 | -515·2 | -217·0 | -206·1 | - 10·9 | -732·2 |
| 8 | 0·900 | -478·9 | -199·2 | -212·9 | + 13·7 | -691·8 |
| 9 | 1·150 | -400·5 | -162·1 | -215·4 | + 53·3 | -615·9 |
| 10 | 1·470 | -310·4 | -120·8 | -207·3 | + 86·5 | -517·7 |
| 11 | 2·160 | -211·5 | - 77·0 | -184·8 | +107·8 | -396·3 |
| 12 | 4·074 | -112·3 | - 35·2 | -145·5 | +110·3 | -257·8 |
| 13 | 4·074 | - 31·2 | - 4·7 | - 82·0 | + 77·3 | -113·2 |
| 14 | 4·620 | — | — | — | — | — |
| 15 | 5·628 | + 38·4 | + 3·1 | +124·1 | -121·0 | +162·5 |
| 16 | 4·962 | - 20·3 | - 2·9 | - 55·8 | + 52·9 | - 76·1 |
| 17 | 5·892 | +102·4 | + 37·4 | + 77·6 | - 40·2 | +180·0 |
| 18 | 5·616 | - 53·1 | - 19·9 | - 42·7 | + 22·8 | - 95·8 |
| 19 | 4·560 | +142·9 | + 59·7 | + 61·4 | - 1·7 | +204·3 |
| 20 | 5·442 | - 70·4 | - 28·7 | - 30·6 | + 2·1 | -101·0 |
| 21 | 4·716 | +152·0 | + 67·0 | + 31·5 | + 35·5 | +219·0 |
| 22 | 5·700 | - 76·5 | - 35·3 | - 5·7 | - 29·6 | -111·8 |
| 23 | 5·370 | +148·8 | + 69·6 | + 6·9 | + 62·7 | +218·4 |
| 24 | 6·484 | - 78·4 | - 37·6 | + 6·2 | - 43·8 | -122·2 |
| 25 | 6·462 | +143·2 | + 68·2 | - 7·4 | + 75·6 | +218·8 |
| 26 | 7·688 | - 69·1 | - 34·8 | + 20·6 | - 55·4 | -124·5 |
| 27 | 8·580 | +125·3 | + 56·1 | - 27·9 | + 84·0 | +209·3 |
| Bal'nce weight | — | — | - 7·5 | + 62·5 | - 70·0 | -70·0<br>+62·5 |

Centre Span.

| Number of bar. | $\frac{10{,}000\,l}{E f}$ | Stresses in tons from | | | | Maximum stresses. |
|---|---|---|---|---|---|---|
| | | Dead load. | Live load. | | | |
| | | | Case 1. | Case 2. | Case 3 | Tons. |
| 0 | 4·104 | — | - 74·3 | -113·4 | + 39·1 | -113·4 |
| 1 | 4·122 | + 31·2 | - 54·5 | - 91·2 | + 36·7 | + 67·9 |
| 2 | 4·146 | +112·3 | - 8·4 | - 40·9 | + 32·5 | +144·8 |
| 3 | 2·896 | +216·3 | + 48·8 | + 20·9 | + 27·9 | +265·1 |
| 4 | 1·640 | +323·2 | +104·7 | + 80·2 | + 24·5 | +427·9 |
| 5 | 1·285 | +421·3 | +158·7 | +138·1 | + 20·6 | +580·0 |
| 6 | 1·073 | +497·9 | +201·2 | +184·2 | + 17·0 | +699·1 |
| 7 | 0·888 | -515·2 | -216·9 | -204·1 | - 12·8 | -732·1 |
| 8 | 0·900 | -478·9 | -195·0 | -178·6 | - 16·4 | -673·9 |
| 9 | 1·210 | -400·5 | -151·8 | -132·7 | - 19·1 | -552·3 |
| 10 | 1·650 | -310·4 | -102·0 | - 78·9 | - 23·1 | -412·4 |
| 11 | 2·900 | -211·5 | - 47·6 | - 19·0 | - 28·6 | -259·1 |
| 12 | 6·110 | -112·3 | + 8·4 | + 40·9 | - 32·5 | -144·8 |
| 13 | 7·100 | - 31·2 | + 54·2 | + 90·9 | - 36·7 | - 67·9 |
| 14 | 4·620 | — | - 1·6 | - 2·1 | + 0·5 | - 2·1 |
| 15 | 7·650 | + 38·4 | + 20·3 | + 21·5 | - 1·2 | + 59·9 |
| 16 | 4·962 | - 20·3 | - 15·4 | - 18·6 | + 3·2 | - 38·9 |
| 17 | 5·892 | +102·4 | + 57·2 | + 62·4 | - 5·2 | +164·8 |
| 18 | 5·616 | - 53·1 | - 33·5 | - 38·4 | + 4·8 | - 91·5 |
| 19 | 4·560 | +142·9 | + 79·4 | + 86·1 | - 6·7 | +229·0 |
| 20 | 5·442 | - 70·4 | - 41·9 | - 46·2 | + 4·3 | -116·6 |
| 21 | 4·716 | +152·0 | + 84·6 | + 90·6 | - 6·0 | +242·6 |
| 22 | 5·700 | - 76·5 | - 47·9 | - 54·3 | + 6·4 | -130·8 |
| 23 | 5·370 | +148·8 | + 85·1 | + 92·6 | - 7·5 | +241·4 |
| 24 | 6·484 | - 78·4 | - 48·5 | - 54·4 | + 5·9 | -132·8 |
| 25 | 6·462 | +143·2 | + 80·8 | + 88·1 | - 7·3 | +231·3 |
| 26 | 7·688 | - 69·1 | - 44·0 | - 49·3 | + 5·3 | -118·4 |
| 27 | 8·580 | +125·3 | + 71·6 | + 78·5 | - 6·9 | +203·8 |
| 28 | 1·580 | -586·3 | -267·5 | -200·1 | - 67·4 | -853·8 |

When, however, the live load enters upon the bridge these two stresses are quantities not known, but calculable from the elastic change of form of the structure. In the present case of a road bridge where great irregularities in the live load do not occur, and where the greatest live load is only one-third of the total load, viz., 1½ ton per foot lineal, it was deemed sufficient to calculate only three cases of its distribution, viz., (1) upon the whole bridge, (2) upon the central span, and (3) upon the two adjoining spans. In each case the shearing stress in the centre is nil, and therefore only one unknown quantity, the stress in the central flange-piece, has to be reckoned with. But instead of this, the stress in any two symmetrically-placed pieces of the flanges, or the two equal balance weights, may be regarded as unknown quantities, and the latter have been chosen as the most convenient. If they did not exist, either in the positive or the negative sense, the stresses in the structure from the live load could be calculated in the elementary way for the three cases of distribution, and the ends would then be raised or lowered; but as they do exist, and as the ends are not free to rise or fall, the unknown balance weights enter into the calculation. The stress in any bar is therefore the sum of two stresses, viz., the one from the dead load and the other from the balance weights, both calculated in an elementary way. The second column in the table gives the extension of the bar from a stress of one ton per square inch $\frac{l}{Ef}$ (length divided by modulus of elasticity and sectional area). Multiplying this with the total stress, we obtain its positive or negative extension, and multiplying once more by the stress and dividing by 2, we obtain the work performed by the stress. Equilibrium prevails if the sum of the work in all bars is nil, and we have therefore an equation from which the balance weight can be calculated, and consequently the stress in each bar determined. The result for the three cases is stated in columns 4, 5, and 6 of the table. To each of these the third column would have to be added to give the total stress; but in the 7th column only those cases have been selected which give an absolute maximum. The process here described has already been referred to in these pages—vol. 64, page 200; vol. 67, page 399; vol. 75, page 429; and elsewhere—and further explanation can therefore here be dispensed with.

The live load has been assumed, as already stated, at 1½ tons per foot lineal, or 82 lb. per square foot. The dead load consists of 1·2 tons per foot lineal steel, and 2·0 tons roadway material. Assuming the footpaths to be made of a 4in. layer of a material weighing 140 lb. per cubic foot, a weight of 123 lb. per square foot of roadway material would remain, which is sufficient to make it optional whether the surface should be of granite or of wood blocks. The sectional dimensions of the steel parts of the structure are arranged so that the stress does not exceed on the square inch gross 5½ tons, or on the square inch net 6½ tons.

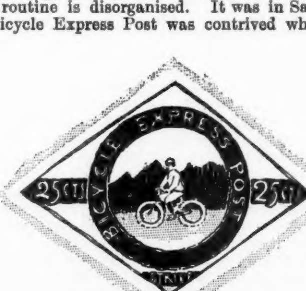
Fig. 2 is a half longitudinal section and a half elevation of the bridge. Figs. 3 and 4 are cross section and elevation at the main post, showing the rocker bearing. The greatest pressure upon this bearing is 465 tons; as there are seventeen rockers, 30in. long, the pressure per lineal inch is about 0·9 ton. The vertical pressure on the post from the flanges and diagonals is about 427 tons, transmitted partially direct in the planes of the diagonals and the vertical webs of the flanges, partially by way of the transverse flange plates and the cast steel saddle over which they are bent. In order to effect a simultaneous transmission of stresses both ways, the saddle is made adjustable by means of wedges as shown.

Fig. 5 is a cross section of the bridge at the second post, showing the construction of the platform. The plating under the roadway consists of flat plates and reversed troughs, the latter pressed in lengths of 9ft. 4¾in. Fig. 6 is an enlarged section of a trough. It is important that the troughs are made with horizontal flanges, as otherwise the horizontal shearing stress in the web, which produces the flange stress, would have to be taken by rivets in the web. In the present, as in most cases, the number of rivets required would be greater than is possible to place in a given length. The load concentrated upon one wheel is assumed at 5 tons, and the concrete is assumed to distribute that load across the flat plate upon two adjoining troughs. Such distribution by means of the concrete is always relied upon in the construction of roadway plating.

Fig. 7 shows the connection of the top flange of the cantilever with that of the cross girder by means of two angle bars and the roadway plates. The load on the central span does not entirely depend on the end spans for its balance weight, but there are anchorages in the first and fourth piers which are sufficient without the end spans. The total weight of metal in the bridge is 722 tons; of this 149 tons are in the roadway and footpath plating, and 68½ tons are cast iron. The bridge has been constructed at the works of the Cleveland Bridge and Engineering Company, under the inspection of the contractors' engineers, where it was temporarily erected as shown on illustration.

## A BICYCLE POSTAGE STAMP.

Here is a singular outcome of the recent railway strikes in America, interesting as showing the strange uses to which necessity can put mechanical inventions when the more ordinary routine is disorganised. It was in San Francisco that a Bicycle Express Post was contrived when railways were "hung up" and rolling stock belied its name, and rolled no longer. Stamps and envelopes were specially designed for this emergency, and were in use while the strike lasted. They are roughly lithographed, and are of only one denomination—25 cents. Already these stamps are being sought after, and command a premium extravagantly higher than their original value, and they will doubtless in time to come be almost the most precious of the stamp collectors' varied hordes.



**Naval Engineer Appointments.**—The following appointments have been made at the Admiralty:—Chief engineers: Frederick W. Wells, to the Fearless, undated; John L. Mitchell, to the Tartar, to date September 18th. Engineers: Edward A. E. Crowley, to the Humber, and W. G. Mogg, to the Curlew, to date September 25th; William H. Meadus, to the Firefly, and G. W. Murray, to the Bullfrog. Assistant Engineers: W. H. Crichton, to the Fearless, to date September 25th; James P. Leahy, to the Tartar, to date September 18th.

# ROAD BRIDGE FOR BRAZIL

MR. MAX AM ENDE, M. INST. C.E, ENGINEER: MESSRS. JOHN BIRCH AND CO., CONTRACTORS

(*For description see page 252*)

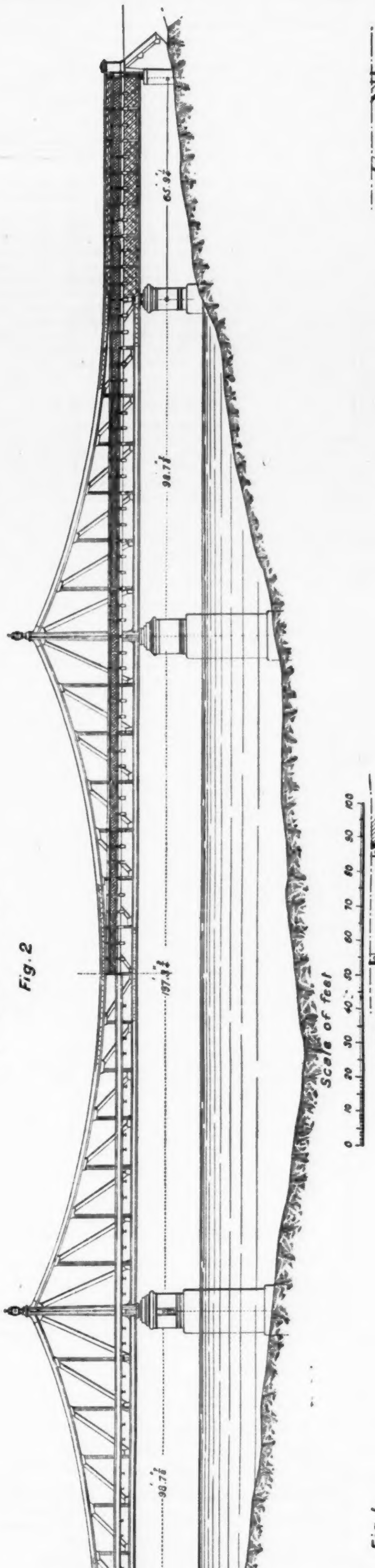


Fig. 2
65.9¾
98.7⅝
197.3¼
98.7⅝
65.9¾
Scale of feet
0 10 20 30 40 50 60 70 80 90 100

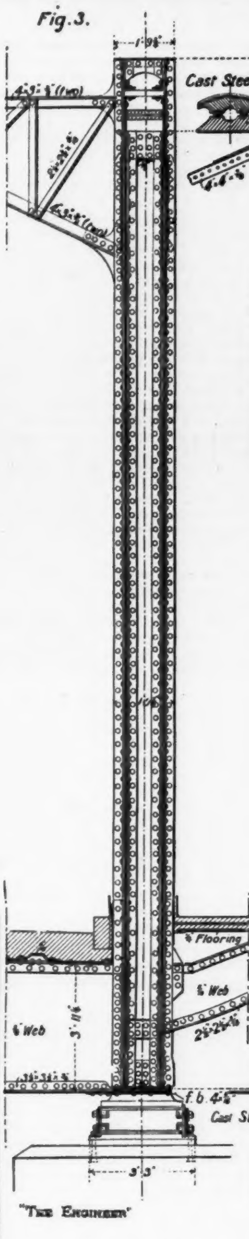


Fig. 3.
1.9¼
Cast Steel Saddle
Flooring
Web
Web
3.1½
f.b 4.⅝
Cast Steel
3.3
"The Engineer"

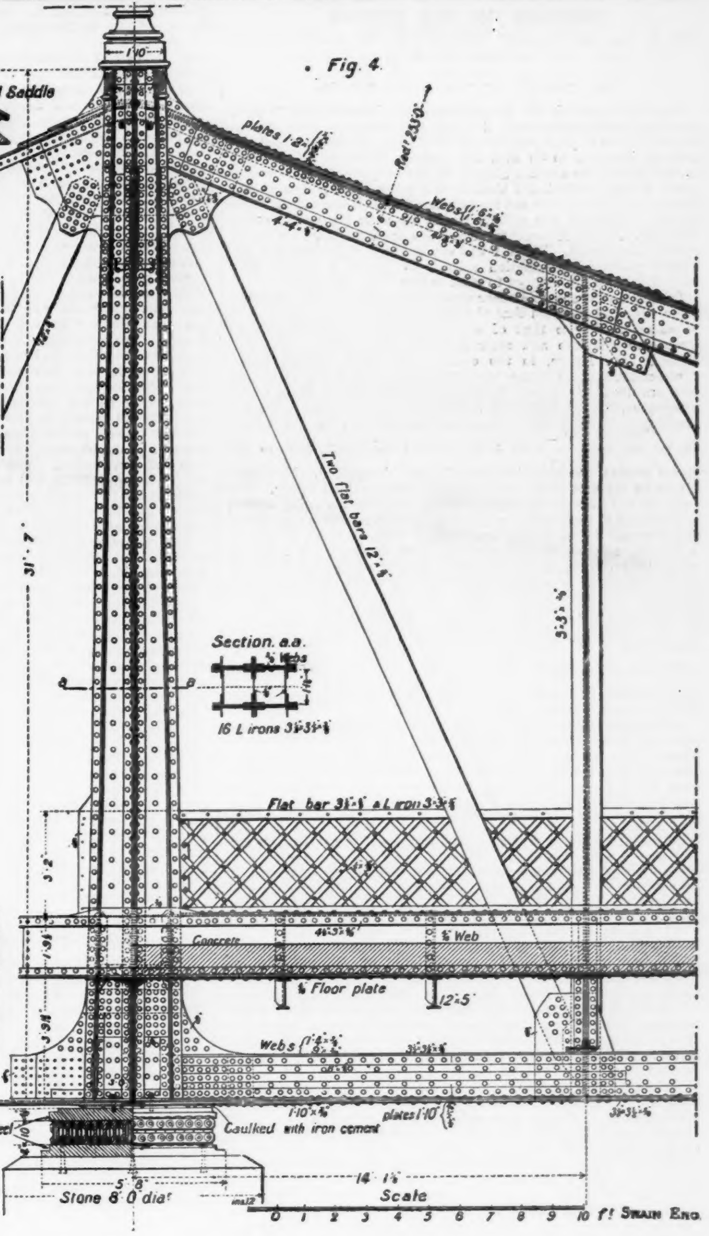


Fig. 4
1.10
plates 1.2
Rad 2350
Webs 1.6
Two flat bars 12.⅝
31.7
Section. a.a.
Webs
16 L irons 3½.3½.⅝
Flat bar 3½.½ & L iron 3.3.⅜
3.2
Concrete
Web
Floor plate
12.5
Webs
Caulked with iron cement
plates 1.10
Stone 8.0 dia
5.8
14.1½
Scale
0 1 2 3 4 5 6 7 8 9 10 ft
Swain Eng.

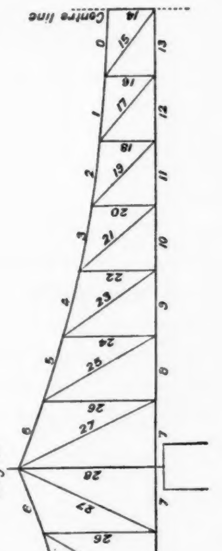


Fig. 1.
Centre line
"The Engineer"

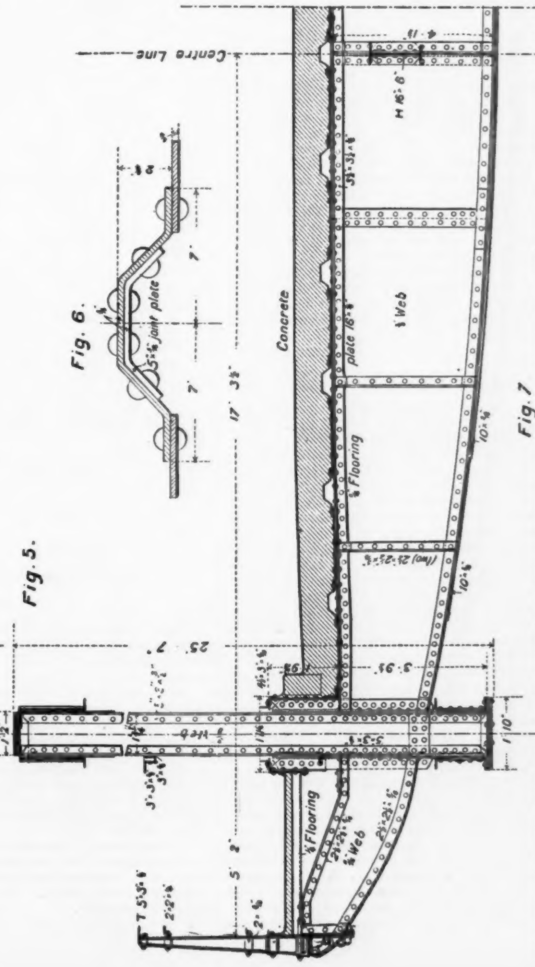


Fig. 5.
Fig. 6.
Centre line
joint plate
7
7
Concrete
Web
Flooring
25.7
17.3
5.2
Flooring
Web

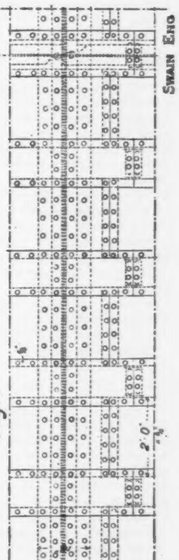


Fig. 7
Flooring
Swain Eng.
"The Engineer"

# LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

## THE THEORY OF THE STEAM ENGINE.

Sir,—The defect in Mr. Cherry's method of discussion is radical, and apparently permanent. I quite well remember what he has written before in your pages anent Dr. Lodge and others. That has nothing whatever to do with the question I raised. Mr. Cherry cannot manage to confine himself to the subject he ought to discuss. I very much doubt that he did more than glance at my letter; he certainly has not made himself acquainted with its contents. I said not one syllable about air near its critical point. With Dr. Lodge's statements, *ex cathedra* or otherwise, I am not at present concerned. What I did say is worth repeating, for Mr. Cherry possesses information enough to handle a subject very well, if only he can manage to stick to one thing at a time.

Permit me to repeat in other words what I have said. We very frequently find it stated that the efficiency of a steam engine is to be ascertained, like that of a hot air engine, by difference of temperature before and after a certain process has been performed. Dr. Lodge, in the case of the steam engine, takes, I understand, the furnace temperature for T and the condenser temperature for $t$; at least I put that construction on some of his utterances, but I admit that I may have failed to grasp his full meaning. Putting this on one side we find that in the hot-air engine we have $\frac{T - t}{T}$ as a measure of efficiency, and to the steam engine precisely the same formula is applied. Now what I said in my first letter was simply that this was all wrong. The basis of the formula is that if air expands without doing work it will not fall in temperature; if it does work it falls in temperature, therefore the fall is due to the doing of work, and the falls bears a definite relation to the amount of work done. Mr. Cherry drags into the discussion irrelevant matter concerning an infinitesimal augment of energy, and something about the condition of air near the critical point. The air in a hot-air engine is not near the critical point. Professor Dewar's results have nothing to say to the question I have raised. My proposition is that, when steam expands it falls in temperature whether it does work or not, and that consequently $\frac{T - t}{T}$ has no application to the steam engine either in theory or practice. To make my meaning clear I will take a numerical example.

A single-cylinder engine is working at an absolute initial pressure of 100 lb. on the square inch, and expands this steam five times. The pressure at the moment the exhaust port opens is a little less than 20 lb. I neglect all questions of cylinder condensation, &c. They have nothing to do with my contention. Now, the temperature of 100 lb. steam is 328 deg., and that of 20 lb. steam is 228 deg. If we write $T = 328 + 460$ and $t = 228 + 460$, we have $\frac{788 - 688}{788} = {\cdot}127$ nearly. But I say that these figures have nothing whatever to do with the work done by the steam. If the steam had expanded and done no work whatever, its initial and terminal temperatures would still have been 328 and 228 deg. Fah.

It is quite possible that Mr. Cherry will come in here and take me to task, if I omit to say that if the steam expands without doing work it will be slightly superheated. At all events, Rankine has said that probably it would be, because the heat required to make a pound of steam of 100 lb. pressure out of a pound of water at 32 deg. is 1181·4 units, and the heat required to make a pound of steam at 20 lb. out of a pound of water at 32 deg. is 1150·9, and the difference must be represented by something when the expansion has been effected. This is a mere trifle, however, and has nothing to do with my contention.

When steam is used to do work, the sensible heat is not converted into work at all; that continues to bear an unalterable relation to the pressure. What is commonly, and very erroneously called the latent heat, is in part converted into external work, with the result that a portion of the steam is liquefied. The actual work that one pound of 100 lb. steam can do in falling from 100 lb. to 20 lb. is given by D. K. Clark as 142,180 foot-pounds, and 184·2 units are expended in doing this work. Now, if the sensible heat of the steam was utilised, and if the specific heat of steam was the same as that of water, then it is clear that we must have a fall of temperature of 184·2 deg.; but, in fact, we have a fall of only 100 deg., although the specific heat of steam is only about half that of water.

The units converted come out of the latent heat of the steam. Steam of 20 lb. pressure has 953 deg. latent heat, and $\frac{953}{184} = 5{\cdot}18$ nearly, that is to say, about one-fifth of a pound of steam will be liquefied in doing the work, and the final pressure in the cylinder instead of being 20 lb. will be one-fifth less, or 16 lb. I am aware that these figures are not strictly accurate; to make them so I should have to resort to mathematics, which would in point of fact tend to obscure my argument. A discussion would probably arise as to what constant ought to be used with $p\,v$ and so on. Such things have nothing to do with my argument, which is that a comparison of efficiencies cannot properly be drawn between the steam engine and a hot-air or a gas engine, on the basis of the range of temperatures, sensible heat in the steam engine being only indirectly concerned in the performance of external work.

Range of temperature may be used to compare the efficiency of two *steam* engines in a rough and ready way, because the greater the range of expansion—other things being equal—the greater will be the efficiency; and the greater in expansion the greater the range of temperature. But this is quite another story.

September 15th. Maurice Cross.

## THE SOUTH WALES COLLIERS' SLIDING SCALE.

Sir,—The sliding scale dispute in South Wales concerns a very much larger public than the coalowners and colliers immediately interested. For fifteen years an almost automatic system of wages adjustment has been accepted and cordially supported alike by employers and employed in the coalfields of Glamorganshire and Monmouthshire. It may have operated disadvantageously on either side at times; but, notwithstanding the collision of feeling to-day, the coalowners and the colliers are in agreement that the sliding scale has preserved tranquillity in the whole of the South Wales and Monmouthshire districts; that, in conjunction with the Conciliation Board, it has kept the forces of capital and labour on harmonious lines; that it has given a measure of stability, unknown before 1879, to the quality of the output, to the profit of the turnover, and to the security of the interest of the money which all parts of the kingdom have been liberally and trustfully investing in South Wales colliery undertakings. Under the sliding scale shippers and merchants and the mining engineer have prosecuted these enterprises with a reasonable confidence in their forthcoming reward. The coal shipper made his contract without fear that a strike would impede its fulfilment; the coalowner could freely develope his "taking," on the assurance that wages disturbances were no longer likely to affect him; and the working collier was made a co-operative member—a profit sharer as also a loss sharer—in a great industrial organisation. This is in brief what the sliding scale agreement has done for South Wales and Monmouthshire, and now, by somebody's blunder, the very root of the scale, its concomitant Conciliation Board, and all the rest of the fabric built up so laboriously since 1879, appears to be in great danger of falling to pieces.

An old memory is not required for a reminiscence of the condition of things which existed in the Merthyr and Aberdare Valleys in the decade between 1865 and 1875. The time dates back a little before the Rhondda Valley began to send out its own store of the famous steam coal from its apparently exhaustless veins to all the ports of the world. Then and afterwards for another four years strikes were a constant incident of the coal-mining industry in the valleys.

There were strikes in this pit and in that pit; there were strikes in this valley and in that valley; there were strikes all over the place, more often than not of local scope and play, but once or twice during the years in question these great labour disturbances assumed a colossal and disastrous dimension. For one thing, the rate of wages differed in almost every pit in every valley. There was no union among the coalowners; still less was there a union among the colliers. There was a continual seismic disturbance among the men who troubled the earth underneath its crust, and the tremor reacted upon the coalowners, as well as on their agents in Cardiff, Newport, and Swansea. It was to find an equilibrium in these shifting sands that the South Wales and Monmouthshire Conciliation Board was established in 1879, and out of the loins of that institution came the historic, and for a long time exemplary, sliding scale agreement. The miners' wages, according to the original plan, were to rise or fall at the rate of 10 per cent. in the shilling on the upward or downward price of coal. There have been some modifications of the first arrangement, and wages now move up or down at the rate of 8¾ per cent. in the shilling per ton of coal. The colliers are now asking that the sliding scale should be re-established on the 10 per cent. basis, but that really is only a small point of detail in comparison with the graver circumstances which have brought about the present crisis. The colliers are this week voting on the question whether they shall give notice to terminate the sliding scale agreement in six months' time. The ballot is to end on the 24th inst., and already it is clear that a great majority are voting against the sliding scale in its existing form and constitution. The cause, or the ostensible cause, of the rupture is supposed to rest on the proceedings of the Conciliation Board at the last monthly meetings of the Joint Committee of the masters and the delegates of the men. It came to pass that the sliding scale auditors had to declare another small reduction of the colliers' wages, and that seems to have been accepted without comment and as a matter of course. But the colliers, through Mr. W. Abrahams, M.P.—"Mabon"—and his colleagues, wanted the coalowners to consent to a revision of the very much revised scale of 1879, chiefly in the sense of altering the incidence of the rise and fall of wages back again to 10 per cent. on the shilling, and to permit of the employment of an umpire in cases of dispute which the Board of Conciliation would not settle of its own accord. So far all would seem to have been fair sailing. The rock ahead appeared in the tribunal which has hitherto done so much excellent work as the Conciliation Board.

Sir W. T. Lewis and the coalowners' representatives declined to accept the evidence of the check weigher of an Abercarn colliery, as a witness to the custom and rates of payments in that particular pit. A small matter this, one would think, to throw 100,000 men into perturbation, and imperil the amicable arrangement which has stood the storm and stress of more than fifteen years of practical usage. It was, however, sufficient to cause a decided rupture between the colliers' delegates and the representative of the coalowners. Without delving for a more intelligible reason, one is constrained to admit that the two combatant parties seem to have found sufficient excuse for a quarrel which can only have the effect of injuring the interest both of them should seek to protect.

Cardiff, September 18th. N.

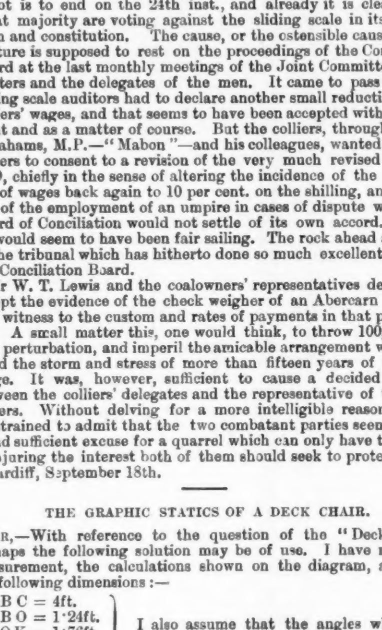
## THE GRAPHIC STATICS OF A DECK CHAIR.

Sir,—With reference to the question of the "Deck chair," perhaps the following solution may be of use. I have made, by measurement, the calculations shown on the diagram, assuming the following dimensions:—

B C = 4ft.
B O = 1·24ft.
O K = 1·76ft.
K A = 1ft.
D O = 1ft.
O E = 2·05ft.
E C = 1ft.

I also assume that the angles which the canvass makes with its supporting struts are as shown on the diagram. I have no measure of their dimension.

Produce sides of these angles till they meet at G. The vertical line passing through the centre of gravity of the body in the chair will pass through this point. Let it cut the base at S, in the proportion, in the present instance, of 65 to 95. The reactions R, R¹ will therefore be 95 and 65 respectively.



Resolve R perpendicular to and along B O, and the compression in B O is found = 54.

Taking moments of P and R¹ around O, we obtain the equivalent force Q acting at E = to 85.

Resolving Q along E O and E K, the tension in E O = 35, and the compression in E K = 99 are found.

Resolving G W along G A and G D, and re-resolving, will give the compression in A K = 218.

Find the component of E K acting along K A, and subtracting from 218, we obtain 188 as the compression in K O.

The compression in D O will be readily calculated as 165. And to sum—

lb.
Compression in B O = 54
" " O K = 188
" " A K = 218
" " D O = 165
" " K E = 99
Tension in O E = 35
Bending Moments at O { = 78 × 1·24
= 22 × 1
" " K = 25 × 1
" " E = 64 × 1

There is also a small direct compression in C E, which can be readily calculated. Friction has not been considered. One half the above quantities will be the strains in each of the frames of the chair.

C. L. S.

## WORK IN DYNAMOS.

Sir,—Will you permit me to direct attention to what seems to me to be a very curious aspect of dynamo work, and one to which no consideration has been given by those who write on the theory of the machine. Let me, however, in the first place, say that I am familiar with the construction and working of dynamos for lighting purposes, so that I am not ignorant of the subject on which I write.

The resistance to the rotation of an armature is due to what has for convenience been termed "torque." This torque is due, of course, to the action and reaction of the field magnet and the armature on each other. The action and its reaction are precisely equal and opposite.

Now it appears to me that to all intents and purposes we may consider that it makes not the least difference whether the armature revolves while the field is at rest, or the field revolves while the armature stands still, and we may have the field running in one direction and the armature in the other at the same time.

The point which I want to raise is this. In an ordinary series-wound machine, let us say, what represents the loss of energy expended by the field in resisting the rotation of the armature? Energy is expended by the engine. To all intents and purposes the whole of that may be regarded as reappearing in the current. The losses are due to heating, friction, air resistance, current resistance in the wire, &c. This current is passed round the field magnets; it does work on these magnets, and it also does work in resisting the revolution of the armature. Why does not this appear?

The only answer must be of course that the field does not do any work. But how is this to be reconciled with the fact that the field offers the resistance?

It may be said that because the field does not itself revolve no work is done; but if this is the true solution of the difficulty, we find that energy may be expended by a current without absorbing power. If, however, we change the arrangement and turn the dynamo into a motor, we find that although the field magnets are doing just the same duty as they did when the dynamo worked as a current producer, they now absorb a great deal of work, although they are not revolving. In either case the field simply produces torque. That is all the engine has to deal with; but the results as to power expenditure are entirely different. What is the explanation of all this, or does it admit of explanation?

Birmingham, September 18th. J. Wolcot.

## TECHNICAL EDUCATION.

Sir,—The latest "Science and Art Directory" seems very much the same old thing. A great deal is heard in these days about technical education. Why cannot the South Kensington Department be made a more efficient instrument in the spread of such instruction? A notion prevails that technical education is essentially a matter of setting up workshops in connection with our public elementary schools, wherein boys are trained in the manipulation of tools. Establishments of the kind are doubtless most needful in great industrial centres. But after all, is that the best way to further the end in view? The general technical instruction of the artisan population is quite unnecessary. The average working man was never less in need of technical education than to-day.

Division of labour is simplification of labour. Take the engineering line: therein the range of work of each man is now restricted to the very narrowest possible compass; instead of the all-round mechanic we have the erector, the fitter, the turner, and the machinist. At the same time the skill, responsibility, and brainwork are centred into one department—the drawing-office. And similarly, in other industrial pursuits, few are those requiring technical knowledge. For such, however, a thoroughly good system of evening classes, in which the sound, common-sense, scientific principles of the chief industrial arts are taught, not by amateurs, smatterers, and crammers, but by practical men, would be useful.

Now the Science and Art Department does not meet the want—it goes from bad to worse. Much misconception is abroad regarding the value of science. As an instance, a writer to your journal recently informed us that "machinery is no more scientific than blankets or tea." The extravagance of the statement renders refutation unnecessary. Manual workers and many others engaged in engineering may not find it necessary to trouble their heads about scientific principles—they are not required to do so, but the draughtsman certainly is. True, very much is gained from experience and trial, and such must ever be the case to a very considerable extent, inasmuch as the acquisition of scientific knowledge is necessarily most limited. But the results derived from practice are often not forthcoming from science, because engineers despise the latter, and will not go thoroughly into it. Too familar acquaintance with the workings of nature—and science is nothing more—one cannot have; it is the lack, and not the abundance, of which makes essential that expensive substitute called practice.

Colchester, September 18th. Stephen Eddy.

## VALUES OF γ AND J.

Sir,—I shall feel obliged if you will allow me to correct two errors in my letter of last week. The two equations near the bottom of the fourth page should be

$$J\frac{dQ}{dv} = \frac{dE}{dv} + \frac{dW}{dv} \quad \ldots\ldots \quad (2)$$

$$J\frac{dQ}{dt} = \frac{dE}{dt} + \frac{dW}{dt} \quad \ldots\ldots \quad (3)$$

September 17th. William Donaldson.

# NEW SOUTH WALES RAILWAYS.

The report of the New South Wales Railways this year shows some very remarkable results, as will be seen from the annexed table prepared by Mr. Price Howell, of Lindfield, near Sydney. The table shows that the result of the year's working gives £61,552 net earnings in excess of all the other Australasian railways combined—Victoria excepted—with £13,046,377 less capital.

*New South Wales Railways.*

| | Year ending. | Gross earnings | Net earnings. | |
|---|---|---|---|---|
| | | £ | £ | |
| New South Wales | June, 1894 | 2,813,541 | 1,221,699 | |
| Victoria .. .. .. | " " | 2,720,000 | 1,070,000 | From Budget statement. |
| *South Australia | " 1893 | 1,022,727 | 370,901 | Latest information obtainable. |
| *Queensland .. | " 1894 | 931,053 | 332,650 | From Budget statement. |
| *West Australia .. | Dec., 1892 | 94,201 | 3,547 | Latest information obtainable. |
| *New Zealand .. | Mar., 1894 | 1,172,793 | 437,434 | |
| *Tasmania .. .. | Dec., 1893 | 152,083 | 15,615 | |

| | Capital. | Gross earnings. | Net earnings. |
|---|---|---|---|
| | £ | £ | £ |
| New South Wales Government Railways .. .. .. .. | 38,855,271 .. | 2,8 3,541 .. | 1,221,699 |
| *All other Government railways in Australasia combined excepting Victoria .. .. .. | 48,901,648 .. | 3,372,857 .. | 1,160,147 |

The Americans do it Better.—A correspondent of a South African paper writes to it as follows:—"Many of the English engineering firms are complaining of large amount of support given to American firms. It is not that the American machinery is better than English. The fact is the American firms do things better than the English. When they send good machinery here they send good men to erect it, and see it put on good foundations, whereas English machinery is left to the mercy of anybody to erect. I can name a place where a large English plant has been fixed by one wagonmaker, one sailor, one handyman, and one boilermaker's labourer. They have put a large air compressor on a rough stone foundation, wedged up with small pieces of iron. Such work is a disgrace to British manufacture." This is a flattering testimonial as to the methods of American manufacturers, and conveys a useful hint to them in their foreign trade.

## RAILWAY MATTERS.

Railway season tickets made of aluminium are said to have been introduced into America. They are of circular form, about the size of a crown piece, and bear an artistic engraving; mention of the period of validity, and a fac-simile of the subscriber's signature.

A train on the Iron Mountain Railroad was blown from the track by a cyclone near Charleston, Missouri, on the 12th inst. Two persons were killed, and twenty others injured. The whole train was, according to a Reuter telegram, overturned by the wind and hurled 20ft. down an embankment.

The Paris, Lyons, and Mediterranean Railway Company is now building three types of locomotives—the first series comprising forty compound engines; the second, sixty electric locomotives, each capable of drawing 800 tons at a speed of 24 kiloms. = 15 miles per hour; and the third, electric locomotives the motor for which is mounted on the rolling stock.

On Sunday evening a Great Northern special train, running from Batley to Wakefield, run off the line at Batley Carr. The engine, in leaving the rails, tore up the permanent way for a short distance, dragging with it one of the carriages, containing a number of people, and was overturned. About fourteen persons were injured. There is a sharp curve close to the spot where the accident occurred.

The directors of the West Highland Railway Company have resolved, as a consequence of the intended promotion by the Highland Railway Company of a line from Fort William to Inverness, contrary to the understanding arrived at during the progress before Parliament of the Bill for the West Highland Railway to Fort William, when the district between Fort William and Inverness was recognised as the district of the West Highland Company, to deposit a Bill in the next session of Parliament for the extension of the West Highland Line to Inverness.

The construction of the Waterloo and City Railway is peculiar in the respect that the staging in the river is the basis of the whole of the operations, the advantage of this being that there will be no openings on land, and therefore no property to acquire in the streets for carrying on the works, and no interruption to traffic. The tunnels will be of cast iron, 22ft. in diameter, where the line is straight and on easy curves, and 9in. wider on sharp curves, so as to allow the running round of the bogey carriages to be employed without fouling the sides. The precise form of the carriages has not been decided upon yet. It is anticipated that the journey from end to end will occupy four minutes.

The Great Eastern Railway Co. have agreed to lay down 1000 iron bark sleepers, and that the London, Brighton, and South Coast Railway Company have ordered 2000 red gum sleepers. The first 500 iron bark sleepers are about to be sent home, and others will be forwarded very shortly. The Government of New South Wales is making special concessions with a view to the introduction of the Colony's timbers into England. It is stated that this will be found far cheaper, besides immeasurably more durable than the soft woods now being used. The durability of hard wood sleepers is said to be three times greater than that of the soft wood used in England.

According to the British Vice-consul at Bourgas, although the Yamboli Bourgas Railway has not yet entered on an era of prosperity, last year a deficit was avoided, and measures are in contemplation for further increasing the usefulness of this line, but the heavy differential tariffs still prevailing on the Oriental Railway Company's line render completion difficult, if not impossible, and grain continues to be sent from the Radné, Maballé, and Nova Lagora districts to Dédéaghatch instead of to Bourgas, which latter appears to be its natural destination. But this ceases to excite astonishment when one learns that by a system of private bargains between the Oriental Railway Company and its customers a discount amounting occasionally to as much as 47½ per cent. is allowed on the carriage of corn from Yamboli to Dédéaghatch.

The number of casualties on Indian railways during last year decreased by 1·26 per cent. as regards killed, and 2·78 per cent. as regards injured, as compared with the two previous years. The proportion of passengers killed in train accidents from causes beyond their own control was 1 in 2,652,215, while that of passengers injured from this cause was 1 in 1,610,261. The chief increases in accidents were reported on the Southern Mahratta, Great Indian Peninsular, the Nizam's Guaranteed, and the Burma State Railways. The highest percentage of casualties to the train-mileage run is recorded against the Nizam's Guaranteed Railway, while the lowest was shown on the Morvi Railway. Taking the aggregate length of the whole Indian railway system as 18,121 miles, the train-mileage run as 2,088,759 miles, and the total number of passengers travelling as 135,269,950, there were 114 killed, and 268 injured, or an average of 1 killed in 1,186,517, and of 1 injured in 504,738.

The first train on the Nilgiri Railway was successfully run from Mettapollium over the Bowani Bridge and as far as Kullar, the foot of the ghaut, on the 26th July in the presence of the chief engineer and other officials of the Nilgiri and Madras Railways. The Bowani Bridge is one of the largest on the line, and has given a great deal of trouble owing to the sudden and unexpected floods to which the river is subject at all seasons of the year. The *Indian Engineer* says that it rose on one occasion as much as 14ft. in the month of February, a month in which, judging from all previous years, it should have been quite safe to work in. Work was in full swing at the time, and the results were most disastrous. Three portable engines and pumps, the cofferdam and all the temporary works were completely swept away. Mr. Weightman determined, on the advice of the consulting engineer, to alter the mode of construction and to place the foundations on wells. The sinking of these through the boulder bed of the river by divers was a tedious process, as it was constantly interrupted by floods. The whole bridge was completed for less than the estimate in about eighteen months at a cost of just over a lakh of rupees, and it reflects the greatest credit on Mr. D. J. Lavelle, the executive engineer in charge, and all concerned in its construction.

A correspondent writing to the *Times* on the subject of light railways says:—"I have travelled to-day in an international—so-called 'lightning'—express on one of the most important highways of traffic in Germany. For a considerable part of the distance the line was entirely unfenced, and I venture to say without fear of contradiction that the permanent way at certain points was in a condition more dilapidated than any English engineer would dare to allow on the most out-of-the-way branch of his company's system. Of course, no accident happened, and a heavy train timed at some thirty-two miles an hour kept time all right. In this instance, it may be that our German friends have gone too far in the direction of economy; but have we not gone immeasurably too far in the opposite direction? What would any reasonable person think of the intelligence of the Little Pedlington Highway Board if it specified for the paving of the village street with jarrah-wood blocks laid on a 6in. bed of concrete, because this is found in Piccadilly the most suitable material? Yet this is really what we in England do in railway matters. We insist that a railway by-road in Caithness or Cardigan shall be paved, lighted, and scavenged precisely like the railway high-roads from London to Leeds or Liverpool. And then we wonder that railway rates are high. The Little Pedlington farmer, if he was fool enough to vote for the jarrah blocks, would at least have the sense to expect to have to pay for them when the rate-collector next came round."

## NOTES AND MEMORANDA.

The deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 15·9 per 1000 of their aggregate population, which is estimated at 10,458,442 persons in the middle of this year.

The rainfall over the Thames Valley during the month of August shows an excess of nearly a quarter of an inch over the 25 years' average; the recorded fall at Oxford being 2 48in., and the mean for 25 years 2 24in. for the same month. The excess of rainfall over the averages for the months of June, July, and August amounts to 1·71in.

When reading from that part of his British Association address which refers to the periodic law generally known as Mendeléeff's, Lord Salisbury read from a separate slip of paper a paragraph which properly gave the credit to Newlands, the first discoverer of the law. Mendeléeff's discovery was first announced, but it was first discovered by Newlands.

According to some experiments on the assimilability of potash by the action of nitrates in poor siliceous soils, by M. P. Pichard, it appears that, in presence of nitrates, a part of the potash combined with silica is capable of being assimilated by various plants, and hence that it is necessary to determine the total potash present in soils as well as that portion eliminated by acids or aqua regia when estimating the agricultural value of soils.

While endeavouring to determine the density of melted magnesia, M. Henri Moissan arrived at the conclusion that the density of this substance increases with the temperature up to bright red. It is thus that by heating in his electric furnace some magnesia, which is irreducible by heat, M. Moissan has been able to vary the density from 3·193 to 3·654. This is all the more noteworthy as this substance affords the only example of such a variation.

In London 2569 births and 1241 deaths were registered. Allowing for increase of population, the births were 111 and the deaths 168 below the average. The annual death rate per 1000 from all causes was 14·9. During the four weeks ended on Saturday last the death rate averaged 14 7 per 1000, being 2 9 per 1000 below the mean rate in the corresponding periods of the ten years 1884-93. In Greater London 3372 births and 1598 deaths were registered, corresponding to annual rates of 29·6 and 14·0 per 1000 of the estimated population.

At a recent meeting of the American Association for the Advancement of Science, Major J. W. Powell, of the U.S. Geological Survey, read a paper on the water resources of the United States. He said that the ultimate development of the United States rested largely upon the most thorough utilisation of the water resources. This was conspicuously true of the vast arid and sub-humid regions extending from the great plains to the Pacific coast. There the almost boundless extent of fertile land could not be utilised for agriculture without the artificial application of water. In all cases, whether in arid or humid regions, the proper solution of the problem rested upon the correct knowledge of the distribution and fluctuation of the available water. This study had been begun by the United States Geological Survey, and was now being carried on. We might commend this to the Geological Departments of the Australias.

Dr. Mansfield Merriman delivered an address before Section D of the American Association for the Advancement of Science on "The Resistance of Materials under Impact." He pointed out that the science of the resistance of materials, as taught in text-books, and used in the daily practice of every engineer, was mainly that of static conditions where external force is resisted by internal stress. The question of resistance to the impact of falling bodies, likely to occur in machinery, on bridges, and to a certain degree also in buildings, is recognised as important, but it is seldom reduced to computation or made the occasion of careful experiment. Even the fundamental principles and laws regarding it seem often not clearly understood. Dr. Merriman's address was an attempt to set forth the present state of knowledge concerning impact, and to reconcile some of the apparent paradoxes that often arise in the discussion and application of its principles. Some of Young's remarks on this subject might be referred to.

M. de Fonvielle calls attention to one of Roger Bacon's essays, published in 1618, in which some of the possibilities of steam are vaguely foreshadowed, and aërial navigation is declared to be a thing of the future. *Nature* quotes from a translation which De Fonvielle has furnished, and reads like Mother Shipton's prophecies. "Instruments may be made for navigating without any men pulling the oars, with a single man governing, and going quicker than if they were full of pulling men. Wagons also can be made so that without any horse they should be moved with such a velocity that it is impossible to measure it. . . It is possible also to devise instruments for flying, such that a man being in the centre if revolving something by which artificial wings are made to beat the air in the fashion of the birds. . . . It is also possible to devise instruments which will permit persons to walk on the bottom of the sea. . . . All these things have been done in old times and in our times, except the instrument for flying, which I have not seen, and I have not known any man who saw it done."

Two methods for the study of currents in open circuits and of displacement currents in dielectrics and electrolytes, were recently described by M. de Nicolaïeff before the Paris Academy of Sciences. Discs or rings of dielectrics are, in the first method, supported by bifilar suspension between the two poles of an electro-magnet, so that the plane of the ring is at 45 deg. to the axis of the electro-magnet, and centrally situated between the poles. The difference in the displacements caused in constant and alternating fields of the same strength is due to a secondary field set up by displacement currents caused in alternating fields. Paraffin shows an augmentation of 12 per cent. for a period of 930 per minute, and 9 per cent. for 770 per minute. In the second method, displacement currents in the rings are caused by the iron in the magnet cores. The ring is suspended perpendicular to the axis of the cores; the polar faces are able to be brought nearer to or removed farther from the parallel faces of the ring. By this method, augmentations have been obtained of 15 per cent. for yellow wax, and 8·3 per cent. for paraffin. Electrolytes in annular glass tubes behave just like perfect dielectrics, sulphuric acid giving an augmentation of deviation of 15 per cent.

An Atlantic race is continually being run by the great passenger ships. A Reuter telegram from Queenstown, dated September 14th, says:—"The Atlantic eastern record has again been broken. The Cunard line steamer Lucania arrived off here at 3.47 this morning, having completed the voyage from New York in 5 days 8 hours 38 minutes, her average speed being 21·84 knots. The daily runs were 447, 512, 494, 514, 506, and 337 knots to Daunt's Rock Lightship. The weather experienced was fine, and the winds were moderate, prevailing south-east to south-west. This trip of the Lucania occupied exactly the same time as her western record; but the performance is a better one, as she covered 23 more knots, 2787 knots being the distance run on the western route, as compared with 2810 on the eastern." A Reuter telegram, dated New York, September 14th, says:—"The American line steamer New York a few weeks ago established a new record from Southampton to New York, and landed her passengers in New York on the sixth day after they left London; but she has now beaten this performance by two hours. She left Southampton last Saturday, and passed Fire Island at 2 p.m. to-day, which will enable her passengers to land in New York before 6 p.m."

## MISCELLANEA.

The Construction Board of the American Navy has decided to recommend the building of a submarine boat on the Holland type.

There is to be a new harbour at Rotterdam on the other side of the Maas, near the village of Katendrecht. The cost is estimated at £22,500.

The entrance to the fourth floating dock in Honfleur Harbour has been widened to 41ft. 4in. This port now admits at spring tides vessels drawing from 21ft. to 22ft.

The highest known flood at Lucknow occurred on the 13th inst., when a large portion of the city and of the civil station was inundated. Many houses in the suburbs were completely submerged, and the safety of the bridge was in doubt.

A Commission has been sent by the City of Bremen to England to study the arrangements at the harbours of London, Liverpool, and Manchester, in order that anything that appears worthy may be adopted in the free harbour that is about to be constructed at Bremen.

The scheme for cutting a canal from Marseilles to the river Rhone is again being discussed in the South of France. Its length would be thirty-four miles, and the average depth is proposed to be 10ft. for a portion of the way, and 6ft. 6in. for the remainder of the distance.

The Admiralty have issued a revised table of the working hours for men belonging to the Fleet and Dockyard Reserves. These have hitherto worked shorter hours than the dockyard men. The Reserve men are now given an eight hours day, or about forty-seven hours more each year than heretofore.

The South African Exhibition, which is to open at the Crystal Palace next May, will be classified under two main divisions, viz., (1) exports from South Africa, and (2) exports from the United Kingdom to South Africa. The subdivisions under these main headings will, roughly speaking, comprise raw materials, manufactures, mining and machinery, natural history and science, and the fine arts.

A series of lectures for sanitary officers has been arranged by the Sanitary Institute. They commence on the 17th of October at the Parkes Museum Margaret-street, at 8 p.m., on Mondays, Wednesdays, and Fridays. A series of inspections of water, sewage, and other works has also been arranged in connection with the lectures. The programme and particulars may be obtained of the secretary, Parkes Museum, Margaret-street, W.

The *Statist* offers a prize of a thousand guineas for the best plan of a Customs union between Great Britain and her Colonies. The competition is open to all, and the conditions will be published early in February. In the meantime, suggestions are invited from all interested as to what those conditions ought to be. The *Statist* adds that it will publish from time to time information bearing upon the question, and that especially it will pay attention to the restrictions imposed by existing commercial treaties both upon the United Kingdom and the Colonies.

A Local Government Board inquiry has been held at Gainsborough by Mr. F. H. Tulloch, M.I.C.E., on Tuesday last, in connection with the application of the Local Board for the transfer of their waterwork's loan from the original well scheme to a borehole scheme—see The Engineer, vol. lxviii., p. 4. Evidence was given by various members of the Board and by Mr. Percy Griffith, A.M.I.C.E.—representing Mr. Jabez Church, M.I.C.E., the engineer—explaining the reasons which led to the change of schemes and describing the one now proposed. No opposition was offered, and after a few questions raised by the inspector had been disposed of, the inquiry closed.

At the invitation of the Hammersmith Vestry, over a hundred delegates of the Wandsworth, Fulham, Putney, Barnes, Mortlake, Chiswick, and Brentford vestries, local boards, and other riparian authorities, together with representatives of the London, Middlesex, and Surrey County Councils, inspected the river Thames on Tuesday to ascertain its condition between Chelsea and Richmond after the recent construction of the new lock and weir at Richmond. The time chosen was when the tide was lowest. The effect of the construction of the Tower Bridge, with its enormous pier obstructions to the waterway, does not seem to have been considered. There is serious interference with the river traffic, the loss of waterway varying from 8in. to 12in. at Hammersmith to 15in. at Kew and Brentford. When the party approached Richmond a meeting was held at which was urged the desirability of convening a conference of all those bodies interested in the matter to consider the means of remedying the present condition of the river, which it is thought may best be done by erecting a new lock and weir at or near Battersea.

The designs for the three new torpedo boats authorised by the present Congress have been completed by the Chiefs of the Bureaus of Ordnance, Construction, and Steam Engineering of the United States Navy. According to *Engineering News*, these boats will be slightly larger than the Ericsson, now on its way to New York from the builders' yard at Dubuque, Iowa. The chief of the novel features to be introduced in the new boats is the placing of the propellers abaft the rudder. As compared with the Ericsson, the dimensions of the new boats will be:—

| | New. | Ericsson. |
|---|---|---|
| Length, load water-line | 160ft. | 150ft. |
| Beam, „ „ | 16ft. | 15·5ft. |
| Draught, „ „ | 5ft. | 4·75ft. |
| Displacement | 135 tons | 120 tons |
| Indicated horse-power | 2000 | 1800 |
| Speed in knots | 24·5 | 24 |
| Coal capacity, tons | 50 | 40 |

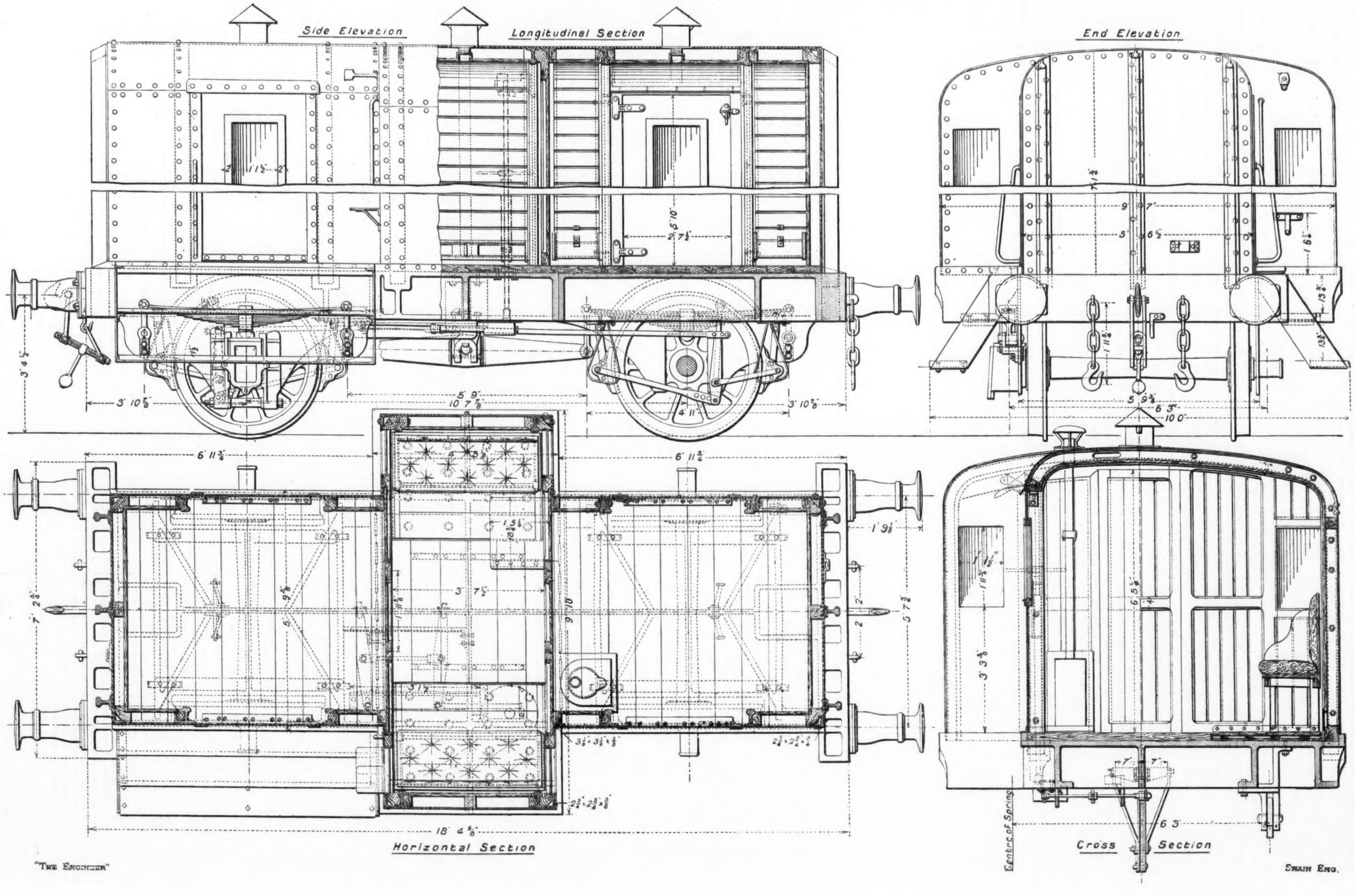
Three separate movable torpedo tubes above deck will be used, instead of three fixed 18in. Whitehead torpedo tubes below deck, as on the Ericsson. The quarters of the officers will be placed forward, and those of the men aft; and these quarters will be unusually roomy, owing to the removal of the tubes to the upper deck.

The Union Company's new twin-screw steamer Guelph, built for their service between Southampton and South Africa by Messrs. Harland and Wolff, of Belfast, went for a trip round the Isle of Wight on the 17th inst. No trial of speed at the measured mile was made, but the ship's performances throughout gave great satisfaction to all present. The Guelph is a sister vessel to the Gaul, the Goth, and the Greek, each of which have made several successful voyages to and from the Cape, but the newest steamer has had many improvements introduced in her internal arrangements and fittings. She is 400ft. in length, 47ft. in breadth, and 31ft. in depth, and 4916 gross tonnage. Her twin screws are driven by two sets of triple-expansion engines, developing an indicated horse-power of about 2200; the diameter of the respective sets of cylinders being 18½in., 30in., and 50in., and the length of stroke 42in. The vessel is fitted with a complete electric installation and cold chambers for the conveyance of fruit. Whilst providing a large cargo-carrying capacity on a light draught, the Guelph has complete accommodation for first, second, and third-class passengers, the majority of whom will be accommodated on the upper deck. The vessel, commanded by Captain J. Morton, leaves Southampton on Saturday next for Hamburg to take in cargo, and on her return to Southampton will start on her first ocean voyage on October 6th in the intermediate service. The company's new twin-screw steamer Norman, of 7500 tons, is nearly ready for sea, having been launched a couple of months ago at Messrs. Harland and Wolff's works at Belfast. She is appointed to leave Southampton on November 10th

# BRAKE VAN FOR GOODS TRAINS, BELGIAN STATE RAILWAYS

M. LEON BIKA, M. INST. M.E., ENGINEER

(*For description see page* 249)


Side Elevation
Longitudinal Section
End Elevation
Horizontal Section
Cross Section
Centre of Spring
2' 11½" 2'
5' 10"
2' 7½"
3' 4½"
3' 10⅝"
5' 9"
10' 7⅞"
4' 11"
3' 10⅝"
6' 11¾"
6' 11¾"
7' 2⅜"
5' 9⅝"
3' 7½"
1' 5⅝"
9' 10"
1' 9⅛"
5' 7⅜"
18' 4⅝"
7' 1¾"
9' 7"
5' 6½"
1' 9"
1' 3¾"
1' 11¾"
5' 9¾"
6' 3"
10' 0"
6' 5¾"
3' 3⅞"
1' 11¾"
6' 3"
7" 7"

"THE ENGINEER"

SWAIN ENG.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, September 21st, 1894. Page

Antwerp International Exhibition .. 247
Harbours and Waterways .. 248
The Prospect Duplex Pump. (Illustrated) .. 249
Belgian State Railways — Brake Van for Goods Trains. (Illustrated.) .. 249
Glasgow Weirs. (Illustrated) .. 250
High-speed Engine. (Illustrated) .. 251
Road Bridge for Brazil. (Illustrated.) .. 252
A Bicycle Postage Stamp. (Illustrated) .. 252
Letters to the Editor—The Theory of the Steam Engine—The South Wales Colliers' Sliding Scale—The Graphic Statics of a Deck Chair—Work in Dynamos—Technical Education—Value of γ and J .. 254
New South Wales Railway .. 254
Railway Matters .. 255
Notes and Memoranda .. 255
Miscellanea .. 255
Leading Articles—The Scotch Coal Strike—The Vibration of Steamships .. 257
Panama Canal—Oil-fired Steamers for Harbour Use—American Tin-plate Manufacture .. 258
Literature .. 258
Books Received .. 259
Fatal Explosion at Tucuman, Argentine Republic. (Illus) .. 260
Primary Batteries for Launch Work. (Illustrated.) .. 261
Abstracts of Consular and Diplomatic Reports .. 262
Probable Iron Imports under the New Tariff .. 262
A Bridge 3100ft. Span .. 262
Rustless Coatings for Iron and Steel. (Illustrated) .. 263
American Engineering News .. 264
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. 264
Notes from Lancashire—The Sheffield District—The North of England .. 265
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. 266
Launches and Trial Trips .. 267
The Patent Journal .. 267
Selected American Patents .. 268
Paragraphs.—Skelton and Brotton Sewage Disposal, 251—Naval Engineer Appointments, 252—International Tunnels, 259—Railways Abroad, 259—Railways in Japan, 267.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. N. B. (Newton Centre, Mass) —*You will see that your question has already been asked in a slightly different form by another correspondent.*

J. C. (Sheffield).—*You can obtain full information at any of her Majesty's dockyards, or by writing to the Admiralty, Whitehall, Engineers' Department.*

J. B. S. (Glasgow) —*The proper way to settle the question is to take indicator diagrams. You will then find whether the exhaust is throttled or not. We cannot pronounce any satisfactory opinion on this point. The exhaust pipe ought to be larger, but probably it is as large as the exhaust port. The heating pipes at A in your sketch make no difference unless water is allowed to accumulate. The steam pipe ought to be 2½in. in diameter all the way between the engine and the boiler. Very little would be gained by the alteration you propose. It would do some good, but not much.*

### SUGAR CANE CUTTERS AND SHREDDERS.

(*To the Editor of The Engineer.*)

Sir,—We should feel much obliged if you would allow us to ask for the address of manufacturers of modern sugar cane cutters and shredders.

Birmingham, September 17th. F. S.

### PARABOLAS OF LEAST RESISTANCE.

(*To the Editor of The Engineer.*)

Sir,—I shall be very much obliged to any reader who will give me the formula for calculating the parabola of least resistance for a given mass of lead ballast. Thus, suppose that I wish to use ten tons of lead ballast on a deep keel, the length of the spindle is not to exceed, say, 10ft. What must the diameter be at, say, every 6in. of length? Five Rater.

Southsea, September 14th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. £0 18s. 0d.
*Yearly* .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. £1 0s. 3d.
*Yearly* .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## DEATHS.

On the 16th inst., at Santa Catharina, Brazil, suddenly, the result of a gun accident, Ernest Cunard Cummins, aged 27, electrician of the Western and Brazilian Telegraph Company's repairing steamer Norseman, eldest and beloved son of Mrs. William Alves Cummins, of 3, Upper Leeson-street, Dublin.

# THE ENGINEER.

*SEPTEMBER* 21, 1894.

### THE SCOTCH COAL STRIKE.

Thirteen weeks ago the Scotch coal miners, partially instigated thereto by the English Federation leaders, struck against a reduction of wages on which the Scotch coalowners insisted. The progress of the strike and its termination confirms the accuracy of the statement which we have often made, namely, that a strike which lasts more than a fortnight usually ends in the defeat of the strikers. Although the East Coast miners prolong the struggle, the West Coast men have nearly all returned to work. The Scotch leaders have been thoroughly discredited, and the miners have found out that they were really the cat's-paws of the Federation. To paraphrase a well-known saying, Scotland's trouble has been England's opportunity. The Scotch miners—who, by the way, are largely Irish and English men—have lost about £700,000 in wages. The iron trade has been for the time ruined. Multitudes of men have been discharged from the shipyards; the coal staiths have been rendered idle; the traffic on the railways seriously diminished; and all this to no purpose, save the profit and advantage of England. The lesson conveyed is very interesting and important; whether it will be of any service remains to be seen.

One of the first points worth notice is the deceptive character of the "Brotherhood of Labour," concerning which we hear so much in the present day from the platform and in certain newspapers and magazines. There is no special virtue in manual work which removes selfishness from the heart of the worker. Coal miners, bootmakers, dock labourers, moulders, are all mentally constituted like other men, and the mainspring of their actions is found in love of themselves. They are neither better nor worse in this respect than their fellow-men. But the schemes of the socialist and the union leader are based on the assumption that a lovely and delightful altruistic spirit is available, and that the working man considers nothing so much as the good of his neighbour. Sentimental clap-trap of this kind seems to take the fancy of the public. It pays the wagonette orator; but it will not bear the test of practical work. The men who most earnestly denounce sweating, for example, are those who render it possible. The Bloated Capitalist and Inexpressible Aristocrat do not buy slop clothes or cheap boots. These things are provided to meet the working man's demand for cheapness. While the collier is striking to make coal dear, and his leaders denounce the colliery owners for selling it below a given price, the Nottingham bootmaker, the Lancashire cotton-spinner, leave no stone unturned to get coal cheap. The collier grumbles because he has to pay so much for his shirts and his boots; the weaver and the bootmaker do what in them lies to make these things dear. If we listened to the union leaders, it would seem that there is no consumer save the rich man. The truth that the great mass of commodities of all kinds produced in this country is used up by the comparatively poor is entirely forgotten. The philosopher sees everywhere self, and self alone, as the mainspring of action; and self will, to the end of time, wreck the socialist and ruin the commune. There can be no such thing as prolonged united action of vast bodies of men until human nature has changed; and of such a change there is no evidence to be found. The Scotch strike supplies an admirable example of this truth. The Scotch miners were told that if they struck the English miners would back them up with considerable subsidies. They did send money for a couple of weeks, but nothing like the amounts expected, and latterly the contributions have almost ceased, and the English Federation leaders have coolly told the Scotchmen that they must make the best terms they can with the mine owners. The average fortnightly pay of each man on strike has been 2s. 5d. It is not remarkable that the Federation is execrated, and that the Scotch Union leaders are not safe from personal violence.

We have here an admirable example of the utter impossibility of getting large numbers of men whose interests conflict to pull together. All may go well for a time, but in the hour of difficulty they are certain to break apart. There is only one possible way out of this difficulty, and that, by the very nature of the circumstances, is prohibited. If three or four hundred thousand miners could be grouped into an army under the despotic control of a leader of genius and will power, great things might no doubt be accomplished. But such a leader could not hold his army together unless he had the power of life and death in his own hands; unless, in fact, his Provost Marshals could shoot or hang mutineers. It is difficult to believe that even under these conditions an army could be kept together when starvation began. But short of this autocratic power no one body of men will ever be got to work together for any period. In a little country like Great Britain it is impossible. How can it be possible all over the world? When the Durham miners struck, the Wales and Midland colliers redoubled their efforts; indeed, numbers of the Durham men went at the outset to Scotland, Wales, Staffordshire, anywhere that they could find employment, knowing very well and caring very little for the fact that they were playing into the hands of the consumer by enabling people to obtain elsewhere the fuel they could not obtain in Durham. It is always the same way. If a levy is raised to support a strike, the men paying the levy only work harder to get the money to pay it.

A Glasgow radical newspaper, the *Weekly Mail*, has been for weeks denouncing the coalowners, and urging the strikers to maintain a firm attitude. For weeks it has been unable or unwilling to realise the truth. At last the reality has dawned upon our contemporary, and a remarkable change has come over its methods. The following passage is so suggestive that we reproduce it:—"The fight has been a long and a hard one, and, looking back now, it seems to us that the Scotch miners would have made a better fight if they had been fighting for their own hand, and not tied neck-and-heels to the English Federation. They were led to expect that the Federation would support them with an allowance of a shilling per day; but, instead of that, many of the men have not got a shilling per week—certainly none of them more than sixteen-pence, and that not for the whole time. *The truth is that the interests of the English and the Scotch miners, like those of the English and the Scotch coalowners, are wide as the poles asunder.* The conditions of trade, of contracts, of everything, point to the impossibility of any effective alliance either in the interests of the masters or of the men. Therefore it is that as nothing more can be hoped for from the English Federation to enable the Scotch miners to continue the struggle, it would be monstrous folly if, by any delay on the part of the men in now returning to work, the settlement offered by means of the concession of the Board of Conciliation were endangered." How, we ask, does it come to pass that an influential Scotch journal should have taken thirteen weeks to find out the truth embedded in the words which we have italicised? Are we to attribute this ignorance of a truth obvious to every reasonable man who knows anything of the coal and iron trades, to accident or design? Union leaders will do well to take the words to heart, and bear in mind in future that the competitor whom any one working man has to fear is another working man. His foes are not the capitalists but those of his own household or his own trade.

But the Scotch strike has another lesson to teach; it shows that the conditions of supply and demand are too strong for combinations of producers. That which cannot be obtained at one shop can be bought at another, and the consumer is an exceedingly independent man in his ways. If the Scotch ironmaster wants to sell iron or steel, it must not cost more than iron or steel made in England or Belgium. The Scotch coalowners satisfied themselves that they could not sell coal at a price which would enable them to pay the existing rate of wages. They have proved this at an enormous cost to themselves. If the ironmasters had been prepared to pay more for coal, they would have intimated as much to the coalowners when they did not possess pits of their own. They did nothing of the kind. They shut up their works instead, and put out or damped down their furnaces. They have proved their sincerity in a way that we should think will satisfy even a Scotch miner. The lesson taught may perhaps bear fruit; at all events it seems to be extremely unlikely that Scotchmen will strike to please English Union leaders in the immediate future. The only satisfactory feature in the whole transaction is, that probably a Conciliation Board will be established; but that could have been done long since. To those who do not know human nature, it seems unreasonable that £700,000 should have to be wasted before men could see this. To those who do there is nothing remarkable in the matter.

### THE VIBRATION OF STEAMSHIPS.

Much has been written and said concerning the vibration of steamships, its causes and its remedies, but even now much remains to be said, and there are few subjects connected with naval architecture and engineering so little understood. We say this, of course, while giving Mr. Yarrow full credit for the work he has done in investigating the subject. But Mr. Yarrow directed his attention mainly to one type of vessel. The nature of the subject is such, however, that while it admits of specialisation, it demands generalisation. The principles involved are but imperfectly understood, and, indeed, in many respects overlooked. We propose here to bring before our readers aspects of the whole question which seem to be very frequently neglected.

In the first place, the word "vibration" is not properly defined. A particular passenger vessel is said to vibrate so badly that she is wretchedly uncomfortable. If we ask how she vibrates, we are told, "Why, in the usual way, of course!" Now, as a matter of fact, not only are there more kinds of vibration than one, but two or more of them may be found in different parts of the same ship at the same time; and until we know something definitely what the character of the vibration is, it is waste of time to attempt to prevent it. Speaking at large, vibration in a ship is of two kinds, lateral and vertical—that is to say, the stern, let us suppose, in the first case swings from side to side, in the second it jumps up and down. The latter is of the two usually the more unpleasant. We constantly find the two motions combined. Generally speaking, vertical vibration is due mainly to want of balance in the engine. But this is not invariably the case, nor does it cover the whole ground. Side vibration is in like manner generally due to the propeller; but, again, this statement does not cover the whole ground. Mr. Yarrow reduced to practical demonstration the fact known before in a more or less indefinite way, that vibration depended largely on the isochronism of certain motions of the engine with the vibrating period of the ship. It is enough to mention the fact here, because it has not any very close connection with what we are about to advance. No doubt the vibration of a ship may be reduced or augmented in many instances by altering the speed of the engines so as to put them out of step with the ship. But this has, as we have said, little or nothing to do with the matter in hand, which is a consideration of the forces which set up the vibrations, the magnitude of which may or may not depend on the "vibrating period" of the ship.

To begin, let us consider what would take place if it were possible to hold the propeller fast and permit the engines to work. In that case the ship would revolve on a longitudinal axis, with the propeller shaft for a centre; and although nothing of the kind takes place in practice, none the less is the effort there. In the well-known cigar-ship—which being a spindle and without a keel, depended on her ballast alone to prevent her rotation—there was provided a special ballast engine. A mass of lead weighing about 15 tons was hung pendulum-wise in the engine-room, and when the engines went ahead the pendulum was thrust over to starboard, and when they went astern it was thrust over to port by a piston in a horizontal steam cylinder, and so it balanced the effort of the engines to turn the ship round on her axis. The turning effort is due to the thrust of the connecting-rods against the guide bars, and it varies continuously in amount during each stroke, as the angle made by the connecting-rod with the guide-bars augments or diminishes. The thrust depends for its existence on the resistance to rotation offered by the propeller. It is clearly a transverse effort acting at right angles to the keel, and it can only be set up by a corresponding effort exerted in the opposite direction, or by two or more efforts not in the same direction, of which the effort in the guide-bars is the resultant. It by no means follows that the two opposing efforts must be in the same plane, and as a matter of fact, one is at the screw propeller and the other in the engine-room, fifty, a hundred, or more feet apart. If, now, the effort were constant, it would not cause vibration. But it is not constant; on the contrary, it is extremely variable, and beyond question it may play an important part in causing that lateral vibration of which we have spoken. Again, we have to take into account the action of the propeller. Although there is no proof whatever that a propeller sends aft or leaves behind it a twisted rope of water as Professor Fitzgerald believes, it is certain that the propeller in its revolution will throw water violently against the stern post and the rudder, and the succession of blows thus given, blade by blade, is very well calculated to set up lateral vibration in the stern of the ship, especially if she is weak. Some years ago a case of this kind came under our own observation. A passenger screw steamer of about 1100 tons displacement was exceedingly uncomfortable because of her excessive vibration. After two or three years' work signs of weakness were noticed about the stern frame and after body of the ship. She was docked, and a considerable quantity of iron was worked into her from the engine-room aft, by which she was stiffened materially. No change whatever was made in the propeller or engines. After the repair she was found to be a very comfortable ship, the vibration almost disappearing. The influence of the propeller is, however, so well understood that it is not necessary to insist upon it. But it is necessary to insist on the influence of the reactions which go on continuously in the engine-room, and which have nothing whatever to do with balancing the reciprocating parts. They are, as we have said, of the nature of a horizontal thrust, constantly rising and falling in amount, and this thrust is very well calculated to cause, as we have said, lateral vibration when combined with the effort of the propeller. In stiff ships it is not so prominent in its effect as in weak ships. In certain high-speed vessels with thin shells and weak frames, in which much, if not everything, has been sacrificed to save weight, the lateral vibration is often excessive, rendering the ship very uncomfortable. It is said that twin-screw ships are better off in this respect than those with single screws, because the effects of the engines revolving in opposite directions neutralise each other, and no doubt there is force in this contention. The engines in such ships never make precisely the same number of revolutions per minute except by chance. Lateral vibration does occur now and then, but on the whole the twin-screw gives immunity, provided, which is not always the case, that the propellers are accurately balanced. This balancing of propellers does not have nearly the attention which it deserves. It is forgotten that the tips of the blades often make sixty miles an hour or even more, and while a hundred pounds of metal more or less in the blade of a screw may seem a trifle, that weight moving at the rate of forty or fifty miles an hour can cause a great deal of trouble.

Almost all that can be said on the subject of balancing engines has been so well said by Mr. Yarrow in his paper read two years ago before the Institution of Naval Architects, that we think it unnecessary to go over the ground again. But we must insist on the fact that, while engines out of balance are pretty certain to cause trouble, it by no means follows that putting them in perfect balance will put an end to vibration. Some years ago a quick-running vertical engine caused a good deal of annoyance by vibration communicated to the building in the basement of which it stood. It was a single-cylinder inverted engine, with a crank disc cored out to partially balance the weight of the piston, cross-head, crank, &c. In the hope of getting rid of the vibration, a balance weight was put into the rim of the fly-wheel. The work was done with the utmost care. The packing was taken out of the stuffing-box, and the piston rings were removed so as to leave the piston quite free in the cylinder. Weights were placed on it equal to that of the rings. The balance was as perfect as it could be got. The engine was put together and started, but the results were most unsatisfactory. The safety of the holding-down bolts was threatened. The engine "wanted to walk about the shop," and the balance weight had to be very quickly taken out of the wheel. The thing was a failure simply because the fly-wheel was some 3ft. away from the crank, and the balancing was not effected in the same plane as the crank. In the same way it is quite easy to put balance weights on a marine engine which will do more harm than good. But this is not all. There is another agency at work which tends powerfully to set up vertical vibration. We refer to the steam efforts on the cylinder covers. On each of these there are stresses of 5 to 30 tons, according to the size of the engines, set up and tending alternately to lift the ship up and force her down. Many persons assume that these efforts are wholly balanced and opposed in the engine-room, but this is not so. The upward thrust on a top cylinder cover tending to lift the whole engine is not balanced by the downward thrust on the crank-pin save at the dead point. We have instead a couple composed of the crank-pin effort and the propeller's resistance to being turned round. The effort on the cylinder covers is simple and straightforward. The way in which it is taken up is complex, and there is no room to doubt that a very potent cause of vibration is thus introduced which is not sufficiently considered. We have then in every steam vessel, large or small, numerous efforts and stresses, which have nothing in common with those caused by want of balance in the matter of weight. We may construct a model, and cause the rotation of the crank-shaft by hand, and so demonstrate at will that by balancing we get rid of vibration, and by not balancing we retain that most objectionable feature. All this is quite true, but it is not the whole truth. When the crank is turned by hand we have only one set of forces to deal with—those due to the momentum and inertia of the reciprocating and rotating parts. But the case is quite different when steam is put into the cylinders. It is not different as regards the engines, but it is different as regards the ship. An excellent illustration of what we mean is furnished by outside-cylinder locomotives. No matter how carefully they are balanced they always have a tendency to run more unsteadily than inside-cylinder engines, and in the smaller and lighter engines "boxing" is always very apparent at certain speeds. The engines are thrown from side to side at the leading end by the alternating effort of the steam first on one cylinder cover and then on the other.

In conclusion, we may say that there is too much tendency manifested in the present day to believe that balancing engines will suffice in all and every case to make passenger steamers comfortable. This is not quite true. Balancing is good as far as it goes, and in some cases it goes very far, but it is not everything. In point of fact, there are dozens of efforts and stresses in an engine-room and a shaft tunnel which all tend more or less, because of their rythmical action, to produce vibration. Whether they will or will not do this depends on a great many circumstances which require the most careful consideration. Thus, for example, the position of the engine-room in the ship may have a marked effect. Thus, as a rule, to which there are no doubt many exceptions, the nearer the engines are to the mid-length of the ship the less is the vibration likely to be. It is, of course, impossible to go here very fully into a subject so abstruse. Our purpose will have been served if we have succeeded in directing attention to the truth that want of balance in engines is not necessarily the only reason why vibration takes place, and it is worth noticing that the actual rate at which vibration goes on is not always the same or nearly the same as that at which the pistons reciprocate.

We direct attention to the fact now, because certain high-speed steamers which have been constructed within the last few years are great offenders in the matter of vibration—it is perhaps as well to add that we are not alluding to Atlantic steamers—while others give no trouble whatever. Naval architects and marine engineers could do excellent service if they would investigate this question, and find out what is the reason for the difference. There is curiously little practical information on the subject available, probably because there has been so much theory written about it. Mr. Yarrow has done a great deal. It is now time that someone else pushed the inquiry further in a different direction and on different lines.

◆

### THE PANAMA CANAL.

THE issue of shares in the new Panama Canal Company has come as a surprise to the French public, who had never thought for a moment that the enterprise would again be put in hand. It was known that the liquidator had been making serious efforts to reconstruct a company, but the different financial bodies whom he approached did not seem inclined to lend their support to a scheme of such doubtful possibilities. At the same time it was necessary that something should be done without delay, in order to prevent the concession from irretrievably lapsing, as the Government of Colombia had only agreed temporarily to prolong the concession upon the condition that a new company should be immediately formed for carrying out the work. As this concession will expire in the course of a few weeks, the new concern has come into existence at the eleventh hour, and it will entitle those interested to claim a further extension of time for completing the canal. The floating of the new company has been an operation of great delicacy and ingenuity. It was, of course, impossible to rely upon the public subscribing any more capital to an enterprise of which the name is associated with nothing but disaster and misery; and it is not surprising that, so far as they are concerned, the new issue has fallen flat, so flat indeed that scarcely any notice is taken of it. Nevertheless, 300,000 shares of 100f. have been offered to the public, preferably to those holding shares in the old company as some compensation for their losses. In the event of the public refusing to take them up they will be purchased with the funds in the hands of the liquidator, M. J. P. Gautron. Another lot of 300,000 shares has already been taken up by three great financial bodies, and 50,000 shares have been offered to the Government of Colombia in exchange for the concession. The way in which the new concern has been sprung upon the public has given rise to a good deal of criticism, as it is felt that there is something behind it that the public are not permitted to know anything about. In the first place the smallness of the capital places the new company in a singular light. The issue is nominally for 24 millions sterling, half of which is said to have been taken up by financial concerns; but seeing how much these bodies have held aloof from the enterprise, it can only be assumed that their participation is conditional upon the public responding readily to the appeal. In the absence of this it is said that the other half will be provided for by the liquidator, who, upon this showing, must have a much larger sum in hand than the shareholders in the old concern thought. Had this confession been made a year or two ago there would have been an immediate demand to have the money distributed. Under the circumstances, the conclusion can only be arrived at that the liquidator is seeking to inspire confidence among the public by making them believe that there is plenty of money behind the concern, but it is very doubtful if this manœuvre will succeed. It is obvious that even if the company raises the whole of the capital asked for, it will not be in a position to carry on the work of cutting through the isthmus. Before operations are begun a great deal of expensive machinery will have to be replaced, and most of the capital will be swallowed up before the work is fairly under weigh. Another point that cannot escape observation is the reticence of the liquidator with regard to the constitution of the company and the project to be adopted. It is indeed rumoured, that M. Bonnardel will be president of the council of administration, and that the technical commission will be placed under the direction of M. de la Tournerie, but nothing definite about these appointments is known. It is, to say the least, considered very singular in Paris, that in promoting such an enterprise as the Panama Canal, it has not been thought advisable to take the public more into confidence, and these may be excused for thinking that there is nothing serious in this new issue. It at least serves the purpose of buoying up the old shareholders with hope, and of prolonging the concession of the Government of Colombia, which would thus keep the question open until such time as the financial condition of France may favour the project being taken up seriously.

### OIL-FIRED STEAMERS FOR HARBOUR USE.

SOME interesting facts as to the result of using oil as fuel on board harbour tugs at Chicago have been communicated to an American contemporary by Mr. F. U. Adams, chief smoke inspector of that city, preliminary to a full official report on the whole subject. The oil to be used is carried in tanks occupying the space usually allotted to coal bunkers; and from these the oil is pumped by a small pump in the engine-room and forced into a small pressure tank holding twenty gallons, from which it is led to the burners. The manner of feeding the oil to the furnaces—adopted after unsuccessful trials in other ways—consists in leading the burners in through the front end of the fire-box, so arranged that the oil is thrown in sprays towards the furnace door, striking against an arch which deflects it back towards the flues. In a test made between the oil-fuel tug and a similar tug burning soft coal over a distance of seventy miles, the result as to the relative consumption of oil-fuel and of coal, and the cost of each, was shortly this. The oil-fuel tug consumed 650 gallons of oil, worth 11·62 dols., and the competing tug burned 6½ tons of coals, worth not less than 21 dols. Both boats maintained a full capacity of steam during the entire trip; but while smoke and soot were copiously emitted from the coal-fired tug, there was entire absence of anything like smoke from the oil-fired one. The former, however, is the faster of the two boats, and she averaged a little over twelve miles per hour as against the eleven miles and a fraction averaged by the latter. Because of this, certain journals friendly to soft coal have attempted to construe the result into a victory for soft coal. The oil-fired tug can hold steam at 85 lb. for any length of time with a consumption of less than two gallons of oil per hour, or about 70 cents per day. To do the same work requires about 1½ tons of coal costing not less than five dols. In view of this, and especially considering the nuisance through smoke, ashes, and other drawbacks incidental to the use of coal, the advantages would seem to clearly lie with the oil-fired vessel, so far, at least, as suitability for plying in harbours and rivers is concerned.

### AMERICAN TIN-PLATE MANUFACTURE.

IT is a singular coincidence, yet it seems to be none the less real, that the passing of the Wilson Tariff Bill, instead of imposing a check to the development of the new industry in America connected with the manufacture of tin-plate, seems rather to have stimulated it. The reduction in the tin-plate duty of one-half is actually encouraging American outturn. The latest information of American doings in the tin-plate world points to the immediate erection of additional works in various centres, and to other preparations for greatly enlarged production. This is so alike in Pennsylvania and Ohio, from whence there is intelligence that contracts for the erection of new tin-plate mills have been given out by several iron firms. More convincing than all is an announcement this week that one of the largest American ironmasters now in this country is arranging with several friends for the formation in Pennsylvania of a tin-plate venture which will very greatly increase the American output, and will be backed by abundant capital. Another tin-plate plant which is to cost £50,000 is being erected in Pittsburg by capitalists who have hitherto had no experience in iron-making, but who are convinced that there is money in the future condition of the trade. This activity would seem to indicate that Trans-atlantic manufacturers believe that those earliest in the field will obtain the biggest share of the profits; and that they are prone to believe that American consumers will buy native-made tin-plate in preference to Welsh wherever it can be offered at the same price. This is an old policy on the part of the Yankees, who are very quick at seizing an opportunity. But to the Welsh tin-plate makers the position is not encouraging.

## LITERATURE.

*The Theory and Practice of Modern Framed Structures.* By J. B. JOHNSON, C. W. BRYAN, and F. E. TURNEAURE. J. Wiley and Sons, New York; and Kegan Paul, Trench, Trübner and Co., London. 1893.

[CONCLUDING NOTICE.]

IN discussing formulas for the strength of struts, our authors begin with one which they term a "strictly rational" one. Unfortunately, it is founded on bad mathematical manipulation, and is in fact wholly delusive. The formula is intended to enable us to deduce the average stress on the strut section from the elastic stress limit for the material when the load is such that the whole stress—made up of average or "direct" and of bending stress—equals this elastic limit. At page 144, if we put in Equation (1) the excentricity of the load $v = O$, and also write $\frac{1}{C}$ for the factor $\frac{1}{10}$ which the authors here use, it is easy to see that the formula reduces to the two equations $p =$ average stress $= C\,E\left(\frac{r}{l}\right)^2$, and $f - p = f - p$.

As the first of these does not contain $f$, the elastic stress-limit at all, it is evident that what the authors have got hold of is a high equation, so far as the relation between $p$ and $f$ is concerned. That is, their investigation gives $p$ the above value, whatever be the elastic limit, unless $p=f$. The authors take C=10, a rough mean between ratios found for various relative distributions of bending moment along a beam, a ratio which in different cases varies from 8 to 12. If C is put=$\pi^2$, which is nearly 10, the above is a reproduction of Euler's formula, the mathematical fallacy in which was demonstrated by Prof. R. Smith twenty years ago. The authors' method of converting this first formula (1) into Gordon's formula is altogether too bad to be fairly allowed a place in a book of a standard to which this volume justly aspires. They next develope Euler's formula, and then two others of their own which, taken as purely empirical ones, appear to have great merit. They ignore the theoretical investigations of Professors Smith, Claxton Fidler, and Perry on this subject, which, however, taken together, very clearly explain the whole actualities of the problem.

A decidedly good chapter follows on combinations of thrust and pull with bending stress, and on secondary stresses due to faulty formation of joints, &c. On page 156 is worked out a curiously useless problem, viz., to find the depth of beam which will give *maximum* stress produced by its own weight. This is *not* a misprint nor an error in calculation, and the heights calculated and tabulated in a long table are therefore those that ought to be sedulously avoided. The succeeding chapters on suspension, swing, cantilever and arch bridges are excellent, and contain a good deal that has probably not previously been published. Very simple and practically useful results are obtained for arches, from an assumption as regards the variation of section, which is a perfectly reasonable approximation, seeing that the section would properly be varied in this way if the arch were loaded only with a permanent load, and its shape were correctly chosen for this same load. The temperature stresses are very neatly deduced. A slight mistake has been made in the drawing of Fig. 257, page 217.

The next part, on deflections and stresses in redundant structures, follows a method which offers great practical facility for calculations and brings out many simple and interesting results. But it must not be forgotten that these all depend on the assumption that the actual stress intensities in all the tension members are the same, and again the same in all the compression members. Now, in bridges, the stress intensities cannot be practically kept the same in all members, some necessarily having very low stresses in them, especially in redundant structures. This applies more particularly to long and short struts whose average stresses are extremely different, and whose ratios of shortening again are still more different, seeing that they are not at all proportional to the stresses. A misprint of 2 for 8 occurs in the second of equations (5), page 222, and the language of the proof on page 221 is in a high degree inaccurate and obscure.

The reasons why equality of stress intensity cannot be maintained throughout a bridge are mainly three. First, there is the variation in strut stress referred to above; secondly, each member must be dimensioned with reference to the heaviest load that ever comes upon it, and these heaviest loads never exist simultaneously in all the members; thirdly, some essential members receive such small loads that considerations of corrosion, and other considerations dependent on the mode of manufacture of small sections, prevent these being given sections small in proportion to the loads coming upon them.

This chapter goes at length into the important question of the relative magnitudes of the parts of the deflection of a girder due respectively to chord strains and to web—*i.e.*, bracing-member—strains. They show that the part due to the strains in the braces may be sometimes more than half the whole deflection. The ratio increases with the ratio of depth of the web to span. This ratio is generally much larger in American than in European practice. Moreover, our authors exaggerate the relative magnitude of the web strains by overlooking the fact that the stresses in the braces—especially in the struts—have a lower average than those in the chords. They do not seem to have noticed that their strong insistance in this chapter on the relatively large importance of these web strains is inconsistent with what is said at the beginning of the book about "sections that are normal before bending remaining normal after bending." We say this not forgetting that in the web of a solid webbed girder the tensions and compressions are of lower intensity than those in the braces of a lattice girder.

In treating of the fatigue of metals, we notice unfortunate misprints of the brackets in formulas, (3), (4), (5), and (6) on pages 243, 244. The reasoning by which the authors lead to the conclusion that the Launhardt and Weyrauch formulæ are "rational in conception" appears extremely shaky, especially their analogy between fatigue in metals and fatigue in living muscle, an analogy wholly unscientific. Moreover their reasoning does not logically lead to the straight-line formulas of Launhardt and Weyrauch. Their logical conclusion would be an equation of the second degree, namely,

$$n^2 - m^2 = \text{constant},$$

where $n$ and $m$ are the upper and lower stress limits. This, however, cannot be a true formula because it would not apply to the extreme case in which $m = n$; and, therefore, the reasoning leading to it cannot be correct. A somewhat similar formula is recommended for other reasons by Professor R. H. Smith, namely, one of the second degree, which gives continuity to the law from the extreme in tension to the extreme in compression. The rules of Weyrauch and Launhardt do not give continuity even throughout the limit range to which they are intended to apply.

The treatment of the stresses in pins is interesting and important. American bridge engineers having a very extensive experience in this matter, their teaching ought to receive careful attention from those of other countries. As regards roller bearings, the authors repudiate as useless the various attempts at theoretic investigation that have been made. They give a formula—see 1, page 276—which thay state that they have deduced as a purely empiric one from experiments made at Cornell University. This rule is stated in a more complicated shape than it need be. A slight examination will prove that it is mathematically equivalent to the very simple law that the depth to which the roller and bearing plate are crushed down is in constant proportion to the load per inch length of bearing contact. This, if true, is most interesting. It would seem to indicate that the roller is deformed to a true elliptical cross-section for all loads, light and heavy. We know that this is not approximately true for rubber tires or solid cylinders; but it may be true for long steel rollers, in which the length is so great as to prevent any appreciable lateral—*i.e.*, axial, bulging.

Passing over the examples of detailed design of roof and bridge trusses, which, however, must be considered as one of the most useful parts of the book, we come to an interesting chapter on the "Æsthetic Design of Bridges." It is a novelty to find this side of a subject treated in a technical book, and one which deserves high commendation. Instead of scorning beauty, as so many engineers ostentatiously do, they ought to consider that they can only prove themselves educated men in so far as they pay a reasonable homage and obedience to the laws of good taste. As Mr. Molitor, the writer of this chapter, truly says:—"Since the civilised world lays a strong claim to good taste, and since bridges are monumental to the advances of civilisation, their design may well be subjected to the laws governing æsthetics." And again:—"Out of the consideration that the general public lays stress on the appearance of its bridges in cities, parks, &c., and often appropriates money to supply this want, we realise an advance in artistic taste." It is much to be deplored that it is the "general public" which in this matter forces the engineer occasionally to deviate into the paths of æsthetic rectitude, instead of the engineer being the leader and educator of the public, as he ought to be, into a correct appreciation of new forms of beauty appropriate to the developing improvement in the scientific design of structures.

But Mr. Molitor's almost invariable criterion of good taste throughout his whole discussion of bridges, is that they should without effort please the æsthetic sense of the mass of people who are very ignorant of the science of such things. He approves of modification of the latest developed scientific styles of designs, so as the more plainly to indicate the meaning of the whole by reference to more familiar and older forms. In other words, his main, if not his sole, criterion of æsthetic excellence is ability to please the popular taste, which of necessity must be ignorant of at least modern improvements. It seems to us that a higher and more absolute criterion ought to rule in this case. There are certain absolute, not relative, principles of gracefulness and fitness. If these are fully obeyed in the design and erection of improved styles of structure, then these will stand before the masses of beholders as great educative influences gradually leading them on to a higher standard of taste, and a truer appreciation of the real beauty of *fitness*.

With the great bulk of what is said in this chapter, however, we cordially agree, the discussions of details especially being most valuable. In what we suppose is one of the first attempts to deal seriously with such a subject, it would be strange if different people found themselves in entire agreement; and, in fact, there would be little hope for the progress of art if there did not exist a wide variety of opinion in matters of taste. For instance, we rather think that Mr. Molitor sets too high a value on perfect mathematical symmetry on either side of a centre as an *essential* of good artistic design. For example, if a bridge be exposed to strong winds, a certain want of symmetry in the direction of the prevailing strong wind is both rational and decidedly picturesque. It occurs to us that he does not sufficiently bring out the *artistic* value of masonry as the intermediary between iron or steel work and Mother Earth—it so suitably forms the connecting part between them, partaking as it does of the natural character of the one as regards its substance, and of the artificial or manufactured character of the other as regards its outlines and detail shapes. He states that stone naturally requires no preservative covering against the weather, and, therefore, requires no colouring; but it is only a few classes of stone that are not the better of a preservative covering, and the artistic fact that it is, as a rule, inadvisable to put any artificial colouring on stone, is, we suspect, more justly explained by its leading function as suggested in the last sentence. But in all practical suggestions on the subject of colouring we think Mr. Molitor a most trustworthy guide, and also as regards ornamentation. His insistence on the policy of bringing out into plain and easy relief the essentially different functions of the main members of the structure as a whole is excellent, and we very heartily agree with him in saying that the line of the roadway ought always to be made boldly apparent. The roadway is, after all, the chief end and aim of the whole structure; and yet, in not a few modern erections of large size, it is a puzzling problem, requiring the aid of the telescope and almost of the microscope, to find out where the roadway is, or if any roadway at all exists.

This book, as a whole, is a most valuable and important addition to our engineering literature. It represents a large degree of technical experience and skill, and it is the product of a vast amount of honest, patient, scientific labour. The duty of a critic leads him to point out what he conceives to be faults and errors; but if we have necessarily devoted much space to this part of our duty, we trust that we have also sufficiently indicated our sincere appreciation of the many high excellences of this work, and that we do not run the risk of being misunderstood to suggest that its faults are not of small importance in comparison with its merits. We offer a hearty welcome to this demonstration of American scientific industry, and heartily recommend it to our English professional men.

*The Physical Geology and Geography of Great Britain. A Manual of British Geology.* By the Late Sir ANDREW C. RAMSAY, LL.D., F.R.S., &c. Edited by HORACE B. WOODWARD, F.G.S., of the Geological Survey. London: Edward Stanford. 1894.

THIS is the sixth edition of a well-known book. It originated in the course of six lectures delivered to working men so long ago as 1863. The object of the course, as stated by Sir Andrew Ramsay, was to show how simple the geological structure of Great Britain is in its larger features, and how easily that structure may be explained to, and understood by, persons who are not practised geologists. The previous edition, which was published in 1878, contained an addition of nearly three hundred pages of detailed information. The sixteen years which have elapsed since then have seen great progress in all departments of geology, and the task of preparing the new edition which had become desirable was confided by Lady Ramsay to the competent and careful hands of Mr. Woodward. The editor has had the advantage of the author's copy of the fifth edition, with his manuscript notes and corrections, and Sir Archibald Geikie has revised the portion of the book dealing with the geology and scenery of Scotland. Anything like a critical review of a work so well known would seem to be unnecessary. Suffice it to say that Mr. Woodward has endeavoured to bring the information in the book up to date, in accordance with the general tenor of the author's plan and teaching, and that, so far as we have discovered, he has succeeded.

*Geology: An Elementary Handbook.* By A. J. JUKES-BROWNE, F.G.S, Member of the Geological Survey. London: Whittaker and Co., and George Bell and Sons; and Fourth-avenue, New York. 1893.

THIS is a little book intended to serve as a popular introduction to the science of geology. It deals chiefly with those branches of the subject which come under the head of physical geography—that is to say, the agencies concerned in the formation of rocks and the structural arrangement of the rock masses which make up the earth's crust. The author sets before himself the task of answering these amongst other questions: How was such a rock made? how does it come to be where we now find it? and why do some rocks contain fossils, while others do not? It is not too much to say that a study of the book will enable any diligent reader to satisfy himself, or at the least to take an intelligent interest concerning any rock he is likely to find in the course of his walks about the British Isles. The language is simple and clear, and the author, as is proper in a work of this kind, avoids as far as possible reference to controversial matter. Even those who have had little or no previous acquaintance with chemistry and mineralogy will have no difficulty in acquiring a great deal of information from it.

## *BOOKS RECEIVED.*

*Heat Treated Experimentally for the Use of Schools and Students.* By Linnæus Cumming, M.A. London: Longmans, Green, and Company. 1894.

*Theoretical Mechanics: Solids, including Kinematics, Statics, and Kinetics.* By Arthur Thornton, M.A. F.R.A.S. London: Longmans, Green, and Company. 1894.

*The Practical Designing of Structural Ironwork.* By Henry Adams, M. Inst. C.E., M.I.M.E., F.S.I., &c. First series, revised and enlarged. London: E. and F. N. Spon. 1894.

*Moravian and Silesian Miners. Statistical Inquiries into their Social and Economic Condition.* By Benno Karpeles, LL D. Vol. i. London: Swan, Sonnenschein, and Company. 1894.

*Journal of the Iron and Steel Institute, vol. xlv.* Edited by Bennett H. Brough, secretary. London: E. and F. N. Spon. Sold also at the offices of the Institution, 28, Victoria-street, S.W. 1894.

*A Treatise on the Richards' Steam Engine Indicator (manufactured by Elliott Bros., London), and the Development and Application of Force in the Steam Engine.* By Charles T. Porter. Fifth edition, revised and enlarged. London: E. and F. N. Spon. 1894.

INTERNATIONAL TUNNELS.—There are two propositions for the construction of international tunnels which are already well advanced in the preliminary stage. One is a piercing of the Simplon, respecting which negotiations have been commenced some time back between the Italian and the Swiss Governments. The Federal Council have approved the official communication, containing a general plan and description of the proposed work, which has been forwarded for the consideration of the Italian Government. When they have expressed their views, it is arranged that the details of the joint enterprise will be settled by representatives of the two nations. A similar engineering work through the mountain barriers separating France and Spain has made some substantial progress, as the undertaking has practically commenced in the latter country. It consists of the establishment of two international lines of railway, each of which has its own separate tunnel. The first of these will start from Saint-Giron in France, having for its objective the town of Lerida in Spain, while the second will take its rise at Cloron in the Basses Pyrenees, and join on to the line from Saragossa to Barcelona. Each tunnel will be about five miles in length, and a period of ten years is assigned for the construction of the entire scheme.

RAILWAYS ABROAD.—A line from Bruges to Swevezeche has been conceded to the Société Nationale des Chemins de fer Vicinaux, by a recent royal decree which also authorises the State to subscribe some £10,000 towards the capital required. In addition to working the small line from Bangkok to Paknam, which, situated near the mouth of the river Menam, is the custom house port of the capital, the Siamese have granted a concession for a railway more in the interior of their country, with a preliminary length of sixty miles. It will need four or five years to complete this mileage, and it is possible that subsequently the line may be extended to the plain adjoining the banks of the Mekong, a river as well as a district in Indo-China, which may probably be known in future history. An extension of the railway Mondania to Brusah, as far as Chemlik in Turkey in Asia, has been petitioned for, from the Sublime Porte, as well as a branch to join the Anatolian line near Eski Shehr. From this latter place to Kutaiah, a distance of thirty-five miles, the works are well advanced, and it is expected they will be finished early in 1895. Most lines of railways, not excepting those in America, look small beside the colossal Trans-Siberian. A section of it from Oural to Omsk was inaugurated a few days ago by the passage over it of the first train, but the regular traffic will not commence to run for another month. It is usual to build temporary timber bridges along this line pending the construction and erection of the permanent iron structures.

# LOCOMOTIVE BOILER EXPLOSION AT TUCUMAN

(*For description see page* 252)

Fig. 1

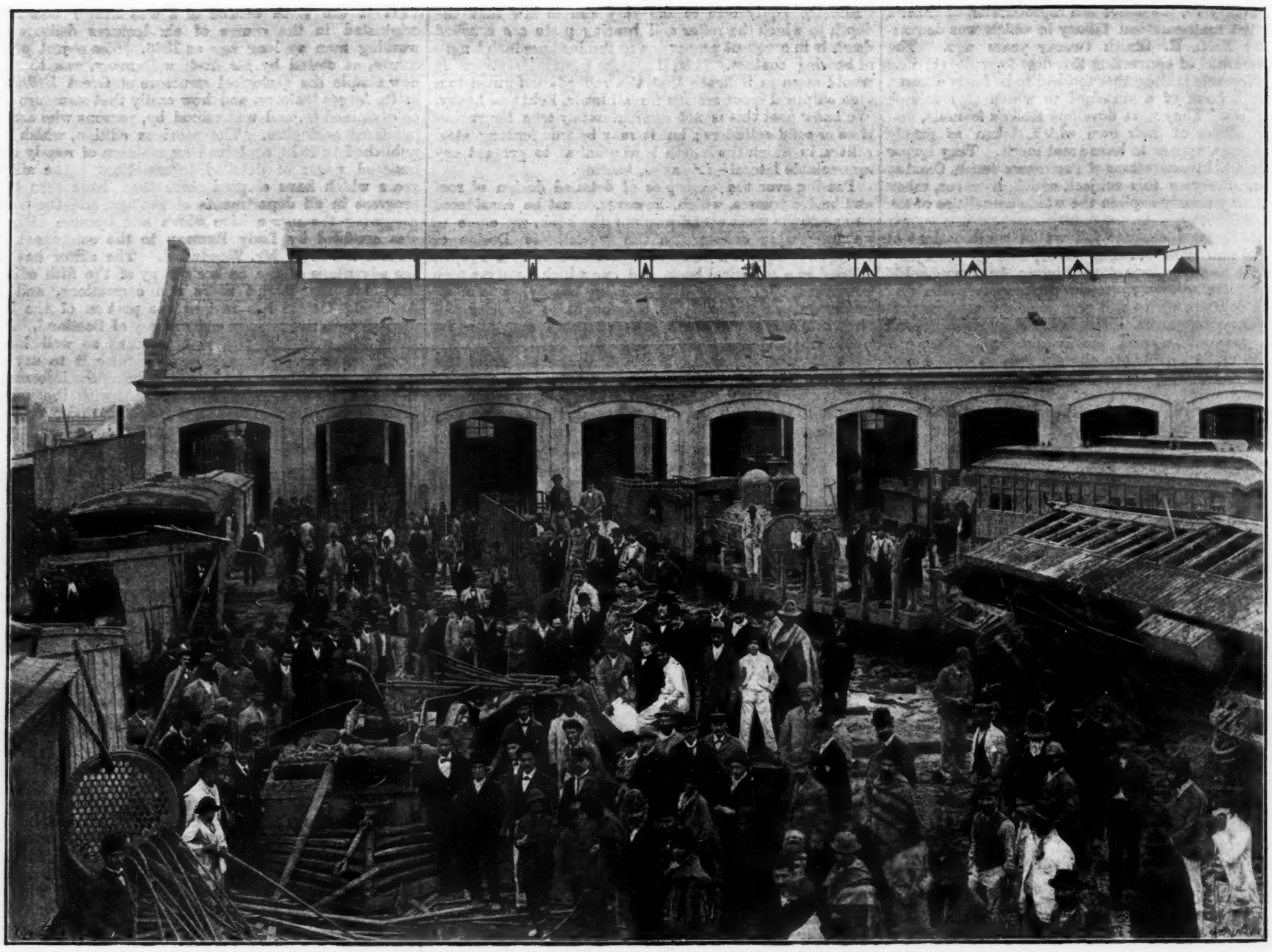
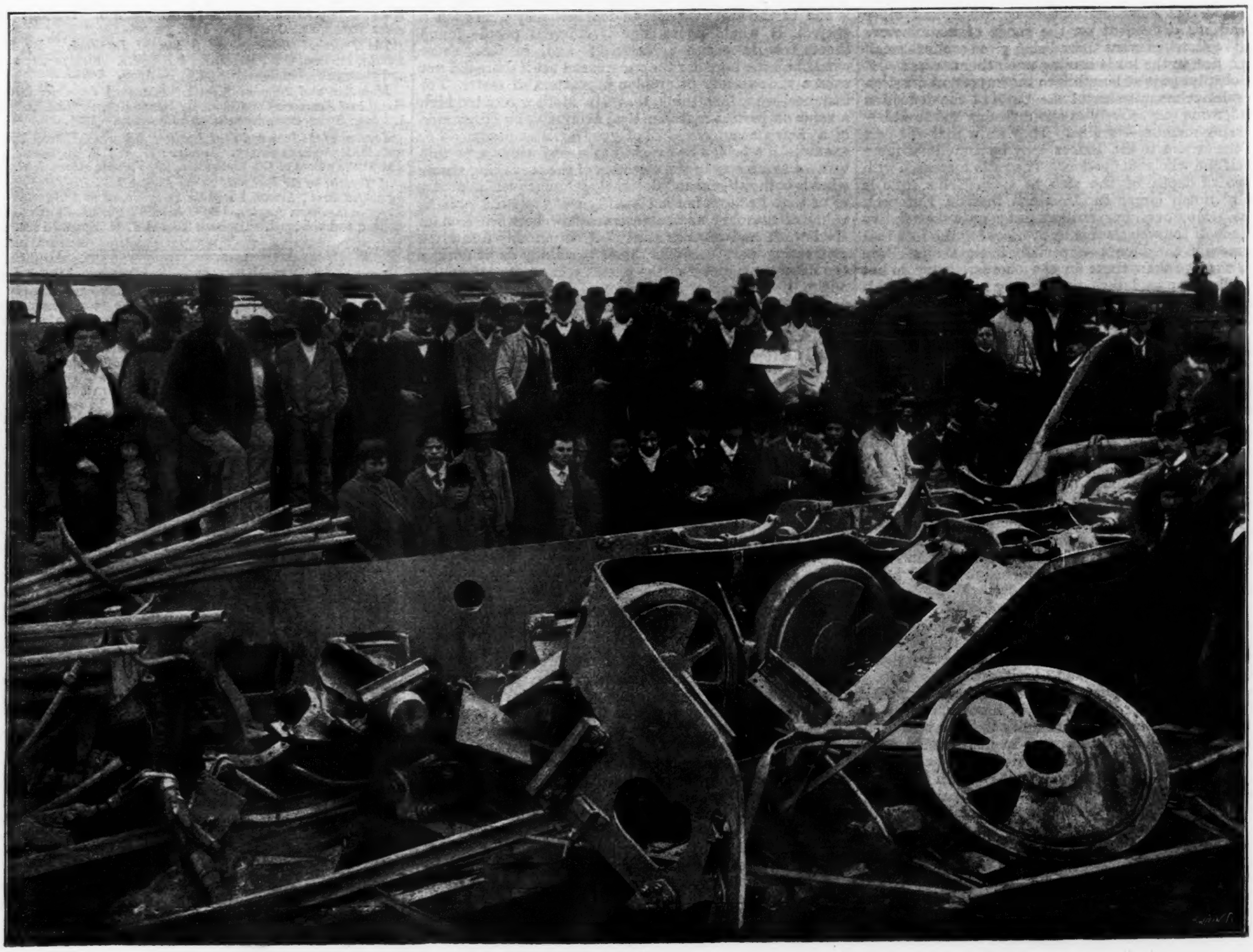


Fig. 2



# LOCOMOTIVE BOILER EXPLOSION AT TUCUMAN

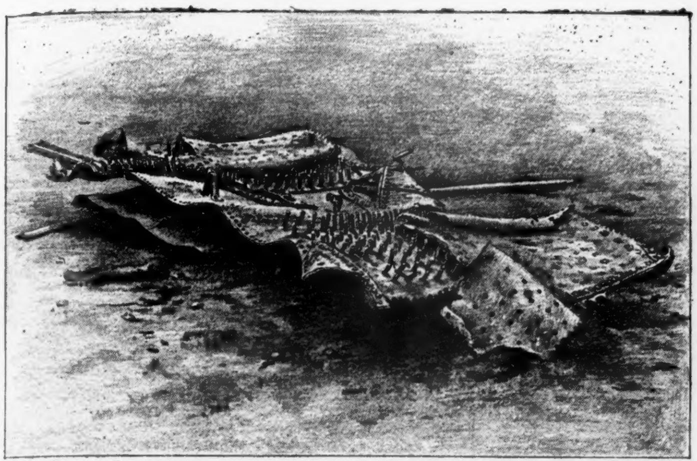


Fig. 3

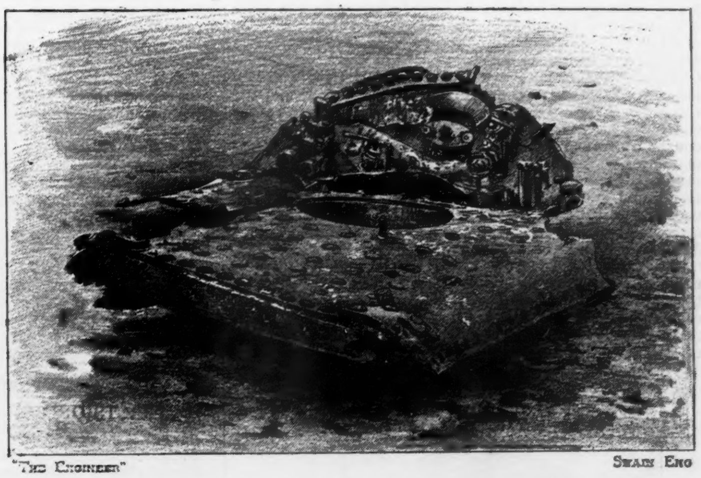


Fig. 4

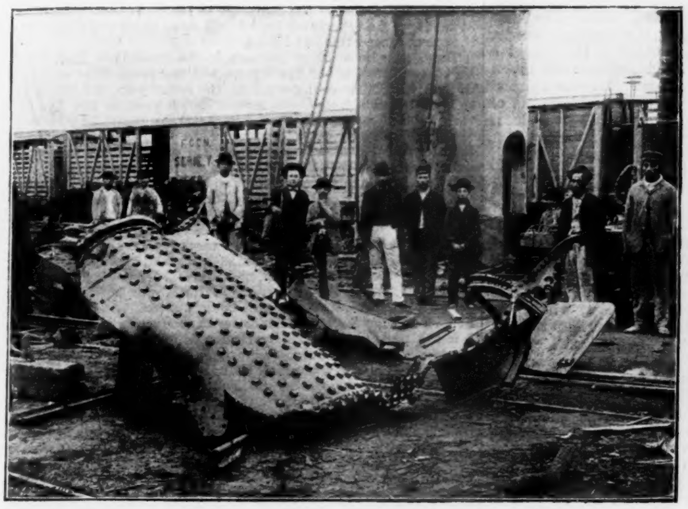


Fig. 5

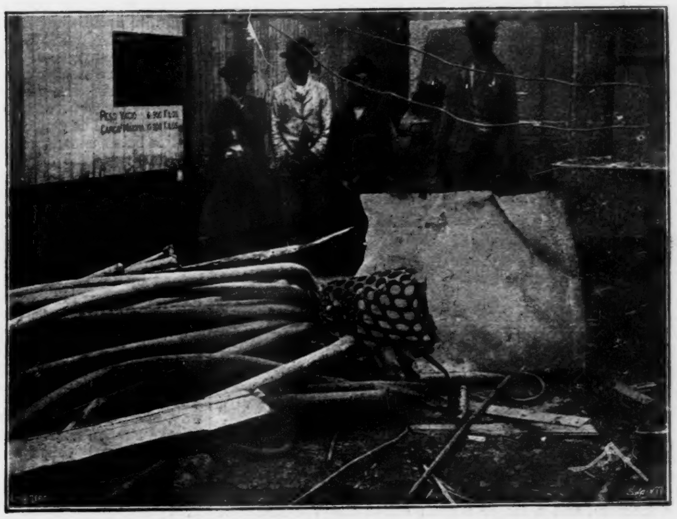


Fig. 6

## FATAL EXPLOSION AT TUCUMAN, ARGENTINE REPUBLIC.

We have received the following communication from an Argentine correspondent. He expresses his regret that the photographs are not of better quality, but that is not his fault, but that of the only available photographer:—

At 7.20 a.m. on the 24th July the town of Tucuman, which is about two miles in length by one in width, containing some 30,000 inhabitants, was suddenly startled by a terrific explosion, which, accompanied by the jarring of doors and windows, those in the more distant parts thought to be an earthquake. The news soon spread that a fatal locomotive boiler explosion had taken place at the workshops of the Ferro Carril Nacional Central Nook, on the west side of the town. This railway is a prolongation of the Ferro Carril Central Cordoba, runs to Salta and Injuy, and belongs to the National Government, by whom it is worked.

An investigation of the accident made within less than one and a-half hours of the event, and when the boiler plates were still hot, revealed an amount of destruction that is difficult to describe.

It appears that the eight-coupled compound—Worsdell and Van Borries—goods engine "Fiambala," No. 38, Sharp Stewart's 3536, built in 1889, was standing within a few metres of a 30ft. tank, preparing to take out a train, when it was discovered that the injectors would not work. The dome joint was also blowing, and the gauge glass also burst, consequently fitters were tinkering about these different parts when the boiler exploded. One or two men lived but a short time, six others were mangled beyond recognition. The fracture commenced at the side bottom corners of the fire-box, the crown and tube plate, greatly distorted, remaining almost *in situ*. The front of the fire-box was carried many yards, and only found the following day, after a diligent search, in a box wagon loaded with flour, it having fallen through the roof.

The shell of fire-box was hurled over eighty yards in front of the engine, and when opening out, had doubled back the engine frame, taking the right trailing coupled wheel off its axle as neatly as if done by hydraulic. The front tube plate did not travel far; the few remaining tubes and stays were all twisted like bits of wire. One plate of the boiler, with dome attached, after first striking and taking a large piece out of the iron tank, was thrown a distance of 250 yards into a quinta, and the inner steam pipe and regulator valve a considerable distance further, while another large piece of the boiler fell through the roof of the goods shed—120 yards away—hurting an employé, and partly burying itself in the ground. Another large plate fell about 100 yards away, narrowly missing a first-class carriage. Very few parts of the engine escaped damage, though the tender was hardly touched.

The adjacent rolling stock also suffered greatly. One 60ft. saloon carriage was thrown on its side and completely wrecked, though standing several yards away, as also were some half-a-dozen wagons more adjacent. The escape of several box wagons sheltering the families of the workmen was something miraculous. Needless to say, nearly all the glass in the station, a hundred yards away, was smashed, while *débris* covered the roofs of all the buildings, and a coat with an arm in it hung across a telegraph wire.

The engine, being only five years old, was practically as good as new, and the materials were excellent. Some few copper stays in the bottom front sides—nine or ten on each side—had previously given way, as also the stays joining the fire-box to barrel, and one, or perhaps two, of the longitudinal stays, but even with these defects the boiler would have easily carried the normal pressure of 175 lb.

The accompanying photographs taken the day after the accident give some idea of the effects of the explosion. Figs. 1 and 2 show the remains of the engine *in situ* with damaged carriages and wagons adjacent; running shed in the rear. Fig. 3 are the side and top plates of the fire-box shell, and the side plates of the fire-box thrown eighty yards away in front of the engine. These at the time of photographing had been turned over for examination. Fig. 4 is the front shell plate with mountings, and front plate of fire-box, found in the wagon of flour about eighty yards distant. Fig. 5 is the under side of crown plate of fire-box, and the high service tank close to. Fig. 6 is a fraction of the fire-box tube plate and *débris*.

Without going into particulars, or attributing blame to any particular individual or individuals, suffice it to say that the railway in question has forty-six locomotives on its books, and that only four are in working order, and that since the above accident occurred two others of a more or less serious nature have happened. This will give an idea of what a railway is like in this country under Government control.

Yo Se.

## PRIMARY BATTERIES FOR LAUNCH WORK.

We had recently an opportunity of examining a new type of primary battery which is being made by the Battery and Motor Co., of Victoria-street, Westminster. The works of the company are situated at Petersham Island, Richmond, and by special invitation we made trips in small electric launches provided with these batteries. After so many attempts have been unsuccessfully made to produce a primary battery which should be of commercial use for the production of light or power, we are rather sceptical about the advantages to be obtained from the use of carbon, zinc, and sulphuric acid. Still we were agreeably surprised to find that there was no "secret solution" deemed invaluable.

The chief point of novelty in this cell appears to be the employment of carbonised velvet as a coating for the carbon, and from this the material has been named "Velvo-carbon." Fig. 1 represents one of the so-called "palisades" which forms the carbon plate used in the particular cells we examined. The carbons themselves are simply ordinary arc lamp carbons, 9 mm. diameter, made hollow for coring, but with the core left out; each rod is 12in. long. Cotton velvet is cut into narrow strips about half an inch wide and is dipped into platinum chloride, and when dry is wound spirally upon the rod and fixed in position with ordinary paste. The rod with its covering is then put into a muffle and the velvet is carbonised, during which process the chlorine is evolved and the platinum in a spongy form is said to be deposited in the pores of the carbonised velvet. We are indebted to Mr. H. A. Barnett, the manager of the company, for details of the construction of the cells. Nine of these prepared carbons are then taken to form a palisade, and in each rod a piece of silver wire, No. 28 gauge, about 2in. long, is fixed into the core hole at one end by means of a small wedge of celluloid or ebonite wire. The group of rods is then fixed top and bottom into wooden cross pieces, and along the top cross piece a silver wire is fixed, which is connected to the several wires and acts as the common conductor for the palisade.

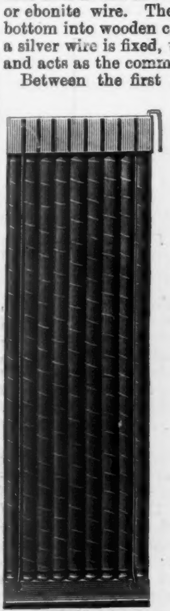


FIG. 1
VELVO-CARBON PALISADE

Between the first and second rods at each side of the palisade are placed ebonite strips slightly wider than the external diameter of the rods, and these prevent the zinc plates from touching the carbon. If the carbon rods are intended to rise above the surface of the electrolyte the upper ends are treated with ozokerit wax, but the palisades just described are intended to be kept submerged. The zinc plates used are each 12¼in. long by 3¾in. wide, they are amalgamated and No. 16 gauge thick of the brand V.M. 3 stars. These zincs have no permanently attached connections. The cell itself measures 10¾in. by 4⅜in. by 14¼in. high, is of ebonite, and weighs 2¼ lb. It contains twelve palisades, each weighing 14 oz., and thirteen zinc plates weighing 6¾ lb., besides about 12 lb. of liquid. The total weight of each cell in working order is 32 lb. The palisades and zinc plates are wedged up tightly in the cell by means of a pair of wooden wedges at one end of the cell. When a number of cells are used together in series, as in launch work, the end of the silver wire from each palisade of one cell is wedged between the corresponding palisade and zinc of the adjoining cell, and the connections of the last cell of the series are made to a brass omnibus bar faced with silver and provided with screws. Dilute sulphuric acid is used as the electrolyte, and a specific gravity of 1150 is preferred, although it may be used of a strength up to 1200. We have had no opportunity of making quantitative tests of these cells, but from reports made by Professor Jamieson, of Glasgow, it appears that the velvo-carbon gives much better results than ordinary carbon. With a constant potential difference of 0·5 volt the plain carbon gave a current of 0·26 ampère at starting, and after twenty-six minutes this had fallen to zero; whereas, when the carbon was replaced by a velvo-carbon and the same potential difference maintained, the initial current was 0·56 ampère, which gradually fell in twelve minutes to 0·488 ampère, and then rose, until at 114 minutes from the start it was 0·604 ampère.

With a cell weighing 17 lb. the output is stated by Prof. Jamieson to be one watt per pound, and it was capable of giving 20 ampères for a seven hours' continuous run on a consumption of zinc of 2¾ lb. per 1000 ampère hours, a mean of 5·1 lb. of zinc per electrical horse-power hour in the working circuit, and nearly 1½ lb. of commercial sulphuric acid is used per pound of zinc consumed. Mr. Barnett states that the zinc plates can be supplied at 5d. per pound, and the sulphuric acid at ½d. per pound, and if the battery be discharged at half its maximum output the cost of material consumed is 2s. 10d. per Board of Trade unit, while at maximum discharge the cost for materials would be 3s. 2½d. per Board of Trade unit. These prices, of course, seem high, and would entirely preclude the use of such a battery for constant work. It is possible, however, that for short runs separated by long intervals the cells might be of value. Our first trip was made in a small launch called the Velvo, 24ft. long with 5ft. 3in. beam and a punt-shaped middle; this was provided with fifteen cells, each being 12in. long by 4in. wide by 6in. deep, and about 6 volts could be obtained with the cells in series; each cell weighed 17 lb. The motor was series-wound, and built by Messrs. Mavor and Coulson, of Glasgow, and is shown in Fig. 2; it is intended for 10 volts, 50 ampères, and to run at 500 revolutions per minute. The maker's number was "349 Sayers' patent." The patent relates to the winding of the armature, to which we shall allude later on. The motor was stated to weigh 2 cwt., and to give an electrical efficiency of 90 per cent. The propeller was 13in. diameter. In this boat we had a run from Petersham Island to Teddington Lock and back. Since that time the battery has been somewhat improved in construction, and a larger launch called the Velvoca, built by Mr. Kerbey Bowen, of Maidenhead, has been acquired. This boat is 35ft. long, double skin, built without keel, and has a beam of 6ft. 6in., and will carry twelve persons; when fully loaded she is stated to draw 16in. of water. The cells were forty-eight in number, placed in the centre of the boat, and were of the large type already described, each weighing 32 lb., so that the total weight of cells was about 14 cwt. The motor was by Mr. Newton, of Taunton, weighing 6 cwt., and is said to give 80 per cent. electrical efficiency with 20 volts and 60 ampères, running at 500 revolutions per minute. Steering was effected from the bow, and the cells could be coupled all in series, or the two halves of the battery in parallel.

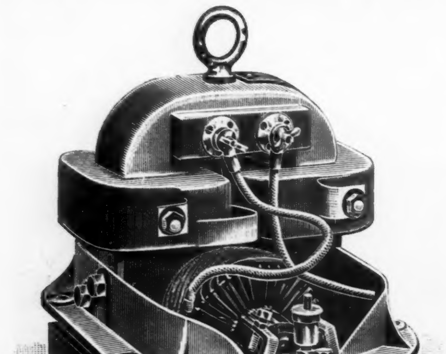


FIG 2

MAVOR AND COULSON'S MOTOR—SAYERS PATENT

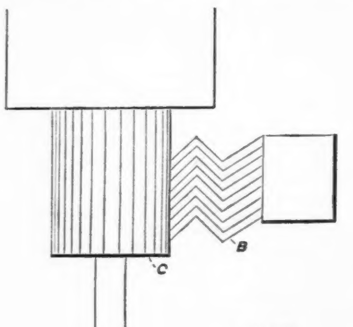


FIG. 3.

SAYER'S BRUSH

The acid was stated to be of 1080 specific gravity, and we started with eleven persons on board, and went from Petersham Island to Teddington Lock, then down to Richmond Lock and back to Petersham Island. Half-speed was used almost all the time, the two halves of the battery being in parallel. An ampèremeter was in circuit, and gave, when ascending the stream, a reading of 12; this required multiplying by two for the two halves, and also by a constant which was said to be 2·16, the result being $2 \times 12 \times 2{\cdot}16 = 51{\cdot}5$ ampères, and the potential difference was stated to be 13 volts. At full speed the reading was in a similar way, $35 \times 2{\cdot}13 = 75$ ampères, and the pressure said to be 22 volts. On the return from Richmond Lock the smell from the battery became very unpleasant, but this was stated to be only found when running at full speed. We were informed that with fresh zincs and acid the boat would run at half-speed for twelve hours with a load of twelve persons, and would cost 1s. 8d. per hour for material used in the battery. An ebonite pump is kept in the boat, and it is used to empty the acid out of the cells after the run is over. It is of course necessary to pump out each cell separately, as there is no fluid connection as there is in some batteries.

Both primary and secondary batteries have a very powerful competitor in the Daimler gasoline motor, which we see is now being used for launches on the Thames. Both suffer from the disadvantage of producing evil smells, and the Daimler motor sometimes causes great vibration, which is absent in the case of electric motors.

We referred above to Sayers' patents for armature winding. As many of our readers are doubtless aware, the connections between the armature winding and the armature sections are not made in the ordinary manner, but these connections, which the inventor calls commutator coils, are wound around the armature core in such a direction, and in such a position relatively to the position of the armature coils to which they are connected, that the electro-motive forces induced in them and the armature coil which forms a connection through the two commutator coils concerned at any time shall tend to neutralise one another if one of the commutator coils is under the pole piece and the other is not there at the moment when the brush connects the two sections of the commutator. The winding is so designed that the resultant electro-motive force shall be just sufficient to reverse the current in the armature coil and to reduce the current in the commutator coil to zero at the moment when it is leaving the brush. A sparkless break is thus obtained. The plates of the armature core are provided with deep, narrow radial slots in which the windings are placed. The brushes consist of flat copper ribbon, bent as shown in Fig. 3, and this form appears to give good results.

## ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

*France: Drainage of Nice.*—Although the reduced mortality of Nice is mainly owing to improved drainage, the system is still incomplete; the construction of drains, according to the new system adopted by the Commission which sat in 1891, and divided the town into sections, one to be taken at a time, having to be suspended during the winter season, to avoid annoyance to the visitors. Much has been done, and the work is being steadily, if somewhat slowly, carried to completion. The system adopted is the "Tout à l'Egout," or everything to the drain. This system was much attacked during the past year, but in these parts an opinion is rarely expressed which is founded on the sole merits of the case, and has generally to be accepted *cum grano*—local politics being usually responsible for the greater portion.

*France: British goods in La Rochelle.*—The sale of British goods has decreased here owing to several causes. The increased protective duties, and the time and trouble required to clear goods through the Custom-house, would not alone have been sufficient to prevent their continued use, but French makers are reducing the cost of production in many competing articles, and selling them cheaper than formerly, helped by the lower rate of wages and the longer hours worked by their men. They are also taking much trouble to suit the requirements and taste of the public, where our manufacturers are stationary, paying no attention to, and perhaps not being aware of, the little details in which the people of this country have to be suited. As to many articles there is the old grievance about the absence of commercial travellers from England. Nearly all shopkeepers buy in this way, and if British goods cannot be thus obtained they prefer to take French ones. Nearly all English goods still sold here are purchased through Paris houses. The most important is coal, the import of which amounted last year to 200,842 tons, a decrease of 20,344 tons, or 9·2 per cent. under that of 1892; while the value rose from £1 7s. 1½d. to £1 8s. 5½d. per ton. Next comes pitch and tar, 5779 tons, valued at £11,000, all seaborne. Among manufactured and other goods imported through indirect routes, and of which the quantities cannot be ascertained, are:—Agricultural implements and machinery, particularly hay and straw cutters, mowing and reaping machines, ploughs, rakes, cycles, stone-breakers, and a number of articles of hardware of a trifling kind. All these articles meet with keen competition from French ones, and from this and the other causes before mentioned are sold in much smaller quantities than formerly.

*Italy: British Engineering Firms at Genoa.*—Considerable slackness and stagnation characterised the metallurgical industry of Genoa in 1892 and 1893, but the prospect was a little more hopeful at the beginning of 1894. Messrs. Odero and Co., of Sestri Ponente, who have an agreement with Messrs. Brotherhood, were fairly busy, turning out twelve torpedo boats, a light draught paddle steamer for the Servian Navigation Company, and a floating dock, also a number of air compressing engines for the Government. They have entered into an agreement with Messrs. Kirkaldy to construct their condensers and distillers, and have provided several sets both for the Government and merchant vessels. Considerable extensions are being made to their works, for the purpose of building two large passenger steamers and their engines for the Rubattino Line. At the boiler works of Messrs. G. Ansaldo and Co., of Sampierdarena, who work in conjunction with Messrs. Maudslay, many large locomotive and marine engines were turned out, some of the latter including one of 20,000-horse power for the armour-clad Sicilia, and one of 10,000-horse power for the fast cruiser Marco Polo. They were also constructing engines of 13,000-horse power for the cruiser Carlo Alberto, and of 13,500-horse power for the first-class battleship Ammiraglio di St. Bon. The boiler shop, one of the largest in the world, was, in the early part of this year, full of work, seventeen boilers having been turned out for the Rubattino fleet, which is being overhauled. Their locomotive department has been busier. There are being constructed nine locomotives for the Southern railways, and eleven of the large powerful ones knows as the Vittorio Emmanuele type, used on the main line between Rome and Turin. The firm builds ships and their material of the largest size, and recently built at their yard, Sestri, the Liguria, cruiser, of 20 knots speed, 2260 tons, and 7000-horse power; the Minerva, first-class torpedo catcher, of 22½ knots speed, 850 tons, and 4000-horse power; twenty seagoing torpedo boats, three cargo steamers, a passenger boat, tugs and other small craft, and machinery for them. They had on the stocks a first-class cruiser, the Guiseppe Garibaldi, of 20 knots speed, 6840 tons, and 13,000-horse power. At the works of Wilson and Maclaren many men were discharged last year, and the proprietors were working a good deal on stock, having a large assortment on hand of boilers, engines, engineering tools, &c., and had sold from stock two steam tugs of 200 and 120-horse power respectively, and were working on another of 250-horse power, the material for the boiler coming from Glasgow. They were also constructing a large hydraulic press for compressing gunpowder, the cylinder, of cast steel, coming from Sheffield. Steel ballast wagons, each carrying 20 tons, were being completed—rather to keep old hands employed than as customary or profitable work. At the end of March things were looking a little better, and a contract was made for another steam tug, though competition and scarcity of orders had reduced prices to their lowest figure. Repairs and additions to one of the "Veloce" line of steamers, and building steel barges for ammunition transport, were also undertaken, but the low price rendered it necessary to purchase the materials in this country—angles coming from Savona and Terni, and plates from Sestri Ponente—and a long time had to be waited for their delivery. A good deal of material for boilers came from the Steel Company of Scotland, Germany, and Belgium.

## PROBABLE IRON IMPORTS UNDER THE NEW TARIFF.

THERE is little probability, while present low prices continue, that the imports of iron and steel will be greatly stimulated by the new tariff. The imports for the fiscal year ending June 30th, 1894, were much below those for the same period ending June 30th, 1893, as will be seen from the following table:—

*Imports of Chief Iron and Steel Products for fiscal years ending June 30th, 1893 and 1894.*

| Articles. | 1894. | 1893. |
|---|---|---|
| Iron ore, tons | 218,550 | 683,056 |
| Pig iron, tons | 25,763 | 62,936 |
| Scrap iron and steel, tons | 2,822 | 18,836 |
| Bar iron, lb. | 22,763,623 | 38,947,476 |
| Rails, tons | 2,178 | 932 |
| Cotton ties, lb. | 1,792,392 | 3,744,482 |
| Hoop iron, lb. | 2,225,690 | 2,782 596 |
| Steel ingots, blooms, &c., lb. | 27,880,946 | 71,432,468 |
| Sheets and plates, lb. | 60 523,632 | 91,246,062 |
| Tin-plates, lb. | 454,130,026 | 628,425,902 |
| Wire rods, lb. | 56,228,155 | 97,067,082 |
| Wire, lb. | 8,710,399 | 9,305,075 |

The year 1894 cannot be regarded as a year of normal imports under the McKinley tariff by reason of the panic, the depression in business, and the tariff agitation. Even 1893 is hardly a fair year, as the uncertainty as to the future, with its depressing effects, began as early as the close of the campaign in 1892. It is very doubtful, however, if the reports for 1894-5 will equal those of 1892-3, while they may exceed those of 1893-4.

There may be a slight increase in the imports of iron ore in 1894-5 over 1893-4, but the figures will not reach those of 1892-3. Of the 683,056 tons imported in the latter year, 413,999, about two-thirds, came from Cuba, most of which went to the Pennsylvania Steel Company. With the works of this company practically out of the rail business, and with the low price of Bessemer pig, in the manufacture of which most of the imported ore is used, it seems impossible that there can be a material increase in imports. The price of Lake Superior ore is so low this year that considerable of it has gone east. As much or more will be consumed probably in the eastern furnaces next year. It is also true that the demand for Spanish ores in Europe is increasing, and must increase each year, while the supply is by no means greater.

The pig iron imported is of a high grade and special iron, largely ferro-manganese, ferro-silician, and charcoal for steel. The average declared value of that imported in 1892-3 was 25 dols. a ton, in 1893-4 a little less, but still some 23 dols. a ton. As this iron was imported to meet actual deficiencies in production in this country, it is not probable that its importation will be at all stimulated by the reduction in the duty.

Scrap iron is not a product, though it interferes to some extent with both pig iron and bar iron. Its importation is always uncertain, but with the low price of pig and the low rates of puddling that prevail all over the United States, especially along the coast, it can hardly be profitable to import scrap regularly. It is evident from the declared values that the scrap is special. The value of the 2822 tons imported in 1893-4 was 45,967 dols., more than 19 dols. a ton.

The bar iron imported, which in 1892-3 was 17,888 tons, and in 1893-4 10,162 tons, was also special iron of a high grade, largely charcoal bars for steel making. Of the 38,947,467 lb. imported in 1892-3, over 32,000,000 lb. were from Norway and Sweden. The value of that imported in 1892-3 was some 41·50 dols. a ton, and in 1893-4 some 42 dols. a ton. This is not common bar iron or even so-called marked bars. There will be little increase in the imports of this bar except as it is needed to re-work into high priced steel, and will not affect the market for merchant bar.

Our manufacturers can hold their own in steel rails. Most of the imports will be at points far away from our mills, chiefly on the Pacific coast.

The imports of steel ingots, blooms, &c., will probably increase somewhat in 1894-5 over 1893-4, though we doubt it if they reach the amount of 1892-3. We have made wonderful strides in our methods and machinery for the production of blooms and billets since June 30th, 1893. Much of that imported in that fiscal year was basic. We are in a better condition now to meet competition from abroad than we were then, and with some reduction in wages can hold our own and keep our trade. There is hardly a product that has declined in price in the United States in the last two years so much as steel blooms. The average price in the early part of 1893 was 22 dols. a ton; a better article has been sold in the last few months at 16 dols. to 16·50 dols., though at no profit, if not at a loss; 17·50 dols., which is a low price to-day, is a better figure.

We cannot speak with as much satisfaction as to the imports of the thin irons and steel. The amount of cotton ties undoubtedly will increase. Indeed, this industry is practically lost to us for awhile. Some more hoops and bands will be brought in unless we can find means to produce more cheaply than now. We shall continue to import sheets and tin-plate, and in large quantities, though all of our market will not be captured by foreign workers, as they fondly hope, if there is a judicious co-operation between employers and employés. It looks as though we were going to make strenuous efforts to increase our production of black plate for tinning, and that an increasing amount of tin-plate made in this country will be from American black plates.

To sum up. In our judgment, while present low prices rule there does not seem much probability of an increase in imports except of the thin irons, as cotton ties, hoops, sheets, and tin-plates. Should there be an advance to fairly remunerative prices, however, the situation would be different, and an increase of imports might be expected.—*American Manufacturer.*

## A BRIDGE OF 3100 FEET SPAN.

FOR some time past there has been a project to build a bridge over the Hudson River at New York City, but the extent and nature of navigation have made it necessary to avoid piers in the waterway. One company has already completed plans for a suspension bridge of 2900ft. span, and an Act of Congress granting another charter to a company which proposed a cantilever bridge, directed the appointment of a commission of prominent bridge engineers and an army engineer to consider and report upon what length of span, not less than 2000ft., would be safe and practicable. They report in favour of a suspension bridge of 3100ft. span as preferable to a cantilever span of 2000ft., a great difference in cost resulting from the deep and difficult foundations required for the latter. The following is an abstract of the report:—

"In making comparative estimates your board selected a location midway between Fifty-ninth and Sixtieth streets, but the difference between this location and one further north, within the limits of the Act, has been considered so far as it affects the general conclusions. The minimum length of span which may be considered is 2000ft., which your board have interpreted as meaning 2000ft. in the clear. The maximum length of span would be a clear span between the pier headlines, this distance varying from

3130ft. at Fifty-ninth Street to 3080ft. at Sixty-ninth Street. The objections which have been raised to a pier in the river apply with equal force to any pier located between the end of a 2000ft. span and the pier headline, the pier being objected to as interfering with the use of the river for harbour purposes, rather than for through navigation. The plan submitted to your board has located the 2000ft. span, in accordance with the requirements of the New York charter, next to the New York pier headline, thus placing the west pier about 1000ft. from the New Jersey pier headline. If the span is increased beyond 2000ft. any injury done to the harbour by obstructing the approach to piers on the New Jersey shore would be greater than any benefit gained by increased width of channel span. Your board have considered that navigation would not be benefited by making a span of greater length than 2000ft., unless such span could reach from pier headline to pier headline, and have, therefore, confined their examination to a span of 2000ft. in the clear as compared with such single span. It must be noted, however, that the pier headlines are artificial, and are subject to change under existing laws. The width between pier headlines at this location is about 400ft. greater than a point two miles below. A small encroachment beyond these pier headlines could be permitted without essential harm; it would obstruct navigation no more than a vessel lying across the head of a pier. A span of 3100ft. in the clear would meet all requirements of a single span.

"The plans submitted by the bridge companies provide for a cantilever bridge carrying six railroad tracks. This number of tracks is the least that has been proposed by any company which has contemplated bridging the Hudson River opposite the city of New York. Your board have, therefore, thought it right to make estimates for a bridge furnishing this accommodation. The fact that the river must be kept unobstructed during erection limits the plans to cantilever and suspension bridges. The plan submitted by the bridge companies provides for a steel cantilever bridge. In the first place, your Board are of the unanimous opinion that a cantilever span of 3100ft. in the clear could be built, and would be a safe structure. In the second place, your board have considered that the practicability of such a structure would depend upon its cost, and to determine this practicability have made comparative estimates of the cost of two cantilever bridges, with clear spans of 2000ft. and 3100ft. respectively. These estimates are comparative rather than absolute; the benefit of the doubt, where any exists, has been given to the longer span. The estimates include both substructure and superstructure, but have been made in round numbers and do not include the costs of tracks and other features, which would be common to both plans."

The board also goes into the question of rock foundation for the bridge, and says that at each pier head line the depth to rock is about 125ft. At the point in the river where the pier would be built in case a 2000ft. span was decided upon, the depth as to the rock is 260ft. All estimates have been made for rock foundations. The board has assumed that the masonry finish for piers would be 50ft. above high water. "The east pier of the cantilever bridge, with a clear span of 2000ft., would be immediately back of the New York pier head line, where the rock is 125ft. below mean high water. The west pier would come in the river where the rock is 260ft. below mean high water. The east anchorage would be within the shore line, where the rock is not more than 20ft. below mean high water, and the west anchorage would be immediately west of the New Jersey pier head line, where the rock is 125ft. below mean high water. The site of the west anchorage calls for an anchorage span 100ft. longer than is shown on the plans submitted by the bridge companies."

The cost of the east pier is estimated at 3,464,000 dols.; west pier, 9,710,000 dols.; east anchorage, 431,000 dols.; west anchorage, 1,038,000 dols. The east pier would consist of four cylinders of 866,000 cubic feet each, and the west pier of four cylinders of 1,880,000 cubic feet each.

Concluding upon the 2000ft. cantilever plan, the board says:—"A careful estimate prepared by the bridge companies makes the weight of the superstructure 230,000,000 lb., including the main span, the towers and the two anchorage spans, covering a total length of 4120ft. The cost of this bridge would then be 25,443,000 dols. This is the cost of a cantilever bridge of the minimum span which your board are authorised to consider, the length of the entire structure from anchorage to anchorage being 4320ft. As this plan of bridge is the one which the New York and New Jersey Bridge companies have selected as the bridge they wish to build, its cost must be accepted for present purposes as the cost of a practicable structure."

Of the 3100ft. cantilever plan the board gives the details of the main features of its construction, and estimates the cost at 51,128,000 dols., and adds:—"Your board are of the opinion that the additional cost of the long span cantilever bridge is so great that it must be considered impracticable."

"A suspension bridge is another possible form of construction at this location. Like the cantilever, it can be erected without false work; unlike the cantilever, it has not generally been considered well adapted to railroad uses. It has less rigidity than the cantilever and deflects more from the combined effects of temperature and load; the flexibility of the cables tends to cause vertical undulations of the platform under a moving load, which are more objectionable for a railway bridge than for a highway bridge, where the live load is less concentrated and is applied less rapidly. These objections lessen in importance as the span of the bridge and the proportion of the dead to the live load increases.

"In a bridge with six independent tracks the condition of the railroad service approaches that of highway service, and the position of trains which will produce a maximum disturbance would be of very rare occurrence. The inclination of the platform longitudinally and transversely, arising from the undulations of the cables under the effect of moving trains, can be reduced within unobjectionable limits by a proper system of stiffening. The effect of wind on cables and platform can be taken care of by cradling the cables and by a lateral system of bracing in the platform similar to that used in truss bridges.

"A single railroad track suspension bridge of 850ft. span has been in continuous use under restrictions of load and speed for nearly forty years at Niagara. With this example before us a six-track railroad suspension bridge of 3100ft. clear span cannot be dismissed without careful consideration. Your board have therefore investigated such suspension bridge with great care, and it is their opinion that it could be built and that it would be a safe structure.

"As this opinion may be thought a departure from general opinion as to the adaptability of the suspension bridge to railroad service, it is proper that the board should state their reasons therefor, and explain the features of the plan adopted by them for a comparative estimate in more detail than was done for the cantilever plans."

Discussing the plan for a lighter structure than has been described, costing 30,743,000 dols., the board says:—

"The calculations of the cost of the suspension bridge which has been described have been made as nearly as possible on the same basis as the estimates for the cantilever bridge, without taking into consideration the fact that the cantilever bridge would be strained nearly to its full capacity by a load 1000ft. long, while the suspension bridge would be fully strained only when covered by a load three times that length. Furthermore, no allowance has been made for the fact that the maximum strains in the stiffening truss would occur only under combinations which might not arise once in a century, and which could be prevented by simple police regulations. The only subject referred to your board is to recommend what length of span not less than 2000ft. would be safe and practicable for a railroad bridge to be constructed over the Hudson River between Fifty-ninth and Sixty-ninth streets. A single span from pier-head to pier-head, built on either the cantilever or suspension principle, would be safe. The estimated cost of a 3100ft. clear span cantilever being about twice that of a shorter span, your board consider themselves justified in pronouncing it impracticable on financial grounds. As the cost of the single span suspension bridge is almost one-third greater than that of the 2000ft. cantilever, your board are unable to say that such greater cost is enough to render the suspension bridge impracticable."

## RUSTLESS COATINGS FOR IRON AND STEEL.[*]

By M. P. Wood, New York City, Member of the Society.

(*Continued from page 232.*)

*Process for enamelling cast iron.*—The records of the Patent-office show many formula for compositions and designs of furnaces used in the process for enamelling cast iron. But few, if any, of either the compounds or furnaces materialise on application, generally leaving the party to his own devices for accomplishing the desired results. There are only two processes by which a satisfactory enamelled surface can be given cast iron. In the first, or hot process, the iron, heated to a bright red, is powdered by a sieve with a flux powder—the borosilicate of lead—then heated until the flux fuses, and is then powdered with a more fusible flux, forming the glaze of the enamel. This is the only direct enamelling process, and is dangerous to the operator, expensive in application, difficult to apply to large articles, nor does it allow of decorations. The second process consists of coating the cast iron with a kind of pottery, by three distinct and successive operations in the furnace. In the Bertrand process the article is first coated with the magnetic oxide as described above, then brushed over or dipped cold into the borosilicate of lead, coloured with metallic oxides, to which is added a little pipe clay to give the bath more body. The article thus covered is put into the furnace, the enamel adheres and vitrifies at the ordinary temperatures used by enamellers. By putting a coating of coloured enamel with a brush on the first plain coat of enamel, it is possible to make any desired decoration, which may be burned in at one operation. The process is particularly adaptable for outdoor vases, statuary, columns, railings, balusters, &c. The results due to the first oxidation with magnetic oxide are remarkable as much for their colour as for the tenacity of the enamel and its resistance to rough usage. The process is adapted to articles of any size or shape, is not dangerous to apply, and is comparatively cheap in application. The back numbers of the *Scientific American* contain some valuable suggestions and information upon the above and other processes for the protection of iron, for which the writer cheerfully renders acknowledgment.

A process of forming a black or magnetic oxide that has a limited application, but worthy of mention as containing some possibilities for the future experimenter, is the Maritens patent process, in which the article to be oxidised is connected to the anode pole of a galvanic battery and immersed in hot water, when it becomes oxidised. A repetition of the process is necessary to secure a favourable result. Full information and detail of the process is given in a publication by Dr. George Langbein, of Leipzig, Germany, of which there is a translation with additions by William T. Bramet, editor of the *Techno-Chemical Receipt Book*, 81, Liberty-street, New York. In this process the water is decomposed by electrosis, the hydrogen being set free, while the oxygen goes to the iron to form an oxide coating. This process appears to be the progenitor of the electric welding process that attracted so much attention at the Columbian Exposition. In the latter case the strong current from the dynamo causes so rapid a decomposition of the water as to surround the immersed article with an envelope of hydrogen of so high tension that it prevents the escape of the heat generated by the decomposition of the water, and a rapid rise in temperature to the welding point results; the oxygen being set free, no oxide forms. The weaker current used in the Maritens process simply reversed the welding method.

*The Gesner rust-proof process.*—This process for the preservation of iron and steel is of comparatively recent introduction, and, like the Bower-Barff process, forms a coating from the metal itself that it is depended upon to protect.[‡] While the Bower-Barff process forms a magnetic oxide coating, the Gesner process claims to change the surface of the metal into a compound of hydrogen, iron and carbon, which is designated as a double carbide of hydrogen and iron; analysis of treated articles showing the presence of hydrogen in quantities from two-tenths of one per cent. and upwards. This coating does not scale off by mechanical injury; articles treated can be bent cold to an angle of 45 deg. without injury, does not alter the dimensions of the articles treated, screw threads and nuts running together as freely after treatment as before; while the Bower-Barff process when carried to the point of forming a heavy coating of magnetic oxide, materially increases the size of the parts, and has to be allowed for in fitting up of finished and jointed parts, such as hinges and loose joints. A claim made for articles treated by the Gesner process that they are unaffected in strength appears to have some foundation. The record of a number of tests made at Philadelphia on an Olsen testing machine show that the wrought iron samples were comparatively unaffected in strength by the treatment, while the steel articles showed a loss in strength of about 5 per cent., and a gain of 5 per cent. in elongation, evidently from the annealing action of the muffle. Cast iron pipe treated shows that the pores of the iron are filled and the strength materially increased. Cases reported show an increase in bursting pressures of over 100 per cent.

The colour of the treated articles is a fine deep blue-black. Tempered articles, such as springs, bayonets, edge tools, &c., cannot be treated, but in some cases articles can be hardened and tempered after treatment. The process does not necessitate the use of skilled labour; after being established ordinary working men are all that is requisite. The process is adaptable wherever tinning or galvanising are employed to withstand atmospheric effects, and is materially cheaper than those methods. Among the adaptations for this process can be named: office railings, grilles, gates, wrought, cast, and malleable iron pipes and fittings, steel and iron shingles, corrugated sheets for roofing, polished wrought iron pipe for bedsteads, steam radiators, builders' and art hardware, architectural ironwork of all kinds, gun fittings, &c. These articles can be treated in small lots for prices from four and a-half to seven cents per pound, and large pieces wrought iron pipe in 20ft. lengths in quantities will not cost over one cent per pound, including manufacturer's profit. One of the principal articles thus far treated is a clock tower on a storage warehouse on Schermerhorn-street, Brooklyn, the clock dials of which are of wrought iron scroll work, 16ft. in diameter. The surface of the treated articles appears to facilitate the spreading and adhesion of paint if any is subsequently required on the structure.

The articles must be cleaned from scale to secure a good result, though the removal of oil and grease due to machining processes is not necessary. The apparatus and process of treatment is, viz.:—Two ordinary clay gas retorts—Figs. 1, 2, and 3—of any required length from 7ft. to 20ft. or more are set side by side with a furnace and grate below and between them, same as a gas retort setting. Suitable doors are fitted to one or both ends of the retorts as used for gas retort work. These retorts are heated to 1000 deg. or 1200 deg. Fah., as may be determined by the character of the articles to be treated. The articles are placed in the retorts and exposed to the heat for twenty minutes, or until they attain approximately the heat of the retort or muffle, when steam at low pressure is admitted to the inside of the retort through an iron pipe lying on the bottom of the retort and called a hydrogen generator, which decomposes the steam, hydrogen being set free, which fills the retorts, the surplus pressure passing out by a purge pipe sealed in about 1½in. of water to prevent ingress of air to the retorts. This steam treatment is kept up for thirty-five minutes, when a small quantity of naphtha—a pint or more—is injected by gravity into each retort and allowed to flow for ten minutes. The hydro-carbon is then cut off, and the steam which has been allowed to flow during the whole operation is continued some fifteen minutes longer. The whole time employed is therefore an hour and twenty minutes for articles of ordinary size and weight, such as builders' hardware, &c. The articles remain in the muffle sealed from air until the heat has fallen to about 800 deg. Fah., when they can be removed without danger of scaling. Ornamental objects, art hardware, &c., while hot are given a bath in whale or paraffin oil, to render them even in tone, prevent finger marks, &c. The process appears to be almost indentical with the Bower-Barff, with the exception of the use of the naphtha, which gives a foundation to the claim for the formation of a carbide that hastens the process; the time of treatment being materially lessened in the Gesner process than by the Bower-Barff to get the same thickness of coating. A number of plants for the working of this process are in operation in various parts of the United States, the principal one, the South Brooklyn Rust-proof Iron and Steel Works, 176, Sullivan-street, near Atlantic Basin, South Brooklyn, has a capacity of two tons daily output of small articles like builders' hardware, and six tons of pipe up to 7½ft. in length, and can treat articles up to 20ft. in length. Members of the American Society of Mechanical Engineers are welcome at any time to inspect the works and product, Mr. Geo. W. Gesner, proprietor, being in charge of the plant. A number of samples of rough surface and polished work are submitted for inspection.

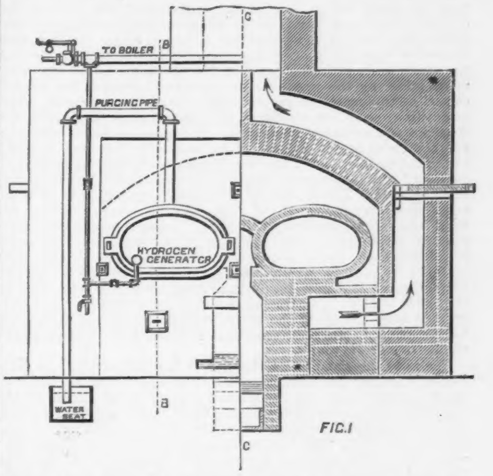


FIG. 1

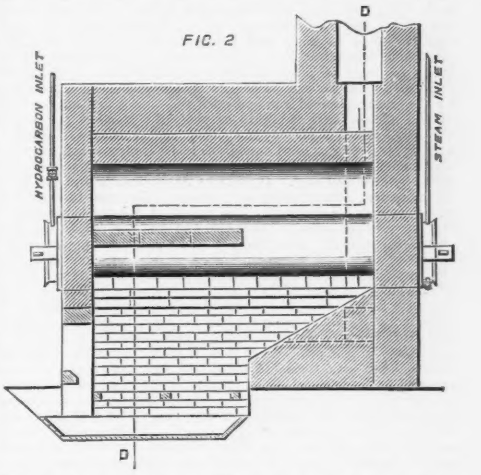


FIG. 2

After quoting at length an article from one of the technical papers, the author went on to say:—I think the presence of the scale found in most boilers acts as a partial preservative, as in general the shells of all types of boilers show the effects of corrosion more upon their external than internal surfaces. Boilers using perfectly pure or distilled water are more liable to pitting than a general corrosion over the whole surface of the shell and tubes. Why this is so is a mooted question. Pure hot water is a strong solvent of nearly all bodies; steel and iron do not escape its action, as the collapse of the Boston, Mass., hot water circulating system forcibly shows, and is fresh in the minds of all engineers. The Heine boilers that furnished the hot water, under a pressure of 450 lb., for the system in question, were comparatively unaffected, and other boilers and pipes under similar conditions have worked for years without showing the tendency to melt away as did the street pipes in this case.

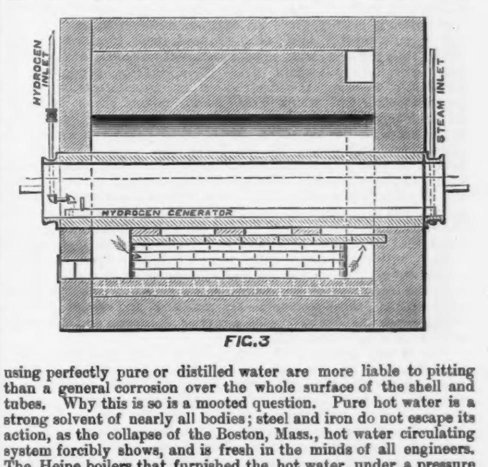


FIG. 3

The course of the Admiralty in causing all boiler plates to be pickled and cleaned from the scale of manufacture is in the right direction, and should be extended to all the plates used in the construction of ships. In fact, all iron and steel requiring protection from corrosion other than by the magnetic oxide processes, and that depend upon paint for their protection, it is an indispensable condition that the scale must be removed in order to secure the best result. When this is done and strictly pure red lead is mixed with pure raw linseed oil that has escaped the manipulations of the whale or Menhaden oil merchant, a paint is produced that will unite so closely to the iron or steel surface as to be only secondary in preservative qualities to magnetic oxide in resisting atmospheric effects. The writer cites from his experience a number of wrought iron tie bars that in an outdoor exposure of over fifty years were as unaffected from rust as though they had been up only a week. Examination showed that the bars had been scaled before painting, and had received two coats of pure red lead and oil paint at the date of their erection, and from their location in the structure could not have been repainted without removal from their position.

---

[*] Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

[‡] United States patents to George W. Gesner, No. 376,874, January 24th, 1888. Apparatus for oxidising the surfaces of metals; described in the *Official Gazette*, vol. 42, page 343. No. 379,866, March 20th, 1888. Treatment of metals; described in the *Official Gazette*, vol. 42, page 1268. See *Iron Age*, April 3rd, 1890, for an illustrated article of the process and apparatus; also the *Engineering Journal* (Forney's), April, 1891, for description of the process.

How rapidly rust will form beneath the scale of manufactured iron, one need but to look at the trusses and iron work of the elevated railways of New York to recognise the importance of this preliminary step in the protection of the surface. In this case successive coats of a poor, cheap paint, are spread at intervals over the whole easily accessible parts of the structure; no efforts being made either by the engineers or painters to remove the blisters caused by the corrosion in progress beneath the first coat. How long this process can continue without seriously weakening the structure is a matter of guesswork. A suggestive lesson upon this point is found in the collapse of an iron and slate roof, covering the retort room of one of the New York Gas Works, that suddenly gave way without warning, and played the part of an extinguisher to all beneath. The tie rods of the trusses proportioned to withstand five times the weight of roof, with the usual allowances for wind and snow pressures, had wasted away beneath successive coats of paint and coal tar applied, until rupture came as a matter of course even under conditions of a minimum strain. The material in the old Hammersmith Bridge across the Thames at London was bought by Sir William Arrol to use for false work at the Forth Bridge. The iron after sixty-two years of service was as good as new. Many of the parts were inaccessible, and had not been repainted since their erection. Pure white lead paint was at the bottom of the secret.

The red houses and barns that are so familiar a feature in New England scenery have been standing from fifty to over one hundred years exposed to an atmosphere and climate charged with all the conditions that cause rapid decay. These buildings, when erected, received in general two coats of red oxide of lead and pure boiled linseed oil paint, that has so thoroughly protected them, that where the paint has in many cases been completely cut away by the sand blast of the Cape Cod storms, the wood sheeting is in good condition and the nail heads are as perfect as when first driven. But the paint was honest, no red or brown oxide of iron with a liberal addition of barytes, whiting, pipe clay, ochre, and other "almost as good as lead" compounds, mixed with sour sig and oil so fishy that one could almost detect the fish scales on the painter's brush, entered into this work. The Puritans knew nothing about railways, steam engines, telegraphy, telephones, the wiles of electricity, or of the Hawaiian question, and even escaped acquaintance with the A. S. M. E.; but they could paint their sheep sheds so thoroughly that the generations succeeding them have had but little to do in the form of renewals and repairs.

The *Engineering Journal*, Forney's, vol. 65, No. 4, page 163, April, 1891, has a long and instructive article on "The Preservation of Iron and Steel Structrual Work," by Woodruf Jones, A.M., that embodies so much useful imformation upon the subject of paint and its application to metallic surfaces, that I quote it almost entire in order to bring the best protective methods of the day down to a point for comparison: "The requisites of a good paint for the preservation of iron and steel are, that it shall adhere firmly to the surface and not chip or peel off; it must not corrode the iron, else the remedy may only aggravate the disease. It must form a surface hard enough to resist frictional influences, yet elastic enough to conform to the expansion and contraction of the metal by heat and cold. It must be impervious to and unaffected by moisture, atmospheric, and other influences to which the structure may be exposed. The paints that have been used for this purpose are principally asphalt and coal tar paints, consisting of mineral and artificial asphalt or coal tar, either applied alone or combined with each other, and more or less with metallic bases, and iron oxide paints and lead oxide paints, especially red lead, in all of which the pigment is held to the surface of the metal by combination with linseed oil. The choice of paints must lie, so far as our present practical experience goes, between these three classes, zinc oxide being found to be entirely unsuitable on account of its propensity to peel off. What then is found to be the experience in actual use with these? Asphalt and coal tar paints run when exposed to the sun and other sources of heat, which is a serious matter with vertical surfaces, and after a time become extremely brittle and scale off entirely, leaving the under surface exposed unless the paint is constantly renewed. In the mean time the exposed iron and steel are being corroded by rust. Iron oxide paints, including 'metallic brown,' are paints made from iron ore, or by some chemical process with an iron base. These are invariably iron in a greater or less degree of oxidation, or, in other words, rusted iron. Now, it is well known that one of the most active promoters of rust or decay in iron is the rust itself. Under the combined influences of the moisture and carbonic acid of the atmosphere, iron oxide, or iron rust, becomes a carrier of oxygen from the air to the metal, rust begetting rust; it is therefore evident that this material alone has no preserving effect on iron; in fact, it promotes its decay. How is it when combined with linseed oil in the form of paint? In the economy of nature iron oxide is a great disinfectant. When in contact with organic matter and moisture, even at a low temperature, under favourable conditions, it readily gives up oxygen, destroying, more or less, the organic matter, and being reduced itself to a lower oxide. When thus reduced, with equal readiness it absorbs oxygen from the atmosphere and again passes it on, thereby promoting and eventually ensuring the destruction or transformation of the organic matter with which it may be in contact either in the soil or elsewhere. The same process appears to take place when combined with linseed oil in the form of paint and exposed to atmospheric influences, the oil being the organic matter. If linseed oil in drying formed an air and waterproof film, it might be urged that the oxide of iron would be entirely protected from the direct influences of oxygen of the air and moisture; such, however, is not the case. The most eminent authorities have recently shown that the dried film of linseed oil, unless united with a pigment that combines chemically and forms a waterproof coating with it, actually absorbs water very much as a sponge. Where water will go, air will also go, and we thus have in direct contact with the iron oxide of the paint, which does not combine chemically with oil, those elements—air, moisture, and organic matter—which cause the iron to become a carrier of oxygen and a destroyer of what it is in contact with.

"It is well known that iron paint darkens with age; this is caused largely by the iron oxide losing oxygen, which is partly transferred to the oil, burning it up, and destroying its tenacity, as may be seen by examining iron structures painted for some time with iron paint or metallic brown, the paint being found extremely brittle and in feathery scales. This is not all the damage done. The iron oxide in the paint becomes a carrier of oxygen to the metal it was designed to protect, and the process of corrosion is commenced and carried on under the paint, which eventually peels off, the surface of the metal being found more or less oxidised and corroded. Asphalt and iron oxide being thus shown to be entirely incapable of preserving iron, it remains for us to consider the effect of red lead. This pigment has the property of forming with linseed oil a hard elastic coating clinging with great tenacity to the metal. It has no oxidising effect on iron, and does not act as a carrier of oxygen from the atmosphere after the paint has set, neither does it render the oil brittle nor promote rust. When red lead fails, it is principally by gradual wear or friction from the outside. It does not scale or blister, which both asphalt and iron oxide paints will do, thereby requiring a thorough scraping and removal of old material before a new coat can be applied. Any red lead pigment adhering to the metal forms a permanent base for subsequent paintings, and is utilised in further preserving the metal. The Government specifications for iron work in the new library building of Congress provide, that 'all the work not Bower-Barffed must be given one coat of pure red lead paint—not metallic paint of any kind, but pure red lead—before leaving the shop and before becoming rusted. The experiments of the Navy Department on the preservation and fouling of plates covered with different pigments may be interesting. A plate of iron covered with asphalt paint was immersed in sea water for eight months and six days. At the end of that period it was found to be covered with scum and mud and very badly pitted. A plate coated with iron paint was found to be covered with shell and coral, but little paint remained, and the plate was badly pitted and rusted. A plate with two coats of red lead was found to have a few barnacles attached, but to be in fair condition, with no rust whatever on the iron after the paint was removed. The red lead not only protected the iron better than the other pigments referred to, but the plates were in better condition as regards barnacles and fouling. The superiority of red lead being thus established, it is adopted for use on the hulls of all Government vessels. If red lead is thus proved to be the best pigment for preserving iron and steel structures, what is the best method of applying it? The value of red lead depends upon its forming a hard, elastic coating having a great tenacity for the metal. This is owing to its forming certain combinations with the oil, and actually setting very much the same as plaster of Paris or cement sets when mixed with water. To successfully work the latter substances it is necessary to put them in shape as quickly as possibly after mixing with water before setting takes place. If the chemical action of setting has partly taken place the material may be moulded, but good results will not be obtained. Red lead, like these substances, must be applied to the work before it sets with the oil. It is on this point that failures in the use of the pigment have generally occurred, because if it be applied after the combining or setting process has taken place the hard, elastic, clinging coating will not be formed on the metallic surface.

"The following is the practice of a large shipbuilding establishment in applying red lead to the hulls of vessels. The plates are first pickled in a dilute solution of muriatic acid, then passed through rapidly revolving wire brushes which remove all scale and dirt, leaving the plates with a bright surface; then are thoroughly washed with pure water and rubbed entirely dry, and immediately coated with red lead and raw linseed oil. The red lead is first thoroughly mixed with just enough linseed oil to form a very thick, tough paste, which will keep for several days without hardening. This paste, as wanted for use, is thinned down to the proper consistency for spreading with pure linseed oil, and applied at once; care being taken to leave the paint-pots empty at night. A gallon of paint thus prepared contains 5 lb. of oil and 18 lb. of red lead, and will cover on first coat about 500 square feet, the second coat about 600 square feet of surface. In this way the red lead and oil get their initial set on the surface of the metal, and the closer the pigment is brought to the metal the more durable will it be found. Iron primed with iron oxide or metallic brown paints before applying the red lead is a mistake, as these paints readily scale, and, of course, carries the red lead with it. Iron primed with oil before applying the red lead prevents the adhering paint from coming in contact directly with the metal, and should be avoided, because it is out of the question for it to hold on to the surface by any process of absorption into the pores of the metal. The rusting of iron before the application of paint, which is sometimes recommended, should by all means be avoided, as it not only prevents the contact of the paint with the metal, but induces a chemical action, which may go on with its corroding work under the applied paint, as referred to before. The application of dry lamp-black, an ounce to the pound of red lead, mixed together dry and before the oil is added, changes the colour to a deep chocolate, and prevents the red lead from taking its initial set with the linseed oil as quickly as when mixed with oil alone. This compound will remain mixed in a paste form for thirty days without hardening. If rapid drying is desired, Japan dryer can be mixed with the oil used in thinning the paste before application with the brush. The first cost of painting structures with iron oxide is less than with red lead; however, as the labour in painting structural work costs twice as much as the material, true economy must, therefore, be sought in the durability of the paint as well as the preservation of the structure from rust. Structures painted with iron paints have to be repainted the third or fourth year, and if the old material be entirely removed before applying the new coat in order to secure a good application, it entails an increased cost; whereas, with red lead applied at the end of the sixth year, no such expense is necessary, but as before stated, the portion of the pigment remaining on the metal continues to protect the surface, and is the best base for the new coat, and contributes materially toward it."

(*To be continued.*)

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Apparatus for coaling steamers.*—On the great lakes there is an enormous traffic in coal from Lake Erie ports to the North-west, averaging over 3,000,000 tons per season, and many of the coal steamers are of 3000 to 3500 tons. It is most desirable to handle the coal quickly without damage from breakage, and a large part of the work of loading is done by rotary derrick travelling buckets of five tons capacity, but even with these the largest vessels were delayed two to four days in loading, and with eight or ten men shovelling into buckets from a car 3ft. deep, and not taking more than 20 lb. at each shovelful, there was still the disadvantage of separating and breaking the coal. The McMyler apparatus recently put in service takes a loaded open coal car of 24 tons capacity, and dumps its contents at the mouth of the hatchway down a chute into the hold, so that the coal has practically no drop or fall. The dumping apparatus consists essentially of a car travelling on a track along the dock, and fitted with a turntable, steam engine, &c. At one end of the car is a plate girder "bridge" turning on a horizontal axis. The bridge is tilted to bring the shore end in line with the loading trucks, and a coal car is hauled upon it by a steel cable, the car being run to the opposite end of the bridge. The bridge is then tilted to bring the upper end down to the mouth of the hatch, the coal being discharged through the end of the car. All operations are effected by steam and hydraulic power. About thirty vessels have been loaded with 60,000 tons of coal in 300 hours.

*Electric locomotive.*—An electric locomotive, weighing 40 tons and having a draw-bar pull of 14,000 lb., has recently been built, and is designed for heavy hauling at speeds not over thirty miles per hour. The engine has an iron frame, with a large and roomy enclosed cab in the middle, and enclosed ends like the backs of two tenders. There is a headlight at each end, an engine bell, compressed air whistle, and air brake hose couplings. The engine is double-ended, having a pilot—or cowcatcher—coupler, and brake hose at each end. Upon the roof of the cab are mounted two trolley poles to bring the current from the overhead wires. The frame is carried upon two four-wheeled trucks or bogies, having frames of steel channels and plates. The wheels are 3ft. 4in. diameter, and the wheel base of each truck is 6ft., the total wheel base being about 15ft. The axle bearings are 4½in. diameter and 8in. long. Each axle is driven by a single-reduction spur gear motor, mounted upon the axle, as in street railway cars. The body or frame rests upon eight elliptical springs, which rest direct upon the axle-boxes, which arrangement secures steadiness and easy riding. The axle-boxes are of cast iron, with phosphor bronze bearings, and slide in jaws with adjustable shoes. The cab is of sheet iron, and contains, besides the controlling apparatus, an air compressor for the brakes. The engine is 24ft. long over the draw-bars, 11ft. 2in. high to top of cab, and 8ft. 4in. wide over all.

*Compound locomotives.*—The following table shows the performance of two consolidation engines—eight driving wheels and a two-wheel leading truck, of the same design, except that one is simple, with cylinders 19in. by 26in., and the other compound, 13in. and 21in. by 26in., in similar service, hauling the same train alternately for the twelve months ending June 1st, 1894. The compound shows a fuel economy of 15 per cent. in the three years of regular daily service, so that all exceptional results are eliminated in the general average:—

| | Simple. | Compound. |
|---|---|---|
| Miles run | 28,629 | 30,210 |
| Coal consumption, tons | 1,594 | 1,484 |
| Lubricating oil, quarts | 607 | 733 |
| Valve oil, quarts | 308 | 502 |
| Waste, pounds | 315 | 344 |
| Miles run per ton of coal | 18 | 20½ |
| Miles run per quart of lubricating oil | 47 | 41 |
| Miles run per quart of valve oil | 93 | 60 |
| Cost of repairs, dollars | 1,359 | 1,046 |
| Cost of fuel, dollars | 2,028 | 1,866 |
| Cost of oil and waste, dollars | 107 | 131 |
| Wages of enginemen, firemen, and wipers, dollars | 1,878 | 1,848 |
| Total expenses of engines, dollars | 5,372 | 4,890 |
| Cost per mile for repairs, dollars | ·475 | ·346 |
| Cost per mile for fuel, dollars | ·708 | ·617 |
| Cost per mile for oil and waste, dollars | ·37 | ·43 |
| Cost per mile run for wages, dollars | ·656 | ·612 |
| Total cost per mile run, dollars | 1·76 | 1·6 |

*Pneumatic dynamite guns.*—The Ordnance and Fortification Boards of the United States Government have recently been making extensive tests of the three 15in. pneumatic dynamite guns for the coast defence at Sandy Hook. The guns are placed in mortar pits, with heavy concrete walls banked with earth. In one test a projectile, weighing 1160 lb. and carrying 500 lb. of nitro-gelatine, was thrown 2400 yards, or one and a-quarter miles and exploded. The cap was set for two seconds after striking the water, and it was calculated that the projectile would be 18ft. under water at the time of explosion. An immense body of water was lifted from 100ft. to 300ft. in the air. This is the largest charge of high explosive ever used under similar conditions; charges of 100 lb., 200 lb., and 300 lb. were also fired and exploded. In the test for rapidity of fire, dummy projectiles were used, made of iron cylinders filled with sand. Each of the first five shots weighed 445 lb., and they were all discharged in 8 min. 45 sec., the contract time being 10 min. Each of the second lot of ten projectiles weighed 556 lb., and these were fired in 14 min. 40 sec.; contract time, 27 min. The third lot of ten projectiles weighed 1140 lb., the full charge, and the firing time was 15 min. 36 sec.; contract time, 40 min. The firing time for the twenty-five shots was 39 min. 1 sec., while the aggregate contract time was 77 min. The final tests for accuracy and rapidity of fire with these pneumatic-dynamite projectiles took place on August 24th. According to the contract the gunner had to land 74 per cent. of the projectiles within a space 30 yards wide by 120 yards long, at 2000 yards range. Five shells loaded with 500 lb. each of nitro-gelatine were landed all on a straight line only 39 yards long. The official firing time, from the order given to load, was 17 sec., 16⅓ sec., 17 sec., 17⅓ sec., and 17⅓ sec. for the five shots respectively. The first projectile, with a two-second fuse, struck the water and went about 150ft. before it exploded, when it threw up a great body of water. The heavy shells wabbled somewhat at times, and the second and third shots struck on their sides and exploded at the surface on impact; but the effect was described as terrific, sending a column of water 200ft. high. The third and fourth shots were perfect. Afterwards five dummy projectiles, weighing 1160 lb. each, were fired in 7 min. 58 sec., the contract time being 40 min. They were only thrown a few hundred yards, however, as the test was for rapidity of fire and not for range. The record made by the guns is so good that their acceptance by the Government is fully expected. The Government is to pay 162,000 dols. for the two 15in. and one 8in. pneumatic gun, with their carriages, electrical appliances, engines and air compressing machinery, dynamite magazines and air storage reservoirs. The wabbling of the big shells is said to be a defect easily remedied. The guns and carriages weigh 52 tons each, and are easily handled by one man, being controlled by electrical power.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

"Go slow," as the Americans say, is this week's motto in the Midland iron and steel trades. In one or two departments sellers have been "jumping" quotations, notably in Midland pigs, for which from 1s. 6d. to 2s. per ton extra has been asked. But any attempt to force the market beyond legitimate limits is deprecated by men of experience as likely to result in a recoil. Wherefore pig iron prices continue for the most part to rule at the figures given last week; though there is certainly more disposition on the part of buyers to operate ahead of consumption.

Does steel for galvanising answer, after all, better than iron? The discussion afresh of this question has been taken up in Midland circles this week. The opinion expressed in some quarters is, that those ironmasters who have lately been substituting steel for iron in the manufacture of galvanised sheets have quite as much as they can do to make the steel sheets a success. It is quite possible therefore that an increased number of forges for puddled iron will be employed in the future—rather than fewer—by those makers who have given the newer material a fair trial for this particular service. Galvanised corrugated sheets, doubles, are £9 15s. to £10, f.o.b. Liverpool; and £9 17s. 6d. to £10 2s. 6d. delivered London. Black doubles are £6 12s. 6d. to £6 15s.; lattens, £7 5s. to £7 7s. 6d.; and singles, £6 10s. to £6 12s. 6d.

Midland manufacturers are in receipt of colonial advices showing that the recovery of Australia's purchasing powers is proceeding satisfactorily. The financial condition of Sydney and of New South Wales generally is declared to be sounder. As compared with the corresponding period of last year, the failures in the Colony for the first half of the present year show a diminution of over 50 per cent. In Adelaide stocks of fencing wire, galvanised sheets, and wire netting were so cleared out a few weeks back that storekeepers could not fill customers' orders. Mining tools and station requisites have been the chief features in demand at Melbourne, whilst fencing wire, owing to the limited stocks, has advanced in price. The prospects of Western Australia in mining affairs are characterised as most hopeful, and considerable orders for mining machinery and tools may be expected to reach England within the next few months.

How far the proposed new Victorian Tariff, if it becomes law, will affect trade between the Midlands and that Colony remains to be seen, but it certainly ought to improve business to some extent, since machine tools are to be reduced from 35 per cent. to 20 per cent.; leather belting from 45 per cent. to 35 per cent.; whilst iron and steel horse nails are to pay a duty of 10 per cent. *ad valorem*, which is considerably less than the old impost. Proportionate reductions are proposed upon other leading classes of hardware also.

Messrs. Henry Lea and Thornbery, civil engineers, of Birmingham, have designed, and the Walsall Electrical Company have carried out, the installation of the electric light at the Birmingham market hall, which it is anticipated will be in actual use in about a fortnight's time. The annual cost of running the electric lamps will be £507 for energy and £25 for carbons, as compared with £522 for gas. It is proposed, however, to pay off the capital outlay of £900 in ten years, making an addition for interest and sinking fund of £100 per annum for the period named. The electric energy will be taken from the Electric Supply Company's mains.

The corporation considered the desirability of establishing their own generating plant, but decided not to do so.

Electrical engineering does not appear to be prospering just at present at Wolverhampton. The Electric Construction Company, of Bushbury, at its annual meeting had not been able to declare any dividend for the ordinary shareholders, but has spent £1819 in paying a 7 per cent. dividend on the preference shares. A profit of £15,764 has been made on sales of "shares and debentures of other companies," of which £12,500 is appropriated in reducing the amount at debit of that account. The amount carried forward to next account is £2260. Depression in trade and the interruption to business caused by the reorganisation of the company and its staff were adduced by Sir Daniel Cooper—chairman—as the reasons for the present position.

## NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

*Manchester*.—The recent improvement in the iron trade of this district is being well maintained. Although the weight of actual buying going on has fallen off considerably, prices continue strong at the advanced rates, and a more hopeful tone prevails as to the future. The improvement that has taken place is, however, still chiefly confined to pig iron, in which a fairly large business has been done. Manufactured iron has not, so far, participated to any appreciable extent in the increased demand, and the position in the steel trade is scarcely better to any material extent, beyond the increased business that has been thrown into the hands of local and district manufacturers by the stoppage of production in Scotland. With regard to the engineering industries there is still no really noticeable move towards improvement. Here and there special machine tool makers are able to report rather more work giving out, and in other branches there are isolated cases of increased activity, but generally the position remains but very unsatisfactory, with new work still coming forward but slowly, and in small quantities.

A fairly healthy tone would seem to prevail generally on the Manchester Iron Exchange on Tuesday, with a moderate weight of inquiry stirring and prices strong at full rates. For pig iron, although there is a considerable falling off in the weight of buying—as compared with a week or so back—there is still a moderate business coming forward, and at a trifle under their quoted rates makers could book fair orders here and there. For Lancashire pig iron makers still quote on the basis of 40s. for forge to 42s. for foundry, less 2½, at the works; or, equal to about 44s. 6d. for forge to 45s. for foundry, less 2½, delivered Manchester, and a limited business is being done at about these figures. For district brands, makers who are well sold for the present have in some instances hardened up their prices; but in Lincolnshire forge there are still low sellers, and business has been put through at about 39s. to 39s. 6d. net cash, delivered Manchester. The leading makers, however, do not quote anything under 40s. for forge, with foundry qualities averaging 41s. to 41s. 6d. net cash, delivered here. The Derbyshire makers are also further slightly stiffer in their prices, 45s. 6d. to 46s. net cash being now about the average quotation for good foundry qualities, delivered Manchester. Outside brands offering here fully maintain late rates, good foundry Middlesbrough being scarcely obtainable under 45s. 4d. net cash, delivered Manchester, whilst holders of Scotch iron are indifferent about selling under 49s. for Eglinton, and 51s. for Glengarnock, net prompt cash, delivered at the Lancashire ports.

Finished iron makers here and there are perhaps better off for work, but except that they are now able to take a firmer stand with regard to their quoted rates, there is no really material improvement in this branch of trade. Lancashire and North Staffordshire bars are not now quoted under £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; with the Association list rates for hoops remaining at £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Nut and bolt makers report rather more business coming forward, but they are obliged to take rather low prices to get hold of orders.

In the steel trade the position is perhaps slightly better, and good foundry hematites are firm at 53s. less 2½ as the minimum for delivery in this district, whilst one or two makers who are well sold are asking quite 1s. per ton above this figure. Ordinary basic billets can, however, still be bought at £4 net cash, delivered here. For manufactured steel prices are firm at about £6 7s. 6d. to £6 10s. for boiler plates, and £6 to £6 2s. 6d. for steel bars for prompt delivery in this district, but there are forward sellers at under these figures.

In the metal market there is very little doing, buyers holding back in the expectation that the downward movement in raw material may bring a return to lower quotations for manufactured goods.

I had an opportunity of witnessing during the week, at the Botanical Gardens, a trial of a steam lawn mower—Sumners' patent—which is being introduced by the Stott Distributor Company, Manchester. This steam mower, which is combined with a roller, is a very handy machine, suitable for cricket and tennis grounds or large lawns, and consists of a boiler and engine mounted on the top of a roller, carrying in front an ordinary cylindrical cutter and grass-box, and the weight being so balanced that the machine can be controlled and directed by hand almost as readily as an ordinary lawn mower. The boiler is of the multitubular type, containing sixty-six copper tubes in a copper fire-box, the shell being made of mild steel. Steam is generated in the boiler by the use of ordinary lamp oil as fuel, which is burnt in the fire-box by a burner similar to that in a naphtha lamp. The oil is carried in a specially constructed reservoir at the top of the chimney, from which it is fed to the burner by a small tube, and the water is carried in a cylinder between the shafts of the machine. The steam pressure is regulated by a diaphragm, which automatically controls the supply of oil to the burner, so that the steam is maintained at a uniform pressure whilst the engine is working. The machine is made in various sizes from 20in. up to 42in. cutters, the one tried, which had 30in. cutters, being readily manipulated even by an inexperienced person. In addition to being used as a steam mower and roller, this apparatus also forms a small portable engine for driving any kind of light machinery, such as chaff-cutters, laundry, churning, and pumping appliances, small lathes, or dynamos for electric lighting.

The members of the Manchester Association of Engineers closed their summer excursions by a visit on Thursday last to the works of the Lancashire Watch Company, at Prescot, which had been kindly thrown open for inspection by Mr. T. P. Hewitt, the managing director. As these works were fully described recently during the visit of the Institution of Mechanical Engineers, it is unnecessary to again enter into details as to their general arrangement, but I may add that the opportunity afforded for the examination of a large number of specially-designed machine tools for performing the minutest possible work, with the greatest accuracy was, from a mechanical point of view, of exceptional interest to the members. After spending several hours in the works, the party sat down to tea at the Royal Hotel, Prescot, and Mr. Thomas Daniels, president of the Association, in giving expression to the great pleasure the members had experienced in going over the works, said that from what they had seen he was sure the company would be able to hold its own with any country in the world in the manufacture of watches. The mechanical ingenuity which had been displayed in developing and perfecting the machinery required for the various processes in the manufacture of watches was something surprising, and the highest credit was due to the management for what had been accomplished in this direction. Mr. Thomas Ashbury, C.E., then proposed a vote of thanks to Mr. T. P. Hewitt and the other directors. It had been said that genius was the perfection of detail, and an opportunity had been afforded them of seeing the perfection of detail carried out to a surprising degree, in the machinery which had been put down in the works for the various special processes in the manufacture of watches, and he was sure the members could not fail to appreciate the wonderful ingenuity which had been shown in designing many of the marvellous machines they had seen that day. Mr. Webb, in seconding the vote of thanks, said he did not know which to admire most—whether the perfect accuracy of the automatic machines, or the skill of those engaged in manipulating the various processes. Mr. T. P. Hewitt, managing director of the company, in briefly responding, said they had a great many difficulties to contend with in establishing the Prescot Watch Factory. Perhaps not the least of them was the prejudice which existed against machine-made watches. They had, however, been able to show that it was possible to produce watches by machinery which were quite as good as—if not better than—those made by hand, whilst the cost of manufacture had been enormously lessened. Operations which under the old process entailed a cost of 12s. up to 20s., were now being performed with perhaps greater accuracy at the cost of a few pence.

The coal trade continues exceedingly quiet, there being no move towards improvement, except perhaps a slightly increased inquiry for house-fire qualities. Pits are still not working more than four days per week, with the output considerably in excess of requirements. Common round coals for steam and forge purposes and engine classes of fuel continue more or less a drug in the market, and with the collapse of the Scotch strike, and the consequent cessation of the large shipments of coal for the above district, there is a probability of still further surplus supplies coming upon the market, which must necessarily tend to weaken prices, and the outlook as to the future is anything but encouraging. Quoted rates remain much as last given, averaging about 11s. for best Wigan Arley, 10s. for Pemberton four-foot and seconds Arley, 8s. for house coals, 7s. to 7s. 6d. for steam and forge coal, with engine fuel ranging from about 3s. 6d. to 4s. for common slack, to 4s. 6d. and 5s. for good medium, up to 5s. 6d. and 6s. for the best qualities, at the pit mouth.

In the shipping trade there has been a decided quieting down during the last few days, but quoted rates for Lancashire steam coal so far remain without any material change, averaging 8s. 6d. to 9s. per ton, delivered at the Garston Docks or the High Level, Liverpool.

*Barrow*.—There is a quiet business doing in hematite pig iron, and orders are not likely to increase. The foreign, colonial, and continental trade is very quiet, but there is still a fair business done on local account. Although the actual home demand and aggregate is small, makers are still quoting 45s. to 46d. net f.o.b. for parcels of Mixed Bessemer Nos., while warrant iron remains steady at 45s. sellers, and 44s. 11d. buyers, net cash. Stocks of iron are 257 less than last week, and now stand at 158,066 tons in warrant stores, or 63,443 tons less than in the beginning of the year.

Iron ore is quiet in tone, and orders are coming to hand slowly from all sources. There is very little doing on local account, and orders from Scotland are fewer than ever. Ordinary qualities are quoted at 8s. 6d. per ton net at mines, and best descriptions run up to 12s. and 13s. 6d.

The steel trade shows rather more life in tin-plate bars, and orders are coming to hand with more freedom. But in rails there is nothing new to report in the way of new business, although inquiries have increased, as is usual in autumn, and it is probable that a fair business will be done during the winter months. There is a brisk business at the steel plate mills, and although orders are not so plentiful as they have been, makers have reason to expect a continuance of briskness for several months to come. A quiet demand is experienced for billets and hoops, and no trade is doing in slabs, blooms, and wire rods.

Shipbuilders and marine engineers are fairly well employed, but new work is not coming to hand, and some orders which were expected have gone past. There is some prospect of new work, however, although it will only represent a small trade. Only a few repair jobs are now to hand.

Coal and coke are quiet at late prices. The consumption is small and is not increasing. Prices are steady.

Shipments are very unsatisfactory. The exports of pig iron for past week amounted to 3513 tons, and of steel 6605 tons from West Coast ports, compared with 2110 tons of pig iron and 8636 tons of steel during the corresponding week of last year, being an increase of 1403 tons of pig iron, and a decrease of 2031 tons of steel. The aggregate shipments for the year so far as it has gone represent 254,061 tons of pig iron, and 283,343 tons of steel, compared with 190,111 tons of pig iron, and 355,846 tons of steel in the corresponding period of last year, an increase of 63,950 tons of pig iron, and a decrease of 72,521 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Doncaster week is mainly a holiday in the Yorkshire coalfield, particularly in South Yorkshire. All Yorkshiremen are "horsey," and the collier is the "horsiest" of all. The Leger Day to him is sacred, and as a rule he does little more work that week. The cessation of the coal traffic on the district railways is rather a relief to the companies; for the passenger trains are so numerous, and require so much attention, that minerals are in danger of being delayed or postponed in their dispatch. On Wednesday very few agents or buyers were at Barnsley, and it was somewhat unusual to find any there on Leger Day. It was stated that, contrary to the custom of previous years, several pits were working; and this may be the beginning of a new order of things, when the collier will take more interest in his work than in his pleasure in Leger week. Other circumstances combined to make last week a dull time in the coalfield. The dispute with the pit lads is not yet settled; and, in spite of the advice of the Yorkshire Miners' Association officials, the youths appear disposed to have a few days' "play." There is also a dispute with regard to the colliery enginemen. They resist the reduction of wages as decreed by the Conciliation Board on the ground that they are not members of that board, and that they are not bound by its decrees. They therefore demand that their minimum wages shall remain at 30 per cent. above the 1888 rates. A ballot of the enginemen has been taken, and the bulk of the papers are already received. A few have yet to be given in, and the time for receiving them has been extended until Saturday next. On the ballot paper they are required to say "Yes" or "No" to the question of a reduction, and further to say whether they will agree to give fourteen days' notice in the event of the reduction being enforced. A strike of the colliery enginemen in South Yorkshire would be a very serious factor in the autumn coal trade, for they practically hold the working in their hands. It is not anticipated, however, that the difficulty will lead to anything like a general rupture in the coalfield.

The demand for house coal is getting more active owing to the easterly winds causing householders to begin stocking for the winter. Summer prices will be maintained until the end of December, after which there will no doubt be an advance. At present Silkstones are making from 9s. 6d. to 11s. per ton, and are firm at the figure. Barnsley House from 8s. 6d. to 10s. per ton; other qualities about 8s. per ton. Steam coal is well called for, the reports of the export trade from Hull and other Humber ports still continuing favourable; prices vary from 8s. to 8s. 6d. per ton. It is noteworthy that although the Baltic trade, in the aggregate, is not quite up to former years, there has been a considerable increase in the weight taken by markets where a heavy trade was scarcely expected. These include Belgium, Germany, France, and several of the Mediterranean ports. Gas coal is rather firmer, but it is not ordered in anything like large quantities. The demand for slacks is affected by the depression in the manufacturing districts. Supplies are largely in excess of the demand, and good slack can be procured from 3s. 6d. to 4s. 6d. per ton. Smudge and small coal are practically unsaleable.

The steel trade does not exhibit any material alteration on the week. There is a brisk inquiry for the higher qualities of tool steel from the Continent, but the call for crucible steel generally is, if anything, weaker in that direction than during the earlier months of the year. On the whole, however, a slight improvement is apparent in business. Railway material scarcely maintains the animation reported a month ago, although several of our firms are well off for orders. The increased value of the rupee is an encouraging feature for India and other countries where a silver currency is in use. If it could be maintained after the termination of the war between China and Japan, business with India and similar markets would be immensely improved. Very little hope is entertained of the rupee remaining above the old figures when the present hostilities are at an end. A general stiffening of prices is reported in pig iron. Hematities are sold in Sheffield at 1s. to 1s. 6d. per ton advance upon the prices obtainable three or four weeks ago. Forge iron has gone up quite 2s. per ton. Hematites are 52s. to 54s. per ton, according to brand. Common forge iron, 39s. to 40s., both in Sheffield. Bessemer billets, £5 10s. to £5 15s. per ton.

Shipbuilding is exceedingly slack, and there are few signs of any improvement, freights indeed being lower than ever, and consequently there is no inducement for new vessels to be built. The P. and O. Company's recent orders for five ships—three with Messrs. Caird and Co., Greenock, one with Messrs. Alexander Stephen and Sons, Glasgow, and one with the Palmer Shipbuilding Company—are practically the only items of importance placed during the last few weeks. So long as a large number of ships is laid up for want of work, one cannot of course look for any improvement in that direction. The want of orders for shipbuilding material has brought the prices of steel plates and bars to a figure which can only leave the makers a loss, and although during the Scotch coal strike sixty-eight out of seventy furnaces in blast have been blown out, trade has been so bad that the absence of this large output has hardly affected the price of pig iron.

At the Cyclops—Cammell's—and River Don Works—Vickers'—armour-plates are being made for two first-class battleships now being built in this country for the Japanese Government. At the Atlas Works—Brown's—the boilers for both ships—eighty furnaces in all, of the Purves type—are being constructed.

The Duke of Cambridge visited the Cyclops Works—Messrs. Charles Cammell and Co.—last Saturday, the principal object of his Royal Highness's visit being to witness the testing of the Boynton shield. This shield is patented by Captain Francis Boynton of the staff of the Cyclops Works. The shield is a plate of specially prepared chrome steel, with a slot in the top for the soldier's rifle, which may be secured to an attachment. The weight is stated to be less than one-half that of a lifeguardsman's cuirass, and it is claimed that the material is absolutely proof against service bullets propelled by cordite through a Lee-Metford barrel at thirty yards distance. The experiments were conducted in a simple though effective manner. Six plates lay on a wooden trestle a few yards away from a tube thirty yards long constructed like a shooting gallery. Near an adjoining wall six shields were buckled together in order to illustrate the effectiveness in a campaign. In this position they resembled six riflemen. In another part of the works a rifleman lay prone with a shield on his head. This was intended to demonstrate the difficulty of any marksman hitting the soldier in a vulnerable spot, the protection at the same time not being so cumbrous as to prevent him assuming the offensive. One of the plates, after a chalked circle had been marked upon it, was fixed at the end of the gallery. Mr. Tucker, R.E., fired five shots from a Lee-Metford rifle, the marksman, by desire of the Commander-in-Chief, placing his shots as nearly as possible in the same spot. Four of the bullets struck the plate within a circle little more than an inch in diameter. The only sign of the impact was a slight tearing of the steel in the rear of the bulge caused by the repeated blows on the same spot. The plate, however, remained entirely unperforated. Each bullet was estimated to strike the shield with more than a foot ton of energy. After the trials his Royal Highness expressed his perfect satisfaction at the results of the tests, as not the slightest damage appeared to have been done to the shield. Messrs. Cammell and Company had, he considered, succeeded in solving a problem which had baffled the experts for many years. The tests were undoubtedly striking testimony to the superior quality of the metal employed, and in his opinion the result of the firing was eminently satisfactory. The Commander-in-Chief had an opportunity of seeing other processes in the works, including the casting of a 52-ton ingot, which, when reduced to the necessary dimensions, will form part of the armour of H.M.S. Magnificent. The hydraulic press of the firm, which exercises a pressure of 6000 tons, was also seen in operation. His Royal Highness likewise witnessed the cutting of both large and small files, the reducing of steel ingots to wire, the preparation of spring steel for use in railway carriages, and other processes. Before leaving the works the Commander-in-Chief expressed the pleasure which his visit had afforded him, and his astonishment at the marvellous operations that he had seen.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUSINESS has become quieter in some departments than it has been for some time past, but in others the improvement is fully maintained, and prices tend upwards, especially for pig iron. There is not much increase in the consumption locally of Cleveland pig iron, as the finished iron and steel works are really not much better off than they were in the summer, but a larger trade has recently been done in pigs for export, and during the last fortnight especially have the sales been heavy to Scotch consumers, who have been buying in anticipation of the termination of the miners' strike, as they expected higher prices to rule when that event occurred. The strike has virtually collapsed, and as the proprietors of the Scotch mills, forges, and foundries can now procure fuel, they have in many cases recommenced operations, but they are not able to secure at home all the pig iron they need, because all but two of the Scotch furnaces have been stopped, and will not be in a position to supply pig iron for some little time yet. Therefore that has to be obtained largely from Cleveland, and orders for considerable quantities have recently been given out, which have served to strengthen the market in this district, and will increase the shipments, which latterly have been disappointing, as was natural when the chief market outside the district for Cleveland iron had its consumption so greatly reduced by the labour troubles. It is expected, therefore, that the pig iron shipments from the Tees to Grangemouth for the rest of the month and for the early part of October will be much in excess of what they have been, and in addition to this merchants and consumers on the Continent will import more freely, as the navigation season will not last more than a few weeks longer. So far this month the pig iron exports from the Tees have been poor; up to Wednesday night they were only 46,125 tons, against 42,665 tons last month, 57,775 tons in July, and 58,855 tons in September last year, all to 19th. As the production has not been at all reduced, but has rather been increased by the blowing in of another furnace in the Middlesbrough district, there can be no doubt that up to the present stocks will have been increasing, more especially of hematite pig iron, the makers of which find their position anything but satisfactory, as they are able to get but a very small increase in their prices, and the cost of production is rising, owing to the advance that is being demanded in the price of foreign ore, particularly Rubio, which is now not less than 12s. per ton delivered at Tees-side furnaces, and more is generally quoted.

A good deal of No. 3 Cleveland pig iron has this week been sold at 36s. 6d. per ton for prompt f.o.b. delivery. Some firms have been able to realise 36s. 9d., and others even 37s. The demand is chiefly confined to iron for early delivery, the disposition to buy forward having disappeared, as many believe that after the Scotch furnaces get to work again the value of pig iron will become easier. Till then it may advance, and some people expect to see 37s. generally realised this month. No. 1 g.m.b. is sold at 38s. 6d., No. 4 foundry at 35s. 6d., No. 4 forge at 34s. 9d., mottled at 34s. 3d., and white at 33s. 9d., all for early delivery. Cleveland warrants have this week fluctuated more in price than usual, owing to speculative operations, but this has had little influence in the prices of makers' iron. Fluctuations in the prices of warrants must be looked for, as at intervals speculators proceed to realise, and such action depresses the value of warrants for a time. The stock of Cleveland pig iron in Connal's public warrant stores on Wednesday night amounted to 90,066 tons, or 323 tons decrease this month. The improvement in the value of East Coast hematite pig iron continues small, and prices have advanced very little. Most makers quote 43s. 3d. per ton for prompt f.o.b. deliveries of mixed numbers, but there have been sales at 43s.

The improvement in the finished iron and steel trades has not been so great as has generally been represented, and the endeavour of manufacturers to secure advanced prices has not been attended with much success. Quotations certainly were raised, but consumers generally were not prepared to pay them. The steel rail trade is very dull, and a large steel and iron company has not been able to avoid the closing of its works. It last Saturday stopped one section entirely, throwing two hundred hands out of employment. This week the large mill has been kept going, the steel necessary for the completion of orders being purchased from other firms. On Saturday, however, this mill employing 300 hands will be closed, leaving in operation only the small mills, employing 300 men, and the work in hand will only suffice to keep this department going two or three weeks more. No doubt the works are disadvantageously situated when compared with the establishments nearer the seaboard for the manufacture of rails. The pig iron alone will cost 2s. 5d. per ton more for carriage, and then there is the cost of the carriage of the finished material to the shipping place, as nearly all the rails are wanted for export. It is not a matter of surprise, therefore, that the Works cannot compete successfully with those which can secure cheaper materials and have superior shipping facilities. These other rail mills are fairly well employed, and the price of heavy steel rails is about £3 12s. 6d. net per ton at works.

The plate and angle makers find the demand very quiet, but that is only what might be expected when the dulness in the shipbuilding industry generally is taken into account. This is not a time to order new vessels, when so many of those already built are laid up, and many of those that are running are doing so at a loss. On the Tyne alone fifty-seven steamers are laid up, and if this is the case in what is usually a busy period of the navigation season, the outlook for the winter is not encouraging. A good many yards have vacant berths, but the leading yard on the Tees, that of Sir Raylton Dixon, appears to be well situated, as they have five large steamers on the stocks in various stages of construction, besides three which are waiting for engines, and the keel of a China tea steamer of about 6000 tons is to be laid down in the berth of a steamer launched this week. On the Tyne work is interfered with by the strike of shipyard apprentices. The pattern-makers are still on strike, and refuse to have their dispute settled by arbitration, or to abate one jot from their original demands. Their action, however, does not interfere much with trade. The engineers are being set to work as rapidly as it can be found for them, but there are still more than 10 per cent. of the engineers idle. Ironfounders are doing better, though not as well as they expected, and some of the bridge-builders find business rather brisker. The bridge work required for the extension of the North-Eastern Railway from Annfield Plain to Consett will be executed by the Stockton Forge Company.

At the annual meeting of the shareholders of Sir W. G. Armstrong, Mitchell, and Co., Elswick and Low Walker, the directors will recommend a dividend of 10¾ per cent. per annum, as against 10 per cent. last year, 9½ per cent. in 1892. For the last eight years the average dividend has been 10⅝ per cent. Since the announcement the £100 shares of the company have gone up from 162 to 173. The profit on last year's operations was over £230,000. The directors say that the Elswick Works, though not so fully employed as they could wish, has a considerable number of orders on hand. They did not suffer so much from the long strike of moulders and pattern-makers as might have been anticipated. The works at Pozzuoli, near Naples, are well employed, and have during the year been turning out excellent work, while they have a sufficiency of orders on hand to keep them occupied during the current year.

The coal trade both in Northumberland and Durham is animated, and the production fully as heavy as it was last month, though it is expected that it will fall off somewhat now that the colliers in Scotland are resuming operations. Not more than 1 per cent. of the colliers in these two counties are returned as out of work, and that those employed have regular work is shown by the fact that the colliers are running 10¾ days per fortnight in Northumberland. Deliveries on export account are increasing, as continental merchants and consumers want supplies before the Northern navigation season closes. The price of best steam coal ranges from 10s. 6d. to 11s. per ton f.o.b. Blast furnace coke is strong at 12s. 6d. per ton delivered on Teesside. The Northumberland miners' representatives are going to discuss with the masters the question of reducing the hours of boys in their mines. The men work only seven hours per day, but the boys are employed ten hours daily. The wages of colliery enginemen in Northumberland have been reduced 2d. per day, and of firemen 1d., making winding enginemen 4s. 8d., hauling and pumping enginemen 4s. 7d., and firemen 4s. 0½d.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been a good deal of activity in the pig iron market, mainly in Scotch warrants, the prices of which, although irregular, have on the whole been rather higher than last week. It is believed that the expected termination of the miners' strike has led to a good deal of speculative business. Be this as it may, consumers have as yet little inducement to purchase. The state of trade is very unsatisfactory, and the prospect is that there will be no lack of iron so soon as the furnaces are set going. For Cleveland iron there is very little demand. Hematite warrants have, however, been more in request.

The values of makers' iron are well maintained. G.M.B. f.o.b. at Glasgow, No. 1, is quoted 45s. 6d. per ton; No. 3, 44s.; Monkland, No. 1, 48s.; No. 3, 44s.; Carnbroe, No. 1, 48s.; No. 3, 46s. 6d.; Calder, No. 1, 58s. 6d.; No. 3, 50s. 6d.; Summerlee, No. 1, 58s. 6d.; No. 3, 52s.; Coltness, No. 1, 59s.; No. 3, 52s.; Glengarnock at Ardrossan, No. 1, 54s.; No. 3, 49s. 6d.; Eglinton, No. 1, 54s. 6d.; No. 3, 48s; Dalmellington at Ayr, No. 1, 50s.; No. 3, 49s.; Shotts at Leith, No. 1, 59s. 6d.; No. 3, 52s.

The output of pig iron consists of the produce of only two furnaces, which are in operation at Coltness. There is so far scarcely any sign of preparation for re-starting furnaces, but as soon as the strike is really over the ironmasters will gradually light up a considerable proportion of the furnaces now idle.

The demand for pig iron for shipment is very quiet. The shipments in the past week amount to 2263 tons, compared with 5568 in the corresponding week of last year. There was sent to Russia, 1000 tons; Australia, 250; Canada, 200; United States, 25; France, 20; Italy, 50; Germany, 40; Belgium, 10; Spain, 86; the quantity sent coastwise being 582, against 1499 in the same week of 1893.

The market for malleable iron and steel continues very quiet. The home inquiry is easily met, and the exports are much below the average. Two or three malleable ironworks have started and are doing a little, but some weeks must yet elapse before work can be anything like general. The steel works are still closed as regards the greater part of their manufacture, only a few men being engaged at special jobs which could not be deferred.

The shipments from Glasgow of iron and steel manufactured goods in the past week embraced locomotives worth £7460, sewing machines £4928, other machinery £1662, steel goods £6719, and miscellaneous iron goods £12,593.

The miners' strike is gradually coming to an end in the West of Scotland. Neither the leaders nor the men themselves appear now to have any hope of the employers making the least concession in the matter of wages. What they are contending for in some districts is a guarantee that wages will not be further reduced for a given period, and that the masters agree to the formation of a conciliation board. The connection of the miners with the English Federation is regarded by the employers as having rendered conciliation impossible. There is nothing to induce the masters to make any concession. They have themselves suffered severely during the prolonged struggle, and the state of trade does not hold out any prospect of activity.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

I AM very sorry to learn that there is a strong likelihood of a coal strike on a large scale in 1895.

One of the influential colliers, a man superior to the haulier class, which is chiefly composed of young and impulsive men, assures me that the principal colliers are almost decided upon giving in notices to terminate the sliding scale. This, he expects, will be done next month, and by the time the notice is matured we shall be in the summer, he said, a more preferable time for fighting than in the winter.

We do not, he continued, intend to join the Miners' Federation, for our coal trade and that of England are radically different. The English trade is a home trade, ours a sea or export one. What we wish to do is to get up a strong union amongst ourselves, and amend the sliding scale. He assured me that a large number of fellow workmen had implicit faith in the principle of the sliding scale, for which they are indebted to Sir W. T. Lewis, though the belief was that some changes were needed to give full satisfaction. So the Welsh coalowners and the country have to look forward to another labour upset. As one of them remarked, they must bear it with equanimity. "It seems in the order of things that we should have a periodical upset.'

At present the demand for best steam coal continues to be very marked. Last week the coal exports from Cardiff, including the Bute, Barry, and Penarth, exceeded 313,000 tons. House coal, too, continues firm in price, and the demand good, and coalowners in the house trade have the satisfaction of knowing that they are on the borders of their "season," with fair prices that will assure contracts being entered into at moderately good prices.

The latest quotations, Cardiff, for all sorts of coal were this week as follows:—Best steam 11s. 9d. to 12s.; seconds, 11s. to 11s. 6d.; dry sorts, 10s. to 10s. 3d.; small, 5s. 6d. to 6s.; best house, 11s.; No. 3 Rhondda, 10s. 3d. to 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 9d.; through, 7s.; small, 4s. 9d. to 5s.

Coke continues in improved demand, and prices show a slight change for the better. Latest Cardiff prices are:—Furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; best, 20s. to 20s. 6d. Swansea prices:—Furnace, 12s. to 12s. 6d.; foundry, 17s. 6d. to 18s. cash; thirty days less 2½.

Other Cardiff quotations this week are:—Pitwood, brisk, 15s. 6d.; patent fuel unchanged. Swansea: 10s. 6d. to 11s., moderate export.

There is a better tone in the iron and steel trade, and more inquiry for rails. 200 tons were despatched to Paysendu this week. For steel sleepers there is a large demand from Africa and the East Indies, and the prospects of a larger tin bar trade are now certain, though the North is doing its best to get a share. This week there has been a large quantity received from Harrington, and I have noticed a considerable increase at the various sidings of the steel works.

Latest Swansea quotations generally are this week:—Glasgow pig, 43s. 11d., cash buyers; Middlesbrough, 36s. 6½d.; Middlesbrough hematite, 43s. 7d.; Welsh bars, £5 to £5 2s. 6d.; sheet iron, £6 to £6 10s.; sheet steel, £6 5s. to £6 10s.; steel rails, £3 15s. to £3 17s. 6d., heavy; light, £4 10s. to £4 15s., Bessemer steel, tin-plate bars, £4 to £4 2s. 6d.; Siemens best, £4 2s. 6d. to £4 5s., all delivered in the district, cash less 2½. Block tin, £73 2s. 6d. to £73 5s. There is a rumour that a "corner" is forming, which would certainly be followed by higher prices.

Swansea anthracite quotations, latest, are:—Best big vein, 12s. to 12s. 6d.; second quality, 10s. to 10s. 6d.; ordinary large, 8s. 9d. to 9s. 6d.; small, 4s. 9d. to 5s.; iron ores, Rubio, 11s. 3d. to 12s.; Tafna, 11s.; specially selected Rubio, 1s. 6d. extra.

The latest report from tin-plate centres is that inquiries are increasing, and there is a great deal more animation exhibited; but, so far, stocks have shown more accumulation. Last week, owing to non-arrival of tonnage, the export was only a little over 41,000 boxes; while 66,426 boxes were received into stock. The total stock is now reported to be higher than at any other period—338,126 boxes. A marked diminution may be expected to be shown next week, as no less than eleven steamers are due in; seven from the United States and Canada. A good shipment has taken place of late from Batoum and Russia. It is also encouraging to note tinned ware is getting more common, and a larger variety of uses found; and the opinion is growing strong that china and earthenware industries will suffer, while our steelmakers will get the benefit. One complaint has been received which will suggest a corrective by the inventive mind. This complaint is, that for cups, water jugs, &c., the hot water so affects the handles that it is difficult to hold them. Tin-plate quotations remain with upward tendency. I visited this week a great track of the Cambrian Railway, and noted the excellence of the arrangements by which great connections, Hereford at the Three Cocks, Newport, Mon., at Partsticill, and Cardiff at Merthyr, are linked with Aberystwith and North Walian resorts. The express arrangements have been worked very satisfactorily, and the corridor carriages answer well. In all respects, passenger and goods, the season has been a satisfactory one, and the administration of Mr. Aslett all that could be desired. There are, however, still developments that are required of North Wales industries to make the line more remunerative. The gold "boom" yet lingers at Dolgelly, and I am sorry to hear that Mr. Pritchard Morgan is seriously indisposed. The development of the rich tracts of manganiferous ores from Dolgelly to Harlech is yet in the future as regards any appreciable extent.

I have also visited this week the Birmingham Waterworks area, near Rhayader, in the Elan and Nantgwilt Valleys. So far the case is one of preparations. Quite a township of huts has been erected; a railway constructed that one would have thought might have been straighter, trees felled, the mountain side scarped, and the bed of the river broken up with a view to get a secure and a fissureless foundation. The latter point is one of marked importance. At Merthyr Tydvil the formation of a reservoir at Dolygaer on a bed of carboniferous limestone—notably full of fissures—has cost many thousand pounds sterling. The chief engineer of the works near Rhayader resides at Nantgwilt, famous as the residence, at one time, of Shelley, the poet. Here, as at the Vyrnwy, the Liverpool watershed, a graveyard is to be submerged.

Cardiff new docks, the great task for the next ten years, but of which, if I am not much mistaken, we shall see practical issues in less than five, are now more than limned out on plans. The site is now very perceptible from Penarth grounds. The work of constructing the embankment is proceeding apace, and up to the present 3000 yards from the low-water pier have been made by the tipping of 100,000 tons of slag from the old tin and ironworks at Walnut Tree. The course adopted is to tip two parallel lines of slag, leaving a space for clay, in order to make a water-tight embankment. The foundation is tolerably solid, but the slag sinks into an average depth of 7ft., and the height of the embankment, including sinkage, is from 22ft. to 23ft. A local authority, to whom I am indebted for the description, states that as the slag sinks down the soft mud comes up between the two ridges, and thus assists in filling up the open space. At the base the embankment is 80ft. wide, and an enormous quantity of rubbish will be needed to make a bank extending from the end of the low-water pier to a point eastward of the Roath Dock. Sir W. T. Lewis is of opinion that this work can be done in twelve months, after which the construction of a dock proper will commence. The dock is to be 700ft. in length, so that mercantile vessels of about 100ft. longer than any afloat can be admitted.

Big steamers are increasing visibly.

Mr. Hedley, who has been called in by the Cardiff Corporation as an expert in connection with the Harbour Trust scheme, met Sir W. T. Lewis this week, as Lord Bute's agent, and had a conference. Several members of the Corporation were present, also Mr. Hunter, engineer of the Bute Docks, and Captain Pomeroy.

The coal trade of Newport is very brisk, and prospects good.

Harbour reports at Swansea are also eminently satisfactory. Last week was a marked improvement on the corresponding week of last year.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE general iron business over here has been showing a little more activity upon the week, and there have been some fairly good orders secured, but the prices makers had to accept were, in most cases, even more unfavourable than before. In some parts of Silesia the condition of the iron industry is reported to have slightly improved, but the greater part of the blast furnace works continue only very moderately employed. On the malleable iron market prices have become easier of late. There has been next to no business done in bars, and Breslau dealers were compelled to reduce the price for merchant bars on M. 120 p.t. at works. In girders and plates the demand coming forward is far from good. The steel trade as a rule is dull, though two or three firms have been rather fully employed upon the week.

Business transactions on the Austro-Hungarian iron market continue quite satisfactory. Pig iron is rather scarce, which is but natural, considering that this year's production in malleable iron has been about 20 per cent. higher than last year. For the different sorts of manufactured iron a regular and even lively inquiry has been coming forward, girders being the only article that has been a trifle dull lately. The railway and engineering department is briskly engaged. An order for 200 freight cars for the Warsaw-Vienna Railway has just been awarded to the Ringhofer Wagon Shops at Prague.

In France the industrial situation is still without improvement, and the works are but quietly engaged, but the general feeling is hopeful, as there are more orders expected to be given out before long, chiefly in girders and structural material. In Paris merchant bars are unchanged at 155f. p.t., girders fetching 165f. p.t.

No signs of revival are as yet to be found in the Belgian iron trade, and the position of both makers and manufacturers remains extremely unfavourable. Pig iron even shows a decrease in demand against former weeks; but fortunately, prices remain tolerably firm—and that is something, after the continued downward movement of the preceding months.

Rhenish-Westphalian iron business remains practically without improvement. Few purchases are made, both in raw and in finished iron; but in spite of this, makers report themselves even more content with the present demand than with the prices obtainable. In iron ore the business, at least in the Siegerland, has not been so lively as before: M. 7·40 to 7·70 p.t. is quoted for spathose iron ore; while for roasted ditto, M. 10·80 to 11·20 p.t. is given. Nassau red iron ore is paid with M. 9·20 p.t., free Dillenburg. In Luxemburg-Lorraine prices are, with few exceptions, pretty firm; red minette, 40 p.c. contents, is quoted M. 3·30 to 3·40 p.t., while for inferior qualities M. 2·40 to 2·60 p.t. is paid. The blast furnace works of the Siegerland are fairly well engaged, common forge being in regular demand at M. 44 p.t. Spiegeleisen is quiet at M. 52 p.t. for the 10 to 12 p.c. grade. For Rhenish-Westphalian forge pig No. 1 M. 46 to 47 p.t. is given; No. 3 costs M. 40 p.t. Hematite remains firm at M. 63; foundry No. 1 M. 63; No. 3 M. 54 p.t. Basic, M. 45 p.t.; German Bessemer, M. 49 to 50 p.t. Luxemburg forge pig continues to be quoted 48f. p.t. free Luxemburg. The different branches of the malleable iron trade are still remarkably quiet, and the condition of prices continues very unfavourable. In the bar trade small orders are coming to hand pretty freely, while large contracts are exceedingly scarce; prices remain very weak, with a good deal of low cutting in the open market. Up-to-date, stocks have been decreasing rather than otherwise. Girders are in moderate call. The hoop mills continue well employed on orders of previous date, and are, therefore, rather independent with regard to new work. The plate and sheet makers have been quite satisfactorily occupied recently, and there is generally a somewhat better tone prevailing in that department, although present list rates still leave no profit. The dulness in the wire trade is as great as ever; in fact, some manufacturers affirm that they have never known it so slack. Foundries and machine shops find it extremely difficult to meet with orders, and if they are fortunate enough to secure a contract, however trifling it may be, they generally have to make substantial concessions, so that there is every cause for complaints. A regular activity continues at the wagon shops.

Latest list quotations, per ton at works, are as under:—Good merchant bars, M. 105 to 110; angles, M. 120; girders, M. 90 to 95; hoops, M. 110 to 115; billets in basic and Bessemer, M. 81; heavy plates, for boiler-making purposes, M. 150; tank do. M. 130 to 135; steel plates, M. 125; tank do., M. 115 to 120; Siegen thin sheets, M. 130; in steel, M. 120. Iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivet iron, M. 130; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

The consumption of coal in Berlin was, for the first two quarters of 1894, in pit coal and coke, 739,539 t., + 47,702 t. against the same period last year, and in brown coal 321,946 t., – 72,270 t. against last year. Of the coal consumed, 94,894 t. came from England, + 4045 t. against previous year; 36,686 t. from Rheinland-Westphalia, – 1081 t. against last year; 501,654 t. from Upper Silesia, + 28,608 t. against last year; and 100,837 t. from Lower Silesia, + 14,043 t. against the corresponding period in previous year.

THE Midland Railway Company has commenced operations on its new line from Chapeltown to Barnsley. The line starts at a point in Whitewool, Chapeltown, at once enters a deep cutting passes over the Thorncliffe Viaduct, and then reaches, near Thorncliffe Works, a tunnel which will be the most important and expensive portion of the line. It will be 1496 yards in length and lined with blue bricks throughout. Five shafts, varying from 20 yards to 50 yards deep, are being put down from the surface to ventilate the tunnel. The new line will give the Midland Company ready access to the capital of the South Yorkshire coalfield. At present its route is by Cudworth, which is a long way round, being 22 miles against 17¾ miles. There is some idea that the new railway will ultimately be carried forward to Bradford, forming part of a new line to the North.

## LAUNCHES AND TRIAL TRIPS.

On Monday, 17th inst., Messrs. Lobnitz and Co., Renfrew, launched the twin-screw hopper dredger St. Dunstan, being the first of two dredgers they are building to the order of the British Admiralty. The dredger will be fitted by the builders with twin-screw engines and dredging machinery, to work easily to a depth of 45ft. below water.

On Monday afternoon, the 17th inst., the Blyth Shipbuilding Company launched from its shipbuilding and graving dock works at Blyth a screw steamer of the partial awning deck type, built to the order of Messrs. Stephens, Mawson, and Goss, of Cardiff and Newport. The framework of the vessel is composed of a very strong section of bulb angle, and web frames are fitted in lieu of hold beams. She has cellular double bottom throughout, and is generally built of exceptional strength, and with all the most up-to-date improvements suitable for a first-class cargo steamer. The captain and officers will have suitable accommodation under the poop, and the engineers are comfortably provided for at the after end of the bridge. The vessel has powerful steam winches to each hatch, Clarke, Chapman, and Co.'s windlass and patent donkey boiler, and Hastie's steam steering gear. The ceremony of naming the vessel Kirkwall was performed by Miss Lydia Stephens, daughter of the senior partner of the firm. The Kirkwall was towed to the North-Eastern Marine Engineering Co.'s works, Wallsend, where powerful triple-expansion engines will be fitted.

On Tuesday Messrs. Wm. Simons and Co. launched from their yard at Renfrew, complete with its dredgings and propelling machinery on board, the twin-screw hopper dredger St. Alban. It is the first of two hopper dredgers recently ordered from this firm by the Government, and the fifth hopper dredger they have constructed for the British Admiralty. The St. Alban is specially designed to dredge and discharge clay of very adhesive nature, and is capable of working to a depth of 46ft. under water. The latest improvements have been carried out in this vessel, and it is expected it will leave for Portsmouth in a few days, where it is to be employed. As the St. Alban left the ways the naming ceremony was performed by Mrs. Robert Crawford, of Greenock. At the launch there were present Messrs. Painter, Parker, and Scoggins, H.M. surveyors, under whose supervision the vessel was built; also Mr. Robert Crawford, harbour engineer, Greenock, and others.

On Monday afternoon, the 17th inst., there was launched from the Cleveland Dockyard of Sir Raylton Dixon and Company at Middlesbrough a very handsomely modelled steel screw steamer, which has been built to the order of Messrs. Elder, Dempster, and Company for the African Steamship Company, and which is intended to run with passengers, mails, and cargo between Antwerp and the Congo and other settlements on the West Coast of Africa. The decks will be of East India teak, and cabin accommodation of very handsome description will be fitted for ninety first-class and sixty second-class passengers, with very spacious state-rooms specially ventilated, and with every improvement which experience has suggested as suitable for the intended trade, with marble baths, lavatories, &c. &c., and fitted throughout with electric light. The first-class dining-room is situated in a large house on deck, and will be panelled with marble and inlaid woods in the handsomest possible manner, the deck over the house being extended as a sunshade to the sides of the vessel so as to give shelter underneath it, and form a spacious promenade above for passengers under the protection of the awnings. A large cooling chamber is placed in the 'tween decks, fitted with Hall's refrigerating machinery, so that fresh provisions can be kept throughout the voyage. The dimensions of the vessel are:—Length, 343ft.; beam, 43ft.; depth moulded, 25ft. 6in. The machinery will be supplied by Messrs. Thomas Richardson and Sons, of Hartlepool, consisting of triple-expansion engines with cylinders 25in., 39in., and 67in. by 45in., with two large boilers working at 180 lb. pressure. On leaving the ways the steamer was named the Leopoldville by Miss Inga Raylton Dixon, daughter of the builder. Messrs. Dixon and Company have five other large steamers on the stocks in various stages of construction, besides two lying in the water waiting for engines, and the keel of a China tea steamer of about 6000 tons will at once be laid down on the berth vacated by the Leopoldville.

---

Railways in Japan.—The first railway in Japan was commenced in 1870, and there are now more than 1900 miles of railway working, besides several lines under construction or proposal, among which a few of the foremost are, according to the *American Engineer*, the Imperial Government Railway, 557·61 miles; Niphon Railway Company, 593·08 miles; Sanyo Railway Company, 145·10 miles; Kinshin Railway Company, 136·76 miles; Tanko Railway Company, 205·09 miles. The standard gauge of Japanese railways is 3ft. 6in. The permanent way consists of flat-bottomed steel rails weighing 60 lb. per yard, laid on cross sleepers, except 66½ miles for Tokyo-Yokohama and Kobe-Kyoto lines, on which double-headed rails on cast iron chairs are used. On the Kobe-Kyoto line cast iron pot sleepers were first tried, but they were gradually replaced with timber cross sleepers. Lately an experiment was made with earthenware sleepers in the Shinbashi Station compound. As there is an abundant supply of wood in Japan, and it is not attacked by insects, timber sleepers answer very well. The railway, are mostly single lines, with the following exceptions:—Shinbashi-Yokohama line, 18 miles double line; Numadzu-Oyama line, 22 miles; Ueno-Omiya line, 16¾ miles; total, 56¾ miles double line. As the country is mountainous and full of rivers and running streams, there are several engineering works—deep cuttings, high embankments, tunnels, bridges, and culverts. In order to carry out earthworks, temporary rails are used. The Japanese coolies are not at all accustomed to use wheelbarrows, but they are well trained to carry earth, stone, or anything on their shoulders with straw net or *mokkō*. In blasting rocks, gunpowder, dynamite, and other explosives are used.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁎ When patents have been "communicated" the name and address of the communicating party are printed in italics.

*6th September*, 1894.

16,975. Lawn Clippers, W. Burrows, London.
16,976. Heating Boiler Furnaces, &c., C. Naylor, London.
16,977. Machine for Stuffing Mattresses, R. R. Thompson, London.
16,978. Briquette Fuel, A. E. Tavernier and W. L. Malcolmson, London.
16,979. Tooth Brushes, L. Ehrlich, London.
16,980. Machine for Printing Oil-cloth, W. H. Schornberg, London.
16,981. Combined Couch and Washing Appliances, E. L. Still, London.
16,982. Hunting Knife or Bayonet, T. Prasse, London.
16,983. Securing Rails to Metallic Sleepers, J. Whitestone, London.
16,984. Combined Fan and Motor, F. Eisenbeis, London.
16,985. Block-sawing Machines, C. Temperley, London.
16,986. Apparatus for Diffusing Vapour, E. W. Frazar, London.
16,987. Red Tint Producing Apparatus, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
16,988. Self-closing Doors, M. Donne and C. J. Mathias, London.
16,989. Castor Cup, E. Core, London.
16,990. Furnace Bars, &c., D. Mellor and M. Mellor, London.
16,991. Horse Pad, T. Cloke and W. J. Standbrook, London.
16,992. Machinery for Wrapping Soap, &c., H. Rose, London.
16,993. Portiere Rods, F. Douglas and J., W. E., and R. W. Cooke, London.
16,994. Boot and Shoe Manufacture, M. W. Martin, London.
16,995. Apparatus for Automatically Operating Railway Crossing Gates, W. R. Lake.—(*C. H. Sherwood, United States.*)
16,996. Filters, &c., A. E. Seaton and F. Pearn, Manchester.
16,997. Ambulance Carriages, W. and G. Marshall, London.
16,998. Coffee Extract, T. O. Kent, London.
16,999. Switch, S. O. Cowper-Coles, London.
17,000. Electric Arc Lamps, J. W. Rogers, London.
17,001. Moulded Article Manufacture, F. W. Oliver, London.
17,002. Smoke-testing Apparatus, J. Jones, London.
17,003. Boots and Shoes, J. H. Hughes, Liverpool.
17,004. Furnaces for Burning Coal-dust, C. Wegener, Liverpool.
17,005. Winding and Unwinding Blinds, O. Westlake, London.
17,006. Wrapping Books for Transmission, J. Lawton, London.
17,007. Envelopes, P. S. Watkins, London.
17,008. Nosebags, H. Lewis, London.
17,009. Receptacle, J. Tile, London.
17,010. Making Hat and Bonnet Shapes, H. Lissack, London.

*7th September*, 1894.

17,011. Peg for the Tuning of Violins, H. H. Wilson, London.
17,012. Pocket Rule and Scissors, T. Pursey, Edinburgh.
17,013. Making Paper, R. Brown, Glasgow.
17,014. Checking Shuttles in Looms, F. Barker, Halifax.
17,015. Protectors for Boots, N. S. Puddy and C. C. Cox, Bristol.
17,016. Hair Nets, G. and H. Lichtenfeld, London.
17,017. Making Cloth, J. Marshall, Glasgow.
17,018. Mechanical Tennis Ball Brush, O. Leak, Trowbridge.
17.019. Umbrella Ribs and Stretchers, W. P. Barber, Birmingham.
17,020. Hydraulic Intensifiers, G. B. Sharples, Manchester.
17,021. Spanners, J. H. Pitt, Birmingham.
17,022. Wire Nails, C. Hide, Worthing.
17,023. Pumps, A. Graf, Glasgow.
17,024. Pneumatic Tires, H. W. Ashby and R. Lindsay, Dublin.
17,025. Braces, Suspenders, Belts, &c., A. Breese, London.
17,026. Floral Pleated Paper, G. Belt, London.
17,027. Automatic Delivery Machine, R. W. Allen, Newcastle-on-Tyne.
17,028. Wood Block Pavements, &c., J. G. Wilson, London.
17,029. Pneumatic Tires for Cycles, W. H. Cresswell, Woodley.
17,030. Adjustable Fire-grate, C. C. Free, London.
17,031. Spark Arrester for Locomotives, J. T. King, London.
17,032. Desk, T. Tobias, London.
17,033. Holders for Stair-rods, H. H. McBride, London.
17,034. Pipe, A. Thomson, London.
17,035. Emery Buffs for Buffing Brass, T. Law, Glasgow.
17,036. Motor, J. S. McAndrew, Glasgow.
17,037. Shoes, J. Macdonald, London.
17,038. Ventilating Covers for Drain Traps, R. Frame, London.
17,039. Covers for Tobacco Pipes, A. A. Percy, Glasgow.
17,040. Gear Cases of Cycles, E. R. Hayes, Birmingham.
17,041. Mechanical Musical Instruments, F. A. Richter, London.
17,042. Moustache Trainer, W. H. Germer, London.
17,043. Clubs for Physical Exercise, F. H. Ayres and E. Grimsdell, London.
17,044. Theatrical Scenery, T. S. James, London.
17,045. Wire Mattresses, A. E. Wale.—(*M. B. Lloyd, United States.*)
17,046. Windows, T. M. Houghton, Surrey.
17,047. Electric Railway Points and Signals, E. Tyer, London.
17,048. Colouring Matter Manufacture, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
17,049. Manufacture of Dye-stuffs, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
17,050. Holding the Dress Skirts of Lady Cyclists, E. Lester and E. Barnes, Manchester.
17,051. Printers' Galleys, E. S. and F. W. Ullmer, London.
17,052. Ball Castors, J. E. Webb, London.
17,053. Spanner, G. W. McIntyre and R. F. Bradford, London.
17,054. Vehicle Wheels, R. W. Thomas, London.
17,055. Horseshoe Rougher, G. S. Hornsby and L. Lewis, London.
17,056. Apparatus for Aerating Liquids, H. Tipping, London.
17,057. Boxing Cops, A. J. Boult.—(*F. Bishop, United States.*)
17,058. Applying Tension to Threads, A. J. Boult.—(*F. Bishop, United States.*)
17,059. Pavements, J. H. Amies and J. U. Robertson, London.
17,060. Neck Scarves, H. Hill, London.
17,061. Rear-driving Safety Bicycles, A. Gibson, London.
17,062. Waterproof Garments, I. Frankenburg, Manchester.
17,063. Apparatus for Mixing Materials, J. E. Smith, Liverpool.
17.064. Machines for Drying Wheat, J. Higginbottom, Liverpool.
17,065. Electric Conductors, S. Z. de Ferranti, Liverpool.
17,066. Electric Cables, S. Z. de Ferranti, Liverpool.
17,067. Apparatus for Starting Vehicles, J. Darling, London.
17,068. Driving Mechanism for Cycles, C. Jacobs, London.
17,069. Securing the "Tips" upon Billiard "Cues," H. C. R. Wainewright, London.
17.070. Waterproof Fabrics, E. Hornung and F. Liebl, London.
17,071. Petrol Burners for Lamps, I. Schwarz, London.
17,072. Device for Suspending Hats, J. Course, London.
17,073. Harness, J. Corp, London.
17,074. Hats, H. Smith, London.
17,075. Dressing Stone, P. A. Newton.—(*H. T. Brown, United States.*)
17,076. Feeding Mechanism for Machines, B. Willcox.—(*J. C. Potter, United States.*)
17,077. Electric Lamps, W. P. Dando and J. E. A. Gwynne, London.
17,078. Wicks for Lamps, B. L. Bagot, London.

*8th September*, 1894

17,079. Valves for Tea Infusers, J. Crabtree, Lincoln.
17,080. Foot-rests for Cycles, A. Blackwell, Birmingham.
17,081. Crowbar, J. W. Riley, Blackburn.
17,082. Tobacco Pipe, G. A. C. Wilford, Stockton-on-Tees.
17,083. Manufacture of Gas, I. Carr, Liverpool.
17,084. Detecting the Removal of Goods, F. A. Newey, Layerthorpe.
17,085. Stable Brushes, G. J. Hobbs, Birmingham.
17,086. Preparing Wheat, J. T. O'Callaghan, London.
17,087. Wooden Wheels for Vehicles, W. C. Coggan, Bradford.
17,088. Moulds for Advertisements, W. H. D'A. Cleminson, Ayrshire.
17,089. Coat Hooks, G. Hudson, Birmingham.
17.090. Cork Holder for Feeding Bottles, A. Smith, London.
17,091. Bearings for Vehicles, W. Landell, Glasgow.
17,092. Collapsible Boxes, H. and A. W. Stevenson, Manchester.
17,093. Cream Separating Machine, F. G. Jones and H. Brecknell, Bristol.
17,094. Mill for Grinding Glass, H. Brecknell, Bristol.
17,095. Brushes, J. G. Willis, Wallsend-on-Tyne.
17,096. Sticking Edges of Pottery, P. Shelley, Longton.
17,097. Enlarging Photographic Negatives, T. P. Bethell and J. W. Rhodes, Liverpool.
17,098. Tram-car Starters, R. Mackay, Glasgow.
17,099. Waist Belt, T. S. Lavis, Devon.
17,100. Advertising on Matches, G. M. Dudley, Dublin.
17,101. Shuttle Boxes of Looms, D. Anderson, Glasgow.
17,102. Swinging Pontoon Bridges, D. Cunningham, Glasgow.
17,103. Apparatus for Drying Cocoa, R. T. Love, Glasgow.
17,104. Construction of Cabinets, S. G. Browne, London.
17,105. Ball Bearings, T. Gerrard, Burnley.
17,106. Gear of Steam Whistles, E. H. Atkinson, Goole.
17,107. Trunk Locks, A. J. Bates, Wolverhampton.
17,108. Coat Hooks, H. Taylor and W. Holland, Birmingham.
17,109. Tires for Cycles, R. Gordon, St. Andrew's.
17,110. Determining the Location of a Distant Object, B. J. B. Mills.—(*W. C. Rafferty, United States.*)
17,111. Piston Packings, R. F. C. Tonge and J. Butterworth, Manchester.
17,112. Oxidising the Protosalts of Iron, N. McCulloch, Glasgow.
17,113. Making Red Oxide of Iron, N. McCulloch, Glasgow.
17,114. Tobacco Pipes, E. W. Gilbert, London.
17,115. Motive Power Apparatus, M. Bates and R. Evans, London.
17,116. Wheels for Road Vehicles, E. Dagnall, London.
17,117. Articles of Furniture, J. Wetter.—(*The firm of Jacob and J. Kohn, Austria.*)
17,118. Hairpins for Ladies' Dresses, A. Franklyn, Manchester.
17,119. Fastener for Window Sashes, J. Byfield, Birmingham.
17,120. Casks for Containing Butter, R. Mahoney, London.
17,121. Sheet-metal Articles, A. J. Boult.—(*E. Hofmann, Germany.*)
17,122. Bicycles, P. J. Deacon, London.
17,123. Winding Cops, A. J. Boult.—(*F. H. Bishop, United States.*)
17,124. Hooks and Eyes, H. Marles, London.
17,125. Albums for Photographic Prints, P. T. Johnson, London.
17,126. Improved Head Gear, J. E. Mathewson, London.
17,127. Main Taps, J. T. Garratt, London.
17,128. Taps or Cocks, J. T. Garratt, London.
17,129. Soldering Irons, P. Stotz and F. W. Schindler-Jenny, London.
17,130. Heating Liquids, P. Stotz and F. W. Schindler-Jenny, London.
17,131. Brooms, J. R. Gilbert, London.
17,132. Nut Lock Washer, W. B. McMaster and F. W. Weise, London.
17,133. Making Hydrazo Compounds, E. Straub, London.
17,134. Brick-making Machine, W. J. N. Tomlinson, London.
17.135. Water Meters, P. C. Duch, London.
17.136. Carving Forks, G. A. Keeler and J. E. Beal, London.
17,137. Collapsible Life-saving Buoys, J. Richardson, London.
17,138. Rubber Tires for Wheels, H. Brooks, London.
17,139. Overcoming Load Resistance, W. Lowrie, London.
17,140. Construction of Spring Clips, S. H. Crocker, London.
17,141. Horizon Glasses for Sextants, G. C. Lilley, London.
17,142. Gas Lamps, T. W. Cowan, London.
17,143. Treatment of Beer, &c., T. D. Lichtenstein, London.
17,144. Treatment of Beer, &c., T. D. Lichtenstein, London.
17,145. Making Lead Pigments, &c., W. B. Priest, London.
17,146. Pots for Boiling Milk, W. P. M. Gottheiner, London.
17,147. Sliding Sash Windows, E. J. Nowell, H. J. Carter, and J. Weymouth, London.
17,148. French Casements, E. J. Nowell, H. J. Carter, and J. Weymouth, London.
17,149. Sash Windows, E. J. Nowell, H. J. Carter, and J. Weymouth, London.
17,150. Apparatus for Bottling Beer, F. W. Jacob, London.
17,151. Metal Cans or Cases, J. A. Lloyd, jun., London.
17,152. Rolling Metal Beams, W. R. Lake.—(*L. D. York, United States.*)
17,153. Bobbin Holders, N. A. Easton, London.
17,154. Breech-loading Guns, A. Siret, London.
17,155. Steady Cycle, L. Wain, Kent.

*10th September*, 1894.

17,156. Turnstiles, &c., S. A. N. Deluce, Cheadle Hulme.
17,157. Leather Binding for Wearing Apparel, A. Garstin, London.
17.158. Opener for Bottles, H. Essam, Woolwich.
17,159. Weighing Machines, J. Hines, Glasgow.
17,160. Apparatus for Beating Liquids, T. Morton, Wishaw.
17,161. Chains for Cycles, T. Poirotte.—(*P. Lavigne, France.*)
17,162. Registering the Length of Yarn, D. Whiteley, Huddersfield.
17,163. Toboggan Skate, H. K. McAllum, Newcastle-on-Tyne.
17,164. Omnibuses, &c., J. Darling, A. R. Harvey, and R. C. Lyness, Glasgow.
17,165. Drilling and Screw-cutting Machines, A. Pickard, Harrogate.
17,166. Point Protector for Pencils, T. Banford, Birmingham.
17,167. Suspenders for Lamps, G. F. Sanders, Birmingham.
17,168. Boat Chocks, J. Muir, Liverpool.
17,169. Disengaging Gear for Ships' Boats, J. Muir, Liverpool.
17,170. Removing Sludge from Docks, H. S. Patterson, Manchester.
17,171. Fixing Brushes to Handles, P. Lucas, Portsmouth.
17,172. Apparatus for Dyeing Yarns, J. Pritchard and F. A. Blair, Glasgow.
17,173. Flower Pots, J. S. Hislop, Glasgow.
17,174. Funnels of Furnaces, L. G. Kok, Glasgow.
17,175. Distilling Sea Water, J. B. Hepburn and C. R. Honiball, Liverpool.
17,176. Chimney for Incandescent Gas, E. R. Kraner, Berlin.
17,177. Holding Bobbins, J. Gregson, Preston.
17,178. Grain Cleaner and Separator, J. P. West, London.
17,179. Supports for Garments, A. McLeod, Glasgow.
17,180. Electric Arc Lamps, R. H. Jahr, London.
17,181. Laying a Grain on Metal Plates, J. Addison, London.
17,182. Application of Gold Leaf to Lace, R. Scott and C. Birch, London.
17,183. Bevel-edge Letter-press Dies, A. Lerpiniere and F. Wallen, London.
17,184. Sealed-bolt Buckle, J. Greenwood, London.
17,185. Connecting Lines of Window-sashes, C. S. Steel, London.
17,186. Clearers for Ring Frames, J. Brooks, London.
17,187. Screw-socket Broom, L. Lewis, London.
17,188. Cooking Vessels, F. Long, London.
17,189. Slotting Machines, F. and C. Berry, London.
17,190. Webbing Weft-fork Blanks, J. Schofield and J. Crabtree, London.
17,191. Medicated Pillow or Cushion, N. B. Paul, London.
17.192. Purse Frames, S. Nathan, London.
17,193. Frame for Gas-light Shades, J. H. Sharp, Helensburgh.
17.194. Punkah Machine or Apparatus, W. G. Doyle, Bournemouth.
17,195. Matrices for Linotypes, O. Imray.—(*C. Sears, United States.*)
17,196. Transferring Articles across Water, D. M. B. H. Cochrane, London.
17,197. Jess for Training Homing Pigeons, M. Arnold, London.
17,198. Bolts, A. Gray, London.
17,199. Axles of Vehicles, J. Tagell, G. B. Edwards, and T. Darby, London.
17,200. Rail Joints, G. B. Ellis.—(*The "White" Patent Rail-joint Company, Australia.*)
17,201. Imitation Cording and Stitching, J. Dowling, London.
17.202. Mechanical Musical Instruments, J. E. Mucker, London.
17,203. Spinning and Twisting Frame, A. Gruschwitz, London.
17.204. Packing-case for Pictures, C. J. Palmie, London.
17,205. Treatment of Textile Materials, A. Dicktus, London.
17,206. Shorthand and other Manuscript Books, G. Hayes, London.
17.207. Closing Bottles, F. H. Lenders.—(*A. Denaeyer, Belgium.*)
17.208. Substitute for Stone, F. H. Lenders.—(*C. Bertin, Belgium.*)
17,209. Cultivators, J. Bamford, Birmingham.
17,210. Packing-case for Cheese, N. McKeever and H. Gray, London.
17,211. Cutting Off Rivet Heads, W. J. Feckett, London.
17,212. Evaporating Vessels, T. Glover and J. Brock, London.
17,213. Attaching Studs to Garments, G. H. S. Farrant, London.
17,214. Elastic Tires for Velocipedes, B. J. B. Mills.—(*P. B. Carante and J. Bocuze, France.*)
17,215. Plucking and Collecting Fruits, L. Götz, London.
17,216. Producing Printed Maps, G. W. Bacon and T. Best, London.
17,217. Apparatus for Mixing Materials, J. E. Smith, Liverpool.
17,218. Goloshes, R. M. Crabbe, Liverpool.
17,219. Feeding Liquid Fuel to Furnaces, R. Altschul, Liverpool.
17,220. Embroidery Machines, H. C. Sheldon and W. Lockwood, London.
17,221. Fireproof Ceilings, J. Rueben, London.
17,222. Carriage Brakes, R. Tucker and F. Boyling, Edinburgh.

*11th September*, 1894.

17,223. Photographic Cameras, &c., J. Ashford, Birmingham.
17,224. Burglar Alarm and Bell, H. Bagley, Birmingham.
17,225. Hydraulic and other Presses, W. Blackwell, Stockport.
17,226. Coating Tin and Terne Plates, A. J. Maskrey, Bristol.
17,227. Needles, F. Merryweather, London.
17,228. Adjusting Tied Bows, C. E. Cotton, Portsmouth.
17,229. Fixing Ends to Poles, H. Windibank and T. E. Smith, Southsea.
17,230. Toy, F. G. Barham, Coventry.
17,231. Cricket and other Balls, C. J. Allen, Birmingham.
17,232. Wood Block Pavements and Paving, F. Hayes, Manchester.
17,233. Oil or Hydrocarbon Engines, J. H. Knight, Farnham.
17,234. Candlestick, J. and H. Smith, Sheffield.
17,235. Electric Incandescent Lamps, G. L. Philips, Holland.
17,236. Pipe Grips, J. T. Towlson, Great Yarmouth.
17,237. Combination Tool or Pincers, G. H. Coleby, London.
17,238. Stopping Noise of Inrushing Water, J. Spear, Portsmouth.
17,239. Oil, Vapour, and Steam Generators, G. Rose, Glasgow.
17,240. Gathered or Plaited Garments, R. Potter, Manchester.
17,241. Method of Copying Letters, W. W. McLauchlan, Manchester.
17.242. Sheet Separating and Printing, C. Reising, Manchester.
17,243. Method of Glazing Houses, J. Quertier, Bournemouth.
17,244. Road Sweeper, A. G. Brookes.—(*F. Hopewell, United States.*)
17,245. Index Cases, A. G. Brookes.—(*H. E. Davidson, United States.*)
17,246. Cock, W. R. Deacon, Bristol.

17,247. The Lytenklean, J. W. Lovell, Rushden, R.S.O.
17,248. Devices for Training Horses, L. Defoy, Manchester.
17,249. Latch and Bolt, E. Baller and E. R. Baller, Southport.
17,250. Neckties, Scarves, and Collars, E. R. Baller, Southport.
17,251. Arresting Decay in Raw Meat, J. A. Wilson, Dundee.
17.252. Perforating Machine, P. W. Peckham, Glasgow.
17,253. Recording Volume of Liquids, W. P. Bruce, Glasgow.
17,254. Utilisation of Waste Products, R. Pickup, Manchester.
17,255. Lid or Cover for Boilers, &c , J. McCullagh, Dublin.
17,256. Pipes, W. Freeman, Leicester.
17,257. Compress or Poultice Protector, I. M. Hemsteger, London.
17,258. Toy Rowing Boat, B. Gott and E. Cousens, London.
17,259. Boiler Tubes, A. J. Boult.—(*C. W. Whitney, United States* )
17,260. Gearing for Bicycles, V. D. Cruser, London.
17,261. Friction Clutch, W. Spiess and C. H. Stoldt, Hamburg.
17,262. Fire Extinguisher, A. Köhler and C. H. T. Stoldt, Hamburg.
17,263. Scarfing the Edges of Metal Plates, H. Smith, H. Smith, jun., and O. Smith, Glasgow.
17,264. Photographic Changing Box, S. J. Levi and A. J. Jones, London.
17.265. Applying Hair to Artificial Skins, F. C. Tussaud, London.
17,266. Lock-up Date and Time Stamp, B. Warwick, London.
17.267. Shafts of Children's Mail Carts, G. Lacey, Dewsbury.
17,268. Convertible Tricycle, F. Leclercq. London.
17.269. The Safety-pin Spring Cuff, F. Jones, London
17,270. Domestic Cinder Sifter, B. Plummer, Newcastle-on-Tyne.
17,271. Propeller Pencils, B. Willcox.—(*The Eagle Pencil Company, United States* )
17,272. Looms for Weaving, E. Jansen, London
17,273. Rotary Motors, W. R. Lake—(*The Consolidated Car Heating Company, United States.*)
17,274. Apparatus for Drying Salt, &c , T. Craney, London.
17,275. Salt Evaporators, T. Craney, London.
17,276. Hinges, J. B. Knittel, London.
17,277. Alcoholic Ferment Mash, J. Takamine, London.
17,278. Mechanical Telegraphs, T. Tomlinson, London.
17,279. Cooking Kettles, B. C. Sabin, London.
17,280. Attaching Broomheads to Handles, F. W. Whitlock, London.
17,281. Transformer for Electric Currents, W. J. Still, London.
17,282. Kilns for Burning Bricks, &c., J. Hamblet, London.
17,283. Bicycles, &c , J. V. Pugh, London.
17,284. Distribution of Electric Currents, J. F. McElroy, London.
17,285. Steam Generators, C. D. Mosher, London.
17,286. Steam Generators, C. D. Mosher, London.
17,287. Valves for Engines, P. A. Newton—(*The Ingersoll-Sergeant Drill Company, United States.*)
17,288. Condiment-holding Appliance, A. E. Crawford, London.
17,289. Condensation of Nitric Acid, H. E. Newton.—(*E. Hart, United States.*)
17,290. Umbrella Tip-cup, F. W. C. Carr, London.
17,291. Manifolding Autographic Registers, W. Assheton, D. Stewart, and C. J. Carroll, London.
17,292 Pessary, J. A. Hurdle, London.
17.293. Dumping Apparatus, W. McMahon and H. J. Reilly, London.
17,294. Bearings for Rotary Blowers, W. W. Wainwright, London.
17.295. Check Book Covers, &c., N. J. H. Kenney, London.
17,296. Armatures for Dynamo-electric Machines, W. R. Lake.—(*R. Eickemeyer, United States.*)
17,297. Armatures for Dynamo-electric Machines, W. R. Lake.—(*R. Eickemeyer, United States.*)
17.298. Novel Construction of Bottles, A J. Weir, London.
17,299. Fire-escapes, E. Kallenberg, London.
17.300. Boot and Shoe Last, W. Armes and O. Wendt, London.
17,301. Braking Device for Cranes, &c., H. Schlösser, London.
17,302. Car Fenders, R Haddan.—(*The Darrach Car Fender Company, United States.*)
17,303. Pneumatic Tire Inflating Apparatus, R. Lucas, London.
17,304 Pneumatic Tires, W. S. Williams, London.
17,305. Printing Machinery, A. F. Battey, London.
17,306. Paper-making Machinery, T. A. and C. D. Marshall, London.
17,307. Cartridges, E. Rubin, London.
17,308. Internal Combustion Engines, J. Roots, Teddington.
17,309. Pasteurising Apparatus, C. W. Ramstedt, London.
17,310. Razor Guards, F. Lomas and T. Crookes, London.
17,311. Protection against Projectiles, A. Appelt, London.
17,312. Casters, L. B. Denton, London.
17,313. Electric Motors, J. S. Losch, J. H. Phillips, J. W. Moyer, and J. H. Williams, London.
17,314. Treating Powdered Materials, J. S. Detwiler, London.
17,315. Blending Powdered Materials, J. S. Detwiler, London.
17,316. Attachment for Umbrellas, &c., S. Joseph, London.
17,317. Pipe Couplings, J. J. Hanbury, London.
17,318. Pipe-making Machinery, R. Stanley and G. Beck, London.

*12th September*, 1894.

17,319. Combined Time-piece and Compass, R. Rood, Southampton.
17.320. Rim Lock Furniture, P. Fugler, Tunbridge Wells.
17,321. Rule, F. R. Jones and L. W. Jones, Birmingham.
17,322. Funnel, W. G. Behenna, St. Austell, Cornwall.
17,323. Combination Kitchen Dresser, T. Dobson, Lancaster.
17,324. Waterproof Paper Bag, W. C. Haigh, Manchester.
17,325. Bottling Aerated Liquids, H. W. Payne and H. C. Cox, Birmingham.
17,326. Egg and Globe Shooting Apparatus, J. Wright, Staffordshire.
17,327. Buttonholes, S. Keightley, London.
17,328 Rope-making Machinery, F. Raichl, London.
17,329. Boots, F. T. Walsh, London.
17.330. Plugs, &c., for Lavatory Basins, K. Jenkins, London.
17.331. Heel Protectors, T. C. Whitney and H. L. G. Dane, London.
17,332. Springs for Cycle Saddles, J. C. Lees, London.
17,333. Envelopes, W. J. Tate, London.
17,334. Apparatus for Pasting Paper, G. Newsum, Bradford.
17,335. Electrically Governing the Voltage of Dynamos, J. Graham and H. Chapman, Bradford.
17,336. Hot-water Boilers, H. Leggott, Bradford.
17,337. Velocipede Saddles, E. Woods, Liverpool.
17.338. Shuttles for Weaving Looms, J. Waddington, Bradford.
17,339. Combined Portiere Rod, &c., J. Hall-Edwards, Birmingham.
17,340. Treatment of Molten Iron, &c., G. Love, Durham.
17,341. Joining Shackle, F. J. and M. B. G. Sinnette, Southampton.
17,342. Scissors, M. M. Smith, Manchester.
17,343. Automatic Atmospheric Ink-supplying Bottle, A. H. Lessells, Cheshire.
17,344. Blind Roller and Slip, W. H. Jordan, Worthing.
17,345. Golf Club, J. D. Dickson, Glasgow.
17,346. Draughtsmen's Squares, S. W. Wilkinson and R. F. Drury, Sheffield.
17,347. Differential Screw Connector, C. P. Kinnell, London.
17,348. Rain and Pocket Protecting Seat Cover for Omnibuses, C. Morgan, London.
17,349. Picture Hook, H. Munslow, London.
17,350. Flange headed Nails, H. Munslow, London.
17 351. Fog-signalling Apparatus, W. A. and G. A Stephens, London.
17.352. Construction of Screw Propellers, C. Givone, London.
17,353. Charging Batteries, S. Miller and C. J. Grist, London.
17.354. Exhibiting Handkerchiefs, &c., J. Bromilow, London.
17,355. Watch and Eyeglass Pocket, J. S. Templar, London.
17.356. Washing, &c., Potatoes, J. Shackleton, London.
17,357. Electric Lamps, S. S. Allin and W. H. Wood, London.
17,358 Stand for Photographs, &c , E. Drechsler, London.
17,359. Driving Mechanisms for Velocipedes, C Stotesbury and W. M. White, London.
17,360. Indicator for Steering, E. A. Veale and W. R. Hayes, London.
17,361. Ladies' Boa Fastener, F. H. Whitlock, London.
17.362. Effecting Photographic Exposures, C. D. Durnford, London.
17,363. Cornice Pole Brackets, R. Jones, London.
17,364. Apparatus for Lace Machines, H. Tiddiman, London.
17,365. Raising Electric Standards, R. W. Braham, London.
17.366. Tiles, Craven, Dunnill, and Co., Ld., and T. Pitt, London.
17,367. Neck-ware, W. Willeringhaus, London.
17,368. Manufacture of Pocket-knives, A. J. Beal, London.
17,369. Secondary Voltaic Batteries, L. Epstein, London.
17,370. Separating Burrs from Wool, G. Riche and A. Rivret, London.
17,371. Horseshoes, W. H. Walker, London.
17,372. Purifying and Sterilising Water, W. Lawrence, London.
17,373. Steam Traps, V. C. J. Ortmans, London.
17,374. Filters, G. Fouchard, London.
17,375. Spring Tire, P. J. Vetter, London.
17,376. Umbrellas, K. Hyman, London.
17,377 Friction Gear, G. G. M. Hardingham.—(*C. Raleigh, South Africa* )
17,378. Transformers, A. B. Blackburn and T. L Boyden, London.
17,379. Electrical Cranes, B. Willcox.—(*The Eisenwerk vormals Nagel and Kaemp Actien Gesellschaft, Germany.*)
17,380. Stoppering Bottles, W. R. Lake.—(*A. A. Pindstofte, Denmark.*)
17,381. Boot-trees, F. E. V. Taylor, London.
17,382. Flow-pipes, W. Youlten, London.
17,383. Bearings, C. W. Brown and M. D. Rucker, London.
17,384. Burglar Alarms, T. A. Clarke, Liverpool.
17.385. Automatic Delivery Machines, T. Cain, Liverpool.
17,386. Station Indicators, M. Treitel and G. Tresenreuter, London.
17,387. Bottles, J. Bradley.—(*The Phœnix Company, New Zealand.*)
17,388. Kettles, Saucepans, &c , C. H. Hutton, London.
17,389. Tap and Measuring Device, E. Clairmonte, London.
17,390. Letter Paper and Envelopes, J. Pitt, London.
17,391. Mud-guards for Bicycles, W. Bransom, London.
17,392. Utilising the Energy of Running Water, R. D. Verbeek, London.
17,393. Transmission of Coins by Post, E. W. Kneen, London.
17 394. Motor and Drilling Machine, J. Abbott, London.

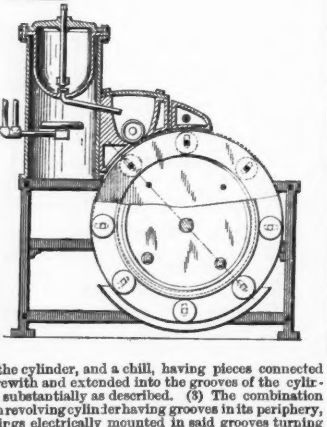
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**521,791.** Machine for Making Storage Battery Grids of Forced Lead, *W. W. Griscom, Haverford, Pa.—Filed July 24th*, 1893.

*Claim.*—(1) A mould comprising a revoluble cylinder having recesses extending around its periphery and provided with excentric ejectors, rotating with the mould, substantially as described. (2) The combination with a revolving cylinder having annular grooves in its periphery, of rings excentrically mounted in said grooves, turning with the cylinder on an axis excentric thereto, a reservoir arranged to supply metal for the cylinder, and a chill, having pieces connected therewith and extended into the grooves of the cylinder, substantially as described. (3) The combination with revolving cylinder having grooves in its periphery, of rings electrically mounted in said grooves turning with the cylinder on an axis excentric thereto a reservoir to contain the metal, and means for forcing the metal into the cylinder, substantially as described.

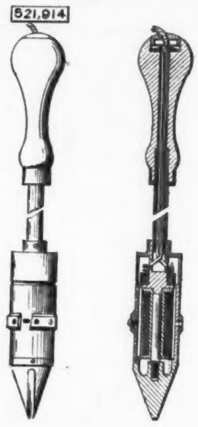
521,791



**521,914.** Electric Soldering Tool, *J. F. McLaughlin, Philadelphia, Pa.—Filed May 19th*, 1893.

*Claim.*—(1) In an electric soldering iron, the combination of a casting, a spool or bobbin removably mounted upon the same, a heating coil upon the spool and binding posts to which the terminals of the coil are detachably secured, with leading wires also detachably secured to the binding posts, a metallic mantle for the coil, and a removable bit securing the mantle in place, substantially as described. (2) In an electric soldering tool, the combination of a heating coil and an inclosing mantle provided with a circumferential series of heat radiating passages, with a ring, rotatable upon the mantle provided with holes corresponding to the said passages, whereby the latter may be partly or wholly closed and the heat of the tool regulated, substantially as described.

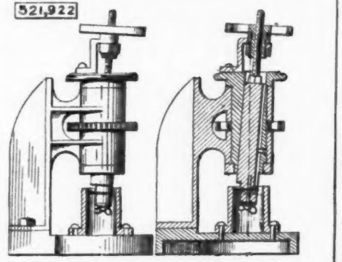
521,914



**521,922.** Metal Boring Machine, *D. Stevenson, Cold Spring, N.Y.—Filed January 30th*, 1894.

*Claim.*—(1) In a boring machine, the combination with suitable bearings, of a rotating bar spindle mounted for a fixed rotation in said bearings and having a longitudinal oblique bore crossing the central longitudinal axis thereof, a boring bar mounted for a longitudinal movement in the oblique bore of said spindle and adapted to turn therewith, means for adjusting the boring bar longitudinally in the spindle and for feeding the same beyond the spindle and into the work, and a tool axially adjustable on the lower projected end of said boring bar, substantially as set forth. (2) In a boring machine, the combination with the bed-plate or table for the work, of the bearing upright having an off-standing vertically-disposed cylindrical bearing, a spindle removably mounted for a fixed rotation in said bearing and having an upper flanged end, an exteriorly-threaded lower end projecting below the cylindrical bearing, and an oblique opening extending longitudinally therethrough, a gear wheel attached to said spindle at a convenient point intermediate of its end, a screw ring removably engaging the lower exteriorly-threaded end of the spindle, and fitting against the lower end of the cylindrical bearing, a boring bar mounted for longitudinal movement in the opening of the spindle and carrying a tool at its lower projected end, beyond the spindle, and a feeding screw connected to the upper end of the boring bar and geared with suitable operating means, substantially as set forth.

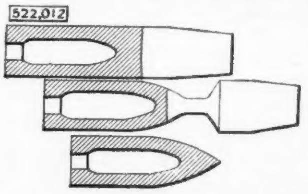
521,922



**522,012.** Shell, *R. A. Hadfield, Sheffield, England.—Filed May 28th*, 1892.

*Claim.*—(1) The herein-described projectile, it having its rear end left in the condition of a casting, and having an integral forged nose or point, substantially as and for the purposes described. (2) A projectile having its chambered rear end left in the condition of a casting, and having an integral forged nose or point, substantially as and for the purposes described.

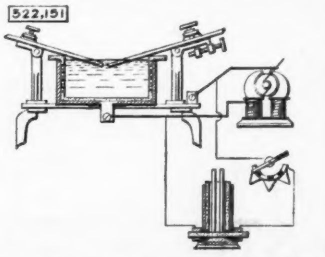
522,012



**522,151.** Method of Heating Metals Electrically, *C. L. Coffin, Detroit, Mich.—Filed November 16th*, 1893.

*Claim.*—(1) The herein-described method of electrically heating metal, consisting in heating the metal, connecting it with one terminal of a generator of electricity, bringing it in contact with a liquid electrode connected with the other terminal of said generator, and establishing a voltaic arc between the two electrodes. (2) The herein-described method of electrically heating metal, consisting in heating said metal previous to its immersion in a liquid electrode, connected to one terminal of a source of electric energy, the said metal being connected to the other terminal of the source of electric energy, and establishing a voltaic arc between the electrodes. (3) The herein-described mode of heating metal electrically, consisting in dipping a heated piece of metal into a liquid, passing an electric current through said metal and liquid, and establishing a voltaic arc between the electrodes.

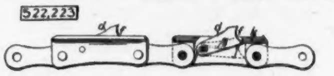
522,151



**522,223.** Carrier Chain for Feeding Boards to Wood-working Machines, *B. G. Luther, Worcester, Mass.—Filed June 15th*, 1893.

*Claim.*—In a carrier chain, the combination with the carrier link provided with the shoulder *k*, of the pivoted engaging dog *d*, provided with the recess *j*, and with the lip *j* adapted to engage with the shoulder *k*, and the spring *g*, arranged substantially as described.

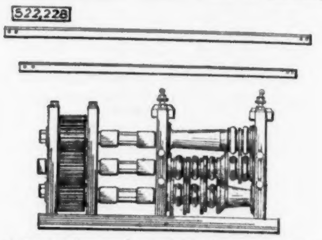
522,223



**522,228.** Process of Renewing Old Steel Rails, *E. W. McKenna, Milwaukee, Wis.—Filed July 26th*, 1892.

*Claim.*—The process of adapting old steel rails to further use, which consists in heating the same to a temperature near to, but below, the point at which the carbon contained therein would be materially affected, simultaneously straightening and reducing the cross section thereof equably in all its parts, but keeping the rail of the original height, and then sawing off the ends, whereby a rail of reduced cross section, but of the same or greater length and the same height as the original rail is produced.

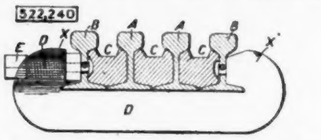
522,228



**522,240.** Railway Frog, *A. L. Stanford, Evanston, Ill.—Filed January 11th*, 1894.

*Claim.*—In a railway frog, the combination of the wing rails B and the point rails A braced intermediately by filling C or the like, of clamps D and D$^1$, each comprising a bar having its ends turned toward each other, affording the hook-shaped extremities X and X$^1$, the said clamps embracing the frog across its base so as to confine the wing and the point rails thereof, said hook-shaped extremity X$^1$ being provided with the projection *d* to penetrate the web of the wing rail to prevent the clamp from slipping from place, and tightening bolts E and E$^1$ for tightening said clamps, substantially as described.

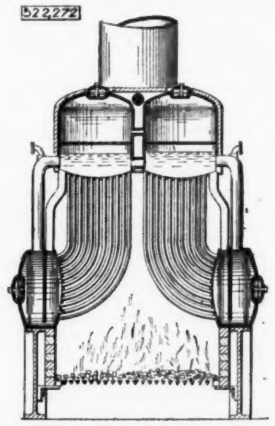
522,240



**522,272.** Water-tube Boiler, *M. H. Plunkett, Baltimore, Md.—Filed September 23rd*, 1893.

*Claim.*—(1) In a steam generator, in combination a cylindrical chamber arranged horizontally, along the side of a furnace, a cylindrical steam chamber arranged vertically above the furnace, bent or curved pipes passing through the furnace and connecting the inner end of the water chamber with the bottom end of the steam chamber, and return tubes located outside the furnace and connecting the steam and water chambers, substantially as set forth. (2) In a steam generator, in combination, horizontally placed cylindrical water chambers arranged in two series in lines with their diameters forming the sides of the fire-box, vertically placed cylindrical steam chambers arranged in two similar rows placed above the water chambers and forming the top of the fire-box, an open space being left between the rows of steam and water chambers for furnace room, and curved pipes connecting the inner ends of the several steam and water chambers, and return tubes located outside the fire-box and connecting the steam and water chambers, as and for the purpose set forth.

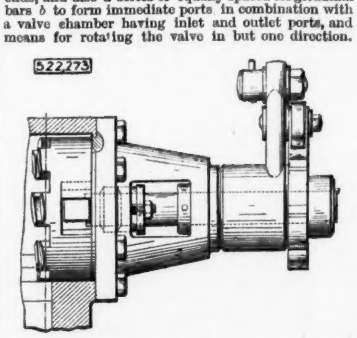
522,272



**522,273.** Valve Mechanism for Blowing Engines, *E. Reynolds, Milwaukee, Wis.—Filed May 1st*, 1893.

*Claim.*—(1) A hollow rotatable valve, having closed ends, and also a series of equally-spaced longitudinal bars *b* to form immediate ports in combination with a valve chamber having inlet and outlet ports, and means for rotating the valve in but one direction. (2) In a blowing engine or air compressor, a cylindrical hollow valve having longitudinal bars separated from each other to form ports, and closed at its ends, means for rotating the valve in one direction, and a valve chamber provided with an inlet port to permit access of the air into the valve at all times, and provided also with an outlet ports or ports.

522,273



## COLONIAL LOCOMOTIVES.

The question whether English or American locomotives are best adapted to colonial railways is one which has received a considerable amount of attention for many years past from engineers abroad. It is somewhat unfortunate for the Governments and corporations owning the railways that this attention has usually been bestowed after the engines have been landed and paid for, thus in many instances leaving a large equipment most unsuitable to the conditions under which it has to work.

Taking in review the rolling stock of the Australian Colonies, it is surprising to find the number of experimental types of engines which have been apparently ordered at random, in small batches, from various makers, English, American, and Colonial—legacies, in many cases, from locomotive superintendents of limited experience who have been changed, at short intervals, often for political reasons. It may be interesting to note the various results which have been obtained after these years of experimenting.

In Western Australia, where the railways are still in an embryo state, and have been largely built with English capital, the English engine at present is universal. It is quite probable, however, that this Colony will go through the usual throes of experimenting as it developes its resources.

In South Australia, where the railways have been constructed to two gauges—3ft. 6in. and 5ft. 3in.—engines of the English type will be found as the standard for the broad-gauge lines, while the American type, with colonial modifications and locally built, has been adopted for the narrow gauge, both for goods and passenger. Possessing two gauges, South Australia loses somewhat for purposes of comparison with other Colonies as to the best adapted locomotive for its railways, from the fact that a broad-gauge line is seldom constructed unless there is sufficient traffic to warrant its being maintained in a reasonable condition of repair, the narrow-gauge lines being left to grapple with the outlying districts of small traffic receipts and lightly constructed, poorly maintained permanent way.

The Colony of Victoria, which has for many years built all its own locomotives, and has a gauge of 5ft. 3in., has adhered almost entirely to the English type of engine. As these engines run through a fairly level country, which is for a new Colony exceedingly well populated, and have not any very long stretches of outlying road, it has never been compulsory to make any radical departures from the practices of the old country.

New South Wales—of which more will be said hereafter—has an almost indefinite number of types of locomotives, many of which are being allowed to fall out of existence as the engines wear out. It is a subject of doubt at the present moment which types will eventually be adopted as standard, though they are almost certain to be of the English family, unless there is some unlooked for change in the administration of the Colony. Amongst the number of useful engines are some four varieties of American construction, in addition to some two others which are being allowed to fall into disuse. With a total of about 2600 miles of road open for traffic, much of which is through mountainous country, with gradients in many places of 1 in 40, the main trunk lines of good construction, and the branch lines or feeders, though well laid and fairly maintained, of a somewhat lighter description, it will readily be seen that New South Wales possesses unusual advantages as an arena for a contest between the rival locomotives.

Passing on to Queensland, a younger, though larger, Colony, with a mileage almost equal to that of New South Wales, though built at a considerably less cost, being all 3ft. 6in. gauge, it will be found that after years of experimenting with almost every conceivable type of engine, from the Fairlie double-ended design to a diminutive copy of the English standard goods, that the American type with colonial modifications and locally built has been adopted both for passenger and goods traffic. Beyond the fact that these engines are somewhat heavy in their consumption of coal, the choice seems to to have been warranted by the successful results.

Were it possible to have access to the engineers' account books of the various Colonies, it would be an easy matter to decide the question of the most suitable locomotive; but this not being feasible, only the information to be gathered from public records and statements, together with any personal knowledge, is for the time available.

It has been much debated amongst railway engineers whether the introduction of heavier engines would result in a reduction of working expenses. The following extract from the report of the Chief Mechanical Engineer of the New South Wales Railways to the Commissioners, and which is embodied in their annual statements for 1893, should go far to prove that such is the case:—"A very large reduction took place in the mileage during the year, which was largely due to the extended employment of more powerful engines, but by economies in the expenditure, a saving of nearly 1¼d. per train mile has resulted, when compared with the result of last year. The whole of the new American engines have been at work throughout the year hauling loads of live stock and goods in single trains; for such loads two engines had been employed previous to their introduction, and consequently their influence in the reduction of train and unprofitable mileage has been substantially felt."

In 1892 the train mileage was 8,356,096, and the engine mileage 12,362,105. In 1893 the train mileage was 7,505,310, and the engine mileage 10,154,648, which shows a decrease of 850,786 train miles and 2,207,457 engine miles, an actual reduction of 948,705 unproductive engine miles, supposing the ratio of train miles to engine miles of 1892 to have been maintained. This should prove, having reduced the cost of working—from the same report—from 22·783d. per train mile in 1892 to 21·632d. in 1893, that the introduction of powerful engines in a country where the grades are heavy is attended with results of a most satisfactory character. Beyond doubt, equally good results will be obtained in all sparsely-populated districts where the traffic is small and of an intermittent nature, as is all agricultural and pastoral produce. Thus, a frequent service of trains not being warranted, it will consequently be found that great economy will result from being able to haul all the traffic on one trip with a heavy train, in preference to making two trips with lighter engines.

The recent depression in trade in Australia has clearly demonstrated that more capital has been sunk in constructing the railways than the traffic receipts promise to pay adequate interest upon. It will therefore be considered necessary in the future to use a still lighter and cheaper form of construction, not to cost more than £2250 per mile.

In order, therefore, to comply with both the above conditions, it will be readily seen that an engine which will draw a heavy load over a lightly and cheaply-constructed road-bed will be one of the chief requirements of the colonial future. This can only be effected in one way, viz., by the careful and even distribution of as great a weight as can be carried with safety by the road-bed, and will vary according to the section of rail and nature of ballast, over as long a wheel base as can reasonably be obtained. It is here that the American locomotive engines have made their prime success. By increasing the number of coupled wheels, and evenly distributing the weight over them, they have complied with the chief requirements of a light railway. In order to compare the difference in some of the main features of English and American engines, the principal dimensions and weights of a few of the leading classes used in the Argentine Republic are shown in detail below. They are taken from the report of the Government experts who in 1892 were instructed by the Department of Engineers to the Republic to examine the rolling-stock equipment of the Southern Railway. The engines picked out are taken as being nearest to each other in size. A few extracts from the report may be of interest.

*Comparison of English and American Locomotives.*

| Service | | Pass. | Pass. | Goods. | Goods. | Goods compound. |
|---|---|---|---|---|---|---|
| Make | | English. | American. | English. | American. | English. |
| Diameter of cylinders | inches | 16·4 | 17 | 18 | 18 | 18·1+26 |
| Stroke | ,, | 24 | 24 | 24 | 24 | 26 |
| Heating surface of fire-box | sq. ft. | 86 | 119 | 86 | 96·1 | 117 |
| ,, ,, tubes | ,, | 984 | 1,169 | 990 | 1076·6 | 1153 |
| Diameter of driving wheel | inches | 68 | 72 | 61·4 | 54 | 55·5 |
| ,, bogie ,, | ,, | 38 | 36 | 39·3 | 29·3 | 38 |
| Weight on driving axle | lbs | 24,723 | 30,725 | 25,286 | 22,110 | 26,739 |
| ,, first coupled axle | ,, | 21,501 | 30,725 | 24,054 | 22,110 | 26,846 |
| ,, second ,, ,, | ,, | — | — | 24,957 | 22,110 | 24,646 |
| ,, bogie axle | ,, | 35,096 | 30,725 | 20,444 | 22,110 | 33,719 |
| Total weight on engine in working order | ,, | 84,320 | 92,175 | 94,741 | 88,440 | 111,948 |
| Steam pressure | ,, | 160 | 135 | 155 | 135 | 175 |
| Weight per square foot of surface | ,, | 638 | 572 | 620 | 462 | 696 |
| Average coal consumption per train mile | ,, | 37 | 30·1 | 51·5 | 43·3 | 39·7 |
| Average mileage per month | | 2,795 | 3,105 | 2,485 | 2,173 | 1,553 |
| Cost on board at port of Buenos Ayres | £ | 2,847 | 2,350 | 3,096 | 2,425 | 3,593 |
| Cost of repairs for two years | £ | 360 | 100 | 390 | 100 | 390 |

"As regards quality of material and its strength, it is all that could be desired; but the builders did not take into account the character of the road-bed on which it was to run, and therefore made it too heavy and the wheel base too rigid. The locomotives might run well enough upon European roads, which are substantially built and well ballasted; but such is not the case in this province, where most of the railways are built on loose soil. The result is a large increase in the cost of maintenance of way and repairs to rolling stock." And in conclusion, after a careful and exhaustive inquiry, these gentlemen remark: "It may be concluded, from all the data furnished in this report, that the Southern Railway locomotives are but iron masses, entirely injurious to the roads and interest of the company, and that a large part of its rolling stock is unnecessary for the service of its lines, as neither the condition of its roads nor the necessities of its traffic require it."

The whole of the equipment was supplied from England by first-class makers; and though no doubt the Argentine engineers are somewhat harsh in their judgment, from the fact that a number of compound engines are found in the list together with a class of engines known as "single-wheelers" which are used in England for light express traffic, it must be concluded that the authorities responsible for ordering the rolling stock are more to blame than the makers, from their ignorance of the actual requirements of the country.

Comparing the English equipment of the Southern road with the American outfit of its Western neighbour, the following remarks in the report may be noted:—"The construction of the sixty locomotives, notwithstanding their simplicity, is first-class, except in a few details, which by no means affect their good conditions for service. The thirty locomotives for mixed trains have withstood very severe tests during the period when the railways had not the number necessary for its service, as, notwithstanding the excessive amount of work imposed upon them, the results have been very satisfactory and economical." It would certainly appear that these gentlemen held a brief for the Americans, and from the cost stated for repairs, as compared with the English-built locomotives, it is apparent that, either there is a very peculiar system of keeping accounts, or that figures have been somehow manipulated. An annual cost of £180 for maintaining a comparatively new engine in repair, even making due allowances for the increased rates ruling abroad, would be a high figure, while the sum of £50 attributed to the American engine must be equally, or more so, erring in the other direction. Should these figures, however, be correct, it is a matter of regret that American engines have not been adopted in England many years ago, as the average cost in that country of maintaining engines in repair is from £70 to £100 per annum. Regarding the stated consumption of coal, it is admitted that the dead loads hauled on the Western road are only about one-third of those on the Southern, the coaches and trucks being of American construction, and consequently of considerably lighter build. When the Railway Commissioners of New South Wales in 1891 decided to place upon their lines a more powerful description of locomotive than had hitherto been used, they submitted a specification to makers in England and America, stating the load to be hauled, the gradients, and the speed required; full particulars of which, together with the dimensions and weight of the two classes of engines supplied, will be found in a later issue. It may be stated here, however, that they were six-wheeled coupled, with cylinders 21in. by 26in., fitted with four-wheeled bogies, and of a weight corresponding with these enormous cylinders.

The American engines being first to arrive were, after the usual preliminary mileage with goods trains, placed upon passenger traffic, with the result that in a short space of time three of the bogie axles broke off short at the journal, which necessitated the withdrawal of the whole from service pending investigation. A commission of experts was afterwards appointed to inquire into the qualifications of these engines for passenger traffic; and after a protracted sitting and the hearing of much evidence, it was decided that they were unsuited for that purpose, and it was recommended that they should be retained for fast goods and stock trains. As will be seen from the list of weights and dimensions when published, the weight of these engines is excessive, and as those imported from England, though much lighter, performed their work in a manner which could not be excelled, it must be considered that the immense weight was unnecessary, and therefore a fault of design. It was chiefly on account of the weight, coupled with the fact that the material and workmanship were of a character incompatible with the care of human life expected in English countries from the travelling public, that the commission decided as they did.

The praiseworthy manner in which the English locomotives performed their work requires no further comment; and it may be stated, without much fear of contradiction, that the cost of repairs has been found at least 30 per cent. less than that of the American type. Also, could adequate conditions of test be applied, that the consumption of coal would be less to an appreciable degree. During the time that the American engines were running the mail service, it was found necessary to employ two firemen to each engine—not only on account of the heavy firing required, but because the arrangement of cab and footplate was such as rendered the fireman useless to assist the driver in keeping a lookout, and in the numerous other minor duties usually performed by him.

There are many points about American engines which require to be carefully considered before arranging to put them to work upon railways which have been constructed by English engineers upon their usual principles; and by so doing many of the sources of expense met with in New South Wales will be avoided. In ordering heavy engines, it should be clear that the rails are of such section as will bear their weight with safety, and that sufficient margin has been allowed in the construction of bridges for the additional strain that will be put upon them. Also it will be found that the position of the cylinders, and their great width over all, will cause fouling of the brickwork at stations, unless the platforms are set unusually far back, thus leaving a considerable space between them and the side steps of the carriages, forming a source of great danger to passengers both entering and leaving their compartments, by night especially. It must be remembered that in America raised platforms are not general, their coaches not requiring it, and that the space between roads or six-foot is much greater than in England. Engines with cabs and overhanging gear designed to pass one another in a space of 8ft., when brought within 6ft. are apt to be found most unpleasantly close together. It has been found in some cases that only about 8in. clear space remains between two engines standing on different roads; and, having regard for the manner in which American engines roll about on their springs, this is not enough to fulfil the usual conditions of safety. Again, in large engines the Americans hoist their boilers to such a height that to clear bridges, &c., built to the English standard limit, the chimneys have to be shortened to such an extent as to give a most unsightly appearance, even if not interfering with the proper working of the draught. Cow-catchers are a source of danger to shunters coupling trucks, and carriages built with the usual double buffers and central coupling, from the distance they project, being liable to mutilate the man's legs when standing in the four-foot. An American whistle, except where an absolute necessity for clearing the road of cattle, should never be introduced, as the shock to nervous passengers and children travelling, especially at night, is positive cruelty, in addition to being a source of nuisance to the population living around stations, crossings, and other places where it becomes requisite to sound the whistle. The quality of the coal to be burned should also be clearly set forth, as the enormous length of fire-box found on American engines and their contracted exhaust nozzles, which tear up the fire and vomit sparks, clinkers, and ashes to the detriment of the fireman and the surrounding country, remind us of the days when their fuel was firstly wood and then anthracite coal, which latter requires a draught, quite unnecessary where good steam coal is procurable. In comparing the cost of American engines with those of English manufacture, it must not be overlooked that, unless stipulated to the contrary, the Americans do not provide for copper fire-boxes and brass tubes, which in the Colonies, where repairs are cheaper than renewals, and the water being seldom filtered or in any way treated, cannot be classified as good, are looked upon as a good investment.

New South Wales certainly deserves credit for having, not only on the present occasion endeavoured to find an engine really suitable for its railways, but for having also made two former attempts, first to Anglicise the American engine by having drawings made from one imported from that country with such modifications as suggested themselves at the time — which modifications it is to be regretted were not all they might have been—and then having the engines built in England. The success of this venture would probably have warranted its repetition had the same superintendent remained in office. The second attempt was to Americanise the English locomotive, and resulted in failure, and as the improvements (?) consisted chiefly in extending the smoke-box, reducing the size of the driving wheels, and placing the cylinders outside the frame—when they might just as well have remained in—without adding in any way to the hauling power of the engine, being only four wheels coupled, it is not a matter of great surprise. Had these engines been made six-wheel coupled, with an adequate boiler, the purpose for which they were intended would probably have been attained. A careful study of American engines, with a few years of experience in their actual working, will soon convince the most sceptical that the principles upon which they are constructed render them admirably adapted to the conditions which the colonial railways demand, and that they have many points which are immeasurably superior to the English article. We may name the flexibility of their springs—to which the Americans devote a vast deal of attention—which are hung on compensating levers, allow the weight to adjust itself easily to the road, thus saving shocks to both the engine and the permanent way. Their flexible bogies, and their apparent immunity from derailment under ordinary conditions. The power saved in running round curves of small radii, so common in hilly countries with railways of cheap construction, by dispensing with the flanges on the middle driving wheels, enabling them to be most suitably and evenly spaced, and rendering any number of coupled wheels possible. The equal distribution of the weight over all axles so dear to the Americans and so beneficial to the road. The enormous capacity of the tenders for both coal and water, an arrangement which is economical and praiseworthy to a degree, in places where the water supply is untrustworthy, and where it is not unusual in the event of the failure through drought of a watering station to have to go on thirty or forty miles to the next, often with small tenders requiring part of the load to be shunted in order to get through, or often entailing total failure. The economy and advantage of being able to carry coal sufficient for the round trip when making a journey to the interior on a branch line, possibly through mountainous country, thus saving hauling, at enormous cost, trucks of coal, and the handling of it at its destination. The system of mounting the tenders upon two four-wheeled bogies again commends itself in many ways. These and many other items about American engines are all more or less admirable, such as their balanced valves, and the numerous devices for cleaning out smoke-box tubes and boilers; but as they do not materially affect the case in point, they may be left out of the question at present.

It will be noticed in the *résumé* of the types of locomotives adopted by the various Australian Colonies that, wherever the American engine has been chosen as a standard, the engines have been locally built; in which case, when carefully modified to suit existing conditions, they become about as desirable an article as could be wished for. In but few cases, however, have repeat orders been sent to makers in America; and the reason is not far to seek. The many admitted advantages of the American locomotive are mitigated by the crude design of detail, and the poor quality of both material and workmanship. In this lies the objection of colonial engineers to engines built in America. Bar frames appear heavy, clumsy, unsuited to the work they have to perform, and wasteful of space—so limited on the standard gauge—are liable to fracture, and require endless attention. The haphazard manner in which all fittings, springs, levers, &c., are attached, give the impression that the engine had been constructed without any consideration of their being required, and the various workmen left to arrange their attachment as most convenient during erection. Endless work is caused to the staff of the running-sheds through this when the engines are placed in working order, as, after a run of 100 to 150 miles, a most careful inspection is found to be required, together with a general screwing-up of all bolts and nuts, and the replacement of any part that may have chanced to shake off during the journey—an occurrence by no means uncommon. This may be what is described in the Argentine Republic as "defects in a few small details which do not affect their conditions of service," but the cost of these continuous small repairs, and the danger caused by this insufficient attention to detail and workmanship, is not easily overlooked by the authorities responsible for the safety of the travelling public. The feverish haste of the American makers to rush through work is responsible for the deficiencies; draughtsmen have not time carefully to place all these details, nor the workman for that admirable finish of work so much admired in English manufacture. Symmetry in appearance is unsought and uncared for. Boilers are punched and their pipe connections made in a manner quite at variance with English practice. Axle-boxes are of the commonest design, the lubrication system wasteful, and the axles, as will be seen from the experience of New South Wales, where all the bogie axles were replaced at the Government works, small and with insufficient journals to secure cool running; collars are attached with set-screws, and excentrics without keys. In a word, while the principle and conception of American engines is good, the detail and execution are crude to a degree as regards those manufactured for export. In America, on the leading railways, a very different state of affairs exists; the engines are built either by the railway companies themselves, or by makers carefully selected, and to the specification of the superintendent of motive power, under his inspection. The quality of the engines is all the time being improved by the introduction of many and useful innovations not considered necessary a few years back.

Colonial engineers are at a disadvantage in America by not having a firm like that of Sir John Fowler, to whom they can entrust their inspection work, and thus ensure at least an honest article in return for their money. As the American locomotive builders become obliged to find an outlet for their manufactures abroad, their export trade having till now been a very secondary consideration, coming of an adaptable race they will no doubt endeavour to comply more closely with the standard of work required by the English and other Colonies. From the manner in which work can be carried out in this large and enterprising country, it is possible that the English makers will meet with a competitor of no mean order in the near future, unless they endeavour to modify their somewhat conservative ideas. It is by no means clear that either English or American locomotive builders have had a fair opportunity to build a typical colonial locomotive, as usually they are supplied with so little data to go upon, that as a natural consequence they supply the article with which they are most familiar. It can at least be said in favour of English firms of any standing that their work is trustworthy and of good material, even if not carried out under rigid inspection, and when they err, it is usually from ignorance of local conditions, coupled with the erroneous impression "that what is good enough for England is good enough for anywhere." When colonial locomotive engineers are able either personally or by deputy to visit the country where they propose to have their locomotives built, and to superintend the design, America offers large inducements, and it would be one of the most interesting departures in locomotive practice to see what could be produced under the joint superintendence of an English purchaser and an American manufacturer. To design a locomotive entirely suitable for English colonies requires thorough knowledge of local requirements, coupled with that insight into economical working and repairing which is possessed by few outside the pale of the leading English railways.

## ANTWERP INTERNATIONAL EXHIBITION.

### THE FRENCH EXHIBITS IN INDUSTRIAL HALL.

IN my last letter I described French exhibits in the Machinery Hall; but engineers who wish to compare the progress made by French mechanics and metallurgists with that of their Belgian and German competitors will have to visit the main building, where the iron and steel industries of France fill a larger space than they do in the Machinery Hall. Why the products of French rolling mills, together with their steel forgings, cannon, and shells, should be shown in a different building from similar objects made by the Société Anonyme de Couillet, or Messrs. Cockerill, it is not easy to see; but I have already pointed out that the absolute want of system displayed in the arrangement of exhibits is one of the worst features of this Exhibition.

Every engineer who visits Antwerp should inspect the calculating machine and other instruments shown by M. Léon Bollée, of Le Mans; but as his stand is surrounded by exhibits of art pottery and dress materials, many pass it without noticing, who would not fail to see it if it were in the Machinery Hall. The calculating machine is an apparatus 3ft. long, made chiefly of brass. By its means additions, subtractions, multiplications, divisions, squaring, and square-root can be made mechanically. It will multiply any number of figures up to 20 by any other number not exceeding 10. The figures to be multiplied are along the front of the machine, near the top, and above them is another row, in which the result is given. Over this is a tape marked "units," "thousands," "millions," &c., so that large numbers may be easily read without counting the figures first. When multiplying with decimals this tape moves automatically, so that the decimal point is always correctly placed in the result. The figures of the multiplier are arranged in another frame below. The machine in several test operations was always accurate, and it is very quick. The inventor says that with any numbers up to the machine's limits, he can do 100 divisions, 120 square roots, or 250 multiplications in an hour.

Another apparatus shown by M. Bollée is a railway ticket distributing machine. This is chiefly intended for use in small stations of branch lines, where the person in charge is not very experienced. The tickets are arranged in piles, according to class, in the compartments of a locked, glass-fronted box. At the side of the machine is a dial bearing the names of the stations. A handle is turned round the face of this dial, till a projection on it enters a slot opposite the name of the station and class. The handle of the machine is then turned, when a ticket comes out numbered and dated; a needle pricks the description of ticket on a register, and a counter marks the total value sold. By using this apparatus the person issuing the ticket has only to see that he receives the value marked on it; a travelling inspector merely requires to ascertain if the cash agrees with the figures indicated on the counter, which he can do in a minute whilst the train is stopping; and if, on account of illness or other emergency, the ticket clerk's work has to be taken over by another man, there is no need for the stock of tickets to be counted, as the newcomer can see the number of the last ticket issued, as well as the cash in the till.

Several different descriptions of cash registers are also shown, arranged for railway way-bills as well as for shops. One of these machines has a horizontal dial like that of the ticket-distributing machine, but with four or more sets of slots, numbered from one to nine. The machine exhibited is for francs and centimes; but they can be equally well made for English money. The handle is placed successively opposite each figure in the bill, and a lever struck each time. By turning another handle a ticket is delivered bearing the name of the firm, &c., amount paid, and date. The tickets are numbered consecutively, and, if necessary, can also bear the number of the department or employé. Another machine issues two duplicate tickets, whilst in another, duplicate copies of each bill are inscribed on a continuous roll of paper.

M. Bollée's most ingenious invention is an apparatus for ascertaining the note of tuning forks by the eye, instead of being obliged to rely on the ear. A fork, of which the note is known, is set horizontally, and the fork to be tested, vertically. The latter is blackened, and then a small spot at the end of one of the prongs is made bright. A strong ray of light is now thrown on the two forks, and they are made to vibrate. If their notes are the same, the vibrations will be isochronous, and the reflection of the light will form a circle. As the notes of the two forks differ, so the curve made by the ray of light varies in form. These curves are in some instances very complicated, but the same variation between the note of the two forks always gives the same curve. M. Bollée uses a fork with the note C as the standard, and by comparing the curve with a set of diagrams, the note of the other fork is at once known. He has also a machine for making these diagrams; bevel-wheels, whose teeth vary as the vibrations of the notes are put in, the handle turned, and the curve corresponding to the difference between the notes is drawn.

The Compagnie Française des Métaux exhibits a plate of aluminium, probably the largest which has yet been rolled, as it measures 18ft. by 5ft. and is $\frac{1}{12}$in. thick. It weighs 52 lb., and is intended for the French torpedo-boat Le Forban, now being built at Havre. This company also shows a series of aluminium angle bars for the same boat. They are all 18ft. long, and vary in section from 2in. by 2in. by $\frac{3}{16}$in. up to $2\frac{3}{4}$in. by $2\frac{3}{4}$in. by $\frac{1}{4}$in. Besides these there are cartridge cases and smaller objects also in aluminium. In copper the company shows fire-boxes for locomotives, a solid drawn tube 12ft. long, 3ft. 3in. diameter, $\frac{5}{16}$in. metal, weighing 25 cwt., a pan 10ft. 8in. diameter, 5ft. 3in. deep, weighing 24 cwt., and other tubes and pans of smaller size. Another branch of its manufacture is that of ornamental copper and brass tubes, fluted or embossed, round, square, or hexagonal in section, and gilt or bronzed. In steel it shows cartridges, a torpedo tube, &c. It also exhibits drawn steel and copper tubes for boilers with internal radial projections ("Serve" tubes), spiral copper tubes 50ft. long by 2in. diameter for distilleries; brass and copper wire, &c.

Messrs. Schneider and Co., of Creusot, have not such a large display as they have had at former exhibitions. They show several samples of steel, including a bar 6in. square, bent cold, and a 10in. plate, with the shells that have been fired at it, imbedded in it. Their chief novelty is a 3in. quick-firing gun, which can be loaded and discharged three times in a minute. When the cartridge has been inserted, the breech is closed, and the handle turned 45 deg. If not closed properly, or not turned so that a clutch on the handle will enter its catch, the gun will not go off. After firing, the breech is turned back, and the act of opening it causes the extractor to throw out the empty cartridge case. They also exhibit several other guns, a torpedo tube, with a guide slot top and bottom, and a good many models. Some of these are of different descriptions of turret guns, another is of a steel torpedo boat 120ft. long, and several are of engines. Amongst the latter is a very pretty working model of the triple-expansion engines for the s.s. Alger, 8000-horse power.

The Société des Forges et Chantiers de la Mediterranée exhibit a fine collection of Canet guns. The largest, of which it only shows a model, is 42ft. long, $12\frac{3}{4}$in. diameter, weighs 65 tons, and carries a projectile weighing 9 cwt. Three guns of this size were made in 1889 for the Japanese war vessels Matsushima, Itsukushima, and Hashidate, and were at that time the most powerful that had been made in France. The initial velocity is 2800ft., and they will pierce an iron plate 4ft. thick placed at the muzzle.

The maximum range is 12½ miles. The makers claim that these guns are equally powerful with those of 15¾in. bore made in England and Germany, and weighing 100 and 120 tons respectively. In the smaller sizes they show the actual guns, and explain the mechanism. Two of these are rapid-firing guns, of 4in. and 6in. diameter. The former is 26ft. long, has a projectile weighing 28 lb., an initial velocity of 3300ft., and will pierce a 20in. iron plate. The latter is 23ft. 6in. long, the weight of the projectile is 88 lb., the initial velocity 2400ft., and it will pierce a 19in. plate. Amongst the other guns shown are two of 4½in. bore. One of these, made for the training ship Zaragoza, belonging to the Mexican Government, has a length of 17ft., an initial velocity of 2300ft., takes a projectile weighing 46 lb., and will carry 7½ miles. The other, of the same diameter, is intended to be used in fortresses. Its length is 10ft. 3in., the projectile weighs 40 lb., the initial velocity is 1900ft., and it will carry 6 miles.

If there is one lesson that the Antwerp Exhibition teaches us more than another, it is that foreign manufacturers in many branches are not only able to compete with us in Japan, Brazil, Chili, Turkey, and other countries which once came to England for their supplies, but that they are even able to supply our Government and our private firms with goods that were once always ordered at home. Another striking instance of this is seen in some shells 15in. diameter and weighing 11 cwt., which have been recently made for the British Government by the Compagnie des Hauts Fourneaux, Forges et Aciéries de la Marine, of Saint Chamond, of whose magnificent exhibit they form a part. They are of chrome steel, and form a portion of a collection of shells supplied to foreign Governments. Amongst these are 13½in., 9in., and 6in. shells for Great Britain, 10in. and 8in. for the United States, and 12in. and 11in. for Russia. Chrome steel is also shown in the form of armour-plates. One of these, measuring 6ft. 11in. by 4ft. 10in. by 10in., was fired at by a gun 6¼in. bore, with gradually increasing charges, the weight of the projectile being 91 lb. When the shell struck the plate with a velocity of 2000ft. the penetration was 9½in., and at a velocity of 2200ft. it increased to 10½in. Another plate measures 5ft. 11in. by 3ft. 3in. by 1¼in. Eight 40 lb. projectiles were fired at this from a gun with 4¾in. bore. At a velocity of 490ft. the penetration was $1\frac{7}{16}$in., increasing to 2¼in. at 690ft. A plate 5ft. 3in. by 3ft. 5in. by ⅛in., intended for decks of war vessels, has been fired at with projectiles 3⅜in. diameter, weighing 11 lb., and at a velocity of 600ft., without being pierced. Other steel plates are shown, and also iron plates of various dimensions, which, for land purposes, are preferred by French military engineers to steel. A detailed list of the tests to which these have been exposed would be too long, but all the plates shown have been tried, some with four or five shots fired at the same spot.

In ordnance, its latest type is the "Eclipse," a disappearing gun for land batteries. The one shown is 5¾in. diameter and 11ft. 10in. long. The projectile weighs 44 lb., and the initial velocity is 1970ft. The back of the gun-carriage runs on a rail, whilst the front is supported on a pivot firmly secured to the base-plate of the carriage. This carriage runs on rails 4ft. 11in. gauge, to which at the moment of firing it can be fixed by four catches, and is practically arranged like the carriage of a travelling crane. The gun itself is carried on the upper end of a lever, which oscillates at one-third of its height on a horizontal axle held by the gun-carriage, and the lower end of this lever is connected with an hydraulic brake. Another support at the back of the gun moves with and remains parallel to the lever, so that the gun in rising does not change its inclination to the horizon. This angle, which is set whilst it is in its lowest position behind the parapet or screen, can vary from +25 deg. to −10 deg. The gun can be turned by hand till it is approximately in the required horizontal position, and it can then be finally adjusted by means of a pinion gearing into teeth on the inner edge of the roller path. The brake, which is the essential part of the invention, consists of two cylinders placed one above the other, with valves by which the connection between them can be opened or closed. The piston of the upper cylinder is joined to the end of the lever carrying the gun by two connecting-rods, whilst that of the lower cylinder is pressed down by a set of "Belville" springs, which are steel discs, slightly dished, and strung in pairs on a central rod. At the moment of firing, the upper piston forces the liquid into the lower cylinder and compresses the springs. At the end of the recoil the valve closes, preventing the return of the liquid, the springs remain compressed, and the gun eclipsed. It is in this position that it is loaded and pointed; and then, when ready, the valve connecting the two cylinders is opened and the springs expand, and bring the gun up into its position for firing. If necessary, it can be raised and lowered without being fired. The difference in height between the loading and firing positions is 4ft. 1in.

Another gun shown is a 3in. bore rapid-firing field piece, in which nearly the whole of the recoil is taken up by the hydraulic brake and the springs. In one tested recently it was found that, after being discharged ten times, the total recoil was less than 4in.

The chief attraction at this stand is a full-sized revolving steel tower, carrying a gun 5ft. 6½in. long, 4¾in. bore. The upper part of the tower is formed of cylindrical armour-plate 8ft. 6in. diameter and 4¼in. thick, roofed over with a spherical plate 6in. thick. The embrasure is in the cylindrical plate, and the spherical roof plate oscillates with the gun-carriage, and causes the eclipse. The oscillation is produced by a balance weight on the platform which supports the gun-carriage, being raised or lowered by means of a winch in the chamber below. When ready for firing, the gun is run out till the muzzle projects 3ft. beyond the embrasure; its position can then be varied 3 deg. to the right or left without moving the tower; it can also be lowered 5 deg. or raised 30 deg., either in its firing position or when eclipsed. To prevent accidents, there is a special arrangement by which the gun cannot be fired until in position with the carriage firmly fixed; nor can the eclipse take place till it has been run in from the embrasure.

Besides the full size tower, three working models are shown, each to carry two guns of 6in. bore. Another part of the Saint Chamont Company's exhibit consists in steel castings. It shows some valves, &c., for marine engines, cylinders, bends, tooth wheels and other pieces. In rolled steel it exhibits plates and bars, many of which have been subjected to the usual tests of being twisted or bent cold; and various sizes of rolled joists, up to 26½in. by 5¾in. by 1⅜in.

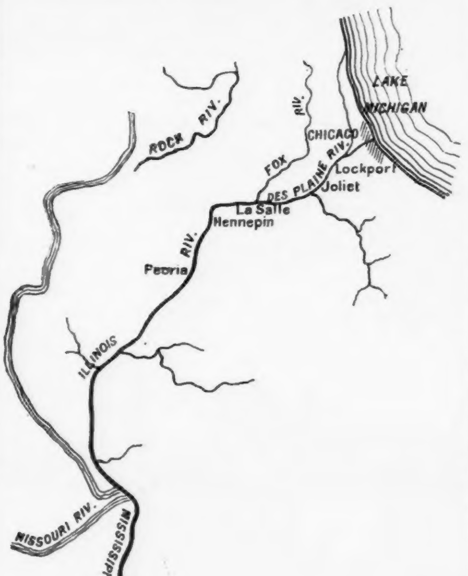
Adjoining the Saint Chamont installation, and scarcely inferior to it in size, is that of the Compagnie des Forges de Chatillon et Commentry. Like its neighbours it shows a full-sized turret. It is rather larger than the other, being for a gun 8¼in. bore. It also shows several models of turrets for weapons of various sizes, from one for two 9½in. guns, 28ft. long, down to a turret for a single 2in. gun. In steel castings it exhibits a gun carriage frame, and a screw for a torpedo boat; and in rolled steel, a series of armour-plates from 3in. thick, down to $\frac{5}{32}$in. Another of its exhibits is steel torpedo netting, of which it says it has made nearly all that is used in the French navy. Finally, it shows some forged steel shells with copper rings, the largest being 16½in. diameter, and some chilled cast iron shells up to 11in. diameter.

Amongst the French rolling mills which are not also exhibitors of artillery, the Forges et Aciéries du Nord et de l'Est have the largest display. They show locomotive and wagon axles in Martin-Siemens steel; joists, angle, T, and channel bars in basic Bessemer steel; steel rails varying from 9 lb. to 90 lb. per yard; and pieces split, twisted, and hammered flat with a 10-ton hammer.

Similar exhibits, but only in iron, are made by the Société de Ferrière-la-Grande and the Société des Hauts-Fourneaux de Maubeuge. The latter make a speciality of a joist with two longitudinal grooves on the under side of the bottom flange, intended to form a key for plaster on ceilings. There are many other French exhibitors of rolled iron and steel, axles, and other forgings, but they occupy less space, and their exhibits are less varied than those of the firms mentioned above.

## THE CHICAGO SHIP CANAL AND DRAINAGE CHANNEL.

A work, which if not entitled to rank in importance with the Manchester Ship Canal, yet is entitled to notice both from an engineering and commercial point of view, is now in operation for the purpose of effecting a waterway for ships of considerable size between Lake Michigan and the Illinois River. The primary object, however, for which this work was undertaken was the conveyance of the sewage of the city of Chicago, and it may certainly be classed as the largest outfall sewer that has ever been constructed. A short description of the physical character of the district and the circumstances which have led to the cutting of this waterway will make the description of the work now in hand more clear.



Chicago stands on the watershed which parts the waters flowing on the one side to the Mississippi and the Gulf of Mexico, and on the other to the St. Lawrence. The geological character of the strata indicates that the outlet of the great lakes was at one period westward, through a river two miles wide and 150ft. deep. Between Chicago and Joliet is a valley, the bed of which is rock, but which is now filled up with alluvial deposit. As the surface of the waters in the great basin of the North American lakes fell below the rocky bed of this valley, the flow westward was stopped and the St. Lawrence became the sole outlet, the valley being subsequently filled with glacial drift. A very slight change of levels would again allow the water from Lake Michigan to flow westward. At Lockport, thirty miles from the south shore, the lake level is reached; the fall then becomes rapid. At Joliet, ten miles further, the fall is 77ft., and at La Salle, 100 miles from Chicago, where the Illinois River is met, the total fall reaches 146ft. This river, after a course of 225 miles, joins the Mississippi. The construction of a canal from Lake Michigan to the Illinois, and the rectification of this river, will open up a waterway from Chicago to the Gulf of Mexico, making it thus the main port for traffic both from the East and from the West. This fact was realised in the earliest days of settlement of this part of America, and Joliet, who discovered the Desplaines Valley in 1673, reported that it would be quite practicable to make a canal so that vessels could pass from Lake Michigan to the Desplaines River, which runs from the summit level to the west of the lake to the Illinois. From that time forward the matter has been constantly brought forward. In 1795 a treaty was made with the Indians by which a free passage by land and by water was secured from the mouth of the Chicago to the commencement of the portage between that river and the Illinois, and down that river to the Mississippi. The subject was once more brought before Congress in 1804, and a survey ordered. The result of this was to show that the bed of the Desplaines was rock, and from 7ft. to 10ft. higher than the surface of the lake. The scheme, however, was considered practicable, and in 1836, with the aid of a grant from the Government, the State of Illinois made a commencement of the construction of a waterway. The width of the channel was 60ft., and depth of water 6ft. The summit level, 22 miles in length, was 8ft. above the lake. After spending about a million of money, the deep cut of 15ft. through the rock, originally intended, was abandoned, and the canal, 100 miles in length, completed in 1848 on a higher level, at a cost of about 1½ millions. In 1871 it was deepened across the "divide," or rocky summit, sufficiently to create a flow of the water by gravitation from Lake Michigan, and to carry away the sewage from the city. For a few years this canal served well both for commercial and drainage purposes. A few years, however, after the deepening the population of the city had so increased, and the amount of sewage sent down the canal became so great, that its water was excessively foul. Pumps were therefore put in operation to raise water from the lake, and thus to create a greater flow of water. As the population continued to increase the nuisance from the sewage became worse, and by backing up into the lake at times polluted the water supply of the city, which was obtained from it. To meet this a tunnel was sunk under the bed of the lake for a distance of four miles from the city, from the end of which the supply was drawn. But even with this precaution, under certain conditions of the wind and weather, the purity of the supply was affected. In 1882 the States Government authorised surveys for the purpose of enlarging the existing canal, and for improving its connection with the Mississippi, and for making it of sufficient size to take vessels of 600 tons. The City Council of Chicago also appointed a Commission in 1886 to report as to the best means of dealing with the sewage. This Commission reported that means must without delay be taken to prevent the sewage of the city flowing into the lake if the water supply was to be taken from it; that it was not practicable at any reasonable cost to deal with it by land irrigation or chemical treatment; and that the only effective way of dealing with it was by a channel down the valley of the Desplaines to the Illinois River, its section being of such an area as to take a sufficient volume of water from the lake to dilute the sewage, so that it should not be a nuisance to the people living in the district through which it passed. Under present conditions, as the sewage flows down the existing canal it passes through Joliet, a city of 25,000 inhabitants, and other towns of smaller size. The offensive condition of the water arising from the sewage of 1½ millions of inhabitants can be traced as far as Peoria, 120 miles from Chicago.

Finally, in 1889, the States Legislature decreed that the construction of a combined drainage and navigation channel between Chicago and Joliet should be undertaken. At the latter point it was assumed that the river would be able to receive and dilute the combined sewage and lake water until plans were completed for the continuance of the navigable channel. This was the origin of the waterway which is now being constructed, and which will be as large as a modern ship canal, and will provide a waterway for the largest lake and river steamers.

The quantity of water that will pass through the channel is put at 10,000 cubic feet a second, moving at a velocity of three miles an hour. It is an interesting question as to what will be the effect of so large a diversion of water, about 4½ per cent. of the total amount that now passes through the St. Clair River, and thence over Niagara to the St. Lawrence. The average variation of the level of the lakes is from 18in. to 24in. during the year, and the loss from evaporation represents a difference of 6½in. in water level. It is estimated that a discharge of 10,000 cubic feet a second into the new canal will lower the level of the four lakes 2·87in. a year. It is the opinion of the engineers who have investigated the subject that when the variations due to wind, evaporation, and rainfall are taken into consideration, the effect of the water which will be abstracted will not be noticeable.

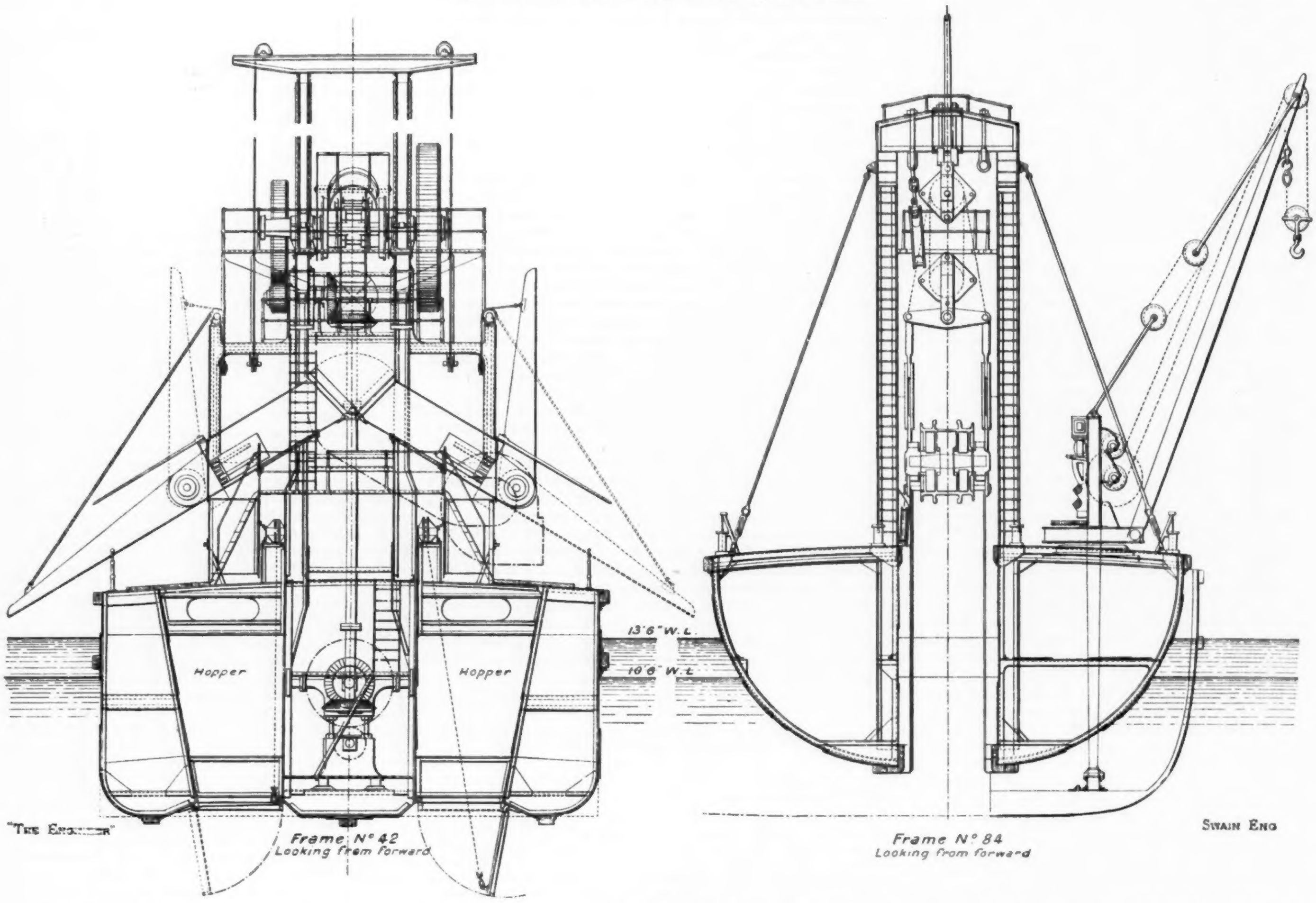
The course of the new channel runs nearly south-west, and at about nine miles from Chicago enters the Desplaines Valley, following the course of this valley for the remainder of its length of about forty miles, till, at a short distance below Joliet, it joins the Desplaines River. Before commencing the excavation of the canal it was found necessary, in order to control the fluctuations of the river, to construct a diversion of thirteen miles of new channel, and to erect thirteen miles of banks to separate the river water from that of the canal. It was also necessary to construct a concrete dam or spillway 367ft. long and 16ft. above the water level at Lake Michigan, to allow surplus water to flow towards Chicago. The width of the bottom through the part where the clay exists is 202ft., and of the other parts 110ft. About twenty miles of the canal is through rock or hard material, and this part will be 160ft. wide at the bottom, with vertical sides; the depth of the bottom from the surface of the earth being from 30ft. to 35ft. The depth of water throughout will be 22ft. The quantity of glacial drift to be moved will amount to 25½ million cubic yards, and of solid rock nearly 11 million yards. The price at which this material is being removed by contract is from 10d. to 15d. for the drift, and from 3s. to 3s. 7d. a yard for the rock.

The works were commenced in 1892, and are expected to be completed in 1896, and the cost is estimated at 5¼ millions of money, while a further sum of about four millions will be required to improve the navigation of the Illinois River below the junction of the new canal. When this is done there will be an unobstructed navigation throughout the 227 miles of the lower part of the river, sufficient for the largest class of Mississippi steamboats, to Utica. Above this a fall of 140ft. will have to be provided for by locks.

Road Bridge for Brazil.—The following corrections have to be made in the article on this bridge which we published in our last impression:—On the 23rd line of second paragraph, page 252, instead of "dead load" read "live load without balance weights;" and in the 4th line, 3rd column of the table of stresses, instead of 116 3 read 216·3.

# THE SOLID ROCK DREDGER MAJESTIC

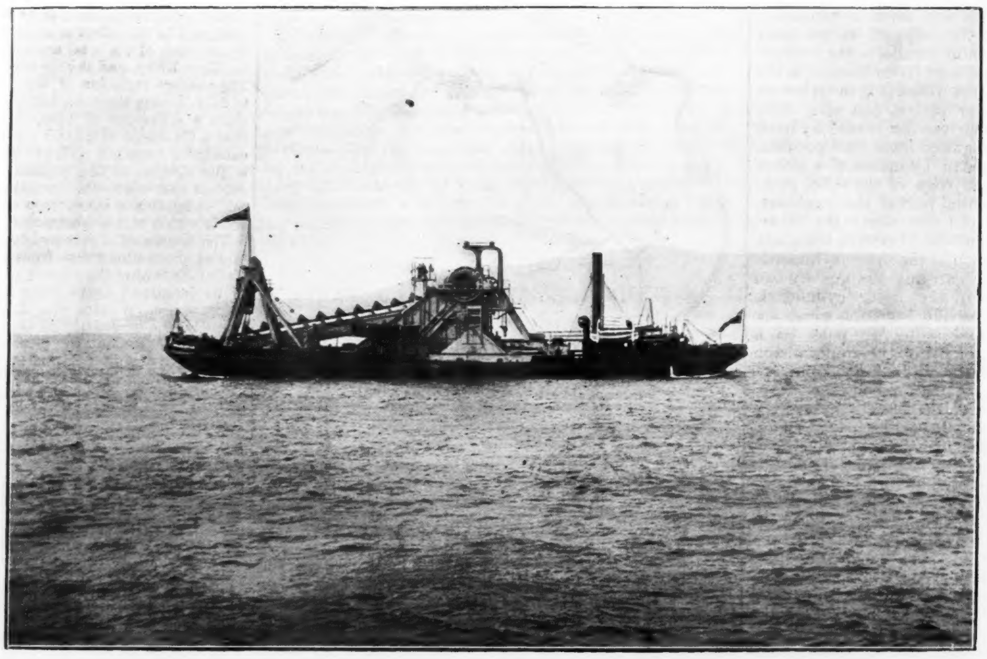
MESSRS. LOBNITZ AND CO., RENFREW, ENGINEERS



## SOLID ROCK DREDGER.

At the time when the entrances to most of the leading harbours and docks of the world were made, they were of ample capacity for the admission of ships of the heaviest burthen. Gradually, however, the tonnage and draught have been increased to such an extent that on the score of safety as well as of convenience it long since became necessary to deepen and otherwise improve these channels. In many instances the entrances have been cut through the solid rock, so that the work of deepening has proved very expensive, and has occupied a long time. Blasting had first to be resorted to and the spoil then dredged up. In some instances the entrances are situated in the open seaway, thus rendering the work increasingly difficult, and protracting the time of its execution. Step by step the strength and power of dredging plant have been increased, so that in some instances the solid rock has been successfully dredged with little or no blasting. In this way the new channel for the harbour of Alexandria was formed by Messrs. S. Pearson and Son, of Westminster. It was a heavy job, being a cutting in the open seaway 300ft. wide, through a series of ridges of solid rock, and running out about a mile from the harbour. The work, however, was satisfactorily accomplished, practically without blasting. Having disposed of the dredger used at Alexandria, and having taken a contract for cutting a channel through the rock at Bermuda, Messrs. Pearson and Son have had another dredger designed, into which they have introduced all the improvements suggested by their experience in previous contracts of this nature, and which is the strongest and most powerful dredger afloat. The vessel has been built, engined, and fitted by Messrs. Lobnitz and Co., of Renfrew, where we were recently afforded the opportunity of inspecting it. By the courtesy of Messrs. Pearson and of the builders we are enabled to illustrate this dredger very fully in our double page engraving this week, and to give particulars of its construction.

The dredger has been built entirely of steel, and is capable of steaming to any part of the world at a speed of 7 knots an hour. In the after peak is a water-ballast tank to carry about 100 tons, and which may be arranged for use as a fresh-water tank and a ballast tank. It is divided by a steel deck with a water-tight manhole so as to carry spare gear in the top compartment, which, however, will also be available for water when required. She is propelled by four-bladed twin screws, right and left-handed, and of 9ft. diameter, which are driven each by its own independent triple-expansion engine, the two representing 800 indicated horse-power. Steam for these and the dredging engines is supplied by two cylindrical steel boilers of the return tubular type, the two representing 1000 indicated horse-power. They are arranged independently, so that one may be cleaned whilst the other is in use for dredging. They are fitted with Fox's suspension flues, and their working pressure is 160 lb. per square inch.



THE MAJESTIC IN THE CLYDE

The dredging gear is of a very massive and powerful character, and is of sufficient strength to pull up the engine should any impediment be met with in the working, by which means the risk of a breakdown will be avoided. The ladder is a strong girder of the box type, with chilled rollers for carrying the bucket chains. A special point here is the manner in which the suspension shaft of the ladder is fixed on the incline of the framing with buffer gear. An elastic buffer 20ft. long, and of special construction, is provided on the incline of the framing on each side. It consists of a series of powerful spiral springs which can be adjusted to take the strain equally and without damage to themselves, and having a combined resistance of over 100 tons. When dredging hard material in a moderate swell, with the vessel rising and falling, the shocks to the bottom tumbler will be cushioned to such an extent that work can be carried on continuously without the liability to serious accident to which ladder dredgers are subject in these circumstances. Buffers have, of course, been used before in this connection, but their construction has usually caused them to give as much trouble as was previously experienced without them by breakages of the dredging gear. The pins of the bucket chain have 3ft. 4½in. centres, this large pitch being adopted with a view to dredging hard coral or other similar rock. Some idea of the massive character of this part of the machinery may be gathered from the fact that one element, *i.e.*, a bucket and one pair of links, weighs over two tons. The total weight of the chain of buckets is 60 tons, and with the ladder the weight is 100 tons. The pins and wearing parts in the bucket chain are of manganese steel, working in bushes of the same metal. The links are built up of three thicknesses of rolled steel of special quality, by which arrangement the liability to trouble from defects from internal flaws is obviated and other advantages are secured. When dredging at six buckets per minute, there will be a strain of 100 tons on the bucket points. The ladder is lowered and hoisted by forward shears with eight-sheaved chain blocks, worked by a powerful ladder-hoist winch, with independent steam engine. Although the dredger cuts her own flotation—that is, cuts her way through a bank above water-level—and has a closed bow, she still has the advantage of being able to raise her ladder and bottom tumbler above deck level through the well. In ordinary work the vessel can dredge to 35ft. below her light load line, but by making use of a guide wheel for taking up the sag of the bucket chain, she is able to dredge to a depth of 45ft. when required. As will be seen from our engraving, the dredger is fitted with overhead gear on top of the main framing, so that she can do her own heavy repairs, independently of assistance from the shore. The heaviest pieces of machinery can be moved about by the aid of steam winches placed fore and aft. The dredging apparatus is driven by a compound engine of special construction, with 16in. and 30in. cylinders, and 2ft. stroke, and which is arranged to meet any sudden changes of power. The bucket chains are driven through treble gearing, so arranged as to be capable of giving three different speeds to the buckets, with the same number of revolutions of the engine, this being effected by means of change wheels.

When dredging rock the spoil falls from the buckets with great force from a height of about 15ft. on to a flap-valve, which breaks the fall and regulates the loading into the hoppers, of which there are two, one on either side of the vessel. This valve consists of a thick armour-plate which normally rests at an angle of about 45 deg., and receives the shocks of the fragments of rock, some of which weigh upwards of a ton and a-half, and so prevents injury to the shoots. The valve, which forms a lid to either shoot alternatively, is worked by steam power, and is so arranged that either shoot can be closed or opened in order to regulate the loading of the hoppers into which the spoil is delivered fore and aft from the shoots by means of breeches pieces. Each hopper is capable of containing 7000 cubic feet of spoil, and when both hoppers are full the vessel will steam out to sea and discharge in the usual way. The hopper doors are built up of very thick steel plates on channel girders, and are opened and closed by special winches. The doors when closed are 1ft. clear above the grounding keels, so that they are well protected from injury by touching the bottom. The grounding keels and under-water fenders are of greenheart, to resist attacks of the *teredo navalis*. Should it be desired to load the spoil into barges alongside, the hoppers can be shut off from the side shoots, and hinged prolongations of the latter lowered by steam power for use. The vessel is also fitted with a centrifugal spoil pump for soft dredging, and she can discharge the spoil on to land through a spout. This pump will be driven by the propelling engines through rope-gear, and will absorb from 350 to 400-horse power, according to the distance to which the spoil has to be delivered. There is also an additional centrifugal pump which discharges a supply of water into the shoot at the top tumbler, and likewise delivers water into the discharge pipe of the spoil pump. The water thus assists in breaking up the soil, and acts as a carrier for it. It will thus be seen that the dredgings can be discharged either into the hoppers, or into barges alongside, or into the spoil pump.

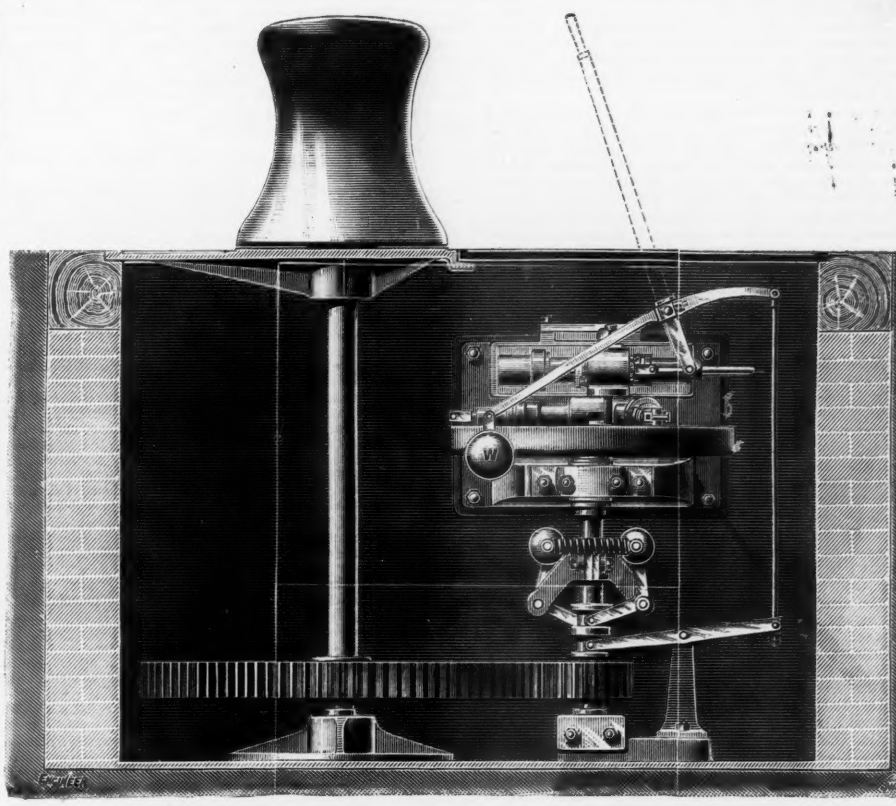
In addition to the dredging appliances, the vessel will carry a rock-breaking apparatus, which will be fitted forward as shown in our engravings. The rock-cutter is an iron bar weighing ten tons, and having a hard steel chisel point. It will be worked by means of a special steam winch and steel wire rope fitted with a monkey clutch, and will be operated after the manner of a pile driver. It is intended for use should any specially hard rock be encountered, which will be broken up by it ready for the dredger buckets to follow and pick up. The dredger carries a ten-ton deck crane with a sweep up to 35ft. radius. She also has powerful manœuvring winches at both bow and stern, each having three independent chain barrels. She is fitted with steam steering gear, which can be operated from the upper bridge and from the lower or navigating bridge. It can also be worked by hand should the steam gear break down, and, should these means fail, the dredger can still be steered by a steam winch. Special workshops are fitted up on board, so that all ordinary work can be done without outside aid. Besides all the usual hand tools, the workshops are fitted with various descriptions of lathes, planing machines, and drilling machines, and there is also a well-appointed smithy.

For ordinary service the dredger will carry 100 tons of coal, but her bunker capacity is 600 tons, which supply she will take in on long voyages. She will be fitted up with the electric light throughout, and will also carry a search light, so as to enable her to pass through the Suez Canal or any other similar channel by night. She will have on board a powerful steam launch as a tender, besides a complete outfit of all kinds of boats. There will be ample accommodation for the officers and crew, and she will, in fact, constitute the best appointed and most powerful dredger ever constructed, and will cover a wide range of usefulness. She has been built to Lloyds' and the Board of Trade requirements as a sea-going vessel, and was launched in February.

The following are the leading dimensions :—

| | Ft. | in. |
|---|---|---|
| Length between perpendiculars | 200 | 0 |
| Length over all | 208 | 4 |
| Breadth moulded | 39 | 0 |
| Depth moulded | 17 | 3 |
| Shear, forward | 4 | 0 |
| Do. aft | 3 | 0 |
| Round of beam | 0 | 9 |
| Draught light, in working order | 10 | 6 |
| Do. loaded, 700 tons in hoppers | 13 | 6 |
| Do. light, with ballast tank full, aft | 13 | 6 |
| Do. do. do. forward | 8 | 0 |
| Displacement, loaded | 2000 tons. | |

RIGG'S GOVERNED HYDRAULIC CAPSTAN



## HYDRAULIC CAPSTANS.

By Mr. ARTHUR RIGG.

HYDRAULIC capstans as hitherto constructed are wasteful in their use of pressure water, actually taking more when running unloaded than when performing their full work. It is mainly from this cause that there has been comparatively little extension in the use of hydraulic engines, and as the governing arrangement now to be described proportions the quantity used according to the demand for power, there is now no further reason why the application of these useful and convenient motors should not become greatly extended.

The hydraulic power supply companies practically restrict their sphere of operations to working lifts and cranes, as their pressure water is so much more costly than gas or steam power, and few opportunities occur where this convenient but costly power can be used for anything else. It does not seem to have occurred to these companies that it might pay much better to supply a cheaper power for a more extended class of customers than to keep up the out-of-date system of high prices and restricted output. As if to handicap still further the use of such hydraulic engines as have been hitherto put up, they use the same quantity of water when running at the same speed whether there be a full load or none, thus comparing in extravagance with a steam engine provided with a throttle valve, and using steam throughout its stroke. Any arrangement, therefore, by which the stroke can be altered in proportion to variations in load improves the economical working of hydraulic engines much as the working of steam engines was improved when an earlier cut-off gave the advantages derivable from expansion. What with the original high cost of water pressure, and its wasteful application, it is not surprising that hydraulic engines have not, up to the present time, become generally used for obtaining power, although their extreme convenience as compared with gas engines or steam engines is allowed on all hands. Before a governor can be applied, it is necessary to arrange for a variable stroke, which cannot well be managed with an ordinary crank. A reduction of speed seems the simplest method for regulating power, but as a uniform speed is so generally required, very few cases occur where this plan can be followed. For cranes or hoists regulation may be carried out by providing two or more rams and a system of valves, whereby one or more rams can be put into action, thus giving relatively proportionate powers. Such systems, however, are inapplicable to engines turning shafts, or at least they would be so inordinately costly and complicated as to preclude their general use, and an alteration in stroke remains the sole convenient and practical method whereby hydraulic engines can be satisfactorily regulated, and the speed maintained at a uniform rate.

In spite, however, of such drawbacks accompanying the use of hydraulic engines, great numbers are used at railway stations, docks, and other places, for driving capstans, and the surpassing convenience of such an unfailing power, so easily distributed, is found to compensate for the waste attendant upon its use. In order to mitigate, in some degree, the losses which occur when such capstan engines are running unloaded, it is usual to design their ports and passages extremely small, so that friction through them shall prevent too rapid a current, and also shall limit the speed at which the capstan can run when unloaded. Then the reciprocation of their rams frequently reverses the current of water, and this operation entails a series of destructive shocks upon the engine. Nevertheless, the combined effect of insufficient passages, and the reversal of currents at a tremendous pressure, imposes a limit—of utterly unscientific and wasteful character, it is true—upon the speed at which such capstans can be driven.

Capstan engines are made with two rams, having cranks at right angles, or with three cylinders, acting on the same shaft and cranks at 120 deg., so that they will start when water is turned on; and their dimensions are such as to provide an ample reserve to start a load beyond the nominal power at which they are intended to work. If we take the case of a capstan engine driven by three single-acting engines set radially around the same crank and at 120 deg. to each other, it is well known that the crank receives a tolerably uniform tangential effort, and a fairly regular movement ensues. But because of the crank turning round it is highly inconvenient to alter its radius; for this has already been attempted with results by no means successful from a practical point of view. If, now, we regard the same three-cylinder engine as having its crank centres fixed, so that when pressure is turned on the pistons will drive the capstan by revolving round the main shaft centre while the cylinders revolve around the crank centre, we get exactly the same results as to power by the ordinary system with more than one very distinct advantage. As the crank has now become stationary, it is easy to move its centre nearer or further from that of the main shaft, and all difficulty as to its regulation is at an end. If the crank centres be 3in. apart, then the stroke becomes 6in.; but if these centres be closed together until only 1in. apart, then the stroke becomes 2in., and there is the further utility in being able to alter the stroke, that by transferring the crank centre to that opposite the main shaft the engine reverses.

Having secured this mechanical convenience, it is no longer necessary to contract the area of water passages, for these can be made as large as desired, and the arrangements for governing, by altering the stroke, are all that remain to be carried out. There is now no appreciable loss by friction, and the full pressure may be admitted under the rams, and the speed can be maintained constant, while the power can be regulated in a thoroughly scientific manner by causing the stroke to vary as the governor balls move in or out. As a considerable pressure is required to move the centre carrying the cylinders, it is necessary to provide a supplementary engine, as a "relay," to perform this duty, leaving the governor to move its valves, and so determine how long the stroke shall be with any current load, and the engine running at any predetermined speed. The method by which this operation is carried out is shown by the accompanying illustrations.

This figure shows a three-ton capstan driven by a revolving engine, with the general arrangements of its governor —an apparatus of any ordinary kind. When the intended speed has been reached, the governor balls extend themselves, and through the intervention of levers and connecting rods, the valves of the subsidiary engine are actuated, so as to shorten the stroke of the main engine until it runs at any speed for which the governor has been arranged. The same speed is kept up while winding slack rope, and as this can now be made much faster than usually permitted with other capstans, a very adequate control is maintained and the capstan quickly gets hold of its load. As the rope tightens speed reduces, and the governor balls close together, permitting the weight W to descend and act upon the valves of the subsidiary engine in such a manner that the main engine has its stroke increased, and the hauling power of the capstan shows a corresponding augmentation, even until its full available power may be brought into operation.

In hauling vessels, a curious effect is shown by the capstan running at a high speed at about one-third stroke while drawing in the slack rope; then it acts with full energy until the load begins to move, and afterwards keeps changing between its shortest and longest stroke, as the cable tightens or slackens. Thus the governor keeps up a constant watch, and always regulates the stroke according to the load, however that may alter. As the capstan runs unloaded at one-third stroke, it may fairly be assumed that the average quantity of water used will, at most, be under one-half of that which would have been used had the hydraulic engine been unprovided with any governing arrangements. As three tons, moved at the rate of 60ft. per minute, requires at least 20-horse power exerted by the main hydraulic pumping engines, it is obvious that any contrivance by which this demand can be reduced to one-half represents a somewhat important economy, and one that justifies any additional cost of a secondary engine, with its valves and governor to gain. It means a saving of one-half the existing engine power, or doubling the number of capstans that might be employed on a railway or docks driven by the same power; and as it is well-known current expenses very soon represent an enormous interest upon capital, such a saving at so moderate an expense is a thing that, in the present days of keen competition, no company can afford to neglect.

It is sometimes useful to have the power of reversing a large capstan, particularly when new cables are being used. These sometimes acquire a kink which cannot be quickly released, and it may become necessary to cut and sacrifice a new cable to let a vessel go free. By reversing the capstan, however, a cable can be released, and the handle—shown dotted—is intended for this purpose. The governor acts only for the usual direction of hauling, but does not act when reversing is adopted for a few moments in order to release a cable. As there are no reversals in the direction of currents when driving one of these engines, it follows that there are no severe shocks in running, and this fruitful cause for the destruction of packings, if not for the breakdown of engines, is absent in those of the revolving type. If the water should not be flowing into one cylinder, it will be flowing into another, and that which is in any one cylinder when the inlet closes revolves with it at a considerable velocity, and in no case is brought to rest, as in any other type of engines with reciprocating pistons. It is this evil caused by stopping and starting a column of water, which so quickly injures the packings of those engines where such shocks occur. In the revolving type either cup leathers or ordinary packing glands can be used, and both are found extremely durable. The cylinder bosses and valve faces are somewhat peculiar in their construction. Their external packings are made of hydraulic leather, and there is a piston within the boss of that cylinder which is furthest from the valve face for the purpose of pressing all the bosses together, and for resisting any pressure against the face of No. 1 cylinder that would tend to force it away from the valve face. By the operation of such a balance piston, all the cylinder faces are retained in proper easy contact, and waste is prevented.

These engines have been running for many years, and although the relay engine, with its valves and governor, may seem somewhat complicated to those who see it for the first time, these additions are by no means so intricate as the Corliss or any other gear used for a like object—the economising of power in the use of steam; and as the cost of water power from an accumulator is necessarily greater than that of the steam power by which its pressure is obtained, it follows that the economical use of water is of correspondingly greater consequence than the economical use of steam.

## APPARATUS AT THE LONDON PHOTOGRAPHIC EXHIBITIONS.

Next Monday, when the Photographic Salon opens its doors in Piccadilly, there will be four photographic exhibitions running in London at one time, three of them of the major description. This position is unprecedented in the history of photography, and tends to show how its popularity has been increasing of late years. The salon devotes itself exclusively to the artistic side of photography, and does not exhibit apparatus. The annual exhibition of the Photographic Society—now the Royal Photographic Society—has on view as usual both photographs and apparatus. It opened last Monday. At the Aquarium at Westminster there is a miscellaneous exhibition devoted to nearly every phase of photography; it began about a fortnight ago. A fourth exhibition, that of the Central Photographic Club, is about to be opened near Covent Garden, of the photographs rejected by the Salon and the Royal Photographic Society, and all the specimens sent in will be hung without restriction.

Last Tuesday night, at a meeting of the Royal Photographic Society, Pall Mall East, under the chairmanship of Mr. Andrew Pringle, the makers of the apparatus placed on view described what were claimed to be the merits of their respective exhibits.

Mr. T. R. Dallmeyer described a new modification of his telephotographic lens, by which it is made suitable for long or short extensions of the camera within certain limits, so as to give the power of obtaining at will a large or small amplification of distant objects. He said that the main point with lenses of this class is the question of rapidity; it is easier to make a telephotographic lens at the sacrifice to some extent of the luminosity of the image upon the sensitive plate. He also exhibited his new naturalist's camera, a long narrow instrument of light weight, made chiefly for photographing wild animals from a distance when the camera is held in the hand, or when it can be partially rested against a tree or other fixed object, or when lying on the stomach on the ground. It is a long camera of light weight, preferably fitted with a telephotographic lens, acting upon a sensitive plate of somewhat small size. It has a lengthy eye-piece mounted upon its upper surface, and when this is adjusted to suit the eyesight of the user, it need never be shifted from that adjustment for the particular user; the image on the plate being at the same time in focus, it is never necessary afterwards to alter the adjustment of the eyepiece, for all the objects he sees in sharp focus through it will also be in sharp focus upon the plate. To minimise vibration a particularly light spring had been made for the instantaneous shutter by Messrs. Newman and Guardia, who, he said, had aided him considerably over the mechanical details. He was asked whether the length of the camera and the long focus of the lens did not add an extra amount of unsteadiness when it was used as a hand camera, and he replied that with a shorter camera more unsteadiness is probable, because then the user is more in the position of a man who is manipulating the short end of a lever. Mr. Fox Shew thereupon remarked that recently he had been using as a hand camera a long one with a telephotographic lens while standing, and resting it upon his left arm; he was taking no particular care, but obtained four images sharp out of six exposures.

Mr. Shew, on behalf of Messrs. J. F. Shew and Co., exhibited one of his hand cameras, the one which he uses himself, and which has adjuncts enabling it to take several classes of photographs. It can be employed as an ordinary fixed focus hand camera; it has also an attachable extension which doubles its length; it has likewise an extra front enabling it to be used as a stereoscopic camera, or for taking two lantern views upon one plate. The different parts will go into suitable side pockets, or can be carried together in a small case. He exhibited a variety of his type of hand or stand cameras, including one called the "Featherweight," with aluminium fittings, and weighing 17 oz., half-plate size, exclusive of the weight of the focussing screen. Fig. 1 represents one of his hand cameras mounted on the top of a stand, and fitted with a roller blind shutter working next the plate, and with a pneumatic release. Fig. 2 represents the same camera closed. We may mention that roller blind shutters working next the plate are theoretically of the highest class for allowing the maximum of light to pass in the shortest time; while they are in action the full selected aperture of the lens is acting upon the part of the plate exposed.

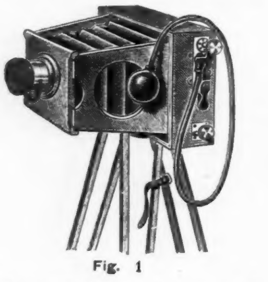


Fig. 1

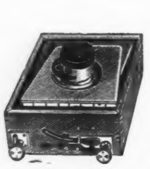


Fig. 2

Among the specimens of apparatus described at the meeting was a new hand camera designed by Major Lysaght, over which much care and thought had evidently been expended, and Mr. T. Samuels, another amateur, who has spent much time in devising simplifications of photographic apparatus, exhibited a new changing back for cameras, fitted with new holders for films, and which grasped them at all four sides.

Mr. Dallmeyer and Mr. Shew are also among those who are exhibiting specimens of their photographic apparatus at the Aquarium, where, among other things, the former exhibitor has on view a photographic telescope, equatorially mounted, and with driving clock complete. The Platinotype Company also is demonstrating there its beautiful process for producing permanent photographic prints in platinum black; it also has on view a new modification of its simple and effective "key" hand camera, adapted to the purpose of taking stereoscopic negatives.

## ENGINEERING LABORATORY INSTRUMENTS AND THEIR CALIBRATION.*

By Professor D. S. Capper, M.A., A.M.I.C.E.

The extent to which laboratory experiments can be relied upon evidently depends upon the accuracy of the instruments employed. The careful calibration of measuring instruments against a uniform standard is therefore of great importance where anything beyond a rough approximation is required.

In experiments on strength of materials, considerable divergence in the results obtained by different observers is due to this cause. In such experiments, both machine and strain-measuring instruments require calibration. A 100-ton vertical machine of the Buckton type, with a jockey weight of one ton, is reliable, and about 20 lb. absolute load if in good order. But errors in placing and reading the position of the jockey weight may amount to 45 lb. absolute load, and specimens to be tested should therefore be of such a sectional area that the resulting error is negligible. In ordinary specification tests it is generally sufficient if the elastic limit and breaking load are known to 1 per cent., but where modulus or resilience is required, a greater accuracy will be necessary. To be certain of the second figure of the modulus, a 10in. steel or iron test bar on the above machine would require to be at least $\frac{3}{4}$in. in diameter. A bronze or gun-metal bar must be of still larger section.

Extensometers to maintain the same reliability must measure accurately to the ten thousandth of an inch. A horizontal machine of the Kirkaldy type, where the jockey weight is adjustable, is suitable for specimens of smaller diameter, the limit being the accuracy of the machine itself. The machine in the author's laboratory at King's College is of this type, and a recent calibration of it against dead loads showed that it could be relied on to less than 20 lb. absolute load.

Another class of experiments which touch commercial work even more closely are engine experiments. The need for calibrating indicator springs and steam gauges is perhaps not always realised. It is impossible to make and keep these instruments reliable under the very trying conditions under which they are used, and where accuracy of power measurement is of importance a direct calibration of the indicator errors against some standard, such as a column of mercury, is indispensable. The author has recently erected such a column for testing indicators and gauges under steam up to 170 lb. pressure in his laboratory, and finds that the best indicators of the parallel lever kind are liable to errors, which reach 10 per cent. values when the indicator is taken over a 2in. pencil range. By plotting the errors at a number of consecutive pressures, it is easy to determine the range beyond which any individual indicator and spring should not be used.

The errors obtained generally fall for a considerable portion of the range reasonably well along a straight line, and from this line the true scale of the spring can be determined. The point which marks any considerable increase in these errors is the point beyond which the spring should never be used. The correction line may be either above or below the nominal scale line of the spring, and may thus either tend to increase or diminish the area of the resulting indicator diagram. Where the deviation from the true scale is found to be small it may be neglected, and the limits within which the indicator readings are true will then be known. Where indicators show much tendency to "backlash," the question of correction becomes much more complex. Two curves will then have to be plotted, one for falling and the other for rising pressures, and separately applied to the rising and falling lines of the diagram. This is a process which is of course out of the question in many cases; and the great object will then be to avoid the use of indicators which show a marked tendency in this direction.

A form of indicator which promises a considerable amount of freedom from backlash has recently been introduced into this country. It is of the rotary form, and is devoid of multiplying and parallel levers of any kind. Very good results, as far as backlash is concerned, have been obtained with this instrument.

## THE INSTITUTION OF CIVIL ENGINEERS.

### SUBJECTS FOR PAPERS—SESSION 1894—95.

The Council of the Institution of Civil Engineers invites original communications on the subjects included in the following list, as well as on any other questions of professional interest. This list is to be taken merely as suggestive, and not in any sense as exhaustive. For approved papers the Council has the power to award premiums, arising out of special funds bequeathed for the purpose:—

1. The Thermodynamic Problems involved in the Production of Power and of Heat without Smoke.
2. The Utilisation of Heat (*a*) generated in the compression of air and other gases; (*b*) carried away by steam engine condenser water; (*c*) contained in boiler furnace flue gases.
3. The Measurement of the Condition of Steam as to Dryness.
4. The Production and use of Superheated Steam.
5. The Comparative Efficiency, as shown by independent testing, of different types of (*a*) stationary engines; (*b*) marine engines; (*c*) locomotives; and (*d*) workshop motors.
6. The different Methods of Governing Steam Engines, so as to give Uniform Speed with greatly varying Loads.
7. The Arrangements of Boilers and Engines best adapted for Electric Light Stations under different conditions.
8. The Machinery of Modern Warships.
9. The Lubricants in use for the Machinery of Steamships, the methods of lubrication employed, and the recovery of waste oil in the engine-room.
10. The Stresses in the Crank and Screw Shafts of Marine Engines.
11. Steam Locomotion for Passenger Traffic on Common Roads.
12. The Application of Oil and Gas Engines to tractive purposes on tramways and on common roads, and to marine propulsion.
13. The losses that occur in Gas Engines and means for reducing them, with special reference to "after-burning."
14. The relative merits of the several Cycles in Gas Engines.
15. The Theory and Development of the Compound Steam Turbine.
16. Mountain Railways: their laying-out, construction, and working by cables, rack engines, &c.
17. The laying out and arrangement of Railway Stations.
18. The Design and Construction of Railway Carriages having reference to (*a*) lavatory accommodation; (*b*) provision for refreshments; and (*c*) sleeping arrangements.
19. The Encroachments of and Reclamation of Land from the Sea.
20. The Buoying and Lighting of Tidal Rivers and Estuaries.
21. Investigations as to the quantity of Water yielded by the Chalk Formation.
22. The Purification of Sewage by Filtration, Precipitation, Electrolysis and otherwise.
23. The Means and Appliances, other than sewers, for dealing with the Refuse of Towns.
24. Plant for the Treatment and Disposal of Waste Effluents from Manufactories.
25. The Working of Inclined Retorts in Gasworks.
26. The Design and Construction of Modern Gasholders of large size.
27. The Methods of Enriching Gas for illuminating purposes and their relative advantages.
28. The Theory and Practical Working of Single and Multiphase Alternate-Current Motors, illustrated by examples of existing installations.
29. Alternate *versus* Continuous Electric Currents for (*a*) Electric Lighting; and (*b*) Transmission of Power.
30. The Forms of Electrical Conductors for lighting, stationary power, heating, and tractive purposes.
31. The Utilisation of Electric Lighting Plant during hours of small demand.
32. Electric Lighting and Haulage Plant in Mines and Collieries.
33. The Application of Water Power, and its transmission to a distance by electricity.
34. Electrical Motors for (*a*) Inland Navigation and (*b*) Ocean Vessels.
35. The Use of Electrical Motors for driving machine tools in engineering workshops.
36. The Design of Navigable Balloons and of their propelling machinery.
37. Quarrying Operations and the Plant employed.
38. Coal-winning in seams situated at great depths below the surface.
39. Explosions from Coal-dust in Mines.
40. The Surface arrangements of Collieries; including those for banking, cleaning, sorting, and screening the coal.
41. Coal-shipping Appliances and Discharging Apparatus.
42. The Comparative Merits of Blast or Reverberatory Furnaces.
43. The Manufacture and Application of Steel for Structural purposes.
44. Standard Designs for Main Girders and Floors of Railway Bridges of Steel.
45. The Present Position of the Basic Steel Process.
46. The Molecular Constitution of Iron and Steel.
47. The Micro-structure of Iron and Steel.
48. The most suitable Alloy for the working parts of Pumps for lifting acid-waters from mines, &c.
49. The Treatment of Tin and its associated Ores.
50. The Effect of small quantities of Impurities in Commercial Copper as regards its use in Electrical work.
51. The Electrolytic Deposition of Copper.
52. The Uses of the Rarer Metals, and the modes of extracting them from their combinations.
53. Aluminium, its manufacture, properties, uses and alloys.
54. The arrangement of Engineering Workshops, with descriptions of modern Machine-Tools and Appliances.
55. The present Limits of Speed at Sea.
56. The most recent types of (*a*) Passenger and Mail Steamers; (*b*) Cargo Steamers; and (*c*) War Ships.
57. On Fast Cruisers, Torpedo Catchers, &c.
58. The Loading and Discharging of Grain Cargoes.
59. The recent developments of Mechanical Refrigeration, and auxiliary Plant employed therewith.
60. The Screw Propeller of the present day, its material, proportions and efficiency, and the Relative Advantages of Single Screws and of Twin Screws in Vessels of High Power.
61. The Comparative Merits of the various modes for Manufacturing and Gauging Ammunition with solid-drawn Cases.
62. The Manufacture of Heavy Ordnance.
63. The Manufacture of Armour.
64. The Organisation and Execution of any Railway or other Work, with reference to the cost of materials, labour, and plant.

## CATALOGUES.

Loewe and Co., Ludw., Berlin. London: H. F. L. Orcutt. Oil Testing Machine. Hammers and Heating Forges. Air and Gas Fans and Furnaces.

Vosper and Co., London and Portsmouth. Oil Engines and Oil Launches Complete. A catalogue which affords some proof of the position now taken by these engines without boilers and of the increasing sizes of launches propelled by them.

Easton and Bessemer, Limited, Taunton. Engines, Boilers, Woodworking, and Grinding Machinery, Pumps, Edge Runners, Pan Mills for Sand and Coal Dust Grinding, Mortar Mills. A well-prepared catalogue illustrated with good engravings.

Herbert, Limited, Alfred, Coventry. Horizontal Milling Machines, Vertical Milling Machine, Universal Cutter-Grinder, Sensitive Drills, Capstan Lathes for repetition and general work, Universal Grinding Machine, Special Machinery for Cycle Manufacture. A catalogue in sections with good illustrations of new machinery.

H. Bamford and Sons, Uttoxeter. Bamford's "Rapid" Grinding and Crushing Mills and Split Pulley.

Joseph Cook and Sons, Washington Ironworks, County Durham. Illustrations of their leading manufactures, including everything used in or about collieries or mines, such as pulley frames, pit gear, iron, steel, and wood tubs, trucks and wagons, engines, iron and steel cages for from two to six tubs, foundry ladles and sinking kibbles, rollers, drums, and sheaves, winding pulleys, pit heapsteads and cleaning arrangements, with picking belts and shaking screens, teaming cradles, coal washers. A costly catalogue of useful size—8vo—full of illustrations, but no name on back.

A Coalowner's Proposal for Settling Coal Values.—Speaking at the annual meeting of the shareholders of the Sheepbridge Coal and Iron Company, at Sheffield on Tuesday, Mr. C. B. Maclaren, M.P., one of the directors, and a large holder in colliery undertakings in South Yorkshire and Derbyshire, made a suggestion which has caused no little comment in the district. It was to the effect that coalowners should work together more harmoniously than they had done in the past, and ought also to co operate with the Miners' Federation in endeavouring to settle and steady prices. The men had a very powerful organisation, and he had not a word to say against it, for he had always contended that a strong Miners' Federation was the best guarantee for good trade, if the masters knew how to take advantage of it. The coalowners, he thought, ought to work with the Federation, and recognise the power the men possessed, instead of trying to undersell each other to gain a paltry advantage over their rivals. Coalowners should aim at steadying prices together, and in concert, if necessary, with the leaders of the Miners' Federation, on a basis which would be remunerative to all parties. He contended that this could be done perfectly well. It was not a question of shillings, but often only a question of pence. These pence, however, meant a matter of pounds. He deprecated any idea of exacting unfair prices from the public. All that was asked was that whilst the men took a fair living wage, the shareholders should at the same time have a fair return on their capital. "That return," said Mr. McLaren, "is not to be obtained by owners slipping out of a meeting by a back door, and wiring acceptances of railway contracts at 6d. less per ton than the price agreed upon at the meeting." That sort of thing, he said, had been done at meetings of owners in the Midlands, and he held that it was not the right state of things, and while it lasted the men might justly complain that the owners did not assist them to keep up prices.

---

* Abstract of paper read before Section G of the British Association at Oxford.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### TRADES UNION POLICY.

SIR,—The events of the Scotch strike have been extremely suggestive. They have been the outward palpable manifestations of a tendency which usually brings about deplorable results. As such, they are extremely instructive.

The mixed multitude of men working in Scotch mines is largely composed of Irishmen. There are also North-country Englishmen, Welshmen, men from Devon and Somerset. Of true bred Scotchmen there are comparatively few, because Scotchmen do not as a rule take kindly to mining. It is, I think, a time for speaking out and stating the plain truth. In the Scotch, as in all other mines, will be found a percentage of shrewd, competent men who are skilled in their business. They are miners in the proper sense of the term. The remainder are mostly farm hands, and what may be termed "drift." The pay that a miner can earn is always greater than that of a field labourer. The moment the pit has been opened in any district the field hands crowd to it for employment. The facts are quite well known. They have been stated over and over again by such authorities as Mr. Pickard. There is not at this moment the slightest difficulty in getting all the hands needed to work the mines, if those who are heart and soul for the strike would quietly withdraw and leave the contented hands and the new men who would come forward to themselves.

Now, any individual who studied the signs of the times must have known that a strike could not possibly succeed. The only chance lay in the power of the colliery proprietors to drive up prices; but this could not possibly be done while the iron and other trades were so bad. It is not too much to expect the colliers to know such things in a general way; and it is certain that the union leaders, whose ostensible business it is to look after the interests of the men, ought to have possessed the most minute information on the subject. In the present day the intelligence department of an army is regarded as of the utmost importance. A strike is an open declaration of war. If the intelligence department of the Union did its business properly, a blunder such as the Scotch strike has been would have been impossible. The patent fact is, that of late years the leaders of the Unions have been deteriorating—and that rapidly—in common sense. Instead of being, as they ought to be, hard-headed sensible business men, they are simply and only blatant wind-bags, who are manifestly incapable of guiding their men to victory. I have heard it said that Mr. Keir Hardie is an enthusiast, and is not to be judged by the same standard as other men. But let us fancy what would take place if a general commanding an army was an enthusiast and nothing else. Trades Unionism is right; it has done much good, it is capable of very considerable things—but its affairs must be managed by competent business men, not by hot-headed dreamers.

It is not enough, however, merely to state a case, we must go on to consider the cause. Why is it that such men as typical Keir Hardie get into the positions that they hold? Now, on examination, I think it will be found that they are one and all great talkers. In all ages mankind has been led by the talkers. But the men who do the world's work are not the talkers after all. If, however, Mr. Keir Hardie and his fellows had to rest content with addressing here and there a few hundred miners they would quickly give up the functions of the orator, and turn to something else. Such men have been rendered possible only by the newspaper press. It is impossible to overrate the vanity of the class, and nothing on earth so flatters and pleases that vanity as the publicity which is afforded by the Press. It would be too much to expect reporters and editors to leave the Union leaders and their utterances severely alone, although the best results would follow from the adoption of such a course. But failing this, it seems to me that the Press, having the interests of the workers at heart, should do that which I am doing, and urge on Unionists throughout the length and breadth of the country the vital necessity of selecting to lead them men who are really competent, from a business point of view, to do the work.

The strike in Scotland has failed. It has inflicted frightful misery on multitudes. It was all brought about by a handful of Union leaders. Now, what excuse have these men to offer for the mischief they have wrought? I will not adopt the monstrous theory that the English Federation selfishly brought the strike about in order that English miners might benefit by the ruin of Scotchmen. But we are in any case face to face with the fact that a fearful blunder has been committed. If we assume that the leaders were confident of success, then it is clear that they were ignorant of facts with which they ought to have been perfectly familiar. The strike was a blunder. If, however, they knew that the chances were a hundred to one against its success, then it was a crime. To me and to, I think, most sensible men it has been nothing more nor less than the result of an overweening self-confidence, backed up and urged on by that senseless antagonism to capital which is an embodiment of one of the heights of human folly. The "working man" would not trust an idiot to spend his wages for him. When will he learn that those whom he trusts to lead him ought to be men possessed of common sense?

As the strike has failed we hear a cry for the nationalisation of the coal mines. When that takes place, and the State becomes the owner, the Union leader will be no more. There will be no place for him in the scheme, and "the State" will make very short work of the matter. The moment coal becomes plentiful in excess of the demand at the price fixed by the State, the pits will be shut and the miners sent about their business. That is what the Government is now doing at Woolwich, discharging men because they are not wanted. If the State fixes a price which no one will pay for coal, there will be an end to the demand for it. So with iron, so with every other commodity. It would not do, however, for a Union leader to make this statement. If he did he would cease to be a leader; his salary would no longer be paid; but that is only because so many workers are so unutterably ignorant of what goes on in the world around them.

There is one bright spot in the whole matter. It is that the Union leaders will discredit themselves by their folly. Already Mr. Keir Hardie has ceased to be a power. There is in every Union a considerable minority of hard-headed, sensible men. There is some evidence that they begin to think it is time that their voices were heard. If they would but combine and exert themselves there would be a chance for labour. Unless the millions of working men in this country refuse once for all to be led by men who are so incapable and so ignorant that they brought about the Scotch strike, the end must be disaster. The one thing of all others most wanted at the present time by the working man is not more wages, or shorter hours, or a higher education, but common sense.

GRETA BRIDGE.

Dunfermline, September 24th.

### THE SCOTCH STRIKE AND THE SCOTCH PRESS.

SIR, I wish your excellent article on the coal strike could be read by the blockheads concerned in it, or even by the newspaper men in the district. As for the *Mail*, any man who by reason of his qualities gets his head above his fellows, is a fair mark for its slings and arrows. Nobody pays much attention to the *Mail* for all its desperate attempts to attract notice.

The whole disturbance would have been over long ago but for the fact that the Scotch papers, even the respectable ones, have devoted whole sheets to the chronicling of the sayings and doings of Mr. Tom at Camlachie, Mr. Dick at Auchengray, and Mr. Harry at Cowdenheath. The ridiculous vanity of these "leaders" has been pampered to the uttermost. Their gabble appears in the evening papers and re-appears in the morning issues. Even the usually sober *Glasgow Herald* has its shrieking headlines to draw attention to the drivel with which its columns are filled. The characteristic interruptions of the Irishry, "To h—l with the coal-masters," and the like, are all duly inserted along with the scarcely less violent utterances of the man on the cart.

It is said, I know not with what reason, that these pests are even *paid* by the newspapers to furnish copy; the effect of this on the duration of the strike may be imagined.

The collapse of the Scotch railway strike dates from the time when the orators on that occasion offended the too sensitive reporters, who retaliated by letting these same orators severely alone. The strike endured every form of adversity except indifference. Mr. John Burns retired to London in disgust when his bellowing attracted no attention beyond the limited circle of his hearers, and the still small voice of common sense began to have a chance.

When the present rabble of agitators is ignored altogether by the Scotch press, the strike will die a natural death.

Glasgow, September 22nd. OLD GLASGOW.

### LABOUR AND LUXURIES.

SIR,—In the report of a meeting held by some of the Woolwich workmen it is stated that one of them made use of words which are worth notice and correction because they are the embodiment of a popular fallacy. The men grumble because many are being discharged by the Government. The man in question said that the wages were "only 19s. 6d. a week, about the cost of a bouquet worn by one of the Government clerks."

The assumption is that the money thus spent—supposing the statement to be true—was wasted. This is a fallacy. Those who are wealthy are blamed for spending money on horses, carriages, and so-called luxuries. It is easy to see that from the political economical standpoint they are not at all blameworthy. Let us stick to the bouquet. The flowers must have been grown under glass, and in their production they gave employment to the bricklayer, the carpenter, the glazier and painter, the ironmonger, the founder, the paint maker. The price of the flowers was divided among all those and the landlord of the garden, the hot-water engineer, the gas company who supplied the coke, the gardener, flowerpot maker, and the maker of artificial manure. Then another portion went to Covent Garden or other florists, and to the girl who made up the bouquet and the wire-drawer who supplied the wire. It would perhaps not be easy to select a worse example of mis-spent money than was this; almost the whole sum was divided among working folk.

If the critic whose words I have quoted had his way, the same sum would have been diverted into a different channel; that is all. The result of the expenditure would have been, say, 19s. 6d. worth of cartridges; of the two it seems to me the flowers are the more innocent. Precisely the same line of argument as that I have employed applies to carriages, rich carpets, &c. In all cases these represent the expenditure of money among a very large number of workers. It may be urged that the result obtained might be better, but this has nothing to do with those who produce. The best possible result for them is money, and that they obtain whether the thing produced is useful, destructive, or ornamental.

The principle involved in my argument has always been held sound by the best authorities. It is a pity it is not better known.

London, September 25th. Y. X.

### THE VELVO BATTERY.

SIR,—We thank you very much for your very full article in your last issue describing our batteries.

Regarding the smell your representative observed on the Velvoca, it was due to the newness of the ebonite cells, and has already nearly disappeared. For some time now there has been no smell from the smaller boat Velvo, and the odour was far stronger during the first few trips than anything we have had on the Velvoca, which, by the way, I think can hardly be called a small electric launch; there are few electric launches on the river of more than 35ft. in length and 6ft. 6in. beam.

Regarding the cost of current, half speed, which costs only 1s. 8d. an hour, is nearly as fast as full speed, and is a perfectly satisfactory rate of progress for the river. The boat will carry a dozen persons comfortably, and the cost of under 2d. an hour per person carried cannot be considered excessive.

In connection with lighting work, there are very few cases in which the cost of current from my batteries would amount to more than 2s. per B.T.U., and in very many cases the cost would not exceed 1s. 6d. I know many small installations fitted up in the ordinary way where the first costs have been far higher than a battery plant would have entailed, and where the working expenses run up to and exceed 2s. per B.T.U.

I claim that one of my ½-kilowatt batteries would not need more than half an hour's attention per recharge in a period averaging three weeks.

I may mention that I will not in the future allow the boat-builder to make the battery box, but shall have it properly dovetailed and provided with a close-fitting lid, a pipe running to the stern of the boat carrying off all hydrogen generated.

For THE BATTERY AND MOTOR CO.
(H. T. BARNETT, Manager.)

53, Victoria-street, S.W.
September 22nd.

### TRACTION ENGINES.

SIR,—I wonder none of your correspondents have called attention to the red tape wrapped round and round traction engines; upon an average, I believe, England contains one traction engine to every three miles of turnpike road. The cost of traction engine haulage may be taken at twopence per ton per mile, and ordinary cartage at one shilling. In the light of recent legislation, the lowest maximum haulage rate Parliament would be likely to sanction upon "light railways" would certainly be at least twopence per ton per mile. But borough and county bye-laws, *i.e.*, red tape, throttle traction engine traffic by differing to an absurd degree; for example, in counties adjoining, a traction engine may travel by night in the one, and in the next an engine must not move after sunset; whilst a borough may insist upon the deposit of £100 being made before a wheel is turned in it. Some of the bye-laws are fifteen to twenty years old, and others, with all the force of law, are out of print.

The statutory right to shut up the roads for eight hours is made use of by some local boards to stop this traffic. Others, again, bar their roads to traction engines by public notice upon their bridges that they will not carry them, though these bridges do. As if this was not enough, every traction engine has to have a separate £10 licence for each county. Now, Sir, if our rulers would only put their heads together and make these bye-laws uniform to the whole kingdom as well as the licence, do you not think a good deal of traffic would result of advantage to the farmer, the railways, and the people too? With bicycles and tramways upon our coach roads, what possible harm can a traction engine do that it cannot be made to pay for?

ROBERT CAPPER.

18, Parliament-street, Westminster, S.W., September 25th.

### THE SAMUEL MORLEY MEMORIAL COLLEGE.

SIR,—May I call attention to the evening classes for working men and women held here? A new session begins October 1st. Fees, from 1s. 6d. a term for the first class, and 6d. for a second-class if more than one is taken. Special lectures 1s. the course to College members, 1s. 6d. to outsiders. The subjects taught are very various. Languages, grammar, part singing, violin, dress-making, cooking, book-keeping, and shorthand are only a few of them. Some, such as mechanics, building construction, hygiene, &c., are in connection with South Kensington. But at this time three courses are about to begin, especially worthy of attention. One is a university extension course on Thursdays, by P. H. Wicksteed M.A., on the "Life and Structure of Human Society," a subject of special interest at a time when social questions are so much to the fore. Another is on "Early Tuscan Art," by Miss Taylor. The third, on Fridays, is by Professor Pritchard, M.R.C.V.S. on the "Care of Horses." A similar course last winter was attended by 130 men, chiefly drivers and stablemen, all practically interested in horses, and taking full advantage of the opportunity given them to ask questions.

Physical training both for men and women is provided by means of a gymnasium. For recreation there are cricket, football, and other clubs, while social evenings once a month offer an opportunity of friendly intercourse such as working people in their crowded homes find unusually difficult of attainment.

Full particulars may be had any evening at the College, or by letter to the Principal.

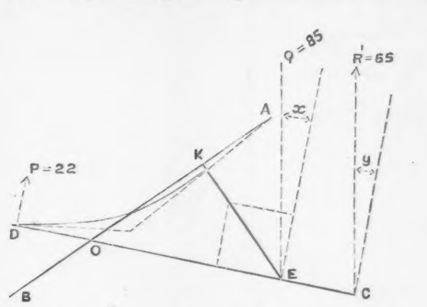
C. A. MARTINEAU,
(Principal.)

Waterloo Bridge-road.
September 26th.

### THE GRAPHIC STATICS OF A DECK CHAIR.

SIR,—I regret to have to ask you to correct an oversight made by me in my last communication on this subject. In computing the tension in O E, I forgot to add to it the difference between the components $x$ and $y$ parallel to O C.

The better way of making this computation would be to find the perpendicular force at E, resolve it along E K and E O, and from the tension obtained in E O, if it be under tension, subtract the component $y$, or the compression along E C.



The tension, therefore, in E O of my former diagram would have to be increased from 35 to, say, 38 or 39. It would perhaps be difficult to bring out the same figures as I gave in my last, as a very slight alteration of the angles makes a considerable difference, and my own measurements were only approximately close.

16, Nelson-road, Southsea, C. L. S.
September 24th.

### THE THEORY OF THE STEAM ENGINE.

SIR,—Mr. Maurice Cross's letter in your issue of the 21st inst. is not to the point. I have not read, and do not intend to read, the correspondence which has appeared in your columns *re* steam engine efficiency, but I did read Mr. Cross's letter on "The Theory of the Steam Engine," and formed the opinion that, as I have already stated, it was either obscurely worded or absolutely erroneous. That opinion I have seen no reason to change; his last letter simply strengthens it. I have introduced no irrelevant matter into the consideration of the point, which, so far as I could comprehend, he was endeavouring to support, viz., that steam and air behaved in an intrinsically different manner when expanded without doing work.

I have not leisure at present to pursue this correspondence very far. I will simply observe that the increase of energy of a pound of air when expanded without doing external work or reduction of temperature is not, as Mr. Cross appears to assert, properly to be termed "infinitesimal." Its amount is calculable, and, although small when compared with the total amount of energy of the fluid, is quite appreciable, and certainly in no proper sense of the word is it "infinitesimal."

Also Mr. Cross appears to imply that Rankine was without experimental verification of the "probable" superheating of saturated steam after free expansion. If my memory serve me correctly, Mr. Cross is in error here, and that experiments have demonstrated the fact of the superheating.

The reason for my reference to air at its critical point appears not to have been understood by Mr. Cross. I should have thought, however, that it was sufficiently clear.

HENRY CHERRY.

21, Festing-road, Putney, S.W., September 26th.

### BELLEVILLE BOILERS.

SIR,—We observe in your impression of the 14th inst., under the heading of "Decennial Programme for Naval Construction in France," mention is made that the vessels Charlemagne and Catinat are to be fitted with Belleville boilers. We beg to draw your attention to the fact that other ships mentioned in your interesting article, viz., Bouvet, Descartes, Pothuan, Pascal, Galilée, and Lavoisier are also to be supplied with boilers of the Belleville type.

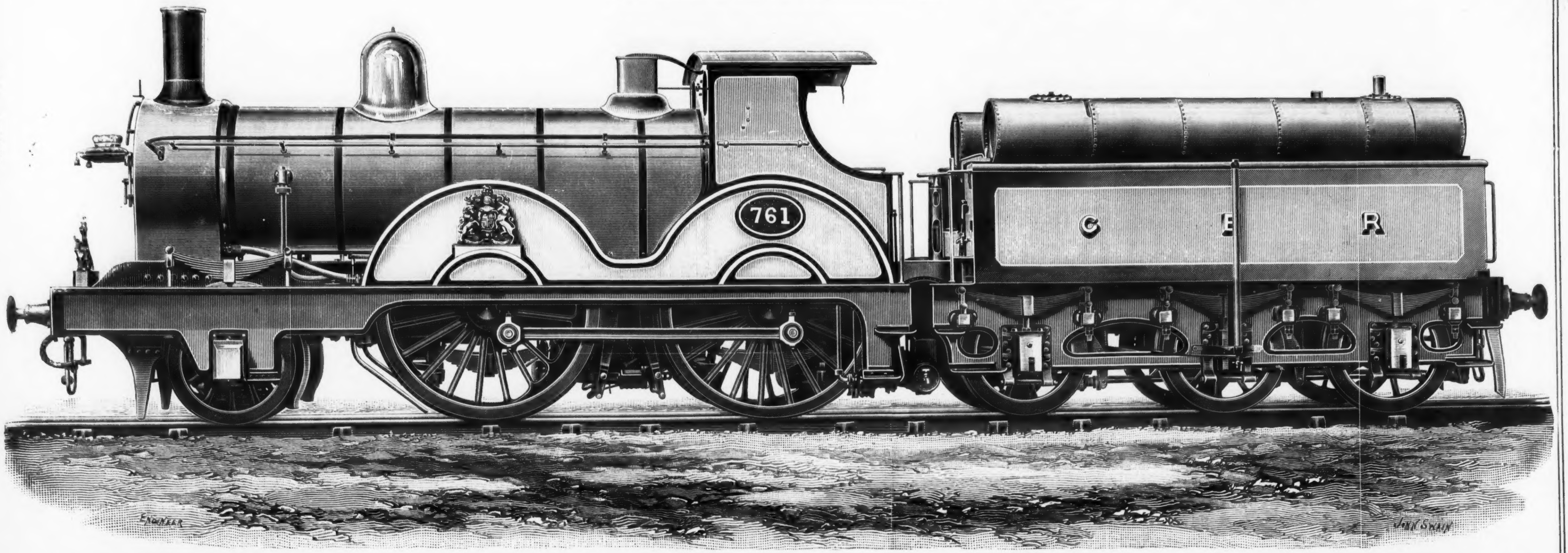
For MAUDSLAY, SONS, and FIELD, LIMITED.
(JOHN SAMPSON, Director).

Lambeth, September 25th.

**PETERHEAD HARBOUR WORKS.**—According to a report on the above for the years 1893-4 by Messrs. Coode, Son, and Matthews, the engineers-in-chief, recently issued as a parliamentary paper, progress is being continued both with the Barge Harbour and South Breakwater. The quarry has been further opened out by the removal of about 5400 cubic yards of boring and decomposed rock. The railway, dockyard, &c., have been properly maintained, and additional plant, comprising steam cranes, travellers, trollies, driving gear, &c., has been provided. In the Barge Harbour there was excavated from its bed to form the new basin 2012 cubic yards of rock, of which 945 cubic yards was below low-water level. The staging in the harbour was extended about 200 lineal yards, and the necessary approaches made thereto. A length of 150ft. of the sea wall was built and blocked with rubble, involving the use of rubble backing, 1865 cubic yards; concrete blockwork, 1301 cubic yards; concrete tugwork, 58 cubic yards; concrete masswork, 556 cubic yards; granite ashlar in facework, 5124 cubic feet. The whole of the blocks required both for the quay and sea walls are made. The South Breakwater has extended 105ft., the foundations of a further length of about 40ft. prepared, and the work thereon brought up partly to the level of 4ft. below, and partly to that of 2½ft. above low water. The foundation work has during the previous year involved much rock excavation and levelling under water by divers. The chief items of work carried out were: Rock removed by divers, 173 cubic yards; concrete blockwork deposited, 3182 cubic yards; concrete tugwork deposited, 584 cubic yards; concrete masswork, 1386 cubic yards; granite pitching, 2525 super. feet; granite ashlar, including facework, 9407 cubic feet; permanent way laid, 60 lineal yards; gas and water pipes, 40 lineal yards. Blocks containing 1261 cubic yards of concrete and 4893 cubic feet of ashlar were made, but not set. The daily average number of men employed during the year was 362, of whom 229 were convicts.

# EXPRESS LOCOMOTIVE, BURNING OIL FUEL, GREAT EASTERN RAILWAY

MR. J. HOLDEN, M. INST. C.E., STRATFORD, ENGINEER



## THE OIL-BURNING LOCOMOTIVE PETROLIA.

In former articles we have described the ingenious arrangements for burning liquid fuel invented by Mr. James Holden, Locomotive Superintendent, Great Eastern Railway. Recently we have spoken of the express engine No. 761, the Petrolia, and we now illustrate that locomotive and the oil-burning arrangements above and on page 277. One of the most recent modifications introduced by Mr. Holden deserves special notice. Although the Westinghouse brake is used by the Great Eastern Company, the Great Eastern engines have frequently to haul mixed stock of other companies fitted with the vacuum brake. It is known that a small ejector has to be kept constantly at work maintaining the vacuum, and the steam used for this purpose represents an expenditure of fuel amounting, it is said, to about one pound of coal per train mile; whether it is less or more, however, is of little consequence. The loss is appreciable. Mr. Holden, to save it, uses the inducing steam blast blowing the liquid fuel into the furnace. The air from the train pipes is, in other words, forced into the fire.

The driving wheels of the engine are 7ft. diameter, the leading wheels 4ft. diameter, and the cylinders 18in. by 24in., cast in one piece, with the valves underneath. The link motion is of the Stephenson type. In this boiler there are 256 steel tubes $1\frac{5}{8}$in. diameter. The shell is of steel plates $\frac{1}{2}$in. thick, the fire-box of copper, the heating surface 1230 square feet, the grate area 17·9 square feet. The total weight of the engine in running order is 42 tons, and that of the tender in running order is 32 tons. The liquid fuel burning apparatus is placed below the footboard, so as not to interfere with the ordinary working of the locomotive. Further, the fire-bars, &c., remain, and are available for coal firing, either for lighting up and raising steam, or for ordinary coal burning, should it by accident or design become necessary. The injectors — described later — face two holes provided through the fire-box casing, about 12in. above the fire-bar level.

The usual practice on the Great Eastern Railway is to keep the fire-bars covered with an incandescent base of solid fuel, limiting the combustion by partially closing the damper; the air necessary for the oil fire is introduced by the action of the ring blower of the injector above the solid fuel base, and as the spraying and distribution are also effected by the steam jets, no exceptional firebrick is required.

For fuel, oil, and coal gas tars, creosote oils and petroleum residues are used. With any of these, if fair samples, one ton will replace nearly two tons of coal. This difference in favour of the oil fuel is not only to be attributed to the higher calorific value of it, but also to the fact that very complete combustion can be secured, and no unnecessary air need be admitted at the fire door, as usually occurs at intervals of firing with a coal fire. In addition, the fire can be exactly regulated to meet requirements.

The liquid fuel is carried in two cylindrical tanks on the tender, with a combined capacity of 600 gallons. From these it is conveyed by pipes and a flexible connection to the engine. Here branch pipes are provided to each burner with regulating valves working through spindles from a convenient position. This regulating gear is shown separately to a large scale on page 277. Liquid fuel can be simultaneously admitted or shut off at both injectors by one horizontal movement of the handle marked A, or the fuel can be regulated and controlled to either one of the injectors by turning the milled heads B′, B″. These lift the valves C′, C″, whereas the partial turn given by the handle A merely revolves the valves like the plug of a cock. On reaching the injector the fuel is sprayed by an internal annular steam jet. This steam, as it escapes from its orifice to receive the fuel, sets up a strong induced current through a central air tube; this eduction of air is utilised for securing the continuous vacuum for the automatic vacuum brake—22in. vacuum—or by means of a cock marked L. The vacuum pipes can be put into communication with air heating coils in the smoke-box, thus supplying hot air to the centres of the injectors for combustion. The fuel spray escaping from the nozzle of the injector is further atomised by the small jets of steam arranged around the ring of the burner, at the same time the ring acts as a blower, inducing atmospheric air for complete combustion, and further it spreads and diffuses the flame and heated gases over the fire-box. Steam is obtained from a fitting on the fire-box front, having an internal pipe to the dome. Four cocks are shown, one for steam to the central jets of the injector, one for the ring blower on the same, one for steam to the warming coils in the oil tanks, and one for allowing a steam jet to enter the oil pipes for cleaning purposes.

In consumption of fuels, the liquid fuel burners for a month's average of over 3000 miles burn:—Coal for lighting up, standing, &c., 11·8 lb. per mile; liquid fuel, running, 10·5 lb. per mile; total, 22·3 lb. per mile. This compares favourably with a consumption of 34 lb. per mile of coal on similar engines on same service. On June 15th, 1894, engine No. 761 ran through from London—St. Pancras—to Scarborough and back, with a special train of saloons, dining car, &c., weighing 200 tons. The total distance is 534 miles, and consumption of fuel 11·5 lb. of coal per mile and 11·25 lb. of liquid fuel per mile; total, 22·8 lb. per mile. The fire was not cleaned, and the only stoppages made were those required for water and oiling the engine.

## ELECTRICITY IN THE TURRET.

Keeping pace with modern progress, the Ordnance Department of the Navy has about determined to operate the guns and turrets of the men-of-war belonging to the United States Navy by means of electricity in future. It is not intended that electricity shall entirely take the place of steam for this work, for there will be no attempt to replace the existing method with the new one. The new system will, however, probably be placed on board many of the ships, where it will take the place of the steam apparatus should the latter be injured in any way. In any event it has all but been decided to equip the battleship Iowa and the new cruiser Brooklyn with this system when they are sufficiently advanced towards completion to receive it.

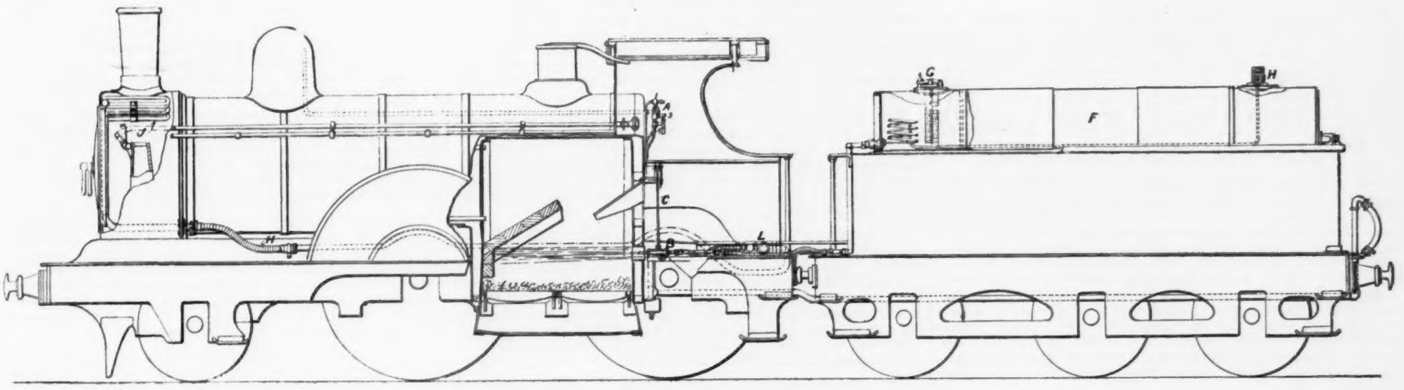
Experiments of a most severe character have been going on with the system for some time past. In order to thoroughly test its capabilities, Capt. Sampson, Chief of the Bureau of Ordnance and Ensign Joseph Strauss, who has special charge of all matters relating to turrets, visited League Island on Wednesday, where they witnessed a severe test of the system, and, in fact, operated it themselves. Electric turning gear has been installed in the turrets of the old monitor Montauk, which is lying at the Navy Yard at League Island. Before the arrival of these officers it had been given a thorough trial and worked admirably. Captain Sampson and Ensign Strauss carefully examined the apparatus and found that it not only worked perfectly, but that it was decidedly better than the steam system now in vogue.

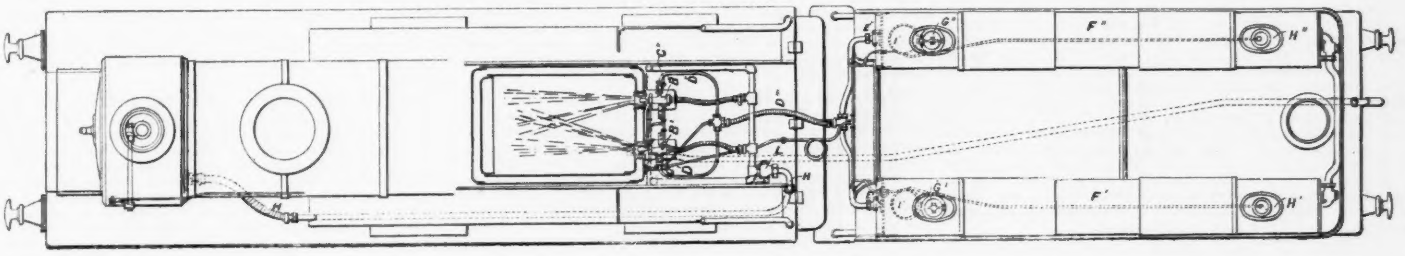
It will be remembered that the Department intended fitting the turrets of the cruiser New York with an electric system, but for some reason or other steam was adopted instead. There are numerous advantages which electricity possesses over steam, and it is because of this fact that the ordnance officials have been anxious to secure some system by which it could satisfactorily be used to operate the guns and turrets of the big vessels. With the new system there would be an absence of the steam pipes which the vessels are now supplied with. The electric wires could be easily run around bulkheads, instead of boring through them, as the workmen are now compelled to do in the case of pipes conducting the steam for the turning gear of the turrets. Should they become injured in battle, there would be no way by which the turrets could be operated and the guns elevated or depressed except by hand power. With an electric wire, a projectile has a smaller surface to strike, and the two ends of the wire could be bound together in an instant and a current re-established without delay were it to be broken.

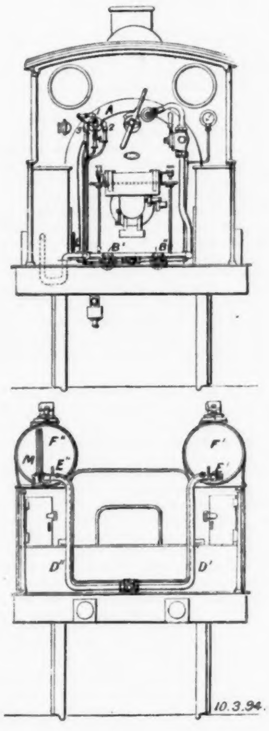
To the minds of ordnance officials the crowning advantage of the new system lies in the ease with which it is handled. Instead of the valves present in the steam system there is a single lever, which, if thrown to the right or left, turns the turrets with it, or if thrown up or down elevates or depresses the guns accordingly. This lever connects with a small switch, which alters the voltage of the current to the motors. The current by which the system is operated may be obtained from the electric lighting machinery of the vessel, a current of 80 volts being all that is necessary to work it. *U. S. Army and Navy Journal.*

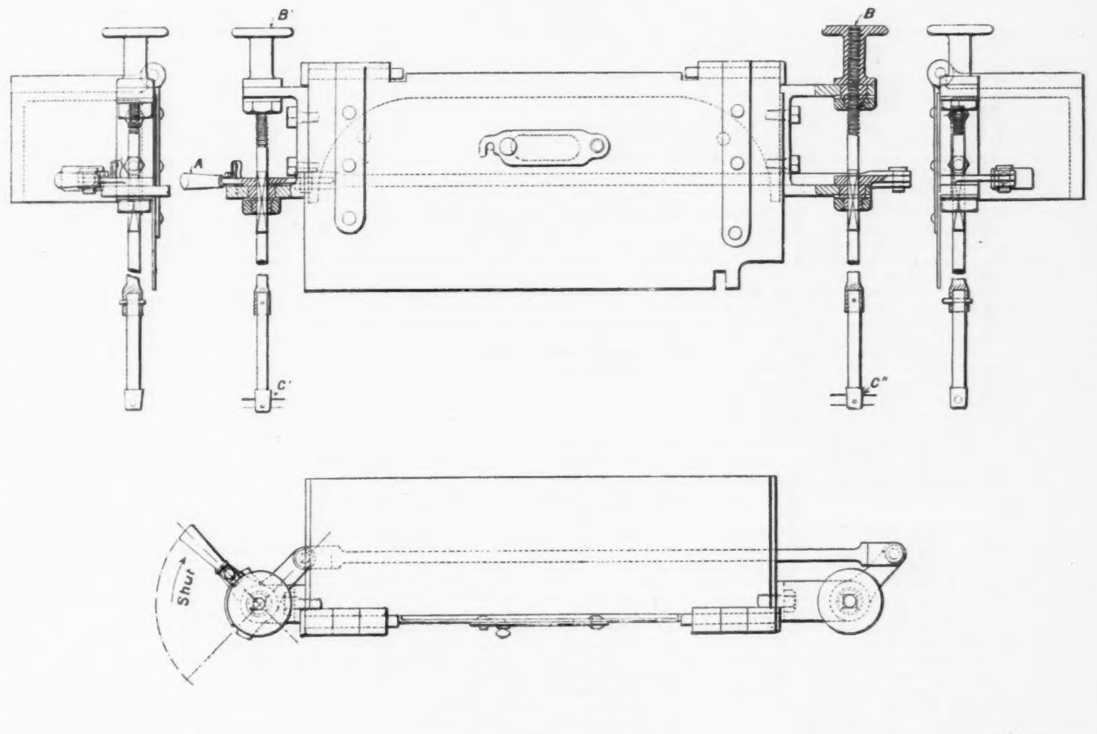
# APPARATUS FOR BURNING LIQUID FUEL, GREAT EASTERN RAILWAY

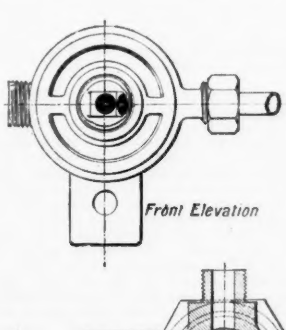
*(For description see page 276)*

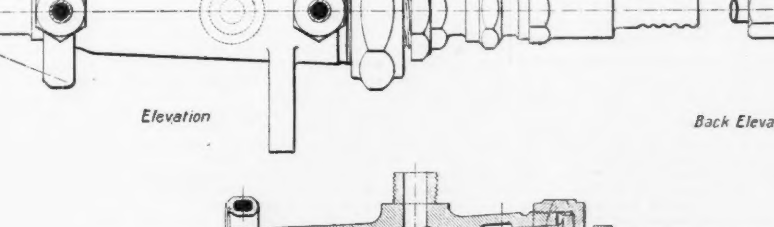


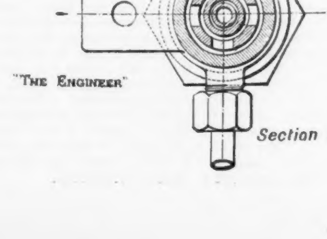

C'
B'
D'
D''
L
H
E'
G''
F''
H''
F'
G'
H'

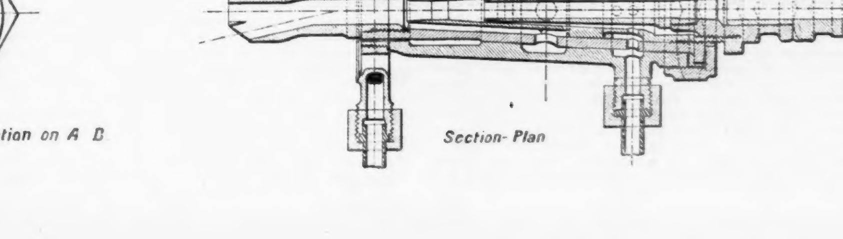


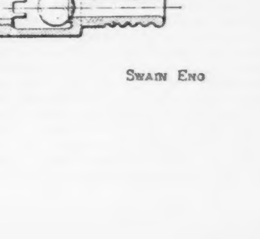


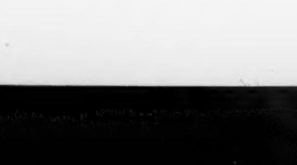

M
F''
E''
F'
E'
D''
D'
10.3.94.

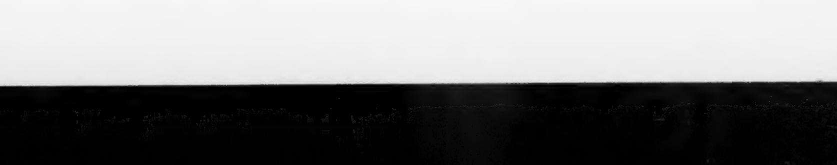



Front Elevation


Elevation


Back Elevation


Section on A B


Section-Plan

"THE ENGINEER" SWAIN ENG

## RAILWAY MATTERS.

It is officially announced from Delagoa Bay that an agreement has been arrived at between the Netherlands Railway Company and the Portuguese Government, in accordance with which a reduction of 12s. per ton will be made for the railway carriage of goods landed at Delagoa Bay ex direct steamers. The agreement is for a term of one year, and is subject to ratification at Lisbon.

The Tonawanda Valley Railroad will hereafter be known as the Buffalo, Attica, and Arcade Railroad. An American contemporary says no other road in the State has had so many titles as this road. It was built in 1853 and called the Attica and Arcade Railroad; then its name was changed to the Attica and Alleghany Railroad, and later on, in 1872, it became the Tonawanda Valley Railroad. Afterwards it was known as the Attica and Freedom Railroad, and now its present name. At first it was built as a standard gauge road, and in 1870 it was made narrow gauge. At present it is being altered to the standard gauge.

The following list of proposed Indian railways to be surveyed, according to present plans, during the winter of 1894 and 1895 is given in the *Indian Engineer*:—Bara-Muttra, 150 miles; Wazirabad-Lyallpore location, 200 miles; Rohri-Kotri location, 206 miles; linking up the metre-gauge systems in Northern India, 90 miles; extensions of the Bengal and North-Western Railway from a point west of the Chota Gunduk to Benares with a branch to Ballia, 157 miles; Hilli-Kaligunge, 48 miles; Northern Bengal-Assam connection—exploration only—200 miles; Arsikere-Mangalore, 125 miles; Shoranur-Cochin, 60 miles; Calicut Cannanore, 55 miles; Tinnevelly-Quilon, 106 miles; Madura-Paumben, 91 miles; Vizianagram-Parvatipore, 300 miles; Chittagong-Minhla, 420 miles; Assam-Burma connection—exploration only; total, 2208 miles.

The second annual convention of the Travelling Engineers' Association was held in Denver, convening on Tuesday, September 11th, and continuing three days. This Association was organised two years ago, for the mutual benefit of the travelling engineers of the country, and "to improve the locomotive engine service of American railroads." The following topics were reported upon and discussed:—True and false economy in caring for and the safe handling of the air brake under all conditions; and when examining a fireman for promotion, how much knowledge of the air brake is it necessary for him to have to be considered fully competent to take a train out on the road? What are the best means of saving coal, and increasing or holding the mileage per ton at a desirable figure? Testing coal in actual service, what are the easiest and most accurate methods? What relation does a clean engine bear to the economical use of oil and supplies? How can travelling engineers improve the service when engines are double-crewed or pooled? On a uniform form of examination for firemen for promotion and new men for employment.

The Bavarian Premier and Minister of Ways and Communications, who has recently returned to Munich from England, Scotland, and Ireland, where he has been spending his vacation, devoted much attention during his visit to the railways of the United Kingdom, of which he speaks in terms of great praise, declaring their traffic arrangements to be excellent and far more developed than in Germany. The Minister was especially struck with the quiet and able manner in which the British railway officials managed to control the enormous amount of traffic which passed through the comparatively small stations, and contrasted their demeanour with that of their colleagues on the Continent, to the disadvantage of the latter. After, however, pointing out the greater speed and smoothness of railway travelling in the United Kingdom as compared with the Continent, the Minister observed that there the advantages of the British system ceased, and proceeded to describe the carriages, the railway stations, and the refreshment rooms as decidedly inferior to the accommodation provided for travellers in Germany.

It is now some two months since it was proposed to adjudicate the concessions for several lines of tramways in the city of Alexandria, and at the appointed date the adjudication was duly announced. Subsequently, however, the Minister for Public Works in Egypt declined to ratify the decision arrived at by the Municipal Council, and the opportunity of re-considering the whole subject *de novo* was taken advantage of, and was unquestionably a step in the right direction. Under the recent fresh arrangement the Municipal Council has invited the assistance and co-operation of the different European tramway companies, who had previously taken great interest in the whole matter, and were fully prepared to do all in their power to further the affair. Unfortunately, the companies retired from the prosecution of the original project, owing to certain clauses in the specification and agreement, which did not coincide with their own particular views. In order to remove this cause of objection, and further smooth away difficulties, the Council, while not losing sight of the interests of the city, will revise these documents, and will shortly announce the date of the next adjudication, which will be as early as circumstances will permit.

It is probable that before the end of this century trains will be running from St. Petersburg through to Vladivostock, on the Sea of Japan. On the eastern division of the Great Siberian Railway trains are running from Vladivostock well into the interior, and it is expected to have the entire line in operation before the end of this year. The western division is also nearing completion. By utilising river navigation, it is found that rails can be laid from three different points at the same time, instead of from but one, as at first supposed; and also that, most unexpectedly, local workmen prove to be very abundant. The Government proposes to spend large sums upon auxiliary enterprises, for the development of the natural resources of Siberia. Branch lines are to be built, the rivers are to be improved, and steam navigation established from points intersected by the railway; colonisation is to be assisted, ironworks are to be encouraged, and scientific expeditions are to be organised for thorough study of the country. For these purposes, along the line of the first division alone 14,000,000 roubles have been appropriated. The total cost of the entire railway is estimated at 350,210,482 roubles. The political and social effects of this stupendous enterprise—which, indeed, is the most gigantic railway undertaking ever planned—will be of tremendous moment.

A recent French railway journal publishes the results of an extensive investigation by M. Couärd, a French engineer, on the life of wood sleepers. He finds that they last much longer under a light than under a heavy traffic. On a line passed by 18,000 trains yearly, the average life was 8·1 years; on a line with 13,000 trains, 9·7 years; and on a line with only 8700 trains per year, the life was 11½ years. He found one local road with only 1760 trains a year, and here the sleepers lasted 18·9 years. The influence of climate may make a difference of one-half in the durability. Further, the number of sleepers per mile has an effect. On a line with 28 per cent. more sleepers per mile than on another, the sleepers lasted 37 per cent. longer. They are worn in proportion to the work they have to do; whence Couärd concluded that heavier rails will make the sleepers last longer. As to grades, he found on double track roads that sleepers on the down track on the average last only 78 per cent. of the life of sleepers on the up track, and that the longest life is on the steepest ascents, which he interprets as meaning that the life of sleepers decreases with the increase of the speed of trains. On some curves the fastening of some chairs—for double-headed rails—are loosened so often that the resetting of them soon destroys the sleepers, the life of which is reduced by one-half in these situations. On other curves he found less effect on the sleepers, yet a reduction of 30 per cent. in their life. Thus he finds the durability of sleepers affected by a great many elements beside the kind of wood and its treatment.

## NOTES AND MEMORANDA.

The deaths registered in thirty-three great towns of England and Wales last week corresponded to an annual rate of 15·7 per 1000 of their aggregate population. This is 1·2 per 1000 more than in London, Halifax had a nominal record for the week, namely, only 6·2 per year per 1000. Liverpool rate was 23·5, and so kept up its reputation which is made for it by its "last end."

It is stated that a Mr. Keyser has soldered aluminium, without the use of any flux at all, by heating the metal and scraping the surface while in contact with a solder, so as to remove the oxidising film until the metal is what is called "tinned." Then union takes place easily enough. The alloy used consists of tin 50, silver 25, aluminium 25, and melts at 750 deg. Almost any tin solder serves, however.

The Glasgow and West of Scotland Technical College Electrical Engineering Laboratory has just received a very handsome addition to its testing apparatus in the shape of Siemens' low resistance bridge, which is capable of indicating resistance to the one-millionth of an ohm. This present is all the more acceptable since it has been given in recognition of the tests done by Professor Jamieson's students during last session.

A feature of the Oerliken Works, Switzerland, is the electric balancing of turbines. There is a 600-horse power turbine, driving a three-phase dynamo. The balancing apparatus consists of a ring-field magnet wound with a single exciting coil, and firmly fixed above the apparatus to be counterbalanced. The shaft carries a ring armature, and when the turbine is running the attraction between this armature and the magnet is 42·6 lb. per square inch. The power required to operate the magnet is only about a third of a horse-power per ton of load carried.

In London 2358 births and 1211 deaths were registered last week. Allowing for increase of population, the births were 234, and the deaths 150, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate declined to 14·4. During the four weeks ending on Saturday last the death-rate averaged 14·5 per 1000, being 2·5 per 1000 below the mean rate in the corresponding periods of the ten years 1884-93. In Greater London 3183 births and 1550 deaths were registered, corresponding to annual rates of 27·9 and 13·6 per 1000 of the estimated population.

Whilst in the Thames Valley the rainfall has been 1·72in. more in June, July, and August than in any year of the last twenty-five, it has been curiously small in the effective supply area of Leicester, where the water supply is rapidly diminishing. Both reservoirs are about 21ft. below the weir level, and even with a greatly diminished consumption on the one hand, and several auxiliary supplies on the other, the quantity in stock is so small that, unless something unexpected happens, not a drop will be left in stock on October 15th. Gangs of men are engaged night and day sinking wells near the river Soar, where it is hoped supplies will be found, and pumping engines are being prepared to force the water direct into the water mains without filtration.

America is now reported to have a moving mountain, that is, one which moves more than most of them. Near the cascades of Columbia it rises, a gigantic mass of dark basalt, six or eight miles long, and 2000ft. high, with a three-pronged pinnacle to tempt the adventurous. Year by year this mountain is moving down towards the river, and some day it will dam it, and form a vast lake. The forests at its root are being gradually pushed beneath the water, and are fringed with submerged stumps. The *Pall Mall* says the railway that runs along it is displaced to the extent, in parts, of 10ft. in a few years. The cause of the phenomenon is supposed to be a gradual subsidence of the soft sandstone at the base of the mountain, which is continually washed away by the swiftly-flowing waters of the Columbia river.

Researches on the movements of the solar atmosphere formed the subject of a recent paper in the *Comptes Rendus* by M. H. Deslandres. An examination of many photographs of spectra of the sun reveals interesting phenomena in connection with a bright line occurring within the wide dark lines H and K of calcium. This line may be resolved into two bright lines enclosing a dark line; the bright lines correspond to the lower layers of the chromosphere, while the dark line belongs to the higher layers. These bright lines often show dissymmetry, sometimes one and sometimes the other becoming the narrower. Spectra of the faculæ do not usually show this dissymmetry, but it is a common condition over the remainder of the surface, and is more pronounced near the equator than in the neighbourhood of the poles. Near spots the observed dissymmetry is often in the opposite direction on opposite sides, and the narrowing of the line is sometimes irregular. These phenomena can be explained on the hypothesis of a continual circulation of the sun's atmosphere, but *Nature* says it is worth noting that a less marked dissymmetry has been obtained in the calcium spectrum produced by the induction spark.

Some little time ago forty-three officers of metropolitan police were deputed to make certain observations concerning road traffic generally during the discharge of their daily duty in the busiest thoroughfares of the world. These observations extended over fifty days for twelve hours each day—namely, from 8 a.m. to 8 p.m.—and granite, asphalte, and wood pavement were considered. In one day of twelve hours no fewer than 12,366 horses and vehicles passed along Cheapside and 5350 along Cannon-street. During the fifty days upon which observations were taken 542 accidents took place on wood pavement, 719 on granite, and 1066 on asphalte. From these figures it was estimated by an expert that a horse could travel 330 miles on wood pavement during the fifty days without meeting with an accident, 191 on granite, and 132 on asphalte; therefore the great superiority of wood pavement over all others—at least, where horses are concerned—is at once apparent. Altogether, 1054 falls were recorded, and an analysis of this number, *London* says, affords some curious information. On asphalte 247 partial and 190 complete falls took place; on wood 326—only 39 complete falls. Roughly, for every fall on wood pavement four took place on granite and asphalte.

The recovery of the india-rubber from goloshes and similar articles forms an extensive branch of industry in the United States. The process by which this recovery is effected consists in the mechanical separation or destruction by means of dilute sulphuric acid of the textile materials and the subsequent treatment of the finely-ground product with steam under a pressure of six atmospheres. The steaming process seems to effect a devulcanisation by oxydation. This assumption is borne out by the fact of the regenerated india-rubber possessing, unlike vulcanised rubber, to some extent the plastic properties of natural caoutchouc, and also by the results of an analysis, which showed the presence of a large quantity of sulphates and but little sulphur in combination with organic matter in the recovered product. The *Journal* of the Society of Chemical Industry says various qualities of this regenerated or reclaimed rubber are met with in commerce. The price of these products, which at best represent but mediocre mixtures approaching closely in composition to the waste material from which they have been obtained, is high—1s. to 1s. 6d. per kilo.—considering the quantity of real caoutchouc contained in them does not exceed 35 or 40 per cent. Their industrial value, therefore, appears doubtful. Three samples in the shape of black sheets, examined by the author, had a specific gravity of from 1·59 to 1·66, and contained lead oxide, calcium sulphate and carbonate varying in quantity from 12·23 to 14·02 per cent., 21·43 to 22·13 per cent., and 10·91 to 18·00 per cent. respectively, together with small quantities of ferric oxide, alumina, silica, and water. The sulphur in combination with caoutchouc amounted to from 0·71 per cent. to 2·03 per cent.

## MISCELLANEA.

Messrs. Charles Churchill and Co., Cross-street, Finsbury, have been appointed special agents for the Brown and Sharp Manufacturing Co., tool makers, Providence, Rhode Island.

On Monday last the large hopper dredger, Percy Sanderson, recently built by Messrs. Wm. Simons and Co., for the European Danube Commission, arrived all well at Sulina, Roumania, after a quick voyage of 19½ days from the Clyde.

The Council of the Society of Engineers have unanimously elected Mr. Perry F. Nursey, a Past-president, and for thirty-six years a member of the Society, as honorary secretary and treasurer, in place of the late Mr. Alfred Williams, who had occupied the position since the foundation of the Society in 1854.

Messrs. W. H. Allen, Son, and Company, of Lambeth, have completed their new works at Bedford, and they are now in working order. The works are built on a site adjoining the main line station, one hour's ride from London. We hope shortly to give a description of these very interesting works, which are driven partly mechanically and partly electrically.

Another Niagara power development company has reached the stage where proposals for actual construction are invited. The work consists of a canal excavation about 7½ miles in length and involving the excavation of about 1,300,000 cubic yards of earth and 4,300,000 cubic yards of limestone rock. An average rate of work of 16,000 cubic yards of excavation daily is to be required of the contractors, at which rate about a year would be required to complete the excavation.

Our cruisers and gunboats seem to comprise a good many crocks. The Barossa is internally very ill; the cruiser Fox was on her eight hours' draught trial off Portsmouth on Wednesday, when she again broke down, and the trial had to be abandoned in consequence of a hot big end; and the gunboat Sharpshooter, which has been a great source of anxiety and expense to the Admiralty since she was first commissioned for sea, developed defects of so extensive a character following on her three-hours' commissioning trial off Plymouth on Monday that her further trials have had to be abandoned; and it is stated to be unlikely that she will be able to join the Channel Squadron on their forthcoming cruise.

A new graphic wire table designed by Mr. A. H. Howard has been issued by Messrs. W. T. Glover and Company, of Westminster and Salford. This table shows the dimensions of copper wires and cables in both decimals of an inch and in metric measurements, the equivalent sizes in solid and stranded wires, the fall of potential, the rise of temperature with given amounts of current, and other necessary information, all arranged in a simple and graphic form. The various wires and cables are arranged above one another in vertical columns according to their area, ranging from ·001in. to 1 square inch, so that all equivalent areas are shown in the same horizontal lines; while diagonal lines give the fall of potential per 100 yards upon any sized conductor with any current from 1 to 1000 ampères. A series of curves printed in red shows approximately the temperature of any conductor with any given current.

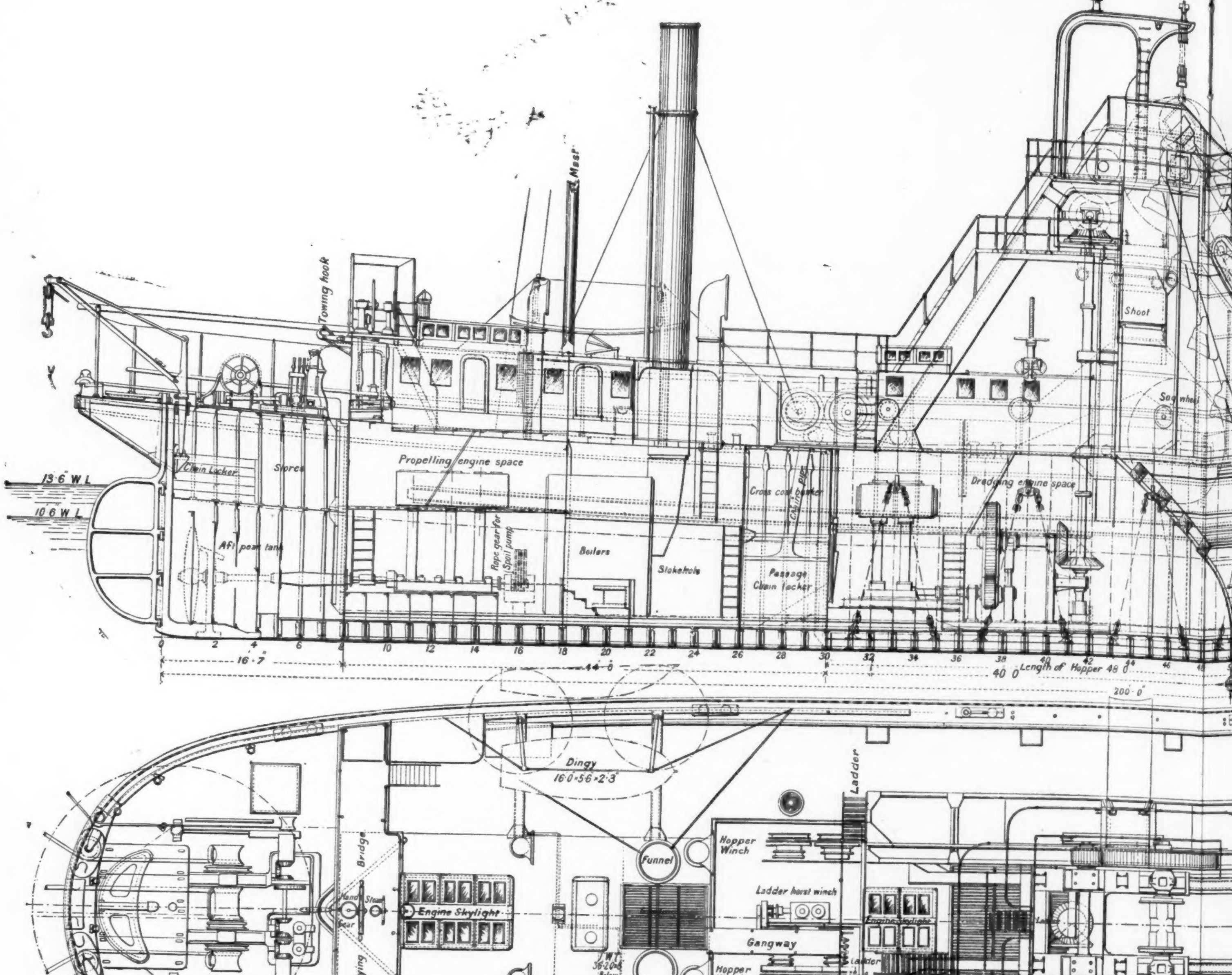
In Louisville, Ky., civil engineers are now required to take out a licence in order to practice, and must pay an annual licence tax of £2. In case civil engineers are associated in a firm or corporation, each member of the firm must pay a separate licence tax. *Engineering News* says: "It seems like a slur on the profession to require licences from those who follow civil engineering; but in several Southern States the old-time custom of raising revenue by laying a licence tax upon those who follow many special occupations is still kept up. Questions occur which have puzzled wiser people than the tax authorities of Louisville. Where is the line to be drawn between the civil engineer and the mechanical engineer; or suppose a man chooses to call himself simply an engineer, can he thus avoid the tax? Again, is the land surveyor a civil engineer, and does the engineer who is employed on a salary 'practise' his profession? Another unique idea which has been recently put in force in Louisville is the requirement that candidates for the office of city engineer must take an examination before a board, in which they must obtain a marking of at least eighty. The examination was one which would puzzle many an engineer of much experience." Evidently the city authorities of Louisville want to employ well crammed school-boys or schoolmasters and to pay for getting their town into a mess.

The French Channel Squadron—Escadre du Nord—is about to be thoroughly re-organised. According to the *Times*, the sea-going coast-defence ironclads Fulminant and Tonnerre, which are nearly twenty years old and proportionately slow, will be withdrawn, and their places will be taken by the new 17-knot coast-defence ironclad Jemmapes, 6590 tons, carrying two 13·3in., eight 3·9in., and fourteen quick-firing or machine guns, and by the new 19-knot armoured cruiser Latouche Tréville, 4750 tons, carrying two 7·4in., six 5·5in., and fourteen quick-firing or machine guns. The Victorieuse, a slow and weak armoured cruiser, dating from 1875, and having a wooden hull, will be temporarily supplanted by the steel armoured cruiser Turenne, and later by the Tréhouart, a sister ship to the Jemmapes. The Valmy, a third vessel of the Jemmapes class, will take the place of the sea-going coast-defence ironclad Furieux. Instead of the battleship Suffren, which has been afloat since 1870, either the Hoche, which is about to exchange her ordinary breech-loading guns for quick-firers, or the Brennus, which is the most powerful completed ironclad in the French navy, will be commissioned. The French Channel Squadron is already fairly well provided with modern unarmoured cruisers and light craft; but to the ships of these classes already flying the pennant there will presently be added the 19-knot cruiser Coëtlogon, 1850 tons, and the 18-knot torpedo despatch vessel Fleurus, 1310 tons. The 19-knot sister cruisers Isly and Jean Bart, 4160 tons, have quite recently been attached to the squadron, which, after the contemplated changes have been made in its constitution, will be exceedingly powerful.

The 30 calibre magazine rifle adopted by the United States army as a substitute for the old ·45 calibre Springfield rifle is to be used with a bullet made of 87½ parts lead, and 12½ parts tin. This bullet will be probably covered with a jacket of cupro-nickel steel as the German silver jacket, used abroad now instead of copper, permits too much deformation of the bullet. Recent tests show that at three yards range the German silver-jacketed projectile will penetrate only 5·3in. into oak, and was much deformed, while with the steel jacket the bullet penetrated 19·5in. to 24·2in. under similar conditions, and was not deformed. The copper-jacketed bullet was also much deformed. The ·45 calibre Springfield bullet gave only 3·2in. penetration at 50 yards. The "humane" purpose of this change in calibre and jacket metal is that the smaller calibre and harder casing of the projectile will disable rather than kill, as the ball will bore clean through a large bone with comparatively little shattering or "shock." As opposed to this theory, an American contemporary remarks that late German experiments have been made with the casing removed from the end of the ball, with the deliberate intention that the lead should "mushroom" on striking and increase the effect on the victim. The tendency in all armies is now to reduce the calibre, though nothing smaller than ·315 calibre has been yet used in actual warfare. Italy, Roumania, and Holland, have adopted a ·256 calibre; our own navy has selected a ·234 calibre, and gun barrels as small as ·197 calibre have been actually made. The United States new army ·30 calibre carries a ball weighing 220 grains, with a charge of about 37 grains of smokeless powder. For the benefit of some readers it should be stated that the calibre of small arms is here expressed in decimals of an inch.

# SOLID ROCK DREDGER MA

MESSRS. LOBNITZ AND CO., L

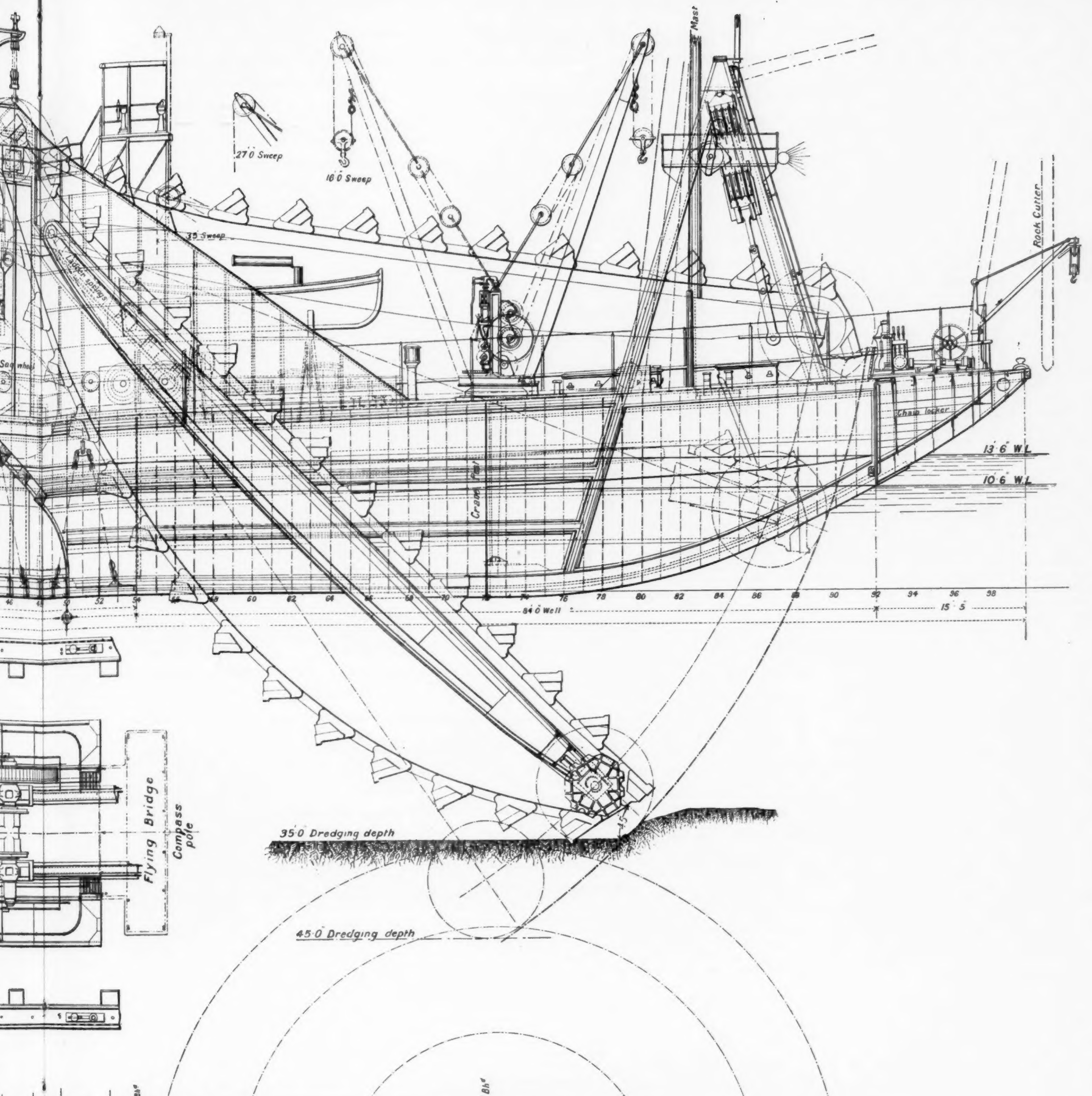


Towing hook
Mast
Shoot
Sea wheel
13·6 W L
10·6 W L
Chain locker
Stores
Aft peak tank
Propelling engine space
Rope gear for Spoil pump
Boilers
Stokehole
Cross coal bunker
Passage Chain locker
Chain pipe
Dredging engine space
16·7
14·6
40 0
Length of Hopper 48 0
200·0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
Dingy
16·0 × 5·6 × 2·3
Bridge
Flying
Hand Steer. Gear
Engine Skylight
F. W. T. 36·2·0·4 Below
Funnel
Hopper Winch
Ladder hoist winch
Gangway
Engine Skylight
Ladder
Life boat
23·0 × 6·6 × 2·9
W. Bhd
Coal Bunker Bhd
Gangway
Bath
Fresh water tank 6·0·3·0·4·0 Deep
Wash house for Crew
Hatch to Chain locker & Stores
Spoil pump shaft
Coal Scuttle
Hopper 48'0" long
Shoot
Spoil pump
Lamps
Steam Steerer
Crane
Gear
Deck Stores
Propelling engine space
F. W. T.
S. W. T.
Galley
Range
Funnel
No. 1 Ash Shoot
No. 2 Ash Shoot
Coal Box
Sink
Bath
Officers Bath Room
Stokehole
Hopper Winch
Ladder Hoist winch
Dredging Engine
Space
Hatch to Chain locker & stores
Hopper 48'0" long

"THE ENGINEER"

# R MAJESTIC, FOR BERMUDA

AND CO., RENFREW, ENGINEERS


27'0 Sweep
16'0 Sweep
35 Sweep
Mast
Rock Cutter
Chain locker
13'6" W.L.
10'6" W.L.
Crane post
84'0 Well
15'5
Flying Bridge
Compass pole
35'0 Dredging depth
45'0 Dredging depth
Gangway
Gangway
W.T. Bhd
Steam Launch 27'0×8'0×3'5
Shoot
Crews Comp
Stove Flange
Crane
H.P.
S.P.
Hatch to Stores
Chimney
Screen Bhd
Hatch to Smithy
Scuttle
Well
Ladder Rest
Ladder Hoist Sheave
Dredging boat
24'0×8'0×3'6
Comp to Offices
Comp to Agent's Office
Stove Flange
Hatch to Stores
Scuttle
60
62
64
66
68
70
74
76
78
80
82
84
86
88
90
92
94
96
98

Swain Eng.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two-page Engraving of a Solid Rock Dredger for Bermuda. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it. Price 6d.*

## CONTENTS.

THE ENGINEER, September 29th, 1894. PAGE

COLONIAL LOCOMOTIVES .. .. .. .. .. .. .. .. .. .. .. .. 269
ANTWERP INTERNATIONAL EXHIBITION .. .. .. .. .. .. .. .. .. 270
THE CHICAGO SHIP CANAL AND DRAINAGE CHANNEL. (Illustrated.) 271
SOLID ROCK DREDGER. (Illustrated.) .. .. .. .. .. .. .. .. 272
HYDRAULIC CAPSTANS. (Illustrated.) .. .. .. .. .. .. .. .. 273
APPARATUS AT THE LONDON PHOTOGRAPHIC EXHIBITION. (Illustrated.) 274
ENGINEERING LABORATORY INSTRUMENTS AND THEIR CALIBRATION .. 274
THE INSTITUTION OF CIVIL ENGINEERS—SUBJECT FOR PAPERS .. .. 274
CATALOGUES .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 274
LETTERS TO THE EDITOR—Trades Union Policy—The Scotch Strike and the Scotch Press—Labour and Luxuries—The Velvo Battery—Traction Engines—The Samuel Morley Memorial College—The Graphic Statics of a Deck Chair—The Theory of the Steam Engine—Belleville Boilers .. .. .. .. .. .. .. .. .. 275
THE OIL-BURNING LOCOMOTIVE PETROLIA. (Illustrated.) .. .. .. 276
ELECTRICITY IN THE TURRET .. .. .. .. .. .. .. .. .. .. 276
APPARATUS FOR BURNING LIQUID FUEL .. .. .. .. .. .. .. .. 277
RAILWAY MATTERS .. .. .. .. .. .. .. .. .. .. .. .. .. 278
NOTES AND MEMORANDA .. .. .. .. .. .. .. .. .. .. .. .. 278
MISCELLANEA .. .. .. .. .. .. .. .. .. .. .. .. .. .. 278
LEADING ARTICLES—Governing Electric Light Engines—Electrolytic Sanitation .. .. .. .. .. .. .. .. .. .. .. .. .. 279
Defective Torpedo Boats in France—Trade and the Labour Problem 280
BOOKS RECEIVED .. .. .. .. .. .. .. .. .. .. .. .. .. 280
TENDERS .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 280
THE CAMPBELL PORTABLE OIL ENGINE. (Illustrated.) .. .. .. .. 281
THE DECAY AND FAILURE OF TAIL SHAFTS IN STEAMERS (Illus.) .. 281
THE COWPER-COLES' GALVANISING PROCESS. (Illustrated.) .. .. .. 282
BRICK AND TILE PRESS. (Illustrated.) .. .. .. .. .. .. .. .. 284
AMERICAN ENGINEERING NEWS .. .. .. .. .. .. .. .. .. .. 284
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. .. .. 284
Notes from Lancashire—The Sheffield District—The North of England .. .. .. .. .. .. .. .. .. .. .. .. .. .. 285
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. .. 286
AMERICAN NOTES .. .. .. .. .. .. .. .. .. .. .. .. .. 287
LONG DISTANCE TRANSMISSION OF POWER .. .. .. .. .. .. .. 287
THE PATENT JOURNAL .. .. .. .. .. .. .. .. .. .. .. .. 287
SELECTED AMERICAN PATENTS .. .. .. .. .. .. .. .. .. .. 288
PARAGRAPHS—Road Bridge for Brazil, 271—A Coalowners' Proposal for Settling Coal Values, 274—Peterhead Harbour Works, 275—Earthquake at Constantinople, 283—Belgian Goods Brake Van, 286—Naval Engineer Appointments, 287—New Works at Salonica, 287.
TWO-PAGE SUPPLEMENT—SOLID ROCK DREDGER MAJESTIC FOR BERMUDA.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. C. (Whitworth Scholarships).—*We hope to publish an article on the subject of your letter in an early impression.*

MAXWELL.—*Write to the Secretary, Institution of Civil Engineers, Great George-street, Westminster, and the Secretary of the Institution of Electrical Engineers, 28, Victoria-street, Westminster.*

H. M.—*You can have copper, silver, or nickel, deposited on the wooden model by any competent electro-plater. The surface is coated with blacklead, and on that the metal is deposited. Or you can prepare a paraffin mould of the model and have an electro-plate shell taken off that. The Elmore process is not in any way adapted for that kind of work. You cannot do better than apply to some of the large electro-plating firms in Birmingham.*

G. A. H. (Newtown).—*There is no difficulty in fitting ships with two sets of paddle-wheels. The Channel steamer Bessemer had them. The after paddles make a greater number of revolutions per minute than the forward wheels. But seeing that all the power needed by the very fastest paddle ships can be exerted through one pair of wheels, no sensible individual would use more. In the case of the Bessemer the whole central portion of the ship was occupied by the Bessemer swinging saloon, and one pair of engines was put forward and the other aft of this space. The ship was a failure, but not because the paddle-wheels were not efficient.*

C. E. R.—*The rapidity of fire of the Maxim gun is about as follows:—With weak Italian cartridges, 500 a minute; poor quality Russian cartridges, 550 a minute; English machine gun cartridges, 666 a minute; Martini-Henry, 650 a minute; American service cartridges, 775 a minute; with French smokeless powder with a muzzle attachment, at the rate of 1000 a minute, but has not been fired for a full minute. The fully automatic 1½in.—37 mm.—has a projectile which weighs slightly over 1 lb., and fires 300 rounds a minute. A 6-pounder fully automatic gun has been made with a belt feed; the rapidity of fire is at the rate of 200 a minute. Semi-automatic guns, such as 1½-pounders, can be fired about 25 or 30 times a minute. 45-pounders may be fired a dozen times a minute.*

### SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

THIN PAPER COPIES—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
THICK PAPER COPIES—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

### MEETINGS NEXT WEEK.

THE JUNIOR ENGINEERING SOCIETY.—Friday, October 5th, at the Westminster Palace Hotel, at 7.30 p.m. General meeting. Annual report of the Council. Election of officers for the ensuing session, &c.

THE SOUTH STAFFORDSHIRE INSTITUTE OF IRON AND STEEL WORKS' MANAGERS.—Saturday, September 29th, at The Institute, Dudley. First meeting of the session, when the President, Mr. Thomas Ashton, will deliver an address.

SOCIETY OF ENGINEERS.—Monday, October 1st, at the Town Hall, Westminster. Paper: "The Utilisation of Town Refuse for Generating Steam," by Mr. T. W. Baker, B.A., of which the following is a synopsis:—Present system of disposal—Destruction by fire, the recognised method—Component parts and quantity of town refuse—Theoretical evaporative value with and without sludge—Description of destructor furnaces—Steam generation in existing plants—Proposed new system for rendering the fumes innocuous and augmenting the steam pressure—Storage of heat and production of purified feed-water—Cost of working and net results.

### DEATH.

On September 22nd, at Southsea, suddenly, of heart disease, J. L. F. TARGET, C.E., aged 65.

# THE ENGINEER.

*SEPTEMBER* 28, 1894.

### GOVERNING ELECTRIC LIGHT ENGINES.

AT various times and from different quarters we receive letters complaining of the difficulty which the writers find in obtaining governors which will satisfy the demands of the electrician. Apparently every centrifugal governor in the market has been tried, and not one gives complete satisfaction. Are we to assume that the governor wanted cannot possibly be made, or that it is beyond the powers of inventors to produce one? We think neither solution of the difficulty is sound. The much desired governor is not forthcoming because the electric light engineers have not explained fully what they want, and—which is perhaps more to the purpose—why they want it. Let us endeavour to make good this deficiency.

The conditions under which electric light engines run are very trying. It is essential that they should always run at precisely the same speed, no matter what the load; or else the speed must be varied with the load in some definite ratio. Then the load varies from time to time through enormous ranges and with great rapidity. Thus, for example, we have an engine of, say, 350-horse power. It is developing 150-horse power. Suddenly, by the turn of a switch, perhaps a mile away, the load is doubled. Now if the engine is not prepared to take this instantly, without a check, the lights already on absorbing the 150-horse power first named will blink, and possibly drop very considerably in intensity, for some seconds. This blinking the public will not stand. It is a thing of all others to be avoided. Under some conditions of working, this engine, now with a load of 300-horse power instead of 150, must make precisely the same number of revolutions as before. If it runs a little faster the first lights may have too much current; if a little slower, too little. Under other conditions of working, the engine must run faster with 300-horse power than it did with 150, but the new speed must bear a precisely definite ratio to the old speed. Thus, then, we have two diverse sets of conditions. Under the first, the number of revolutions made per minute must remain unaltered, no matter what the load; under the second, the speed must bear an invariable ratio to the power. It will be seen that in either case the conditions are extremely trying.

When the ordinary centrifugal governor is used, no matter whether it acts on the throttle valve or on the expansion gear, a definite speed of engine accompanies each position of the governor balls. If the engine is making 100 revolutions and indicating 150-horse power, the circumference of the circle described by the centre of gravity of the balls has a given dimension. If the engine takes more steam and developes 200 or 250-horse power, then the circumference of the circle must be larger, for unless it is larger the throttle valve will not be opened further, but the balls cannot remain further apart unless the number of revolutions is augmented. Clearly, therefore, such a governor cannot comply with the condition of constant velocity of rotation of the crank shaft. Consequently, a centrifugal governor will not comply with one set of conditions. On the other hand, however, it might be made to comply with the second set of conditions, under which the speed is to vary with the power, if only a definite relation between the speed of the governor and the power could be commanded. It will not suffice to have a definite relation between the speed of the engine and the position of the governor balls. Only those who have tried to get a throttle valve or a Corliss governor to bear a definite relation in position to the power and the speed of the engine, can realise the difficulty of the problem to be solved. In practice a great deal has after all to be left to the engine driver, and he has to do the work that a properly made governor would perform. All this, it will be seen, applies to the action of the governor in keeping the engine to the normal rate and correcting the small changes in speed due to a thousand-and-one trifling irregularities of load, friction, steam pressure, &c. The great initial difficulty remains untouched, namely, the power of the governor to deal with lightning speed with large alterations in load. What appears to be needed is a governor which the moment the speed drops or rises—say 1 per cent.—will open the throttle valve full or shut it absolutely, and will then by a series of very rapid alterations or oscillations open and close it through smaller and smaller arcs until the new position suited to the load has been attained. Something quite analogous to this is found in the gas engine, and it is by no means certain that the same principle might not be applied with advantage to the steam engine. Messrs. Brown Brothers make an anti-racing gear for marine engines. Mr. Weir has, we fancy, something of the same kind. The moment the engine tends to race, the inertia of a small moving weight opens a trigger and the throttle valve closes. We have here the fundamental idea of a governor for electric light engines. The isochronal governor complies well enough with the conditions up to a certain point. The balls will remain in any position independent of the speed; it is only a change in speed that will cause them to move in or out, to or from the central spindle; but the isochronal governor is altogether too delicate a plant for the engine-house of an electric light station, and, besides, it is prone to "hunt" to a most distressing degree. On the whole, it appears to us that a modification of Pitcher's governor would best satisfy the conditions. This governor was at one time largely used by Fairbairn for regulating cotton mill engines. The principle involved is very simple. A piston driven by the engine works up and down in a cylinder, and pumps air under another piston in a second cylinder. The air escapes through a snifting cock. The piston rod of the second piston is jointed to the throttle valve. If the engine runs too fast the air cannot get away in sufficient quantity through the snifting cock; the second piston rises and shuts off steam. In the same way, if the engine runs too slowly, the second piston sinks and opens the throttle valve. By substituting water for air the whole apparatus can be reduced in dimensions, and a very obvious modification will put the governor into such a condition that the opening of the throttle valve may be anything for any speed, its position not depending on the speed, as is the case with the centrifugal governor, but on change of speed.

Whether the governor acts on a throttle valve or on the expansion gear seems to be a matter of no consequence, as far as governing is concerned; we have seen an expansion gear governor taken off and replaced by a throttle-valve governor with excellent results, and no appreciable difference in steam consumption. Throttle-valve governors generally fail because the valve is not properly constructed. There is no sort of relation between the area opened and closed and the position of the governor. The result is of course disappointing. The best arrangement, it appears to us, would consist in passing the steam through a circular orifice in a plate in which moves a cone. If this cone is sufficiently tapered a very long range of motion will be required to make any material alteration in the area opened for the steam to pass through. But if, instead of making the sides of the cone straight, we curve them, then it is obvious that we can establish what relations we please between the position of the governor and the area for steam admission.

It is quite beyond our purpose to go into matters of detail, our principal object has been to direct attention to a much felt want. Some electric light engineers are no doubt satisfied; but we often find that the satisfaction is based on ignorance. They do not know what a first-rate governor could do for them. Engine builders, again, often say that if the engine does not govern properly, the conditions under which current is generated are at fault and should be changed. The electrician's answer is simply, in some cases, that he cannot change them, and in others that he will not. We have ourselves no doubt that any competent inventor who would take the trouble to master the whole question could produce what is desirable. But the thing will never be done if a cotton mill engine is taken as a standard. The conditions to be satisfied are in essential particulars totally dissimilar. In what respects, the would-be inventor will do well to find out before he does any scheming.

### ELECTROLYTIC SANITATION.

A FEW years ago every new process of empirical character and doubtful merit was dubbed "electrical," much to the ultimate discouragement of legitimate enterprise. Names, not things, are mutable; and the same spirit of obscurantism has led to the wholesale adoption of the term "electrolytic" as the modern analogue of the older word. A similar effect on reasonable and well-considered methods involving the use of electrolysis is again apparent. Many persons, including those whose opinion is best worth having, are insensibly prejudiced against any suggested process bearing a name associated in their minds with much quackery and fraud; and a new electrical or electrolytic method has to contend with personal bias in addition to the ordinary physical difficulties which attend the establishment of all novel undertakings. The proper spirit in which to approach a matter of this kind consists in deliberately ignoring the association of ideas connected with its title, and in looking only to the method and its results—an attitude much aided by considering that electrolysis is only a particular means of effecting chemical change, and that the reactions attending or consequent on that change can be profitably discussed separately from their ultimate cause.

The strong advocacy and the unsparing condemnation which the method of sewage treatment proposed by M. Hermite has received in the lay and technical Press render it more than commonly necessary to adopt the attitude of impartial criticism to which we have alluded. With this attitude as our aim, it has seemed best to accumulate a sufficiency of data in the form of reports published concerning the process, both in France and in this country, before pronouncing an opinion having a greater value than that of a surmise. Such data being now available, a tolerably definite conclusion can be reached. Before dealing with the merits and shortcomings of the Hermite process, it is necessary to recall briefly its leading features in its present experimental form. Sea water is electrolysed with the formation of magnesium hypochlorite from the magnesium chloride naturally present, and the resulting solution, which has well-marked bleaching, oxidising, and sterilising properties, is used to flush water-closets, and to disinfect general household waste water. The ideas underlying the invention are the disinfection and sterilisation of fœcal matter in the act of passing to the sewer, and the preparation of the disinfectant from a cheap material occurring on the spot at all towns on the coast, and costing nothing but its freight when conveyed inland.

The apparatus adopted for the electrolysis of sea water —in order to convert it into a sterilising solution—cannot be usefully described here, published accounts being scanty and barely intelligible. This circumstance offers no obstacle to the consideration of the character of the reactions brought about, or to the discussion of the efficiency of the solution produced; and, indeed, only becomes of importance to a municipality contemplating the adoption of the system, in which case expert advice would presumably be sought. It is a matter of common knowledge that a bleaching and oxidising solution can be prepared by the electrolysis of magnesium chloride solution when the cathode and anode products are allowed to interact, and the temperature is kept below that which determines the formation of chlorate. For all bleaching solutions containing unstable chlorine compounds it is customary to measure their oxidising or chlorinating effect in terms of "available chlorine." Thus the quality of common bleaching powder, "chloride of lime," is estimated in this manner, a content of 35 per cent. of available chlorine being a normal amount present in a fresh sample of good quality. The Hermite solution may contain from 0·25 to 1·0 grammes of available chlorine per litre, *i.e.*, 0·025 to 0·10 per cent., stronger solutions being found uneconomical both in preparation and use. Choice between these strengths is much guided by the investigations of Dr. Alain Piton, of Brest, who has dealt with this and other points in a lucid report addressed to the municipality of the town in which he holds office. From his results it appears that a solution containing 0·025 per cent. of available chlorine is very unstable, while, when 0·05 and 0·075 per cent. are present the solutions keep well. Dilution of a strong solution with fresh sea water is to be avoided, as the mixture loses strength rapidly on account of the action of the chlorinated substance on the organic matter present in ordinary sea water.

It follows from this—and the matter is of sufficient importance to be insisted on—that sea water is a wasteful material to choose for the preparation of a bleaching and sterilising liquid, inasmuch as a notable fraction of electrical energy is expended in the early stages of electrolysis in oxidising the organic matter present, and it is only after this task has been accomplished that the formation of the active constituent takes place unimpeded. When once the solution has been prepared it can be diluted with clean fresh water without appreciable loss of strength other than that determined by the degree of dilution, *i.e.*, the total quantity of available chlorine in the diluted solution is sensibly equal to that originally present in the undiluted sea water. Transmission to a distance, and dilution on the spot where the solution is to be used, are therefore practicable. The electrolysed solution is perfectly efficient as a deodoriser, removing the characteristic smell of fœcal matter with rapidity and completeness. It has, however, but little solvent action upon solid fœcal matter and paper. In this connection it may be mentioned that a report published by the *Lancet* states that although there is but little solvent action on paper, yet that certain kinds, *e.g.*, newspaper, cause a loss of strength of the solution in contact therewith. Newspaper is no doubt particularly active in this respect, because of the impure woody character of the cellulose from which it is made (mechanical wood pulp being largely used), the substances other than cellulose which are present possessing considerable chemical activity, and suffering oxidation and chlorination more readily than cellulose itself. With regard to the quantity of solution needed for complete sterilisation, it was found that a given quantity of solid fœcal matter required about 3 per cent. of its weight of available chlorine—*i.e.*, 9 litres of 0·05 per cent. solution for a mass weighing 150 grams. With a solution of this concentration a period of ten minutes contact with the liquid was necessary, even longer being required with micro-organisms of resistant type. A natural consequence of this fact is that some device must be adopted whereby each flushing of a water-closet shall be kept in contact with the matter flushed out before both find their way to the street sewer—that is, there must be a filter basket or syphon in the soil pipe.

The investigation already referred to as having been carried out at the instance of the *Lancet*, adds certain conclusions to those arrived at by Dr. Piton. In this investigation an attempt was made to determine the nature of the constituents of the electrolysed solution. The strength in terms of available chlorine was determined by the standard method used for the valuation of bleaching powder, which consists in titration with a solution of arsenious acid, and the results were found to agree fairly with those obtained by measuring the quantity of iodine which the solution was capable of liberating from potassium iodide in neutral and acid solution. A large difference was, however, observed in comparing the amount of available chlorine determined by titration with arsenious acid, with that liberated by distillation with sulphuric acid, the first value being about half that arrived at by the second method. An explanation of this discrepancy is attempted by the erroneous statement that the available chlorine produced by the interaction of free hydrochloric acid and hypochlorous acid according to the equation $H\,Cl + H\,Cl\,O = H_2O + Cl_2$ is greater than that represented by the direct oxidising power of a hypochlorite in suffering reduction to a chloride, thus $Na\,Cl\,O = Na\,Cl + O$. So far from this being the case it is clear that the $Cl_2$ set free in the first equation is strictly equivalent to the O available in the second reaction. We should not have adverted to this mistake in chemistry on the part of our contemporary were it not that the matter has more than an analytical interest. If a Hermite solution contains an oxidising or chlorinating substance which is only capable of exhibiting activity on distillation with acid, it follows that it must contain some oxidised chlorine compound such as a chlorate, useless for disinfection and representing a waste of the electrical energy needed for its formation. Careful control of the process of electrolysis will therefore be necessary to avoid the production of useless substances of this type. There seems reason to believe that a part of the active substance present in the electrolysed solution is free hypochlorous acid instead of magnesium hypochlorite. This accounts for the activity of the solution being greater than that of chloride of lime of the same strength in terms of available chlorine, for in the latter instance calcium hypochlorite is undoubtedly present, accompanied by no hypochlorous acid save that liberated by the action of the carbonic acid of the air. This interesting distinction between the two chlorinated substances—chloride of lime and Hermite solution—is of direct practical significance. On the one hand, it explains the special efficiency claimed for bleaching solutions made by electrolysis, and proves it to be due merely to the presence of free hypochlorous acid, and not to any magical compound unknown to chemists and obedient only to the wand of the patentee, and on the other, leads directly to the preparation of what is termed an "artificial Hermite solution" in a manner vastly simpler than by electrolysis. By passing carbon dioxide into a solution of bleaching powder, the very feeble hypochlorous acid which is present in solution as calcium hypochlorite is set free, and the solution thus obtained is found to present the salient features of the Hermite solution prepared by electrolysis. In short, the latter may be regarded as a solution of hypochlorous acid prepared by taking advantage of the instability of magnesium hypochlorite.

The facts having thus been set forth, it remains to state the conclusions to which they lead. In the first place, there can be no reasonable doubt but that an actively oxidising and sterilising solution can be prepared by the electrolysis of sea water. Secondly, that this solution is unstable in the presence of oxidisable matter, exerting thereupon a well-marked action with considerable rapidity. Thirdly, not only dead organic matter but living organisms are attacked by this solution, and complete sterilisation of liquids containing even hardy bacteria can be effected, provided a large quantity of sterilising solution be used, and adequate time be allowed. Fourthly, all these results can be equally well produced by hypochlorous acid prepared by any well-known method. The whole question, therefore, is brought within very narrow limits. Only two phases need be closely considered. The first is whether it is desirable to sterilise human fæces immediately after their disjection. Seeing that many diseases are propagated by organisms passing from one human being to another by a circuit including the excreta of the diseased person, and the food or drink of the sound individual, only one answer can be returned. It is eminently desirable that immediate and regular disinfection of the excreta of all persons, hale or diseased, should be effected. How far the addition of the necessary disinfectant will affect the growth of innocuous organisms, whose important function it is to decompose and oxidise all waste organic matter in sewage on its way to or passage through a river or the land, is a matter which experiment only can decide. On account of the large dilution which excremental matter suffers from the addition of domestic washing waste and surface drainage by the time it finds its way into the main sewer, it is unlikely that the disinfectant added to the first-named material will be sufficient appreciably to retard the growth of scavenging organisms. Granting then that immediate and local sterilisation is desirable, the device of an effective system of flushing with the disinfectant selected may safely be left in the hands of the sanitary engineer. The second point for consideration is the best method of preparing a disinfecting solution of the requisite activity. Now, in this case there is one governing condition, and only one, viz., the cost of the process of manufacture. This vital question has not yet been dealt with by M. Hermite as explicitly as is desirable. One estimate states that 1 kilo. of available chlorine per hour can be obtained from an electrolyser absorbing 12-horse power. This, at the rate of ½d. per horse-power hour, equals 2·7d. per lb. of available chlorine. Another estimate gives one shilling per year as the cost of 40 litres of disinfecting solution per day. Taking the strength of solution at 0·05 per cent. of available chlorine, this is equivalent to 20 grammes of chlorine per day, or 7·3 kilogs. per year, corresponding with a cost of available chlorine of 0·75d. per lb., including, be it noted, the cost of distribution. The reconciliation of these estimates is a matter of some difficulty. Meanwhile, it may be observed that 35 per cent. bleaching powder at £8 per ton is equivalent to 2·4d. per lb. of available chlorine. To this must be added the cost of treating the bleaching powder solution with carbon dioxide—by no means an expensive item however. Thus it is plain that any process using hypochlorous acid as a disinfectant must, to compete successfully with bleaching powder, be manufactured at a rate not exceeding 3d. per. lb. of available chlorine produced. It is futile for any inventor to fall back upon the elegance and directness of an electrolytic process as distinct from one purely chemical. The brutal necessities of every-day life require a given end to be attained by the cheapest method, and take no account of purely æsthetic advantages.

◆◆◆

### DEFECTIVE TORPEDO-BOATS IN FRANCE.

It will be remembered that a few months ago M. Lockroy made certain surprising declarations in the French Chamber of Deputies as to the condition of some of the vessels composing the French war fleet, and for thus exposing the weakness of the navy he was pounced upon by a crowd of writers who blamed him for his want of patriotism. The outcry against these revelations was the more bitter as at that moment some orders for ships were placed by the Governments of Russia and Japan with English firms, and it was stated that the allegations of M. Lockroy would deprive France of the business which she had been building up in the construction of war vessels for foreign Governments. A commission was appointed to make a thorough inquiry into the state of the navy, with special reference to the alleged defective torpedo-boats, and a report has just been drawn up by M. Lockroy for presentation to the Chamber. The report deals principally with the behaviour of the three torpedo-boats Nos. 167, 168, and 169. The first of these was ordered from Creusot in April, 1890, but exactly two years elapsed before the boat arrived at Toulon, and it was not until April, 1893, that it was delivered up to the Minister of Marine. No penalty whatever was inflicted upon the builders for the delay. Shortly after its reception it was found that the zinc sheathing on the hull was damaged, and the Government had to repair it at its own expense. The torpedo-boat 168, which was ordered about the same time as the preceding one, was not delivered until August, 1893. It was then examined in a dry dock, and it was seen to possess exactly the same defects. Six months afterwards an engineer discovered that the hull had become oxidised at the water-line, and was in some parts eaten through. A thorough examination of the vessel was then made, and it was not until May last, four years after the order had been given out, that the boat entered into service, and notwithstanding the repairs that had been made it seemed likely that the vessel would have to be again overhauled at an early date. The boat was accepted on condition that the builders should consent to a reduction in the price paid equal to about half what it would cost to have the hull thoroughly repaired. The torpedo-boat 169 remained a year and seven months before it was examined by the commission preparatory to official acceptance. Soon after its completion in August, 1892, it was found that no fewer than 300 rivets had not been properly zinced, and that the steel plates were likewise insufficiently protected. The boat was consequently sent back to the builders upon the understanding that the hull should be entirely re-sheathed. At the end of six months the work had not even been begun, and a voluminous official correspondence took place as to what should be done. The original decision to have the hull re-sheathed was reversed, and it was proposed to merely paint the hull, and to reduce the sum to be paid to the builders. As the efficiency of the boat was greatly impaired by its numerous imperfections, it became a question as to how much of the contract price should be deducted. Nothing so far has been decided, and the boat which was ordered in 1890 has not yet been delivered. In his report M. Lockroy also deals at length with the boilers of these torpedo-boats, and states that they are not placed in competent hands. Altogether he draws a very gloomy picture of these vessels, some of which, in their actual state, are quite unfit for service, but he thinks that a remedy would be found by keeping them in more active work, which would prevent the machinery and boilers from so rapidly deteriorating, and would at the same time afford more experience to those in whose charge they are placed.

### TRADE AND THE LABOUR PROBLEM.

Whenever the Duke of Devonshire addresses himself to trade questions his utterances are always of a sort commanding careful attention. The important position which this nobleman occupies as a capitalist deeply interested in iron and steel and shipbuilding manufacture, as also in colliery undertakings, invests his communications with especial weight. Some remarks which his Grace has made within the last few days at Staveley, in Derbyshire, on the labour position, evince an originality of thought and a weighing of surroundings which should appeal to manufacturers engaged in the industries we have mentioned, and to workmen in all parts of the country. The Duke of Devonshire is clearly to be reckoned among the number of iron and steel masters who to-day, in face of increasing competition from Belgium, Germany, America, and other of the world's manufacturers, view with alarm the demands of the operative classes. His Grace points out that there was a time when it was possible for English miners and ironworkers to strike and bring about the closing of collieries and ironworks without doing serious damage to the trade of the country. England's customers could not go elsewhere, for no other nation was in a position to supply them. But now all this is changed. Strengthened doubtless by the published testimonies of the iron and steel masters who recently visited Belgium with the Iron and Steel Institute, his Grace observed that we no longer possess a monopoly of iron and steel and coal manufacture and raising. Other countries have now learned to use their minerals in manufacturing processes, and their workpeople are as well trained as ours, both physically and mentally, perhaps in some cases better trained, to make the best use of their enterprise and resources. His Grace warns labour that by their ignoring of employers' interests in their demands for shorter hours and higher wages they may probably be taking a course which, instead of operating to their advantage, may result in there being no profits to divide at all.

## *BOOKS RECEIVED.*

*Notes on Docks and Dock Construction.* By C. Colson, M. Inst. C.E. With illustrations. London: Longmans, Green, and Company. 1894.

*An Introductory Account of Certain Modern Ideas and Methods in Plane Analytical Geometry.* By Charlotte Angas Scott, D.Sc. London: Macmillan and Company. 1894.

*First Principles of Building.* Being a practical handbook for technical students. By Alex. Black, C.E., Architect. Illustrated. London: Biggs and Company.

*Newfoundland as it is in* 1894. A handbook and tourists' guide. By the Rev. M. Harvey, LL.D., F.R.S.E. London: Kegan, Paul, Trench, Trübner, and Company. 1894.

## TENDERS.

### MANSFIELD CORPORATION WATERWORKS.

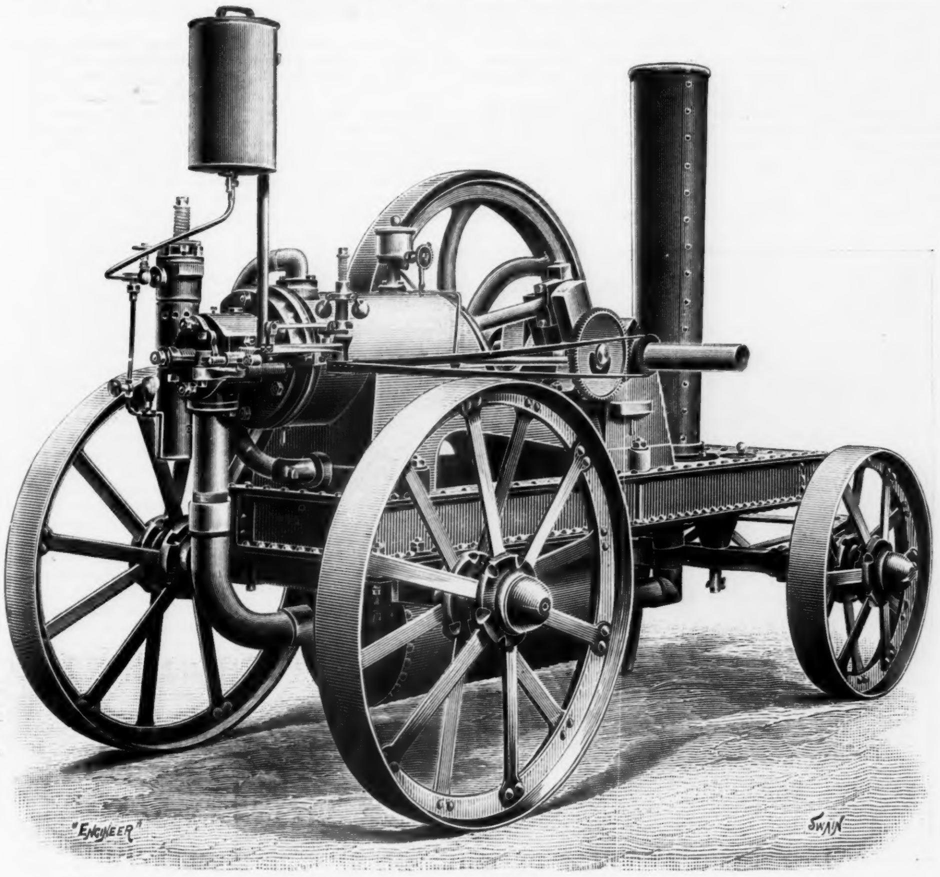
CONTRACT No. 2.

For Rainworth Pumping Station, pumping and gravitation mains, and Berry Hill service reservoir, Mr. George Hodson, engineer.

| | |
|---|---|
| Messrs. Fotherby and Sons, Burnley | £22,845 |
| Mr. J. Greenwood, Mansfield | 22,500 |
| Messrs. Williamson and Co., Sunderland | 22,360 |
| Messrs. Kirk, Knight, and Co., Sleaford | 22,248 |
| Messrs. Jenkins and Son, Leamington | 21,949 |
| Mr. H. Shardlow, Nottingham | 21,700 |
| Mr. J. H. Vickers, Nottingham | 21,604 |
| Mr. J. F. Price, Nottingham | 21,500 |
| Mr. T. Smart, Nottingham | 21,400 |
| Mr. J. Tomlinson, Derby (accepted) | 21,344 |

# THE CAMPBELL OIL ENGINE

THE CAMPBELL GAS ENGINE CO., HALIFAX, ENGINEERS



## THE CAMPBELL PORTABLE OIL ENGINE.

THE above engraving illustrates a new form of the Campbell portable oil engine which has been made since the trials at Cambridge in June last. The truck of the engine is made of two channel irons 7in. deep by 3in. by 3in., and the plates ¼in. thick. The capacity of water carried is 55 gallons; oil capacity is 30 gallons. The wheels of the truck are 4ft. and 3ft. diameter, made of wrought iron. The weight of the whole engine, complete with shafts, is 3 tons 2 cwt., as compared with the weight of the same size of engine at Cambridge, which was 4 tons 18 cwt., a very large reduction.

A cooling arrangement for the water supply is provided. The water is pumped out of the truck tank and delivered into the jacket of the engine, and from there taken by the pipes from the top of the water jacket to a perforated pipe situated in the hollow of the engine bed-plate. This bed-plate is cut away at the sides, and currents of air, caused either by the wind when the engine is working out in the open, or by the draught caused by the fly-wheels, act together to help to cool the water as it issues from the perforated pipe. The water on issuing from this pipe falls into an open space cut in the top plate of the truck; this also gives cooling surface to the water, but the exhaust is also utilised to induce a draught of air over the heated water. The round box shown underneath the truck is used to silence the exhaust. The driving arrangements are so made that a driving pulley can be put on either side of the engine, and a belt can be taken therefrom in either direction. The engine thus contains several improvements made in the last few months.

The engine itself is very similar to the fixed engine, but mounted on wheels and truck; and this Mr. Campbell considers the best method of making a portable oil engine. He thinks that for oil engine purposes sufficient strength and rigidity cannot very well be obtained with a cylinder bolted on a light wrought-iron truck, and entirely separated, except by two stays, from the crank bearings, as these engines must stand the hard wear and tear in agricultural or contractors' work. With designs such as that shown, the engine is in one part, and that part strong enough in itself to stand all working stresses without any chance of details moving out of position or out of line. It can, if necessary, be disconnected from the truck and used as a fixed engine with little trouble. Some well-known makers adopt this method in their portable steam engines. The engine illustrated is made by the Campbell Gas Engine Company, Halifax, and is of 8 nominal horse-power, giving, we are informed, 10 brake horse-power.

---

## THE DECAY AND FAILURE OF TAIL SHAFTS IN STEAMERS.

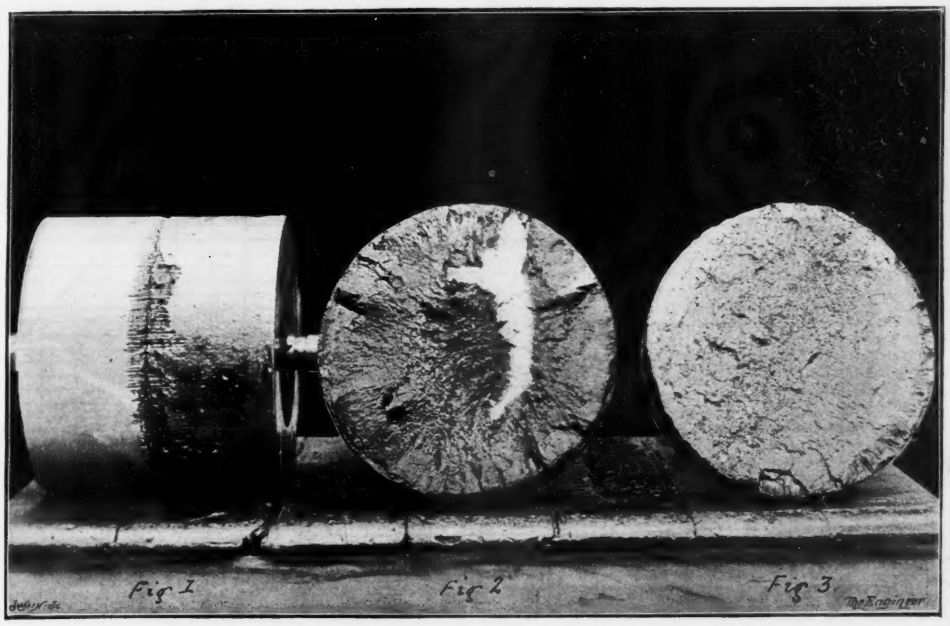
THE theory that the corrosion from which tail shafts suffer near the ends of the brass liners is induced by galvanic action has sometimes been assailed, and the breakage of the shafts attributed to other primary causes. It must be admitted that when a shaft has become corroded greatly throughout the length of the part exposed to the action of water between the liners, it becomes difficult to determine from that case alone what was the whole history of its failure. But when experience of a great number of shafts is accumulated, and a life history built up from numerous scraps of indisputable evidence, the theory referred to at the outset of these remarks appears to be amply justified.

Our illustrations, if at first sight of small significance, and such as are within the experience of thousands of engineers, are nevertheless interesting as representing actual examples of various stages in the life history of unprotected tail shafts. Fig. 1, perhaps more graphically than could be shown in any other way, illustrates a somewhat early stage in the process of decay. The object shown in this figure is a piece cut from a condemned tail shaft, and it has been turned so as to be mounted upon journals and preserved as a specimen. The left-hand portion of this specimen is the part on which the brass liner had been shrunk, and the right-hand portion is part of the exposed middle body of the shaft between the liners. This shaft had been less than two years in work, and the important thing to note about the illustration is that there is but little general corrosion of the part exposed to the action of water, but severe corrosion around a narrow zone just at the end of the part covered by the liner. This example, therefore, illustrates and bears out very conclusively the theory of galvanic action between the metals inducing the initial corrosion, and the fact of the corrosion proceeding largely in deep longitudinal grooves is a further proof of the decay being due to galvanic action, and not, as is sometimes asserted, to mere wash or eddying in the water, caused by the rotation of the shaft at the angle made by the liner with the shaft.

After studying this zone of corrosion in the region of the end of the liner, which is pretty equally distributed on both sides of the line formed by the end of the liner, we come to study what is of still more consequence, viz., the narrow but deep gutter or knife-like cut which has taken place immediately at the end of the liner, and which is very distinctly illustrated in our engraving. It would appear that the galvanic action inducing the corrosion is enormously more intense at the sharp angle of the liner where it meets the shaft than at a short distance away therefrom, resulting in this nicking of the shaft all round, and which is further illustrated in Figs. 2 and 3, but especially visible in the latter. Fig. 3 is a condemned shaft that was broken for fuller examination, and it will be seen that the shaft had been originally quite sound, but that the corrosion above alluded to had penetrated it to a depth of about 1in., and which is visible on the face of the break for about half-way round the shaft. It may be assumed that if the shaft shown in Fig. 1 had been broken it would have exhibited also just such a fracture as that shown in Fig. 3.

We then come to examine Fig. 2, which is a shaft that had been running for six years, and which had exhibited on the surface signs very little more disturbing than those shown in Fig. 1, excepting that the whole body of the shaft between the liners had become pretty deeply corroded, due to the longer time the shaft had been exposed to the action of water. Herein, perhaps, lies a considerable danger, viz., that the general corrosion here alluded to is apt to obliterate the appearance of deep local corrosion such as is shown in Fig. 1, by making it all appear general throughout the shaft. This shaft, however, was fortunately condemned, and it was broken by dropping a ball upon it to see what the fracture was like. It is one of the worst cases the writer has ever seen, inasmuch as the light-coloured vertical strip was all the sound metal left, although the shaft had been a thoroughly sound and good shaft originally. The whole of the remaining section of the shaft was fractured and discoloured, and it appears almost a wonder that the shaft could be lifted up in the crane without the thing falling in pieces, and yet it had been driving the propeller and was not suspected of being in this condition. It is not contended that the galvanic action and consequent corrosion above alluded to had penetrated to the heart of this shaft, and of itself caused the total destruction of the shaft, but that, given the initial local decay and nicking of the shaft by galvanic action and corrosion, as shown in Fig. 1, the strains due both to ordinary driving and the more severe ones due to heavy seas or running light ship, when the blades of the propeller frequently flop upon the flat surface of the water so as to cause shocks out of all proportion to the normal driving stresses, become concentrated upon this particular reduced section of the shaft, and, naturally, all the fatigue takes place there, and actual fracture then proceeds to the ultimate destruction of the shaft.

It is sometimes argued that when a shaft shows a broken fracture like that in Fig. 2 that it was of too light a section for its work. This, however, is by no means proved by the circumstances, and the addition of more metal subjected to the same conditions could have little effect in ultimately saving the shaft, though it might defer for a short time the date of its ultimate failure. The whole matter appears to be a sequence of events which bear one upon another. First a galvanic couple is formed between the brass and the iron, which in the presence of water induces corrosion at an abnormal rate. This corrosion penetrates a short distance straight into the shaft around the end of the liner, and so weakens the shaft like nicking a stick that it is intended to break over one's knee. This reduction of strength all in one plane at right angles to the axis of the shaft concentrates all strains upon that unfortunate section, and the ordinary work to which a tail shaft is subjected then proceeds to complete its ruin. Obviously, if the initial stages of this process can be averted there is hope, if, indeed, there is not certainty, of averting also the later stage; and it is this averting of the insidious initial stages of the process alluded to, that is the object of the tail shaft preserver patented by Mr. Mudd, of Hartlepool, and which has now been applied to the tail shafts of a large number of ocean-going steamers.



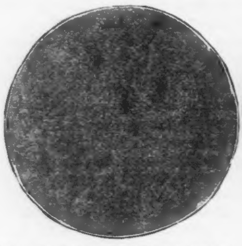
EXAMPLES OF CORROSION IN TAIL SHAFTS

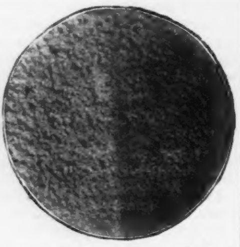
The elastic sleeve, which is pulled over the shaft and cemented thereto, overlaps the end of the brass liner some 5in. or 6in., the liner being thinly tapered down to receive it, and thus the water is excluded from the shaft altogether in a very simple and cheap manner, the consequence being that no corrosion whatever can proceed at the end of the liner, or at any part between the liners. The strains, therefore, due to the work passing through the shaft are left to be distributed evenly throughout its length, and no dangerous nicking of the shaft at a particular section is at any time in existence when this sleeve is applied. A fracture occurring in a shaft thus protected would be one from a blow or accident, such as would fracture the shaft in any case, and would not be the much lighter shock that would be sufficient to shatter a shaft that has already been nicked around and reduced in sound section at one point by perhaps 20 per cent. of its area. The improvement implied by the adoption of this sleeve appears to be a small and simple one, but when one remembers the thousands of shafts that have failed from these causes, it becomes evident that in its results it is an exceedingly important matter, and one that should not escape the attention of shipowners and their superintending en-engineers. The india-rubber being in the dark, cool, and always wet, ought to last without "perishing" for a very long period.

## THE COWPER-COLES GALVANISING PROCESS.

The Cowper-Coles galvanising process, which we briefly noticed in a former issue, has since that date been considerably developed, plants being now in course of erection with a bath capacity of some 14,000 gallons, capable of turning over forty tons of light work per week. Certain fallacies have long existed with reference to the relative merits of the dry and wet methods of galvanising. Zinc, as a protective coating, is unexceptional, on account of its electro-chemical relation to iron. The comparative inertia of lead to the chemical action of many acids has led to the contention that it should form as good, if not a better protection to iron than zinc, but in practice it is found to be very deficient as a protective coating against corrosion. A piece of lead-coated iron or terne plate cut from a sheet and placed in water will rust badly in the course of twenty-four hours, the water and plate being discoloured with a red oxide.

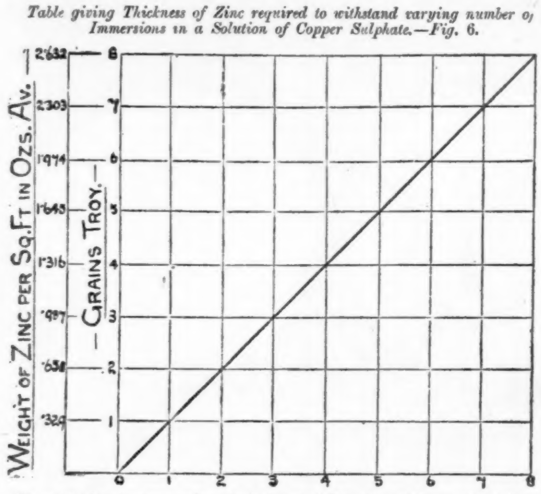
Iron coated with zinc by passing it through a molten bath of that metal has the somewhat misleading name of "galvanised iron," unless the term is taken as applying to the nature of the protective coating, not the process. The first method employed for coating iron with zinc was electrolytical; but it was soon abandoned in favour of the dry, or molten, process, as the results obtained were not satisfactory, and the process was found to be too slow and costly. With the object of cheapening the process of coating iron with spelter and of avoiding the deterioration of the quality of the material which usually follows pickling and hot galvanising, the application and the electro deposition of zinc has been the subject of many patents, as the records of the Patents-office bear ample evidence. Most authorities recommend a current density of 18 or 20 ampères per square foot of cathode surface, and aqueous solutions of zinc sulphate, acetate or chloride, ammonia chloride or tartrate, as being the most suitable for its deposition. Hermann's process has also been experimented with on a commercial scale; the chief feature being the addition of the sulphates of the alkalies or alkali earths to a weak solution of zinc sulphate. Electrolytes made by adding caustic potash or soda to a suitable zinc salt have been found to be unworkable in practice, on account of the formation of insoluble zinc oxide on the surface of the anode.


Zinc Coating Applied by Hot Galvanising Process—Magnified Five Diameters—Fig. 2


Deposit from Zinc Sulphate Solution (Acid — Magnified Five Diameters—Fig. 3

To all intents and purposes the deposits obtained from acid solutions under favourable conditions are fairly adhesive when great care is exercised in the preparation of the receiving surface; but unfortunately the zinc coating is of a transitory nature, its durability being incompatible with hot galvanising, as the deposit is porous and retains some of the acid salts which cause a wasting of the zinc and rusting of the steel or iron. Castings coated with zinc, in a similar manner, rust comparatively quickly even when the porosity has been reduced by oxidisation, aggravated by forcing some corroding agent, such as sal ammoniac, into the pores of the metal. The relative porosity of zinc coatings applied by different methods is shown by the above micrographs, Figs. 2 and 3.

*Table giving Thickness of Zinc required to withstand varying number of Immersions in a Solution of Copper Sulphate.—Fig. 6.*



No. of 1 Minute Immersions in Saturated Solution of Copper Sulphate

Other matters of serious moment are the slowness of ordinary electro-zincing, the trouble experienced in coating articles of irregular shape, and the trouble caused by the formation of loose dark-coloured patches on the work. These difficulties, and the unhealthy non-metallic look of the zinc coating obtained by the humid process, its want of brilliancy and glitter, has prevented ordinary electro-zinced articles finding favour with engineers and the trade for many purposes. The thickness of the zinc coating on different articles is for many purposes found to vary considerably, dependent as it is on a long immersion in the zincing solution, and consequently on the care of the workmen. Troubles have also been experienced from the scaling and furring up of the anodes, and the resultant increased electrical resistance, and the electrolytes are also constantly getting out of order, as more metal is taken out of the solution than could possibly be dissolved from the anodes by the chemicals set free on account of the rapid formation of an insoluble scale on the surface of the anodes. The illustration—Fig. 4—is a faithful representation of a portion of a zinc anode with scale over the metal core, averaging nearly ⅛in. in thickness. These difficulties are claimed to be entirely overcome in the Cowper-Coles process.

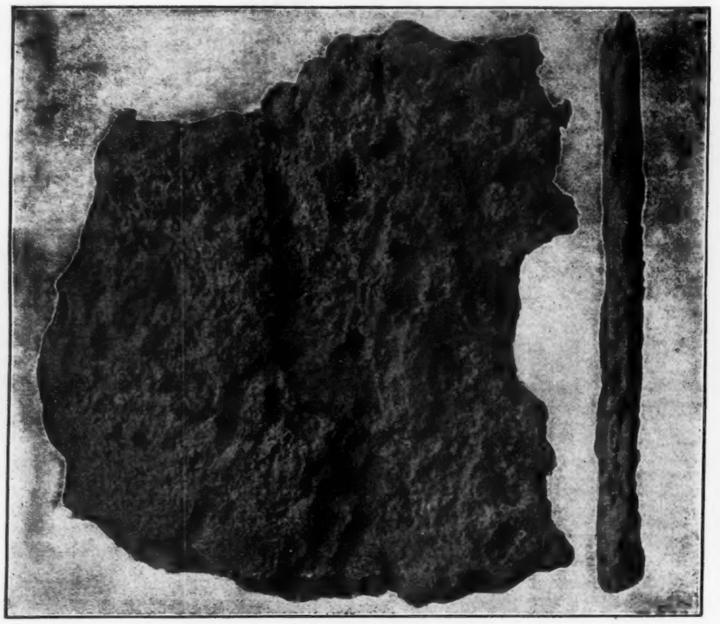


Fig. 4—PORTION OF ZINC ANODE, FULL SIZE

When galvanised iron is immersed in a corrosive liquid, the zinc is attacked in preference to the iron, provided both the exposed parts of the iron and the protected portions are immersed in the liquid. The zinc has not the same protective qualities when the liquid is sprinkled over the surface, and remains in isolated drops. Two metals in contact, in the presence of moisture, form a galvanic couple, and the result of the galvanic action set up under these conditions is analogous to that which takes place in a galvanic battery, viz., the electro-positive element is dissolved or corroded, while the electro-negative element remains unaffected or protected as long as the action continues; the intensity of the chemical action being governed by the relative position of the two metals in the electro-chemical series, wrought iron and steel gives rise to a feeble action; tin and iron and copper and iron standing some distance apart, give rise to decided galvanic actions, in which the iron, as the electro-positive metal, is corroded more rapidly if the coating is partially removed than it would if not coated. For similar reasons copper sheathing which was first used for wooden vessels of the English navy about the year 1770, is now insulated from iron and steel hulls by a wooden casing. With zinc and iron the position is reversed, and the results obtained diametrically opposite. Zinc is positive to iron, and consequently, whatever galvanic action is set up by their contact in the presence of moisture or other excitants, must have for effect the solution or corrosion of the zinc and the protection of the iron. Tinned iron is very durable as long as the coating of tin leaves none of the iron exposed, as in the presence of a film of moisture containing carbonic acid a galvanic couple is formed and the iron rapidly destroyed. Unlike tinned iron, galvanised iron resists the action of the weather to a remarkable degree, even when the coating is not perfect. The following tables show the electrical relation of the most common metals to one another in various solutions.—See Fig. 5, page 283.

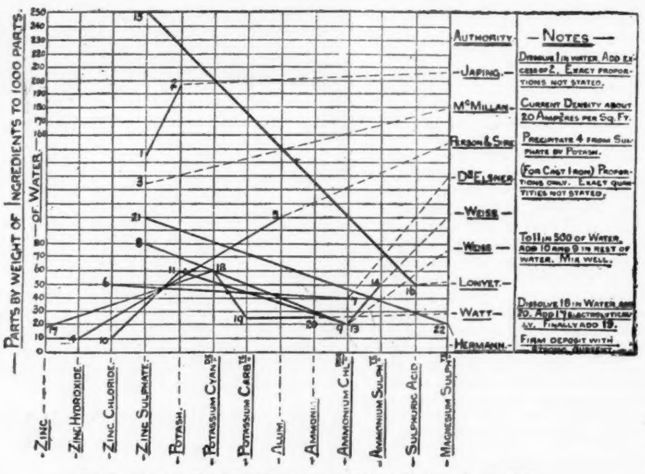


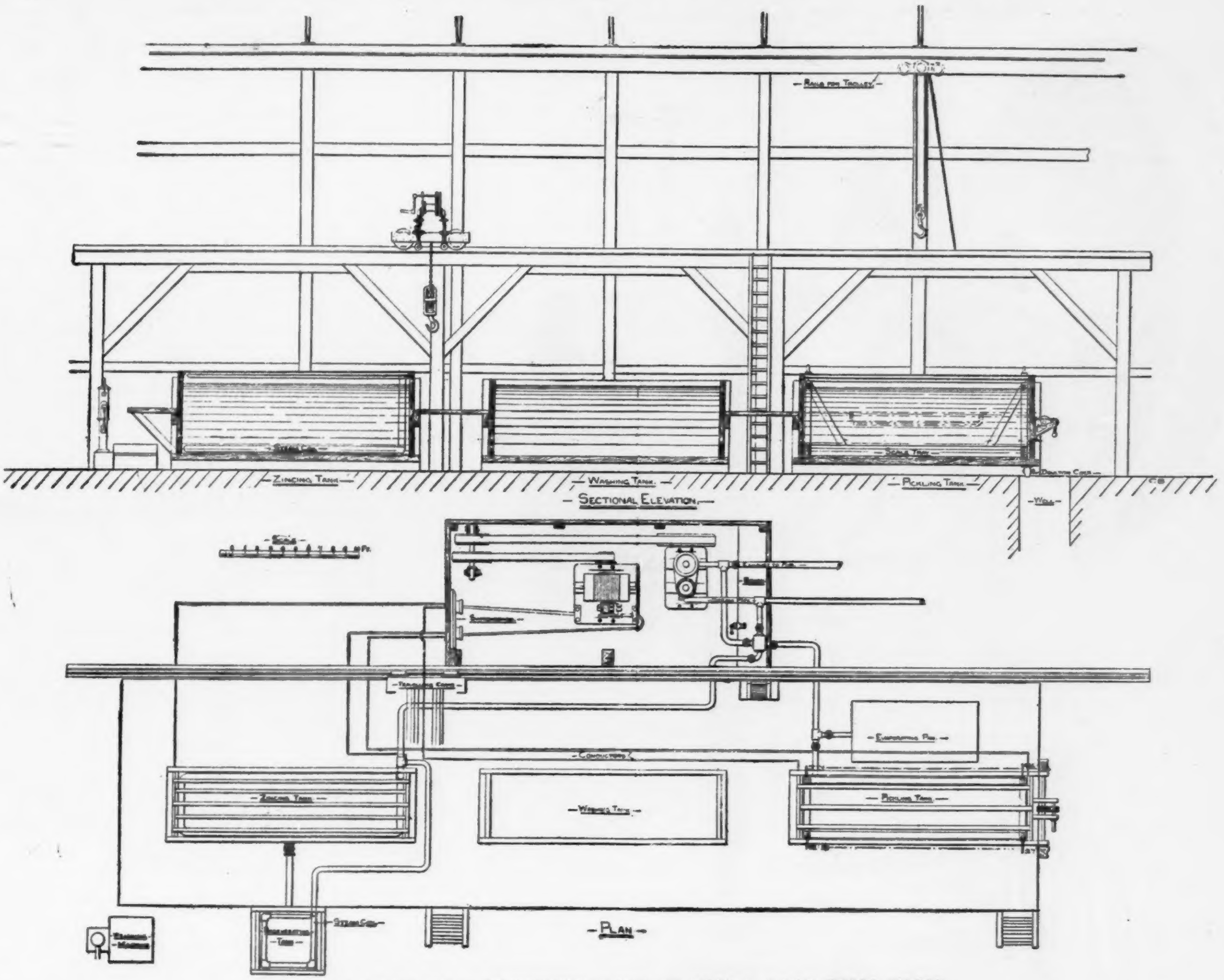
Fig. 1—Zincing Solutions Recommended by Various Authorities

Zinc surfaces, after brief exposure, become coated with a thin film of oxide—insoluble in water—which adheres tenaciously, forming a protective coating to the underlying zinc. So long, therefore, as the zinc surface remains intact the underlying iron is effectively protected from corrosive action. Sea air, charged as it is with brine, is more destructive in its action upon galvanised ironwork, forming a soluble chloride. As zinc is amongst the metals most readily attacked by acids, ordinary galvanised iron is not suitable for positions where it is much exposed to an atmosphere charged with acids sent into the air by some factories, or to the sulphuric acids found amongst the products of combustion of coal and gas.'

The efficient protection of steel from chemical action is becoming a matter of considerable importance now that steel is so extensively taking the place of wrought iron, as owing to the increasing cheapness of steel, ironmasters are dispensing with the puddlers' services, and using steel instead of puddled bars for rolling down into sheets, hoop iron, &c. Thin steel plates are largely used for constructing the hulls of small craft, such as torpedo boats; but corrosion is found to be more marked in steel vessels than iron, for which reason some engineers still object to its use, or have the steel galvanised. Lieut.-Colonel G. Findlay mentions in his book, "The Working and Management of an English Railway," that the corrosion of steel rails as compared to iron rails is in the proportion of about five to four, and he has found in tunnels and manufacturing districts where sulphurous and other acid gases are present in the atmosphere the life of the rail is shortened to a material extent. The best preservative for iron is a covering of an electro-positive metal, as it is necessary for rapid rusting to take place to have an electric substance in contact, such as rust or oxide of iron, which acts as a negative element to the iron, and aggravates the process of rusting. The durability of painted ironwork, therefore, largely depends upon the surface of the metal being properly cleaned and prepared. Engineers recognise the fact that the best results are obtained when the paint is applied direct to the iron surface before it has had time to rust, as the rust prevents the intimate contact of the paint and induces chemical action, which causes the paint to peel from the iron. It has been found that this desirable end may be obtained at a very small cost by "zinc flashing," that is, coating the iron or steel, after pickling, with a thin coat of zinc, which will resist the inclemency of the weather, and retain a perfect surface for receiving a coat of paint until such time as it can be applied. A special feature of the cold process is that plates of very large dimensions can be readily zinced on one or both sides, which is a matter of some importance now that plates some 60ft. in length are being put in the straight line of steamers' hulls. The frames of such craft as torpedo-boat destroyers can also be galvanised after riveting up. The first cost of a plant having a bath capacity of 6700 gallons—30ft. by 6ft. by 7ft.—is found to be little more than a hot galvanising plant having a bath capacity of only 10ft. by 4ft. by 4ft. 6in. outside dimensions. The cost of such a bath is £125, and would hold twenty-eight tons of zinc, which at £17 per ton—£476—to keep this large quantity of zinc in molten condition, entails a heavy expenditure in fuel, the thickness of the iron bath averaging more than 1in.; moreover, the iron galvanising baths are also a constant source of annoyance and expense.

Both pickling and hot galvanising have the disadvantage of reducing the strength of wires, and of distorting and rendering brittle iron and steel of small section. By exposure to the lowest temperature of the galvanising bath—which averages some 1000 deg. Fah., the fusing point of zinc being 775 deg. Fah.—steel wire of high breaking strain has its hardness, and consequently its ultimate tensile strength and elongational efficiency reduced by the drawing of the temper and formation of an iron zinc alloy on the surface of the iron by as much as from 5 per cent. to 10 per cent. It is the practice, when coating steel wire, to keep the bath of molten zinc at as low a temperature as possible, and to run the wire through at a high rate of speed. Both these causes lead to a considerable waste of zinc by reason of the rapid solidification of the metal on the comparatively cold wire, and consequently the ready breaking or cracking-off of the covering metal on bending or twisting, owing to the difficulty with which molten zinc of low temperature adheres to the steel, except after prolonged contact. In some cases the wire on leaving the bath is wiped between asbestos rubbers; but steel thus treated is found to resist corrosion only for a short period. Many attempts have been made to electro-zinc wire, but it has not been found practicable to produce a wire capable of withstanding more than one immersion in a copper sulphate solution. Most manufacturers have ceased to galvanise the best classes of steel wire, which cost some £35 per ton, on account of the great risk there is of rendering it worth-

# THE COWPER-COLES GALVANISING PROCESS



Figs. 7 and 8—LARGE COLD GALVANISING PLANT AT MESSRS. LAIRD BROS.' WORKS

less, which is clearly a disadvantage, although the advisability of protecting the steel is unquestionable, as corrosion is found to be very marked on the inner strands. The zinc coating put on by the hot process is also uneven, and the increased weight is often a matter for consideration; the thickness can only be varied within narrow limits, the minimum weight of zinc being about 1¼ oz. per square foot, maximum 3 oz., except when the molten zinc can be raised many degrees above the most economical working temperature, and the articles removed gradually from the bath so as to give the zinc time to drain off before getting chilled, or in the case of thin sheet or wires, which are capable of having some of the zinc squeezed or wiped off by rollers or other suitable mechanical means. The weight of metal on lead galvanised sheets or terne plates is usually ¾ oz. per square foot. The following table gives the percentage increase of weight for different thicknesses of metal:—

*Percentage Increase of Weight due to Hot Galvanising.*

| Description of article. | Weight of zinc per foot. | Percentage increase of weight. |
|---|---|---|
| Thin sheet iron = ·025in. No. 22 B.W.G. .. | 1·196 oz. | 18·2 |
| $\frac{5}{16}$ Plates .. .. .. .. .. .. .. .. | 1·76 | 2·0 |
| 4in. cut nails .. .. .. .. .. .. .. | 2·19 (approximately) | 6·72 |
| $\frac{5}{8}$in. bolt and nut .. .. .. .. .. .. | 1·206 | 1·00 |

Tin is often added to the bath for the purpose of obtaining a smoother surface and larger spangles or facets, but it is found to shorten the life of the protecting coating considerably. A portion of a zinc coating applied by the hot process was found to be very brittle, breaking when attempts were made to bend it; the average thickness of the coating was $\frac{15}{1000}$ = ·015 of an inch. An analysis gave the following result:—

| | |
|---|---|
| Tin .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. | 2·20 |
| Iron.. .. .. .. .. .. .. .. .. .. .. .. .. .. .. | 3·78 |
| Arsenic .. .. .. .. .. .. .. .. .. .. .. .. .. .. | Trace |
| Zinc (by difference) .. .. .. .. .. .. .. .. .. .. .. | 94·02 |

The filling up of the crevices and binding together of loose parts by dipping in a bath of molten zinc is sometimes taken advantage of for the purpose of making tanks water-tight instead of properly caulking them, and for hiding bad workmanship and welds; on the other hand, the soldering together of the twisted portion of wire netting adds much to its stiffness. A small quantity of iron is dissolved from all articles placed in the molten zinc; and a dross is formed amounting in many cases to 25 per cent. of the whole amount of the zinc used. The zinc-iron alloy is very brittle; it has been found to contain by analysis six parts of iron and ninety-four of zinc. The zinc is usually recovered by distillation in clay retorts; but some of the alloy is exported to India and elsewhere for casting small ornaments. There is no dross to be got rid of in such a process as that of Mr. Cowper-Coles. All but the very largest manufacturers have been prevented from having their own galvanising plants on account of the difficulties enumerated above.

The zinc coating put on by the cold process is, we are informed, found to resist the corroding action of a saturated solution of copper sulphate—Post-office test for telegraph wires—very much better than hot galvanised iron. A specimen of hot galvanised iron, having 1·48 ounces per square foot, withstood three immersions, whilst a similar piece of iron, cold galvanised, having 1·26 ounces per square foot, withstood five immersions, as shown in the following table. With equal amounts of zinc per unit of area, the zinc coating put on by the cold process is more resistant to the corroding action of a saturated solution of copper sulphate than is the case with steel coated by the ordinary hot galvanising process, and it may be inferred from this, that with coatings of zinc of equal thickness, the wire coated by the cold process will withstand the ordinary corrosion due to atmospheric influences much better than steel coated by the ordinary hot galvanising process, or, expressed in other words, steel coated by the cold process should have an equally long life to that of hot galvanised steel, with less zinc than would be necessary in the case of the ordinary hot process.

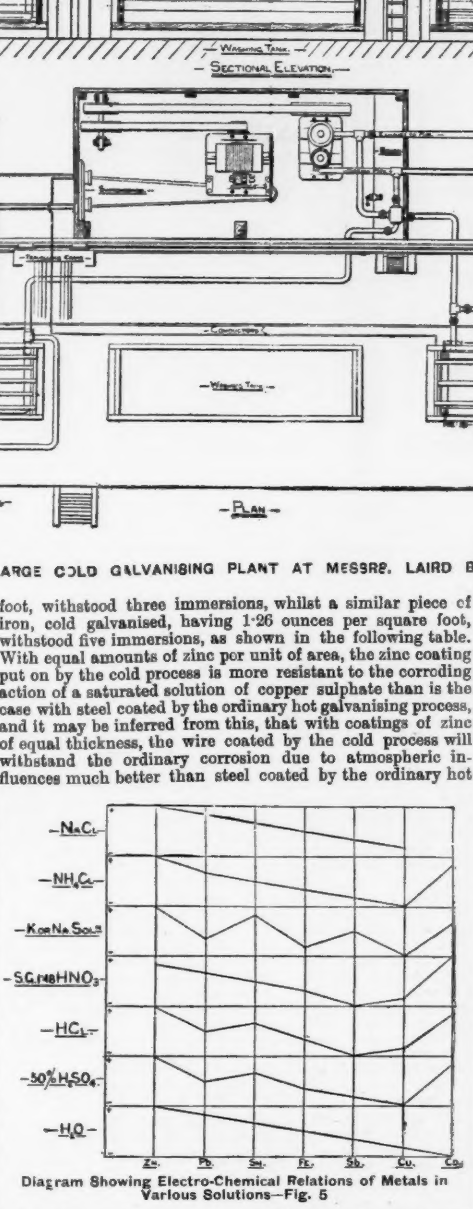


Diagram Showing Electro-Chemical Relations of Metals in Various Solutions—Fig. 5

*Results of Process Tests made on Samples of Charcoal Iron coated with Zinc by various Processes.*

| Process used to test the iron. | Grains per square foot. | Ozs. per sq foot. | No. of one minute dips samples stood without showing metallic copper. |
|---|---|---|---|
| Hot galvanising .. .. | 648·5 | 1·48 | 3 |
| Acid bath Zn $SO_4$ . | 446·4 | 1·02 | 4 |
| Cowper-Coles process | 552·64 | 1·26 | 5 |

The hardness of the zinc surface is a matter of considerable importance. With this object in view aluminium has been added from a separate crucible to the molten zinc at the moment of dipping the article to be zinced, so as to form a compound surface of zinco aluminium, and to reduce the formation of ashes to less than the usual amount when protective coverings are used of sal ammonia, fat, or glycerine. The addition of the aluminium also enables a thinner coating of zinc to be applied. Cold and hot galvanised iron should stand abrasion equally well, the thickness of the coatings being the same, the hardness of the zinc applied by the wet and dry methods, as determined by means of the Schlerometer, being equal:—Cold galvanised sheet, 6·0; hot galvanised sheet, 6·0; terne plate, 2·0; tin-plate, 2·0. The figures represent the load in grammes upon a diamond point, just sufficient to cause it to scratch the specimens.

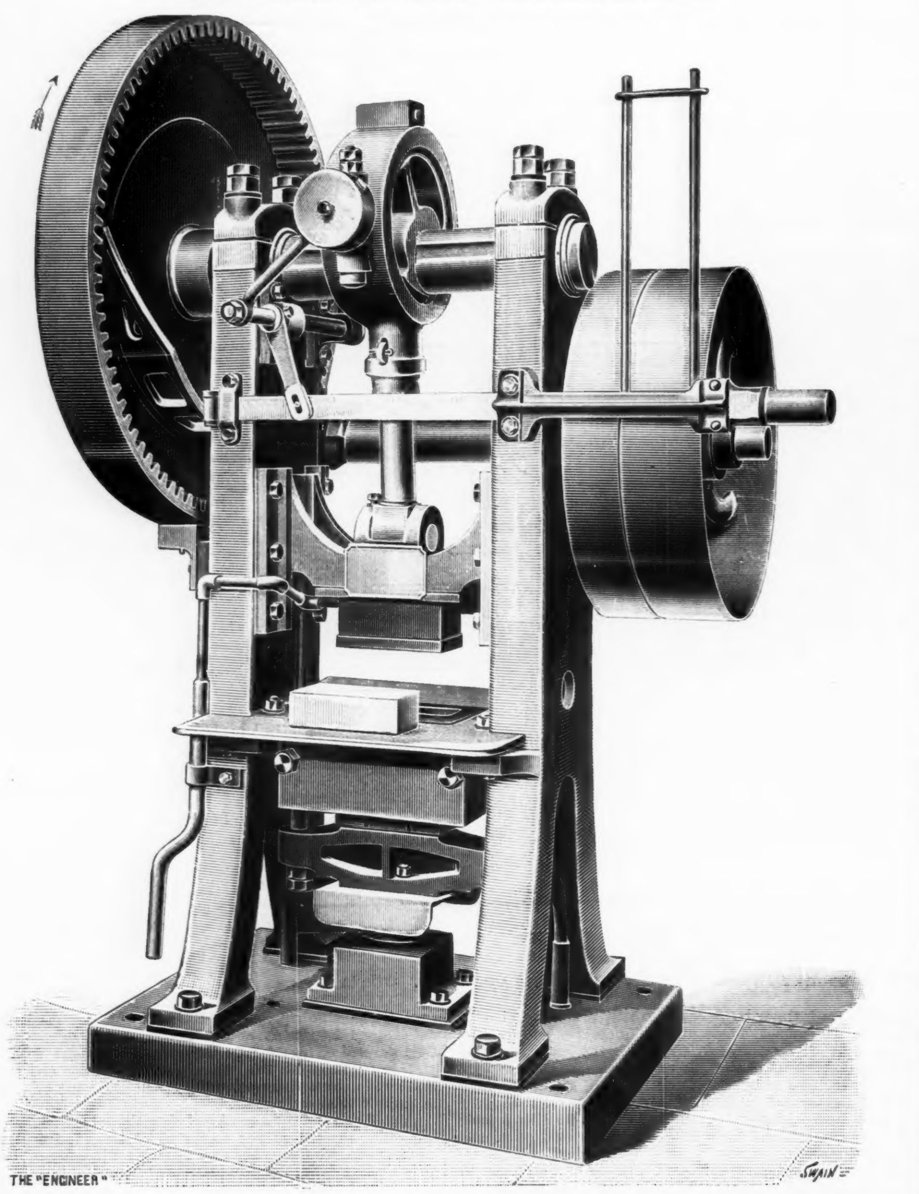
Figs. 7 and 8 show a sectional elevation of a cold galvanising plant erected at the works of Messrs. Laird Bros. at Birkenhead, who were the first to adopt the process, for the purpose of zincing the skin plates and frames of torpedo-boats and torpedo-boat destroyers. The baths are capable of dealing with plates 18ft. long, and have a capacity of about 4000 gallons. The heavier classes of work are transferred from the vats by an overhead carrier, the lighter by a trolley running on rails. The total current available is over 2000 ampères at an electromotive force of 5 volts. The current is conveyed to the tanks by bare copper rods. The pickling tank, which contains a very dilute solution of sulphuric acid, is heated by steam jets, the spent liquid being recovered in an evaporating pan as shown in the illustration. The articles after pickling are passed through the washing or oxidising tank, and then placed in the zincing tank, which is heated with a steam coil, into which live or exhaust steam can be passed. One ounce of zinc per square foot is found to afford sufficient protection for most purposes. The plates, after removal from the zincing vat, are ready for riveting into the vessel under construction, as they do not require drying or stoving.

---

EARTHQUAKE AT CONSTANTINOPLE.—Some observations of M. D. Eginitis, communicated to the *Académie des Sciences*, by M. F. Tesserand, respecting the recent earthquake at the Turkish capital, are of considerable scientific interest. We extract from our contemporary, the *Annales Industrielles*, the following account of the conclusions at which that gentleman has arrived. On the 10th July last, at twenty-four minutes past noon, mean local time, a severe seismic dislocation shook Constantinople and its suburbs. By collating the different observations he was able to make on the ground, by availing himself of a full use of the official dispatches, and by pressing into his service a large mass of miscellaneous valuable information on the same subject, M. Eginitis has formed a tolerably exact idea of the extent and intensity of the phenomena at distant localities, and has traced the course of the isoseismic curves. The depth of the focus of seismic action, he estimates, according to the rules laid down by Dutton and Hayden, to be 21·25 miles, a distance which, according to Mallet's earthquake formulæ, would be somewhat less on similar bases. By the aid of the observations made in France, Russia, and Roumania, he has, it is stated, been enabled to calculate the velocity with which the successive shocks of the earthquake were propagated. Commencing with Paris, he ascertained that the shock reached that city with a velocity of 1·875 miles per second. In the same unit of time the speed at Pavloxsk was 2·178 miles, and 2·25 miles at Bucharest. It may be regarded as established beyond doubt that premonitory signs invariably act as avant-couriers to the actual shock of the earthquake itself. M. Eginitis draws attention to the period of seismic action which for about the last two years has traversed the eastern portion of European territory. The Isle of Zante was the first sufferer, then came Thebes, followed by Lochrida. Constantinople was the next victim, and Sicily completed the list. In addition to these great shocks, a very considerable number of minor disturbances occurred during the same time in various localities, in both the East of Europe and Asia Minor. It is worthy of notice that the places previously cited are all situated in nearly the same straight line, and are moreover located in a part of the terrestrial surface which has been subjected to important geological transformations and dislocations.

# BRICK AND TILE PRESS

## MESSRS. BRADLEY AND CRAVEN WAKEFIELD, ENGINEERS



## BRICK AND TILE PRESS.

MESSRS. BRADLEY and Craven have just brought out a new steam power brick and tile press of which we give an engraving. The internally geared wheel on the press shaft is fitted with a cam or inclined plane; this comes in contact with the end of the bar carrying the belt guide forks at every revolution, and shifts the belt on to the loose pulley. The wheel has an adjustable balance weight to overcome the momentum of the wheel and stop the excentric when it gets to the top of the stroke, or before the crosshead has commenced its downward stroke. The piston being stationary with the excentric at its full stroke, there is no danger of the attendants getting their fingers caught in putting in or removing the bricks; the press cannot start again until a lever on the belt guide bar is operated. If desired, however, the press can be made to start automatically in the following manner: The spur wheel has in this case a longer inclined plane or cam; this cam knocks off the belt at the given time and place, but the momentum of the wheel carries it until the inclined plane passes the end of the belt guide bar, and by placing a weight on the starting lever the leverage of this weight moves the guide bar and the belt is put on to the fast pulley, and work is carried on with only a slight pause when the belt is on the loose pulley during the time the guide bar is travelling over the inclined plane in the wheel. The press is in daily operation at the maker's works.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Electric locomotives.*—Electric locomotives will be used to haul trains through the new tunnel under the city of Baltimore; and the first of these has been built. It has two four-wheeled trucks or "bogies," each fitted with two electric motors of 200-horse power. These motors are carried on springs, and connected with the driving axles by flexible connections. The power plant will consist of four Corliss compound engines of 750-horse power each, coupled direct to four multipolar direct-current generators of 700-horse power each. These will furnish the current for the locomotives and for lighting the tunnel. Steam will be supplied by eleven boilers of 250-horse power each, operated under forced draught; the products of combustion escaping by a steel smoke-stack or chimney 50ft. high. For lighting the new station, &c., there will be eight arc-light dynamos of fifty-lights capacity, and incandescent generators of 2000 lamps capacity.

*Hydraulic dredge.*—On one section of the Chicago canal, which is being cut through a soft black loam, the excavation is being done by a hydraulic dredge. From a derrick frame at the front end of the barge is slung the end of a 20in. pivoted suction pipe 40ft. long, the inboard end of which is connected by a universal flexible joint with the fixed suction pipe. The outboard end is fitted with a revolving drum, concentric with the pipe, which drum carries on its periphery a number of steel cutters or blades, inclined so as to throw the material inward to the mouth of the pipe. The drum is 5ft. diameter and 4ft. long. On the barge is a 6ft. centrifugal pump, which draws the water and earth—5 per cent. to 30 per cent. solid matter—through the suction pipe, and discharges it through an 18in. discharge pipe supported on pontoons and leading to the shore, where it is deposited outside the levées built along the canal. The barge is 105ft. long, and 33ft. beam. The pump is driven by a 250-horse power engine coupled direct to the pump shaft, and the same engine also drives the cutting drum and the hoisting and winding drums. The barge is fed forward by an inclined stern spud connected to the ram of a hydraulic cylinder, and the vertical spud upon which the barge turns in cutting is also operated by a hydraulic cylinder. The dredge is worked continuously day and night, with occasional stoppages to clear the cutters from long grass and bulrushes, or to remove boulders from the pump. The excavation averages 450 cubic yards per hour, but nearly 600 cubic yards per hour have been excavated.

*Railway statistics.*—Statistics just issued for the year 1893 show 177,753 miles of railway in operation on December 31st, 1893, an increase of 2549 miles. A general summary is given in the following table:—

| | 1893. Miles. | 1892. Miles. |
|---|---|---|
| Mileage of railroads .. .. .. .. | 175,441·77 | 171,804·72 |
| Second track, sidings, &c. .. .. | 53,410 89 | 49,823·81 |
| Total track .. .. .. .. | 228,852·66 | 221,628·53 |
| Steel rails in track .. .. .. .. | 191,717·71 | 182,710·76 |
| Iron rails in track .. .. .. .. | 37,134·95 | 38,917·77 |
| Locomotive engines, No. .. .. .. | 36,012 | 34,626 |
| Cars—Passenger .. .. .. .. .. | 27,169 | 24,604 |
| Baggage, mail, &c. .. .. .. .. | 7,805 | 7,830 |
| Freight .. .. .. .. .. .. | 1,161,282 | 1,117,728 |
| Total revenue cars .. .. .. | 1,196,256 | 1,150,162 |
| Capital stock, dols. .. .. .. .. | 5,021,576,551 | 4,863,119,073 |
| Bonded debt, dols .. .. .. .. | 5,510,225,528 | 5,405,049,969 |
| Unfunded debt, do's .. .. .. | 409,909,043 | 285,455,287 |
| Current accounts, dols. .. .. .. | 381,575,253 | 417,466,957 |
| Total liabilities .. .. .. | 11,323,286,375 | 10,971,091,286 |
| Excess of assets over liabilities .. | 406,750,426 | 388,469,733 |
| Total .. .. .. .. .. .. .. | 11,730,036,801 | 11,359,561,019 |
| Cost of road and equipment .. .. | 9,573,703,214 | 9,293,052,143 |
| Real estate, stocks, bonds, and other investments .. .. .. | 1,671,841 101 | 1,600,493,849 |
| Other assets .. .. .. .. .. .. | 244,614,098 | 253,089,497 |
| Current accounts .. .. .. .. | 239,878 388 | 212,925,530 |
| Total assets .. .. .. .. | 11,730,036,801 | 11,359,561,019 |
| Miles of railway operated .. .. | 173,370·07 | 170,606·84 |
| Revenue train mileage:— | | |
| Passenger .. .. .. .. .. .. | 340,352,211 | 328,930,550 |
| Freight .. .. .. .. .. .. | 531,340,754 | 523,831,458 |
| Mixed .. .. .. .. .. .. | 17,751,928 | 17,148,455 |
| Total .. .. .. .. .. .. .. | 889,444,893 | 864,910,463 |
| Passengers carried .. .. .. .. | 628,965,973 | 575,769,678 |
| Passenger mileage .. .. .. .. | 15,246,711,952 | 13,584,843,804 |
| Tons of freight moved .. .. .. | 757,464,480 | 730,605,011 |
| Freight mileage .. .. .. .. .. | 90,552,087,290 | 84,413 197,130 |
| Passenger earnings, dols. .. .. | 311,978,342 | 293,557,476 |
| Freight .. .. .. .. .. .. | 808 494,668 | 794,526,500 |
| Miscellaneous .. .. .. .. .. | 88,168,488 | 80,952,864 |
| Total .. .. .. .. .. .. | 1,208,641,498 | 1,169,036,840 |
| Net earnings .. .. .. .. .. | 358,648,918 | 352,817,405 |
| Receipts from other sources .. .. | 111,166,837 | 114,428,952 |
| Total available revenue.. .. | 469,815,755 | 467,246,357 |
| Payments:— | | |
| Rentals, tolls, &c. .. .. .. .. | 64,698 368 | 62 541,445 |
| Interest on bonds .. .. .. .. | 236,755,805 | 229,909,292 |
| Other interest .. .. .. .. .. | 7,107,718 | 6,593,287 |
| Dividends on stock .. .. .. | 93,537,681 | 93,862,412 |
| Miscellaneous .. .. .. .. .. | 38,190,641 | 32,708,646 |
| Total payments .. .. .. | 440,290 213 | 425,615,082 |
| Balance, surplus, or deficit .. .. | $29,525,542 | $41,631,275 |

During the eleven years 1883-1893, inclusive, the average receipts per passenger per mile declined from 2·422 cents to 2·046 cents; the average receipts per passenger fell in like manner from 66·14 cents to 49 60 cents; the average receipts per mile of railway quite regularly declined from 1934 dols. in 1883, to 1721 dols. in 1892, but rose to 1799 dols. in 1893, just as it rose from 1645 dols. to 1693 dols. during the cessation of railway building in 1885-86. The average number of passengers carried per mile of railway was 2923 in 1883, and 3627 in 1894. The average distance travelled per passenger in 1893 was 24·24 miles, against 27·31 miles in 1883. The mileage run by freight trains was 350,108,255 in 1883, against 531,340,754 miles in 1894, the same general mileage of railways operated being taken as for the passenger traffic. The freight carried for the same two years increased from 400,453,439 tons to 757,464,480 tons, and the freight movement increased in like manner from about 46,000 million miles to over 90,000 million miles. The freight rates have been very steadily decreased in this period, as is shown by the following table for the two extreme years:—

| | 1883. | 1893. |
|---|---|---|
| Average receipts, ton, per mile .. .. .. | 1·224 cents. | 0·893 cents. |
| ,, ,, per ton .. .. .. | 134 72 cents. | 106 74 cents. |
| ,, ,, freight, train mile .. .. | 154 09 cents. | 152·16 cents. |
| ,, ,, per mile railway .. .. | 5,045 dols. | 4,663 dols. |
| ,, tons per mile railway .. .. .. | 3,744 tons. | 4,369 tons. |
| ,, ton-miles, freight, train mile .. | 125 86 miles. | 107·42 miles. |
| ,, haul p.r ton .. .. .. .. .. | 110 04 miles. | 119·55 miles. |

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE October quarterly meetings of the Midland iron trade are fixed for the 10th and 11th of next month in Wolverhampton and Birmingham respectively. To these gatherings the iron market is looking with marked anticipation, ironmasters being very desirous to gauge on the occasion of these fixtures whether the revival which has set in will be maintained during the winter. There is a general impression that prices at the quarterly meetings will be strong, both in the raw and finished iron departments, and makers in neither branch are anxious just now to book forward. Marked bars are firm at £7 10s., second branded qualities £6 10s., and common bars £5 10s. Galvanised sheets continue active at £9 15s. to £10 for 24 w.g., f.o.b. Liverpool, while galvanising doubles are sharing in the improvement at £6 12s. 6d. to £6 15s., and £7 5s. to £7 7s. 6d. respectively. Hoops are strong at £6 10s., and thin strip and angles at the same figure. Gas tube strip is quoted £5 15s. Best Yorkshire engineering iron, delivered into this district, is quoted £17 10s. for bars, and £22 10s. for plates, but only meets with a limited demand from the best engineering houses. Pig iron prices continue rigid, and several producers have sold their output to the end of the year. Staffordshire all-mine hot-blast is quoted 55s. to 57s. 6d.; part-mines, 41s. 6d. to 42s.; and cinder, 38s. to 40s. Northamptons are quoted 41s. 6d. to 42s.; Derbyshires, 42s.; and Lincolns, 43s.

It is a matter for gratification that the manufactured iron production of this district continues to be nearly a quarter of the whole make of the kingdom, and even with regard to pig iron the falling off, it is to be noted, has not occurred within very recent times, the present output of this district being very nearly the same as it was ten or twelve years ago. Hence the recent sensational talk about the decay of the iron trade applies more forcibly to other iron-making centres rather than to the Midland district.

The best piece of news for trade this week is the intelligence that, instead of being dismantled, as at one time was feared would have to be the case, the blast furnace plant of the new British Iron Company has found a purchaser in the person of the late general manager of the company, acting for himself and other capitalists with him. Only the manufactured iron and steel works will, therefore, now be broken up. The news of the purchase is among the best that has had to be recorded in this district in connection with the iron trade for many a day, and experience has shown that there is yet plenty of money to be made out of the raw iron branch of the Staffordshire trade, whatever may be the probable fate in store for the manufactured iron business. The competition of the Derbyshire, Leicestershire, Nottingham, Northampton, and Lincolnshire pig iron makers with the South Staffordshire producers is, of course, a factor to be reckoned with which was non-existent ten years ago.

Considerable comment has been occasioned in engineering circles here by the paragraph in last week's ENGINEER on the American method of machinery erecting in foreign markets. Local firms will not have it that the strictures passed by the South American correspondent on English practice are deserved, and suggest that the pronouncement was guided by an exceptional instance. At the same time, I am myself bound to say that in other departments of manufactures I am constantly hearing of complaints of the superior packing and mode of turning out American manufactures, compared to British work in the Colonies and elsewhere abroad, though I have not previously heard that the matter extended to machinery erecting.

Much interest has been excited in a communication which has this week been made by Mr. I. C. Sharp, of Corporation-street, Birmingham, on the question of light railways or tramway construction in the agricultural districts. Mr. Sharp suggests that the best method of construction would be laying them down on the spare land on the sides of the public highways with the gradients adapted to that of the roads, where practicable, so as to reduce the necessity of excavating. The rate of speed should be about ten or twelve miles an hour, and the motive power could be either steam or electricity. In Mr. Sharp's opinion there is no doubt that in the immediate future electricity will prove the cheapest and best, and that the various streams of water about the country will be used for driving the dynamos to generate the electricity required for the purpose. There has not for some years, he points out, been any competition between existing British lines, so far as the traffic charges are concerned, and the investment of the new construction would be a safe and profitable one. In Belgium, where the cost of light railways has been £1500 a mile, including full equipment, the capital is subscribed in the following proportions:—The State, 27 per cent.; the provinces, 28 per cent.; the communes, 40·9 per cent.; and private individuals, 4·1 per cent. He suggests that County Councils should be empowered by Parliament to authorise construction, and to find the money for the same.

The value of mechanical coal cutters was debated on Monday at the North Staffordshire Mining Institute. Mr. B. Woodworth, of Fenton, suggested that such machinery should be introduced into the North Staffordshire mines for getting the thin seams. These at present cannot be got at a profit by hand labour, but machine cutting would, Mr. Woodforth suggested, overcome this difficulty. An important debate followed, in which it was stated that the chief trouble in working the seams was their inclination. Some seams of 2ft. thick were being worked in the district, but only after considerable persuasion of the men, who could hardly be got into them, and it was thought to be scarcely possible to get mechanical coal cutters to work, considering the inclination of the strata referred to.

Some startling information concerning a revolution in the present method of preparing the raw materials necessary in pottery construction, and which it is stated will be of the utmost importance to machinery makers, inasmuch as it will displace a great deal of the heavy grinding machinery now used, comes from North Staffordshire. It is stated that by the adoption of certain new laboratory discoveries on the behaviour of various materials at different degrees of temperature, and the chemico-electric treatment of certain of them, the ponderous and expensive grinding machinery now erected at British pottery works will be rendered obsolete, and a net saving in the present methods of manufacture obtained of "about two-thirds." Pottery ware which has been experimentally made by the new process on the Continent is credited with being much purer in colour than that hitherto manufactured, while the loss during the firing in the ovens is reduced to a minimum. Particulars of the new discoveries are awaited with great interest.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The general position throughout the engineering and iron trades of this district has undergone no material change during the past week. As reported in my last notes, further buying in the pig iron market at the advanced rates has slackened off, but makers are very firm, and show no disposition to entertain offers where they are put forward at under their quotations. Finished ironmakers are in a stronger position as regards their order books, but specifications come forward very indifferently. The steel trade shows some improvement, but it is difficult to say whether this is due to the stoppage of production in Scotland or to actually increased requirements. Amongst engineers there seems to be a more hopeful tone as to the future, and here and there increasing activity is reported. The position, however, remains generally very much what it has been for some time past, and the out-of-work returns of the trades union organisations do not as yet show employment to be any better.

The Manchester Iron Exchange on Tuesday was moderately attended, but for the most part only a slow business was reported. For pig iron there are still fair inquiries stirring, and business to a moderate extent might be done at a little under current rates, but as makers are not at all anxious sellers, low offers do not result in transactions being put through. In pig iron Lancashire makers still quote on the basis of 40s. for forge to 42s. for foundry, less 2½, at the works, or equal to 42s. for forge and 44s. 6d. to 45s. for foundry, less 2½, delivered Manchester district, and occasional orders are secured at these figures. District makers report only a very limited business coming forward; but, except that forge Lincolnshire is a trifle weaker, prices are very firm at full quotations. Delivered equal to Manchester, Lincolnshire averages 39s. to 39s. 6d. for forge to 41s. for foundry, and Derbyshire foundry about 45s. 6d. to to 46s., net cash. Outside brands offering in this market are fully maintaining their prices, good-named foundry Middlesbrough not being quoted under 45s. 4d., net cash, delivered Manchester, and business is done at this figure. With a steadily decreasing quantity of Scotch iron obtainable, anything like definite prices are scarcely quotable, but sellers who have anything to offer are not disposed to come below 49s. to 49s. 6d. for Eglinton, and 51s. to 51s. 6d. for Glengarnock, net prompt cash, delivered at the Lancashire ports.

The finished iron works in the district continue only indifferently employed, as notwithstanding makers' books are fairly well filled, specifications on account of orders come to hand but slowly. Prices, however, remain very firm at £5 7s. 6d. to £5 10s. for Lancashire and North Staffordshire bars, £7 to £7 5s. for Lancashire and Staffordshire sheets, and £5 17s. 6d. for random to £6 2s. 6d. for special cut lengths of Lancashire hoops, delivered Manchester or Liverpool.

Nut and bolt makers still report the weight of business doing improving, but no better prices obtainable.

In the steel trade hematites show a hardening tendency, the minimum quotations being now 53s. to 53s. 6d., less 2½, for good foundry qualities, but ordinary Bessemer basic billets can still be bought at £4 net cash delivered here. Steel bars are quoted at £6 to £6 2s. 6d., and steel boiler-plates £6 7s. 6d. to £6 10s. for delivery in this district.

In the metal market there has been a rather unexpected advance of ¼d. per lb. on manufactured goods during the past week, and list rates for delivery in the Manchester district are now as under:—Solid drawn brass boiler tubes, 6d.; solid drawn brass surface condenser tubes, 7½d.; solid drawn copper tubes, 7½d.; brazed copper gas and steam tube, 7¼d.; brazed brass gas tube, 6½d.; brass wire, or rolled brass, 5½d.; copper wire, 6¾d.; sheet brass, 6½d. per lb.; strong copper—sheets—55s. per cwt.

Amongst a few interesting items that I have come across during the past week, I may mention a new patent wood-working machine which is being introduced by Messrs. T. and R. Lees, of Hollinwood. This is a panel planing and thicknessing machine fitted with a rising and falling table, and a special chain feed gear, the advantage of which is that the feed wheels are driven direct by a strong steel endless chain, and cannot possibly get clogged with the chippings from the machine or come out of gear, whilst the tension and lift of the feeding rollers is not interfered with by any varying thickness of timber, and the driving gear can be placed all on one side of the machine, leaving the opposite side quite free from belts, and allowing plenty of room for manipulating the timber. Messrs. Cunliffe and Croom, of Manchester, are busy on a number of orders for various special tools. They have in hand for the Admiralty a number of drilling machines and cold iron sawing machines capable of sawing mild steel and iron plates up to 6in. in thickness, the top of the table being clear to set work in any direction; also a number of machine tools for producing cotton machinery of high-class work, and they have just completed a plant of machine tools adapted for the economical production of prepayment gas meters, on the "penny-in-the-slot" system, consisting principally of specially-designed automatic milling and drilling machines, and ungeared hand lathes. As a result of investigations which have been carried out for some time past by Mr. John J. Royle, of the Dalham Works, Manchester, with regard to the production of a highly-compressed carbonaceous material as fuel for various heating appliances, he has succeeded in obtaining a smokeless fuel which will probably be a keen competitor with gas and oil, and which, when properly made, burns with great regularity and trustworthyness. This he is now introducing for use in specially designed heating stoves, and a further very useful application is being made in a specially constructed glue-kettle to be heated with this fuel, which is certainly a great improvement upon this class of appliance at present in use. In this kettle the fire-box is so arranged that there is no possibility of the burning fuel coming in contact with anything outside, and the glue kettle can be kept hot for any length of time by simply adding two or three pieces of the fuel from time to time as it burns down. I understand that one of these kettles has been kept boiling for about six hours at a cost of something like one penny, and whilst there was no smoke whatever from the fuel, the boiling of the water was absolutely steady and uniform the whole time.

Only a slow business continues to be reported in the coal trade, with no present indication of any increasing demand except as the approach of the winter season brings forward gradually enlarging requirements for house-fire consumption. All descriptions of fuel for ironmaking, steam, and general manufacturing purposes continue bad to sell, and pits are still only kept going about four days per week with supplies in excess of requirements. With regard to prices, these are not more than maintained for the better qualities, whilst inferior descriptions are rather weak and irregular, slack showing, if anything, a downward tendency. Best Wigan Arley is still quoted 11s. to 11s. 6d., Pemberton four-foot and seconds, Arley, 10s. to 10s. 6d.; common house coals, 8s. to 8s. 6d.; and steam and forge coals, 7s. to 7s. 6d. per ton at the pit mouth, but only in exceptional cases are the maximum figures being got. Engine fuel ranges from 3s. 6d. to 4s. for common slack, to 4s. 6d. to 5s. for good medium sorts, and 5s. 6d. to 6s. for the best qualities at the pit mouth.

Although there is still a fair weight of business being put through in the shipping trade, further buying on Scotch accounts is being carried on very cautiously, and there is not the same firmness as recently in prices, common steam coal, delivered at the High Level, Liverpool, or the Garston Docks, being obtainable about 8s. 6d., with better qualities quoted at 8s. 9d. to 9s. per ton.

Whilst the miners in this district naturally accept the election of Mr. Samuel Woods, M.P., President of the Lancashire and Cheshire Miners' Federation, to the secretaryship of the Parliamentary Committee of the Trades Union Congress, as a sort of compliment to themselves, the election is regarded with still further satisfaction as an important recognition of the efforts which have been put forward to secure the passing of the Eight Hours (Mines) Bill, and the Lancashire and Cheshire Miners' Federation have passed a resolution congratulating their president "On his appointment to the position of secretary to the Parliamentary Committee of the Trades Union Congress, as, on his election to that office, they recognise the hearty co-operation of the different trades unions in their efforts to secure a legal eight hours day for miners."

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE fine weather during the second week in September gave hope of an Indian summer, and consumers of coal, anticipating a warm September and October, held their hands in expectation of lower values. A week of sunshine, however, terminated with the Doncaster Races, and dull cold weather having set in, there is not much probability now of any change taking place until the beginning of October, when the usual winter advance will be made. House coal is in much larger demand, and the output of the district, although unevenly distributed over the various colliery concerns, is large. It becomes increasingly evident that the smaller collieries will have the greatest difficulty to make a profit at present prices, and under existing conditions of working. The large firms have, up to this time, had less difficulty in carrying on their business at a profit, though that is admittedly very lean. With the exception of the trouble amongst the colliery enginemen, which at present is assuming a rather acute and threatening aspect, other disputes with regard to wages are being gradually overcome. In several instances the points of difference have been, by agreement, referred to the Joint Conciliation Board. Several extensions of existing workings are in progress, and from these an increased output will very soon be available. A fair average tonnage is forwarded to the metropolis, but there is no great rush there on the part of householders, and the demand is therefore moderate. Sea-borne fuel from the Northern coalfields, having been largely sent elsewhere during the Scotch strike, is less abundant than usual in the London district. This, of course, helps inland coal, and values are rather firmer than at the corresponding period of last year. Silkstones are from 9s. 6d. to 11s. per ton; Barnsley softs, 8s. to 9s. per ton; other qualities 9d. to 1s. less. These are the quotations at the pits. In steam coal Hull and the other Humber ports continue to take a full average tonnage, there being the usual pressure at this time to complete deliveries to the Northern ports while the markets still remain open. For Barnsley hards 7s. 9d. to 8s. 3d. per ton is quoted, other qualities from 7s. per ton. Gas coal, which is in abundant supply, makes 7s. to 8s. per ton. Manufacturing fuel, the supply of which is in excess of the demand, can be had at 4s. to 5s. per ton, good slack being 2s. 6d. to 3s. 6d. per ton, and smudge, &c., as low as 2s. per ton. Coke is quoted at from 9s. to 11s. per ton, with a moderate demand for Lincolnshire and Northamptonshire.

Manufacturers having a connection with the United States report that business in cutlery and hardware is increasing gradually every week. At the same time there is nothing like the heavy "boom" which was anticipated on the termination of the period of suspense, while the Bill was lingering in the Senate. Several of our largest firms, reluctant to deprive their hands of employment, kept them engaged in making stocks, in the expectation that these would be speedily cleared when all uncertainty was at an end. They have been disappointed in that expectation, the orders which have come in having been light. One or two manufacturers state that they have not been able to clear off one-half of the finished goods they had accumulated. This small demand has been caused largely by the depression of trade in America itself, where the high tariff imposed under the McKinley Act has not had the effect its authors anticipated—viz., to benefit the American cutlery and plate manufacturers. The advices received in Sheffield state that the McKinley Act, instead of fostering the native industries in the goods which are usually obtained from the Sheffield district, has really had an adverse influence. Business is reported all round rather bad in the States, but there are signs of an improvement, and on these becoming more definite Sheffield will participate in the benefit. The cutlery manufacturers in this city have somewhat more work in hand than during the summer months. Novelties, both in the cutlery and the plated trades, chiefly in the latter, are now being got ready for the approaching season. There is more doing in electro-plate and silver goods, in which great progress in the combination of the artistic with the useful has been made in Sheffield of late years. The Japanese and Chinese War is reported to have affected the copper market, causing a rise in the value of that metal, which operates directly upon the makers of electro-plate goods.

It is gratifying to note that the South American markets are beginning to look up. London shippers, through whom most of our Sheffield houses do the bulk of their business, are giving more hopeful accounts of that market. Inquiries are much more numerous than has been the case for several months, and these are not altogether fruitless of work. Although trade with the Argentine Republic can scarcely at present be said to be up to the average, the agents of Sheffield houses report to their principals that before the end of the year an improved state of affairs may be looked for. Within two months the shipment of produce to this and other European countries will then have set in, causing an improvement in the rate of exchange from the other side, and increasing the business over here. The protracted disturbances and financial embarrassments in Argentina have caused merchants out there to limit their orders to pressing requirements. Stocks of hardware and goods are therefore very low, and the beginning of an active demand must inevitably cause large quantities to be sought from England. Better accounts are also being received from the Brazils. A welcome rise in the rate of exchange has taken place during the last fortnight, owing principally to the extensive shipments of coffee and other goods. Several of our manufacturing houses, during the dislocation of business caused by internal trouble, withdrew their travellers from the Brazilian and other South American markets, but these have again resumed their journeys and are reopening business with altogether a much more hopeful prospect. Trade with Spain, on the other hand, is anything but encouraging, several of our houses being exceedingly slack, while the advices sent home are not hopeful of any early change for the better. Business all round in cutlery and hardware goods for the Far East cannot possibly get brisker until the conflict between Japan and China has terminated in some fashion.

Comment has been freely made on the railway traffic returns for August as showing a very large increase compared with the corresponding period of last year. This is no doubt the case, but it seems to have been forgotten that the coal traffic last year was at a standstill owing to the seventeen weeks' stoppage. Not only did the strike entirely paralyse the coal trade, but it also prevented the movement of iron and steel and other goods. The only fair comparison of the traffic returns of August last is to put them side by side with those for August, 1892. The result is to bring out a very considerable falling-off, but the general view in the Sheffield district is that the traffic will increase as trade, particularly in the heavy departments, slowly revives.

The movement in railway material, to which attention was directed a month ago, has not quite been maintained, recent orders having been exclusively for the home companies. It is expected, however, that foreign railways must soon begin to place more work, but there can be no general animation until the great South American markets resume their normal condition. Several of our manufacturers anticipate that the result of the war between Japan and China will be to wake up the Chinese Government to the necessity of a reorganisation of their entire military and naval system. This would not only involve an immense amount of work in military and marine material, but the development of the country, particularly on the Eastern seaboard, in railways, telegraph wires, and other facilities for rapid and effective conveyance of troops and material. If this should be brought about, the effect will be felt far beyond the manufacture of warlike goods, for the abandonment of the old policy of excluding the foreigner and all his works would be inevitably followed by the opening up of markets for European goods in nearly all directions. England would be sure to benefit, with Germany, more than any other country.

The stiffening in the iron and steel industry, to which reference was made last week, still continues. The advance of 2s. to 3s. per ton obtained in the Birmingham iron market, as compared with the quotations of six weeks ago, is an important factor in the situation. Lancashire pig iron has similarly moved upward, and with a perceptible disposition on the part of consumers to do business. Hematites are making from 52s. to 54s. per ton; common forge iron, 39s. to 40s., delivered in Sheffield; Bessemer billets, £5 10s. to £5 15s. per ton.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE end of the Scotch miners' strike having failed to come as speedily as was expected last week, the buying of pig iron in this market has been checked, more especially as the disturbance has extended, some of those who resumed work last week at the old rate of wages, and against the wishes of the Federation, having again come out, and there is likely to be as great a scarcity of fuel as there was before. In that case the Scotch mills, forges, and foundries, which recommenced operations last week, will in many cases have to stop again, and that will affect the consumption of Cleveland pig iron. Large quantities of it have recently been bought by Scotch consumers, and during the past few days there have been heavy deliveries to Grangemouth from the Tees, but these will have to be suspended if adequate supplies of fuel cannot be obtained. Apart from this the trade is better, and a more hopeful tone is generally manifest. A more confident tone is apparent, for consumers are now desirous of buying for delivery over a considerable period, and they would hardly adopt this policy if they had any reason to expect lower prices. Hitherto this year they have confined their purchases to hand-to-mouth requirements, as prospects have been too uncertain to encourage them to speculate. That a larger volume of trade is this half-year being done in the North of England may be judged from the traffic receipts of the North-Eastern Railway, which has practically the monopoly of the carrying trade of the district, because the receipts since July have reached £1,866,909, or £58,548 more than in the corresponding period of last year, which itself was not an unsatisfactory time. Last week's receipts were £154,340, or £5291 above those of the corresponding week last year, and nearly £10,000 more than in the same week of 1892. Somewhat more encouraging reports are given by some of the shipbuilders, and these have not failed to strengthen certain departments of the finished iron and steel trades, as large orders for plates and angles have been given out; and the shares of limited companies enjoyed in the iron and steel industries, notably those of Armstrong-Mitchell, have increased considerably in value, as investors are very desirous of buying them, believing that they will reach higher prices.

The tendency of pig iron quotations is decidedly upwards, and sellers are little affected by the fluctuations in warrants, for these latter are brought about chiefly by the operations of speculators, selling out to take their profits or buying for a further rise. Producers are so well supplied with orders that they can hold out for better rates, and this week they have not been doing business under 36s. 6d. per ton for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron, while some who have scarcely any available for sale have been able to get 36s. 9d. and even 37s. Cleveland warrants have been as low as 36s. 3½d. cash, but on Wednesday reached 36s. 4½d. The stock held by Messrs. Connal and Co. on that evening was 89,719 tons, or 670 tons decrease this month. No. 4 Cleveland foundry pig iron has been 35s. 6d., and grey forge has been advanced to 34s. 9d., owing to the large sales that have recently been made to Scotland, and the readiness with which buyers paid 34s. 6d. Relatively these common qualities of pig iron are cheaper than No. 3, as usually there is only a difference of 1s. per ton between that and grey forge. Hematite pig iron is in brisker request, and M. Nos. of local brands have been raised to 43s. 3d., and in some cases to 43s. 6d. per ton for prompt delivery, while 43s. 6d. is regularly asked for deliveries to be made over the next quarter. Shipments of hematite pig have increased to Scotland and the Continent, and local consumption is also larger. Foreign ore improves in price as freights increase, 12s. per ton being quoted and paid for ordinary Rubio delivered Tees. The exports of pig iron from the Tees this month have reached 68,180 tons, as compared with 57,498 tons last month, 77,419 tons in July, 1894, and 74,782 tons in September, 1893, all to 26th. The shipments have increased considerably during the last ten days, owing to the pressure of Scotch consumers' requirements in view of the termination of the strike.

The official returns of Mr. Waterhouse to the Board of Conciliation, showing the deliveries and prices of manufactured iron in the North of England for the two months ended August 31st, may be looked upon as satisfactory, though they differ little from the figures for the previous two months, there being an advance in prices of less than 4d. per ton, and this being so, wages at the mills and forges during October and November will, in accordance with the sliding scale, be the same as have ruled during the last two months. Rails, iron, have fallen 1·51d.; plates, 0·2d.; and bars, 5·4d.; while angles have advanced 0·03d., and the total average 3·92. The decrease of 2787 tons in the deliveries may partly be accounted for by the stoppage of the mills in Teesside for Stockton Races in August. It is noticeable that the production of shipbuilding iron has fallen off, only about 38 per cent. of the iron being in the form of plates, against 41 per cent. in the previous two months, while the proportion of angles fell from 16 per cent. to 12¼ per cent. On the other hand, the deliveries of bars increased, and the proportion went up from 40 per cent. to nearly 48 per cent. The summary of the statistics is interesting, and is as under:—

| Description. | Weight invoiced. Tons. | cwt. | qr. | lb. | Percentage of total. | Average net selling price per ton. £ | s. | d. |
|---|---|---|---|---|---|---|---|---|
| Rails .. | 417 | 12 | 2 | 7 | 1·94 | 4 | 6 | 5·51 |
| Plates .. | 8,179 | 14 | 2 | 5 | 37·89 | 4 | 14 | 7·51 |
| Bars .. | 10,321 | 4 | 3 | 12 | 47·81 | 5 | 1 | 9·72 |
| Angles .. | 2,669 | 5 | 0 | 26 | 12·36 | 4 | 15 | 6·77 |
| | 21,587 | 17 | 0 | 22 | 100·00 | 4 | 18 | 0·22 |

It has been officially ascertained that the average price for steel plates realised by the Consett Iron Co. during the three months ended August 31st differed so little from that of the preceding three months, that in accordance with the sliding scale wages for the next quarter will be the same as those now prevailing at Consett Mills, and other works which regulate their wages by Consett will continue the old rates.

A slight improvement may be reported in the finished iron and steel trades of this district, but to secure the orders manufacturers have had to reduce their quotations, as consumers would not pay the rates which have recently been asked, and which producers expected to get. Their endeavour to raise prices has not been successful. The improvement has been chiefly in steel ship-plates, due to the increased business done by some of the shipbuilders, who have in some cases booked fair orders for new vessels during the last few days from some of the leading shipping companies, who are taking advantage of the low prices to replace vessels that have been lost. One of the shipyards on the Tyne which has practically been idle all this year has recommenced regular operations. Sir Raylton Dixon and Co., Middlesbrough, have booked another order for a steamer of 5500 tons burthen for a continental shipping concern. There have been sales of steel ship plates at less than £4 17s. 6d., less 2½ per cent. at works, but £5, less 2½ per cent. is the regular quotation, while £4 15s., less 2½ per cent., is the figure for steel angles, which are not so readily obtainable, now that the large works of Messrs. Dorman, Long and Co., are closed.

The Darlington Steel and Iron Company's establishment will be altogether closed next week, and now there remain at work only 300 out of the 800 usually employed. At present the company finds it impossible to compete with the firms nearer the seaboard, and the supplies of raw material. The Darlington Company has to pay 2s. per ton carriage for its pig iron, which the Middlesbrough firms escape, and there is the extra carriage to the shipping port of rails that are for export. Heavy steel rails are at £3 12s. 6d. net at works. A good demand is reported for steel billets, chiefly for the tin-plate manufacturers of South Wales, but an increasing trade is done with Manchester *viâ* the Ship Canal; a cargo of 660 tons was sent this week.

Ironfounders are only poorly employed, and prospects have been injuriously affected by the recent lengthy strike. On Tuesday, the North-Eastern Marine Engineering Company, Wallsend-on-Tyne, cast at its foundry one of the largest castings ever made in the North. It is a bed-plate weighing nearly 40 tons for the plate-rolling mills of Messrs. John Spencer and Sons, Newburn Steel Works. Engineers are somewhat better off, but are far from able in most cases to keep their establishments in full operation. Messrs. Ashmore, Benson, Pease, and Co., Stockton, have just completed at Selby the conversion of a large gasholder from a single lift to a telescopic holder, the work being executed within six weeks. Messrs. Furness, Withy, and Co., shipbuilders, West Hartlepool, have commenced the construction at their yard of an extensive graving dock, Mr. Walter Scott, of Newcastle, being the contractor. The locomotive shops are fairly well occupied, but a number of men have been paid off at the North-Eastern Railway's North-road shops, Darlington. Bridge builders have a tolerable amount of work on hand, and prospects are more encouraging.

The Stockton Forge Company, which has secured the contract for the bridges on the new Annfield Plain and Consett line, has just completed the reconstruction of the Wylam bridge over the Tyne. The new superstructure, which has been placed upon the original stone piers, consists of steel plate girders, with a decking of creosoted pitch pine planking 6in. thick, laid at right angles across, and overhanging the main girders, whilst on the upper surface is a substantial layer of tar-concrete paving. The designs are by Messrs. J. Watt, Sandeman, and Moncrieff.

The death took place on Saturday of Mr. George Young Blair, of Stockton, one of the leading marine-engine builders in the North of England, and head of the eminent firm of Blair and Co., marine engineers. Mr. Blair, who was sixty-eight years of age, has been suffering from heart disease for some years, but was only confined to his house for the last five weeks. Mr. Blair was a native of Drumranck, in the Dundee district, and early devoted himself to engineering pursuits, especially in the marine departments. After gaining experience in Scotland and Lancashire, he became manager of the engineering department of the Jarrow Works of C. M. Palmer and Co.—now Palmers' Shipbuilding and Iron Company. In 1855 he left Jarrow to assume the managership of Messrs. Fossick and Hackworth's engineering works at Stockton, and on Mr. Hackworth's leaving it in June, 1864, the name of the firm was changed to Fossick, Blair, and Co., Limited. Shortly afterwards Mr. Blair became the head of the concern, and the name was changed to Blair and Co., Limited, under which designation it has since been carried on. The works employ 2500 hands and cover fourteen acres of ground. Mr. Blair was highly respected in commercial circles, and greatly beloved by his workmen.

The members of the Boilermakers' and Iron Shipbuilders' Association on the North-East Coast have determined to oppose an agreement which has been made between the Employers' Association and their own society. This agreement deals with wages disputes and new machinery introduced by the employers, and affects only the North-East Coast. Though their Association, as a whole, approves the agreement, the local members do not, and they have held a meeting and passed a strong resolution demanding the suspension of the agreement, which resolution they have sent to the Council. This is the first time the members in this district have ever met in conference in opposition to the executive.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has been comparatively inactive this week. The uncertainty which exists with reference to the termination of the miners' strike has almost put an end to speculative business for the time. Transactions have been, for the most part, of a jobbing description, and confined to Scotch warrants, scarcely anything being done either in Cleveland or hematite iron. Prices are 3d. to 4d. per ton lower than a week ago, Scotch warrants being done at 43s. 5d. to 43s. 5½d. cash.

The values of makers' special brands are somewhat irregular, while Summerlee No. 1 has declined 1s. 6d., and No. 3 6d.; Glengarnock No. 1, and Dalmellington Nos. 1 and 3, are 6d. higher. The prices are as follows:—G.M.B. f.o.b. at Glasgow, No. 1, 45s.; No. 3, 43s. 6d.; Monkland, No. 1, 48s.; No. 3, 44s.; Carnbroe, No. 1, 48s.; No. 3, 46s. 6d.; Summerlee, No. 1, 57s.; No. 3, 51s. 6d.; Calder, No. 1, 59s.; No. 3, 50s. 6d.; Coltness, No. 1, 59s.; No. 3, 52s.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 49s. 6d.; Eglinton, No. 1, 54s. 6d.; No. 3, 48s.; Dalmellington at Ayr, No. 1, 50s. 6d.; No. 3, 49s. 6d.; Shotts at Leith, No. 1, 59s. 6d.; No. 3, 52s.

The output of pig iron consists of the produce of three furnaces making ordinary pigs at Coltness, an additional furnace having been lighted there since last week. No arrangements are yet completed for restarting the furnaces, but as soon as the miners are back to work in large numbers, the lighting of the furnaces will proceed. Weeks must pass, however, before iron is made in the usual quantities. Some think that on this account the market is likely to become firmer, while others are of opinion that the lighting of the furnaces will be the signal for a drop in prices.

There is a slight improvement in the pig iron shipments, which are still, however, comparatively small, the figures being 3569 tons, against 3231 in the corresponding week. There was despatched to Holland 835 tons, Belgium 550, Canada 355, Germany 320, India 20, Australia 285, France 28, Spain 60, China and Japan 200, other countries 206, the coastwise shipments being 700, against 946 the same week of 1893.

Little can be said as yet with reference to the finished iron and steel trades. A beginning was made with the manufactured at several of the works a fortnight ago; but it was impossible to continue regularly, owing to the intermittent supply of coals. There is now a prospect, however, of a commencement being made in earnest.

The prices being quoted for mild steel are now lower than those fourteen weeks ago, previous to the strike. Ship plates have declined 5s., and angles 2s. 6d. per ton.

There was shipped from Glasgow in the past week locomotives worth £5000, sewing machines £4400, other machinery £8360, steel goods £2752, and miscellaneous iron goods £16,123.

Some interest is shown by pipe founders in the contract which is about to be arranged for cast iron pipes for Preston.

The coal trade still consists almost entirely of imports. The whole of the shipments for the past week reached only 9622 tons, against 230,381 in the corresponding week, and the total shipments for the year to date now show a decrease of 1,498,570 tons. There is a contract in the market consisting of from eight to a dozen cargoes for the Danish State Railways. Whether our coalmasters will go in for this or not seems to be a little doubtful, although the prospect of steady labour being secured in the Slamannan district, from which such coals are usually drawn, is now more hopeful.

The strike of miners is now in its fourteenth week, and great efforts are being made by the leaders to keep the men out. Picketing has been carried on incessantly day after day, and in Lanarkshire, particularly, something like a reign of terror has prevailed for weeks. Occasionally excited mobs of miners have had to be dispersed by the police and military. The authorities have shown great forbearance—some are inclined to think rather too much. Picketing has been organised by the leaders under the eyes of the police, and there can be no doubt that intimidation has prevailed very generally throughout the mining districts. In spite of this, many hundreds of men go to work in different localities, eluding the pickets in such a way as to show that they have no desire to continue the struggle. There is no prospect whatever of any concession on the part of employers.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The "ukase" of the colliers' representatives, that each colliery should ballot for or against the sliding scale, has been brought practically to a finish, and the "noes" have it in overwhelming numbers. In national questions which have led up to hostilities, the smaller the cause the graver the results, and here the objection to take a checkweigher's evidence by the Coalowners' Joint Sliding Scale Association promises to destroy the scale. The prevailing opinion is that the scale has come to an end; but I have hopes that during the ensuing six months' notice common-sense views will predominate, and amicable arrangements will prevail and preserve the broad principle of the scale. Probably some wise amendments may be suggested and adopted.

At present the Welsh collier has very little reason for complaint. The demand for coal is well maintained, and prices are good. Last week there was an unusually heavy shipment at the Cardiff ports, no less than 315,000 tons, and I hear that in several instances coalowners found a difficulty in completing orders. Best steam has touched 12s. Latest quotations on 'Change, Cardiff, are:—11s. 6d. to 12s.; seconds, 11s. to 11s. 3d.; dry sorts, 10s. to 10s. 3d.; best Monmouthshire, 10s. 6d. to 10s. 9d.; seconds, 9s. to 9s. 9d.; small, 5s. 3d. to 5s. 9d.; f.o.b. House coal keeps up well, and at present quotations it has been difficult to get orders booked forward, showing that higher prices are in view. Latest Cardiff prices are:—Best households, 11s.; No. 3 Rhondda, 10s. 3d. to 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 9d.; through, 7s.; small, 5s.

As invariably happens when coal prices are up, other industries are in harmony. Pitwood commands 15s. 9d.; patent fuel, 11s. to 11s. 6d., and coke is firm at 15s. to 16s.; furnace, 17s. to 17s. 6d.; foundry and special foundry, 20s. to 21s.

Swansea, similarly with Cardiff and Newport, is in the enjoyment of a robust coal trade. Last week the shipment of coal and patent fuel largely exceeded the average, totalling over 50,000 tons. The Port trade in all respects was brisk, exceeding by 18,000 tons that of the corresponding week last year, and by 5000 tons the totals of the preceding week. Some of the coal items are suggestive. France 13,183 tons, Spain 663, Sweden 650, Denmark 2660, Germany 500, Italy 3222, Tunis 640, Buenos Ayres 670, Rio de Janeiro 1210, Montreal 3296, San Francisco 3000, United States 2222, home ports 9418.

In patent fuel France took 2000 tons; Spain, 2200; Italy, 5870; Tunis, 112 tons.

I shall not be surprised to see a steady advance in the demand for patent fuel both at Cardiff and Swansea, where the make is of exceptionally good quality. The knowledge is spreading that while small and large coal lose a percentage of value by weather exposure, patent fuel escapes. Swansea quotation is 10s. 6d. to 11s. 6d.; coke—furnace, 12s. to 12s. 6d.; foundry, 17s. 6d. to 18s. Iron ore—Tafna, 11s.; Rubio, 11s. 3d. to 12s.; Pitwood, 16s. 6d. to 16s. 9d.

I am glad to be able to record more buoyancy in the steel trade. The requirements of the Great Western, local railways, and increased sidings, and colliery requirements for light sections, with a better demand foreign, has given more animation to the rail trade, and the steel bar trade is certainly benefiting from the increased activity in the tin-plate trades of the West of Wales and of the Newport district. At length this trade appears to have really turned the corner, and prospects are every week becoming brighter. The total shipment last week from Swansea was 113,408 boxes, or 90,000 boxes—so reported on 'Change—more than in the corresponding week of last year. If with this is coupled the fact that the quantity brought from works last week was only 57,793 boxes, it is tolerably clear that the stocks will not long last the influence of the reduced tariff. The stock in warehouses and vans is now down to 282,505 boxes, so an improvement in price may be regarded as close at hand.

Swansea Exchange quotations, iron, steel, and tin-plate, this week are as follows:—Glasgow pig, 43s. 4½d.; Middlesbrough, 36s. 3d. prompt; hematite, 43s. 1d.; Welsh bars, £5 to £5 2s. 6d.; angles at usual extras, f.o.t. at works; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s. f.o.t.; sleepers, channels, &c., according to section and specification; steel sheets, £6 5s. to £6 10s., with the usual extras for the higher gauges; sheet iron, £6 to £6 10s.; Bessemer steel, tin-plate bars, £4 to £4 2s. 6d.; Siemens best, £4 2s. 6d. to £4 5s.; all delivered in the district, cash less 2½.

Tin-plates, makers' last quotations:—Bessemer steel cokes, 10s. 6d. to 10s. 9d.; Siemens coke finish, 10s. 9d. to 11s.; best charcoal, 12s. to 12s. 6d., according to finish; ternes, per double box, 28 × 20 c., 20s. to 24s.; wasters, 6d. to 1s. less than primes; odd sizes, usual extras; all delivered in Prince of Wales Dock, Swansea, cash less 3 and 1 per cent. Block tin has receded slightly, and now is £71 7s. 6d. to £71 10s. Lead, English up to £10 1s. 3d.; Spanish to £9 17s. 6d.

The tin-plate trade with Russia is improving rapidly, and the clearances for the United States this week up to my despatch were close upon 5000 tons. Iron ore is coming in pretty freely to all the large works.

Notice of a restart of the Blaina Iron and Tin-plate Company has appeared. It will date from the 15th October. A contemporary states that inquiries amongst the workmen are to the effect that they will take no action until it is ascertained under what conditions the neighbouring works owned by Capt. Phillips will be carried on on and after September. It is stated that since the resumption of work the workmen have given a concession of fifteen sheets per box. The meeting of the Abertillery and Nantyglo men held of late appear to suggest that their concessions will cease, but upon this head possibly the intention will be altered. Some doubts also prevail with regard to the Pontymister and Waterloo workmen. Treforest has been restarted on the old lines. A satisfactory condition prevails at Briton Ferry. Taking a survey of the whole of the district, there is reason to hope that there will be no labour upset in the event of improved times and prices.

The result of the ballot at the Albion Colliery, for and against the scale, has been as follows:—For giving notice to end the scale, 910; against, 232. Work is being carried on with a considerable degree of vigour since the explosion.

The appeal to the public has met with a generous response. The Central Fund acknowledges over £13,000, the Mayor of Cardiff over £9000, and the *Western Mail* and *South Wales News* funds total up over £3000.

A good deal of discussion prevails in the district regarding explosives, and it seems almost certain that in dry and fiery mines gunpowder will be disused and cordite or other explosives used instead. Several of the conditions prevailing before great explosions are constantly met with; driving ahead day and night to meet the demand for coal, sudden barometrical changes, blasting. Fortunately the colliery management is thoroughly on the alert, and the keenest vigilance is being used. On the part of the men, too, I am pleased in not having had of late to record any gross irregularities or rashness.

An exceptional case against tin-plate workmen was heard at the Swansea police-court on Saturday. Twelve men of the Fox Hole Works were charged with breach of agreement with their employers. They had agreed to a certain reduction, and upon the strength of this the company entered into contracts to buy and sell metal; but the defendants refused to abide by the terms of the agreement, and serious losses resulted. They were fined according to damage from £4 to £10 each.

The Vale of Glamorgan Railway is well in hand. Messrs. Pethick Brothers are the main contractors, and the preliminary work at Barry is nearly completed prior to the excavation of the large tunnel at Porthkerry. Mr. Woolley, of Wrexham, has entered into a contract to make eight miles of the line on the Bridgend side.

An inquiry before Sir George Nares, regarding an application by the Barry Dock Company to construct an embankment or breakwater, has been adjourned, to enable Sir George Nares to see the effect of the south-westerly gales upon the small craft in the harbour.

The Cambrian Miners' Society at their last meeting condemned the continuance in the district of the double-shift system.

The Atlantic greyhounds, as the Campania and others are called, are stated to use 600 tons a day when going at their fullest speed.

Steamers of 3000 and 4000 tonnage have been plentiful in Cardiff during the week, and several instances have occurred of 2000 tons of iron ore coming in.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

Only a slow inquiry for either raw or manufactured iron has been reported upon the week, and prices are rather irregular. The chief iron-using industries have so far shown no sufficiently increased activity to represent any established material improvement. New work certainly has been coming forward more freely in some departments, and in many cases engineering establishments have been getting busier since the beginning of this quarter, but the present state of the iron industry, taking it all through, is still anything but one of activity, a number of works only running short time, while the best that can be said is that business is likely to slowly improve. Another unsatisfactory feature is that the different branches of the manufactured iron trade continue in a more or less depressed condition, and until there is some really substantial improvement in that direction, the prices for raw material can hardly be expected to advance. On the other hand the general absence of stocks and the improbability of lessened cost of production operate as a check on any downward move in the market, and it is therefore scarcely probable that quotations of pig iron will recede to any material extent.

Only a moderate activity exists in the iron and steel trades of Silesia, pig iron meeting with limited request, while malleable iron has been in tolerably good call. Bars, for instance, are well inquired for at M. 120 p.t., free at works, and M. 125 p.t., free Breslau, and there have been some fair orders coming in from abroad. Plates, too, have been in fair request, while for girders only a weak demand is experienced. Business on the Austro-Hungarian iron market remains quiet, and but few contracts have been booked lately. One fact is apparent, that buyers are not going in for quantities. Small parcels only are bought at short terms of delivery. Bars and girders are in regular demand, and plates have been quite actively inquired for. A decidedly increasing demand is to be noted in English foundry pig. The business in hardware is rather lively, especially in the Hungarian market. Official quotations show no alteration generally both for raw and finished iron.

There is little of interest to note in connection with the French iron business. Buyers have been slow in placing orders, and there is some weakness noticeable in prices; the only branch with life in it is the bar trade. Heavy rails in steel are also in tolerably good request at 160f. p.t.; steel bars fetch about 130 to 140f. p.t., free at works.

On the Belgian iron market the demand for the different sorts of iron and steel continues exceedingly quiet, and the transactions noted during the past week are of small account. With regard to export trade, there has been a better tone reported lately, at least so far as steel manufactured goods are concerned. Prices, if anything, are perhaps a trifle more firm, or rather less inclined to give way than they were a short time ago.

There is very little of a novel character to report with reference to the Rhenish-Westphalian iron trade. Buyers maintain a reserved position generally. Small lots for immediate delivery are being purchased with considerable regularity. Stocks have in some instances decreased. The restriction in the output of pig iron begins to be felt in the iron ore trade, and a certain weakness in demand is complained of; for the present a change in prices has not taken place, but it is not at all unlikely that quotations will become easier. The position of the pig iron business is still the reverse of satisfactory. There has been no improvement in the export demand, and the orders that have been coming in on home account are not sufficient to keep the works in full employment, and there is consequently a feeling of uncertainty, and even distrust, noticeable in some quarters. On the malleable iron market demand and sale have continued fairly good, while prices are inclined to give way a little when there is an order of even moderate weight in question. This is specially the case in bars. Hoops and girders are remarkably quiet. Heavy plates are satisfactorily inquired for, and the mills continue in good activity. Quotations remain the weak point, as usual, and there is little prospect now that a change for the better will set in before the year ends. Sheets are in a similar condition. Steel makers have been doing only a small trade, rails being in poor request generally. The construction shops have also been but moderately engaged for some time past, and prices are exceedingly low. Up to date, a regular activity is maintained at the wagon shops.

Belgian Goods Brake Van.—M. Léon Bika writes to us from Brussels, pointing out an omission in our description of the brake van for the Belgian State Railways, on page 249. The object of connecting the two springs on one side of the van is that the vehicle should be suspended on three points. Our description should have read:—"The two springs, on one side only, are connected by a balance beam;" but the words, "on one side only," were accidentally omitted.

## AMERICAN NOTES.

*(From our own Correspondent.)*

New York, September 20th.

American manufacturers are promptly making whatever reductions are necessary to protect themselves against competing imported products. Home makers are in control of the cotton tie trade, and a 22½ per cent. reduction has just been made in glass to offset the difference of 16 per cent. made by the new tariff list. All necessary reductions will be promptly made. The workmen appreciate the situation and accept the reductions philosophically. A proposition has been made to reduce wages of tin-plate workers 25 per cent. to offset the reductions in duty. A big reduction will be accepted. The real contest has only opened. Wages are declining, but this loss is partly offset at least by cheaper cost of living.

The iron trade is rather quiet. Prices are in some instances quotably lower. Pig iron sales are large; but production has been expanded to 160,000 tons per week, against 85,000 tons twelve weeks ago. Throughout the West demand for mill products is improving, but until railway construction is resumed on a scale of 5000 miles per year there can be no decided improvement in the steel industry of America.

## LONG-DISTANCE TRANSMISSION OF POWER.[*]

By E. Arnold.

In this article the author discusses the influence of the static charge in long-distance power lines, and gives the results of a series of experiments carried out with the three-phase transmission plant between Hochfelden and Oerlikon, in Switzerland. The distance of transmission is 14½ miles, and the plant is of similar construction to that used for the Lauffen-Frankfurt transmission, where the static induction has never given rise to any difficulties even with the most varying atmospheric conditions. The generators at Hochfelden deliver 300-horse power at 50 volts and 3 × 1400 ampères. The current is transformed up by three-phase transformers, having a ratio of 1 : 154·6. The line consists of four wires of 16 0 mm. diameter, run on poles 25ft. high, and at an average distance of 17·7in. from each other. In order to determine the influence of the static charge the delivery ends of the line were disconnected, and the generators were run both with variable speed and constant pressure, and with constant speed and variable pressure. The frequency was varied from 49·3 to 21·6, and tables are given showing the low-pressure and high-pressure currents under these varying conditions. Generally speaking, when the frequency is constant the secondary or high-pressure current, which in this case is entirely due to the electro-static capacity of the line, rises with the pressure, whilst at constant pressure it rises as the frequency is increased. The same tests were repeated when the line was entirely disconnected, and the results are shown plotted in curves, from which it is seen that the primary current, both for the line connected and disconnected, is directly proportional to the pressure. One diagram is given which shows that the curve of primary current when the line is disconnected intersects the corresponding curve when the line is connected, from which the author concludes that the capacity of the line tends to diminish the primary current at the generating station, and in certain cases acually does so. This point he then investigates theoretically, and he finds that by the addition of self-induction to the line it is always possible to so balance the effect of capacity as to work without any phase-difference between current and electro-motive force.

The practical conclusion of this investigation is that the capacity of the line need never interfere with the proper working of a long-distance transmission plant.

Launch.—On the 18th, the s.s. Torbryan, 178ft. by 28ft. by 14ft. 2½in. moulded, built by Messrs. R. Craggs and Sons, of Middlesbrough, was taken out for loaded trial with satisfactory results. Engines, 14in., 22½in., 37in., by 27in., by Messrs. Westgarth, English, and Company, of Middlesbrough. This, we are informed, is the third vessel built by the same firms for the owners, Messrs. Whiteway and Ball, of Torquay.

New Works at Salonica.—It appears that the acceptance of the tender of a Belgian firm of contractors for the construction of the new marine works in connection with the port and harbour of Salonica has not been unattended without unsatisfactory circumstances. The French society for the working of Eastern railways has protested against the award on the grounds that by the terms of its contract with the Turkish Government it is entitled to the preference in all engineering works of this or of a similar description. It remains to be seen what conditions are attached to the same contract, for an absolutely unconditional agreement would be a somewhat unusual circumstance, even for the Government of the Ottoman empire.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Engineer: Ernest F. Sparkes, to the Buzzard, in lieu of a chief engineer, to date September 22nd; George L. R. Perkins, to the Bullfrog, to date September 25th; George H. Morris, to Victoria and Albert, to date September 24th. Assistant-engineer: W. F. Montgomery—temporarily—to the Buzzard, to date September 22nd; Lewis J. Watson, Henry C. Anstey, G. W. Baldwin, and Samuel P. Ferguson, to the President, additional, for Royal Naval College, to date September 29th. Probationary assistant-engineers: James Maxwell, Charles G. Ware, John Thompson, Henry F. Bell, Percival C. W. Howe, Charles A. Hardinge, Henry J. Loveridge, Walter Stokes, Henry F. Smith, Edward P. Soper, James T. C. Butland, Gilbert H. Page, William B. Hall, Francis J. Charlton, and Percy Stocker, to the President, additional, for Royal Naval College, to date September 29th.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

*13th September*, 1894.

17,395. Gas Washer, G. Pettigrew, Middlesbrough-on-Tees.
17,396. Soap, M. Evans, Wavertree.
17,397. Packing for Stuffing-boxes, A. G. Brown, Liverpool.
17,398. Steam Hauling Machinery, H. C. Lobnitz, Glasgow.
17,399. Steam Pumps, H. C. Lobnitz, Glasgow.
17,400. Aerial Signs, G. A. Baker, Gloucester.
17,401. Apparatus for Aerating Liquids, R. W. Stuart, London.
17,402. Food Preserver and Refrigerator, R. W. Stuart, London.
17,403. Manufacture of Bricks, B. Cochrane, Newcastle-on-Tyne.
17,404. Pistons for Steam Engines, &c., G. Finney, London.
17,405. Measuring Helical Surfaces, W. C. Carter, London.
17,406. Coal-boxes, F. W. Vernon and J. Blackham, Birmingham
17,407. Boot-nailing Machines, W. H. Dorman, Stafford.
17,408. Protecting Plaster Casts, J. V. and A. Hibbert, Preston.
17,409. Taps, J. Mallol, Birmingham.
17,410. Preventing Bicycles Slipping, E. Cusack, Clontarf.
17,411. Chain, W. H. Bailey, J. H. Brindle, A. T. Newbold, and J. Mason, Manchester.
17,412. Hose Boards, G. Tilley, Leicester.
17,413. Kaleidoscopic Toy, H. J. Hayes and C. B. Clarke, Norwich
17,414. Holding Cords, Ropes, &c., J. S. Orton, Birmingham.
,415. Manufacture of Cut Nails, &c., C. March, 17Glasgow.
17,416. Keys for Securing Rails to Chairs, R. Frame, London.
17,417. Fire-lighter or Kindler, A. Drennan, Glasgow.
17,418. Letter-copying Books, W. Howard, South Benfleet.
17,419. Bushes and Bearings for Axles, J. and C. A. Baker, Grimsby.
17,420. Postal Boxes, R. A. Casson, Birmingham.
17,421. Hubs of Velocipede Wheels, J. T. Robson, London.
17,422. Shoe Lasting Machines, W. R. Mudd and A. N. Mawbey, London.
17,423. Music Stools, J. W. Deans and A. M. Foster, London.
17,424. An Attachment to Bottles, F. T. Mott, London.
17,425. Photosculpture, H. H. H. Cameron, London.
17,426. Bow Nut for Instrument Bows, W. Needham, London.
17,427. Hinges and Fasteners for Doors, H. A. C. Foot, London.
17,428. Shears, W. Clark, London.
17,429. Folding Umbrellas, Tents, &c., E. R. Kesterton, London.
17,430. Secretary Drawers, T. Potter, London.
17,431. Coin-freed Gas Meters, G. P. Wadsworth, London.
17,432. Water-closets, W. Cliff.—*(The J. L. Mott Ironworks Company, United States.)*
17,433. Oil Cooking Stoves, E. Rippingille and W. Porter, London.
17,434. Motor, F. Hraba, London.
17,435. Shin or Leg Guards, &c., J. H. Haywood, London.
17,436. Fasteners for Boots and Shoes, R. Gough, London.
17,437. Door Fastener, C. H. Cload and W. H. Mardon, jun., London.
17,438. Self-acting Copying Books, C. J. Davison, London.
17,439. Cycles, J. D. Derry, London.
17,440. Fixing Broom or Brush Handles, J. Burnett, London.
17,441. Bats and Racquets, G. H. Webb and H. M. Walker, London.
17,442. Soldering Metal Boxes, J. Gersant and A. G. Buttifant, London.
17,443. Pivoted or Swinging Mirrors, M. Gillespie, London.
17,444. Busks, G. Carcaut, London.
17,445. Electro-magnetic Friction Clutch, W. C. Bersey, London.
17,446. Plug for Tobacco Pipes, E. M. Richford, London.
17,447. Electrically Propelled Vehicles, W. C. Bersey, London.
17,448. Stoves for Gas, Oil, &c., P. R. Poore, London.
17,449. Lamps for Burning Oil or Spirit, A. Kiesow, London.
17,450. Watch Pockets, S. Glasgo, London.
17,451. Melting Snow, P. R. J. Willis.—*(C. F. Springfiels, United States.)*
17,452. Detaching Block or Hook, G. W. Moore, London.
17,453. Brake Apparatus for Trains, C. Luyers, London.
17,454. Cycles and Velocipedes, P. H. Pritchett, London.
17,455. Charging Gas Purifiers with Lime, H. Gardener.—*(F. D. Marshall, Denmark.)*
17,456. Paper Chamber Vessels, A. R. Newnham, Boscombe.
17,457. Tires for Vehicles, T. T. Roe and F. Parr, London.

*14th September*, 1894.

17,458. Self-starter for Gas Engines, J. A. Ewins, Birmingham.
17,459. Self-driving Motor, A. Blattner, London.
17,460. Lamp Automatic Extinguisher, W. Richardson and W. Jackson, Birmingham.
17,461. Valve for Syphon Cisterns, H. C. Willings, London.
17,462. Furnace Tubes of Steam Generators, W. M. C. Howatson, Perthshire.
17,463. Process for Treating Meat, D. Cook, Surrey.
17,464. Securing Breast Pins, W. Gaskell, Nottingham.
17,465. Working the Points of Tramways, T. Albin, Glasgow.
17,466. Letter Copying Pad Damping Machine, P. Burt, Glasgow.
17,467. Flushing Cisterns for Water-closets, J. Fagan, Keighley.
17,468. Fishing Rods, W. Quine, jun., Isle of Man.
17,469. Advertising, L. Koffman, Manchester.
17,470. Chaff Cutters, T. Sabine, Derby.
17,471. Seats, H. T. Wells, London.
17,472. Mud Guards for Cycles, S. R. Ramsbottom and H. J. Rofe, Manchester.
17,473. Ships' Deck House Lights, J. Shaw, Northumberland.
17,474. Keyholes of Night Latches, A. R. Tonks, Staffordshire.
17,475. Mouthpiece for Tobacco Pipes, T. Legat, Motherwell.
17,476. Machines for Pressing Hay, J. E. S. Perkins, Peterborough.
17,477. Printing Fabrics, W. Pickup and W. Knowles, Manchester.
17,478. Regulating the Feed of Textile Fibre to Openers, &c., T. R. Marsden, Manchester.
17,479. Distribution of Sanitary Fluids, C. E. Macnamara, London.
17,480. Glazing Bars for Windows, P. Y. Lyle, Glasgow.
17,481. System of Cutting Dresses, &c., R. Fox, Glasgow.
17,482. Ring Adjuster, A. E. Lay, London.
17,483. Trunk and other Lock Fastenings, A. J. Bates, Wolverhampton.
17,484 Manufacturing Artificial Fuel, E. Kirbis, Berlin.
17,485. Reversible Safety Stirrup, B. E. T. Cope, Walsall.
17,486. Composition for Preserving Wood, J. Matthews, London.
17,487. Paint Spraying Appliances, G. Skinner, London.
17,488. Connecting Metal Tubes, A. Girbes and P. Foucher, London.
17,489. Rotary Motors, A. Chauveau and L. Guichard, London.
17,490. Railway Chairs and Sleepers, A. E. Muirhead, Glasgow.
17,491. Making Gas, G. Rose, Bishopbriggs.
17,492. Machinery for Cutting Biscuits, G. S. and J. A. Baker, London.
17,493. Machinery for Preparing Cotton, F. Topp, London.
17,494. Trouser Clips, S. Smith, London.
17,495. Boots and Shoes, S. Goodacre and A. F. Sharman, London.
17,496. Line or Cord Fastener, J. J. and T. I. Day, London.
17,497. Filling Lamp Reservoirs, T. E. Phillips and F. C. Chirm, London.
17,498. Alarm Clocks, E. Benest, London.
17,499. Chimney Cowls, F. C. Woodford, London.
17,500. Lamp Shade Holder, A. G. Pretious, London.
17,501. Pipe Mount Appliances, J. Cheshire, Birmingham.
17,502. Electric Time-signalling System, P. R. J. Willis.—*(W. A. Purcell, United States.)*
17,503. Feed Roll for Planing Machines, J. de Sigler, London.
17,504. Tires for Travelling Wheels, A. A. Crozier, London.
17,505. Mud-guard for Cycles, H. G. Payne, Sussex.
17,506. Tongueless Buckle, J. Schwarz London.
17,507. Cycle Frames, C. W. Brown, London.
17,508. Wheat-drying Machines, J. Higginbottom, Liverpool.
17,509. Tricycles, &c., H. Wadsworth, Manchester.
17,510. Electro-depositing Apparatus, H. Le R. Bridgman, London.
17,511. Mills for Grinding, &c., Colour, E. Bush, London.
17,512. Felloes and Tires of Wheels, H. T. Stephens, London.
17,513. Syrens, I. and S. Smith, London.
17,514. Horse-bin, E. S. Colchester, London.
17,515. Postage Stamps, H. R. Winkelmann and P. Sattelkau, London.
17,516. Pneumatic Wheels, F. King, London.
17,517. Type-composing Machine, A. E. Vorreiter and E. Müllendorff, London.
17,518. Stuffing-boxes, T. B. Lightfoot.—*(Gesellschaft für Nindes Eismaschinen, Germany.)*
17,519. Horseshoes, W. and S. Maddock and F. S. Perkins, London.
17,520. Hydraulic Riveting Machines, H. Berry, London.
17,521. Hydraulic and other Valves, H. Berry, London.
17,522. Mortice Bolts, W. A. E. Crombie and the Paragon Bolt Syndicate, Ld., London.
17,523. Clip for Securing Boot Laces, W. H. Thrift, London.
17,524. Hydraulic Lifts and Cranes, G. Andrews, London.
17,525. Laying Electric Conductors, J. A. Jeckell, London.
17,526. Utilising Waste or Excess Heat, L. Jacquin, London.
17,527. Sporting and other Ammunition, W. Hope, London.
17,528. Link-belts, E. F. Sargeant, London.
17,529. Telephone Transmitters, F. H. W. Higgins, London.
17,530. Button-holes, A. Reikmann.—*(The Heaton Peninsular Button Fastener Company, United States.)*
17,531. Shearing Machines, E. T. Hughes.—*(H. S. Daggett, United States.)*
17,532. Fastenings for Hats, C. E. Fonblanque, London.
17,533. Shuffling Playing Cards, C. V. V. Childs, London.
17,534. Pencils, S. W. Pedley, London.
17,535. Devices for Exhibiting Umbrellas, A. Steer, London.
17,536. Fountain Pens, I. Golwer, London.
17,537. Pumps, G. F. Harvey, London.
17,538. Wheels having Pneumatic Tires, J. Elsden, London.
17,539. Connecting Gun Locking Lumps, C. G. Haenel, London.
17,540. Construction of Perambulators, L. Debefve-Moyano, London.
17,541. Lock, C. Smith.—*(J. M. Mushet and N. G. de B. Priestley, India).*
17,542. Lining of Electric Batteries, J. E. Liardet, London.
17,543. Washing Fibrous Material, J. C. Walker, Bradford.
17,544. Destroying or Removing Paints, E. Tessen, London.

*15th September*, 1894.

17,545. Safety Collar Stud, H. F. Schwarz, London.
17,546. Fastenings for Baskets, &c., T. Tilford, London.
17,547. Smoke Bells for Lamps, W. and S. Jones, Stockport.
17,548. Treating and Aerating Milk, J. Gray, Glasgow.
17,549. Internal Combustion Engines, P. Maccallum, Dumbartonshire.
17,550. Cardboard and other Reels, W. Dickinson, jun., Manchester.
17,551. Wheels, W. Haslewood and J. Hazlewood, jun., Birmingham.
17,552. Driving Tandem Bicycles, A. T. Austin, Birmingham.
17,553. Ventilators for Railway Carriages, P. J. Wilson and W. R. Wright, Sheffield.
17,554. Apparatus for Teaching Arithmetic, J. S. Towers, Southsea.
17,555. Making Gas from Coal, H. R. Dinsmore, Liverpool.
17,556. Manufacture of Sodium Biborate, J. Ascough, Birmingham.
17,557. Lubricating Cans, E. Atherton, Brinscall, near Chorley.
17,558. Stable and Out-door Lamps, J. H. Fergusson, Dumfries.
17,559. Fence Standards, R. Howie, Glasgow.
17,560. Price Ticket for Shop Use, J. Wilson, Glasgow.
17,561. Hydraulic Falling Weir Shutter, R. G. Kennedy, Fife, N.B.
17,562. Ventilating Railway Carriages, J. H. Brierley, Halifax.
17,563. Paper for Memorandum Purposes, H. Thompson and A. Catley, Birmingham.
17,564. Clip for Holding the Legs of Trousers, H. Terry and Sons, Redditch.
17,565. Endless Cigarette-making Machines, H. Korte, Germany.
17,566. Electrodes, W. Schäfer and A. Heinemann, London.
17,567. Children's Swings and See-saws, F. A. Wallis, Basingstoke.
17,568. Portable Trouser Stretcher, J. Kiddle, London.
17,569. Apparatus for Receiving Ashes, R. E. Holt, Manchester.
17,570 Affixing Lamps to Cycles, A. Davey, Manchester.
17,571. Mechanism for Water-closets, D. D. White, London.
17,572. Electrical Switches, &c., H. G. Keeble, London.
17,573. Vents, H. Hatton and T. W. and G. Nayler, London.
17,574. Pneumatic Tires, R. R. Gubbins, London.
17,575. Power Indicator for Engines, W G. and C. W. G. Little, London.
17,576. Organs, J. J. Walker and J. Cowling, London.
17,577. Blasting Cartridges, G. Trench, London.
17,578. Small-arms, H. W. Holland and T. Woodward, London.
17,579. Manufacture of Flower-pots, T. Harvey, London.
17,580. Game Apparatus, G. H. Webb, London.
17,581. Collar Studs, W. J. Bax, London.
17,582. Cleaning Tobacco Pipes, P. G. Lewis, London.
17,583. Harness Hames, J. R. Walcock London.
17,584. Skates, H. Kemper, London.
17,585. Engaging Devices for Ropes, A. W. Lewin, London.
17,586. Lighting, &c., Street Lamps, W A. Hunter, Liverpool.
17,587. Hydrocarbon, &c., Burners, J. Watts, Liverpool.
17,588. Cables for Electrolytic Purposes, J. Leith, Liverpool.
17,589. Bearings for Shafts and Axles, N. Roussello, London.
17,590. Plant Fumigating Apparatus, J. Watkins, London.
17,591. Curling Tongs, R. Friedel, London.
17,592. Ferrotype Photographs, H. J. Haddan.—*(R. Aramburu, Spain.)*
17,593. Pumping Liquids, T. T. Best, S. A. Hollingsworth, and J. Brock, London.
17 594. Navigable Vessels, S. Lacavalarie, London.
17,595. Menstruation Bandage, M. Jope, London.
17,596. Inflating Pneumatic Tires, W. E. Kay, Glasgow.
17,597. Making Mortar, W. R. Lake.—*(F. L. Moores, United States.)*
17,598. Pneumatic Tires for Vehicles, F. R. von Felbinger, London.
17,599. Leg-guards, &c., for Cricket, H. S. Matthews, London.
17,600. Military or Travellers' Valise, P. M. Sykes, London.
17,601. Mats, &c., H. Schürholz and A. Stevens, London.
17,602. Coin-freed Machines, H. Burnham, London.

*17th September*, 1894.

17,603. Injectors for Cleaning Bottles, J. Stow, London.
17,604. Jet for Conveyance of Light, T. Goodwin, Bilton.
17,605. Safety-valves, E. G. Hiller and H. Hiller, Manchester.
17,606. Water Indicator, R. H. N. Lindley and F. J. Mudford, London.
17,607. Pumping Engines, L. P. Perkins, G. F. Buck, W. Rose, and O. F. Vollhard, Manchester.
17,608. Duplex Castor, W. Grimshaw, Manchester.
17,609. Bicycles, W. Thomson, Glasgow.
17,610. Lace Machinery, A. E. Slater and A. E. Stroud, Derby.
17,611. Steam and like Motor Engines, J. Pearson, Keighley.
17,612. Cisterns, G. Brindley, J. McEwen, and S. Thompson, Birmingham.
17,613. Duplex Pivot Hinge, E. Spinney, Tunbridge Wells.
17,614. Sliding Hinge, E. Spinney, Tunbridge Wells.
17,615. Cycle Cranks, G. Pirnie, Dundee.
17,616. Pneumatic Tire Fastening, J. T. Grey, South Shields.
17,617. Coal Distilling Apparatus, W. R. Hutton, Lanarkshire.
17,618. Wire or Cord Clip, H. Hirst and W. E. Gibson, London.
17,619. Hanging Window Curtains, J. Kynaston, Liverpool.
17,620. Pneumatic Crutch, G. A. Russell, Newport, Mon.
17,621. Manufacture of Building Blocks, W. Smith, Dublin.
17,622. Cable Tramways, A. B. Wilson, Co. Down.
17,623. Oil Gas Burners and Furnaces, J. Johnston, Dundee.
17,624. Dress Improver, R. P. Dodd and E. Dodd, Birmingham.
17,625. Scouring and Washing Wool, A. Stephenson, Bradford.
16,626. Combing Machines, J. Cooke and A. Stephenson, Bradford.
17,627. Matchbox Cases, W. Sandland and J. T. Martin, London.
17,628. Water-closet Syphon Cisterns, H. Bartlett, Birmingham.
17,629. Butter-working Apparatus, T. Bradford, Manchester.
17,630. Washing Blue, K. Ammann, Manchester.
17,631. Horseshoes, A. Wright, Leicester.
17,632. Catapults, S. S. Hazeland, Cornwall.
17,633. Firebar, H. Hase, Berlin.
17,634. Safety Appliances for Hoists, S. G. Bennett, Smethwick.
17,635. Match and Card Box, W. H. Smyth, Southampton.
17,636. Wedge, J. Reynolds, Wednesfield.
17,637. Measuring Woven Fabrics, J. H. Duckworth, Blackburn.
17,638. Latch Needle Knitters, J. W. Watts, Countsthorpe.
17,639. Luggage and other Labels, W. E. Pierson, London.
17,640. Coal-saving Device for Grates, E. W. Banner, Liverpool.
17,641. Knitting Machine, B. Kerr and I. L. Berridge, London.
17,642. Corsets, W. A. J. Bussey, London.
17,643. Lamp Frame for Heating, S. Whitworth, London.
17,644. Forming Bodies of Canisters, F. W. Durham, London.
17,645. Folding Sheet Metal, &c., F. W. Durham, London.
17,646. Typewriter, G. C. Walker and T. S. Paynter, London.
17,647. Sharpening Scissor Blades, &c., A. R. Catlin, London.
17,648. Method of Sewing Books, W. Davies, Birmingham.
17,649. Enamel Devices, H. H. Wright and N. Lambert, London.
17,650. Boxes, W. T. Pretty, London.
17,651. Dress Fasteners, J. D. Hurst, London.
17,652. Attaching Loose Cuffs to Shirts, A. Clinch, London.
17,653. Bilge Keels and Centre-boards, H. E. Earle, London.
17,654. Safe Deposits, D. R. Ratcliff and J. M. Horner, London.
17,655. Chimney Pots, F. J. Orwin, London.
17,656. Apparatus for Storing Spirits, T. Perry, London.
17,657. Card Case, C. Hunter, London.
17,658. Frame for Photographs or Pictures, E. A. Grimm, London.
17,659. Rock Drills, J. McCulloch, London.
17,660. Fluid Pressure Engines, J. McCulloch, London.
17,661. Ambulance Litters or Stretchers, R. Morgenstern, London.

---

[*] "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

17,662. **Anti-fouling Composition**, R. Hingston and J. P. Wernegreen, London.
17,663. **Apparatus** for **Games**, R. Bodington and H. W. Sharp, London.
17,664. **Knitted Fabrics**, T. Hill and A. D. Whitehead, London.
17,665. **Sleeve Links** or **Solitaires**, A. Ingram, London.
17,666 **Furnaces**, S. Trivick, P. A. J. Head, and J. Elsner, London.
17,667. **Stirrup Ironer**, H. Gattwinkel, London.
17,668. **Dry Batteries**, H. and F. Nehmer and T. A. Reynolds, London.
17,669. **Riddles**, W. S. Barrett, London.
17,670. **Making Articles** from **Mica**, &c., D. Jaroslaw, London.
17,671. **Driving Mechanism** for **Cycles**, J. Bénaset, London.
17,672. **Cutting Metal Joists**, **Bars**, &c., C. Hoppe, London.
17,673. **Car Replacers**, R. E. Alexander, London.
17,674. **Fastening Buttons** to **Leather**, H. F. Welke, London.
17,675. **Carrier** for **Photographic Films**, T. Samuels, London.
17,676. **Preserving Milk** and **Cream**, J. C. Benit, London.
17,677. **Horses' Collars**, W. Williams, London.
17,678. **Sifting Machines** for **Granular Substances**, H. Seck, London.
17,679. **Apparatus** for the **Carburation** of **Gases**, F. Bremme, London.
17,680. **Working Single Line Railways**, I. A. Timmis, London.
17,681. **Car Couplings**, C. A. Gould, London.
17,682. **Valves** for **Steam Engines**, C. W. Thompson, London.
17,683. **Shoe Sewing Machines**, G. H. Scetrini and H. K. Bridger, London.
17,684. **Rubber Pad** to **Insert** in **Stirrups**, G. Martin, London.
17,685. **Transmitting Power**, C. Guest, Manchester.
17,686. **Clothing** for **Horses**, P. Taaffe, London.

18*th September*, 1894.

17,687. **Cycles**, W. F. Humber, R. Cripps, and J. Goddard, Nottingham.
17,688. **Photographic Films**, J. R. C. Gale and J. W. T. Cadett, London.
17,689. An **Improved Door Spring**, J. S. Shelley, London.
17,690. **Feeding-up Machine**, C. B. Bergen, Oldbury.
17,691. **Apparatus** for **Teaching Music**, J. H. Towers, Southsea.
17,692. **Blowers** for **Domestic Purposes**, J. Greaves, Birmingham.
17,693. **Extracting Impurities** from **Gases**, J. W. Scott, Manchester.
17,694. **Weavers' Loom Shuttles**, J. Cooper and J. Wilkinson, Yeadon.
17,695. **Forming Warps** into **Balls**, A. Leach, Manchester.
17,696. **Holding** or **Raising Mattresses**, J. A. Crane, Handsworth.
17,697. **Construction** of **Window Sashes**, A. Coleman, Glasgow.
17,698. **Cutting Steel**, A. Doughty, Glasgow.
17,699. **Supplying Water** to **Urinals**, G. W. Harrison, Leeds.
17,700. **Pad** for **Cycle Seats**, T. Guthrie, W. T. Hall, and The Guthrie-Hall Company, Ld., Newcastle-on-Tyne.
17,701. **Dredging Apparatus**, A. G. Lyster, Liverpool.
17,702. **Cranks** and **Pedals** for **Cycles**, G. Pirnie, Dundee.
17,703. **Feed-water Heaters** for **Steam Generators**, S. Hey.—(*J. O. Davis, United States* )
17,704. **Covering** the **Space between** the **Hinged Side** of a **Door** and **Door Frames**, F. C. Cawdell, Barnsley.
17,705. **Manufacturing Cork Carpet**, J. Ingleby, Leeds.
17,706. **Supplying Gas** on **Prepayment**, J. Hawkyard and J. Braddock, Manchester.
17,707. **Sewing Machines**, A. Anderson.—(*G. Neidlinger, Germany.*)
17,708. **Air Pumps**, A. Dittmar, Glasgow.
17,709. **Pneumatic Tool**, J. Wolstencroft Glasgow.
17,710. **Removing Hair** from **Pelts**, L. Werner, Manchester.
17,711. **Treating Maize**, &c., E. G. Francis, Manchester.
17,712. **Method** of **Conditioning Beer**, E. G. Francis, Manchester.
17,713. **Pneumatic Tires** for **Cycles**, E. G. Francis, Manchester.
17,714. **Furnaces** for **Steam Boilers**, H. Lutz and W. Schaefer, Manchester.
17,715. **Grates** for **Furnaces**, A. G. Brookes.—(*E. Fales, United States* )
17,716. **Method** of **Ventilation**, J. F. Flannery and S. H. Terry, London.
17,717. **Vehicles**, J. Willoughby, London.
17,718. **Construction** of **Discharging Bags**, W. Jordan, London.
17,719. **Designing Patterns** for **Fabrics**, H. L. Cribb, London.
17,720. **Egg Opener**, E. Jouhaud, Enfield.
17,721. **Hoisting Apparatus**, L. Rosenfeld, London.
17,722. **Steam**, **Gas**, or **Oil Engines**, S. H. Berry, London.
17,723. **Paper Fasteners**, G. Hayes, London.
17,724. **Inking** and **Winding Typewriter Ribbons**, S J. F. Guibal, Liverpool.
17,725. **Shielding** the **Openings** of **Dresses**, W. Salmon, London.
17,726. **Eyes** for **Fastening Dresses**, F. E. Windsor, London.
17,727. **Stop** and **Burglar Alarm** for **Doors**, F. Botting, London.
17,728. **Electrically Propelled Vehicles**, E. A. Sperry, London.
17,729. **Shoe-sewing Machines**, G. R. Peare, London.
17,730. **Middlings Purifiers**, T. F. Hind and R. Lund, London.
17,731. **Spraying Liquids**, L. Rusden and R. Eeles, London.
17,732. **Spreader** for **Watering Cans**, W. E. Tidy London.
17,733. **Shoe-horn** for **Boots** and **Shoes**, E. J. Voss, Bexley Heath.
17,734. **Tool** for **Punching Metal Plates**, B. Haigh, London.
17,735. **Preparing Cereals**, A. J. Boult.—(*Catskill Mill Company, United States.*)
17,736. **Air-brake Couplings**, &c, S. W. Summers, London.
17,737. **Insulation** of **Electric Cables**, G. H. Nisbett, Liverpool.
17,738. **Tabulating Statistics**, A. J. Boult —(*H. Hollerith, United States* )
17,739. **Carriage Ventilators**, J. Taylor, Liverpool.
17,740. **Crystals** for **Decorative Purposes**, J. Morris, London.
17,741. **Galvanic Batteries**, W. P. Thompson.—(*A. Lessing, Germany.*)
17,742. **Manufacture** of **Rubber Tubes**, A. J. Boult.—(*The United Berlin-Frankfort Rubber Works Company, Germany* )
17,743. **Vapour Burners**, V. Simonet, London.
17,744. **Brewing Syrup**, L. I. N. Norman, London.
17,745. **Fastening Rail Joints**, G. B. Ellis.—(*The "White" Patent Rail-Joint Company, Ld., Australia.*)
17,746. **Printing Ink**, F. W. Oliver, London.
17,747. **Paint**, F. W. Oliver, London.
17,748. **Clamping Device**, H. J. Haddan.—(*H. S. Buckland, United States.*)
17,749. **Clamp Device**, H. J. Haddan.—(*H. S. Buckland, United States.*)
17,750. **Friction Buckle**, W. Häusler, London.
17,751. **Mandolines** and other **Instruments**, J. Connery, London.
17,752. **Centrifugal Separators**, O. J. R. Ström, London.
17,753. **Velocipedes**, J. Quincy and V. Bélanger, London.
17,754. **Sausage Machines**, H. Lefeber and L. Heuber, London.
17,755. **Coffee Pots**, L. Béchaux, London.
17,756. **Governors** for **Engines** and **Motors**, J. Dow, London.
17,757. **Prepayment Gas Meters**, W. N. Milsted, London.
17,758. **Photographing** in **Colours**, V. Mathieu, London.
17,759. **Artificial Fuel**, W. B. Hartridge, London.
17,760. **Artificial Fuel**, W. B. Hartridge, London.
17,761. **Electric Arc Lamps**, J. Brockie, London.
17,762. **Paper Cuff Protectors**, &c., F. C. Watts, London.
17,763. **Draught Regulators**, C. F. Kaul, London.
17,764. **Self-acting Disinfecting Closets**, T. Temple, London.
17,765. **Gas Engines**, Tangyes, Ld., and A. J. Lester, London.
17,766. **Hydraulic Motors**, E. F. Piers, Bart., London.
17,767. **Cleaning Trunks**, B. Willcox.—(*J. C. Potter, United States* )
17,768. **Band Cutters** and **Feeders**, V. C. Bailey, London.
17,769. **Shears**, P. R. J. Willis.—(*D. H. Hollingsworth, United States.*)
17,770. **Grinding Cocks**, C. M. Jarvis and R. S. Byron, London.
17,771. **Generating Steam** by **Gas**, W. Felton, London.
17,772. **Air Compressors** for **Tires**, J. A. Clarke, London.
17,773. **Mud-guards** for **Cycles**, &c., W. R. Ridings, London.
17,774. **Electric Signal**, The Phonopore Company, Ld., and E. W. Smith, London.
17,775. **Washing Machines**, E. J. Hodge, London.
17,776. **Tips** for **Billiard Cues**, W. R. Yates, London.
17,777. **Screens**, A. M. Jones, London.
17,778. **Advertising**, H. Downer, London.
17,779. **Paper-making**, T. A. and C. D. Marshall, London.
17,780. **Water Meters**, A. J. Boult.—(*T. Derichs and Messrs. Hegenscheidt Bros.*, ———.)
17,781. **Clutch Speed Mechanism**, J. Redding, London.
17,782. **Sketching Canvas Holder**, J. G. Jones, London.
17,783. **Attaching Heels** to **Boots**, T. Peberdy and W. Earp, Leicester.

19*th September*, 1894.

17,784. **Galley**, A. W. Townshend, London.
17,785. **Reflector**, F. J. Borland, Leeds.
17,786. **Circular Weaving Machine**, C. T. B. Brain, Liverpool.
17,787. **Filters**, L. Padé, Manchester.
17,788. **Woven Fabrics**, A. Brunton and A. Hewitt, Manchester.
17,789. **Driving Gear** for **Dynamos**, G. Twigden, Bristol.
17,790. **Mild Steel Railway Chairs**, T. Williamson, Wishaw, N.B.
17,791. **Furnaces**, S. Wilson, Bedford.
17,792. **Faller Motion** for **Self-acting Mules**, J. Lees, Oldham.
17,793. **Paper Bags**, F. E. Hollyer, Brentford.
17,794. **Frame** for **Cycles**, W. Earp and W. Askham, Nottingham.
17,795. **Vehicles**, J. Inglis, Glasgow.
17,796. **Stiffenings** for **Corsets**, &c., J. M. Ballantyne, Glasgow.
17,797. **Window Fastener**, J. Kennedy, Glasgow.
17,798 **Gearing** for **Velocipedes**, C. R. Garrard, Worcester.
17,799. **Deal**, **Batten**, and **Board Elevator**, P. E. Robilliard, Guernsey.
17,800. **Pneumatic Safety Appliance** for **Boats**, A. Johnson, London.
17,801. **Coin-freed Automatic Machines**, R. Gell, Douglas, Isle of Man.
17,802. **Firing Keys**, H. C. L. Holden, Woolwich.
17,803. **Pyramid Margarine Boxes**, W. McDonnell, Limerick.
17,804. **Food** for **Horses** and **Cattle**, A. Neumann, Manchester.
17,805. **Insulating Hot Chambers**, M. C. Bannister, Manchester.
17,806. **Preventing Straining** in **Machinery**, H. C. Lobnitz, Glasgow.
17,807. **Children's Carriages**, W. S. McLennan and T. Morton, Glasgow.
17,808. **Electric Arc Lamps**, H. Lyon, Glasgow.
77,809. A **Trousers Suspender**, G. Franke, London.
17,810. **Velocipedes**, C. Renysen, Birmingham.
17,811. **Speed Gearing**, G. E. Graves and W. A. Webb, Newcastle-on-Tyne.
17,812. **Checking Engines**, E. Waddington, Barrow-in-Furness.
17,813. **Railway Porters' Lamps**, C. Tennett and H. Leggott, Bradford.
17,814. **Newspaper Self-binder**, E. G. Parry, Llandudno.
17,815. **Coupling Main Driving Ropes**, W. Haigh, London.
17,816. **Horseshoes**, G. B. Birch, Birmingham.
17,817. **Bottle Stopper**, F. W. Kitto and W. Haworth, London.
17,818. **Bottle Stoppers**, A. J. Boult.—(*M. W. Nachfolger, Germany* )
17,819. **Keeping Foods Hot**, E. W. Crebbin and J. W. S. Holt, Liverpool.
17,820. **Soldering Aluminium**, W. P. Thompson.—(*O. Nicolai, Germany.*)
17,821. **Device** for **Testing Drain Pipes**, R. T. Bells, Birmingham.
17,822. **Raising** or **Lowering Curtains**, J. W. Hinchliffe, London.
17,823. **Weighing Machines**, J. C. B. Jones, Liverpool.
17,824. **Razors**, C. W. S. McHugh, London.
17,825. **Speed Indicators** for **Vehicles**, T. S. James, London.
17,826. **Tires**, H. Parsons, London.
17,827. **Luggage Carrier** for **Cycles**, H. J. Owers, London.
17,828. **Shoe** for **Sculls**, E. W. Aldridge, F. W. Moss, and H. Thornton, London.
17,829. **Self-righting Lifeboat**, E. W. Aldridge, F. W. Moss, and H. Thornton, London.
17,830. **Fire-resisting Curtains**, &c., E. Taylor, London.
17,831. **Chainless Gear** for **Cycles**, W. Rose, London.
17,832. **Decoration** of **Movable Surfaces**, A. Mudie, London.
17,833. **Coat**, I. Finberg, London.
17,834. **Washing** and **Wringing Machines**, H. Heinrichs, London.
17,835. **Driving Mechanism** of **Cycles**, L. Clement, London.
17,836. **Drying Apparatus**, W. W. Wardle, London.
17,837. **Engine Reversing Mechanism**, C. E. R. Martin, London.
17,838. **Cycles**, W. R. Lake.—(*Freeman High Speed Bicycle Company, United States.*)
17,839. **Sewing Boots** and **Shoes**, &c., W. E. Tyrrell, London.
17,840. **Combination Sleeve-links**, C. E. Whitlock, London.
17,841. **Shaping Necks** of **Bottles**, H. H. Lake.—(*W. Painter, United States.*)
17,842. **Carriages** for **Common Roads**, A. W. Knight, London.
17,843. **Axle-boxes** for **Locomotives**, J. Richardson, London.
17,844. **Photographic Shutters**, C. P. Goerz and E. R. Nerrlich, London.
17,845. **Electric Lamps**, J. Devonshire.—(*E. Thomson, United States.*)
17,846. **Electric Lamps**, J. Devonshire.—(*E. Thomson, United States* )
17,847. **Construction** of **Buildings**, F. W. Holloway, London.
17,848. **Apple Wine** and other **Presses**, C. J. Ollagnier, London.
17,849. **Appliance** for **Supporting** the **Arch** in **Cases** of **Flat Feet**, W. S. Melsome, London.
17,850. **Shaving** and **Paste Brushes**, S. M. Holmes, London.
17,851. **Nuts**, E. J. O'Neill, London.
17,852. **Tidal Motor**, D. Newell, London.
17,853. **Hauling Apparatus**, A. Taylor, London.
17,854. **Printing Blocks** or **Plates**, W. A. Day, London.
17,855. **Cycle** and **Carriage Wheels**, W. H. Serjeant, London.

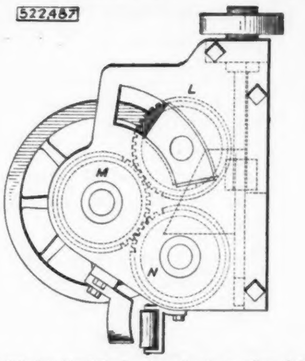
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**522,487.** **Machine for Flaring and Bending Hoops**, *J. Pleukharp and T. Schramm, Columbus, Ohio.—Filed May* 20*th*, 1893.

*Claim.*—(1) In a hoop-flaring machine, the combination of a series of three rollers, L, M, and N, guides for the bearing of the roller L formed on the arc of circles whose centres coincide with the axis of the roller M, a slide having inclined portions to engage with the said bearings, and a screw for moving the said slide to adjust the bearings to change the relative position of the said roller L, substantially as and for the purpose described. (2) In a machine for flaring hoops the combination with a frame having slotted slides, bearings arranged within the slots, rollers journalled between the sides, a roller journalled in the bearings, a slide having an inclined face adapted to bear upon the bearings and adjust the same and means for moving the said slide back or forth, substantially as shown and described.

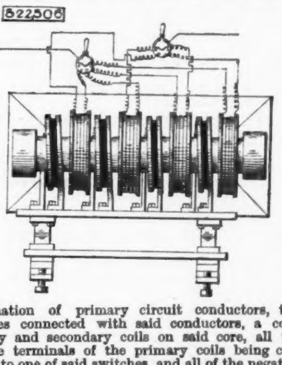
522487



**522,506.** **Electric Converter**, *G. D. Purton, Boston, and E. E. Angell, Somerville, Mass.—Filed November* 14*th*, 1892.

*Claim* —(1) In an electric converter the combination of two standards provided with eyes at their upper ends, a tubular sheath disposed at its opposite ends in said eyes, iron rods disposed in said sheath, primary and secondary coils disposed on said sheath, the secondary coils having rigid terminal arms and plates connecting said arms of the same polarity. (2) The combination of primary circuit conductors, two switches connected with said conductors, a core, primary and secondary coils on said core, all the positive terminals of the primary coils being connected to one of said switches, and all of the negative terminals of said primary coils being connected to the other switch, said secondary coils having horizontal arms constituting terminals, and a positive pole plate attached to one set of said arms, and a negative pole plate attached to the other set of said arms, substantially as set forth.

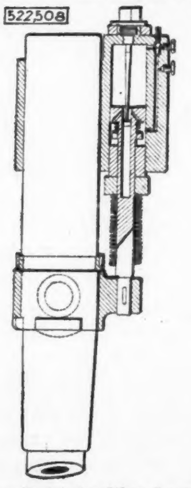
522506



**522,508.** **Recoil Check for Ordnance**, *J. B. G. A. Canet, Paris, France.—Filed February* 9*th*, 1893.

*Claim.*—(1) In a gun mounting, a hydraulic brake apparatus comprising a cylinder, a piston and hollow piston-rod, apertures leading through to the front of the piston from the interior of the rod, a spring loaded non-return valve for closing said apertures to allow the liquid to flow therethrough in one direction only, a taper spindle secured to the cylinder end and adapted to enter the piston-rod and control the area of the outlet opening for the liquid during recoil, a thoroughfare forming a communication between the ends of the brake cylinder on opposite sides of the piston, and an adjustable screw valve operated from the exterior of the brake cylinder for controlling said thoroughfare, and regulating the speed of running out the gun, substantially as set forth for the purpose specified. (2) The combination with a gun, of a hydraulic brake cylinder, a thoroughfare formed in the cylinder to communicate with the opposite ends thereof, an adjustable screw-down valve for closing said thoroughfare, and apertures leading into the thoroughfare at opposite sides of the adjustable screw-down valve and provided with non-return valves, said apertures being adapted to receive the delivery pipe of a force pump to run the gun in or out when the adjustable screw down valve is closed, substantially as described.

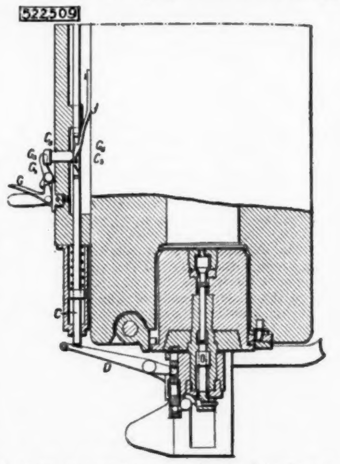
522508



**522,509.** **Firing Mechanism for Ordnance**, *J. B. G. A. Canet, Paris, France.—Filed April* 27*th*, 1893.

*Claim.*—(1) In a breech-loading gun, the combination of a bracket or support, a recoiling gun, trigger mechanism and an actuating lever therefor mounted on and carried rearward by the recoiling of the gun, and lever operating mechanism arranged in operative connection with said bracket or support, and set to operate the actuating lever of the trigger mechanism by the forward movement of the gun, substantially as described. (2) In a breech-loading gun, the combination, with the gun and its trigger mechanism, of a hook J secured to a part that recoils with the gun, and an axially movable spring-controlled rod C adapted to be engaged by said hook and to be moved forward to compress the controlling spring thereof during the running out of the gun, the rear end of said rod being in a position to strike the firing lever when released from the hook, substantially as described for the purpose specified. (3) The combination, with the gun and its trigger mechanism, of the hook J secured to a part that recoils with the gun, a spring-controlled rod C adapted to slide axially in fixed bearings on the gun carriage, and to be engaged by said hook J during the running out of the gun, the rear end of the said rod being in a position to strike the firing lever D when released from the hook J, and means for disengaging the hook J and thus liberating the rod C, substantially as and for the purpose specified. (4) The combination, with a gun and its trigger mechanism, of a spring controlled rod C axially movable in stationary bearings, and the rear end of which is adapted when released to strike the firing lever D, a slot $C^3$ in said rod, a hook J secured to a part that recoils with the gun and adapted to enter said slot $C^3$ and thus engage the rod C, and the pin $G^2$, lever $G^3$, and lever G for disengaging the hook J from the rod as required, substantially as and for the purpose specified. (5) The combination, with a gun and its trigger mechanism, of a spring-controlled rod C axially movable in stationary bearings, and the rear end of which is adapted when released to strike the firing lever D, a slot $C^3$ in said rod, a hook J secured to a part that recoils with the gun and adapted to enter said slots $C^3$ and thus engage the rod C, the pin $G^2$, lever $G^3$, and lever G for disengaging the hook J from the rod as required, an inclined part $C^4$ at the forward end of the slot $C^3$, and a corresponding inclined part $G^5$ on the end of the pin $G^2$, whereby the said pin is moved out again during the rearward movement of the rod C when said rod is released, substantially as described for the purpose specified.

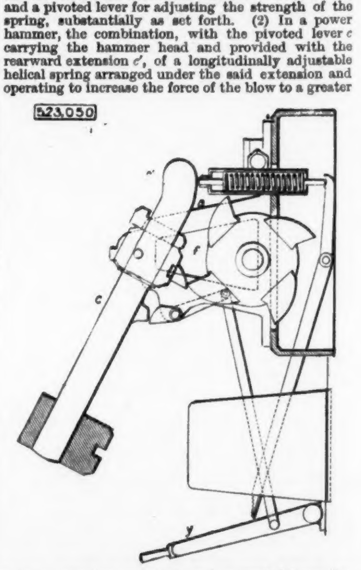
522509



**523,050.** **Machine for Forging or Hammering Metal**, *L. A. Parrock, Birmingham, England.—Filed October* 2*nd*, 1893.

*Claim.*—(1) In a power hammer, the combination, with the pivoted lever *c* carrying the hammer head and provided with the rearward extension $c'$, and the segment *f* below its pivot; of a spring operating on the said extension to increase the force of the blow, and a pivoted lever for adjusting the strength of the spring, substantially as set forth. (2) In a power hammer, the combination, with the pivoted lever *c* carrying the hammer head and provided with the rearward extension $c'$, of a longitudinally adjustable helical spring arranged under the said extension and operating to increase the force of the blow to a greater or less extent as required, and a pivoted lever for adjusting the said spring, substantially as set forth. (3) In a power hammer, the combination, with the standards *a*, of the hammer lever pivotally supported by the said standards and provided with the projection *v*, the handle *y* pivoted in one of the said standards and provided with a cam-shaped stop *u*, arranged under the said projection, a pivoted lever at the front of the anvil, and a rod pivoted to the lever and handle for operating the said handle, substantially as set forth.

523050



## WHITWORTH SCHOLARSHIPS.

We have received from time to time so many letters upon the subject of the Whitworth Scholarships, inquiring for particulars as to regulations and also for advice, that we think it desirable to put in a concise form some account of the history of these prizes, and if possible to assist those of our younger readers who may become competitors. The desire of Sir Joseph Whitworth—then Mr. Whitworth—to assist in forming a faculty of engineering similar to the faculties of divinity, law, and medicine, led him on 18th March, 1868, to write to the Right Hon. B. Disraeli, M.P., offering to found thirty scholarships of the annual value of £100 each to be applied for the further instruction of young men, her Majesty's subjects, of the United Kingdom, India, or the Colonies, selected by open competition for their intelligence and proficiency in the theory and practice of mechanics and its cognate sciences.

The first competition was to be held in 1869, and the age of competitors was not to exceed twenty-six years. Candidates were to be of sound bodily constitution, and equal credit was to be given for proficiency in handicrafts as in theory. As the scheme could only come into use gradually—for it was proposed that each scholarship should be tenable for three years—ten scholarships were offered for competition in May, 1869, and sixty exhibitions or premiums of the value of £25 each were put absolutely at the disposal of various universities and colleges, to be awarded by them in 1868 to students under twenty-two years of age who should undertake to compete for the scholarships of £100 in May, 1869. The deed by which the necessary endowment was made sets forth that Mr. Whitworth desired to assist the Education Department to regulate the competition during his own lifetime, and thereafter to enable the committee to alter the regulations as might seem best. The scholarships were each to be tenable for two or three years, as might seem preferable. The whole of the examinations were to be carried out by the Science and Art Department at their ordinary May examinations.

In the first year's competition, 1869, the first name upon the list is William H. Greenwood, aged twenty-three, who obtained 74 marks for theory and 69 for practical work—making a total of 143. John Hopkinson, B.Sc., aged nineteen, student of Cambridge University, appears third on the list, with 122 marks for theory and 12 for practical work—making a total of 134. This is the gentleman who is now Dr. John Hopkinson, and has attained such a prominent position in the engineering world. The examination in the use of tools was very practical; for example, under the heading of axes, we find the competitor was required to true up an octagonal block of wood like a sample block, using the axe only; to make an axe haft like a pattern, using axe and spokeshave. In fitting he had to chip a piece of cast iron over the top surface; file up any two adjacent sides of a cast iron cube, giving the file 9in. stroke. In the earlier years the competition was divided between students and workmen; the theoretical part of the examination was the same for both, but the practical part required a higher standard of attainment on the part of the workmen. In the year 1870 among other names, we find that of John Perry, now so well known from his work in connection with his co-professor, Mr. Ayrton.

In the year 1873 it was specially pointed out to intending competitors that the scholarships were not founded with the object of rewarding past merit, but as an aid to further study. Those who had shown most proficiency in theory would be required to follow practical work, and *vice versâ*. Sir Joseph Whitworth offered to allow the scholars to attend his shops at Manchester free of cost. The scholar was not to be allowed to take a place of profit, or to continue in any business he might be engaged in when he obtained a scholarship, but was to devote himself to completing his education at some place of study approved by the Department. Robert H. Smith's name heads the list of successful scholars for 1872, and he has since become Professor Smith, of Mason College, Birmingham.

In July, 1873, a change was made in the tenure of the scholarships, and it was decided that in the competition of 1875 every candidate for a scholarship must produce a certificate that he had worked in a mechanical engineer's shop, or in the drawing-office of a mechanical engineer's shop, for two years consecutively, but in 1874 only six months' consecutive work was required. The candidates were to be under twenty-two years of age. In 1875 and the following years each holder of a scholarship was required to produce satisfactory evidence at the termination of every year that he had made proper advances in the science and practice of mechanical engineering by coming up for an examination similar to that prescribed for the competition. The number of scholarships was reduced from ten to six; each was of the fixed annual value of £100, but bonuses were also payable, so that if one scholar were first in all the three years he would be awarded a total sum of £800. We have looked over the lists of successful competitors, and find that one William Sisson, aged twenty-one, of Gateshead, was successful in 1874, and during the term of three years was paid in all £780. We should like to know what has become of this gentleman, and what his success in the profession has been. In fact, we may say that we feel it would be a very desirable thing to collect information as to the life-history of all the Whitworth Scholars, with a view to seeing what positions they have attained in the profession.

New rules were brought out for the award of Whitworth scholarships in 1879. In that year they were (*a*) of the value of £125 tenable for three years, and (*b*) £200 in one sum; the successful candidates had the option of selecting which they preferred. Eight scholarships were offered for competition, and it was not necessary that the candidates should be examined each year they competed, in all the essential subjects. There were no conditions applicable to the scholarships of £200 in one sum; but for those of £125 for three years it was stipulated as before that the holder should give up his situation and devote himself to study, proving his advances each year.

For the year 1880 there were again changes; the scholarships were open to competitors who were of sound bodily constitution, who had not completed the twenty-second year of their age before May 1st of that year; and it was necessary that they should have spent at least six consecutive months in each of three successive years at handicraft. These changes were brought about by Sir Joseph Whitworth himself, who stated on December 13th, 1878, that after ten years' experience he had come to the conclusion that the withdrawal of a student from his business for three years seemed specially to militate against the success of the scheme as a means of improving the technical education of mechanical engineers in this country. From and after 1882 there were to be annually one scholarship of £200, eight of £150, and sixteen of £100, and these were to be awarded annually. The age of candidates was changed to twenty-six, as at first.

The report for the year 1883 recounts that from the year 1869 to 1873, both inclusive, ten scholarships were awarded each year of the annual value of £100 for three years. Of the fifty scholars appointed under these rules, thirty-one were believed to be engaged in business or professional work, eleven in teaching, two dead, and the Science and Art Department had no information relating to the other six. From 1874 to 1878 inclusive the scheme of bonuses previously described was adopted, and the limit of age reduced to twenty-two years, while the entire "student" class was shut out owing to the requirement of two years' workshop experience. Thirty-two scholars were appointed, and of these in 1883 twenty-one were believed to be engaged in business or professional work, four in teaching, and no data were available of the other seven. By the regulations, all candidates were required to give evidence of their practical skill in handicraft, and this might be tested if thought necessary by the Department.

In the thirty-third annual report of the Science and Art Department will be found an abstract of reports from Whitworth scholars appointed between 1869 and 1883 inclusive, stating the profession or occupation in which they have been engaged since the expiration of their scholarships. This is very interesting reading, and shows what has become of most of the men. We see sketches of the history of Professor Greenwood, of Firth College, Sheffield, Dr. John Hopkinson, Professor Garnett, Professor Perry, Professor R. H. Smith, of Birmingham, W. R. Bousfield, Q.C., Professor Hele Shaw, of University College, Liverpool, Professor Ryan, of Bristol, &c.; and we would recommend future competitors to refer to this report—page 59—and read these abstracts. The rules as applicable to the examinations in 1888 and future were altered as follows:—Whitworth exhibitions are some of them of the value of £100, and others of the value of £50 each, tenable for one year only. The scholarships are of the value of £125 a-year, tenable for three years. A candidate must not have completed his twenty-sixth year at the date of the examination. He must have been engaged in handicraft in the workshop of a mechanical engineer for at least three years on the 1st May of the year in which he competes, and have been at work at the vice and lathe or the forge or the bench during working hours for at least six consecutive months in each of those years. Twenty £100 exhibitions, ten £50 exhibitions, and four scholarships of £125 a year, tenable for three years, were competed for in 1888. Ten £100 exhibitions, twenty £50 exhibitions, and four scholarships of £125 a year, tenable for three years, were competed for in 1889; and since that date thirty £50 exhibitions and four scholarships of £125 a year, tenable for three years, in each year. The candidates are divided under three headings: (*a*) those who are or intend to be engaged in machine making, cotton, woollen, flax, &c.; or in engineering—marine, locomotive, and fixed; or in artillery. (*b*) Those engaged in the building trades and coachmaking. (*c*) Those engaged in naval architecture. The subjects are slightly different for each of these classes. Each exhibitioner will be required to submit, for the approval of the Department, a scheme of work or study for the year of holding his exhibition, and considerable latitude is allowed. On the approval of his scheme half the money will be paid, and the other half is paid on receipt of a satisfactory report at the end of the exhibition year. Exhibitioners are permitted to hold posts of profit or emolument while holding their exhibitions. No person can take an exhibition twice, but if otherwise eligible may compete in a subsequent year for a Whitworth scholarship. The competitors who obtain the scholarships are required to devote their time entirely to the prosecution of their education as mechanical engineers.

Before the scholarship can be finally awarded, the scholar must propose for the approval of the Department of Science and Art precisely how he will spend his time during his tenure of the scholarship, and it must be clearly understood that the tenure is subject to the condition that he pursues such a course of work. The payments are made half-yearly, and each payment is only made after the receipt of a satisfactory report. No holder of a scholarship can compete for a Whitworth exhibition. It is now considered sufficient to obtain a certificate of proficiency in practical work, but the Department reserve to themselves the right of testing a candidate's ability by requiring him to make two Whitworth screw bolts 1in. in diameter and 4in. to 6in. long, with hexagonal heads and nuts, alike within 0·001in.

The last set of rules still apply to the competition, and although, as we have seen, Sir Joseph Whitworth considered it was not advisable to cause the young engineer to give up all his practical work for three years, still, in the judgment of the Science and Art Department, it has been thought best to give a limited number of three years' scholarships.

The young aspirant for honours is usually anxious to know what is the best plan to follow when in preparation for the examination, what books to read, and where to study. We do not think any hard-and-fast rules can be laid down, but we believe the practice of most competitors to have been to work during the day in the shops while serving their time, and to attend evening classes for theoretical training. If a young man wishes to make his way in the world he will find this quite a feasible plan; in fact, after a day's manual labour he will probably find himself fresher for study than if he had been poring over a desk in an office. The practical work is absolutely essential, and cannot be shirked. The scholarships are not intended for the mere student, but for the practical man. In case a competitor is successful in obtaining a scholarship, he must of course devote himself according to the rules solely to study, and our opinion is that he would do well to attend one of the fine technical colleges either here or abroad, preferably the latter, as he would then be able to get such a solid practical acquaintance with one or more languages as would be found exceedingly useful in after life. If his time were divided—say, eighteen months at a French college and eighteen months at a German college—he ought, on the completion of his term, to be a very valuable man. On his return to England he should at once aim at taking a subordinate post in some large works, and his training should, while abroad, have been specially in one direction as much as possible. For example, he should have made a speciality of mechanical engineering, electrical engineering, or some other branch. His early mechanical training in the workshop would form the basis for the whole of his subsequent training, and is invaluable. By foreign travel the youth's ideas would be widened; and though we hear occasionally, especially in the North of England, foreign practice spoken of slightingly, there is no doubt it is a valuable addition to the knowledge of any engineer. With respect to books for study, it would be invidious to make a selection; that can safely be left to the professors of the evening classes which would be attended by the intending competitor.

One last word. We have had inquiries as to the addresses of "grinders;" we cannot give them, and if we knew them we should not think it desirable to give them if a system of cramming is to be pursued. It is useless for any young man to attempt in the short space of a few months to cram up a lot of formulæ and rules-of-thumb, and so hope to be successful. Steady and continuous study is necessary, and few young men are in a sufficiently easy financial position to pay a private tutor for such a lengthened course.

Advantages are now offered to young engineers which were by no means available twenty years ago; and it is quite possible first to obtain an exhibition which will materially assist the student, and help him eventually to win a Whitworth scholarship. The critical point in the career of the successful scholar is at the end of his third year; he feels perhaps that it is not to his taste to go back into the works or to obtain a post as outdoor foreman, and tends to diverge into science teaching. This should be carefully avoided. The object set before him by Sir Joseph Whitworth was the assistance of the mechanical engineer to rise in his profession as an engineer. Some few men of genius have been able to combine professional work with professorial work, but the majority of those who begin to teach will gradually and surely lose touch with practical work—at least that is our experience.

## BELGIAN EXHIBITS AT THE ANTWERP INTERNATIONAL EXHIBITION.

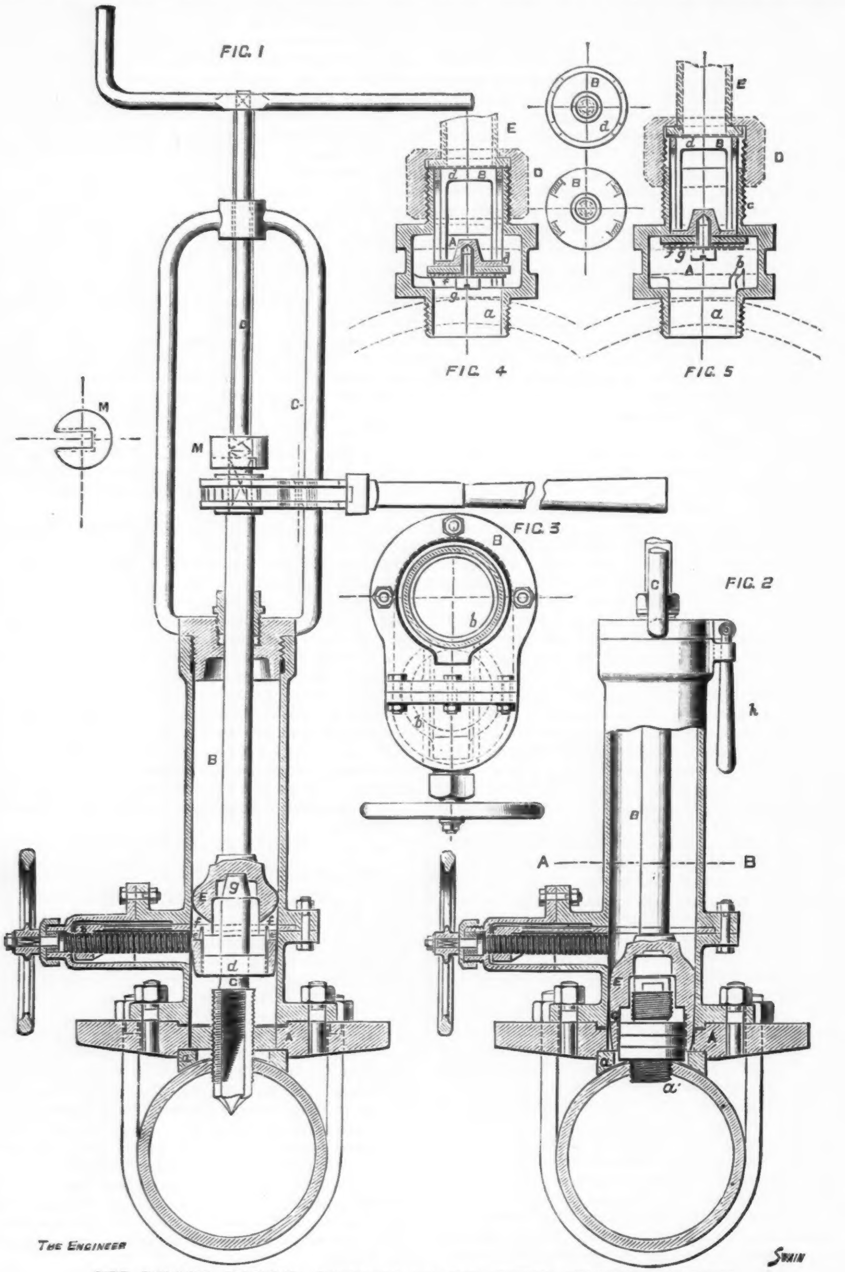
(*From our Special Commissioner.*)

One of the most conspicuous objects in the Main Exhibition Building is a trophy of cast iron gas and water pipes, surrounded by gas valves, penstocks, retort doors, &c., forming the exhibit of the Compagnie Générale des Conduites d'Eau, of Vennes, near Liége. This trophy, which serves to introduce bends, T pieces, and other joints, commences with pipes 4ft. 1in. internal diameter. It is 46ft. high, and the weight of the castings which form it is over 100 tons. The Vennes Foundry Company states that it exports more cast iron than all other firms in Belgium taken together. At its stand is a list of cities and towns in all parts of the world whose waterworks and gasworks have been supplied by it. To mention a few, I observe that it has had the contract for the gasworks of Lisbon, Madrid, Malaga, Alicante, Rio Janeiro, and Ostend; and for the waterworks of Turin, Lisbon, Windsor (in Canada), Guatemala, Huelva, and Pireus.

The chief novelty is a machine which the company has recently patented for drilling, tapping, and connecting a small pipe to a large one; whilst the latter is filled with water, or other liquid, under pressure. By using this apparatus there is no loss of the liquid contained in the large pipe; neither is any permanent saddle nor strap required. In the illustrations, Figs. 1 to 3 show the method of drilling the hole and fixing the connection in place. The saddle A, Figs. 1 and 2, has four slots in it, converging towards the centre, and enabling different-sized straps to be used, according to the diameter of the pipe to be drilled. The lower side of the ring *a*, on which the saddle rests, also varies according to the size of the pipe, and its interior diameter is large enough to allow the connecting piece to pass through it. The body of the apparatus, B, is bolted to this saddle, and a circular valve *b*, conical in section, and shown in plan on Fig. 3, can be screwed down by means of a hand-wheel when the tool has been removed, and it is necessary to take away the upper strap C in order to insert the connecting piece. This valve closes like the door of a penstock; and when closed the pressure of the liquid helps the pressure of the screw to keep it tight. The strap C is fastened to B with a bayonet joint, and it carries a screw D, whose thread is to the same pitch as that of the point of the connecting piece marked *a* in Fig. 2. The small safety handle *h*, shown at the top of

Fig. 2, is to keep the thread from unscrewing when the apparatus is fixed. The tool-carrier E, which is properly centred in C, first holds the tool, which is a combined drill and tap, and afterwards the connecting piece.

In working, the pieces *a*, A, and B are placed over the place where the connection is to be made, firmly secured by the straps, and the slide *b* is drawn back. The tool G is then placed in the tool-holder, where it is held in place by the springs *e e*. The upper strap C with its connections is then put on, and the hole drilled, either by turning the handle at the top, or, if necessary, by means of the ratchet-brace handle. When the hole has been drilled, the piece M—Fig. 1—which joins the head of the tool-holder to the bottom of D, is placed in position; the hole is then tapped by means of the upper handle. As soon as the hole has been drilled and tapped, the upper handle is reversed until the tool has been raised sufficiently high to allow of the slide *b* being closed. C is then taken down, the tool removed and replaced by the connecting piece—Fig. 2—which also fits into the tool-holder, and is kept in place by the two springs *g g*. It is then only necessary to replace *c*, and to screw down the tool-holder till the point *a* of the connecting piece enters the hole which has just been made. The apparatus can then be taken down.



PIPE DRILLING MACHINE, EXHIBITED BY THE VENNES FOUNDRY COMPANY

The shape of the connecting piece can be seen more clearly from Figs. 4 and 5. It consists of two essential parts, the lower solid piece A, and the valve B. In A there is a centre part *b* into which the bottom of the valve B descends, the upper end *c*, on to which the cap D is screwed, and the lower end *a*, which is screwed into the main pipe. This point is slightly conical, and it has been so screwed that whilst the first turns of the thread correspond exactly with that of the main pipe, the rest are a little larger in diameter; and, as the metal in this connecting-piece is softer than the cast iron of the main, it is, when screwed up tight, so compressed as to fill every crevice in the latter, and make a perfectly water-tight joint.

The main part *d* of the valve B fits into C, and a joint of leather, india-rubber, or asbestos, according to the nature of the liquid in the pipes, is held up by a hexagonal plate *f*, and a screw *g*. If desired, a spring can be introduced into *d* to balance the weight of the valve, but this is rarely considered necessary, as the slightest pressure of water is sufficient to keep the joint tight.

Until the connecting piece is in place, the valve B occupies the position shown on Fig. 4; the cap D and branch pipe E are only connected with it after it is in place. Directly it has been screwed into position, the pressure of the water lifts the valve B, and presses it against its seating, as shown on Fig. 5. The cap D, which carries the branch pipe, is now screwed on to *c*, and, as D is screwed down, the valve B is forced to descend. The main and branch pipes are then in connection, as shown on Fig. 4. When it is necessary to shut off the water from the branch, this can be done by unscrewing D and allowing the pressure to lift the valve B. As the valve is carefully centred, and with long guides, it is not likely to get out of order, or to require repairing from any reason; but if it has to be removed, the connecting piece can be taken out by the same apparatus which was used to insert it, and a plug substituted. In that case a little thin red lead should be put on the screw before replacing it.

The Vieille Montagne Company has an elegant little kiosque at the beginning of the Belgian section. It is covered with zinc tiles, painted with white oxide of zinc paint, and serves to display specimens of zinc in different stages of manufacture, and examples of the different purposes to which it can be applied. Commencing with samples of ore, they pass on to ordinary or commercial zinc, considered sufficiently pure for the manufacture of galvanised iron, or for remelting with copper to produce bronze. Samples of these are shown, as well as models of roofing covered with galvanised corrugated iron. A better quality of zinc is used for rolling into sheets, and a series of these are exhibited, running from $\frac{1}{250}$in., up to $\frac{1}{8}$in. Next come the applications of sheet zinc in tubes, gutters, Italian and ordinary corrugations, and roofing tiles, both plain, lozenge-shaped, and ornamental. Models of roofing made with these tiles are exhibited, including domed roofs, in which the size of each course of tiles is slightly less than that of the one below. Other applications of sheet zinc to roofing, such as cresting, finials, and cornices, are also shown. As examples of other forms in which zinc is used, it exhibits nails, wire, perforated sheets, sheathing for vessels, zinc plates for suspending in boilers to prevent corrosion or incrustation, and plates for zincography. The purest quality of zinc, which is found on analysis to contain less than one half-thousandth part of foreign matter, is used chiefly in the production of brass for cartridge cases. Of nearly equal purity is the metal from the ores of Moresnet, and this is employed for the manufacture of artificial bronze, chiefly for statuary. Finally it shows various forms of zinc plates for electrical purposes.

Considering the enormous consumption of beer in the Exhibition grounds, and indeed in the whole of Belgium, one would naturally expect that the show of brewery plant should be important. But though it covers a large space, it chiefly consists of bottle washing and bottling machinery, cooling apparatus, and various appliances such as counter fittings, which are connected rather with the consumption than with the manufacture of beer. One or two small coppers are shown, and five or six mash tuns about 8ft. in diameter. A peculiarity about these is that the makers do not seem to agree as to the best method of arranging the rousers. Thus M. Désiré Mathieu, of Thuin, exhibits a mash tun with the driving wheel running on a rack round the interior, and three arms on each side, each set with thirty-two beaters 9in. long. In M. Aug. Lermusiaux, of Jemappes, mash tun there is a horizontal shaft with vertical beaters on one side, and a vertical shaft with horizontal beaters on the other. Messrs. Struyf and Coppens, of Antwerp, have one resembling the above, but with the shafts which carry the vertical beaters curved. This firm exhibit a complete plant, engine, boilers, &c., including some copper pipe coolers of the usual type. Similar brewery plant is shown by M. de Coster Van de Velde, of Thielt, and M. F. Lermusiaux, of Antwerp, who both also exhibit mills, cleaning machines for malt, &c.

The most interesting collection of appliances in this section is that of Messrs. Pfaffenberger Brothers, of Brussels. One of these is a cooler, called the "Victoria Refrigerator." In this the beer to be cooled enters a trough at the top, and flowing over the edge on to the irregularly-shaped sides, which are made of tinned copper, falls in small cataracts to the bottom, where it is collected in another trough. Between the copper sides water circulates in the usual manner, but the peculiarity of this machine is that though iced water is used, ordinary water can be employed as well, thus economising the former. The ordinary water is passed through the upper part of the cooler, and the iced water through the lower part, so that they really form two separate machines, one above the other, though they can be connected when all the cooling water which is being used is of the same temperature. Another exhibit at this stand is an apparatus for washing bottles, called "La Rapide," and capable of cleaning two thousand per hour. An octagonal frame, carrying iron cylinders which are long enough to hold three bottles each, revolves in a tank filled with water. This takes five minutes to revolve, and as a bottle is removed another is pushed in behind, so that each one is soaked for a quarter of an hour. It is then transferred to the bottle washer, a wheel with eight bottle-holders, with a revolving brush to each, that enters the bottle directly it is in position. These brushes make 300 revolutions a minute. The wheel holding the bottles is also pivoted over a tank filled with water, so that four of the bottles are always under water. On emerging, another brush cleans the outsides to remove labels, and they are then automatically ejected on to a strainer. The machine makes four revolutions a minute, which is found to be an easy rate for a beginner, but it can be made to travel faster, as soon as the attendant can place the bottles more quickly.

An appliance for aërating and mixing yeast consists of a tinned copper vessel, at the bottom of which there is a wheel formed of six copper tubes of different lengths, the ends of which are all bent sideways in the same direction. Pure sterilised air, at a pressure of from 7 lb. to 14 lb. per square inch, is forced into these pipes, first passing through a filter at the side of the vessel. The exhibitor says that the volume of yeast in the vessel is at least doubled, as well as being thoroughly mixed, and that by the use of this aërated yeast, from one to three days are saved in the fermentation, and that a better beer results. A similar apparatus, consisting merely of a copper pipe with stop cock and small air filter at the top, and at the bottom the wheel, protected by a cage, is used for mixing the wort in the working backs. This machine, like the other, is entirely of tinned copper.

Another useful machine is for labelling bottles. In this the labels are in a receptacle below, and the paste in one above; the latter has small holes at the bottom, through which the paste exudes. The paste box is brought down to the top label, and then raised by a foot lever; whilst the box containing the labels falls with a spring as soon as the bottle is placed on it, leaving the upper label adhering to the bottle.

Messrs. Pfaffenberger say that next to the Victoria refrigerator their greatest novelty is a machine for repitching the insides of barrels and for removing the old pitch. It is called "l'Incomparable," and they claim that by its use a hundred barrels can be treated per hour, against twenty when the usual hand process is adopted, also that the work is done more thoroughly and that the pitch is applied more evenly, though less is used. It consists of a covered tank on wheels with a fire-box underneath, and a pump by means of which the melted pitch at a temperature of 480 deg. to 570 deg. Fah. is forced through a vertical tube with closed top, but pierced with a number of small holes. The barrel is placed on a ring which surrounds this pipe, so that the latter enters the bung-hole. The ring is connected by levers with the handle of the pump, so that it cannot be worked unless the ring is pressed down by the weight of the barrel. This prevents the ejection of pitch from the tube, when it is not covered by the barrel. The old pitch is melted by the fresh hot pitch, and flows back into the tank to be reheated. The ring on which the barrel rests is pivoted in the centre, and five or six strokes of the pump, whilst ring and barrel are slowly turned and make one complete revolution, are sufficient to remove the old pitch and to spread a thin and even layer of new. The exhibitors maintain that by the use of this machine not only can barrels be treated at much greater speed, and with a great saving in pitch, but that accidents to workmen and burnt barrels are rendered nearly impossible.

Messrs. J. Pagny and Co., of Saventhem, show appliances for drying malt, including models of complete hot-air apparatus. Their speciality is the manufacture of lattice work of iron wire, and of narrow strips of flat iron, for drying floors. Instead of these, in positions where greater strength is required, they recommend a floor made of straight galvanised rods ⅜in. or more in diameter, set at any required distance apart, and joined at intervals of 1¼in. to 3in. by a much finer wire. The latter only is twisted, and the larger wire, not having been weakened by bending, is stronger than if woven, thus giving a flooring of greater strength for the same weight of metal, besides one which offers less impediment to the free passage of the hot air, than a floor made of woven material.

At an exhibition held in Quentin Metsys' native city we might reasonably expect to see many examples of the blacksmith's art; for the Antwerpers are still proud of their skill at the forge. Unfortunately, the display of decorative wrought iron work is not great, and most of those who have exhibited have contented themselves with copying ancient locks and hinges, or the celebrated fountain at the back of the cathedral, instead of sending in original work. In this class, the exhibit which has met with most admiration is a grape vine, shown by M. Edouard Vosters, of Arendonck. The stem, leaves, grapes, and tendrils, are all cleverly copied, and naturally and gracefully arranged. The same exhibitor also shows a bough of a cherry-tree with leaves and fruit, which, like the vine, is entirely forged work.

M. Pierre Tavernier, of Ghent, has a good selection of art ironwork—it adjoins the exhibit of M. Vosters, in a side passage not easy to find. The principal pieces are a staircase railing and a lamp pedestal, both of beautiful workmanship, and apparently of original design.

Another interesting exhibit which might easily be overlooked is the "warning barometer"—*baromètre-avertiseur*—shown by Messrs. Harze and Closset, of Brussels. This instrument is intended to give warning of sudden falls in the barometer, and is meant chiefly for use in the offices of mine managers. It consists of two aneroid barometers, connected with a clock, and so arranged that one shall be free to work in the usual way, whilst the finger of the other is held electrically, and only allowed to move during the first five minutes of every hour. The instrument will sound an alarum if the difference is more than $m$ in $n$ seconds, the values of $m$ and $n$ being decided according to the locality, and the rapidity of a barometrical fall which may be considered to indicate danger in the underground workings. In the apparatus exhibited the alarum is rung when there is a fall of $\frac{1}{25}$in. per hour.

North's Portland Cement Works, whose concrete bridge was described and illustrated in The Engineer of June 15th, page 520, show samples of concrete and briquettes. A concrete testing machine exhibited at their stand is made by Messrs. Richter and Co., of Dresden. In this machine, the strain is put on by shot which fall one by one into a bucket. Directly the briquette breaks, the bucket falls and touches a trigger which shuts off the slide, so that the exact weight on the lever is shown by the shot in the bucket. They also exhibit blocks, gutters, &c., in concrete, and various descriptions of bricks and tiles.

Tiles are also shown by the Pottelberg Company of Courtrai, who manufacture several special forms. One of these is a tile intended for ceilings, and shaped so that it fits in between the bottom flanges of two joists. Another form of tile is intended for use on angle iron purlins 14½in. apart, no wooden laths being required.

Belgian civil engineers have a separate exhibit, consisting chiefly of projects. Some of these are for turning Brussels, Bruges, and other inland cities into seaports by the construction of ship canals. Several others are for improving the river Scheldt, and more particularly that part of it opposite and just below Antwerp, and for utilising the land on the opposite side, called the Tête de Flandres. The most important set of projects are by M. Alph. Müllender, of Liége. They comprise an underground electric railway for Brussels, another under the Scheldt, a large iron-lined tunnel under the same river intended for foot-passengers and carriages, and a proposed new town on the Tête de Flandres. He also shows a full-sized model of the front of a tunnel formed of cast iron rings, like those of the South London Railway. It is 10ft. 6in. diameter, and the front of an electric locomotive is shown in it, to indicate the space it would occupy. Mr. J. H. Greathead, M.I.C.E., has worked with M. Müllender in these projects, which are now under consideration by the Belgian Government. The river at Antwerp makes a wide bend, the city being on the concave side, whilst the opposite shore has no docks, no important buildings, and is from a commercial point of view hardly utilised. English visitors are very surprised at this, and still more so on being told that the reason is because it is in a different province. Could we imagine Liverpool merchants refusing to invest money in Birkenhead unless it were transferred from Cheshire to Lancashire, or Greenwich boycotting the Isle of Dogs unless the Government agreed that it should form part of Kent? Yet this is the case with the Tête de Flandres. It is in the Province of East Flanders instead of in that of Antwerp, and Antwerp capitalists would sooner invest their money in the Congo than in the neighbouring Province. Bridges have frequently been proposed from Antwerp to the opposite side, but have always been opposed by the shipping interest, so that passengers from Antwerp to Ghent, Bruges, or Ostend, have first to cross the river by a ferry. A tunnel would certainly solve the difficulty, and enable railways from the west to have a terminus in the city, whilst it does not seem likely that such a splendid site for docks will remain unoccupied much longer, even if the work has to be done with foreign capital. One difficulty appears to be that of the fortifications. Three times this century the ramparts of Antwerp have been demolished, and reconstructed at a greater distance from the centre; and even now there are many who cannot see that with modern artillery, ramparts are of no use for the protection of a large city, which must rely on its isolated fortresses. Antwerp is surrounded by a ring of these, but Belgian military engineers say that larger ones are required at a greater distance from the city; so that if the course of the Scheldt is to be rectified and the Tête de Flandres utilised, it would seem that the present would be a suitable time for carrying out these undertakings. Any rectification of the Scheldt must necessarily take land from one province and add it to the other; but whatever increases the commerce of Antwerp is beneficial to the whole of Belgium, and it is to be hoped that no local jealousies will be allowed to stand in the way of the improvements which are being advocated by M. Müllender and others.

An exhibitor whose products are to be seen in several different parts of the Exhibition is M. Achille Legrand, of Mons, probably best known in England as the constructor of the rails, trestles, and rolling stock for the single-rail, or Lartigue railway, from Listowel to Ballybunion. His exhibits at Antwerp comprise different descriptions of portable railways, with switches and other accessories; locomotives and carriages for various kinds of produce, as well as tip-trucks and other appliances for contractors. He also shows plant of a more permanent character for the Congo Railway. In M. Legrand's system of portable railways, no bolts or wedges are required in putting each length together. The sleepers—which are of rolled steel, usually channel section—have clips riveted on, into which one side of the bottom flange of the rail fits; and these clips take the inner and outer side of the rail alternately. Thus, a length consists of two rails—usually 14 lb. or 18 lb. per yard—three sleepers with the clips on the outside, and three with them on the inside. There are no loose pieces except the fish-plates and bolts, and when once erected, the former are usually left fixed to one end. In putting a section together, the sleepers with outside clips are laid parallel and at their proper distance apart; the others are placed between them, but diagonally. The rails are then put in place, with the flange entering the outer clip, and the sleepers bearing the internal clips are then driven into position with a hammer. Where the traffic is comparatively heavy, the inner clips reach to the top of the web of the rail, and are bolted to it, the outer ones simply taking the flange as described above. In another variation of the same system, where there is no difficulty about riveting, and the sections do not require to be taken apart after they have once been put together, both inner and outer clip reach to the top of the web to which they are riveted. This gives a line capable of standing a good deal of rough usage without getting out of gauge.

The most extraordinary boiler at the Exhibition is that shown by M. G. Nechelput, of Ecaussines d'Enghien, in the grounds adjoining the Congo Section. The furnace is formed of an iron box ⅛in. or $\frac{3}{16}$in. metal, lined with firebrick. In this a series of steel tubes is caused to revolve. Water which has been heated almost to boiling point by the waste heat passing from the furnace to the chimney, is allowed to enter these tubes, and immediately vaporised.

The system is of course that of Maughan's "Geyser," except that this application of the idea of revolving tubes seems to be new. These tubes, as well as the connecting pieces on either side, are made of ¾in. steel plate. The exhibitor considers that in letting the tubes revolve, he prevents any of them from being subjected long to the fiercest heat of the furnace, and thereby adds considerably to their durability. He also maintains that a dangerous explosion would be impossible, as the quantity of steam at any time in the boiler is so small. A 30-horse power boiler occupies a surface of 3ft. 3in. square, and stands 6ft. 6in. high from the bottom of ashpan to top of feed-water heater; its total weight is 24 cwt. I saw the boiler pressure raised from 150 lb. to 250 lb. in a few minutes; but there was no means of ascertaining whether it would keep this pressure when supplying steam to a 30-horse power engine in full work, though the exhibitor assured me that it would do so easily.

## IS OUR IRON TRADE DECAYING?

In the *Times* appeared recently a somewhat sensational article on "The Decay of the British Iron Trade." The article was written in the most pessimistic spirit. The author was impressed with the belief that our trade was in an exceedingly bad way, and the only remedy he could suggest was a lowering of railway rates or the development of canals. It has been said, however, that it is possible to prove anything by figures, and the article in question was nothing if not statistical. A comparison was drawn between 1883, when the iron trade of Great Britain had reached its zenith, and other years, such, for example, as 1893. The figures were sufficiently startling to induce inquiry into their accuracy. One example of the result of the inquiry is sufficient. 1883 was credited with the production in round numbers of about 14,000,000 of tons. Now in 1893 there was produced in Great Britain 6,976,990 tons of pig iron, according to one authority, which we shall name presently. Here is a tremendous falling off, to all appearance; as nearly as possible, one-half as much made in 1893 as in 1883. But those who know something of the iron trade, are aware that no country under the sun ever made 14,000,000 of tons of iron in one year. As a matter of fact, the returns of the British Iron Trade Association show that in 1883 not 14,000,000 of tons, but 8,529,300 tons of iron were produced in Great Britain. The writer in the *Times* quietly added together the manufactured iron and steel and the pig iron, thus crediting the year with the same iron twice over. The manufactured iron and steel were made out of the pig iron. Treating 1893 in the same way, we have a total of 11,374,769 tons—a set of figures which of course convey a totally erroneous impression.

In order to arrive at an accurate idea of the position of the iron trade of this or any other country, attention must be confined to the production of pig iron and the quantity in stock, and to these things only. Mere weights cannot go beyond these. Either the trade is progressing or not, or is at a standstill. If it is getting on, the production of pigs will increase. If it is not, the production of them will diminish. The quantity in stock at the end of each year must not be overlooked. If stocks do not increase, then clearly we have been able to sell in the raw or manufactured state all the iron made. If they augment, then more has been produced than could be sold. In this way no doubt an idea of the position of the trade may be obtained, but to get a complete knowledge of its position the question of price must not be ignored. In a general way it may be said that the *Times* article is wholly misleading. The year 1883 was abnormal in various ways. It is, of course, true that other nations have greatly developed their means of production; but it does not in any way follow that because Belgium, France, the United States, and other countries can make pig and rails and such like, that we must be ruined. The demand for manufactured iron has grown to enormous dimensions. It would have been impossible for Great Britain to have gone on supplying the world, and there is no good reason now why we should not continue to do our share. We have already had something to say concerning the Belgian iron trade. That, like the trade of this and all other countries, has its good and its bad times. If we compare the progress of events in the United States with those of the trade in this country, we shall see that America has apparently far more cause for alarm than we have, yet we suppose that no American who is conversant with the subject would dream of talking of the "Decay of the American Iron Trade."

The annual report of the American Iron and Steel Association has just been issued. The figures cannot be minutely accurate, any more than are our own; particularly as regards manufactured iron and steel. The principal data are given in the accompanying table:—

| | U.S. America. | | Great Britain. | |
|---|---|---|---|---|
| Gross Tons. | 1892. | 1893. | 1892. | 1893. |
| Coal produced ... | 160,115,242 | 162,814,977 | 181,786,871 | 164,325,795 |
| Iron ore produced | 16,296,666 | 11,587,629 | 11,312,675 | 11,203,476 |
| Iron ore imported | 806,585 | 526,951 | 3,780,503 | 4,065,864 |
| Pig iron produced | 9,157,000 | 7,124,502 | 6,709,225 | 6,976,990 |
| Pig iron in stock | 506,116 | 662,068 | 872,095 | 868,730 |
| Bessemer steel ingots ... ... | 4,168,435 | 3,215,686 | 1,500,810 | 1,493,354 |
| Bessemer steel rails ... ... | 1,537,588 | 1,129,400 | 535,836 | 579,386 |
| Open-hearth steel | 669,889 | 737,890 | 1,418,830 | 1,456,309 |
| Total steel production ... ... | — | 4,019,995 | — | 3,049,663 |
| Coke produced, net tons... ... | 12,010,289 | 9,477,580 | — | — |

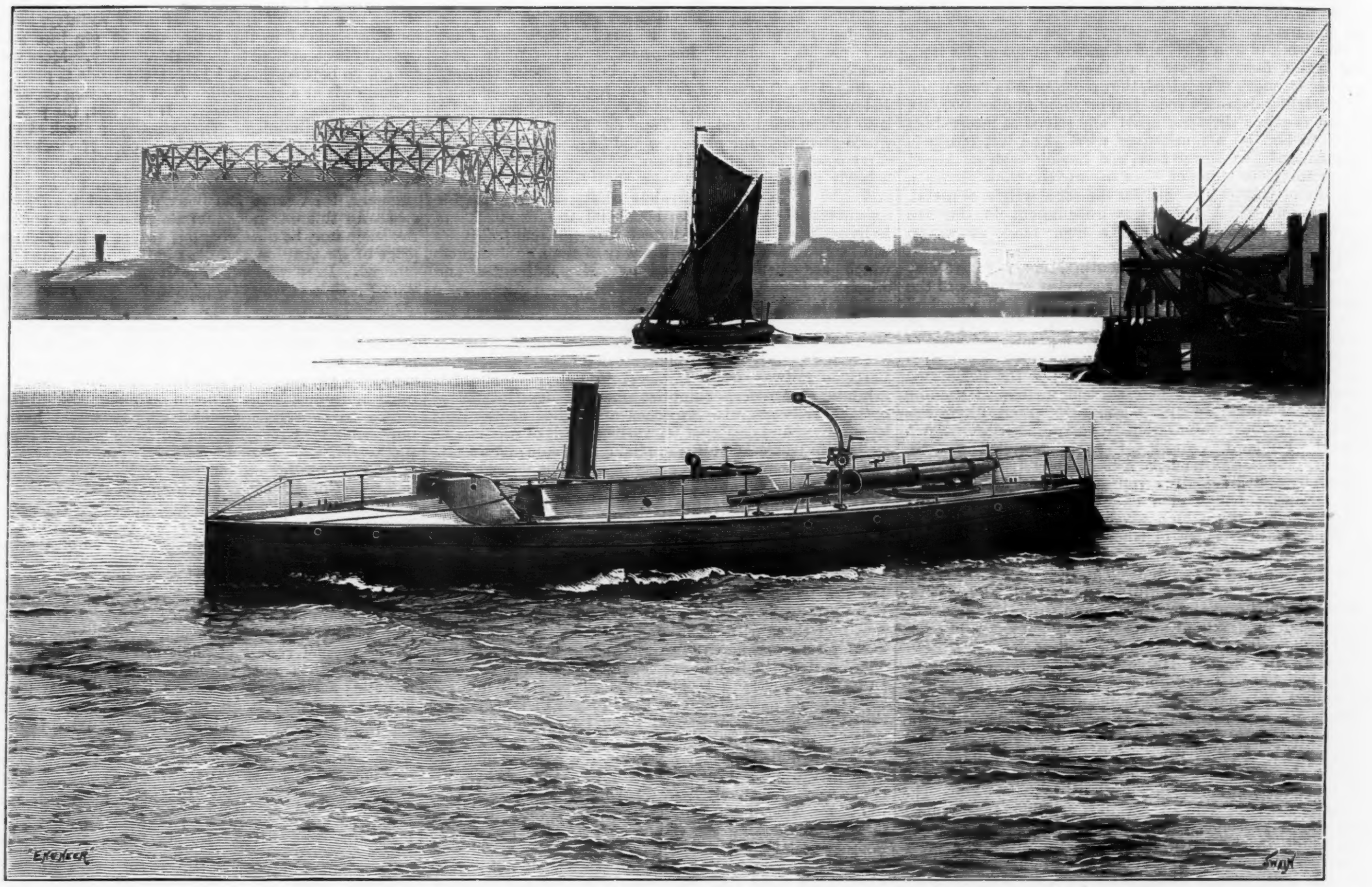
Here it will be seen that while the production of pig iron in this country was in 1893 greater by 267,000 tons than in 1892, it fell in America by no less than 2,033,000 tons. Our American contemporary, the *Engineering News*, commenting on these figures, says: "The shipment of iron ore from the Lake Superior region in 1893 amounted to 6,060,492 tons, against 9,069,556 tons in 1892, a decrease of 3,009,064 tons from this region alone. The decrease noted in pig iron productions was almost entirely in the second half of 1893; the decline in that half-year amounted to nearly 44 per cent. The production for the first half of 1894 was but slightly in excess of that of the last half of 1893, and the year ending June 30th, 1894, shows the lowest production of pig iron since the dull year of 1885." This does not look as if the United States iron trade was enormously prosperous or progressive.

It must not be forgotten, however, that the price of iron must be considered as well as the quantity. Assuming that gold is a metal with which pig iron is exchangeable, it is a matter of importance whether we get half an ounce of gold or a larger or smaller quantity for a ton of pig iron. The price of iron fluctuates in a very curious way, and seems to be more affected by what the purchaser will give for it than by the cost of production. It is certain at all events that the cost of making a ton of pig iron could not have been much more a few years ago than it is now, but the difference in prices has been very considerable. The report from which we have already quoted gives the following table of prices:—

| Articles. | 1873-9 Dols. | | 1884-5 Dols. | 1891-4 Dols. |
|---|---|---|---|---|
| Old iron T-rails, at Philadelphia ... | 25·18 | 22·05 | 19·48 | 16·43 |
| No. 1 anth. foundry pig, at Phila. ... | 18·40 | 17·52 | 15·75 | 14·52 |
| Gray forge pig iron, at Philadelphia... | 15·82 | 14·52 | 13·54 | 12·73 |
| " " Lake ore, at Pittsburg ... | 15·78 | 14·06 | 12·81 | 11·77 |
| Bessemer pig iron, at Pittsburg ... | 18·85 | 15·95 | 14·37 | 12·87 |
| Steel rails, at mills, Penna. ... ... | 31·75 | 29·92 | 30·00 | 28·12 |
| Steel billets, at mills, Pittsburg ... | 30·52 | 25·32 | 23·63 | 20·44 |
| Best refined bar iron, store, Phila. ... | 2·05 | 1·90 | 1·87 | 1·70 |
| Puddle bar iron, Pittsburg ... ... | 1·85 | 1·71 | 1·64 | 1·50 |
| Wire nails, per 100 lb., Chicago ... | 2·51 | 2·05 | 1·70 | 1·49 |

The ton here is the English ton of 2240 lb. Bar iron is rated at so much per 100 lb. Here we have a considerable drop in prices. Seeing then that there is both a fall in quantity and in price, it would be a very easy matter for the writer in the *Times* to prove that the United States iron trade is decaying. Precisely the same process must be applied to that of all other nations, and thus on a mountain of figures might be founded a story of national disaster sufficiently appalling to awe the stoutest heart. We see no reason, however, to assume that the iron trade of Great Britain or that of the United States is decaying. The demands made for work by the furnaces and mills of both countries are not easily satisfied. Not many years have elapsed since an order for 30,000 tons of rails would have filled the books of a large mill for a year. Half the quantity would have delighted the soul of any rail maker in this kingdom. Now, such an order barely suffices to keep a place going for a month. When complaint is made that trade is bad, it must not be forgotten that bad as it

## SECOND-CLASS ALUMINIUM TORPEDO BOAT FOR THE FRENCH NAVY.



is, it would have represented a period of feverish excitement with mills running night and day as hard as they could be driven but a few years since.

As to the suggested remedy—the reduction of railway rates and the development of railways—it is not necessary to say much here. The subject is one of colossal dimensions. It may be worth while, however, to say a word of warning. The discussion of such railway questions cannot be done to advantage except by those who understand very clearly what the difficulties are that the railway companies and their servants have to overcome. Thus, for example, if a company has already more traffic than it can deal with, a reduction in rates could do nothing to help the trader. As for the assertion made so freely by those who know least of the facts, that the glut of traffic and crowding of lines is due to gross mismanagement, it is enough to say that English traffic managers presumably know their business better than those whose acquaintance with the working of railways is obtained while travelling in passenger trains. An amusing instance of the mistakes that can be and are made through ignorance was recently supplied by an article in a daily contempory advocating the development of a canal between London and Birmingham. It was sadly admitted by the writer that the locks would be a great drawback; but he cheered up suddenly on remembering that in Belgium there is no trouble with locks on the canals. Lifts are used in that country, why not in England? The writer seems never to have been in Belgium, or else to have forgotten that it is for the most part an ideal country for canals, being dead flat; and as for lifts there is only one, that at Fontenette.

---

## AN ALUMINIUM TORPEDO BOAT.

Ten tons with steam up and coal in the bunkers; twenty and a half knots speed; 300-horse power. Ten years ago—perhaps five years ago—the man who suggested the possibility of producing a boat which could live in a sea and satisfy the conditions embodied in the first lines above would have been regarded as a lunatic by those who had not watched the progress of events. On Saturday last Mr. Yarrow demonstrated on the Thames the possibility of producing such a vessel, when, with a small party of guests on board, he ran an aluminium torpedo boat, which he has just completed for the French Government, from Greenwich Pier to Crossness and back. The boat which has not yet received either a name or an official number, is the largest vessel yet built of aluminium. Indeed, she is the largest structure of any kind yet produced in that metal, a small yacht and an arctic boat, recently illustrated in our columns, being her only predecessors. The torpedo boat is of the second-class. She is 60ft. long, and 9ft. 3in. beam. Thus she has 9in. more beam than the English 60ft. boats, a most important improvement in many respects. The object of what is termed a second-class torpedo boat is to be carried on the deck of large men-of-war, to be lowered in the water and to act, when necessity requires, as a scout to watch the movements of the enemy's torpedo boats, or for the use of the ship for landing and embarking the officers. The ordinary armament of a second-class torpedo boat consists of one or two machine guns placed forward and a torpedo launching tube aft.

It is self-evident that lightness of construction is of paramount importance in craft of this kind, not only because reduced displacement secures increased speed, but, considering that the boat has to be lifted and lowered by the tackle available on board the ironclad or other vessel, it is clear that the weight to be handled should be reduced to a minimum. Moreover, as these boats are placed high up on a ship's deck, any reduction of top weight increases the stability of the ship to which they are attached. In the English Navy a large number of these second-class torpedo boats is used to form part of the standard equipment of all men-of-war. The French naval authorities, however, up till last year had not adopted them, and, as they were desirous of introducing them into their Navy, they invited tenders for the best torpedo boat of this class which modern improvements enabled constructors to build, to serve as a type to be followed in the future. The primary conditions imposed were good sea-going qualities and lightness, combined with the highest obtainable speed. The proposal submitted by Messrs. Yarrow and Co. was the one accepted, as they were prepared to guarantee a higher speed and lighter weight to be lifted than any other firm, mainly in consequence of having determined to adopt aluminium for the construction of the hull. The boat illustrated is the first aluminium vessel built for the French Government.

Comparatively little has hitherto been known about aluminium as a structural material, and before adopting it Messrs. Yarrow and Co. carried out a series of elaborate experiments on the metal to obtain information. The great and uniform success of this firm in all their ventures is largely due to the elaborate system of experimenting carried out at Poplar. The trials of aluminium referred to its stiffness, best working temperature, corrosion, &c. It was found, in the first place, necessary to alloy the metal, by which its tensile strength was raised from 9 tons per square inch to about 18 tons. The alloy is mainly 6 per cent. of copper. As regards stiffness, &c., a general result was arrived at. All scantlings were increased 25 per cent. over that allowed for steel, and as aluminium weighs about one-third of steel, it follows that a reduction of about one-half was effected in the weight of the hull, which was reduced from about four tons for steel to about two tons for aluminium. In order to arrive at some precise information concerning corrosion, two aluminium plates were accurately weighed, and then secured on the sides of a wooden coppered sailing ship, the copper being removed and replaced by the aluminium. This ship made a voyage round the world, then the aluminium plates were removed, weighed, and found to have suffered no appreciable loss. The great foes to aluminium are alkalies, which attack it powerfully, and heat. It fuses at a moderate heat, and loses much of its strength at comparatively low temperatures. In the case of a torpedo boat there is no trouble incurred in avoiding both sources of risk. No plates cr angles were touched by the fire; everything was bent cold. The frames are a little closer together than they would be if of steel. The extra cost of material in the use of this particular boat being £1000 as compared with that of steel. In return there is a saving of about two tons in weight and a gain of about 3½ knots in speed over vessels of the same class and dimensions in the British Navy which steam under the like conditions at 17 knots. The boat is built in the usual way, and triple-riveted with aluminium rivets. Her machinery consists of a set of triple expansion engines, driving an aluminium bronze propeller at 580 to 600 revolutions per minute. These engines are balanced without bob weights, on Mr. Yarrow's principle, at two points only, the balance weights being fitted at properly calculated angles to the cranks. The boiler is of the ordinary Yarrow water-tube type.

The official trial took place on the 20th of September, the French Government being represented by a Commission, of which Captain L. Clerc was the president. We give below a copy of the official report of the trial:—

*Official Trial of Aluminium Second-class Torpedo Boat for the French Government by Yarrow and Co. Dimensions, 60ft. by 9ft. 3in.*

The trial consisted of a continuous run of two hours' duration in the estuary of the Thames. Weather, calm; number of persons on board, seventeen; total load on trial, three tons.

| No. of run. | Steam in boiler. | First receiver. | Second receiver. | Vacuum in condenser. | Air pressure in stokehold. | Revolutions per minute. | Time on knot. | Speed. | First means. | Second means. | Mean of means. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | in. | in. | | M. S. | | | | Knots. |
| 1 | 185 | 72 | 12 | 24 | 2½ | 600·36 | 2 42 | 22·222 | 20 893 | | |
| 2 | 185 | 72 | 12 | 24 | 1¼ | 598·80 | 3 4 | 19·565 | 20 721 | 20·807 | 20·503 |
| 3 | 175 | 72 | 12 | 24 | 2⅜ | 593·40 | 2 45 | 21·877 | 20 412 | 20 566 | |
| 4 | 175 | 62 | 11½ | 24 | 1½ | 578·16 | 3 10 | 18·947 | 20 187 | 20 299 | |
| 5 | 180 | 65 | 11 | 24 | 1½ | 586·80 | 2 48 | 21·428 | 20·496 | 20 341 | |
| 6 | 185 | 70 | 12¼ | 24 | 1¾ | 591·48 | 3 4 | 19·565 | | | |

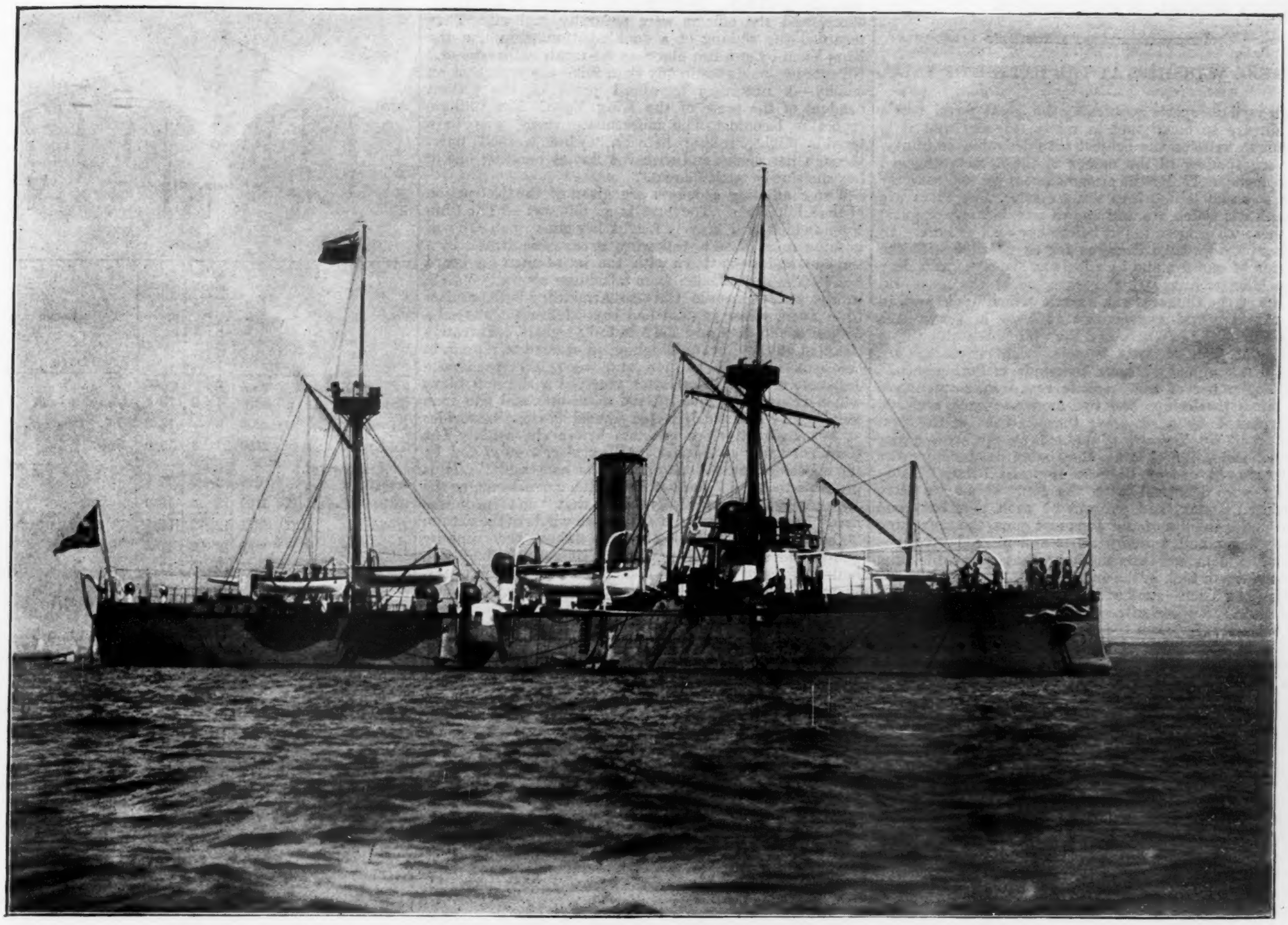
During the trial of two hours' duration the engines made 70,948 revolutions, being at the rate of 591·2 revolutions per minute, corresponding to a mean speed during the entire run of 20·558 knots per hour. The boiler—Yarrow's patent water-tube—made ample steam without priming, and the engines worked without any heating. The vibration was very slight, and not appreciable.

During all the trials of this boat, the absence of vibration and of noise in the engine-room has been most noteworthy. On Saturday she was run at various speeds from dead slow up to the highest attainable, and at none was the slightest vibration to be felt in any part of the boat forward, aft, or amidships. The only thing of the kind perceptible was a species of purring thrill. Part of this is no doubt due to the construction of the engines; but much remains to be explained by the metal. Although aluminium is in some forms one of the most sonorous in existence, in the shape of a torpedo boat it is wanting in that resilience and vibratory stiffness peculiar to steel. This largely explains the comparative silence of the engines. In a thin steel hull every sound is magnified, in the aluminium boat it is deadened—the new metal behaving apparently very much like wood. Nor is this silence without its value. Such a boat as this of which we write might be able to creep alongside an enemy and take him unawares, where the ordinary boat would be detected in the stillness of a night by the clank of its machinery.

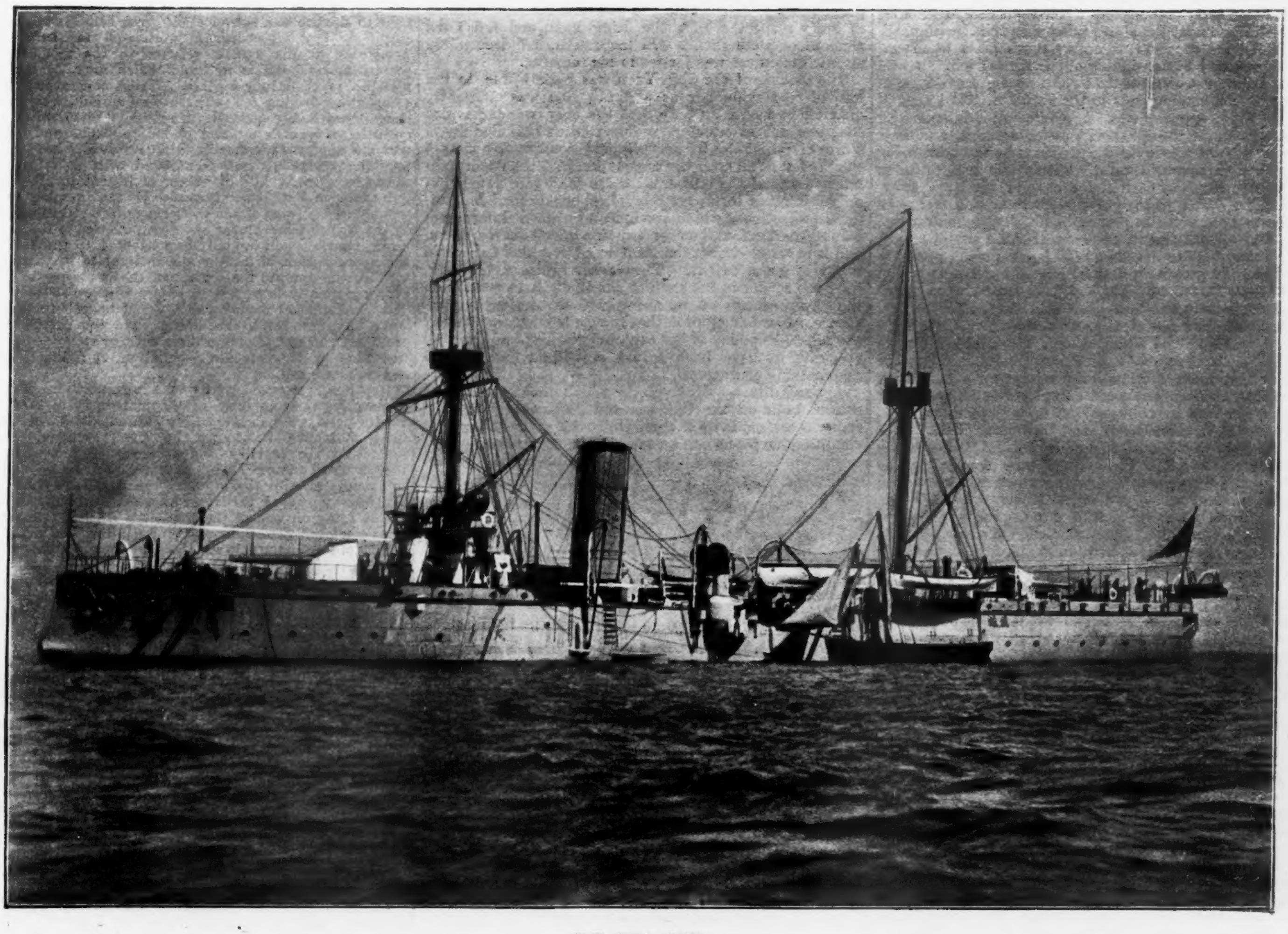
Beyond all question Mr. Yarrow has achieved a remarkable success. Many wise men shook their heads when he suggested the use of aluminium, and did not hesitate to

# UNARMOURED CHINESE WARSHIPS

(*For description see page 294*)



THE CHING YUEN



THE CHIH YUEN

say he was courting failure. The result has, however, more than justified him; he has succeeded in producing the best torpedo boat of the size that has ever been built. It now remains for the makers of aluminium to improve their processes and cheapen their material, so that the use of the new metal may be widely extended.

## CHINESE WARSHIPS AT THE BATTLE OF YALU.

The various reports concerning the great naval battle of Yalu are so conflicting in many respects that it is difficult to write on the subject with desirable certainty. The very spelling of the names of the vessels engaged is perplexing. Under the circumstances we can scarcely hope to avoid falling into some error. But there are certain facts which are well known and beyond dispute, and these we propose to put before our readers here. In another page we have dealt as far as possible with the question of gun-fire and its effects as displayed at Yalu.

We have engraved this week some of the most important of the Chinese war vessels which took part in the recent naval engagement at Yalu in Corea—the King Yuen and Lai Yuen, and the Chih Yuen and Ching Yuen—two pairs of sister vessels. The engravings are from photographs by Messrs. Symonds, of Portsmouth.

In September of 1887, a little squadron, consisting of two small battleships and two moderate-sized cruisers, accompanied by a sea-going torpedo boat of the first class, built by Yarrow, assembled at Spithead under command of Admiral Lang, they being destined for the reinforcement of the Chinese Imperial Fleet. These vessels were identical with the four which we have illustrated to-day, and one out of each pair has gone down under the fire of the Japanese guns, the remaining vessels being hulled many times and pierced upon the water-line, demonstrating the important part which the whole of them took in the engagement.

The King Yuen—sunk at Yalu—and the Lai Yuen, two small twin-screw barbette ships, partially armour belted and intended for coast defence, but capable of making extended passages at sea, were laid down for the Chinese Government by the Vulcan Company at Stettin, and were launched, the first on the 3rd of January, 1887, and the last on the 25th of March, 1887. They were completed in the summer of 1887, and left England, as mentioned above, in September of the same year.

The armour was compound, and consisted of a belt for protection of the engine and boiler-rooms from 2ft. above the water-line to 4ft. below it, and was 9½in. to 5¼in. thick. This belt was terminated and reinforced by transverse bulkheads 8in. thick. A protective deck 1½in. thick extended over the belt, the extremities of the vessel being protected by an armoured deck, sloping down, of 3in. in thickness. Their heaviest guns were coupled in a pear-shaped redoubt forward of the funnels, with 8in. of compound armour, whilst a strong steel shield extended over this barbette.

There was a conning tower abaft and above the barbette protected by 6in. armour. A double bottom extended for about two-thirds of the length of the ship, which was divided into sixty-six separate water-tight compartments, of which those next the ship's side were packed with cork. We shall have occasion to notice these facts when we allude presently to the sinking of the King Yuen.

The armament consisted of two 21 centimetre—8¼in.—Krupp breech-loading guns in the barbette, two 15 centimetre—5·9in.—guns of the same description in sponsons on the beam amidships, seven machine guns, and four Schwartzkopff torpedo dischargers, one in the bow under water, and three above water. There was one military mast. Ammunition carried for each of the large guns, 50 rounds. The principal dimensions, &c., were as follows:—Length, 270ft.; breadth, 40ft.; extreme draught, 16ft. 6in.; displacement, 2850 tons. The engines were triple expansion, to develope 3400 horse power, giving a speed of 15½ knots with natural draught and a speed of 16½ knots with forced draught. The boilers were cylindrical and four in number. The coal storage 325 tons.

The two twin-screw steel-protected cruisers, Chih Yuen—sunk at Yalu—and Ching Yuen, were laid down at Elswick in October, 1885. The first was launched on the 29th of September, 1886, and the second on the 14th of December, 1886. They were completed, and went out with the two ironclads built at Stettin, in September, 1887.

They had a turtle-back steel armoured deck from 2in. to 3in. thick, and a double bottom beneath the machinery. Two 8in. 12-ton guns were coupled in the bows upon a Vavasseur mounting, which was protected by 12in. of steel, and a protective shield. A third 8in gun was at the stern, whilst a 6in. 4-ton gun was sponsoned out on each broadside. They also carried seven 57 mm., two 47 mm., and eight 27 mm. quick-firing guns, six machine guns, and four torpedo tubes. The dimensions, &c., were as follows:—Length, 250ft.; breadth, 38ft.; draught, 15ft.; displacement, 2300 tons. The engines were triple-expansion, designed to develope 5500-horse power, and the estimated full speed was 18 knots. Coal capacity 450 tons.

A graphic description was given by the Flag Lieutenant of the Japanese Admiral of the way in which the King Yuen was fought by her Chinese captain, and her subsequent going down. The error which was made by the Japanese in mistaking her for her sister-ship, the Lai Yuen, is obvious. We have necessarily transposed the names. The report ran as follows:—"After a time the Chinese Admiral apparently became desperate. His formation was broken, and two or three of his ships advanced against us at full speed." Apparently the King Yuen and Chih Yuen. "The fighting became furious, but our weight of metal told, and one ship, the King Yuen, was crippled in this venture. When the Chinese resumed their line formation our guns were directed upon the disabled ships, particularly the King Yuen. She had been riddled by shot and shell, and it was evident that she was sinking. The Chinese gunners worked their weapons to the last. Finally, she went down slowly stern first. Her bows rose clean out of the water, and she remained in this position for a minute and a-half before she disappeared in one last plunge. We had used no torpedoes upon her, but sank her by fair shot and shell fire. It spurred all our men to additional effort, and the officers were naturally exultant. They regarded the sinking of a double-bottom ship like the King Yuen by gun fire alone as no mean achievement." No more valuable testimony than this—the report of an enemy—is necessary to afford proof of the gallant conduct of the crew of the King Yuen. The Chinese report is laconic. The unfortunate vessel was in a terrible plight, rolling heavily, "when a shell burst through her decks, and with the flames bursting out of her she slowly settled down."

Two conflicting accounts are given of the destruction of the Chih Yuen. The first is as follows:—"The Chih Yuen, which still bravely fought her guns when she was nothing more than a wallowing wreck, was struck by a torpedo, and went down with the brave men on board her." The second, also from a Chinese source:—"Late in the afternoon, the Chinese Armstrong-built cruiser Chih Yuen, whose captain had several times displayed a disposition to disregard the Admiral's signals, deliberately steamed out of line, although again ordered to remain in the spot assigned to her, and went full speed at a Japanese cruiser. The latter received a slanting blow, which ripped her up below the water-line, and she soon foundered. But she delivered several parting broadsides at her enemy at close quarters before she sank. The Chih Yuen was so injured by the cruiser's guns and by the effects of the collision that she also sank." It is probable that the latter account is the correct one, as the Japanese admiral positively asserts that "no torpedo was fired" by any of his vessels during the whole of the action.

Only one ship, therefore, appears to have been sunk by gun-fire alone, the King Yuen. Probably she had been hulled over and over again beneath and upon the water-line, when she rolled and exposed her bottom. Her sixty-six separate compartments failed to keep her afloat. It would be interesting to know whether, in the exigencies of service during the fight, the water-tight doors had to be left open. Reports say that the pumps of all the vessels were working furiously, and this shows that the engines and boilers were intact. It is possible that the one shell particularly alluded to, which burst through the deck, after which the vessel settled down, may have got into and wrecked the engine or boiler rooms. The stoppage of the pumps would necessarily have hastened the foundering of the vessel.

Whether, however, the vulnerability of the King Yuen was due to the thinness of the protective deck over the vitals—that being only 1½in.—or to failure of the water-tight door system, or to the awful concentration of the efforts which were made to sink her, the fact remains that she did go down under gun fire alone. In this connection it may not be inopportune to quote some remarks which were made by an officer on board of her at Spithead in September, 1887. He was drawing a comparison between her and her sister-ship, and the Chih Yuen and Ching Yuen turned out by Elswick. The two latter he pronounced to be splendid and powerful cruisers, finished in every respect, whilst the King Yuen and Lai Yuen were incomplete shells. On inspection, it did certainly appear that there was justice in his remarks.

The sinking of the Chih Yuen was clearly due to the folly of employing her as a ram. She was eminently unsuited to such a purpose, and the only wonder is not that she did eventually go down when assailed by a storm of projectiles in her crippled condition, but that she floated at all after her concussion with the enemy. In later vessels of the cruiser class the solid ram bow is not only reinforced in strength by phosphor bronze longitudinal projections, which are built into the cellular mass behind the forefoot, but the armoured deck curves down, and is associated with the stem so as to stiffen the whole to a very great extent. The earlier cruisers, however, were too tender in the stem to admit of their sustaining the severe shock of ramming without serious injury. Hence, we are of opinion that the Chih Yuen was lost by the mistaken policy of her captain, who appears from all accounts to have been a rash and ill-advised, though undoubtedly courageous, sailor.

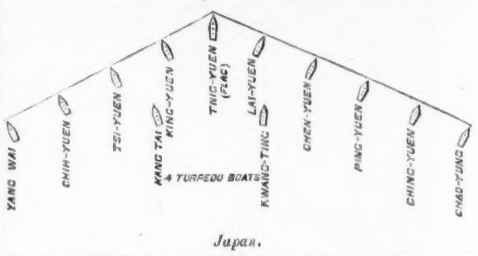
Appended is a list of vessels which took part in the action, both on the Chinese and Japanese sides, and remarks are made in the margin as to their subsequent condition, so far as can be ascertained at present:—

*China.*

| Ships. | | Displacement. | Armament Heavy | Armament Small | Speed. | Remarks. |
|---|---|---|---|---|---|---|
| *Armoured.* | | Tons. | | | Knots. | |
| Chen Yuen | P.3″ | 7430 | 6 | 8 | 14·5 | Belted. Disabled. |
| King Yuen | P.3″ | 2850 | 4 | 7 | 16·5 | Do. Sunk. |
| Lai Yuen | P.3″ | 2850 | 4 | 7 | 16·5 | Do. Caught fire; much damaged |
| Ping Yuen | P.2″ | 2850 | 3 | 8 | 10·5 | Do. |
| Ting Yuen | P.3″ | 7430 | 6 | 8 | 14·5 | Do. |
| *Unarmoured.* | | | | | | |
| Chih Yuen | P.4″ | 2300 | 5 | 23 | 18·0 | 10″ steel armour on barbette. Sunk. |
| Ching Yuen | P.4″ | 2300 | 5 | 23 | 18·0 | Do. Hulled badly. |
| Kwang Kai | P.1″ | 1030 | 3 | 8 | 16·5 | One of these subsequently said to be destroyed. |
| Kwang Ting | P.1″ | 1030 | 3 | 8 | 16·5 | |
| Tshao Yung... | ... | 1350 | 6 | 7 | 16·8 | Destroyed. |
| Tsi Yuen | P.4″ | 2355 | 3 | 9 | 15·0 | Disabled. |
| Yang Wai ... | ... | 1350 | 6 | 7 | 16·0 | Destroyed. |

And four torpedo boats.

The crushing damages that the Chinese squadron sustained are only too apparent. The Kwang Kai and the Kwang Ting, which were up the river with the transports when the Japanese appeared in sight, are the only vessels not reported to be injured, yet one of these was afterwards found on shore and torpedoed. The position of the Chinese was approximately thus, at first:—



*Japan.*

| Ships. | | Displacement. | Armament. Heavy | Armament. Small. | Speed | Remarks. |
|---|---|---|---|---|---|---|
| *Armoured.* | | Tons. | | | Knots | |
| Fusoo ... ... ... | | 3718 | 6 | 5 | 13·2 | Iron ship, old. |
| Hi-yei ... ... ... | | 2200 | 9 | — | 13·0 | Old. Disabled. |
| Tschiyoda | P.1″ | 2450 | 24 | 3 | 19·0 | New. |
| *Unarmoured.* | | | | | | |
| Akagi ... ... ... | | 615 | 2 | 2 | 12·0 | |
| Akitsuschima | P. | 3150 | 13 | 6 | 19·0 | |
| Hasidate | P.2″ | 4277 | 12 | 12 | 17·5 | 12″ steel on barbette. |
| Itsukusima | P.2″ | 4277 | 12 | 22 | 17·5 | Do. |
| Matsuchima | P.2″ | 4277 | 12 | 22 | 17·5 | Do. Disabled. |
| Naniwa | P.3″ | 3650 | 8 | 12 | 18·72 | |
| Takachiho | P.3″ | 3650 | 8 | 12 | 18·72 | |
| *Yoshino | P.4½″ | 4150 | 12 | 22 | 23·03 | Much injured. |

* Illustrated in our impression for February 16th, 1894.

The Sakiomaru was accidentally present in the engagement, and appears to have suffered severely if not sunk. It seems, thus, that whilst no vessels were actually lost by the Japanese, except possibly the Sakiomaru, three were either disabled or terribly injured; and, as the only reports upon their actual condition have been received from Japan, the whole truth may be much more serious than is admitted to be the case. But, clearly, China has come out of the action very much the worst.

## LORD ARMSTRONG ON SHIPS AND GUNS.

On Thursday, September 27th, the annual general meeting of the Elswick firm was held, and passed through with the brevity and calmness characteristic of these meetings. As the firm, in spite of the troubles of the past year, has been able to declare a dividend of 10¾ per cent., it is scarcely surprising that all concerned were well satisfied. Lord Armstrong in his speech referred to the moulders' and pattern makers' strikes in terms which must be far from pleasing to the labour leaders. Whilst congratulating the company on having a floating capital of sufficient bulk to carry them safely through these trade disturbances, and ensuring to them a position of independence and dignity, without appreciably affecting the dividend, he said the moulders' strike has now terminated with no other result than loss of trade, loss of wages, detriment to all cognate industries, and a large increase of the number of the unemployed. None of the great battleships recently ordered by the British Government have been allotted to the Tyne, a circumstance which can only be attributed to the fact that the apprehension of further labour troubles in this strike-torn locality damped the courage of the employers to tender at a sufficiently low price to secure a share of the orders. Thus vast sums of money which would have been spent in wages have been lost to the district, and the chief sufferers are those who seek to obtain their ends by stoppage of work instead of by dispassionate negotiation, or failing that, by impartial arbitration.

He then reviewed briefly the advances in hydraulic engineering as exemplified in the machinery of the Tower Bridge and Manchester Ship Canal, and in quick-firing ordnance as shown by the result of experiments on the rapidity and accuracy of fire. Some of the figures quoted have appeared in these columns in connection with the ordinary reports of the ship trials. The following are of particular interest:—In competition at target firing on one of the first-class English cruisers, the guns employed were 6in., weighing 6¼ tons, and firing projectiles of 100 lb.; the ship was steaming at eight knots an hour; and the range of the target varied from 1600 to 2200 yards. The best gun's crew fired 18 rounds in three minutes, and hit the target 14 times; the second crew got 12 hits out of 18 rounds, and the third 12 hits with 17. On the Royal Sovereign, a 13½in. gun, weighing 68 tons on an hydraulic mounting, and fitted with hydraulic breech-opening gear, fired seven rounds with projectiles weighing 1250 lb. in 12 minutes; and whilst the ship was steaming at eight knots an hour hit the target six times, the range varying from 1600 to 2000 yards.

Lord Armstrong, in remarking on the Chino-Japanese naval battle, said he preferred to reserve his opinion till further details were to hand, but he thought it had been clearly shown that swift cruisers, while "undoubtedly best for protecting commerce and for every variety of scouting and patrolling service, are also capable of acting with effect in pitched battles where vessels classed as 'battleships' are opposed to them."

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Chief Engineer: Arthur J. Jones, to the Racer. Engineers: Edwin Cudlip, to the Daring; and Hamilton J. Coad, to the Hornet.

## RAILWAY MATTERS.

The Mafeking Railway was opened on Wednesday amid great festivity.

The underground portion of the Walthamstow and Epping Forest Railway will be constructed on the Greathead shield principle. This is the only line that is authorised to use either steam or electricity.

From a report recently issued, it appears that during the last ten years, in the face of an increase of 1963 miles of railway, and large additions to the train mileage and number of trains, the accidents connected with shunting and the "coupling" and "uncoupling" of trains, decreased from 29 and 341 killed and injured in 1884, to 11 and 286 respectively in 1893.

The Executive Committee of the Mansion House Association on Railway and Canal Traffic for the United Kingdom have resolved to initiate test cases under the new Act in regard to the increased rates on merchandise and agricultural produce. It has also been decided to invite the co-operation of those traders and trade and agricultural organisations who desire to avail themselves of the provisions of the Act.

The subject of street car fenders has been investigated by Mr. Mendes Cohen, Past President of the American Society of Civil Engineers, who reports to the Car Fender Commission of Baltimore, that the best devices are those including a projecting front fender and a wheel guard. A new ordinance requiring the street railway companies to use one of the improved fenders, recommended in the report, is expected to be submitted to the City Council.

The Midland Railway Company are employing 500 workmen in laying pipes for the conveyance of water to Leicester to supply their engines. Pumping engines are also being erected to pump the water, and they will be in full operation in a few days pumping the water from Wigston Junction to Leicester, a distance of five miles. The little water left in the reservoirs is rapidly diminishing, and there is still no sign of the heavy rainfall which has so long been looked for.

The running of the Highland Railway Company's trains is being somewhat interfered with by the Scotch coal strike. Owing to the impossibility of obtaining Fife coal, for the consumption of which the fire-boxes have been designed, Newcastle coal has been resorted to, with the result that the trains are, by their lateness, inflicting much inconvenience on the large numbers of people at present travelling. The caking of the Newcastle coal on bars which are so close to one another as to prevent the necessary supply of air from passing, is presumably the chief cause of the trouble.

On the opening of the line north of the Godavria of the East Coast State Railway—standard gauge—in India, the rates per mile for passengers were fixed as follows: First class, 1d.; second class, 0 50d.; third class, 0·125d. On and from January 1st, 1894, however, a fourth class—cooly class—for local booking only, was introduced on this line at the rate of 0·125d. per mile, and the ordinary third-class fare increased from 0·125d. to 0·167d. per mile. It would be interesting to see the effects of the Board of Trade requirements as to signalling, fencing, &c., on the profits of Indian railways at such fares as these.

A report just published shows that the casualties on Indian Railways during the year 1893 have decreased by 1·26 per cent. in killed and 2·78 per cent. in injured, as compared with the previous two years. The proportion of passengers killed in train accidents from causes beyond their own control was one in about 2,652,215, while passengers injured from this cause was one in 1,610,261. Taking the aggregate length of the whole Indian railway system as 18,121 miles, the train mileage run as 2,088,759 miles, and the total number of passengers travelling as 135,269,950, there were 114 killed and 268 injured, or an average of one killed in 1,186,517, and of one injured in 50,472.

For lighting their carriages, the Indian railways seem to have very fully adopted the Pintsch's system of gas lighting. In 1893 on the East Indian Railway, 56 out of 180 vehicles have been fitted with gas lamps on this system. On the Indian Midland Railway sanction has been received for lighting 225 carriages by this method, and a few carriages on the Great Indian Peninsula Railway have also been fitted with the necessary apparatus for the system. Sanction was given during the year for the substitution in the carriages of the Bombay, Baroda, and Central India Railway of Pintsch's gas system instead of oil lighting. On the Madras Railway the estimate of the gas plant and fittings was sanctioned at the close of the year 1893, and the material necessary for the introduction of gas lighting will shortly be received from England. This system of lighting costs so much less than the old oil lamps, that the Government of India have ordered that arrangements should be made to introduce the compressed gas system on State lines of the standard gauge, as soon as funds can be made available for the purpose.

The railway across the Isthmus of Tehuantepec is reported as practically completed and about to be opened to traffic. This road is 192 miles long, from Coatzacualcos, on the Gulf of Mexico, to Salina Cruz, on the Pacific. As a competitor with the Panama Railway, it would make the distance from New York to San Francisco 4325, against 6107 miles by way of Panama. This is a saving of 1182 miles in distance, and fully three days of water travel. The Isthmus of Tehuantepec has been discussed as a railway route since 1842, and in 1878 Mr. Edward Learned, of New York, completed about twenty-two miles of line, when the contract was annulled. In 1882 a contract was let to a Mexican by the name of Sanchez, who built about sixty miles of wretched road. In 1888 the Mexican Government let the contract to Edward McMurdo, of London, and on his death a new contract was made, February, 1892, with Messrs. C. C. Stanhope, of England, and I. M. Hampson and E. L. Corthell, of the United States. As the original appropriation was exhausted, a new contract was made in December, 1893, with Stanhope and Co. to complete the final forty miles of the road, and this is the contract now declared finished and completing the railway from ocean to ocean. Mexico proposes to spend about £800,000 more on harbour and terminal facilities at the two ends.

The death took place at Rouen last week of an engineer named Martin, for whom, in France, is claimed the invention of what is known as the Westinghouse brake. M. Martin took out a patent on March 10th, 1860, for a compressed air brake, which those in France consider identical with the Westinghouse brake, and anticipated also the Smith and Hardy vacuum brake, of which the improvement, patented in 1877, for utilising the steam by means of the injector for producing the vacuum was exactly similar to that brought out seventeen years before by MM. Martin et du Tremblay. At that time M. Martin tried to induce the railway companies to adopt his invention, and the Compagnie de l'Est allowed him to carry out experiments upon one of their trains. For some reason or another the experiments never came to anything, and no further attempt was made to introduce the brake. M. Martin never made anything out of his patent, and he was reduced to a state of great poverty. In 1882 the Société d'Encouragement pour l'Industrie Nationale had their attention called to the case of M. Martin, and they granted him a gold medal, together with a sum of 3000f. It may be mentioned that a continuous compressed air brake was designed and published in 1851 in England; but Westinghouse was the inventor of the real complete working brake, and the man who not only made it, but made it a working success.

## NOTES AND MEMORANDA.

In Greater London last week 3310 births and 1573 deaths were registered, corresponding to annual rates of 28·1 and 13·8 per 1000 of the estimated population.

According to a recently described patented apparatus for precipitating gold and silver from cyanide solutions, by A. H. Bell and C. Carter, the solution is made to rise up against and between movable and stationary zinc surfaces, which are kept bright by friction against each other. The particles of zinc so removed pass into the solution together with the precipitated gold and silver, which are collected in a settling chamber, and taken out at suitable intervals.

The rainfall for the six months of the recent summer at Greenwich was 12·58in., or 0·34in. below the average of forty years, and July and August were the only months in which the rainfall was in excess of the normal, but in each of these the amount measured was more than 3in. The greatest frequency of rain at Greenwich was in July, when rain fell on 19 days, and in August it fell on 16 days. During the whole summer rain was experienced on 88 days, which is, roughly, one day out of every two. In other parts of the kingdom the rainfall was generally in excess of the average, but in the Midland Counties there was a deficiency amounting to 2in. in the six months.

The following recipes for new stains for wood are given in the *Scientific American*:—A solution of 50 parts of commercial alizarin in 1000 parts of water, to which a solution of ammonia has been added drop by drop until a perceptible ammonia odour is developed, will give to fir and oak a yellow-brown colour and to maple a red-brown. If the wood is then treated with a 1 per cent. aqueous barium chloride solution, the first-named become brown and the latter a dark brown. If calcium chloride be used instead of barium chloride, the fir becomes brown, the oak red-brown, and the maple a dark brown. If a 2 per cent. aqueous solution of magnesium sulphate be used, the fir and oak become dark brown and the maple a dark violet-brown. Alum and aluminum sulphate produce on the fir a high red and on oak and maple a blood red. Chrome alum colours maple and fir reddish brown, and oak Havana brown. Finally, manganese sulphate renders fir and maple a beautiful dark violet-brown, and oak a dark walnut-brown. All the colours are said to be very fine.

An interesting paper upon the age of Niagara Falls was read at a meeting of the American Association for the Advancement of Science. Professor Spencer said that the first conjecture as to the age of Niagara Falls was made by Andrew Ellicott in 1790, who supposed the falls to be 55,000 years old. About 1841 Lyall estimated the age of the falls as 35,000 years. According to Professor Spencer the evolution of the falls was as follows:—A little stream draining the Erie basin only fell about 200ft. over the brow of the Niagara escarpment, and in magnitude was just about the size of the American Falls. This stream was not over one-fourth the present volume of the great cataract, and, consequently, was able to excavate the gorge at a much lower rate than at present. During this early history of the river the waters of the three upper lakes emptied through the Huron basin, by way of the Ottawa River. The height of the falls has advanced several times, and, owing to this change and the variation in the discharge of the water, retreat of the falls has varied greatly during changing episodes. The computations of the age have been based upon these changing conditions of elevation and downfall of the river. The first episode, as before stated, represented a small river, with a total fall of 200ft. This lasted about 11,000 years. Then fell another episode, where the height of the Falls was increased from 200ft. to 400ft., succeeded by the entire drainage of all the upper Great Lakes. At the same time there were series of three cascades, the lower gaining on the upper, until finally they were all united in one great cataract, much higher than that of the present time. Subsequently the waters were raised at the head of Lake Ontario so as to bring about the present conditions after a lapse of 17,000 years from the end of the first episode.

At the Goldsmiths' Company's Technical and Recreative Institute, Mr. George Livesey, the chairman of the South Metropolitan Gas Company, recently delivered an address on gas manufacture, being the first of a series of twenty-eight technical lectures which will be given at the institute on the subject of gas industry. Mr. Livesey, after giving an interesting history of gas production, said that gas now had fierce competition, and no monopoly as a lighting agent. It, however, not only held its own, but continued to gain ground at a most encouraging rate. Having referred to the extended uses of gas for cooking, heating, and other purposes, Mr. Livesey observed there did not appear to be scope for much improvement in manufacture, so far as turning out a better article was concerned. Most of the improvements had for some time been in the direction of a reduction of cost; in the matter of purity there was very little more that could be done. The only so-called impurity of which the public complained was what they called smokiness, or, to use their expression, "dirty gas," because in gas-lighted rooms the ceilings became blackened sooner than in rooms where gas was not used. If architects and builders would construct flues which would conduct the products of combustion away from the room, the most perfect ventilation could be attained by utilising the heat of the gas for that purpose, and the gas would not only give light, but at the same time ensure the removal of its own and of all vitiated air. After referring to the great improvement in recent years in burners and to the advantages thus given to the consumer, he stated that consumption of coal for gas-making was about 12,000,000 tons per annum in the United Kingdom, it being in London and its suburbs alone 3,250,000 tons in 1893. The maximum quantity used in one day in the depth of winter in Greater London would be about 18,000 tons, or 750 tons an hour.

In our report of the meeting of the British Association at Oxford, and the discussion on Mr. Maxim's paper, we mentioned that Mr. Maxim had found that the resistance of the air against a thin stiff plane caused to move at sixty miles an hour through it, in a direction inclined to the plane at a slope of about 1 in 8, was found to be about fifty-three times as great as the estimate given by the old "theoretical" (!) formula, and something like five or ten times that calculated from some more recent formula. Lord Kelvin now writes to *Nature*, saying:—"I had always felt that there was no validity, even for rough or probable estimates, in any of the 'theoretical' investigations hitherto published; but how wildly they all fall short of the truth I did not know until I have had opportunity in the last few days, *procul degotiis*, to examine some of the observational results which Maxim gave us in the introduction to his paper. Mr. Maxim said in his paper:—'The advantages arising from driving the aeroplanes on to new air, the inertia of which has not been disturbed, is clearly shown in these experiments.' Founding on this principle, I have at last, I believe, succeeded in calculating, with some approach to accuracy, the force required to keep a long, narrow, rectangular plane moving through the air with a given constant velocity, $V$, in a direction perpendicular to its length $l$, and inclined at any small angle $i$ to its breadth $a$. In a paper, which I hope to be able to communicate to the *Philosophical Magazine* in time for publication in its next October number, I intend to give the investigation, including consideration of 'skin-resistance' and proof that it is of comparatively small importance when $i$ is not much less than one-tenth, or one-twentieth, of a radian, and the 'plane' is of some practicably smooth, real, solid material. In the meantime, here is the result, with skin-resistance neglected: The resultant force—perpendicular therefore to the plane—is $\frac{1}{2}\pi V^2 \sin\theta \cos\theta\, la$; which is $\frac{\cos \pi \theta}{\sin \theta}$ times—or for the case of $\sin\theta = 32$, one hundred times—the old miscalled 'theoretical' result."

## MISCELLANEA.

The Physical Society will henceforward hold its meetings in the rooms of the Chemical Society, Burlington House.

A new gun-mounting for 12-pounders has been delivered at Portsmouth from Elswick, to undergo a series of trials.

The strike among the dredger-men of the Suez Canal is seriously extending. It is stated that all the dredgers as far as Ismailia have been abandoned.

The Benbow, battleship, has been absent from her station at Greenock, the Admiralty having decided to fit her barbettes with steam heating arrangements similar to those recently put on board the Rodney, battleship.

We have received the First Part of Cassell and Co.'s new "Popular Educator," revised and brought up to date. The style of the work appears of a kind eminently calculated to maintain the reputation which has been obtained in the past by this excellent publication.

The only medal awarded by the Sanitary Congress, at their recent assembly at Liverpool, for an efficient method of connecting pottery to lead, was awarded to Messrs. Doulton and Co., for their metallo-keramic joint, which we noticed in our columns some while ago.

The Bellona cruiser, recently commissioned at Devonport to take the place of the Barrossa in the Channel Squadron, has undergone her three hours' steam trial. Shortly after starting her safety valves were discovered to be leaking, although the pressure in her boilers was comparatively low. An attempt to make temporary repairs failed, and the trial was abandoned.

The Canadian Parliament has just passed an Act providing for the inspection of electricity meters. This Act allows consumers, whenever they are dissatisfied with the action or tests of the electric light contractors, to have their wires and fittings tested by an electric light inspector, upon application to the Inland Revenue Department, which has charge of the inspection under the Act. The Act also settles a question upon which there was formerly no written law, in providing that any persons discovered maliciously or fraudulently abstracting, or causing to be wasted or diverted, any electricity, shall be dealt with as guilty of theft, and punished accordingly.

It is stated by the chairman of the Water Committee of Leicester that although the need of economy in water is pressing, the service being now only from 7 a.m. to 6 p.m., there is no prospect of the water famine which has been persistently threatened by the daily papers. There is at present in the reservoirs over 100,000,000 gallons, and this may probably be reduced to 30,000,000. Besides this available supply the steps which are now being taken will amply protect the town against any disastrous consequences of the recent drought. The rainfall of this district averages 28in. In 1891 the rainfall was about 32in.; in 1892, slightly under 23in.; and in 1893, slightly under 22in.; in 1894 to the present date, about 15½in., of which less than 1in. fell in September.

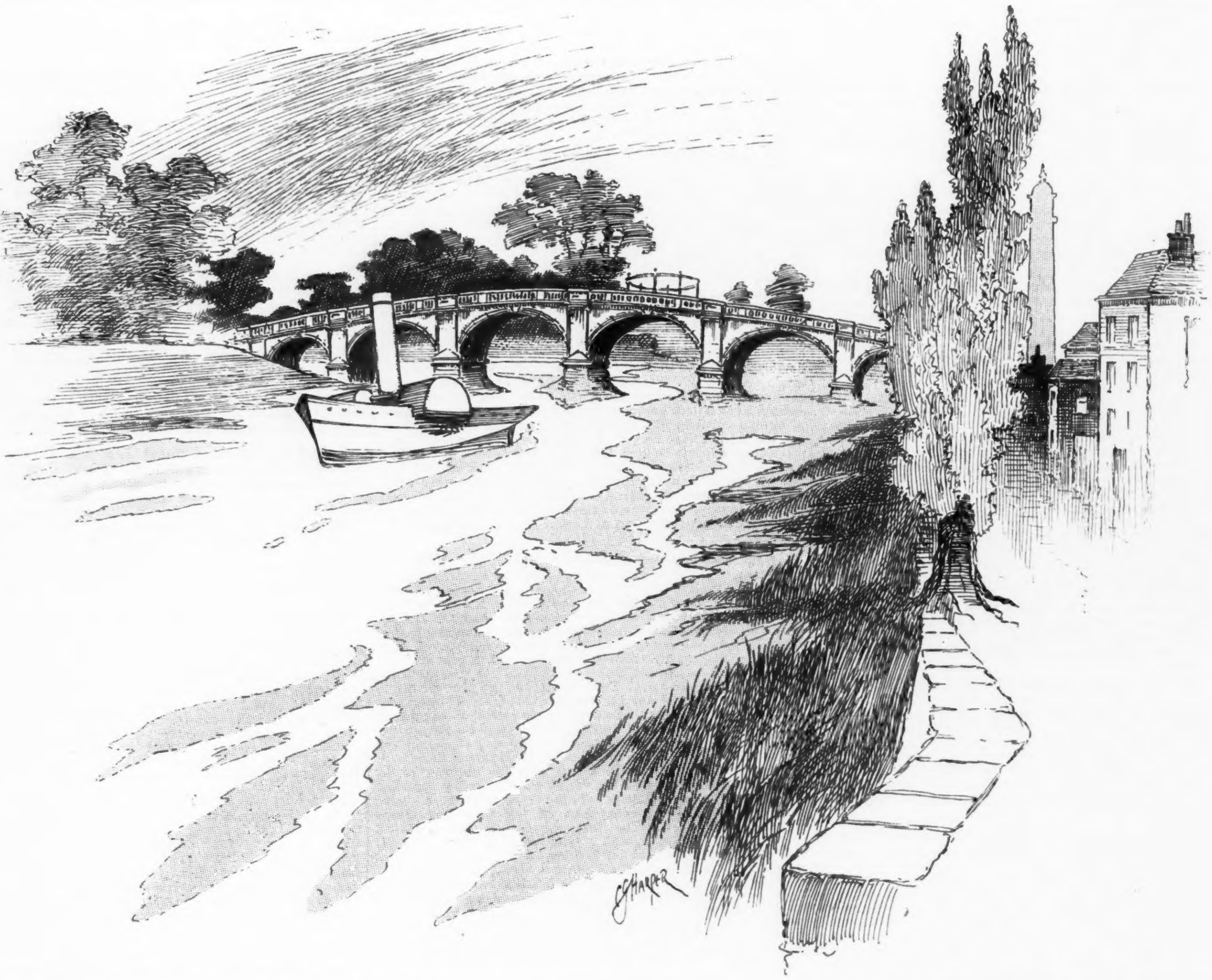
In a letter to the *Times* on the Royal Commission on Water Suppy and the river Lea, Sir John Evans says:—"In September, 1893, appeared the report of the Royal Commission on the Water Supply of the Metropolis, in which, among other things, was recommended the abstraction of 22½ million gallons of water daily from the valley of the Lea, in addition to the 72 million gallons daily at that time obtained from that source. In September, 1894, circumstances remaining the same or nearly so, with the exception of the rainfall, the directors of the East London Waterworks, in consequence of the diminution in the water of the Lea, and in order to economise to the extent of 10 million gallons of water daily, are compelled to cut off the supply to their mains at night. No more practical testimony to the real value of the report of the Commissioners can be imagined. Not a word of comment is necessary."

Writing to the *Indian Engineer* a correspondent says, the chief difficulty to the success of the numerous punkah-pulling devices which are annually brought forward has been with the provision of motor power. "The punkah-wallah at four or five rupees a month is a cheap instrument, even if liable to get out of order, and hard to beat. The best attempts to supersede him have lain in the use of water-power in his place. For such work, as constant motion of almost invariable rate is required, very efficient impact motors are clearly indicated. A machine is therefore wanted which could claim to combine great efficiency with economy and steady working under comparatively low heads. It should be self-governing, self-lubricating, fairly noiseless, and readily started or stopped. On the whole, a simple and cheap appliance is the desideratum for turning water, at the comparatively low pressure at which it is generally supplied to houses, into punkah swings."

The telescoping of a large cupola, an accident which is said to be rare in the experience of foundrymen, is described in the *Engineering Record* as follows:—Possibly owing to faulty construction, the cupola spread at the charging door section, allowing the stack to drop about 5ft. The repairs necessitated some careful work, for it was desired to restore the cupola to its original position without removing the lining or taking it down section by section. This was expeditiously accomplished by first lashing the cupola at the top to the main building of the pipe foundry; then large cast iron shoes were bolted to the shell just above the roof of the cupola-house, and these in turn were bolted to long timbers 12in. by 12in., which were securely blocked and wedged into position as the cupola was straightened back into place by the use of chains and turnbuckles. As soon as in position, the under sections were taken away, leaving the stack in mid-air securely lashed to the building and supported by timbers and castings just described. The roof of the cupola-house was strengthened in the meantime by heavy timbers running from the ground to the cupola loft and thence underneath the roof. As the lower part of the old cupola was somewhat worn, and a new one of larger size was desired, a new 96in. Whiting cupola was erected in place of the old and joined to the stack, which had been held in place.

At a meeting of the Society of Engineers on Monday, a paper was read by Mr. T. W. Baker, B.A., on "The Utilisation of Town Refuse for Generating Steam." The refuse to which this paper refers is the usual contents of the ash-bin, with street sweepings and sludge, collected by local authorities. The recognised means of disposal is now by fire, so destroying all germs of disease, and the heat set free by the process of destruction, the author shows, by reasoning from his own experience and that of others corroborating him, should and can be utilised. The large bulk of 420 tons per week, collected from an average vestry area, necessitates a special furnace or destructor, while the noxious fumes arising have also to be destroyed. Up to the present time this has been imperfectly done, most of the heat having been allowed to go to waste. The author submitted a new system as efficiently meeting the difficulties, and the results deduced from his calculations and experiments showed that, after paying for the plant, working expenses, depreciation, interest, and redemption, a net saving of £2666 per annum could be obtained on a plant capable of dealing with 420 tons per week as above referred to. The author claims that this scheme is particularly applicable to the generation of electricity by the steam, providing a means for heat storage arrangements to meet the well-known fluctuation in demand; and for pumping, baths, and wash-houses, it is equally applicable.

# THE CONDITION OF THE THAMES BELOW KEW BRIDGE AT LOW WATER



## THE CONDITION OF THE THAMES—PROPOSED LOCK AND WEIR AT PUTNEY.

When poets of other centuries wrote of Thames that his "silver flood" was "strong without rage, without o'erflowing, full," they little thought that a time would come when, so far from overflowing, the stream would dwindle to the likeness of the attenuated rivulets of type that run through the broad margins of *editions de luxe*. But a water supply for several millions of people was undreamed of in those days, and no one ever imagined that one-third of the stream would pass through insatiate intakes at Thames Ditton, for the benefit of London water-consumers, leaving the Thames below that place a poor wraith of its former self, or, at all events, helping to bring about a condition of river bed which used only to occur after very dry seasons. We have prepared the above engraving to show what the river is now sometimes like. Another, and a newer grievance of the riverside parishes below Richmond, is the Richmond Lock and Weir, recently completed. It seems, according to the authorities of the several parishes of Isleworth, Brentford, Kew, Hammersmith, Mortlake, and Putney, that this new weir has rendered worse the already alarmingly inadequate flow of the river, and that navigation for steamers is becoming difficult. The remedy for this state of things is proposed in a scheme now being prepared for a new lock and weir to be situated at or just below Putney. A party, composed of engineering experts and delegates from the local bodies affected by the condition of the river, proceeded up-stream to Richmond some few days since in a launch of light draught, in order to observe the present state of affairs. One of the worst points appears to be at Kew, just below the bridge, off Strand-on-the-Green. Here the actual stream is reduced to a narrow gutter at low water, and steamboats that formerly experienced no difficulty in proceeding as far as Kew Bridge or Richmond, have become hopelessly grounded until the flow of the tide comes to their assistance. Kew Eyot can now be easily reached afoot, and even the deep and swift bend of the river opposite Brentford Creek, well known to boating men from the dangerous nature of the current at this point, is reduced to a shallowness that has never before been observed here.

Certainly a lock and weir at Putney would greatly improve the appearance of the river, and would do away with the offensive mud banks that now appear at every low tide; but this would be a big undertaking, of considerably greater magnitude than that below Richmond—itself the largest of its kind. The magnitude would not, however, of necessity be the stumbling-block. It has to be shown that the improvement would not be accompanied by an objectionable, or even harmful, condition of the river below a new weir; that it would not, in fact, merely hand down to the wharf-sided lower river below Putney the condition of things now existing above it, even with a year of plentiful rainfall. The extraction of water for the supply of the five millions of London people is possibly a sufficient explanation of most of the difference between now and half-a-century ago, but the difference imputed to the bridges and the embankment must not be overlooked. Moreover, it may be questioned, shortness of memory does not account for some of the alleged recent changes.

## HAMPSTEAD ELECTRIC LIGHTING STATION.

The new and commodious station for the supply of electric current to the parish of Hampstead was opened with great form and ceremony on Monday evening, October 1st, and it started its career without a hitch, in, we trust, happy augury of its future success, the light streaming forth without accident upon the action of Mr. Hackworth in throwing over a little switch deftly contrived upon the rail of the switchboard platform. The invitations had been issued for seven o'clock in the evening, and as, in order that the "switching on" of the light might be attended with true dramatic effect at eight o'clock, the guests were compelled to wander about in Cimmerian darkness for an hour, varying the monotony of such perambulations by now and then stopping to hear some speeches being delivered from the platform, and in which each excellent vestryman of St. John felicitated his brother, and all combined to compliment Mr. Preece, Mr. Alexander Siemens, and others of the contractors and engineers. When at last we got the "100 volts which is light," the crowd in the little station was so great that it was not easy to see much of the detailed arrangement, nor to get round many of the machines, but we hope at a later date to be able to study the many excellent points of the system adopted, and to give description and illustrations in detail, being content now with a general statement of the broad outlines.

The buildings consist of an engine-room in two spans, one of 26ft. and the other of 16ft. The size of the room is 58ft. by 42ft. by 23ft. high, and it is large enough to accommodate a 50 per cent. increase in the incandescent and arc lighting machinery. The boiler house is covered by one roof having a span of 43ft. It is 58ft. long and 24ft. 6in. high. Its floor is 9ft. below that of the engine-room, which is on the ground level, thus allowing space for coal bunkers under the roadway; these bunkers will contain 100 tons of coal. Complete and separate lavatory accommodation is provided for the engine-room and boiler house staff. The chimney is 130ft. high and 8ft. internal diameter; up to a height of 52ft. it is divided into two compartments, only one of which is used by the present boiler plant, the other half being provided for extensions. The offices are complete, consisting of the engineer's office, clerks' office, stores, and testing room. Separate lavatory accommodation is also provided.

There are four boilers of the Lancashire type, each boiler is 28ft. long by 8ft. diameter, and is guaranteed to evaporate 5000 lb. of water an hour, at a pressure of 150 lb. per square inch. The material used throughout is Siemens-Martin steel, and each boiler has been tested to a pressure of 250 lb. per square inch. The usual fittings are provided, and include two safety valves, duplicate feed-water check valves, and mechanical stokers. Coal is supplied to the stokers by a coal elevator, consisting of an endless chain and buckets working in a sheet steel case, and a conveyor, consisting of a worm working in a trough, from which the coal falls through shoots, placed at necessary intervals, into the stoker hoppers. The stoking machinery is worked by a small vertical engine, provided in duplicate, and the whole is arranged with clutches, loose pulleys, and striking gear, so as to be completely under control, and so that the breakdown of an portion of the machinery cannot interfere with the workin of the station.

There is a complete duplicate service of feed-water to each boiler, a supply being obtained from the water company's mains, and also from a storage tank having a capacity of 10,000 gallons. There are two Worthington feed pumps, each of which can supply water to any or all of the boilers, independently of the other. The feed-water is heated by an exhaust steam heater, and also by a Green's economiser of 192 pipes placed in the main flue. Each heater is provided with a bye-pass, and each can be used together with or independently of the other.

Steam is taken from the boilers to the engines in a wrought iron ring main divided by valves placed between each engine and each boiler into sections, each section being drained. A small auxiliary steam ring connected to two sections of the main steam ring supplies steam to the feed-water pumps and stoker engines. The exhaust steam is carried to the atmosphere 50ft. above the ground level, through a cast iron exhaust pipe. The engine-room contains the following dynamos, erected on solid concrete foundations, finished off with a plinth of glazed brick:—For incandescent lighting, one 200 kilowatt alternator supplying 5700 8-candle power lamps; two 100 kilowatt alternators, each supplying 2850 8-candle power lamps; one 20 kilowatt alternator supplying 570 8-candle power lamps. For arc lighting, two 13 kilowatt dynamos, supplying twenty-two 2000-candle power arcs. For exciting the above and for station lighting, two 18 kilowatt dynamos. The engines are by Willans and Robinson, and the dynamos of the Siemens type, and are in all cases direct coupled. The current is taken from these dynamos to the station switchboard, which is built up of polished slate panels, one panel being provided for each dynamo, and one for each circuit; through these panels the alternators are connected by omnibus bars to the circuits, and are arranged to work in parallel, a synchronising panel being provided for the purpose. Each panel is provided with the necessary instruments for measuring the current and electro-motive power, and the whole of the switchboard is mounted in a polished teak frame and is railed off from the engine-room.

The incandescent lighting current at a pressure of 2000 volts is taken from the main switchboard by high-tension feeder cables to seven sub-stations, each of which supplies a small area, all seven sub-stations being connected by low-pressure distributing mains. The feeders are Siemens H.C.N. type, protected with iron armour insulated with special fibrous material cased in lead, and are connected in the sub-stations to Siemens transformers, which transform from 2000 to 105 volts, at which pressure customers are supplied with current from low-tension mains, similar to the high-tension mains, but not so highly insulated.

The sub-stations are small brick chambers, 6ft. by 5ft., and are built under the pavement, access being obtained through a small manhole in the top. Each sub-station contains two 25-kilowatt transformers, a high-tension fuse board, and a low-tension switchboard, from which the distributing mains are taken, and so arranged that the supply to any length of dis-

# DYNAMOMETRIC CAR, WESTERN OF FRANCE RAILWAY

*For description see page 301*

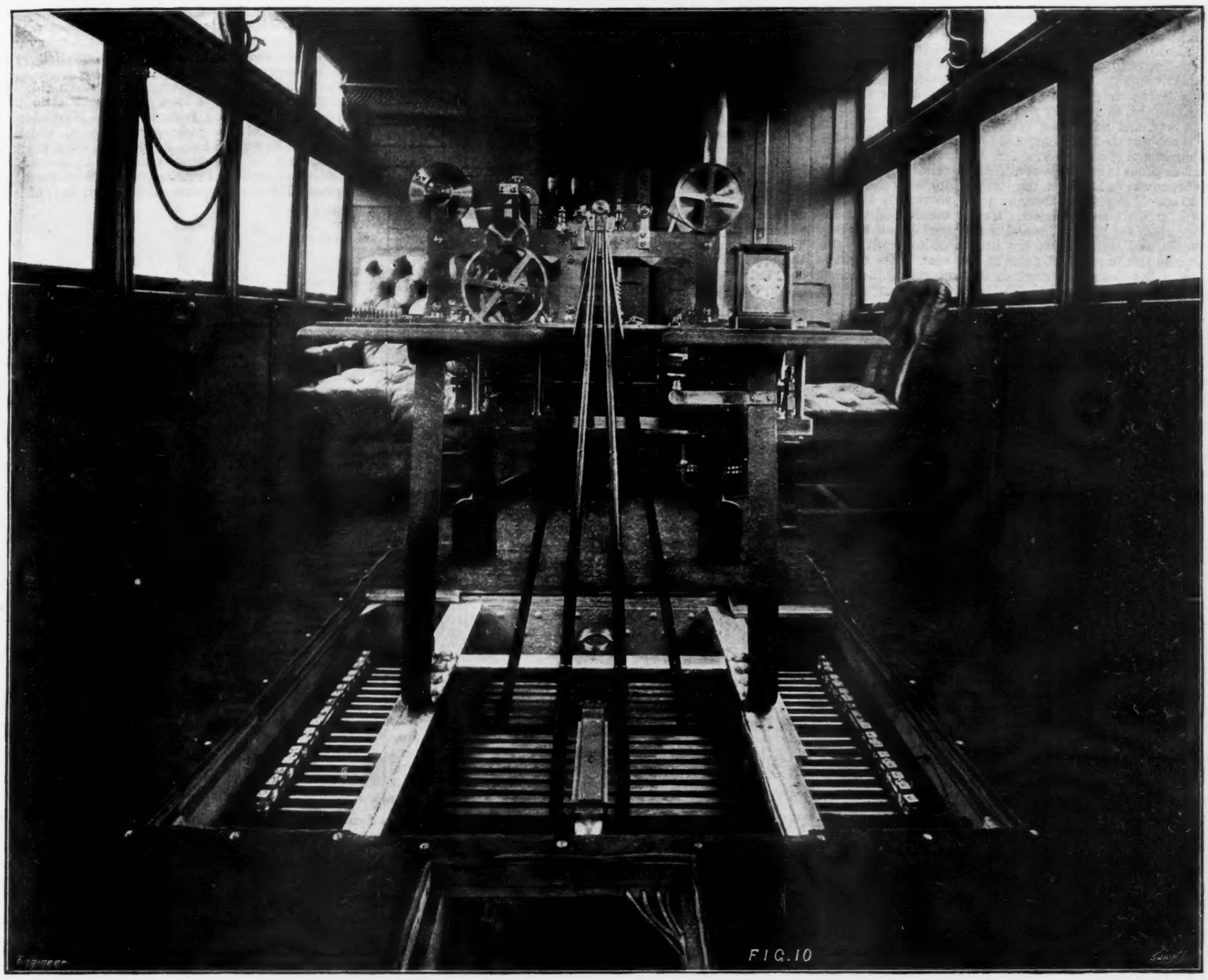


FIG. 10

tributing main between the sub-stations can be cut off for the purpose of connecting customers, without interfering with any other part of the system. Each sub-station will supply 1430 8-candle power lamps. The total length of feeder main is a little more than 3½ miles, and will carry current for the supply of 17,000 8-candle power lamps; the total length of low-tension main is 3½ miles, and is sufficient to supply 10,000 8-candle power lamps.

For street lighting twenty-two Siemens 2000-candle power arc lamps have been erected on iron posts in the Finchley-road. Each lamp post consists of a substantial cast iron base surmounted by a wrought iron stem and an arched bracket. They are supplied with current through a Siemens cable protected with iron armour and insulated with vulcanised rubber.

The building contractors are Messrs. Yerbury and Sons. The general plant contractors are Messrs. Siemens Brothers, Messrs. Willans and Robinson supplying the engines, Messrs. Belliss and Co. supplying the boilers and pipes, and Messrs. Lucas and Aird supplying the sub-stations. Mr. Arthur Ardron, F.R.I.B.A., acted as architect to the vestry. The whole of the scheme has been designed and carried out under the supervision of Mr. W. H. Preece, C.B., F.R.S., who has acted as consulting engineer to the vestry.

## THE WORKS AT THE PANAMA CANAL.

The company which has just been formed for taking over the works at the Isthmus of Panama has issued a report, giving what it professes to be an accurate idea of the present state of the canal. It had been expected that after being abandoned for nearly five years to the ravaging influences of the floods from the river Chagres, and the growth of vegetation which flourishes with remarkable luxuriance at the Isthmus, the works would have been greatly deteriorated, necessitating perhaps the re-excavating and banking of those sections of the canal already completed. Judging from the report issued by the liquidator, the canal itself has remained practically intact, and the machinery and other plant has only partly deteriorated from the climate. The first section of the canal, from Colon to a distance of 21·700 kiloms. has been greatly modified by the action of the river which has flown into it, and after following the incline of the canal for about 5 kiloms., the river deposits a great deal of sediment and turns off into the Rio Mindi, which has considerably enlarged during the past four years. Beyond the point where the Chagres breaks into the canal the works are in very good condition, though they are so covered with vegetation as to be sometimes indistinguishable from the surrounding country, and it is explained that this is one of the reasons why untechnical observers have insisted so often upon the complete ruin of the works. The report urges that, so far from being a disadvantage, this growth has actually been of service in preserving the canal, and the vegetation can be cleared away at very little cost. After the maritime reach, which terminates at 22·500 kiloms., are the works of the first lock, and these are in excellent state of preservation. From this point the cutting continues with an embankment 50 metres in height, but notwithstanding the steepness of the sides not a stone has given way, and this is set down to the protection afforded by the dense vegetation. This state of things is unchanged across the plain of Tavernilla as far as kilom. 36; at this point the excavation runs close to the river, from which the water descends during the rainy season. This is particularly noticeable between kiloms. 25 and 28 and between kiloms. 33 and 34. In the middle of the plain of Tavernilla are the large cunettes which, notwithstanding their steep incline, have been in no way affected by the severe floods of four years ago. The works facing San Pablo are also unchanged, though entirely covered with vegetation. The same condition prevails up as far as the second lock, where the cutting had first been made in view of a level canal, and then altered to meet the exigencies of the plan ultimately adopted. The canal then follows the bottom of the narrow valley, where it now and then cuts the river as far as the 40th kilom. The result is that the filling-up process has been very active, in consequence of the floods, and the vegetation in this part is particularly luxuriant. At Matachin, where preparations were made for the third lock, the works are often covered with water, but the cutting is nevertheless in a good state of preservation. After Matachin the canal leaves the valley of the Chagres and enters the valley of the Obispo. Here, at the 46th kilom., the works for the fourth lock are in good order, and owing to the eneven state of the ground the canal has a depth in certain places of 44 metres. A little more than a kilometre further on the banking fell in during the work of cutting. From the 48th kilom. a cunette has been made over a distance of several hundred metres through a very hard rock. Then, after passing the works between the Obispo and the Rio Camacho, the valley extends and merges into the plain of Emperador. In cutting through the high ground in this plain the canal has a depth varying from 35 to 40 metres. The fifth lock at this point is likewise in an excellent state. From kilom. 52·600 are the works of the Culebra, and at one place, where the depth is about 40 metres, the bank has fallen in. Notwithstanding the influx of water, the works are very much in the same state as they were five years ago, though between kiloms. 54·300 and 55·400 the soft soil that had to be cut through has given way. This is due entirely to the action of the water, and it is stated that with proper drainage the difficulty can be overcome. The same influence has been at work on the Pacific slope, where a great deal of shifting soil has been met with. Between the sixth and the tenth lock, descending towards the Pacific, there is nothing worthy of remark, except that the works are very humid and the vegetation is consequently very thick. From the tenth lock the valley opens out in a low, marshy country, and between kiloms. 65·500 and 66·700 the canal has been partly filled up. Further on the canal is in a better state of preservation owing to the water having a freer course. The maritime channel commences at the 68th kilom. It makes a detour around the mouth of the Rio Grande, and then continues in a straight line until within 200 metres of the northern point of Perico Island. In some parts, where the channel is exposed to the winds, it has been filled up by as much as four metres.

As regards the machinery and other material, the report speaks favourably but sparingly. Of the sixteen dredgers of 120-horse power ten are almost as good as new, and have hardly been used, but the others will require a great deal of repairing. There are several other dredgers, including two marine dredgers and two of the Suez type. All the floating material is found on different points of the canal, principally at Colon and upon the Pacific slope. The rolling stock is likewise distributed over different portions of the canal, and it is not in such a bad condition as might have been expected. Some of the locomotives have been repaired since 1888, and may again be put into service; but many of the wagons have rotted in the destructive climate. In short, it is thought that all the metal plant will be available for use after being overhauled. The wharves at Colon and Boca, the docks and other installations will have to be entirely reconstructed, and repairs will be needed in every direction before the work can be resumed. The railways will likewise have to be relaid; the wooden sleepers are entirely useless, but the steel sleepers are still serviceable. The rails, nuts, and bolts will all have to be replaced. In view of the many costly repairs that will have to be carried out before the work of cutting the canal can be proceeded with, it is difficult to fully understand the project of the new company, whose available capital of not more than twelve millions sterling will be practically swallowed up in preliminary works. It is not pretended, even, that the new company has any definite plan in view. The first object is to get a few hands at work upon the Isthmus, so as to fulfil the clause of the agreement with the Government of Colombia, which makes it necessary that the work should be resumed before the end of October, in default of which all the material would be confiscated. When half of the capital has been spent in preliminary works the technical commission will meet to decide whether it is worth while to continue the work, in which event the public will be asked to subscribe about twenty millions sterling. If, on the other hand, it is found inadvisable to pursue the undertaking any further, the money already subscribed will be used for working the Panama Railroad, in which the old company had a considerable interest. So far, no plan for completing the canal has been definitely adopted, and this matter will be left to the technical commission which will be appointed as soon as the company is in working order.

## ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

*Germany: Coal and iron in Mannheim.*—As a coal market Mannheim is growing in importance; the arrivals by river in 1893 amounted to 1,171,678 tons. The year began with fair prospects for the coal trade, the severity of the winter having pretty well cleared stocks, and prices at the pit's mouth being low. In March consumption had again so far diminished that dealers were forced to accumulate stocks, and on the other hand the syndicate of coalowners was defective in organisation. Contracts had been based on the very low Rhine freights of 1892, which turned out to be a serious mistake, as not only was the river very low throughout the year, and navigation difficult and expensive, but all cargo space was strongly competed for owing to the unusually large shipments of corn and fodder. At the Ruhr mines it was difficult at times to get ships at all. And, again, when the coal strike broke out in England, the Ruhr mines were also called upon to supply the North German ports, so that it became, in turn, difficult to get coals. Under these conditions a regular supply for Mannheim and the Upper Rhine became impossible, and dealers were but little able to profit by the consequent rise in prices of some 25 per cent. The extending use of the so-called American stoves involved increased consumption of anthracite. The coal strike cut off the supply from England, and Belgium availed herself of the opportunity to secure a share for this kind of fuel in the fresh field of South Germany. All hopes entertained during the last few years of an improvement in the iron industry have hitherto proved deceptive, and if there was little good to report concerning consumption and prices in 1892, there is still less to be said for 1893. One large firm states:—"It would really seem as though we were getting towards the middle of the seven lean years, for there is hardly a trace of courage or enterprise left, and the condition of other branches of industry and trade is not cheering." This is taking too dismal a view of the situation, but in face of excessive competition, falling prices, finely cut profits and over production, the position of the German iron industry in 1893 was rather difficult. The tariff war with Russia had very disastrous consequences, the home market being flooded, but the manufacturers of agricultural implements and machines did a good trade. There was a strong demand for all kinds of machines for preparing cattle food. Agricultural steam engines and threshing machines were less in demand, but this was compensated for by the active inquiry of the corn and saw mills, that through diminished water had to resort to steam power. In almost all the branches of this industry represented in the Grand Duchy of Baden, such as boilers, brewing plant, chain, nail, and wire making, cranes, gas and boiler meters, hydraulic disintegrators and presses, pumps, railway axles, plant and springs, Roots' blowers, weighing machines, the trade was more or less unsatisfactory. Irish stoves have been introduced successfully into Baden for several years past, and in 1893 improved make and reduction of price caused a further extension of sales. The renewal of commercial relations with Russia will be of great relief to the German iron and metal industry, although it is not expected that the lost ground will be easily or quickly regained. As regards the iron industry in general, a comparison of prices during the last seven years may be of some interest, In all other descriptions prices were in proportion.

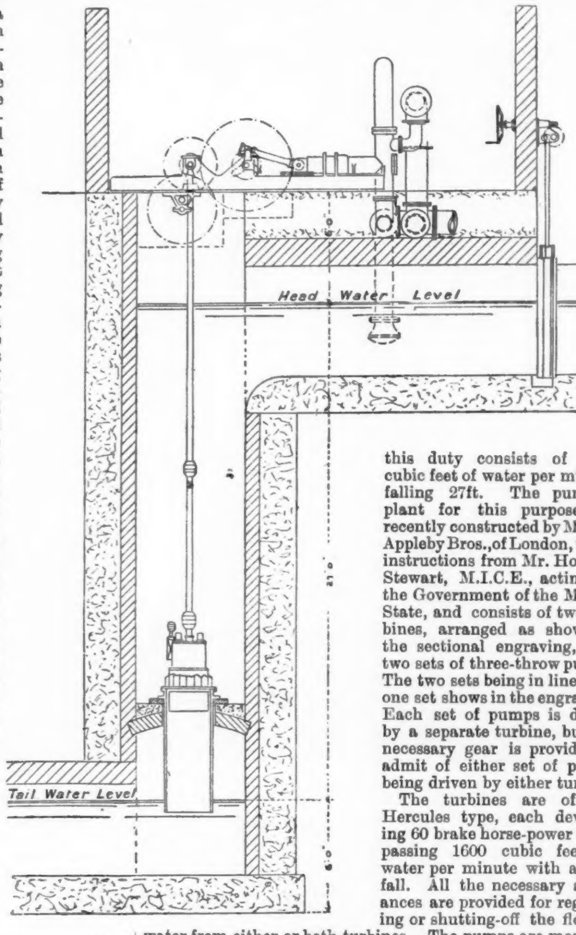
| | Price per ton. | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1887. | | | 1888. | | | 1889. | | | 1890. | | | 1891. | | | 1892. | | | 1893. | | |
| | £ | s. | d. | £ | s. | d. | £ | s. | d. | £ | s. | d. | £ | s | d. | £ | s. | d. | £ | s. | d. |
| Boiler-plates | 8 | 0 | 0 | 8 | 10 | 0 | 12 | 10 | 0 | 10 | 0 | 0 | 8 | 5 | 0 | 7 | 15 | 0 | 7 | 5 | 0 |
| Pig iron.. .. | 2 | 10 | 0 | 2 | 14 | 0 | 4 | 18 | 0 | 2 | 14 | 0 | 2 | 12 | 0 | 2 | 8 | 0 | 2 | 5 | 0 |
| Rolled iron .. | 5 | 18 | 0 | 6 | 2 | 0 | 9 | 0 | 0 | 6 | 10 | 0 | 6 | 5 | 0 | 5 | 15 | 0 | 5 | 0 | 0 |
| T-beams.. .. | 5 | 6 | 0 | 5 | 10 | 0 | 7 | 10 | 0 | 6 | 5 | 0 | 5 | 0 | 0 | 4 | 12 | 0 | 4 | 5 | 0 |

*Wurtemberg: Reports of factory inspectors.*—In general the year 1893 was very similar in industrial depression to 1892, but a slight improvement was noticeable. The building trades were active, especially those dealing with large towns, and brick kilns, cement and plaster works, also quarries were fully occupied. Saw mills and factories for building purposes did well; but those dealing with the agrarian population were less prosperous. Manufacturers of hardware and lamps report a satisfactory year, but there was a falling-off in refined steel, and some small works had to close, whilst others had to reduce their staffs and working hours. Iron smelting, tin trades, and machinery factories also report a good business, but there was a falling-off in orders for agricultural machinery. Wages are paid fortnightly when not weekly, and occasionally monthly, varying according to districts. Higher wages are paid at Stuttgart, Cannstatt, and Esslingen than at Heilbronn, Oehringen, and Hall. The system of workmen's committees produced satisfactory results in the cases both of employers and employed. The total number of accidents during the year was 1465, an increase over those of 1892; but the number of deaths and serious accidents were fewer. The increase was caused chiefly by the exceeding dry and warm state of the weather, which produced an amalgamation of dust. Attention is called to the habitual carelessness of the workpeople in spite of the various notices posted up warning them of the places where there is danger; but there is room for improvement in the better security of galleries, side entrances, and staircases, and provision of ventilation. The factory regulations are considered too detailed, and should be curtailed and made clear.

*Agricultural machinery in Southern Russia.**—According to the British Consul-General at Odessa, the scarcity of labour during last harvest caused a brisk demand for agricultural implements and machinery, especially steam and horse threshing machines. Every threshing machine that could be purchased here was sold off last autumn, and orders came in that could not be met. The demand this spring both for steam and horse threshers is very good, and all the orders received cannot be complied with. A very useful threshing machine worked by from eight to twelve horses is manufactured by an English firm at Elizabethgrad, in the province of Kherson, which seems to have met a want, and many thousands of these are being sold in that district. Similar threshing machines are also manufactured in Odessa.

## PUMPING MACHINERY FOR THE WATER SUPPLY OF THE CITY OF MYSORE.

The machinery which is illustrated by the accompanying engraving has been designed to supplement the existing water supply of Mysore, under the following conditions:—The additional quantity of water required for the service of the city, including provision for loss, is 1,300,000 gals. per day, to be raised to a height of 240ft. through a 14in. rising main, 8400ft. in length. The motive power available for this duty consists of 4200 cubic feet of water per minute, falling 27ft. The pumping plant for this purpose was recently constructed by Messrs. Appleby Bros., of London, under instructions from Mr. Houston Stewart, M.I.C.E., acting for the Government of the Mysore State, and consists of two turbines, arranged as shown in the sectional engraving, with two sets of three-throw pumps. The two sets being in line, only one set shows in the engraving. Each set of pumps is driven by a separate turbine, but the necessary gear is provided to admit of either set of pumps being driven by either turbine.



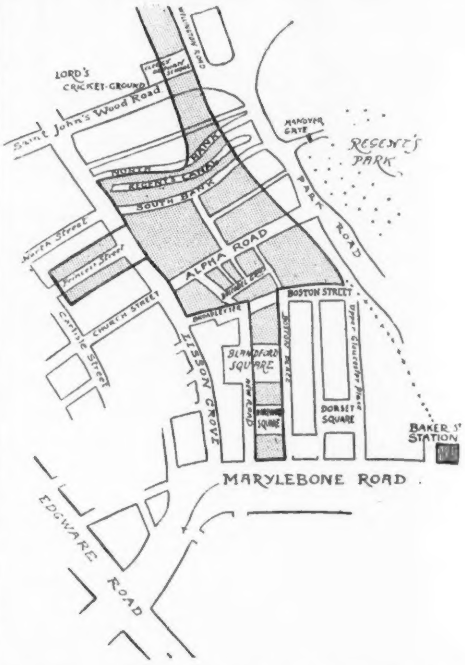
The turbines are of the Hercules type, each developing 60 brake horse-power when passing 1600 cubic feet of water per minute with a 27ft. fall. All the necessary appliances are provided for regulating or shutting-off the flow of water from either or both turbines. The pumps are mounted on strongly-ribbed cast iron girders, of the box section, bedded on concrete. The plungers are of gun-metal, 11½in. diameter and 18in. stroke. The turbine speed under the above conditions is 300 revolutions per minute, and the speed of the pumps twenty-five strokes per minute. Each set of pumps will deliver 450 gallons of water per minute against a head of 260ft., and they were tested to double that pressure. The suction and delivery valves are of hard gun-metal, and doors are provided for easy access to the valves. An air vessel is fixed over each valve chest. The shafting throughout is of mild steel, with bearings of gun-metal. Power is transmitted from the turbine spindle to the second motion shaft by means of bevel gear—the pinions being of malleable cast iron—gearing into mortice wheels with beech cogs. The arrangement is very compact and well considered. The floor space occupied in pump-house is 20ft. by 17ft. 6in.

## THE NEW RAILWAY TO LONDON.

The Bills having safely passed the House of Commons and the Committees, and the plans being now all complete, the Manchester, Sheffield, and Lincolnshire Railway Company is proceeding to work on the various sections of their new extension to London. The contracts have all been let, and the work of clearing the large area scheduled for the London terminus in St. John's Wood will be put in hand immediately. This particular portion of the new enterprise will be one of the most extensive London clearances of recent years, no less than sixty acres being set apart for passenger station, goods yards, and approaches in Marylebone. The shape and size of this area can be judged from the accompanying sketch map, and from a glance at it one may see how important an alteration this will make in this hitherto secluded and quiet artistic neighbourhood.

Coming from Finchley-road and Marlborough-hill, the new railway will run, chiefly in tunnel, beside the Wellington-road, and so underneath a corner of Lord's Cricket Ground and the Clergy Orphan Schools, across the Regent's Canal. Here the width of 124ft., which the new line will occupy from Finchley-road downwards, will spread out over an extensive tract bounded on the west by Grove-road, on the north by North Bank, on the south by Broadley-terrace and Boston-street, and to the eastward approximately by the Park-road. An offshoot will spring from the west side, running up to Carlisle street. Here will be situated a coal-station which, it is anticipated, will absorb a great deal of the London coal traffic which now-a-days centres so largely at King's-cross. The company looks forward with much satisfaction to the future of these new coal sidings; a satisfaction, it is scarcely necessary to say, not at all shared by the inhabitants of this shortly to be metamorphosed neighbourhood. To anyone who is acquainted with the grimy purlieus of King's-cross and Battle-bridge, the alarm felt by these folk will not seem uncalled for.

Another offshoot springs from the southern side of this large area, and runs in a long and narrow strip through Blandford and Harewood squares to the Marylebone-road. This is the site of the passenger terminus, which it is intended shall be fronted by a large hotel, after the manner of Euston and St. Pancras Stations. Alpha-road, South Bank, Boscobel-gardens, Princess-street, Omega-place, Blandford-square, Harewood-square, and a number of smaller thoroughfares will be demolished; and a new road of the commendable breadth of 60ft. will be formed from the Park-road to Lisson-grove, through Boston-street and Broadley-terrace. Another new road will be formed on the next side of the passenger station, running from the Marylebone-road and joining the other new thoroughfare at the point where the goods-yards will commence.



Baker-street Station will, as hitherto, be used for purely local traffic, and the Metropolitan line from Finchley-road to London will be quite distinct from the new scheme. Lord's Cricket Ground will derive an immediate benefit from a portion of land formerly belonging to the Clergy Orphan Schools being handed over to the club, as the price of the withdrawal of their opposition to the scheme; but it seems likely that this concession will be made altogether valueless by the radical change in the character of the district that is bound to follow the setting up of a great terminus in the midst of a high-class residential neighbourhood; and with this change will essentially come the removal of Lord's to a purer atmosphere, and some quieter corner than this will be in time to come. Already, artists whose number has given this quarter so distinctive a *cachet* have taken alarm, and, even where their houses have not been scheduled for appropriation by the railway company, are removing to "fresh fields and pastures new," prophetically conscious as they are that the quiet roads of villas, isolated within high garden walls, that are so characteristic a feature of St. John's Wood, will inevitably give place to streets of shops and the busy haunts of commerce that invariably accompany the termini of great railways. Some time since the occupants of the houses required for the new railway were served with notices requiring them to give up possession; but one artist, wishing to remain to the last, on asking what would be done with his house after he had gone, being told that a caretaker would be installed, suggested that surely he himself would be the best caretaker possible. His offer was accepted, and there he is to-day.

## SPRATT'S ELECTRICAL SPEED AND DIRECTION INDICATOR.

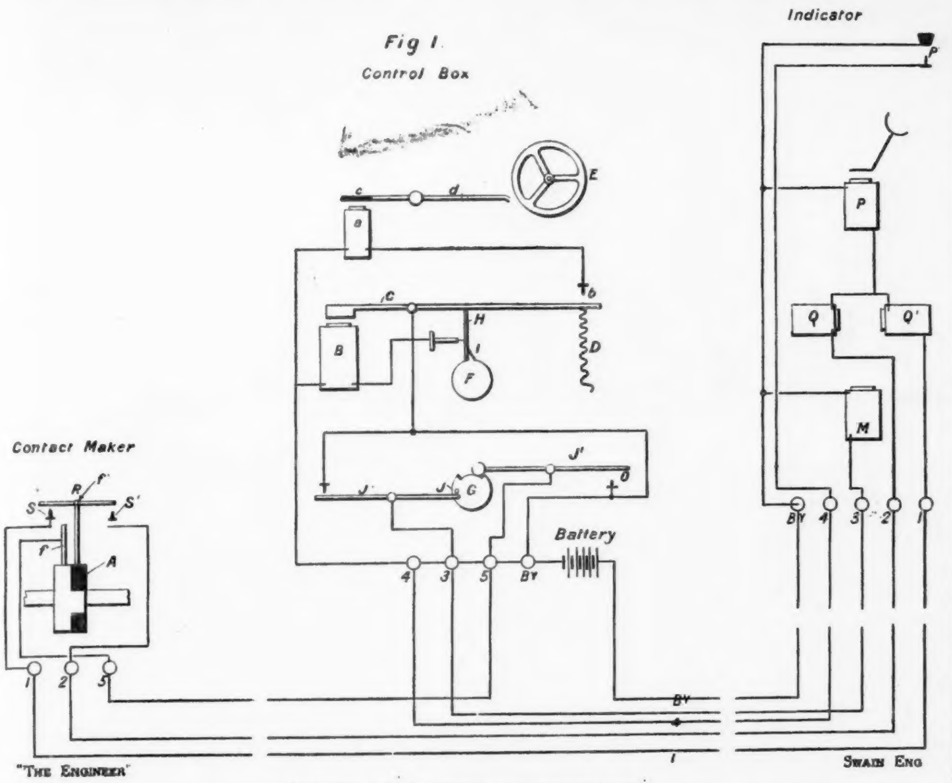
While great advances are being made in our ships, both for the Royal Navy and for our mercantile marine, and while the brain power of our marine engineers might almost be said to exhaust itself in perfecting the design of steam machinery for vessels great and small, there is another field of progress which has not been allowed to go to waste; and much of the success in handling such a complex mass as one of our great battleships must depend upon the skill and genius of the instrument maker who provides the means for intercommunication, for control, and for observation which are necessary to the efficient and trustworthy working of every department on board ship. The old-fashioned skilled handicraftsman who made instruments a generation ago has given place to the modern scientist, who devotes the highest powers of a trained mind, and the most perfect mechanical knowledge and workmanship to the production of instruments of great delicacy and accuracy, without which modern progress could not have been what it is.

In a recent number of The Engineer we described some cleverly designed instruments which have been fitted by Messrs. Elliott Brothers on board ships of all sizes and for all services, and we have since then had the opportunity of closely examining the working at sea of a new electrical speed indicator which is being introduced by the same firm, and which we now illustrate.

Amongst the various systems of signals required on board ship, perhaps one of the most important is a ready means of quickly ascertaining on the bridge or in the chart house—or in a warship, in the conning tower—the number of revolutions per minute of the engine shaft, or shafts in the case of a ship fitted with twin screws. This need is now felt more than ever, on account of the present tendency to fit ships with higher speed engines. Consequently many inventors have been at work on the subject, and a great number of attempts has been made to produce a trustworthy instrument for filling this requirement. Mechanical contrivances have been designed, but these have presented difficulties in large ships, especially as it has been found very inconvenient, and in some cases impossible, to take the necessary gearing from the shaft to the bridge, the friction of the working parts at this distance being too great to allow of the indicators being worked with satisfactory results.

---

* The Engineer, vol. lxxviii., page 549.



"The Engineer"
Swain Eng

SPRATT'S SPEED INDICATOR—CONNECTIONS

Pneumatic and hydraulic contrivances have from time to time been experimented with, but have developed defects which have been fatal to their introduction. The inventor of the instrument under notice has adopted electricity as the base of his system, but has applied it in a different manner to any that has before been attempted, and by so doing has devised an apparatus which is not only practical, but gives the result with the greatest accuracy. This has been verified by a severe trial, extending over a period of six weeks, made on a torpedo boat, the instruments being subjected to the excessive vibration of the boat going at full speed, and exposure to rain and sea water; in fact, the indicator at times was completely under water.

The engineer stated at the termination of the trial that in no case, even at the highest speed of 400 revolutions per minute, had there been a variation of 2 per cent. between the readings taken on Spratt's speed indicator and those taken on the engine counter working directly off the shaft, and this error, being always in the same direction, could easily be allowed for.

The general arrangement and working of the revolution counter is as follows: — Looking at the diagrammatical sketch Fig. 1, the contact maker is shown on the left. It consists of a metal ring A fixed round the shaft, the number of revolutions of which it is desired to record. There are four pieces of insulating material let into the periphery of the ring, which, passing under the metallic brush R, break the circuit four times for every revolution of the shaft. There is a second brush *f* which is continuously in contact with the metal part of the ring. The control box contains a simple self-winding electrical clock, which makes and controls the duration of the necessary contacts. The counter or indicator is shown on the right-hand side of sketch; it contains the counting mechanism, and the indicator for showing whether the shaft is running ahead or astern; there is also the necessary mechanism for automatically putting the counter to zero before the counting mechanism commences its operation. When it is desired to know the revolutions at which the shaft is running, the button $P^1$ on the right-hand side of the indicator is pressed in; this causes a current to flow from the battery along the wire marked B Y to the terminal of the indicator marked B Y; thence by a wire to the top contact of the button $P^1$, and to bottom contact, and by a wire to terminal 4; from there by the wire 4 to terminal 4 on control box; from there through the large magnet B, which winds up the clock by pulling on the left-hand end of the arm C, thus extending the spring $D^1$ which is the driving spring of the clock. Directly this is done, the spring catch H jumps over the projection I on the wheel F, and breaks the circuit through B. At the same instant a current is sent through the small magnet *a*, by the right-hand end of the lever C coming against the contact *b*; the magnet *a* now attracts its armature *c*, and pulling the lever *d*, gives the escapement wheel E a flick and starts the clock; the above cycle of operations is almost instantaneous. The clock being started the cam wheel G revolves, the pin J presses down one end of the lever $J^1$ and closes the contact at the other end of it. The current now flows from the battery again along the wire B Y through the magnet M, which operates the zeroising mechanism and sets the counter to zero. The pin J having passed over the end of the lever $J^1$, the circuit is broken. The cam-wheel G next lifts the end of the lever $J^{11}$ and closes the contact O at the other end; this is the counting circuit and is kept closed exactly fifteen seconds. This period, however, may be shortened if desired by increasing the number of contacts on the shaft ring). The current now flows through B Y, again through the magnet P, then through the magnet $Q^1$ down the wire marked I to the terminal *l* of contact-maker; thence to the contact S on to the cross piece of the brush R, then where the metal part of the ring comes under, across to the brush *f*, and thence by wire 5 back to control box and to battery. The counting circuit being closed for fifteen seconds, and this circuit being broken by the ring four times for every revolution, the number of revolutions per minute are thus recorded. The brush R in the contact-maker is pivoted at $f^1$ and is thus carried over by the friction of the brush rubbing on the ring, and the contact S or $S^1$ is closed according to which direction the shaft is running; the current thus flows either through the magnet Q or $Q^1$ in the indicator, and by means of an armature pivoted between them turns a disc showing either ahead or astern, as the case may be.

The operation of taking a record is, therefore, briefly as follows:—On pressing the button at the side of the indicator, Fig. 2, the last indication is automatically cleared away and the wheels set to zero. So soon as this operation is completed the counting commences and lasts for fifteen seconds, at the end of which time figures appear at the circular openings of the indicator showing the number of revolutions per minute, and at the large opening is indicated the direction. For instance, if the figures 1, 2, 5 (ahead) appeared at the openings it would indicate the engines are working 125 revolutions ahead. Whilst these operations are going on, all instruments in the circuit are automatically locked, so that it is impossible for anyone, by pressing the button of any other indicator, to upset the record being taken. The following are the advantages claimed over other systems:—(1) Great and uniform accuracy at high and low speeds. (2) A number of indicators can be worked from one control box. (3) If any indicator be damaged in any way, it does not affect the working of the others. (4) The indicators are not affected by the rolling, pitching, or vibration of the ship. (5) All vital parts are enclosed in a water-tight case. (6) The speed is given in figures, and not by a hand pointing to divisions, thereby avoiding any mistake in reading. (7) No winding of clocks required. The only attention required to keep the system in good working order is the occasional lubrication of the contact ring on shaft.

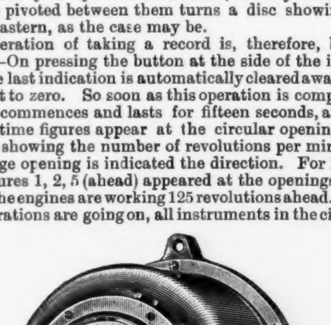


Fig. 2—SPEED INDICATOR

## ROADS AND RAILWAYS OF ASIA MINOR.

According to the British Consul at Aleppo a public road from that place to Biredjik, on the Euphrates, a distance of eighty-five miles, has been commenced, and 12½ miles of it completed. Permission has been granted by the Government to convert the existing camel road from Aleppo to Afseen into a carriage road, by which twenty-four miles will be saved between Aleppo and Alexandretta.

The hopes raised that the recent grant of railway concessions in Asia Minor, Palestine, and Syria by the Ottoman Government would include one of a short line from Aleppo to its natural port, Alexandretta, a distance of 100 miles by the carriage and seventy-five miles by the ordinary camel and mule road, have not been realised, and the consequent development of the province is retarded.

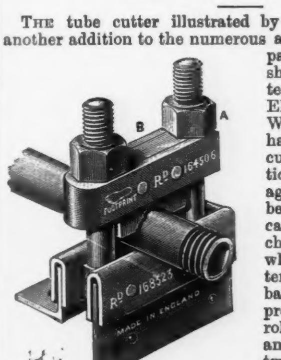
In June, 1893, a concession was granted by the Porte to Mr. Motran, acting on behalf of a group of French capitalists, for a line of normal gauge from Damascus to Biredjik, on the Euphrates, a distance of about 350 miles, with power of extension to Telek, near Diarbekir, a further distance of 150 miles. This group has since amalgamated with the French company constructing the port of Beyrout, the steam tramway from Beyrout to Damascus, a distance of about ninety-two miles, and the Belgian steam tramway from Damascus to the plains of the Hauran, forming together what is known as the Compagnie des Chemins de Fer Economique de Beyrouth-Damas-Hauran en Syrie.

The line from Damascus to Biredjik has a Government mileage guarantee of £804 13s., and would be 306 miles in length to its junction with the steam tramway between Beyrout and Damascus, the places passed through being Aleppo, Hamak, Homs, Baalbec. This gives the railway distance, with break of gauge, from Biredjik to Beyrout at 344 miles, and from Aleppo to Beyrout at 250 miles. The military authorities are said to view unfavourably this proposed deviation from the direct route of Aleppo to Damascus, with the disadvantage of break of gauge, and prefer the line being carried direct from Homs to Damascus, which would lengthen the railway distance from Aleppo to Beyrout by about forty-four miles, making from Aleppo to Beyrout 360 miles, and from Biredjik 440 miles. As to the proposed railway rates, the Cahier de Charges fixes the minimum charge at 2·355d. per ton per mile, thus making the lowest cost of transport of a ton of merchandise from Biredjik to Beyrout by the company's proposed route to be £3 6s., and from Aleppo to Beyrout £2 8s., while by the direct route *viâ* Damascus, insisted upon by the military authorities, it will be £4 5s. and £3 6s. 9d. respectively. This is irrespective of extra charges, such as carriage from the warehouse at Biredjik or Aleppo to the railway stations, carriage at Beyrout to the quay, and the new port and quay dues, which are very heavy.

Against these prospective charges for produce by railway transit must be placed the far cheaper and economical charges by camel and mule direct to Alexandretta, averaging from Beridjik £2 6s., and from Aleppo £1 10s. per ton. These rates are subject to violent fluctuations, and in March last heavy produce was being carried by camel from Aleppo to Alexandretta—75 miles—where there are not any port or quay dues, at 15s. per ton. The same considerations apply to the produce of Mesopotamia brought for export through Biredjik, and to that of the plains of Hamak and Homs, of which latter Tripoli is the natural port. In all these cases the proposed line cannot compete with the camel, while the Government has to pay a serious annual charge for the mileage guarantee. It is calculated that all possible available traffic can at the minimum rate barely reach one-third of the guarantee, as producers will inevitably prefer the much cheaper, if not the most expeditious, route by camel and mule to Alexandretta. The company has by its concession the preference to construct branches to the sea, but these would be a serious detriment to the main line, and reduce its small earnings to nil. Such short lines—Biredjik to Aleppo, 94 miles; Aleppo to Alexandretta, 75 miles; Hamak to Homs, 31 miles; and Homs to Tripoli, 60½ miles—if working independently, would compete most successfully with the camel and do wonders for the country.

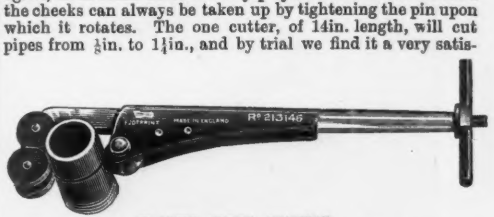
While produce, chiefly grain, the principal resource of the district, rots for want of cheap communication with the sea, it can hardly be expected that the hopes of the company to develope production and attract traffic by the simple process of doubling or trebling the cost of transport can be realised.

## A NEW TUBE CUTTER.



TUBE VICE

The tube cutter illustrated by the engraving below is another addition to the numerous articles made wholly or in part with pressed or stamped sheet cast steel, on the system adopted by Mr. T. R. Ellin, of the Footprint Works, Sheffield. The main handle bar of this tube cutter carries four anti-friction rollers at its outer end, against which the tube to be cut bears. The cutter is carried between two side cheeks, which, with a tube which slides over the internal part of the handle bar, are of a piece of pressed sheet steel. The roller cutter is held upon an adjustable steel pin between these, and it therefore takes a position central between the anti-friction rollers, which are on either side of the handle bar. The burr thrown up by the cutter thus runs between the anti-friction rollers, and is not continuously rubbed down and rolled up again, as in some cutters. Any play between the cutter and the cheeks can always be taken up by tightening the pin upon which it rotates. The one cutter, of 14in. length, will cut pipes from ⅛in. to 1¼in., and by trial we find it a very satisfactory tool. The cutter, it should be mentioned, is set up by the fly or bar nut seen at the end of the handle.

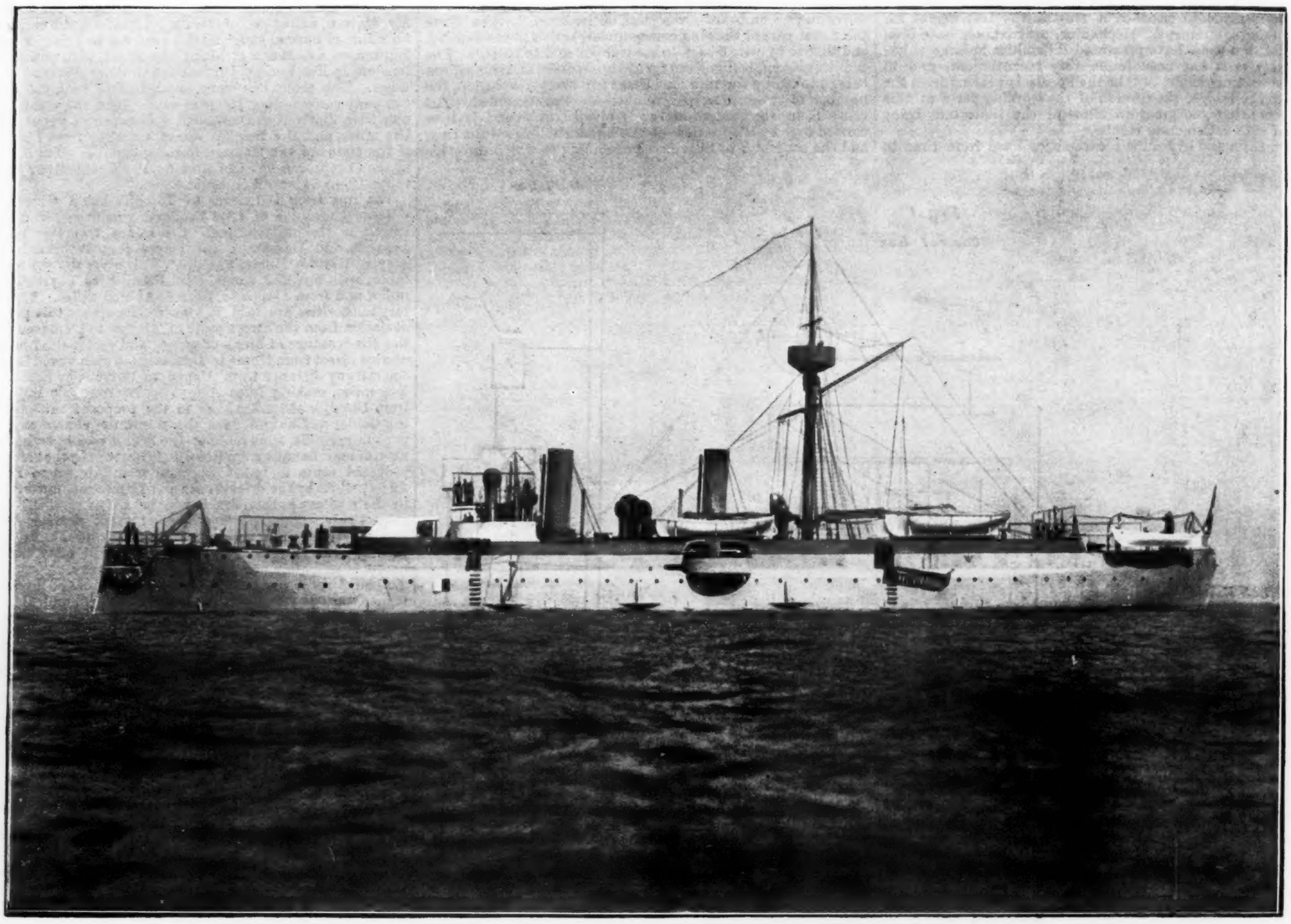


ELLIN'S TUBE CUTTER

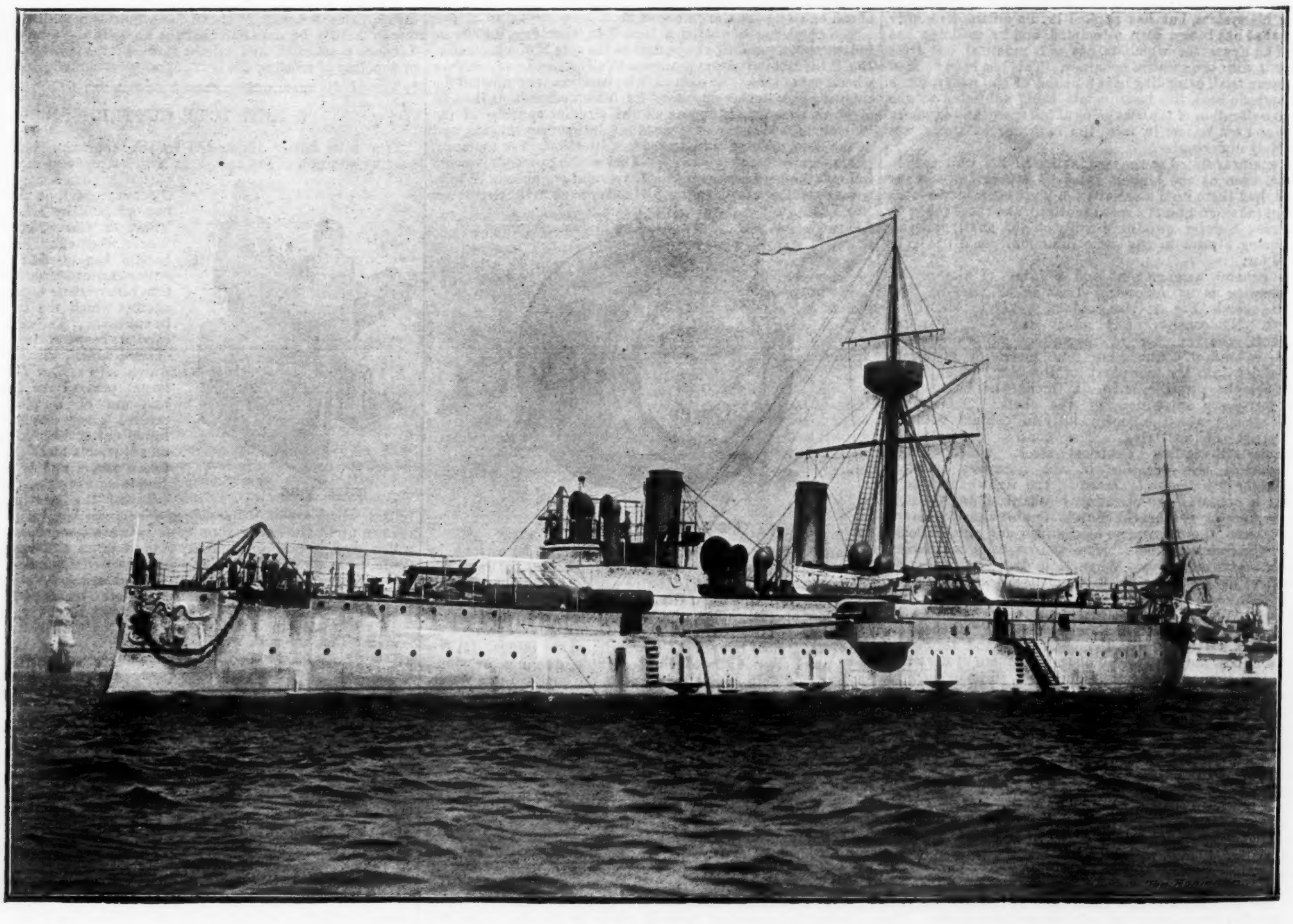
Mr. Ellin is also making a "Footprint" pocket tube vice for the use of gasfitters. It is very similar to that illustrated by the accompanying engraving, but with a single steel angle piece for each side of the lower jaw instead of that shown. It will take tube from ⅛in. to ⅜in., which is as large as gasfitters usually require; and it is easily carried and temporarily fixed to a bench or table or plank.

## ARMOURED CHINESE WARSHIPS

(*For description see page* 294)



THE LAI YUEN



THE KING YUEN

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, October 5th, 1894. Page
Whitworth Scholarships .. .. 289
Belgian Exhibits at the Antwerp International Exhibition (Illustrated.) .. .. 289
Is Our Iron Trade Decaying? .. .. 291
An Aluminium Torpedo Boat. (Illustrated.) .. .. 292
Unarmoured Chinese Warships .. .. 293
Chinese Warships at the Battle of Yalu. (Illustrated.) .. .. 294
Lord Armstrong on Ships and Guns .. .. 294
Railway Matters .. .. 295
Notes and Memoranda .. .. 295
Miscellanea .. .. 295
The Condition of the Thames—Proposed Lock and Weir at Putney. (Illustrated.) .. .. 296
Hampstead Electric Lighting Station. (Illustrated) .. .. 296
The Works at the Panama Canal .. .. 297
Abstracts of Consular and Diplomatic Reports .. .. 298
Pumping Machinery for the Water Supply of Mysore. (Illus.) 298
The New Railway to London. (Illustrated.) .. .. 298
Spratt's Electrical Speed and Direction Indicator. (Illus.) .. 298
Roads and Railways of Asia Minor .. .. 299
A New Tube Cutter. (Illustrated.) .. .. 299
Armoured Chinese Warships .. .. 300
Leading Articles—Artillery Fire in the Chinese War—The Working of the Railways .. .. 301
Brighton Beach .. .. 302
The Co-operators in Conference—Nine Months' Clyde Shipbuilding The Coming American Transatlantic Liners—Ealing Electric Supply Works .. .. 303
Literature .. .. 303
A Dynamometric Railway Car. (Illustrated) .. .. 304
Barber's Split Tool Holder. (Illustrated.) .. .. 306
Tower's Steady Platform. (Illustrated.) .. .. 306
Catalogues .. .. 306
Letters to the Editor—The Theory of the Steam Engine—Governing Electric Light Engines—Labour and Luxuries .. .. 307
Rustless Coatings for Iron and Steel .. .. 308
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. 308
The Sheffield District—The North of England .. .. 309
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. 310
American Notes .. .. 310
Launches and Trial Trips .. .. 311
A New Method of Reducing Metallic Oxides .. .. 311
The Patent Journal .. .. 311
Selected American Patents .. .. 312

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

⁂ *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

⁂ *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

⁂ *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. L. (Leicester) —*The tank will hold* $10 \times 10 \times 12 = 1200$ *cubic feet.*

A. E. K.—*You will find it necessary to use a check spring acting against the weight.*

G. A. R. (Newport).—*Your letter is so vague that it possesses no interest whatever. If you discard steam, gas, and electricity, you have nothing left as motive power, for muscular effort will not suffice.*

J. G. (Sheffield).—(*1*) *There is no rule for calculating the strength of spiral springs which is worth much. Rankine gives* $D = \sqrt[3]{\frac{w \times d}{3}}$ *for round steel. Here D is the diameter of the wire in* $\frac{1}{16}$ *of an inch, w the weight in pounds, d the diameter of a coil centre to centre. We have not space here to do more than refer you to Clark's "Rules and Tables," page 672.* (2) *In calculating the area of such a figure as that enclosed, the best plan is to cut out a parallelogram of good cardboard which will just enclose the figure drawn on it with fine ink lines Weigh the cardboard accurately. Calculate its area. Then cut out the figure whose area you want and weigh it. Its area will be to that of the parallelogram as its weight is to that of the parallelogram.*

## SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. £0 18s. 0d.
*Yearly* .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. £1 0s. 3d.
*Yearly* .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

## ADVERTISEMENTS.

⁂ *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

The Junior Engineering Society.—Saturday, October 6th, at 3.30 p.m. Visit the Gigantic Wheel Works, Earl's Court Exhibition, West Kensington.

## DEATH.

On Sunday, September 30th, at his residence, Havelock-road, Croydon, **William Topley**, of her Majesty's Geological Survey. Aged 53. Interment is at Woolwich Cemetery, 4.30, Thursday, 4th inst.

# THE ENGINEER.

*OCTOBER* 5, 1894.

### ARTILLERY FIRE IN THE CHINESE WAR.

The story of the battle of Yalu has now been told in various ways, and the accounts are, on the whole, consistent, so that we can draw some conclusions as to the behaviour of heavily armoured ships and cruisers, and as to the effects of the fire of guns of new type. That story we have told in another page. The opposing fleets were singularly different in their character. That of China consisted of four fairly modern barbette ships; two, the Chen Yuen and Ting Yuen, each of 7430 tons displacement, carried compound armour from 14in. to 12in. thick, with powerful 12in. Krupp guns and auxiliary armaments of 6in. guns and mitrailleuse, but no quick-fire guns. In fact, they were good representative heavy armour-clads of their dates, that is of 1881 and 1882. The King Yuen and Lai Yuen were much less powerful, each only 2850 tons, but were built in 1887, and the Ping Yuen is a coast defence ship of 1890. With these were the unarmoured cruisers Chih Yuen, Ching Yuen, Tsi Yuen, Yang Wai, and other ships of less importance. The main features, then, of the Chinese fleet were heavy guns and thick armour. Their defensive power was in some cases great, and they were capable of striking very heavy blows, but few and slow compared to those the Japanese ships could deliver. Two Chinese cruisers had a speed of 18 knots, but the barbette ships had at most a nominal speed of 16½ knots, and we think that their actual speed fell very far short of this. Of the Japanese fleet we have less particular information. It consisted, however, of armoured and unarmoured cruisers. Indeed, the Japanese only possess one ship carrying more than 4½in. of armour on a belt, namely, the Fu Soo, an old-fashioned central battery ship of 1877, carrying 9in. of armour, and she counts for but little. In any case the character of the Japanese fleet was wholly different from that of China. Some Japanese ships possessed high speed. The Yoshino is credited with 23 knots, and carries an armament entirely consisting of 6in., 4·7in., and smaller quick-firing guns. The Akitsuschima has a speed of 19 knots. The Naniwa and Takachiho are sisters, of 18·7, and the Itsukusima and Metsuchima of 17·5 knots speed. Many of the Japanese ships, however, could not have been faster than those of China. The Akagi, for example, is a 615 ton ship, of only 12 knots speed; nor could they have carried many powerful quick-fire guns. In short, if we consider the general bearing of the battle on the probable future of the war, it argues very badly for China, for it may be seen that her entire armour-clad force except one gunboat was engaged, and while the Japanese ships were decidedly faster than the Chinese, the powers of the former, both offensive and defensive, must in many cases have been inferior to that of their adversaries. The commanders appear to have handled their ships at least as well as could be expected. The Japanese captains tried to keep up a running fight at long ranges. Probably from being in better condition, practically the whole of the Japanese ships had the advantage in speed, and being better gunners and sailors, it was to their advantage to fight in this way.

The Chinese tried to close, and the evolutions are described as consisting of the circling of the Japanese divisions round the Chinese, the latter running in smaller circles. The Chinese unarmoured cruiser Chih Yuen, having a speed of 18 knots, tried to utilise her powers, and ran straight for a Japanese ship, which, the Chinese say, was sunk, though not, it seems, by ramming; indeed, the actual sinking is a little uncertain. Apparently the Japanese Yoshino, the most modern and formidable ship in their fleet, was very severely handled. Eventually the Chih Yuen was herself sunk as well as the King Yuen—armoured barbette ship—and a third Chinese vessel, the Choo Yung, as well as the fourth ship eventually, both the last apparently of less importance. The two heaviest Chinese armour-clads, the Ting Yuen and the Chen Yuen, appear to have got into thick of the Japanese fire, and to have borne the brunt of the attack admirably. Their upper unarmoured portions were naturally riddled, but the barbettes and vital parts were not penetrated. It could hardly be otherwise, seeing that the 6in. quick-fire guns are not nearly powerful to pierce them, and consequently the hundreds of shot that made holes or indentations 3in. deep were thrown away. The firing generally was at a long range, and was therefore necessarily not directed to the best purpose, so that much of it was wasted, and we do not doubt that the Japanese had run out of ammunition, and their retirement was a necessity. The Chinese, however, were also running short of shells, and were in some cases using steel shot to bad purpose on their unarmoured adversaries.

The first lesson to be drawn seems to us the very obvious one that, if a fight is to be carried out at long range, eventual success greatly depends on the supply of ammunition. Nearly all the injury done was effected by artillery fire, neither the ram nor the torpedo was used to any purpose, indeed, hardly tried, but the action taking place at long range, there was probably little scope for them. Even under these circumstances, the destruction was less than might have been expected. The Chinese appear to have shot very badly. It is, however, to be borne in mind that the fire in each case was that which the enemy could best resist. The Chinese armour was absolutely inpenetrable to the Japanese guns, so that their possible scope was limited to the destruction of the structural parts of secondary importance. On the other hand, the Japanese armour would have been perforated by quick-fire guns, and the entire ships would have been cut away at a great rate, had the Chinese posssesed quick-fire guns. Instead of this, they were only exposed to very slow fire. The actual projectiles employed against them were certainly very powerful and a fortunate shell might totally destroy a Japanese ship; but at a long range with bad gunners, this was not very likely to happen, so that the Japanese were exposed to a much less severe ordeal than if the enemy had consisted of cruisers of their own type. It must be remembered also that the Chinese ships were only exposed to a very limited number of heavy quick-fire guns, for most of the Japanese ship's armaments, while they consisted of excellent new type pieces, did not include heavier quick-fire guns than 6-pounders.

On the whole, then, we are forced to the conclusion that the general lessons to be drawn from this battle are influenced by the following facts:—First, that the long range precluded our learning much as to the use of the ram or torpedo, and secondly, that the artillery fire was in each case the kind which the fleet was best able to bear. We fear that in a close encounter, when these peculiar features were not found, the destruction would be very much greater. This would no doubt make it less likely that the fight would end, as we imagine it did in this instance, from the supply of ammunition failing.

The immediate effect on the war is, as we have said, likely to be very bad for the Chinese. Their whole armour-clad fleet having concentrated, the Japanese have not feared to attack it and give a very good account of it, sinking four ships, and demoralising the Chinese navy no doubt. We can fancy a parallel being drawn between their action and that of our fleet, when it fought the Spanish Armada. We prefer, however, to confine ourselves to more practical issues. Let us consider what would happen if really brand-new ships and armaments were to engage. Lord Armstrong on September 28th—last Friday—spoke of the extraordinary ballistic powers that have been developed with cordite. The velocity of 3000ft. has been attained with a 100 lb. shot from a long 6in. gun. A speed of six rounds a-minute has been achieved under service conditions when the ship was in motion, and firing with such accuracy as to hit a target twelve or even fourteen times out of eighteen. The significant features in this statement are, we think, the speed and accuracy under service conditions, coupled with the fact that there is no smoke. On the very high velocity we lay very little stress, because experience has shown that even for direct-fire, projectiles require to be very excellent to hold together on impact at very high velocities, and on service most of them would strike obliquely. The increased speed, accuracy, and absence of smoke, however, would tell so greatly that we think the battle would be brief and terrible, and that it is a question whether a fleet possessing sufficient speed to control the range, and a larger supply of ammunition, would not have the possibility of destroying an enemy by the tactics of long bowls carried out with such success by the Americans against ourselves in our old war. Happily, British ships at present, we believe, carry a larger supply of ammunition than those of other navies. Moreover, it is possible that if cruisers tried this experiment against heavy ships commanded by cool men with good gunners under them, they might find some of them were sent to the bottom by the occasional powerful shell that the heavy battleships would discharge. Lastly, we would call attention to the fact that the Ting Yuen and Chen Yuen have not complete armour belts, and that they were exposed to the main attack of the Japanese quick-fire, so that the conditions were those which would fairly try the powers of the horizontal armour, and it appears to have answered its purpose.

### THE WORKING OF THE RAILWAYS.

Board of Trade publications respecting the railways of the United Kingdom have lately been coming upon us in rapid succession, three of these documents appearing on as many consecutive working days. Two cover the whole of last year, and a third consists of returns relative to accidents occurring in the first half of the present year. All are in the form of papers presented to Parliament. The two which refer to 1893 are each described as a general report, one treating of accidents and the other of finances, including revenue and working expenses. This latter report is based on the returns issued by the Board of Trade in the month of August, and on which we commented at the time, giving many of the results and comparisons which now appear in the official report. The account now presented points out the serious extent to which the railway receipts were affected by the great coal dispute of last year. Until 1893 there had been no actual decrease in the gross receipts of the railway companies for seven years, and for the forty years over which the records extend the figures show an almost uninterrupted increase. The reduction last year, although it does not stand quite alone, is yet without precedent in regard to its amount, this being as much as £1,460,000. Following the usual tabulated statement as to traffic receipts, working expenses, and net earnings, the remark is made that "from whatever point of view this table is looked at, the general result is unsatisfactory." A sentence pregnant with meaning says, "The dislocation of trade and industry caused by the coal strike of last year will long be remembered by those interested in railway undertakings as materially helping to produce net results which make 1893 the worst year on record, so far as they are concerned." A hope is expressed that the ground lost in 1893 will prove to have been made good in 1894, and that the revenue side of the account will even show some improvement as compared with 1892. Unfortunately the coal strike in Scotland will not help to make matters better, though it has been partly counterbalanced by the quickened coal trade in the North of England. The effect on the iron and steel industry beyond the Tweed has been exceptionally hurtful, and the Scotch railways have suffered in their mineral and goods traffic.

If railway finances languished in 1893, there was a bright feature in the chapter of accidents. The passengers killed by accidents to trains were seventeen compared with twenty-one in the year before, and the proportion was simply one passenger killed in above fifty-one million passenger journeys. There was also a decrease in the number injured by accidents of this description, the reduction being considerable compared with the previous year, and falling as much as 45 per cent. below the number in 1891. It is true that the number killed in 1891 was only five, but twelve passengers lost their lives in one disaster last year, near Llantrissant Junction, on the Taff Vale Railway. If these were deducted, we should get the same result as in what is now the best year on record. We have remarked on a former occasion how one accident on a large scale will mar the statistics for the whole year. In 1879 only two passengers would have been killed had it not been for the terrible Tay Bridge disaster, which by a singular fatality happened only three days before the year came to a close. In the first half of the present year no passenger has been killed by a train accident, and only seventy-three have been injured. But the passengers killed last year were only one in the first six months, leaving sixteen to come later on.

There is one fact in the history of 1893 which is eminently satisfactory. The train accidents were fewer than in any year since 1874, and probably the favourable comparison might be carried further back, if the figures were produced. Forty-six train accidents in 1893 stand in striking contrast to 161 in 1875, when the traffic was so much less than it is now. In seventeen instances last year collisions occurred within fixed signals at stations or sidings; ten accidents were due to engines or vehicles meeting with obstructions, or leaving the rails in consequence of obstruction, or as a result of some defect in connection with the permanent way or works. The next in point of frequency were eight accidents arising from trains entering stations at too great speed. In these three classes there were thirty-five accidents out of the entire forty-six, whereas in 1881 the corresponding group registered sixty-five. Collisions within fixed signals at stations or sidings have fallen off one-half, and accidents from engines or vehicles leaving the rails have declined in a still greater degree, though not to the same extent as in 1890-91-92. While accidents from excessive speed in entering stations happened on eight occasions last year, there were ten such occurrences in 1892, and fifteen in 1891, but only two in 1890.

Among the accidents of 1893, one was somewhat singular in its operation, a down train on the South-Eastern line running through the gates at a level crossing near Erith, and one of the passengers subsequently dying from the shock. It transpired that the man in charge of the gates could neither read nor write. A copy of the rules relating to his duties was found in his box, but it did not appear that they had been explained to him. Of course the great disaster of the year was that which happened on the Taff Vale line. This was due to the fracture of a T-link hung from the axle-box of the engine, to which was attached an under-hung spring. The latter ultimately fell off, and got under the wheels of the leading van, causing it to leave the rails. Out of the seventeen collisions within fixed signals at stations or sidings, fifteen are attributed to mistakes or negligence on the part of the companies' servants. In three cases attention was called to long hours worked by the employés. Taking the whole range of the forty-six train accidents, it is found that as many as seventy-five circumstances contributed to their occurrence. Of these practically one-half are reported as due to "negligence, want of care, or mistakes of officers or servants." In seven instances we are told of defective arrangement of signals or points, or the want of proper locking apparatus. Excessive speed is mentioned in five cases. In all the preceding years the contributing circumstances were more numerous, being as many as 212 in 1883. Of the specified train accidents, four occurred on the North British line, and a like number on the North Eastern. These were the highest number on any line. But we are bid to remember that accidents taking place upon a railway may occur to trains belonging to other companies, and may not be caused by any fault of the company owning the line.

The accidents to servants of companies show a tendency to diminish. The number killed by train accidents last year was 10, and from other causes 450. There have been better years, so far as absolute numbers are concerned, yet there is a marked improvement compared with periods about 1874 and some time afterwards. The fatalities arising out of coupling and uncoupling operations are fewer than in previous years. Including all shunting operations, the killed were 125, whereas the fatalities in 1892 were 158, and in 1891 rather higher. Compared with the number employed, the loss of life is greatest amongst shunters, being at the rate of one in 179, the injured being one in 17. This is a melancholy record, and the report states that although there is a decrease in the casualties, both on the whole and in respect to shunting, yet "the figures must be looked upon as far from satisfactory." It is further intimated that the subject is receiving the earnest attention of the Board of Trade. While the employés thus suffer, it has to be observed that a large number of accidents befall the passengers from a variety of causes, in some of which their own want of caution or their actual misconduct are concerned. Eighty-nine lives were lost in this way last year. But in 1892 there were as many as 108. Apart from the passengers, trespassers present an extraordinary total, and show an increase of fatality, 274 being killed last year, compared with 258 the year before. Deaths at level crossings undergo a reduction from 77 to 55. Suicides are slightly fewer, being 86 in place of 89, and the miscellaneous class are 30 instead of 43. The total death roll for 1893 is 1011, and it is somewhat encouraging to find that this is 119 less than the total for 1892. The cases of injury are also fewer. It is reasonable to infer from these figures that increasing care is exercised in working the traffic, and that means and appliances are introduced which tend to make railway travelling safer, at the same time reducing the risk of accident from other causes which stand in some relation to the traffic. In the case of the passengers, it is a matter for congratulation that while the number carried in 1893 was several millions greater than in the previous year, the proportion of passengers killed, from all causes, was changed from one in 6,700,000 to one in 8,237,000.

In the working of the trains, an important aid to safety is to be sought in the absolute block and interlocking systems. Of 19,499 miles of line open to passenger traffic, over 18,000 miles are now worked on the absolute block system. The proportion in which the signal and point levers have been interlocked is 99 per cent. for England and 98 per cent. for the whole of the United Kingdom. While the companies are rendering better service to the public than at any previous period, it is to be regretted that the profits of the undertakings, taken as a whole, have undergone diminution. As pointed out by Mr. Giffen and Mr. Hopwood, there has been a decrease in the net amount earned and available for distribution among the railway shareholders in each of the last four years in succession; but the decrease last year far surpasses that in each of the three previous years, as it does also the decrease in any year since anything like accurate information has been obtainable. The retrogression is shown by the circumstance that in 1889, when the net earnings were the highest on record, the amount reached was nearly £37,000,000, whereas last year it was under £35,000,000, the falling-off being nearly £2,000,000. There is also the further disadvantage that these diminished earnings have to be spread over an enlarged capital. The real increase of railway capital last year, apart from the nominal, is shown to be about £17,000,000. It is computed that the amount paid in dividends to ordinary shareholders in 1889 was £15,210,000; whereas the corresponding amount last year was only £12,400,000, a reduction of £2,810,000, or fully 18 per cent., while the capital account had increased by about £28,000,000 during that period. The public expect great things from the railways, but the shareholders are reaping a slender reward, while those who travel are daily receiving greater advantages and are looking for more.

### BRIGHTON BEACH.

When writing our last article about Brighton beach the public at large was wholly unacquainted with the fact that the Brighton Town Council were then awaiting a report and proposition with respect to the further sea defences of their town from their engineering advisers. Brighton has learned, however, that these have, during the last few days, been submitted to the Council, and that as the result it has been determined to expend a sum of no less than £47,000 upon the defence and additional ornamentation of the sea frontage of the town. The resolution so come to is possessed of a particular interest for ourselves. The work now proposed to be undertaken embraces to a very great extent the principle we have throughout our series of articles on this subject advocated as being the only one on which full security could be obtained. At the same time that the Council and its advisers have thus very largely endorsed our views, we do not feel altogether assured that the works contemplated are of the complete character that is, in our judgment, to be desired, for in some degree we feel that they are of the nature of a compromise. Compromises, as we know, are rarely wholly successful: they may include all that is best in schemes of a more thorough-dealing character, or they may embody only that which might deservedly be rejected. Before, however, entering upon any discussion of what has been resolved upon, it is desirable to give an outline of the main features of the new scheme. Turning our attention first of all to the eastern extremity of the town, we would remind our readers as to the stress we have laid upon the dangerous condition of the cliffs at Black Rock, to which subject we devoted more than one separate article. Naturally this matter is one the consideration of which has for some years been forced upon the municipal authority. Of the repeated accidents taking place at this point, and of the serious consequences involved to the drainage works of the town, we have fully informed our readers. We see no reason to dispute the sufficiency of the course now resolved upon in order to secure this locality from further damage. Adopting our view that groyning, under the changed conditions of the flow of the shingle brought about by the erection of the sea wall at Hove, would be insufficient to meet the case, it has been determined to erect a massive sea wall well in advance of the foot of the cliff. Within the line so to be attained an extension of the present Madeira-road is to be formed, a boon which the inhabitants of the east end of Brighton will certainly appreciate. This design is to supersede one presented to the Council only last year which made provision for the construction of three groynes, 150ft., 250ft., and 600ft. in length respectively. In place of the central of these three groynes, a sea wall is now to be built, the other two being retained to aid in the deposit of beach along the face of the wall, one being 350ft. long and the other 500ft. This new sea wall, the intended length of which has not been stated, will have its top 12ft. 6in. above high-water mark, the thickness at its summit being 6ft. The space to be recovered from the foot of the cliff, and that will be available for the extension of the Madeira Drive, will be 60ft. in width. The estimated cost of this portion of the general scheme is £14,000, the material of the wall being of concrete with flint-facing blocks.

Passing westwards, the next section to be dealt with is the extension of the present raised terrace below which are shelters and reading-rooms. This extension will increase the length of the existing handsome erection by 1530ft., and sloped ascents will be provided whereby Bath chairs can reach this intermediate level between the upper and lower parades. Of course this work does not come within the category of the defensive works we are now immediately considering; but as being part of the general design decided upon, it seems to be desirable not wholly to omit reference to it. The estimate for this work is also £14,000.

It is when we arrive at the third and last proposition that we reach the point to which we have in our former articles mainly called attention; for it has been on this section of the foreshore that the effects of the sea wall at Hove have shown themselves most seriously. When remarking in our recent article upon the result to the extensive groyning that has, during the past few years, been added between the end of the Hove wall and the West Pier, we observed that the character of the limited amount of shingle arrested by it was not such as to promise the required degree of permanent lodgment. The shingle, as we have always foreseen that it must do, passes in its present line of travel too far seawards to admit of its arrest by the new groynes, which, although of very considerable length, do not reach that line. We have from the very moment that denudation threatened this section of the sea frontage, expressed our opinion that a sea wall would be necessary, and that the expenditure on mere groyning would fail of its hoped-for result. Apparently, conviction in this sense has now been forced upon the local authorities, and we learn that a sea wall, about 1620ft. long, is to practically connect that built at Hove with the large concrete groyne just eastward of the West Pier. This will, however, be of a different character to the massive wall built at Hove. It is intended primarily to serve as a base for now existing groynes and for the additional one contemplated with the object of reaching the hitherto unattained line of shingle travel. In addition to this function, the wall is to serve as a retaining wall for the extra land to be added to the existing lawns, provision being made whereby interference with the present facilities for boating and bathing will be avoided. In our last article we suggested that means could be found whereby this interference might be provided against. The space to be recovered by this wall will give an additional width of 30ft. to the gardens. The slipway for boats is to be maintained as now provided between the Hove wall and that proposed, and is to be defended by a timber breastwork 100ft. long, but how this is to be constructed we have learned no detail. A further additional concrete groyne is to be built opposite to Preston-street, and sundry additions made to those others constructed within the last few years. The cost of these new works and alterations has been estimated at £18,894 7s., bringing the total for all the three sections we have dealt with to the sum of £47,000.

We have above referred to these several works as seeming to us to be to a great extent of the nature of a compromise between what we have ourselves expressed as being necessary and the system upon which the Town Council has hitherto solely relied. But although this is so, we feel that our previous contention receives a large amount of endorsement under the new scheme, this being the result of a protracted and very costly experience of failure to that system. We are not blind to the distinction that has to be drawn between the wants of Hove and those of Brighton influencing the decisions now taken. Hove consists largely, and mainly, of residential property, the occupiers of which are by their tastes independent of the ordinary amusements sought for by visitors to the neighbouring borough. For these last a beach, with its somewhat vulgarised entertainments, is the chief attraction. The maintenance of a wide stretch of this is, therefore, in the case of Brighton, more of a necessity than it is in the instance of Hove. This distinction was brought out very forcibly during the discussion by the Town Council of Brighton of the schemes just submitted to it. Hove cares only for quiet recreation for its inhabitants; Brighton visitors for the most part are attracted by the rather noisy elements suited to the excursionists who throng daily during the season the fine parades and foreshores of the town. It is for this reason—and for this reason only perhaps—that the Town Council supports a compromise between full and partial efficiency. For this its members can hardly be blamed. The sea wall resolved upon by them must certainly form an efficient second line of defence, but it will not be—if the hope of securing shingle be realised—the first and permanent line of defence that the Hove wall is. It is the hope of the Council, in fact, that ultimately even the top of the new wall will become covered with shingle. This anticipation may be justifiable, but it is one that should not be too confidently entertained. We only hope that, with too great a reliance upon it, it may not be attempted to make the new wall of a strength insufficient to withstand direct attack by the sea in the event of its possible non-realisation. But should this required strength be given, the principle we have so persistently advocated will have been at least admitted, and a large amount of ultimate, if not first, security attained.

Nevertheless, it is greatly to be feared that the endeavour to adhere in part to a system of multiplying groynes will result in the almost total spoiling of this part of the beach for the objects it is desired to secure. The remedy may almost prove to be worse than the disease, for when last writing we remarked upon the unsightliness and splitting up of the beach into uneven levels caused by what has already been done in this direction. We even doubt, as we have before done, whether the multiplication of these high and costly concrete groynes can be justified. If the line of shingle travel can be reached, a few years would probably establish a beach firm enough to withstand all future attack. When once so established there should be little or no tendency to resume travel, and timber groynes would have acted as efficiently during those few years as would the high and more expensive ones of concrete, while the beach formed would be less inconveniently broken up than it must be by the latter. Of course the peculiar conditions we have named as ruling the decisions of the Town Council in this matter do not apply to the protective works decided upon at Black Rock. Here the intended sea wall will be the first and the only line of defence, and it will therefore differ materially in character from that we have named as contemplated for the western works. Probably some result may follow the construction of the two groynes to be built in connection with this, and some shingle may accumulate to protect the foot of the wall. But in that particular locality addition of beach is not required for pleasure purposes, and the wall might be left to fulfil unaided its intended function. Hence we cannot see why one at least of these groynes might not be done without, unless, indeed, it is wished to protect the line of coast eastward beyond the limits of the town's jurisdiction and responsibility. But it may possibly be thought desirable to proceed in that direction in view of the fact that the main drainage outfall of the town lies considerably to the eastward of Black Rock, and already shows signs of being affected by the fall of cliff in its neighbourhood. On this ground we should not feel disposed to dispute the wisdom of constructing the groynes, although on others we should deem one of them at least to be superfluous.

We congratulate the Brighton people on at length showing themselves alive to their great and increasing responsibility in this matter. Time alone can demonstrate if the new western work, when it has achieved—if it ever does—the success hoped for from it, may not be productive of renewed injury on other parts of their sea frontage. Neither do we note in the details of the scheme resolved upon any allusion to the denudation now going on in the neighbourhood of the old Chain Pier. We remarked upon this when last directing attention to the subject, but it is possible that the estimate for the improvement of the Madeira Drive may include provision for the required defensive work at this point. It is only to be regretted that the principle of building sea walls has been so tardily accepted. Had it received adoption earlier, very serious expenditure would most probably have been saved to the already heavily burdened ratepayers of Brighton. We are ignorant of the engineering authority that has been consulted as to these intended works, but it should be evident that a true economy would dictate that it should be of the highest and most experienced standard.

◆

### THE CO-OPERATORS IN CONFERENCE.

The Co-operative Societies in the South Yorkshire district held a conference of delegates at Kilnhurst, a colliery district, last Saturday. The conference, which was unusually representative, was mainly important for some plain speaking on the part of the more intelligent and clear-seeing of its members. Some of the remarks made are so sensible and so unusual at workmen's gatherings that they deserve more than local notice. A paper was read by Mr. T. Whitfield. of Kilnhurst, on "The Co-operative Movement and How it can Help on the Principles of Trades Unionism and Socialism." His reply to the question, "How can we reach the poorer classes?" was the extension of what he called "the great social principle of co-operation." Fifty years ago twenty-eight pioneers represented all under that banner. Now there is an army of 1,240,013. Their dealings had swelled into £50,318,977 annually, and the slender capital of £28 had grown into £14,013,687. These are noteworthy figures, but the comments by which they were accompanied are more noteworthy still. Mr. Whitfield disclaimed all sympathy with that system of socialism which implied "dead level uniformity and perfect equality," contending that equity was not the same thing as equality, and pointing out that the early co-operators had the instinct of equity in their hearts. His plain doctrine of social regeneration, was that they must raise the moral character, elevate the social tone and domestic tastes, make a man more self-reliant and self-reflecting. He deprecated the attacks of labour upon capital, holding that co-operators were not haters of capital, but creators of it. Other speakers were even more pointed in insisting upon the necessity of working men looking to themselves more than they did for their improvement. The Chairman of the Sheffield district declared bluntly that working men had the matter largely in their own hands as to their own happiness and prosperity, and that "it was possible for them to work out their own salvation." Another Sheffield gentleman was strongly of opinion "that it was not a revolutionary spirit that was needed, but a reasonable and conciliatory spirit, rather than flying in the face of their employers." Mr. Hall, a miner, pronounced boldly against both strikes and lockouts, and another miner said he was convinced they would all be acting very wisely if they spent their capital by being their own producers, rather than let it go to strikes and lockouts. Mr. Scotton, who is represented as "of the wholesale department," spoke vigorously against the foolish system of working men wasting their money in fighting capitalists. "Certain leaders," he said, "were constantly denouncing the capitalists, and yet these very individuals were charging large amounts to attend meetings and speak. These persons were becoming capitalists as fast as possible, and when these leaders had 'feathered their own nests' it would be good-bye to the working men whom they had duped. Talk about Parliament helping working men, if they would not help to raise themselves they never would be raised." These and other healthy utterances appear to have been taken in a friendly spirit. It is to be hoped that working men will continue to receive equally wholesome advice from their own order, and come at last to act up to it, particularly in the direction indicated by the Masbro' delegate, who candidly declared that working men were deficient in self-reliance and the virtue of economy. When they got good wages they did not know how to take care of them, and were "too much in the habit of visiting the Black Bull and the Red Cow."

### NINE MONTHS' CLYDE SHIPBUILDING.

For the nine months of the year now completed the output of new shipping on the Clyde amounts to 252,100 tons, a figure which has only been surpassed for the same period twice during the past decade, viz., in 1892, when the nine months' output reached 275,935 tons, and 1890, when it was 256,333 tons. Notwithstanding the fact that operations have been considerably handicapped on account of the miners' strike, the output during September is comparatively large, being not less than 19,295 tons over the production of September of last year. Altogether twenty vessels, measuring 38,070 tons, were placed in the water, as against sixteen vessels, aggregating 18,775 tons, in the corresponding month of last year. The vessels launched consisted of two war vessels and fourteen steamers, measuring 30,370 tons, and four sailing vessels of 7700 tons. Seventeen were for British owners, one for German, one Brazil, and one for San Domingo. Five of the new steamers measure over 5000 tons each, and include the Strathgyle of 7350 tons capacity, launched by Messrs. Russell and Co., Greenock, for Messrs. Burrell and Sons, of Glasgow; the Orestes of 6400 tons capacity, launched by Messrs. Scot and Co., Greenock, for the Ocean Steamship Company, Liverpool; the Planet Venus, 5600 tons, by Messrs. Hamilton and Co., Port Glasgow, for a Liverpool firm; and a vessel unnamed, of 7000 tons capacity, launched by Messrs. A. and J. Inglis, of Pointhouse. A number of important contracts have been placed during September, the new work secured representing nearly 30,000 tons, as compared with 24,000 tons last September. The orders include four steamers of 4500 tons each for the Peninsular and Oriental Steam Navigation Company—three to be built by Messrs. Caird and Co., Greenock, and one by Messrs. Alexander Stephen and Sons, Linthouse. The continuance of the coal strike is still having a retarding effect on the work in the various shipyards, for the firms are unable to procure adequate supplies of constructive material to meet their requirements. At Clydebank, Fairfield, and Govan, where there are important Government orders on hand, labour is much delayed, with the result that the builders have been compelled to suspend many hundreds of workmen who would otherwise have been employed.

### THE COMING AMERICAN TRANSATLANTIC LINERS.

From authoritative statements emanating from the "American Line," it would now appear that, contrary to the statements appearing in American papers, and repeated by many journals on this side, it is not at all the intention of the American Line to make any effort in their new steamers, St. Louis and St. Paul, building at Messrs. Cramps, of Philadelphia, to beat the Cunard Company's Campania and Lucania in the matter of speed. The management of the American Line are satisfied—and have been from the first, one is left to infer—that the speed and power of the Paris and New York will be ample for every requirement of the Transatlantic service for years to come, without going to the extraordinary expense and size of the Cunard steamers, which, it is pointed out, have to be taken off the service in the winter. When they are in service, it is maintained, it not infrequently happens that they have to wait outside the harbour until the tide accommodates them, while the New York and Paris go right to their berth at New York when they arrive. The St. Louis and the St. Paul, therefore, are to be mates of the Paris and New York as to speed, being about the same size and having the same power. The builders, it is authoritatively admitted, have in large measure followed the model of the Clyde-built vessels, but in some respects the new steamers will even excel those vessels. This, we understand from a good source, will hold true as regards the saloon and passenger accommodation; some arrangements connected with the dining, cooking, and commissariat departments—based on experience with American river passenger steamers, and quite novel on the Transatlantic service—being a feature in the new vessels. They will be launched next month, it is stated, and will be ready to join the line between Southampton and New York in the coming year.

### EALING ELECTRIC SUPPLY WORKS.

The town of Ealing has long been accustomed to take the lead, among modern English towns of rapid growth, in several matters relating to sanitary engineering, and every surveyor and borough engineer who has ever had to consider the problems relating to sewage treatment and town refuse disposal is familiar with the work by which the name of Mr. Charles Jones, M. Inst. C.E., the borough engineer of Ealing, is associated with these branches of engineering. To its already existing accomplishments Ealing has now added that of public electric lighting of streets and public buildings, by means of works which have been carried out from the designs and under the superintendence of Messrs. Bramwell and Harris. When it became necessary to permit a company to undertake the lighting of Ealing, or to take the work in hand as under a Provisional Order, the Ealing Board decided upon the latter course, and the necessary sum of £25,000 was borrowed forthwith to carry out the scheme devised by Messrs. Bramwell and Harris. The area to be lighted is a large one, and the number of lights, in comparison with the distances served, rather small under the best circumstances. As compared with the cost of gas, and as a matter of trade for shops and other lighting, there is, however, no doubt that the works will soon earn a profit to the benefit of the ratepayers, and indeed it is already obvious that the works will have to be extended. They were formally opened on Wednesday evening by Mr. E. M. Nelson, J.P., as chairman of the Board, and a dinner was afterwards given in the Lyric Hall, at which the members of the Board, the eminent engineers and the contractors were entertained. The works are in several respects similar to those carried out under the same engineers and so successfully lighting the town of Derby. The engines are by Messrs. Browett and Lindley; the dynamos, continuous current for arc and alternating for incandescent lighting, and the transformers and switches are by Messrs. Siemens Brothers; the boilers, Lancashire, by Messrs. J. Watt and Co., Birmingham; the street mains, by Messrs. Callender and Co.; and the surface condensers are to be by Messrs. Belliss and Co. The latter are to receive as circulating water the effluent from the sewage works, and the boiler power is to be supplemented by the batter of refuse destructors which are so well known as an important part of Mr. C. Jones' work. The buildings have been erected by Messrs. Wilkinson Brothers, Finsbury Park. The whole of the works have been carried out in a remarkably short time, although the area of supply is a very large one.

## LITERATURE.

*Coal Dust an Explosive Agent, as shown by an Examination of the Camerton Explosion.* By Donald M. D. Stuart, F.G.S. Office of the *Colliery Manager*, London. 1894.

Mr. Stuart has given us an accurate, and therefore valuable, description of an explosion which occurred at the Camerton Collieries, situated in the Radstock district. The part of the colliery where the explosion took place was worked in three eight-hour shifts, of which the eight hours from 8 p.m. to 4 a.m. were occupied in repairing and road making. On November 13th, 1893, two men were sent down to blast the roof of an incline, to make height for the loaded trams to pass under, and an explosion or series of explosions took place, by which the men lost their lives and much damage was done to the underground workings. The seams in the district had been worked for about a hundred years, and fire-damp had never been detected "in either the coal faces, the goaves, or the faults." Naked lights only were used, and no danger from an explosion was apprehended. The minute examination of the mine after the accident, so clearly recorded by Mr. Stuart, shows without doubt that the calamity was caused by coal dust. The danger of coal dust in fiery mines has long been known. Recently the subject has been carefully studied, and is now being inquired into by a Royal Commission. The experiments made by Mr. H. Hall, H.M.'s Inspector of Mines, for this Commission have demonstrated that, under certain circumstances, coal dust alone will explode in presence of a gunpowder shot; and Professor Dixon, in his report on the recent explosion at the Albion Colliery, states as his opinion that this was a pure dust explosion. But then the coal dust from the Albion Colliery was found by Mr. Hall to be specially fiery, whereas the "dust from the non-gaseous mines of Gloucestershire and Somersetshire proved to be inexplosive agents." The surroundings at the Camerton Colliery were opposed to the probability of an explosion taking place. There was no fire-damp in the mine, the dust had been tried and found non-explosive; and "the main roads are to a large extent in solid strata, and as a rule they retain more moisture than those in the seams; and their own *débris* and dust are of an argillacious and incombustible character." How, then, did the explosion occur? The actual ignition is closely traced to a partially blown-out shot, fired with about 12½ oz. of gunpowder. Mr. Stuart calculates that the temperature of the products of such a shot would be 2896 deg. C., which would be not only sufficient to liberate the gas out of the coal, but also to decompose it. The gaseous products would then, in the presence of great heat, take fire, and an explosion would follow. Referring to the evidence of high temperature, Mr. Stuart describes the effect produced at No. 2 refuge-hole, about fourteen yards from the shot, "where there was a calico bag, containing the food of one of the deceased men firmly suspended by an ordinary cotton tape from a timber roller in the roof. This bag was found still hanging after the explosion, but the texture of the material was changed—the fibrous structure and tensile strength were destroyed." This seems to indicate that the bag had not been exposed to the action of flame, but only to intense heat. The men were found in a refuge-hole thirty-five yards from the shot, and, according to the medical report, death was owing to severe burns. Mr. Stuart says:—"Flame of sufficient persistency to effect burns of such a nature must have consumed all the hair upon their heads," whereas it was only singed. The theory adopted by Mr. Stuart to explain this explosion is that the heat from the blown-out shot was sufficient to decompose the gaseous products of the coal dust, and that the explosions were due to the liberated hydrogen of the marsh-gas. The ten explosions which were traced were separated by intervals varying from 45 to 460 yards, and it is scarcely probable that flame travelled those distances. It must therefore be admitted that a separate motion took place.

With reference to the action of flame in explosions of hydrocarbon, it may not be out of place to quote Mr. Boverton Redwood, who, in a paper recently read before the Institution of Civil Engineers, says: "There are several cases on record of so-called 'spontaneous' explosions of benzoline vapour"—which indicates that a hydrocarbon vapour or gas may ignite without the presence of flame.

There is another point which must be taken into account to explain the possibility of an explosion of coal dust in a district where circumstances similar to those attending the accident at Camerton had prevailed for many years—namely, the ventilation of the colliery had recently been improved, and a greater current of air forced through the workings than formerly; and therefore it is most probable that the coal dust would be desiccated and carried up by the current to a greater extent. The coal is used for gas making, and yields 11,134 cubic feet of purified gas per ton, and would, in presence of heat, give out a considerable quantity of inflammable gas.

It is already demonstrated that, in coal mines giving out fire-damp, the use of gunpowder is quite unsafe; that the presence of coal dust enhances the danger; and that the only explosives which ought to be used under such circumstances are the so-called "high" explosives. Now, it appears that a shot fired in an atmosphere absolutely devoid of explosive gases, but holding in suspension a certain proportion of fine and dry coal dust, may be the cause of an explosion. We cannot help observing that the coaldust danger is directly connected with the great velocity of the ventilating currents in modern collieries, which carry with them a constant danger in the clouds of dust, for which some remedy must be found. The most obvious would be the absolute prohibition of all explosives in coal mines. This drastic measure would, however, entail a considerable rise in the cost of working coal.

Mr. Stuart has written a most valuable addition to the series of records relating to the important subject of danger from coal dust. We cannot, however, agree with him when he states that:—"The records of mining show that explosions cause greater destruction of life and property than any other class of accident."

Death of Mr. John Hastie.—We regret to have to record the death, on the 22nd inst., of Mr. John Hastie, partner of the firm of Messrs. John Hastie and Co., Kilblain Engine works, Greenock, the well-known makers of ships' steering-gears, winches, &c. Mr. Hastie and his brother succeeded about twenty-three years ago to the engineering business in Greenock established about 1850 by their father. Mr. Hastie served his apprenticeship with his father, and afterwards worked in some of the leading engineering establishments in Glasgow and Manchester. He was a man of considerable inventive talent, particularly in connection with hydraulic engineering, including the well known and ingenious capstan engine with the variable throw crank. He was the author of several interesting papers on engineering subjects, which he read before the Scottish Institution of Engineers and Shipbuilders at their meetings in Glasgow. Mr. Hastie was slightly over 50 years of age.

# DYNAMOMETRIC CAR, WESTERN OF FRANCE RAILWAY

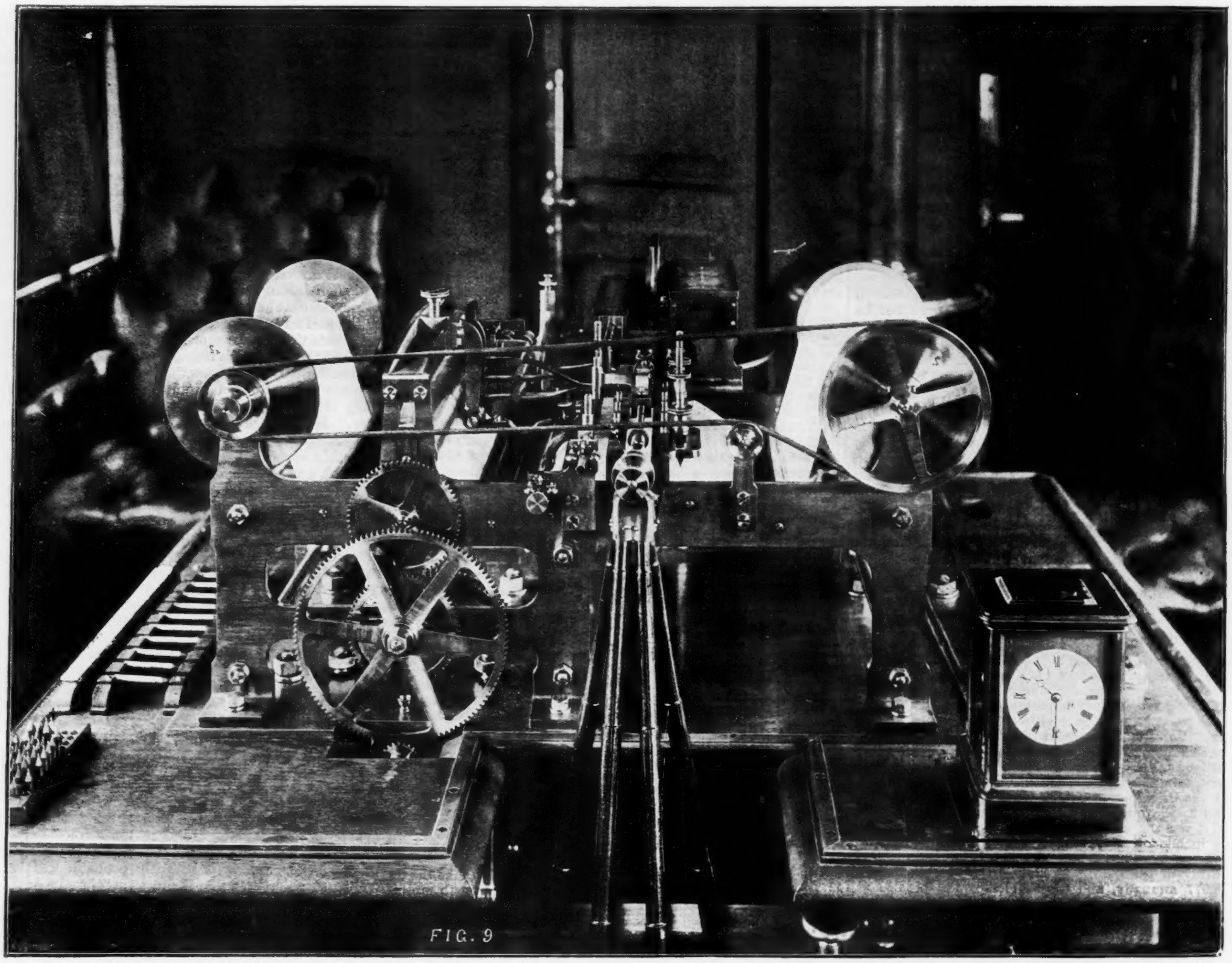


FIG. 9

## A DYNAMOMETRIC RAILWAY CAR.

The particular dynamometric railway car which we are about to describe is the property of the Western of France Railway Co. Our special attention has been attracted to its employment from the fact that it has been used to record the performances of the Heilmann electric locomotive, which we described in our issue of February 9th, 1894, page 109. We learn that the locomotive has been in regular service between Paris and Mantes, and we hope shortly to be in a position to give a detailed account of the results obtained, and to compare them with those from the ordinary steam locomotives performing similar duty upon the same line. The car is designed to afford a means of recording the speeds attained during a given trial, the pull upon the draw bar, the total power developed, and other interesting facts. This car was exhibited at the Paris Exhibition of 1889, and since that time two similar cars have been built for foreign railway companies; one for the Russian South-Western Railway, and the other for the Hungarian State Railways.

The general programme of what was required was laid down by Mr. F. Clerault, engineer-in-chief of the Western of France Railway, and the details were worked out by Mr. E. Gauthier, chief of the central service, in concert with Mr. Digeon, manufacturing engineer, of Paris. We give upon page 305 a number of sectional drawings of the vehicle, and also Figs. 9 and 10, above and on p. 297, which are reproduced from photographs, showing the interior of the car with the recording mechanism. The car is carried upon two axles, and a special coupling arrangement is employed to eliminate the influence of curves while permitting the buffers to make contact; for this purpose the buffers are connected to a transverse bar, which rests at its centre upon a group of rubber washers. Upon the platform at the end of the car a trap door is arranged, so that the dynamometer may readily be put in or out of gear. At each side of the entrance door is a raised seat, from which an attendant can observe the track, train, and locomotive, and have within reach electric press buttons to note upon the diagrams particular points upon the roads, also a speaking tube to the locomotive, and apparatus for the purpose of collecting gases from the chimney. Under the seats are arranged the Orsat apparatus for gas analysis.

Outside the end windows are placed inclined plates to prevent the deposit of dust and soot upon the glass. In the centre of the car is placed a table, upon which are collected all the recording apparatus described below. At one end of the vehicle there is a lavatory, and also a workshop in which any slight necessary repairs may be done while travelling. The car is heated by means of a small stove, and ventilation is assured by means of two Pignatelli apparatus, one opening above the end windows and the other in the ceiling of the central compartment. The results obtained in each particular trial are all recorded upon a single band of paper which receives its motion from the axle of the car, and is unrolled continuously during the journey proportionally to the distance covered. All the recording apparatus also is put into action by the car itself. Referring to the engraving on page 305, it will be seen that a worm V is keyed upon the axle, a worm wheel X gears with it, and transmits motion to a vertical shaft Z through two bevel wheels. The spindle Y is provided with a Hooke's joint to allow for play of the axles. The apparatus can be put in and out of gear from inside the vehicle by turning the screw K, and so raising the wheel X, the bearings of which can slide in collars which surround the screw V. The bearings are connected by a cross-piece provided with a tapped hole, in which the screw K works. The upper end of the screw rod is fitted with a worm wheel K$^1$ at the top of the pillar, and this wheel is controlled through a worm by a handle. At the top of the vertical spindle Z is fitted a set of bevel wheels, with a Dobo driving clutch in each; this gear is shown on a larger scale in Fig. 5, and causes the paper to move in the same direction, whichever way the train is travelling. The bevel wheels E′ E″ set the main spindle T in rotation at a speed precisely the same as that of the axle O of the car. From the shaft T are taken all the different movements of the recording apparatus; for example, the traversing of the paper, and that of the disc for totalising the work. The movements for the screw and for the tachometer are, however, taken off an auxiliary shaft N, which is driven by the wheels D$^1$ and D$^2$. A clutch Θ, acting by friction and also through teeth, and placed upon the spindle T, allows all the motions of the recording apparatus except the screw *a* to be stopped, in order to be able to constantly observe the speed of the train, by means of a graduated scale placed upon the controlling rod $t^1$ of the pencil 3. The action of the clutch takes place gradually, whatever be the speed of the train; at first by friction alone, and afterwards by the teeth, which ensures the constant relative position of the two parts of the spindle T. A second auxiliary shaft T$^2$ has been put in, so that it may be used if required. It will be noted that all the gearing is below the table, and that therefore there is no danger of an accident while attending to the recording apparatus above the table.

*Tractive effort.*—The pull on the draw bar only is measured, as it is considered that this is all that is required to compare loads which can be drawn by different engines. The measurement is made by means of a dynamometer, shown in section in Fig. 1, and in plan in Fig. 3, and composed of two groups of flat springs, the ends of which are linked together two and two and form a rigid stirrup with the frame. This arrangement is used to ensure the proper relative positions of the groups of springs. The head C of the forward part of the dynamometer is joined to the draw-bar at the end of the car next to the locomotive, and this bar is guided between horizontal and vertical rollers to avoid cross-cornering, due to the passage round curves and to side play. This bar has also a knuckle joint at *w* to allow for the swing of the draw-bar, and no appreciable friction is felt upon the connecting bar.

The head C$^1$ of the rear end of the dynamometer is fixed to a cross beam of the frame. The head C, which moves under the action of the locomotive, is mounted upon a carriage B, which rolls upon three small wheels resting upon an iron plate placed in a horizontal plane and carefully trued up. Upon this same carriage are fixed the four columns of the pencil carrier P; these columns formed of steel tubes are very light and are at the same time very rigid. The end P of the pencil carrier, which forms the head of the four columns, actuates by means of a rod *t* provided with a double knuckle joint a pencil 1 mounted upon a piece which is guided in a slide, besides this there is an opposing spring *f* which acts through a flexible band passing in the groove of a pulley $f^1$ upon an extension of the rod *t* and neutralises the play which might take place in the knuckle joints. The pencil registers the pull on the draw-bar upon a band of paper, which is unwound proportionally to the spaces traversed. The complete dynamometer spring has a flexibility of 0 63in. per ton, and can measure up to a maximum of 7·5 tons. The bending of the dynamometer spring is transmitted full size to the paper, and besides this a fixed pencil 7 traces continuously a base line corresponding to the zero position of pencil 1. It is thus easy to obtain the effort on the draw-bar at each moment.

*Total work.*—In order considerably to reduce the labour of calculation, the work is measured and totalised by an apparatus with disc and roller, shown in Figs. 1, 2, and 4. It consists of an elongation of the rod $t^1$, which transmits the movements of the pencil carrier to the pencil 1 for recording the pull on the draw-bar, and upon this elongation is mounted a fork which moves a roller *m* in a corresponding manner to the pencil, and this roller is kept in contact with a disc *p* by means of a spiral spring *r*, the tension of which is adjustable by means of nuts *v* mounted like the spring *r* upon the spindle of the disc. The spindle upon which the roller *m* moves is parallel to the rod *t*, and passes through the centre of the disc *p*, and the latter has a speed of rotation proportional to that of the axle of the car. When there is no pull on the draw-bar the roller rests at the centre of the disc, but when there is a pull on the bar the roller moves away from the centre and turns on its own axis. The number of turns made by the roller—of course depending upon the distance of the roller from the centre of the disc—is a measure of the work done to a constant scale, which is a function of the diameter of the roller. In this particular machine one turn of the roller corresponds to 72,330 foot-pounds; it is therefore sufficient to record the number of turns of the roller to obtain at each instant from the datum line the work developed. For this purpose a revolution counter is fitted up in connection with the spindle of the roller, and the total work can be read off at once in foot-pounds. It was, however, desired to have also a record of the total work upon the paper bands, and to allow of this the spindle of the roller actuates a cylinder, *d*—Fig. 8—upon which is cut a screw-thread, which is continuous and closed on itself. In this thread runs a kind of roller of suitable form which moves a rod, carrying a pencil 2, pressing upon the paper band. The whole apparatus is so designed that the roller gearing with the thread moves from one end of its course to the other for each sixty turns of the roller on the disc, the pencil therefore traces a kind of sinusoidal curve

# DYNAMOMETRIC CAR, WESTERN OF FRANCE RAILWAY

(*For description see page 304*)

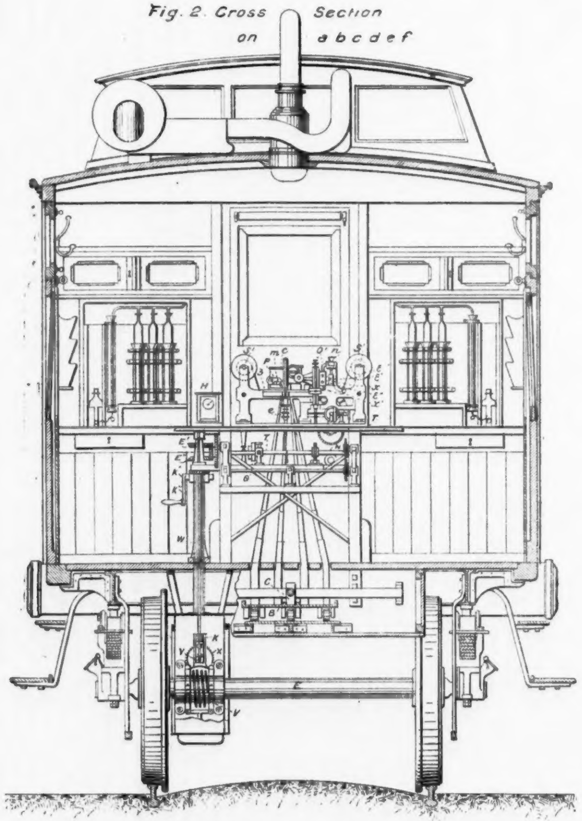


Fig. 2. Cross Section on a b c d e f

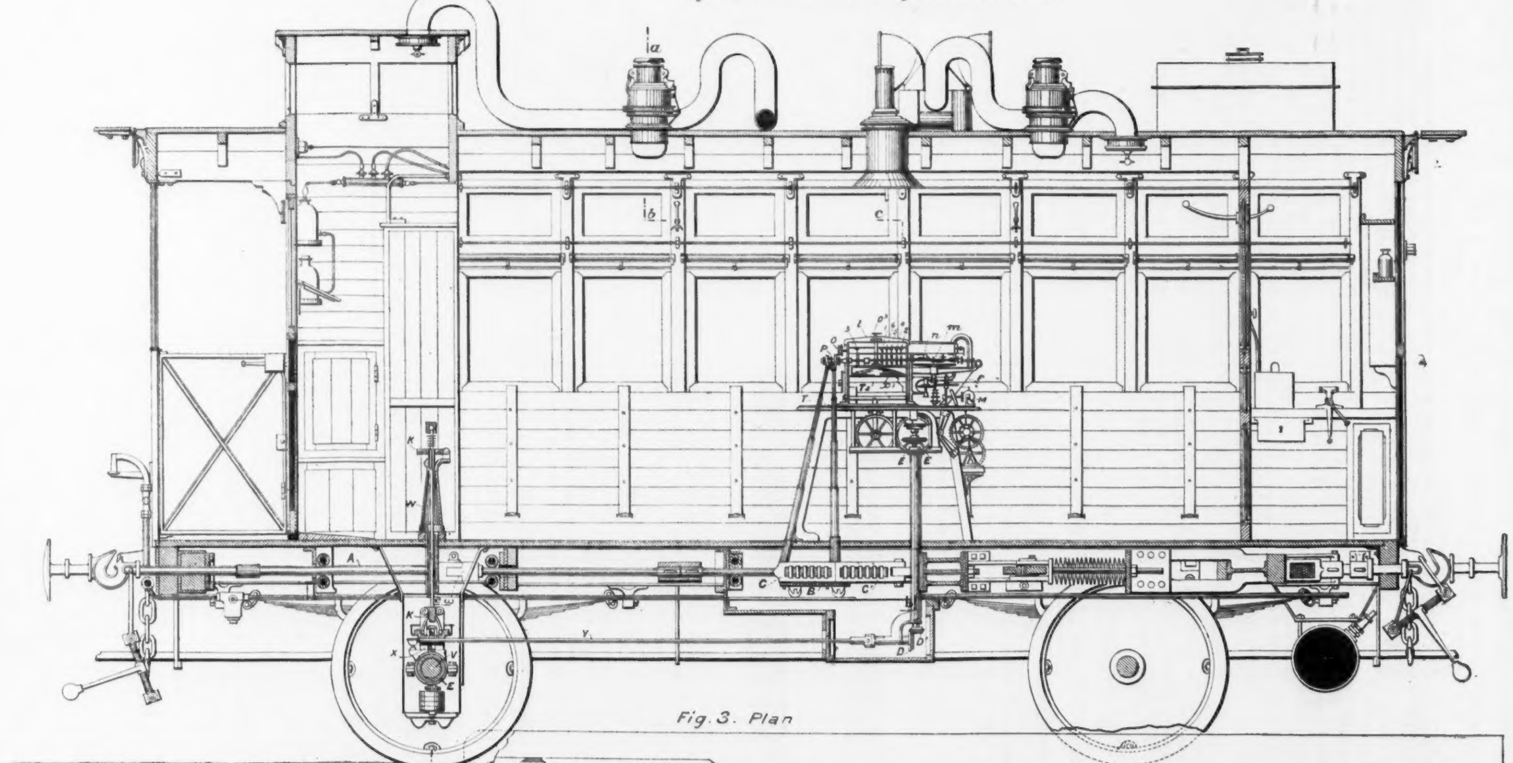


Fig. 1. Elevation and Longitudinal Section

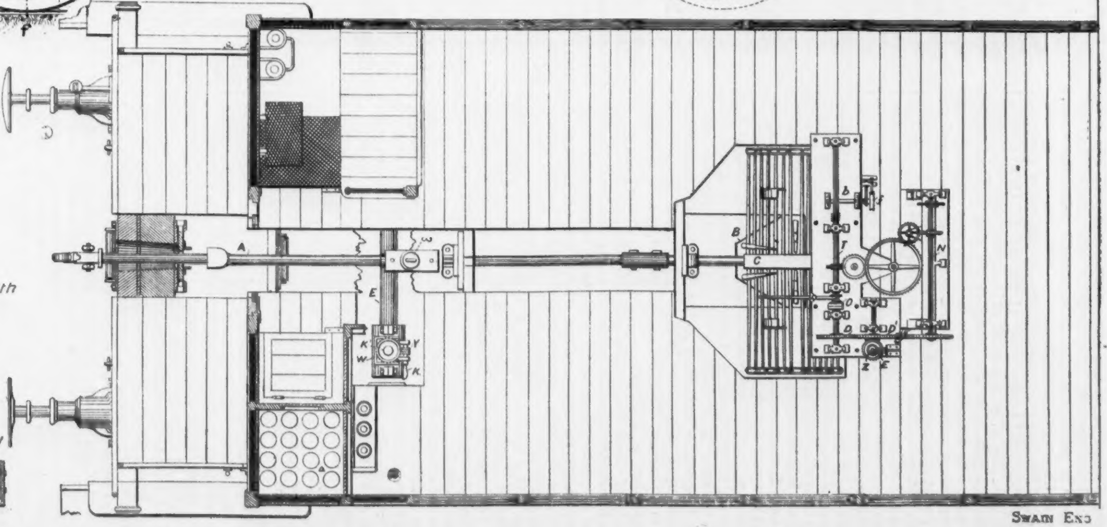


Fig. 3. Plan

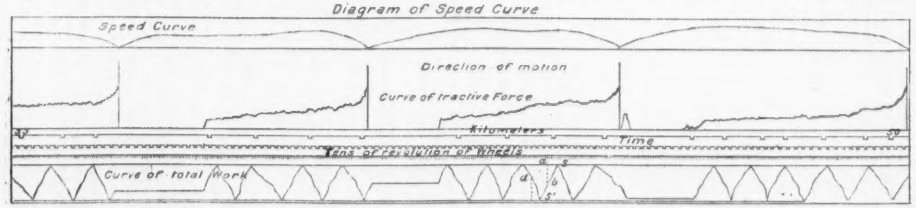


Diagram of Speed Curve

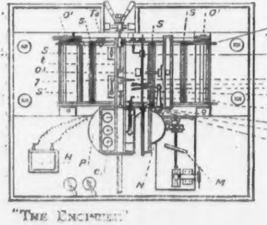
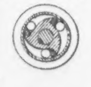


Fig. 4. General Plan of the Recording Apparatus



Dobo Clutch

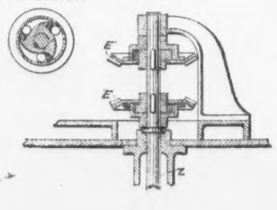


Fig. 5. Upper end of Shaft Z

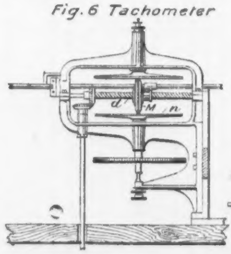


Fig. 6 Tachometer

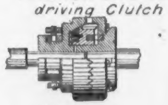


Fig. 7. Friction and Tooth driving Clutch

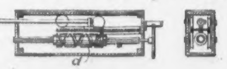


Fig. 8. Driving mechanism of the work recording Pencil

"THE ENGINEER"

SWAIN ENG

between two parallel lines, 2·36in. apart. The ordinate to each of the summits of the curve corresponds to 72,330 × 60 = 4,339,800 foot-pounds. An ordinate to the curve from an intermediate point will give to a certain scale the work developed from the last summit.

*Speed.*—The speed is measured by an apparatus giving a record proportional to the speed of the train. Upon a horizontal disc, Fig. 6, rests a roller *m* mounted upon a screw *d*, with its axis parallel to the plane of the disc and vertically above one of its diameters. The disc obtains a constant and uniform rotary movement from a special governor, and in this special car makes 180 turns per minute. The screw obtains rotary motion from the principal shaft of the apparatus. The directions of rotation of the screw and the disc are so arranged that the movement of the screw causes the roller to move away from the centre of the disc, and at the same time the disc causes the roller to turn in the same direction as the screw upon which it is mounted, and therefore in case of a stop it brings back the roller to the centre of the disc. It is therefore obvious that the roller will always move away from the centre of the disc until a point is reached where the speed of the disc exactly counteracts the speed of the screw, and at this point the roller will remain fixed so far as distance from the centre of the disc is concerned, and this radial distance is a measure of the speed of the train. Pencil 3, which is connected to the roller, records the curve of speed upon the paper band. The second disc, which turns in a contrary direction to the disc *n*, is used to ensure proper contact with disc *n*.

*Record of revolutions of the wheels.*—The number of turns of the wheels are recorded by pencil 4 actuated by an electro-magnet $\epsilon$. This electro-magnet is placed in a circuit, which is closed each ten turns of the wheel by a commutator *f*, mounted on a spindle *b*, geared to the spindle T, which makes the same number of revolutions as the axles.

*Time.*—The time is registered by means of a clock with electrical contacts H, by means of which a current is sent every ten seconds into an electro-magnet $\epsilon'$. The latter actuates a pencil 5, which traces six notches per minute upon the paper band.

*Distance record.*—Pencil 6 is moved by an electro-magnet $\epsilon''$, into which a current is sent by means of press buttons placed upon the front end wall of the car, close at hand for the attendant, who is thus able to note the kilometre posts passed and any other interesting points on the route. A printing mechanism $O_3$ figures the number of each post as it is passed.

*Datum lines.*—Fixed pencils, which can be regulated by hand, trace upon the travelling band base or datum lines, pencil 7 effecting this for the draw-bar pull, and pencil 8 for the speed.

*Delivery of the paper.*—The paper band, which is wrapped upon the cylinder $S^1$, is drawn out by the roller X, with which adhesion is maintained by the pressure of roller $x^2$, and the paper winds on to roller $S^2$. The latter is driven by the cylinder $S^1$ by means of an endless band passing over a pulley $O^1$ fixed to the shaft of the latter cylinder, and over a smaller loose pulley $O^2$ mounted upon the shaft of the cylinder $S^2$. By means of a friction clutch regulated by a screw, the loose pulley can be driven so as to allow a certain amount of slip, and thus regulate the tension on the paper band in spite of the changing diameters of the rolls $S^1$ and $S^2$. The paper leaving roller $S^1$ passes beneath some small rollers *s*, then over the table $T_a$, upon which the pencils work; thence it passes under another little roller *s* before passing between rollers *x* and $x^2$, and finally, after passing under a small roller *s*, it is rolled on roller $S^2$.

*Gas analysis.*—The analysis of the products of combustion is effected by two sets of Orsat apparatus placed below the observation seats. The analysis consists of measuring the percentage of carbonic acid, carbonic oxide, and oxygen. The residue is supposed to consist solely of nitrogen. A copper tube is suspended from the top of the locomotive chimney, and is connected by india-rubber tube to a fixed flask into which the gas is drawn by an aspirator. The volume of gas to be analysed is passed into a graduated tube, and then passed into test tubes containing absorbents. The first tube contains a solution of caustic potash, which absorbs the carbonic acid; the second contains a solution of potassium pyrogallate which absorbs the oxygen, and the third tube a solution of cuprous chloride which absorbs the carbonic oxide. After each absorption the gas remaining is measured in the graduated tube, and the volume absorbed is the difference between the first and last measurements. The final residue is considered as nitrogen. On page 305 we give to a reduced scale a record of results obtained upon the Western Railway of France between Paris and Neuchatel, and we hope shortly to publish the actual results obtained in the regular service of the Heilmann locomotive when working between Paris and Mantes.

### DESCRIPTION.

*Measure and record of draw bar pull.*—C movable head of the dynamometer coupled to the draw bar A; $C^1$ fixed head of the dynamometer; $\omega$ knuckle joint of the bar A; B movable carriage supporting the head C; P pencil carrier transmitting the movement of the head C to the rod *t*, held back by the spring *e*.

*Record of the total work.*—*m* roller recording the work and moving with the rod *t*; *p* plate for roller *m*, having a speed equal to that of the axle E; $C^1$ counter of revolutions of *m*; 2 pencil recording work developed; *d* cylinder with closed screw thread.

*Speed recorder.*—$\alpha$ screw on axle E; M clockwork imparting uniform motion to plate $\pi$; M roller forming a nut and mounted on the screw $\alpha$; 3 pencil recording the speed and controlled by the roller M.

*Revolution of wheel counter.*—4 pencil recording the tens of turns of wheels; $\epsilon$ electro-magnet moving pencil 4 and placed in a circuit closed by switch *f*; *b* shaft carrying the switch *f*.

*Time recorder.*—H clock sending every ten seconds a current into electro-magnet $\epsilon^1$; 5 pencil controlled by the electro-magnet $\epsilon^1$ and making a notch every ten seconds.

*Kilometre record.*—6 pencil moved by an electro-magnet $\epsilon''$ into which the current is sent by a press button.

*Datum lines.*—7 pencil tracing the datum line for draw bar pulls; 8 pencil tracing the datum line for draw speed.

*Transmission of motion.*—V worm upon the axle of car; W pillar supporting wheel $K^1$ controlled by worm and handle K″; K screw controlled by wheel $K^1$; T principal shaft driving the recording apparatus; $\Theta$ friction and toothed clutch for throwing out of gear the recording apparatus; N counter-shaft driven off shaft Z.

*Movement of paper band.*—$S^1$ cylinder carrying paper; $x_1$ roller drawing out paper and driven by the shaft T; $x_2$ pressure roller; $S_2$ cylinder upon which the paper is rolled; *s s s* small rollers guiding the paper; $T_a$ tracing table; $O_2$ pulley with friction clutch on spindle of cylinder S; △ batteries.

*Part of a Diagram of Trial made on August 28th, 1891.—Train 108, Neuchatel to Paris.*

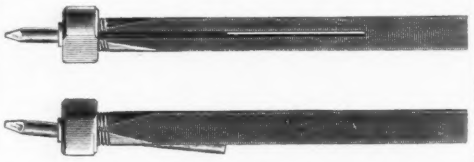
| | |
|---|---|
| Fuel | Briquettes |
| Boiler pressure | 120·8 lb. per square inch |
| Diameter of cylinders | 15·6in. |
| Stroke | 24in. |
| Diameter of driving wheels | 4ft. 3½in. |
| Tractive effort $\frac{p\,d^2\,l}{D}$ | 11,741·4 lb. |
| State of weather | Fine |
| Temperature | 59 deg. Fah. at starting,<br>53·5 deg. on arrival |
| Direction of wind | N.W. |
| Force | Very slight |
| State of rails | Dry |
| Observers | Gauthier<br>Digeon<br>Guilbert |

*Composition of train.*

| | |
|---|---|
| 13 brake vans<br>1 first-class carriage<br>2 second-class carriages<br>2 third-class carriages | Total net weight 139·3 tons |
| Total gross weight | 170 tons |

## BARBER'S SPLIT TOOL HOLDER.

The engraving below illustrates a form of tool holder which has been designed to suit all kinds of work, and to withstand the hard usage and knocking about which most tools receive in the machine shop. The holder is a split bar with a tapered screwed end carrying a taper nut, by which the two halves of the holder are pulled together, and the tool firmly held. There is no overhanging head, and consequently the slide rest can be brought close up to the cut; the tool will also cut either left or right hand, and will easily cut into corners of collars, &c. There are only two parts, a bar and a nut—nothing to get out of working condition. It will take the cut that can be made by the ordinary bar tool. Ordinary round steel is used for the tools. It is made in sizes to take $\frac{5}{16}$in. tool steel, and in large sizes, equal to the heaviest work and cut met with in an engineer's shop. Such holders must save a great deal of time on the part of turners and tool smiths, and they are not expensive. It is made by Mr. T. W. Barber, Queen Victoria-street, London.

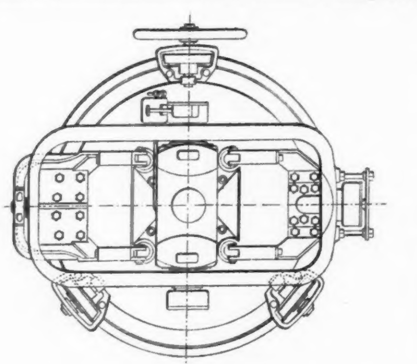


## TOWER'S STEADY PLATFORM.

This is an apparatus, manufactured by Messrs. Sir W. Armstrong, Mitchell, and Co., Newcastle-on-Tyne, for obtaining steadiness as regards angular motion on board ship, any object mounted on it being entirely exempted from pitching and rolling motion.

The steady platform is supported on gimbals so as to have within certain limits complete angular freedom. The rings and joints of the gimbals are made hollow so as to provide a passage for high-pressure water, which is pumped from a small steam pump to actuate the mechanism on the steady platform.

This mechanism consists of a heavy wheel revolving rapidly in a horizontal plane on a ball-and-socket bearing. This bearing is hollow, and through it the high-pressure water passes into the interior of the wheel, from whence it issues in three jets, two issuing from the periphery of the wheel in a tangential direction maintain the wheel's rotation by their reaction; the other issues upwards in the direction of the wheel's axis. This is called the axial jet, and two-thirds of all the water supplied to the machine passes through it, and by it the gyrostatic steadiness of the wheel is imparted to the platform as follows:—The wheel revolving on a ball-and-socket bearing, its plane of rotation has a small amount of angular freedom, but by a system of four small pendulums pressing by means of bell-crank arms on its rim it is caused to slowly become horizontal, and owing to its gyrostatic properties it remains so in spite of forces acting through short intervals of time tending to disturb it.



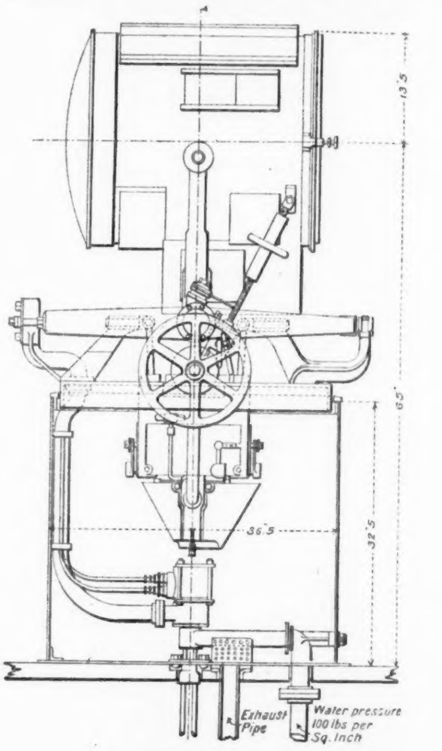
PLAN

The plane of the wheel being horizontal, the direction of the axial jet must in consequence be vertical, and it is the maintenance of this vertical jet which is the sole object of the wheel.

Immediately above the nozzle of the axial jet, and at a short distance from it, there are four open ports or holes close together in a horizontal metal face. Each of these ports is the open end of a passage communicating with a cylinder. These four cylinders are fixed at the corners of the platform, and push by means of rams or plungers against fixed points outside the platform, so that by the relative strength of their pushing they can cant the platform in its gimbals and control its plane relatively to the ship's deck.

The water pressure in these cylinders, and consequently the strength of their pushing, is regulated by the position of the centre of the axial jet in striking the four open ports. If the centre of the axial jet strikes exactly on the centre of the four ports, the water is equally divided between them, and a consequent equality of pressure exists in the passages and cylinders, but if the axial jet is the least out of centre to the ports, one port receives more and another less of the jet, and an inequality of pressure thus established causes some of the cylinders to press harder than others and cant the platform in such a way as to restore the concentricity of the axial jet and the four ports. Thus the gyroscopic wheel compels the platform to remain in a plane parallel to itself, and yet no force tending to disturb the platform can be communicated to the wheel. The water from the axial jet, after striking the ports, rebounds downwards and falls into the tank, which forms the base of the apparatus, from whence it returns through a pipe to the pump. When owing to the motion of the ship the plungers are moving in and out of the cylinders a portion of the axial jet water is being taken in by some of the cylinders and expelled from others; in order to establish this flow the ports communicating with the receiving cylinders have to be more covered by the axial jet than those communicating with the expelling cylinders. This would cause a small departure of the platform from the true horizontal, the error being in the direction of the ship's motion and of an amount proportioned to the velocity of its motion. This error is exactly compensated by the correcting cylinder, which is a small cylinder having a piston held in mid-stroke by a strong spring, the top of the piston-rod forming the point of attachment of the elevating screw. The two ends of the cylinder communicate by pipes with two narrow ports formed in the partitions between two pairs of the ports against which the axial jet plays. Any departure of the axial jet from concentricity covers more of one and less of the other of these narrow ports, and sets up a difference of pressure in them, which, acting on the piston in the correcting cylinder, displaces it by an amount depending on the strength of its spring, but which is adjusted so as to exactly compensate for the above-mentioned error.

This apparatus may in the future be used for many purposes for which steadiness at sea is desirable; such, for instance, as the mounting of telescopes, range finders, even smaller classes of quick-firing and machine guns, or other instruments, the use of which would be facilitated by a steady platform, but at present its use is confined to the mounting of search-light projectors, which are quite useless unless their ray can be kept directed horizontally. To illustrate this, suppose a vessel using a search-light takes five seconds to roll from port to starboard, and to be rolling through 10 deg., she will have a maximum angular velocity in the middle of the roll of 3 deg. per second. Supposing a torpedo boat to be approaching at a distance of two miles, the ray of the search light will at that distance be rising and falling at the rate of 630ft. per second, or 378 miles per hour. Supposing if by chance the ray crossed the point of the horizon where the torpedo boat happened to be at the moment, the small fraction of a second during which she would be revealed to the observer would be too short to be of any use, and the chance of seeing her again in any future rolls would be very remote; whereas, if the ray is kept always on the horizon, the observer has only to sweep it round to be sure of detecting a vessel approaching from any direction, and can then keep her constantly within the illuminating ray.



ELEVATION

The utility of vidette boats carrying search lights mounted in this manner for protecting an anchorage against torpedo boats is obvious; but such boats could not without steady platforms use search lights with any effect, owing to the liveliness of the motion in the least sea.

This apparatus has been found to keep a search light perfectly steady in a steam launch 50ft. long and 11ft. beam in the roughest sea.

## CATALOGUES.

The Farringdon Works, Limited, Shoe-lane, E.C. Pumping machinery, sanitary appliances, brass work, and copper goods. The catalogue contains several useful tables with an exhaustive index, is strongly bound, with name on back, and should be a valuable addition to the trade library.

Charles Burrell and Sons, Limited, Thetford. Agricultural engines, road locomotives and rollers, &c. A well illustrated catalogue of the firm's well-known agricultural appliances.

The Gardner Gun Company, London. Illustrative and descriptive of the various types of the Gardner machine guns.

The "Albion" Works, Sheffield. Catalogue of machinery in stock.

The Pneumatic Tire Company, Limited, Coventry. Pamphlet containing full particulars with regard to pneumatic tires for vehicles, with price list.

The Unbreakable Pulley and Mill Gearing Company, Limited. Price list.

Two heavy engines for fast passenger service are being built by the Schenectady Locomotive Works for the Boston and Albany R.R. They are intended to haul the Boston and Chicago limited express on the mountain division between Albany and Springfield, where the grades are sometimes as much as 85ft. to the mile. The cylinders are 19in. by 24in., and the driving-wheels 5ft. 9in. diameter.

## LETTERS TO THE EDITOR.

*We do not hold ourselves responsible for the opinions of our correspondents.)*

### THE THEORY OF THE STEAM ENGINE.

Sir,—Mr. Cherry, having first stated that my views were erroneous, and being pressed for elucidation of his own, gives up, contenting himself with restating that I am wrong. Now, if Mr. Cherry were a wholly obscure individual, this would matter very little; as it happens it may matter a good deal, for, unless I am led astray by a name, Mr. Cherry does something in the way of educating young men who would be engineers. Under the circumstances he has no right to perpetuate error. My contention is that certain things are daily taught concerning the steam engine which are not true. If they are true, Mr. Cherry, who defends them, can prove their truth. He is quite competent to the task. If they are not true, then he should hold his peace, and not endeavour to escape by saying that he has no time to deal with the subject. He should have thought of that before he wrote his first letter. This much premised, I take leave of Mr. Cherry and proceed to explain more precisely what it is that I want to prove.

In the first place no distinction is made in text books between different classes of heat engines; on the contrary, we are told that their efficiency is totally independent of the nature of the working substance, which may be gaseous, liquid, or solid; the amount of work which the material can do depending on the difference between an initial temperature T and a terminal temperature *t*. This proposition I assert to be untrue as regards steam, and any theory of the steam engine based upon it must be false and misleading.

Let us consider what a pound of steam represents. I condense the following figures from Isherwood's tables:—

| | | H Thermal units D ÷ 772 | D Dynamical Equivalent H × 772 | Per cent. of total heat. |
|---|---|---|---|---|
| | Total heat of steam of 212° from water at 32° .. .. .. .. .. | 1146·6 | 885,175·2 | 100·0 |
| Heat in water | Raising temperature from 32° to 212°, and lessening cohesion of water .. .. .. | 180·89 | 139,653·3 | 15·77 |
| | Increasing the volume of the water between 32° and 212°.. | 0·00187 | 1·44 | 0·0002 |
| Heat in steam | Destroying cohesion of the water, that is converting it into steam .. .. .. .. | 893·66 | 689,910 | 77·94 |
| | Increasing the volume of the water from that which had as water to that which it has as steam .. .. .. .. .. | 72·03 | 55,610 | 6·28 |
| | Total .. .. .. .. .. .. | 1146·6 | 885,175 | 100· |

The first mistake made in text books lies in calling the 893·66 units, given above, "latent heat." The heat expended in doing the work of steam making has been entirely lost as heat; it has been converted into work. It is true that the work can be got back again in the form of heat, but for the time being it has been lost.

It is necessary here to direct attention to a circumstance continually overlooked, which will serve to show how vague and indefinite are received ideas on the subject of latent heat. If we turn to a steam table and look up, let me suppose, steam of 100 lb. pressure absolute, we find that there was expended in producing 1 lb. of it 1181 units; that is to say, 1 lb. of water at 32 deg. has been all boiled away into steam of 100 lb. pressure. But according to the tables, the resulting pound contains only 883·38 units of heat. What has become of the difference? If we condense 1 lb. of steam to water at 32 deg., we shall get the whole of the work back, but we ought to get back only 883·38 units. The explanation of the seeming puzzle is, of course, that the heat which we apply is expended not only in making steam, but in raising the temperature of that steam. The temperature part represents unconverted heat, the "latent" units represent "converted heat," and the title "converted" is in every repect superior to "latent." It does not mislead.

Now it is a physical or natural law that steam of a given pressure must have a given temperature, so long as the steam is saturated. I have mentioned the fact that Rankine believed that steam allowed to expand without doing work would be superheated. I am not aware of any experiment being made to test the question, and it is worth while to quote Isherwood on this point. After quoting Joule's and Thomson's monumental experiments on the free expansion of gas, he says: "When the pressure on one side of the diaphragm was 4·7 atmospheres and on the other 7 atmospheres the interior work was $\frac{1}{858}$ the exterior work, in the case of hydrogen, $\frac{1}{174}$ in the case of air, and $\frac{1}{32}$ in the case of carbonic acid gas. Of the gases, hydrogen appears to approach nearer than any other to the state of a perfect gas; that is to say, it is at equal temperatures and pressures the furthest removed from liquefaction. Oxygen and nitrogen much less resemble a perfect gas; while carbonic acid gas is greatly different in mechanical characteristics. A just analogy therefore allows the presumption that steam, which liquefies by the slightest abstraction of heat, and has considerable cohesion, departs immeasurably from the state of a perfect gas, and, when freely expanding, undergoes much condensation, due to the transmutation of a portion of its heat into the internal work done upon its particles in overcoming their cohesion and forcing them further apart. Nor is this conclusion opposed to the fact that, as a given weight of steam of higher temperature possesses more heat than the same weight at a lower temperature, the change from one to the other by expansion must be accompanied by an evolution of the difference between these quantities; for the heat transmuted into internal work during the change is so great as not only to absorb the quantity evolved by it, but an additional quantity to be obtained only by the condensation of a portion of the steam." The fact that steam is superheated by wire-drawing does not controvert Isherwood, because, in the first place, the expansion is not free, much work being done in forcing the steam through a reduced orifice, and in the second it is generally admitted that the superheating is due to the friction of the particles against the metal.

Now let us see what happens when steam is admited to a cylinder, and for simplicity of statement I will assume that the initial pressure of the steam is 150 lb. absolute, that the cylinder is non-conducting, that the steam is dry saturated, that is to say, carries no free water, that the expansion is tenfold, and that there is no clearance. Any of your readers who understand the subject can correct my figures for an actual case.

The temperature of steam of 150 lb. is 305·5 deg. That of steam of 15 lb.—the terminal pressure of 150 lb. steam expanded ten times—is 213 deg. Then by the $\frac{T-t}{T}$ rule we have an efficiency of ·12, which means that of the whole heat in the steam 12 per cent. has been converted into work done on the piston.

Now let us proceed to see how far the statement agrees with facts.

Starting nominally from zero, we have in one pound of steam 1191 units, representing 919,452 foot-pounds. The pound of steam represents 3 cubic feet and a minute fraction, with which we need not concern ourselves. In the first place I will, for an obvious reason, deal with the steam as if it were a perfect gas, that is to say, there shall be no liquefaction caused by the performance of work. Starting with 3 cubic feet, we have at the end of the operation 30 cubic feet. Let us suppose that we have a piston 1 square foot in area traversing a cylinder 30ft. long. The average pressure will be $\frac{150 \times (1 + \text{hyp. log. } 2{\cdot}3)}{10} = 50\text{lb.}$, and $144 \times 50 \times 30 = 216{,}000$ foot-pounds; that is to say, 23 per cent. of the total heat expended in producing a pound of steam can be converted into work instead of 12 per cent. In this case I have treated the steam as a permanent gas, to bring it on all fours with air, and I have shown that its efficiency, dealing with heat as a quantity and not as a temperature, is nearly double that given by the $\frac{T-t}{T}$ rule.

But steam is not a permanent gas, and because it is not, the efficiency will not be so high as I have stated, because the average pressure will be less than 50 lb. "The pressure varies," says Rankine, "as the reciprocal of the tenth power of the ninth root of the space occupied," or as $p\,v^{\frac{10}{9}}$. But scientists are not agreed on this point. In the United States $p\,v^{\frac{17}{16}}$ seems to be preferred. Under the circumstances, I do not think it is necessary that I should take up further space by making the small alterations needed in my figures.

I have said enough to show that, confining our attention to the temperatures of the working fluid steam in the cylinder, we get results which are deplorably wrong. The true efficiency depends on the amount of heat expended measured in foot-pounds—in the case of the steam engine in making the working fluid and in raising its temperature—and on the quantity of work got back, also measured in foot-pounds. In the case of an air or other gas engine, no work is expended in making the fluid, but only in heating it. The two cases are quite dissimilar. It will be found that every writer on the subject of recent years, seeing that while $\frac{T-t}{T}$ may be made to do for cylinder temperatures in an air engine, it cannot be made to do at all for a steam engine, has altered the base, and takes furnace temperatures at one end and condenser temperatures at the other, a method quite as misleading as that which I have criticised. In short, the efficiency of a heat engine is not independent of the nature of the working substance.

I shall perhaps be told that I ought to take the condenser temperature for *t* instead of the temperature at the point of release; but the moment the steam leaves the cylinder we are done with it, and it can no longer do useful duty.

I have heard it argued that $\frac{T-t}{T}$; the thermodynamic function, and so on, only refer to a complete special cycle. Quite so. That is my contention. The head and front of my argument is that in practice the efficiency of a heat engine is not independent of the nature of the working substance, and that text-books of the steam engine are, with a few exceptions, quite misleading on the point. In fact, theoretical thermodynamics are not only useless but mischievous, as far as the steam engine is concerned.

October 1st. Maurice Cross.

Sir,—I have read with interest the letter of your correspondent, Maurice Cross, in your issue of 22nd September, on the above subject. He takes exception to the use of the formula $\frac{T-t}{T}$ as a standard of efficiency for steam engines, and from the way in which he has attempted to make good his theory, it is clear that he has slipped into the common mistake of applying a result deduced under certain assumed conditions to a case in which these limiting conditions do not obtain. The conditions on which the formula in question is based are that the working fluid must pass through a complete cycle of operations, and that this cycle must be a reversible one. It is obvious then that any argument built on the application of this formula to a portion of a cycle is both worthless and misleading. Any one familiar with the cycle of operations in actual steam engines knows that it is not a reversible one, and therefore the formula in question is inapplicable. For a description of the ideal case of a reversible steam engine cycle, your correspondent may refer to Professor Cotteril's work on the steam engine, Art. 83. There he will find a comparison of the actual steam engine cycle with the ideal or reversible one.

It is well to remember, however, that although this formula is not applicable to the actual steam engine as a standard of perfection, it is nevertheless important, from a thermodynamic standpoint, to have a common standard of efficiency for gauging the efficiencies of all heat engines. If the steam engine does not conform to the conditions of maximum efficiency, so much the worse for the steam engine. Whether the formula $\frac{T-t}{T}$ can be rationally considered as a standard of perfection for any heat engine is, to say the least of it, doubtful, implying as it does that heat can be got into and out of the working fluid without expenditure of energy, an assumption as untenable as the possibility of perpetual motion. James D. Mackinnon.

Glasgow, October 1st.

### GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—Your article upon this subject is valuable and interesting, but it may be doubted whether the subject is so much in need of the "competent inventor" as is assumed. It is right to say that "the thing will never be done if a cotton mill engine is taken as a standard," but there are high-speed engine makers who have given as much attention to the subject of governing as cotton mill engineers, and, as they believe, with as much success; it is only necessary to refer to the late Mr. Willans. You, apparently, intending to take a typical electric light engine, select one running at 100 revolutions per minute. Your argument is of course unaffected by the number of revolutions, but does not the selection suggest a turning of the eyes towards the cotton mill engine after all, in forgetfulness of the fact—about which I believe there can be no doubt—that of all the public electric lighting work in Great Britain, very much more than half is performed by high-speed engines running at from 350 to 400 revolutions per minute, and standing on a much better footing as regards governing than an engine designed to run at 100 revolutions only? Surely it would not be unreasonable to take an engine of the high-speed class as the typical electric light engine. The first point I would refer to in your article is the very useful demonstration of the inevitableness of some change of speed with a change of load, owing to the different position necessarily assumed by the governor balls. It were well if this fact were generally understood; there would be less asking for impossibilities. It is, however, easy to give an accuracy of governing quite sufficient for the purposes of an electric lighting station; a total variation of 2 per cent. between full load and a very light load—which means a variation of speed of less than 1 per cent. through any variation of load likely to occur in practice—is easy of attainment. The change from 150-horse power to 300-horse power, which you consider, need not involve a greater change of speed than this, and certainly, if in any station the engines are run with a much greater variation of load than from full load to half load, there must be something so radically wrong, either in the design or in the management of the station, that all governing questions sink into insignificance beside it. The continental blunder of using a very few large units of power, instead of a greater number of small units, is happily understood, and is generally avoided in this country.

Having in view important stations where direct-coupled alternators of large power are driven at high speeds by Willans engines, and where the working is reported to be absolutely satisfactory, one is tempted to wonder what class of plant it is which gives rise to the complaints of electrical engineers which you refer to. If closer governing than is above described is required by any electrical engineer—though it is hard to understand why—the means for attaining it are quite well understood. It is only necessary to fit a Knowles supplementary governor to bring the main governor balls always back to the original position. There are places where this is worth doing, but surely electric light stations are not amongst them.

Of equal interest are your remarks upon sudden changes of load, and the avoidance of "blinking" in connection with them. You advise a governor which on a small change of speed shall absolutely close the stop valve or open it wide. Now this is what any really well-designed governor, such as that originally schemed by Mr. Willans, does; except that, for the avoidance of hunting, it never absolutely closes, but always leaves an opening sufficient for the passage of steam enough to run the engine light. The throttle valve is of such proportions that a very small travel covers its whole range from closed to open, and is produced by a correspondingly small movement of the governor balls. Your picture of the desired effect—"a series of very rapid alterations or oscillations"—suggests rather what one tries to avoid, though it is very likely to ensue if the change from full open to closed, or nearly closed, is produced by too small a movement of the governor balls. In other words, if the apparatus is too sensitive it will also be too delicate; it will move too easily, and the governor will hunt upon small provocation. To avoid this we must govern a little more coarsely, and substitute, say, 2 per cent. for 1 per cent. Nevertheless, it is comparatively easy to work to the 1 per cent. standard so long as disturbing causes, like variation of boiler pressure, grit in the valve, &c., are absent. But what should be pointed out is, that when we have thus been given exactly what in your article is asked for, we shall be no nearer to the desideratum—viz., the power to instantly increase the load from 150-horse power to 300-horse power without causing the lights to blink, and possibly to drop in intensity. No quickening of the governor action will help, for it already acts so quickly that in a slow-running engine the throttle valve may be shifted long before the next cylinder admission comes round.

The truth is that the interesting point you have raised is not a governor question at all; it relates solely and only to the fly-wheel. With such an increase of load as you suppose, no augmentation of the next supply of steam to the first cylinder, in a compound or triple engine, can produce power enough at once to prevent a check to speed. That can only be avoided by storage of power. For the moment the full power cannot be obtained from the engine, it must be obtained from a heavy fly-wheel, and there is no other way of preventing the drop in intensity of the lights. Needless to say, the whole matter is merely one of calculation when the data are given. The smaller the permissible drop in speed, for a given change of load, effected with a given quickness, the heavier the fly-wheel must be. As a fact, there never ought to be a serious "blink" in the lights, because there never ought to be a change both great enough and sudden enough to cause one. An instantaneous addition of 150-horse power to the load is scarcely conceivable in any lighting station, or if conceivable, it implies a plant of great size, giving an output compared with which 150-horse power is small. Let it be borne in mind that the supposed difficulty hangs upon the word "instantaneous;" if the change is spread over a few seconds even, the difficulty vanishes. An hotel or other large building may be brought on very rapidly, but scarcely instantaneously.

Engineers should recognise that in a great number of cases where they speak of good or bad governing, they really mean sufficient or insufficient fly-wheel power for the particular work in view, and nothing else. Mark Robinson.

Thames Ditton, October 2nd.

Sir,—I can fully endorse what you have said in your leader on this subject last week. To hope that we shall get what we want from the makers is waste of time. Engine builders neither understand our wants nor see their way to supply them. A favourite way out of all difficulties lies in suggesting the addition of a subsidiary governor, such as Knowles', or "The Cat." Very good in their way, no doubt, but much too slow. To me it seems that the best arrangement would be a clock governor; that is to say, there are two shafts revolving; one is kept to time by a clock or its equivalent, the other is the crank-shaft. So long as these revolve at the same pace the throttle valve is suspended. Any change opens or closes it by means of very simple well-understood mechanism.

About twenty-five years ago Mr. Bailey, of Manchester, made a governor very much of this type. I wonder if it is ever heard of now?

If steam engine makers only knew what we have to contend against, they would have supplied what is wanted long ago, perhaps.

It seems, however, scarcely worth while to spend much money in perfecting electric light governors, because the demand for them must be limited. Electrical Engineer.

October 3rd.

### LABOUR AND LUXURIES.

Sir,—The letter of "Y. X." in your last issue, with reference to some remarks made by a Woolwich workman, call, I think, for comment. The man's protest against being discharged when his services were no longer required was, of course, an absurd one, but hardly more absurd, I imagine, than your correspondent's threadbare fallacy that the expenditure of the wealthy on luxuries is necessarily beneficial to those who have to produce them.

The workman's objection to being stopped was on the ground that the wages paid to him per week only amounted to the cost of a bouquet worn by a Government clerk, whereon your correspondent goes on to explain a principle that "has always been held sound by the best authorities," namely, that the wearer of expensive bouquets is a benefactor to the whole army—which he cites—of bricklayers, carpenters, glaziers, gardeners, flower girls, &c., because he compels these people to work and provide him with luxuries, in order to win from him the money which—assuming for the sake of argument, he is of the independent classes—he himself has done no work to earn. This, though a most prevalent view of the case, is surely the fallacy.

For the sake of our argument, let us assume a more extreme case, namely, that of a millionaire who has got his money by cornering pork, wheat, or cotton, and who gives a smart function at his West End house, in which in the course of an evening flowers are consumed to the extent of £1500. Let this sum be taken as representing the labour of thirty men—in the shape of the aforesaid bricklayers, carpenters, glaziers, &c.—for one year at 20s. per week. Then what really happens is that these thirty men have to do a year's work in order to get back from your millionaire the £1500 which he took out of the pockets of the public when he cornered his pork and raised the price on them, and to obtain which he not only did nothing in return towards assisting in the production of the commodities of which he is a general consumer, but actually taxed the public.

But for the unsolicited and undesired attention of this gentleman in the interest of pork, the flowers in question might certainly not have been produced; but, on the other hand, the public would have been able to buy the same quantity of pork and still have the £1500 to expend on other labour for their own additional benefit, instead of having to produce flowers for a man who had exploited them.

There is no escaping from the fact that since commodities, be they flowers, carriages, dress, or what not, are only produced by labour, those who consume them without assisting in the production—directly or indirectly—do so entirely at the expense in labour of those who produce them; and, in proportion as our social system permits of wealth being accumulated without equivalent labour, in precisely the same proportion is the labour of the working classes increased beyond what is requisite to produce the commodities they themselves consume, the balance between what they consume and what they produce going to the idle; this being the reason why idleness and luxury are invariably found side by side with poverty and overwork.

I am far from wishing to imply that honourably won leisure is to be deprecated; but, on the other hand, let us be honest enough to see and admit that no benefit is conferred by the wealthy being in a position to command commodities which existing social conditions force the working classes to produce for them. R. G. B.

Macclesfield, October 2nd.

## RUSTLESS COATINGS FOR IRON AND STEEL.*

By M. P. Wood, New York City, Member of the Society.

(*Continued from page* 264.)

Sir Wm. Thompson's paper, read at a recent meeting of the Manchester Association of Engineers, states "That he had found red lead the best preservative coating for structural iron and steel from rust. This result," he says, "is remarkable, as red lead is a highly oxidising substance; but the reason is found that the red lead had the effect of producing a skin of black or magnetic oxide on the iron itself under the paint." Manganese dioxide, a strong oxidising substance, also forms an excellent paint for metallic surfaces, principally from the same cause that Sir Wm. Thompson gives for red lead. Cast iron generally seems to withstand corrosion from exposure to the atmosphere, sea water, acidulated water, sulphuric and chemical fumes better than either wrought iron or steel. Trautwine's citation of the cannons immersed in the sea for 62 and 133 years, and being as soft as plumbago when taken out, can be supplemented with the fact that they were nearly of the original size, while the anchors and chain cables removed at the same time were corroded away to but skeletons, and had hardly more strength per inch of metal than the cannons. It may be noted that when the cannon and anchors were first taken out of the sea, they absorbed oxygen from the atmosphere at so rapid a rate as to become so hot that they could not be handled, a condition noticeable for a number of days. As between a gray cast iron recommended by Mr. Turner, Assoc. R.S.M., F.I.C., for iron constructions immersed in the sea; and Mr. Trautwine, who recommends white close-grained cast iron, I should prefer to follow Mr. Trautwine, but it is a question of guessing which to select. Parts that need machining will require to be softer than those that can be put in place as they come from the foundry. Accurate data is wanting on all these points. Experience is a dear school, and a slow one in its deductions. It has been noted that cast iron car wheels immersed in both fresh and sea water for many years, show less corrosion on the chill part of the wheel than on the body. The iron is necessarily the same in both points, but the molecular arrangement of the iron due to the chill, not only imparts a higher resisting power to wear, but also to corrosion. This example shows that both Trautwine and Turner are right, though diametrically opposed to each other primarily and the governing effect of a condition rather than a theory.

Professor V. B. Lewis, of the Royal Naval College, Greenwich, England, at a recent meeting of the Institute of Naval Architects, London, states:—"The rusting of iron and steel is a definite chemical process due to the conjoint action of air, moisture, and carbon dioxide upon the metal. The increased rate of chemical corrosive action due to a local increase of temperature is noticeable, and may be due to galvanic action set up between portions of the same metal at different temperatures. It is an undoubted fact that the double bottom of ship plates near the boilers corrode more rapidly than similar plates in other parts of the vessel, and the increase in temperature near the boiler is the only factor. It is also noteworthy that the plates at the bottom of the cellular spaces, which are kept cool by contact with the sea water, do not corrode; and cases are noted in which parts of a plate, which get locally warmer than other parts—although the difference can only be a few degrees—corrode much more rapidly than the cooler portions. Experiments show that the rapid corrosion found in the double bottoms near the boilers or other sources of heat is due to galvanic action, and not to the increased chemical activity due simply to the increase of temperature. As the ashes are drawn and quenched with sea water near these exposed plates, no doubt some of the corrosion can be traced to the gases thus formed; the sulphur in the ashes also contributing its effect."

Graphite, mixed with pure boiled linseed oil in which a small percentage of litharge, red lead, manganese, or other metallic salt has been added at the time of boiling to aid in the oxidation of the oil, forms a most effective paint for metallic surfaces, as well as for wood and fibrous substances. Wood surfaces protected by this paint, and exposed to the action of sea water for a number of years, are found in a perfect state of preservation. Some recent experiments with this paint applied to the surface of boiler flues show that it prevents the formation of scale to a wonderful degree, and though it would seem in this case to also prevent the transmission of the heat to the water, yet it appears to be a better conductor than the scale which it prevents from forming. Steel tubes in locomotive and other high-pressure steam boilers pit more readily than iron tubes under the same conditions of service, so much so that on many railways the use of steel tubes is prohibited. If the experiments now in progress with this paint applied to locomotive boiler tubes are as successful to prevent corrosion and the formation of scale as in the case of the boiler flues, its use will add materially to the economies of railway locomotive service, and can hardly be less effective in many cases on marine boilers.

In many places in the south-western section of our country the water is so bad in scale-producing qualities as to require the removal of the boiler tubes after only two weeks of service, or a little over a 2000 miles run. Innumerable compounds of the anti-incrustation order have been tried and found useless to correct or even mitigate the trouble. If the simple application of a coat of plumbago paint furnishes a remedy for this evil, no better example of the "unexpected happenings" in favour of the engineer can be had. Engineers requiring a ready rule to determine the amount of paint required to cover any structure may find the following, from my own experience, to be of use:—Divide the number of square feet of surface by 200, the result will be the number of gallons of liquid paint required for two coats. Or, divide the square feet by 18, and the result is the number of pounds of pure white lead required to give three coats.

Another method or process for the protection of iron and steel has been recently invented by an Austrian, and is in practical use in Vienna. The United States patent No. 453,355 was issued June 2nd, 1891, and is described in the *Official Gazette*, vol. 55, page 1199. It is called the Haswell electro-browning or electro-enamel process, and consists of protecting the surface of iron and steel by a deposit mainly of peroxide of lead, prepared by the electrosis of a suitable lead salt in cold water. The deposit is produced and completed in twenty minutes, and does not require more than one treatment. Several samples of it are presented for the examination of the members. It appears to be best adapted to articles like shelf goods, hinges, and other cast iron articles of general hardware, also axes, edge tools, scythes, &c., that require protection from changes of temperature that cause sweating, also from the effects of handling and storage in damp places. The coating, while possessing considerable resisting power to the moisture, carbonic acid, and ammonia, that is in the air in its normal state; also, to diluted mineral and organic acids, and the chemical and other fumes of the workshop, is, not, however, of so high resisting power as to withstand immersion in either water, sea water, or acidulated mixtures beyond forty-eight hours, which under these conditions appears to be about the limit of its protective qualities. It can be polished on ordinary buffing wheels after it is applied, as shown by the round samples, it being unnecessary to polish the article before browning it, its colour then being decidedly pleasing, while the coating on the rough ground surface of the sample is far from objectionable. The sheet iron sample shows its effect upon iron as it left the rolls, a pickling to remove the scale being the only preparation required. The sheet iron can be bent to a right angle over a moderately sharp corner without cracking the coating or injury to its protective power. The coating has no chemical affinity with the metal which it is to protect. Whether dry or moistened it creates no changes on the surface of the article coated, and is not affected by mechanical injury like a blow, so as to flake off, expose the surface, and cause a rust spot to form. It stands hard rubbing with pumice stone wet or dry on a piece of felt, is not affected by the usual changes of temperature of the atmosphere, and bears a temperature of 350 deg. Fah., without injury. The cost of material in the electro bath is ten cents for 100 square feet of surface coated. The apparatus required consists of a few tanks to hold the lead solution, a few reels or racks to support the articles according to what they are; the whole at a cost of from 25 dols. to 250 dols. An ordinary electro-plating dynamo is required, the size depending upon the amount of work to be done, and power to drive the dynamo, &c., from $1\frac{1}{2}$ to 2 voltage is all that is necessary. Water must be provided, and drying facilities by steam oven or otherwise as is most convenient. The articles must be cleansed from oil or finger marks before immersion in the bath, but a limited amount of skilled labour is required in the process. The royalty for the use of the patent is not included in the above statement of cost. The technical value of the invention as to cost of application and its effectiveness, appears to rank next to the nitre process of Lieutenant-Colonel Buffington heretofore described; but for all purposes requiring the preservation of the finish and cutting qualities of highly tempered edged tools it has no competitor. The coating is easily removed by friction with turpentine, concentrated lye or benzine. Its application to finished shafting and kindred articles is feasible and practical, but on pulleys, machine tools, engines, and like bulky articles, the old white lead and tallow pot will hold its own for yet awhile, and the machine shop apprentice will not be deprived of a chance to develope his artistic proclivities. There are a few compounds for the temporary protection, rather than the preservation of machined or bright surfaces, of iron and steel that, not an enduring as paint, may be denominated lotions; some of them are effective and easily applied. Krupp uses a compound called Mannocitin for his bright steel, machined articles, and ordnance in store. It does not turn rancid or harden with age, is consistent enough to resist torrid temperatures without slumping off, is easily removed by turpentine or benzine, and is a valuable substitute for the old tallow pot product. Coal-tar, a product from the distillation of gas coal, when properly prepared forms an effective protection from corrosion of iron and steel from ordinary atmospheric attack, and if reduced to a pitch compound and applied to the metal in form of a hot bath, in which the article is immersed for a sufficient time to allow it to attain the same temperature as the bath, the coating formed is but slightly inferior to red oxide of lead paint, and in some applications is much cheaper. In all cases the removal of the scale of the rolls or foundry sand produces superior results. The coating formed has about the same elasticity as the metal, and withstands mechanical injury very well. The composition of the tar has much to do with the success of the application. Coal-tar from gas coal and cannel coal, as it is collected from the hydraulic main, by analysis consists of the following elements as averaged from a large number of samples. A 40 gallon barrel consisting of:—$1\frac{1}{2}$ gallons, or 3 75 per cent. of light oils, consisting of benzole, naphtha and carbolic acid. $9\frac{1}{2}$ gallons, or 23·75 per cent. of heavy oil, consisting of creosote oil and anthracine; 29 gallons, or 72·5 per cent. pitch. Boiled in open kettles, this should be reduced from 15 per cent. to 25 per cent., according to the duty required of it. The tar resulting from the distillation of petroleum oils for gas is of a decidedly inferior quality to that obtained from gas coals, and is better adapted for coating the cruder forms of wood constructions, piles, dock timbers, fence posts in the ground apart, than metal work. But this same oil tar, if distilled at heats from 600 deg. to 800 deg. Fah., forms a pitch of almost adamantine hardness when cold, and resists almost all corrosive agents, except those of the hydrocarbon class. When the concentration of the gas coal-tar is carried to the 25 per cent. or 30 per cent. stage, the product is comparatively ordourless, or at least is not any more objectionable than that from oil paint, the pungency due to the light oils and carbolic acid being dissipated.

Galvanising or coating metals with zinc, and its alloys of tin, antimony, arsenic, lead, &c., is a well-known process, and its value is well recognised, as the extensive application of it for a large variety of purposes shows, but it is easily attacked by weak acidulated liquids, sulphurous and other atmospheric fumes, and the protection afforded, except in fairly protected and favourable locations, is but temporary. Its mission is so short lived, and corrosion once commenced proceeds so rapidly in unlooked-for spots, that one is forced to recognise the potency of the remark, "and the end of that process was worse than its first condition." The Ajax patent coating, so extensively advertised a few years ago, was a coating of lead and its alloys applied to iron surfaces which had undergone a peculiar pickling and cleaning process to free them from scale, sand, &c. Other than this point it had no merit over the ordinary galvanising process. Zinc and tin, with the other before-named metals, are by themselves all electro-positive to iron and steel, but when alloyed or combined with each other are more potent to introduce electrosis action upon the baser metal and hasten decay. The covering of church spires and court house cupolas with bright tin used to be a familiar method of marking the importance of the structure to the rustic communities. These were undimmed by paint, and in many cases were uncorroded and bright after fifty years or more of exposure, but the covering was pure tin plate and honest work, and when leaks did occur in the covering, it was always in the seams where the solder had introduced some lead alloy to begin its incipient work of decay. When the tinning fraternity began the use of acid in connection with resin—and in many cases used acid alone—as a flux to the solder, the life of the roofing was materially shortened, the job hastened to completion, but the tinker never took a cent off the bill.

The advent of coal as a domestic fuel instead of wood, as well as the fumes of coal smoke from multiplying manufacturing establishments, soon produced an effect upon the bright tin roofs, and paint of varying qualities, and in too many cases of a cheap John order, as being good enough for a house roof, became the order of the day to preserve the work. At present the fierce competition for orders between our Free Trade brothers across the sea, as well as the unscrupulous character of some of the Budensiek contractors and builders—and in many cases the engineering craft are guilty of acquiescing in and calling for cheaper materials—has brought into the market a quality of tin and terne plates that have about reached the maximum point of cheapness and nastiness as a vehicle to hold paint on a metallic surface. As an engineer remarked when questioned as to the quality and merits of a special brand of tin roofing plate, imported for a specially fine job, "Oh, yes, we had it painted when it was boxed and shipped, it was painted again when we received it and took it out of the box, painted again when it was ready to lay in place, and after laid had two coats given it, and the business lasted about six years, when we ripped the thing off in midwinter and laid a tarred felt, coal tar and gravel roof, which has been down twelve years, and is sound and tight as when laid, and did not cost one-half as much as the blessed tin did, including the expense of taking the thing off." The failure was due wholly to corrosion from the inside outward. Certainly all of the plates, nearly a thousand in number, could not all have been improperly pickled, scaled and cleansed before coating; but they did receive from the tin bath a uniform application of a tin and lead or other alloy coating, that pitted in a dozen places almost every plate laid on the roof. I hardly think it advisable for any one to approach that engineer for an order for tin roofing plates even if backed by a strong guarantee.

The alloy of zinc, lead, antimony, arsenic, &c., with the tin used in the cans and vessels in which so large a quantity of our daily food is now marketed, is a serious menace to the public health. The most casual inspection of "the dump" that graces all our cities, towns, villages, hamlets, and even the solitary cottage beside the sea or 'neath the sheltering hill, can but convince one of the dangers we are daily exposed to from the cumulative poisons taken into our systems from this cause, and though we as a nation are wont to demur to the too close inspection of and interference in our so-called private affairs, matters are so fast assuming a crisis stage from our greed for the almighty dollar, with the sentiment as a ruling passion: "No matter what happens so it does not happen to me," that relief and reform must be had, even if national, state, city, and town inspectors and Boards of Health one and all are called into being; happily if they could be divested of all political character, for the purpose of curtailing and controlling this growing cause of disease and death. The terror that lurks in the deadly tomato can is fast losing its joke and becoming a sober reality. The benefits that arise from a careful inspection of the metal wares enclosing food products, even if the proceeding may partake too much of the paternal government character, is strikingly shown by the examination of the French articles so prepared, and a comparison of that tin ware with the best samples of English, German, and other continental countries, and noting its superior qualities, and how remarkably they resist corrosion or change from any of the vegetable acids in food or to that due to fermentation. Our American tin-plate manufacturers have much to learn in this matter, and may study French methods of manufacture with better results than those the imported Welshmen are trying to introduce.

(*To be continued.*)

---

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

---

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(***From our own Correspondent.***)

Business on the Birmingham Iron Exchange this week has been a good deal contracted, owing to the near approach of the quarterly meetings next week. Nevertheless the improvement in the tone of trade exhibited no signs of lessening, and ironmasters take an encouraging view of the future. It is generally held that the past three months will compare satisfactorily with either of the third quarters of 1893 and 1892 as regards the quantity of work given out. The continued intelligence from the United States of trade revival is occasioning much satisfaction locally, and is tending to strengthen these exchanges.

It is considered improbable that the official minimum of marked bars, viz, £7 10s. to £8 2s. 6d., will be altered next week, as it is reported within the last few days that contracts for branded iron have been entered into up to the end of the year at present rates. Second-branded bars are quoted £6 10s., but some makers have endeavoured to obtain 2s. 6d. per ton beyond this figure to compensate them, they state, for the higher prices which have to be paid for crude metal, but in very few cases has it been allowed. Common bars are firm at £5 10s. Galvanised sheets remain at £9 15s. to £10. Plain sheets, doubles, are firmer at £6 12s. 6d. to £6 15s., and lattens, £7 5s. to £7 7s. 6d.

The firmness in pig iron is upheld by the iron and steel bridge work orders, amounting, it is rumoured, to some 20,000 tons, which have been placed with local firms for the new Sheffield-London railway. It is understood that other considerable bridge work contracts for the same scheme have been secured by Messrs. Handyside and Co., Derby. The names of two large Staffordshire constructive engineering concerns are mentioned in connection with the Staffordshire orders already received, and the probability is that additional local firms will be favoured later on. Staffordshire pig iron is quoted 55s. to 57s. 6d. for all-mine hot air qualities, part mines 42s., and cinder 38s. Northamptons are this week 41s. 6d. to 42s. 6d., Derbyshire 42s. 6d., and Lincolns 43s.

The accountants to the Midland Iron and Steel Wages Board have declared the net average selling price of iron for the months of July and August to be £5 18s. 5·46d. per ton. This, as compared with the price of the two previous months—May and June—is a decline of 11d. per ton, the average at the end of those months being £5 19s. 4·98d. Contrasted with the corresponding months of 1893, the present declaration is a drop of 1s. per ton, the value decreed for July and August last year being £5 19s. 5·67d. Notwithstanding the fall, puddlers' wages are to remain unaltered, the operatives continuing to receive 7s. 6d. per ton, and millmen in proportion.

A claim for superiority of iron over steel for special engineering purposes was made by Mr. Thomas Ashton, of the Netherton Ironworks, Dudley, in his presidential address to the Staffordshire Institute of Iron and Steel Works' Managers a few days ago. Mr. Ashton believed that, notwithstanding the advance of steel, there would permanently exist a good demand for weldable fibrous iron for special engineering purposes. This, he held, would be preferable to a rigid homogeneous ingot iron, notwithstanding the assertions of steel makers to the contrary. A more uniform and satisfactory metal could be obtained by the puddling process where a ductile, weldable material was essential. Mr. Ashton claimed that the results of experiments proved that the ultimate strength of steel was less than that of iron. For this reason a marked reaction has of late taken place in favour of high-class iron for special engineering and locomotive work. The President of the Institute stated that a case had recently come to his knowledge where a railway company, after a lengthened and thorough trial of steel gearing and couplings, finding that they were not to be relied upon, refitted the whole of their rolling stock with others made of iron. Mr. Ashton's views have been challenged by Mr. R. Smith Casson, late of the Earl of Dudley's Iron and Steel Works, one of the best authorities on steel making in this district, who especially takes exception to the statement that steel will not weld.

The strike of miners in the Romley district continues, and to all appearances bids fair to do so for some time. About three weeks ago wages were reduced 10 per cent., in accordance with the general reduction arranged by the Staffordshire Wages Board. The operatives objected to the full reduction, declaring that they had voluntarily suffered a diminution at the Rowley Station Colliery, varying from 1d. to 3d. per day, about two years ago, and that this should be taken into account. The proprietors of the mine appear willing to restore the 3d. per day reduction referred to if the miners submit to the Wages Board reduction, but at present matters are at a deadlock.

## NOTES FROM LANCASHIRE.

(***From our own Correspondents.***)

*Manchester.*—Except that makers and manufacturers have their books better filled, and are therefore not at all anxious sellers, the position in the iron trade of this district so far as actual business doing is concerned, is getting back to very much what it was a couple of months ago. There is little or no inquiry of any weight stirring in the market, and although there is no pressure to sell, prices have scarcely the firmness they had a week or two back, a tendency to give way slightly being already noticeable in some cases. The engineering industries still show no sign of real improvement. So far as there is any change, it is perhaps for the better, but not to any sufficient extent to make itself actually felt. Engineers, however, talk more hopefully, and there seems to be an undercurrent of feeling, which although it has at present no very substantial basis, gives a more encouraging tone as regards the future.

The Manchester Iron Exchange on Tuesday brought together about an average attendance, but only a very slow market was reported generally. Users of pig iron are just now buyers of only very small quantities, and the demand is chiefly upon foundry qualities, forge numbers not only meeting with little or no inquiry, but in some cases consumers are scarcely taking the deliveries of iron they have already bought. Lancashire makers are still quoting on the basis of 40s. for forge to 42s. for foundry, less 2½ at the works, or equal to 42s. 6d. for forge and 44s. 6d. for foundry, delivered Manchester; but they are only booking occasional small parcels—chiefly of foundry—at these figures. With regard to district brands, foundry descriptions are fully maintaining late rates, Lincolnshire not being quoted under 41s., with Derbyshire remaining at about 45s. 6d. to 46s. net cash, delivered Manchester; but forge qualities are in some cases becoming rather more plentiful in the hands of makers, and a disposition is being shown to give way slightly upon recent quotations, forge Lincolnshire scarcely now averaging more than 39s. to 39s. 6d. net cash delivered Manchester. Outside brands offering in this market have not been appreciably affected by the slight giving way in warrants during the week, which has probably in some measure been due to the evident collapse of the Scotch miners' strike. Ordinary foundry brands of Middlesbrough might be bought readily at about 44s. 10d., but for special brands makers are still firm in quoting 45s. 4d. net cash delivered Manchester. As sellers of Scotch iron have only very limited quantities to offer, and the supplies coming into the market are not likely to be at all appreciably affected for some weeks to come, buyers who require prompt delivery have still to pay special rates, Eglinton being scarcely obtainable under 49s. 6d., and Glengarnock 51s. net prompt cash delivered at the Lancashire ports.

In the finished iron trade the position is still without improvement, forges only in exceptional cases working more than four days per week, and manufacturers report no increased weight of business coming forward. Quoted prices remain unchanged, Lancashire and North Staffordshire bars averaging £5 7s. 6d. to £5 10s., Lancashire and Staffordshire sheets £7 to £7 5s., and Lancashire hoops £5 17s. 6d for random, to £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

In the steel trade there is only a quiet sort of business doing, with good foundry hematites quoted at 53s. to 53s. 6d., less 2½, and ordinary Bessemer basic billets about £4 net cash delivered Manchester. With regard to manufactured steel, makers of boiler-plates are still quoting £6 7s. 6d., but there are sellers at £6 5s., with Scotch makers quoting for delivery when works restart at £6 5s. per ton, delivered in this district, and this figure seems to represent the top price that is obtainable from consumers here.

In the metal market the recent further advance in list rates for manufactured goods still operates as a complete check upon business beyond the merest hand-to-mouth requirements, consumers evidently anticipating that prices will have to get back to previous rates, as raw material is showing a downward tendency.

The various works in connection with the Manchester Ship Canal are making satisfactory progress, and the same may be said with regard to the steadily increasing traffic along the waterway. The new three-storey sheds at the Manchester and Salford Docks, of which a full description has already been given in the columns of The Engineer, are being rapidly pushed forward, and will very soon be completed. At the Eastham end some modification is being made with regard to the scheme for constructing a guiding jetty outside the locks, and in the place of this jetty, a series of dolphins extending 1800ft. on the river side, and about 400ft. on the opposite side, are being constructed to provide additional facilities for guiding ships entering the canal, and preventing any possibility of tide-wash dragging them out of the way. The contract has been placed in the hands of Messrs. Topham, Jones, and Railton, of London, and should the dolphins, when completed, be found insufficient, the original intention of erecting a jetty can be readily carried out by constructing this between the dolphins which are now being put down.

The only improvement that can be reported in the coal trade is a slightly increased demand for the better qualities suitable for house-fire purposes, which is only to be expected with the approach of the usual winter requirements. For other descriptions of fuel there is a continued only very slow demand, and it is exceptional where pits are working more than four days per week. Common round coals are in very indifferent request for iron-making, steam and general manufacturing purposes, and engine classes of fuel continue more or less a drug in the market, with excessively low figures taken in some instances to effect clearance sales. At the pit mouth prices for the better qualities of round coal are steady at about 11s. to 11s. 6d. for the best qualities, 10s. to 10s. 6d. for seconds, and 8s. for common sorts, but it is only in exceptional cases that more than these figures is being got. Ordinary descriptions of steam and forge coal can be readily obtained at 7s., with some of the better qualities quoted at 7s. 6d., and engine fuel ranges from about 3s. 6d. and 4s. for the very common sorts, to 4s. 6d. and 5s. for medium qualities, up to 5s. 6d. and 6s. for the very best descriptions.

In the shipping trade a fair weight of business is being done for Ireland, but there is a falling-off in the demand for Scotland, and prices are perhaps not quite so strong as they were, common round coal delivered at the ports on the Mersey scarcely averaging more than 8s. 6d. to 9s. per ton, according to quality.

For some time past negotiations have been going on between the official representatives of the Lancashire and Cheshire Coalowners' and Miners' Federations, with the object of forming a Conciliation Board for the settlement of local disputes which would not in the ordinary course come before the general Coal Trade Conciliation Board; but at a joint meeting of coalowners' and miners' representatives held in Manchester on Wednesday to consider these proposals, the Chairman of the Coalowners' Association, Mr. Alfred Hewlett, intimated that at a previous meeting they had passed a resolution to the effect that inasmuch as under the provisions of the Lancashire and Cheshire Coalowners' Defence Association there already existed a machinery for the settlement of local disputes, it was undesirable for the present to proceed further with the establishment of a local Conciliation Board. The miners' representatives have of course to accept this decision on the part of the coalowners; and for the present, what would seem to have been a very sensible proposal on the part of the miners' representatives, for avoiding local stoppages and strikes in the future, falls to the ground.

*Barrow.*—There is still a very slow market in hematite pig iron. Business from all quarters is quiet, and there seems less disposition to order on home account, which has been the mainstay of the small trade which has been done for a considerable time past. Prospects for the winter months are not in any sense cheerful. Prices are weak at 45s. to 45s. 6d. for mixed Bessemer numbers, net f.o.b., and warrants are at 44s. 4½d. sellers, and 44s. 4d. buyers, net cash. The output of the furnaces is maintained, but there are only 33 in blast, 42 standing idle.

Iron ore is depressed in tone, especially as the local demand is very quiet, and as Scotch users are still requiring such small deliveries. Prices are easy, but are unchanged at 8s. 6d. for ordinary sorts, and 12s. to 13s. for best descriptions net at mines.

The steel trade is exceptionally quiet, and the outlook for the winter months, as in the pig iron trade, is very poor. Rails are still in quiet demand, and the orders held only represent a small trade generally. Plates are still in large production, and orders are fairly held. New business is offering, bnt prices are low. Tin-plate bars offer a better prospect. Billets and hoops are quiet. There is briskness in the steel casting department. Other branches of the trade are very quiet.

Shipbuilders and engineers are busy on Admiralty work generally, but they report a slow inquiry. Some orders have lately gone past Barrow at prices which are considered to leave no margin for builders. Ordinary mercantile marine work, however, is in very poor request. Engineers and boiler makers are very busy.

The extensions which have recently been made to the Kellner-Parlington Paper-pulp—Sulphite Process—Works at Barrow are nearly ready for operation. They will double the output of the concern, and the works will then be by far the largest concern of their kind in the country. There is a good trade in sulphite pulp.

The coal and coke trades are exceptionally quiet. The consumption is small on manufacturing and shipping account, but prices are steady, and there is no prospect of a reduction.

Shipping is depressed, both as regards imports and exports. Freights are low and unprofitable.

Traffic on local railways is poor.

There is a proposal at Barrow not only to increase the present gas plant, but to put down a public electric installation, for which the necessary parliamentary powers have been obtained.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The condition of the coal trade in the South Yorkshire district remains as last reported; the demand is still up to the average, and the outlook is fairly cheerful. Not much is heard of the minor troubles in the coalfield, and it is hoped that the question of an advance in wages for topmen and pit lads will soon be settled. The other rupture—that of the enginemen—is still going on; and, although it was stated the men had decided to vote for the giving in of their notices if the coalowners did not accede to their requests, it is not thought that any general stoppage of work will ensue. This view is strengthened by what occurred at the meeting of the Executive of the Yorkshire Coalowners' Association, held at Sheffield on Tuesday, when the question came up for consideration. A request was made on behalf of the men that the coalowners should give them an interview. This was at once conceded, and a committee of the coalowners was appointed to meet a deputation of the Enginemen's Association. The position is a very simple one. Most of the enginemen obtained advances of 30 per cent. since 1888. Under the Conciliation Board arrangement they were required to submit to a reduction of one-fourth, leaving their advances at 22½ per cent. They declined to concede that reduction, holding that as they are not represented on the Board they are not bound by its decisions. They therefore require that their wages shall be fixed at 30 per cent. above the 1888 rates.

Now that the season is advancing, and the cold weather setting in, more business is doing in household sorts, and in view of the increase in prices this month, orders are more freely given. In the London markets 1s. per ton advance has already been obtained on the retail prices. Pits in this district have been sending a fair tonnage to the metropolis, and the returns are more regular. The advance in household coal has been reported as from 9d. to 1s. per ton, but this rise in values has not been generally made. One of our most important companies, who send an immense quantity into the London market, are still quoting lowest summer prices, and no change is expected in their case until next week. Other collieries are also supplying at September rates. The present quotations are:—Silkstones, 9s. 6d. to 10s. 6d. per ton; Barnsley House, 8s. to 9s. per ton; inferior qualities from 7s. 6d. per ton. The demand for steam coal is very large, and the most is being made of the remaining portion of the export season to the northern ports. An average tonnage in steam coal has been sent by the district pits, and when the projected railway extensions are brought into operation, the local coalowners will have a good deal more business in hand. Railway companies are taking a fair share of the average business, and the trade is fairly well maintained on the whole. Barnsley hards, 7s. 6d. to 8s. 3d. per ton; other qualities, 7s. per ton. Gas coal is plentiful, and in increasing demand at from 7s. to 8s. per ton. The trade in manufacturing fuel is quiet, large supplies causing prices to be as low as from 4s. 6d. to 5s. 6d. per ton. Pit slack in fair demand at 2s. 6d. to 3s. 6d. Smudge and small coal can be had at 2s. per ton. Prices of coke are well maintained, prices ranging from 8s. 6d. to 10s. per ton at the ovens.

It is locally reported that the improved tone which prevailed in the iron trade a fortnight ago has been maintained, but inquiries made this week fail to support that view. In fact, iron is perceptibly weaker. Hematites of the best quality do not make more than 53s. per ton, West coast, and from the North-east coast 51s. per ton. This is a fall of 1s. a ton on the prices current ten days ago. Common forge iron is now at 38s. 6d. a ton, a drop of 6d. per ton on the week. The reason for this weakness is not far to seek. Consumers are supplied for the moment, having placed their orders, and the promise of an improvement a short time ago encouraged makers to increase the output. Having now more than they want, they are competing with each other for such orders as are in the market.

Full employment is still being given in the armour plate mills, and there is an anticipation of further important work coming to hand shortly. A revival in the shipbuilding trade, which would give the much-needed stimulus to the marine material departments, is now more likely than at any time during the year. Considerable contracts have recently been placed for some large ships, and as foreign Governments are expected to strengthen their Navy, the result is certain to bring good business to this district. Some very good orders for Serve tubes for Atlantic-going steamers have been placed with Messrs. John Brown and Co. The settlement of the contracts for the new line to London has helped firms engaged in the production of the plant required by contractors for that purpose. Merchants who deal in second-hand rails, &c., also find a ready sale for their goods, owing to the number of new lines now being constructed. Hope is entertained of a general revival in railway material, both at home and abroad. Inquiries have of late been very large, and reports state that one company intends giving out a considerable order for rolling stock.

The quarterly return of exports from the Sheffield consular district to the United States exhibit a total value for the three months of £108,100 17s. 6d., as compared with £73,315 16s. 10d. for the preceding quarter. The total for the corresponding quarter of 1893 was £74,551. During the last quarter the new tariff has come into operation, and the result is particularly evident in regard to cutlery. The entire business in cutlery for the United States markets during the quarter ending June was only £6518 6s. 2d., while for the three months just ended the value is £42,677 1s. 2d. Steel has not been so much affected, the value for the quarter ending June having been £51,777 3s. 1d., as compared with £52,089 8s. 3d. For the previous quarter steel manufacturers expected that the new tariff would operate favourably, and one or two are already in receipt of better orders. Although these figures show a remarkable increase in cutlery, it must not be forgotten that the trade practically collapsed while the tariffs were in suspense, and that whilst stocks on the other side were brought down to almost nothing, the workmen here were engaged on American patterns, getting ready for the rush which was expected to come the moment the Wilson tariff came into operation.

An improvement is reported in the demand for cutlery from Brazil and the Argentine. The colonies, however, are sending few orders here. Ivory merchants and dealers state that they are not at all busy, except on orders for special lines. At this time of the year the silver and electro-plate firms put on more men to the Christmas trade. This industry is in a poor condition now, the aggregate output being far from the average. The makers of agricultural machinery have had a very good season, especially in reapers and mowing machines, owing to the exceptionally large harvest. The demand cleared out the stocks of some of our largest firms.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The improvement in trade which has for several weeks been in progress has this week been checked in this district, and reports generally are unfavourable, as very little business can be done, and what is done is in some branches at a lower range of prices. The decline in prices has caused consumers to hold off, notwithstanding that the general trade of the country appears to be brightening up, as evidence of which we have the Board of Trade revenue returns, and the increased railway traffic receipts. But just now the fluctuations on the warrant market detrimentally affect business, and the tone has become very flat. The fact seems to be that the gradual return of the Scotch colliers to work leads some of those who have been speculating freely to think that they will not see any further advances in prices, and they are anxious to clear out, so as to secure the best possible profit on their transactions. At the first sign of an easing of prices, therefore, they began to put their iron on the market, and a large quantity was on offer. This served to help prices down, and made buyers the more resolved to wait. As a matter of fact the collapse of the Scotch colliers' strike should improve business in this district, because it will lead for a time to an increased demand from Scotland for Cleveland iron, seeing that the Scotch mills and forges will recommence operations as quickly as possible, and being unable to procure supplies of pig iron from native firms, owing to the stoppage of the blast furnaces, they will have to consume large quantities of Cleveland pig. It might have been expected that sellers in this district would have been able to have at least maintained their prices, but there has been so much speculation, and of late by unsubstantial and timid persons, that the course of the warrant market has had more effect upon the general market.

The adverse circumstances this week have chiefly affected the business in No. 3 Cleveland pig iron, which has been the quality in which most outsiders have been speculating, and it is this which is most freely offered for sale now. It is scarce in makers' hands, but that has not mattered, for second hands, though able to offer only comparatively small lots, have ruled the market. Makers would take 36s. 3d. per ton for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron, but there has been business done by second hands at 36s. 1½d., and even at 36s., this latter being 6d. below the best price recently paid. Cleveland warrants have fallen to 35s. 11d. cash, whereas 36s. 3d. was last week's closing price.

The stock of Cleveland pig iron in Connal's warrant stores at the close of last month was 89,745 tons, or 644 tons decrease for the month. The same firm held 62,766 tons of hematite pig iron in this district—an increase of 7000 tons in September, and of 19,449 tons in the last two months. For several months now the stock has been increasing not only in Connal's stores, but also, it is believed, in makers' hands and yet the production has been maintained. The prices of the commoner qualities of Cleveland pig iron have not fallen, makers being very well off for orders, and Scotch consumers are requiring more as they get their mills to work, while others are putting into stock in preparation for a start. Not long since grey forge was again becoming a drug upon the market; but this is not so now, and some makers are disposed to hold it rather than sell at the present price, for they say that will not pay them. It costs as much—and in some cases even more—to produce grey forge than to make No. 3, and yet the former is 1s. 6d. per ton cheaper than the latter, and has been 2s. cheaper until recently. No. 4 Cleveland foundry is at 35s. 6d., and grey forge at 34s. 6d. For mixed numbers of East Coast hematite pig iron 43s. 3d. is generally quoted, but business may be done at 43s., as there has been a considerable fall in warrants, buyers offering no more than 42s. 6½d. cash for them. Foreign ore prices, however, are maintained, 12s. 6d. being the figure for best Rubio, delivered in the Tees. The Normanby Ironworks Company have adopted the eight-hours' day at their furnaces, this making the fourth firm of ironmasters who have gone in for the three-shift system; but it is reported that, in one case, neither masters nor men are very well satisfied with the change. The Cleveland ironstone miners have decided to claim a 5 per cent. advance in their wages; but the masters cannot arrange to discuss the question with their executive until next month.

The September statistics of the Cleveland Ironmasters' Association, issued on Wednesday afternoon, were not worse than were expected, it being calculated that the increase in stocks would be between five and six thousand tons, and the actual increase was 5476 tons, but that certainly is not satisfactory for this season of the year, when there should be a substantial decrease. All the summer the returns have been unsatisfactory, the make exceeding the requirements, whereas the opposite should be the case. The total stock of Cleveland pig at September 30th was 192,185 tons, of which makers held, unsold, 96,205 tons—5150 tons increase; in makers' stores there were 2720 tons—30 tons decrease; in the North-Eastern Railway Company's stores, 3515 tons—1000 tons increase; and in Connal's, 89,745—644 tons decrease. Of the 141 blast furnaces in the district 95 were at work—one more than in August, Sir B. Samuelson and Co. having relighted a furnace at Newport—and of these 51 were making Cleveland pig, and 44 hematite, &c. The output of Cleveland pig was 122,358 tons—5373 tons increase on August—and of hematite, &c., 129,913 tons—increase 2527 tons; the total make was 252,271 tons—increase 7900 tons.

Pig iron exports from the Tees last month were rather better than were expected, reaching 80,139 tons—4416 tons increase in August, but 9824 tons decrease as compared with September last year. The quantity forwarded to Scotland was 24,105 tons, this being more than in August, but considerably below the average. In Russia, only 1695 tons were sent, whereas in September last year the quantity was 15,000 tons. To Germany also the quantity exported was less than usual—11,790 tons being forwarded direct, and 5947 tons *viâ* Holland. A much smaller proportion of the pig iron exported from the Tees has of late been of hematite quality than was the case last year, only 6860 tons out of the 80,139 tons last month being hematite, &c., whereas out of the quantity shipped in September last year 15,402 tons was hematite, &c., iron. The exports of manufactured iron and steel were fair last month, especially to India, which had 6128 tons of steel, and 996 tons of finished iron. To China 1178 tons of steel were exported, and to Japan 370 tons of steel, and 1128 tons of manufactured iron, notwithstanding the war. The total exports of pig and manufactured iron and steel from the Tees last month, as compared with August this year and September last year, have been:—

| | Pig iron. | Manufactured iron. | Steel. | Total. |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| September, 1894 | 80,139 | 10,603 | 18,707 | 109,449 |
| September, 1893 | 89,963 | 9,569 | 19,161 | 118,693 |
| August, 1894 | 75,723 | 11,164 | 13,425 | 100,313 |

The manufactured iron and steel industries are very quiet, and producers have had to reduce their quotations, as they have found that they put them up rather too quickly, and checked the improvement that was setting in. Very little iron has been sold at the advanced rates, because consumers would not pay them. Iron and steel ship plates are at the same rates, and though £4 17s. 6d., less 2½ per cent., f.o.t., is generally quoted, there has been business at £4 15s. Angles are relatively dearer than plates, as one of the leading works is closed, and there is not so much competition. About £4 15s., less 2½ per cent., f.o.t., is the price for steel angles, and £4 12s. 6d., less 2½ per cent., for iron angles. Common iron bars are at £4 17s. 6d., less 2½ per cent., f.o.t. Heavy steel rails, £3 12s. 6d. net at works, with a little better prospect, a brisker inquiry being reported on export account. Bridge builders also speak more hopefully; they are generally well employed, and expect a considerable accession of work on export account. Some good orders have lately been secured by Staffordshire firms, and the competition is less keen than it was, so that more favourable prices are looked for. Engineers are running their establishments more regularly, but nevertheless the prospect for the winter is not very satisfactory, as the shipbuilders are not well off, half their building berths being unoccupied. Mr. Percy Sadler-Blair has been appointed managing director of Blair and Company, marine engineers, Stockton, in succession to his late father-in-law, Mr. G. Y. Blair, whose death was recorded last week.

The directors of Palmer's Shipbuilding and Iron Company, in their twenty-ninth annual report, state that since the re-organisation of the Board important changes have been made in the management of the staff, considerable economies have been effected in administrative charges, and improvements have been introduced into the work in order to lessen the cost of production. The company have delivered to the Admiralty the first-class battleship Revenge, one of the finest and most efficient warships afloat, and are now building three swift torpedo boat destroyers for H.M. Government, also a P. and O. steamer.

The steel works and blast furnaces have yielded improved results, and an amalgamation of the management of the two departments has been effected, whereby a considerable saving will be made. I understand that Mr. F. W. Dick is now the manager of these two departments. Mr. John Price, who has been head of the whole concern, has resigned his position, and is succeeded by Lieut.-Col. English. Additional capital to the extent of £200,000 is to be raised on the security of debentures in order to discharge the existing debenture debt of the company, which carries an onerous rate of interest, and part is to be applied to other purposes. It is now hoped to secure for the concern a renewal of prosperity.

The demand for coals is still active, and, though quieter than it was from Scotland, is yet heavy; in fact, the coalowners are sending less of their produce to London, and more to Scotland, because they can get better prices for it there. Northumberland best steam coal is 10s. 9d. per ton f.o.b., seconds 9s. 9d., and small 5s. An improving demand for gas coals is reported, and some large local contracts have been arranged for the Newcastle and Gateshead Gas Company at something like the combination price, 7s. 3d. per ton. Stockton Corporation have ordered 20,000 tons of screened coal from Broompark Colliery, 5000 tons from Thornley Colliery, and 4000 tons from Newfield Colliery, all at 9s. 1½d. per ton, and 1000 tons of unscreened coal at 8s. 9d. from Kimblesworth Colliery.

Coke is in excellent request, and the price is very firm at 12s. 6d. per ton delivered at the Middlesbrough furnaces, while 13s. 6d. to 14s. is the f.o.b. price. The North-Eastern Railway Company have decided to light Tyne dock—the largest coal shipping dock in the world—by electricity, and have placed the order for the work in the hands of Messrs. Crompton and Co., of London and Chelmsford. The installation will consist of two large boilers, two compound engines, three dynamos, sixty Crompton-Pochin arc lamps, with cable, posts, and all accessories.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

GLASGOW pig iron market was active in the early part of the week. Warrants were thrown upon the market owing to the break away of the miners from the control of their leaders. It was reported that upwards of 20,000 men have gone to work in the collieries of the West of Scotland, and the prospect of a cheaper and more plentiful supply of fuel led to an easier feeling in the market. The impression prevailed that prices had seen their highest for the present, and speculators were therefore disposed to unload. Scotch warrants declined from 43s. 3½d. to 42s. 10d.; Cumberland hematite from 44s. 2d. to 43s. 11d.; and Cleveland from 36s. 3½d. to 36s.

Makers' special brands being scarce, have changed very little in price. G.M.B. f.o.b. at Glasgow, No. 1 is quoted 45s. per ton; No. 3, 43s. 6d.; Monkland, No. 1, 48s.; No. 3, 44s.; Carnbroe, No. 1, 48s.; No. 3, 46s. 6d.; Summerlee, No. 1, 57s. 6d.; No. 3, 52s.; Calder, No. 1, 58s. 6d.; No. 3, 50s. 6d.; Coltness, No. 1, 58s. 6d.; No. 3, 51s. 6d.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 49s. 6d.; Eglinton, No. 1, 54s. 6d.; No. 3, 48s.; Dalmellington at Ayr, No. 1, 50s. 6d.; No. 3, 50s.; Shotts at Leith, No. 1, 59s. 6d.; No. 3, 52s.

The output of pig iron in Scotland is still limited to the produce of three furnaces making ordinary iron at Coltness. The furnacemen have suffered much through enforced idleness during the colliers' strike, and it is believed the ironmasters will set them to work as soon as possible. Some weeks must elapse, however, before the output is materially increased. The demand will be largely for hematite pig to supply the steel works, and inquiries are now being made for steamers to import hematite ore from Spain. The first charters made for three months have been effected this week, the rate paid from Bilbao to Glasgow being 5s. 3d. per ton, or 1½d. more than to Middlesbrough. There is a steady although not a very large consumption in Cleveland iron, and this is likely to increase.

The pig iron shipments are very small, being only 2566 tons, against 4225 tons in the corresponding week. There was sent to Canada, 500 tons; Italy, 320; United States, 50; India, 115; Australia, 60; France, 10; Germany, 150; Holland, 110; Belgium, 20; China and Japan, 325; other countries, 31; the coastwise shipments being 875 compared with 680 tons in the corresponding week.

The market for finished iron and steel so far exhibits little change; makers are, however, looking forward to an improved inquiry, and they are getting their works put into order, so that they may be in a position to meet any demand that may arise.

The exports of manufactured iron and steel in the past week embraced sewing machines worth £6550; machinery, £5600; steel goods, £1958; and miscellaneous iron goods, £5610.

Under the auspices of the British Iron Trade Association it has been arranged that a conference of representatives of the iron and steel trades shall be held in Glasgow on the 30th instant. Mr. William Jacks, M.P., president of the association, will preside, and a number of subjects will be introduced and discussed bearing upon the prospects of trade and foreign competition. The miners of the West of Scotland have returned to work in large numbers, notwithstanding the resolution of the Edinburgh Conference of the British Federation that the strike should be continued at some places, notably in the Motherwell district. The men have made quite a rush for the pits, fearing that places might not be readily found for them. There does not now seem any likelihood of the leaders being able to rally the men, and the belief is that in a very short time they will be all back to work.

The coal market is much easier, as supplies are rapidly increasing, and prices will soon be back to a level that will allow of free purchases for manufacturing purposes.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE one prominent subject of discussion on Monday was the "Fate of the Sliding Scale." On Saturday, at the audit meeting held in Cardiff, under the presidency of Mr. W. Abraham—"Mabon"—in the absence of Sir W. T. Lewis, a declaration of 1¼ per cent. reduction was announced as a result of the audit of the coalowners' books for July and August, the reduction dating from 1st October.

At the same meeting of coalowners' and colliers' representatives, the following notice was handed in:—"To the members representing the Coalowners' Association upon the Sliding Scale Joint Committee. Gentlemen,—We, the undersigned, hereby give you six months' notice that the existing sliding scale agreement, now in force, regulating the workmen's wages at the South Wales and Monmouthshire collieries in the Coal Association, will terminate on the 31st day of March, 1895. Dated 1st October, 1894. (Signed) W. Abraham, D. Morgan, D. Beynon, Thos. R. Thomas, Alfred Onions, T. Darounz Isaac, Isaac Edwards, John Morgan, Thos. Richards, Philip George, Thos. Davies, Lewis Miles."

The coalowners, upon receipt of this ominous notice, agreed to defer the consideration of any questions arising out of it until a future meeting. When the reduction and the giving of notice was made known in the district, many well-disposed colliers regretted that at such a crisis a reduction should have been declared, quite ignoring the fact that the scale is built up upon rigid and impartial foundations, and could not be swayed from the straight line for purposes of policy. As this dawns upon the men, I have hopes that they will agree eventually not to abandon the principles of the scale, which have yielded them regular work and good pay for seventeen years. The last reduction now leaves the colliers' wages at 22½ above the standard. The impression amongst leading coalowners is that September and October audit will be to declare a small advance.

Last week's coal shipments were a good deal above the average at Cardiff; and Newport and Swansea exhibited large returns, the latter still keeping above the average, but in patent fuel there has been a falling off. At Cardiff prices slightly drooped towards the close of the week, and quotations were given at 11s. 6d. to 11s. 9d. for best steam. This week they have recovered firmly, and the latest figures were 11s. 6d. to 12s. Seconds 11s. to 11s. 3d., dry sorts 10s., ordinary small 4s. 9d. to 5s. 3d., best small 5s. 6d. to 5s. 9d. All figures were firmly maintained. In house coal a brisk demand is setting in, and prospects of a vigorous trade in the next few months are very certain. Ruling prices, Cardiff, were, for best house, 11s.; No. 3 Rhondda, 10s. 3d. to 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d. to 6s. 9d.; No. 2 Rhondda, large, 8s. 9d.; through, 7s.; small, 4s. 6d. to 4s. 9d. Patent fuel remains steady at 11s. to 11s. 3d., Cardiff. Swansea prices are 10s. 6d. to 11s. Other quotations of the week are, Cardiff—Coke, furnace, 15s. 6d. to 16s.; foundry, 17s. to 18s.; special foundry, 20s. to 21s. Pitwood is in excellent demand, as can be seen by the quantities on rail, and the accumulations being made at the collieries. Good wood realises 15s. 3d. to 15s. 6d., ex ship; Swansea prices are 17s. into truck, net cash 30 days.

Swansea harbour returns show an increase of 14,000 tons for last week, as compared with those of the corresponding week last year.

The great feature in the tin-plate trade at Swansea is the large increase taking place in shipments. Last week the biggest shipment on record to Russia took place, no less than 3000 tons being despatched to Batoum by the Hebron. This, and the improvement in the American trade, are gratifying facts, and if workmen now subdue the disposition to hamper trade, and work energetically with their employers, better prices and wages must follow. I note that last week the total tin-plate shipment was 123,275 boxes, while the quantity sent in from works only totalled 68,081 boxes. This again reduces stocks, which are down to 227,311 boxes, as compared with 282,585 boxes last week. It will be seen from this that it is now more a question of clearing out stocks than of increased animation at the works, but I quite agree with the opinion on 'Change, Swansea, that a little more depletion must alter figures.

There is little change to report in the iron and steel trades. Increased briskness is to be noticed in stocking foreign ore—the usual forecast of the coming events. All the principal works have figured largely during the week, amongst them "Tredegar." This by some is taken as an indication that a movement is probable amongst the "dry bones." I should only be too happy to verify, but find that the name of the vessel was Tredegar. The shipment was to Tapson and Co. In the coal development, as at Rhymney, the Tredgar Company are doing well, and it is fortunate that the ironwork companies have two strings to their bow, and can afford to wait. It is, however, more than local rivalry that they have to contend against. Cyfarthfa with its remarkable management, and Dowlais with its sea-shore advantages, are great factors; but I find that northern opposition is getting keener, and many instances have occurred of late where the Welsh ironmaster has been successfully opposed by his northern rival. This week large cargoes of tin bars have come into Swansea, and 700 tons pig from Millom, and a quantity from other quarters, with scrap steel from Port Glasgow.

Pig iron warrants have further declined at Swansea during the week. Lowest figure has been 42s. 10d.; Middlesbrough, No. 3, 36s. 1½d.; hematite, 43s. 11½d.

Other quotations, mid-week, were:—Welsh bars, £5 to £5 2s. 6d.; sheet iron, £6 to £6 10s.; steel sheets, £6 5s. to £6 7s. 6d.; Bessemer steel bars, £4 2s. 6d.; Siemens best, £4 to £4 2s. 6d.; all delivered in the district cash, less 2½. Steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s.

Makers' quotations for tin-plates are:—Bessemer steel cokes, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; ternes, per double box, 28 by 20 c., 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; wasters, 6s. to 1s. less than primes.

Block tin is at £70 5s.

Iron ores slightly changed—Tafna, 11s.; Rubio, 11s. 3d. to 12s. per ton ex ship; 1s. 6d. extra for selected large per ton, Swansea.

It is expected that the wage reduction by American ironmasters and "tin-plate" makers to their workmen will have the effect of sending a large number of Welshmen home to their old industries.

"The dispute at Llanbradach" was one of the subjects keenly discussed on "Mabon's" day at the Caerphilly meeting, and South Wales colliers were appealed to keep away and not interfere. The contention is that the price list offered to the men wants improving.

Reduced rates on pitwood have come into force this week on the Great Western Railway from Swansea. The tariff reduction is from 3d. to 9d., and considerable local benefit is anticipated.

Up to the present pitwood quotations at Swansea are higher than at Cardiff, though Swansea is a tide nearer the supplies. This anomaly may now be corrected.

At Bangor, North Wales, the Corporation have acquired the Anglesey Ferry by purchase. It is intended to erect a pier at an expense of £10,000, for which the necessary parliamentary power has been obtained.

Some slight hitch has occurred at one of the Plymouth collieries this week. The hauliers are credited with the difficulty.

There has been a Congress of the Amalgamated Society of Railway Servants at Newport, Mon., and a reception by the Mayor. The leading feature on the first day was the election of president, Mr. Hudson for the fourth time obtaining that honourable distinction. The leading points of discussion at the Congress were to be the abolition of the seven-day system and the establishment of an eight-hour day.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

BUSINESS, all through the iron and steel trade, continues generally quiet. For some sorts of iron there was perhaps some little extra inquiry here and there, which may be traceable to anxiety on the part of users to cover themselves against any possible contingency which might arise through stoppage of works or restriction of output; but, on the whole, there was no real weight of buying going on, and quotations are but moderately maintained.

In Silesia the business in pig iron has improved; some fair export orders have been booked recently, one for 3000 t. for an Austrian works, and there are more contracts holding out, so that makers have fairly good prospects for the immediate future. The rolling mills have also got some fresh orders, but, to secure them, manufacturers had to reduce their quotations. Breslau dealers now ask M. 120 p.t. for girders, which is about M. 10 less than was formerly quoted. On the whole, there are more offers than inquiries in all branches of the iron trade.

In Austria-Hungary the iron industry presents no new feature. Pig iron continues rather scarce, and the Rima Muranga Iron Company have even been compelled to order 3000 t. from Silesia. The works producing rails and railway requirements are still but weakly engaged, demand being altogether insufficient, while prices are, naturally, wanting in firmness.

Iron business in France has improved, although, for the present, small lots only are sold; but there is quite a confident tone noticeable in all departments, and the tendency of prices is good, especially when compared to June and July of present year. The iron foundries are all reported in regular employment. In Paris merchant bars have been sold at 155f. p.t.; girders, at 65f. p.t.; while free at works prices are about 8f. to 10f. lower. In the Departement Nord the market is more quiet, and for orders of some weight prices are decidedly less firm.

On the Belgian iron market, the tone of the malleable iron business is tolerably satisfactory, while makers of pig iron have to fight against the almost crushing competition of Luxemburg and Longwy; and some of the larger firms—Athus, for instance—found themselves obliged to agree to a reduction, and are now selling forge pig at 43f. p.t., instead of 44f. p.t., although the prices of coke have risen lately, and a considerable firmness is exhibited in the finished iron trade. Of 42 existing blast furnaces, 29 were in blow on September 1st, 13 producing forge pig, 3 foundry pig, and 12 producing basic. The following shows the output of pig iron in August, and for the first eight months of present year and of the year before:—

| | August. | | January to September. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | Tons. | Tons. | Tons. | Tons. |
| Forge pig | 37,820 | 33,480 | 263,640 | 259,200 |
| Foundry pig | 6.820 | 6,510 | 52,800 | 50,400 |
| Basic | 35,650 | 20,150 | 276,300 | 156,000 |
| Total | 40,490 | 60,140 | 592,740 | 465,600 |

Makers of steel report themselves in a somewhat better condition than a few weeks ago, and some firms are contemplating the enlargement of their establishments, so that production will increase in the next quarter. The following table shows prices—in francs—of Belgian coal and iron, per ton at works, since 1875:—

| | Coal. | Foundry pig. | Bars, No. 1. | Plates, No. 2. |
|---|---|---|---|---|
| 1875 | 15·50 | 70 | 176 | 242·50 |
| 1876 | 14·30 | 62·25 | 150 | 226 |
| 1877 | 11·90 | 56 | 132·50 | 190 |
| 1878 | 10·20 | 55·75 | 124 | 177·50 |
| 1879 | 9·45 | 49·10 | 115 | 154 |
| 1880 | 10·20 | 54·20 | 156 | 205 |
| 1881 | 10·55 | 54 | 125·50 | 171 |
| 1882 | 10·37 | 58 | 134·50 | 187·50 |
| 1883 | 10·62 | 57 | 120·50 | 176 |
| 1884 | 9·80 | 49·50 | 117 | 159 |
| 1885 | 9·05 | 47·25 | 107 | 143 |
| 1886 | 8·30 | 43 | 102·50 | 126 |
| 1887 | 8·25 | 45·50 | 112 | 133 |
| 1888 | 9·50 | 51·25 | 120 | 140 |
| 1889 | 10·90 | 57·25 | 129 | 151 |
| 1890 | 16·55 | 67·25 | 160 | 181·50 |
| 1891 | 13·60 | 51·75 | 131 | 149 |
| 1892 | 11·15 | 50 | 117·50 | 135 |
| 1893 | 10·12 | 48·25 | 110 | 128·75 |
| 1894 | 10·70 | 49 | 110 | 130 |

The Rhenish-Westphalian iron market shows, on the whole, the same feature as in former weeks, and buyers still show little inclination to purchase more than what is immediately required. On the iron ore market demand is moderate, and the prices tolerably well maintained. Spathose iron ore is paid with M. 7·40 to 7·70 p.t., roasted do. fetching about M. 10 to 11 p.t at mines, inferior qualities are quoted M. 9 to 10·20 p.t. at mines. Nassau red iron ore meets with a fair demand, the 50 p.c. grade being quoted M. 9 20 p.t. free Dillenburg. For Luxemburg-Lorraine minette prices vary from M. 2·40 to 3·20 p.t. net at mines. In pig iron a pretty regular business has been doing upon the week, small lots being sold at comparatively firm quotations. The prolongation of the Rhenish-Westphalian Pig Iron Convention till July next year is regarded as a sort of guarantee for the future development of the iron market.

In the Siergerland the iron business is quiet just now; the following prices are quoted:—Spiegeleisen, 10 to 12 p.c. grade, M. 52 p.t.; Rhenish-Westphalian forge pig, No. 1, M. 46 to 47; No. 3, M. 40; Siegerland, good forge quality, M. 44; hematite, M. 63; foundry pig, No. 1, M. 63; No. 3, M. 54; basic, M. 46; German Bessemer, M. 49 to 50 p.t.; at works. Iron for making steel, Siegerland brands, M. 45 p.t.; Rhenish-Westphalian brands, M. 47 p.t.; Luxemburg forge pig costs M. 48 p.t., free Luxemburg.

In the malleable iron department the demand is quiet, especially in bars, and prices are somewhat depressed. Much the same can be told of girders. The hoop trade is in an improving condition compared with last week, and a generally stiffening tendency in prices can be noticed, which may be accounted for by the increasing weight of new work that has been coming forward lately. The activity at the plate mills continues satisfactory, though certainly not remunerative; the same holds for sheets. In the wire and wire nail branch both demand and prices leave very much to be desired; and the rivet business has also been very quiet for some time past, the few orders that are actually booked being mere trifles. Machine and wagon shops are irregularly and, for the most part, unsatisfactorily occupied.

Latest list quotations, per ton at works, are as under:—Good merchant bars, M. 105 to 110; angles, M. 125; girders, M. 90 to 95; hoops, M. 108 to 115; billets, in basic and Bessemer, M. 81; heavy plates, for boiler-making purposes, M. 150; tank, do., M. 130 to M. 135; steel plates, M. 125; tank do., M. 115 to 120; sheets, M. 120 to 150. Iron wire rods, common quality, M. 115 to 120; drawn wire, in iron or steel, M. 105 to 120; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to M. 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

The total production of pig iron in Germany, including Luxemburg, was, for August of present year, 489,211 t., of which 133,266 t. were forge pig and spiegeleisen, 37,023 t. Bessemer, 239,466 t. basic, and 79,456 t. foundry pig. Production in August, 1893, was 420,949 t.; in July, 1894, it was 476,894 t. From January the 1st to August 31st of present year no less than 3,615,176 t. were produced, against 3,236,680 t. for the same period the year before.

## AMERICAN NOTES.

NEW YORK, Sept. 27th, 1894.

THE slacking up in demand for iron, steel, and railway material, at a time when a general expansion of demand was expected, has been a surprise to manufacturers and brokers. The general election occurs within six weeks, and it is believed that will be a sweeping Protectionist victory. The effect will naturally be to stimulate demand in all channels of trade. Railroad managers are completing their requirements for the coming year, and large contracts will soon be placed, covering rails, track equipments, engines, cars, and machine shop machinery. Steel billets are declining, and when they touch sixteen dollars at Pittsburgh, large orders for fall and winter delivery will be placed. Prices are weak in all channels, and the banks have more money than they have use for. Business men are discouraged at the slow growth of trade. Merchant bar mills are running out of business. The production of anthracite coal is 1,500,000 tons less than at this date last year. Coke production is now 105,000 tons per week.

DURING the recent summer months, in Westminster, the sun was shining for 803 hours, which is 130 hours less than the average during summer for the ten years 1881 to 1890. The greatest deficiency was 39 hours in August, and in May there were 32 hours less than usual, while September was 29 hours below the average. In the Channel Islands the sun was shining for more than 1100 hours, and in the south-west of England for upwards of 1000 hours. In Scotland, Ireland, the North of England, and in the Midland Counties, the amount was only slightly in excess of 800 hours, or very near the record for London.

## LAUNCHES AND TRIAL TRIPS.

On Saturday afternoon, the 29th inst., Alderman Charlton, J.P., launched from his yard on the west side of the Royal Dock a handsomely modelled iron screw steam trawler. The dimensions of the vessel are—Length 102ft., beam 21ft. and depth 11ft. The machinery will be supplied by the builder, consisting of the triple expansion engines, with cylinders 12¼in., 20in. and 32in. by 22in. stroke, and are supplied by steam at 155 lb. pressure by extra large steel boiler fitted with Holmes' furnaces. The vessel will also have powerful steam winch specially made for steam trawlers by the builder, and of which a great number have been made. There is a comfortable cabin aft for the captain and engineers, also a roomy forecastle, which shows the builder has studied the comfort of the crew. The ceremony of naming the vessel Agnes was performed by Miss May Collingwood, and we are pleased to say the launch was successful in every way. The vessel was towed into the Alexandra Dock, where she will have her machinery put on board.

On Saturday afternoon there was launched from the East Yard of Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, a large steel screw steamer, which has been built to the order of Messrs. Christian, Michelson, and Co., of Bergen. The dimensions of this vessel are 341ft. by 44ft. by 29ft. 10in. She has been constructed to take the highest class at Lloyd's, and will carry about 5500 tons deadweight, thus constituting Messrs. C. Michelson and Co. the owners of the largest steamer under the Norwegian flag. In the design of the steamer special attention has been paid to details relating to expeditions, manipulations of cargo, and 'tween decks of unusual height, viz., 8ft. 6in., have been provided, so that the vessel will be admirably adapted for emigrant requirements, or for the conveyance of horses, cattle, or troops. The vessel will be supplied with triple-expansion engines by the North-Eastern Marine Engineering Company, Wallsend, the cylinders being 34in., 40in., 64in., by 42in. stroke, with two large steel boilers working at a pressure of 160 lb. During construction the steamer has been inspected and superintended by Captain Rodseth on behalf of the owners, and on completion this gentleman, who is a seaman of wide experience, will take command. The steamer was named the Solveig by Mrs. Anderson, of Newcastle.

On October the 2nd, 1894, Messrs. Furness, Withy and Co., launched from their yard at Hartlepool a large screw steamer, built to the order of Messrs. Burdick and Cook, London. She is a fine type of a modern cargo boat, measuring over 280ft. in length, and built throughout of iron, with a large measurement and deadweight capacity, and built to the highest class at Lloyd's. The vessel has a long raised quarter deck, short poop, long bridge-house and a topgallant forecastle. The holds are fitted with iron grain divisions, and all decks, deck erections, skylights, bulwarks, bulkheads, &c., are constructed of iron. Cellular bottom fitted all fore and aft for water ballast. The greater portion of the plates are in 24ft. lengths, making the structure of the ship very strong. Four steam winches, one donkey boiler, patent steam steering gear amidships, screw gear aft, patent windlass, stockless anchors, hauling into hawse pipes, and other modern appliances are fitted for the handy working of the vessel. The saloon and cabin providing accommodation for the captain, &c., is handsomely finished in polished hardwood, with a number of hand-painted panels, executed in an effective style by the staff of ladies employed by the firm. The steamer will be rigged as a two-masted fore-and-aft schooner, and has been constructed under the personal supervision of Mr. J. Cook. She will be fitted with triple-expansion engines by Messrs. Blair and Co., Stockton-on-Tees. On leaving the ways she was named Nellie by Miss Lindsley, of Hartlepool.

On Saturday afternoon, the 29th ult., Messrs. Craig, Taylor, and Co. launched a very handsome steel screw steamer, which has been built to the order of Mr. Joseph Hoult, of Liverpool. The dimensions are 342ft. by 43ft. by 29ft. 9in. depth moulded to the spar deck, with full poop, long bridge, and top-gallant forecastle. She is built to the highest class in Lloyd's, and has six large steam winches, multitubular donkey boiler, direct-acting steam windlass, patent steam steering gear, and all modern improvements. One of her special features is the large quantity of water ballast, being fitted with tanks to carry no less than 1250 tons. In addition to the ordinary cellular bottom, the vessel is fitted with a deep tank abaft the engine-room, which can be utilised either for carrying water ballast or any description of cargo, being fitted with large hatches, also a special system of ventilation, so as to obviate the difficulty so frequently occurring in those deep tanks. The vessel is rigged as a two-masted schooner, with telescopic masts, and carries about 5500 tons deadweight, with large cubical capacity. The engines and boilers, which are constructed for a working pressure of 200 lb., are being built by Messrs. Thos. Richardson and Sons, Hartlepool. This vessel, which has been built under the superintendence of Mr. A. C. Hay, of Liverpool, is the third built by these builders for Mr. Hoult, and they have another similar one on the stocks. As the vessel was leaving the ways she was named the Benrath by Mrs. Pyke, of Southport, who was presented with a very pretty bouquet by Master Robin Craig.

The s.s. Ranza, which was recently launched by Messrs. Palmer's Shipbuilding and Iron Company, went on her trial trip on 27th ult. She has been built to the order of the Caledonia S.S. Company, Liverpool, under the superintendence of Messrs. Flannery and Blakiston, of Liverpool and London, and is of the following dimensions:—Length, 410ft.; breadth moulded, 49ft.; depth moulded, 34ft. The vessel is estimated to be capable of carrying fully 8000 tons deadweight on Lloyd's summer freeboard. She has been built to Lloyd's highest requirements, and her machinery, which has also been supplied by Messrs. Palmers, is of ample power, and developed a mean speed of 11½ knots on the trial in light condition. Her engines have cylinders 27in., 44½in., 73in. by 48in. stroke; steam is supplied by three single-ended boilers fitted with Eaves' patent induced draught arrangement. This system consists of assisting the draught by induction, the fans being placed upon the chimney side of the fire, and it is claimed that the intensity of local heat arising from forcing fires by pressure of air below them is avoided under this system. The Ranza is the fifth vessel fitted with it, and considerable interest attaches to the result. In addition to the main boilers, the donkey boiler is fitted so as to supply steam to the intermediate steam chest, and thus in case of need assist supplying steam for the propulsion of the ship.

On Monday there was launched from the Cleveland Dockyard of Sir Raylton Dixon and Co., Middlesbrough, a very fine steel screw steamer, which has been built to the order of Messrs. David MacIver, Sons, and Co., of Liverpool and London, for their River Plate Line. This is the second of three sister vessels which these builders are now constructing for the same owners, all of which have been specially designed and fitted for the River Plate trade, comfortable and well-ventilated accommodation for the passengers being fitted up in the poop. The vessel is of the partial awning deck type, with long raised quarter-deck and poop, and has been built under special survey for Lloyd's highest class, the principal dimensions being 305ft. by 41ft. 3in., by 20ft. 3in., with a deadweight carrying capacity of over 3500 tons on a very light draught of water, and all the deck erections are so arranged that the steamer can be promptly adapted for the purpose of carrying cattle. She will be rigged as a fore-and-aft schooner, with Sidgwick's patent hinged topmast, which can be immediately lowered when the steamer is required to pass under such obstructions to navigation as the permanent bridges over the Manchester Ship Canal. The engines will be fitted by Messrs. Blair and Co., of Stockton, the cylinders being 23in., 37in., and 61in. by 42in., with two large steel boilers working at 160 lb. pressure; and as the vessel is of fine model, a good sea speed will be economically maintained. The steamer has been built under the superintendence of Mr. P. H. Roscoe, of Liverpool, superintending engineer to the owners. As the vessel was leaving the ways she was named the Normandy by Miss Raylton Dixon, the daughter of the builder. The owners were represented by Mr. Charles Livingston.

## A NEW METHOD OF REDUCING METALLIC OXIDES.*

By H. W. Greene and W. H. Wahl.

Among the reducing agents commercially available for the producing of maganese from its oxides in a state free from carbon besides aluminium, which has already been applied by the authors, silicon is obviously the most likely one, as the heat developed by its oxidisation to $SiO_2$ is sufficiently in excess of that required to reduce 2MnO to permit the supposition that the desired reaction would take place. As, however, pure silicon can only be obtained by complicated and costly means, the direct use of this re-agent is out of the question, but it is different with metallic silicides such as ferro-silicon and silicon spiegel, which contains large proportions—5 to 30 per cent.—of silicon with comparatively little carbon, as the latter diminishes as the former increases. These silicides the authors propose to employ in the production of ferro-maganese and maganese steel, which latter substance under the present condition of manufacture, where ordinary ferro-manganese is added to fluid iron, is limited in its manganese contents by the carbon, 5 to 6 per cent., which is present in the ferro-manganese, and which cannot be eliminated from the steel on account of the affinity of the manganese for carbon.

The chemistry of the operation is exceedingly simple. When ferro-silicon is heated in a crucible or furnace lined with lime or magnesia in contact with a metallic oxide or a mixture of such oxides with lime, magnesia and a lumina for fluxing, the silicon is oxidised by the oxides, and combines with the fluxes to form a slag, while the metals set free combine to form an alloy. Assuming the oxide to be that of manganese, as MnO or $Mn_3O_4$, and the silicides to contain—iron 88, silicon 10, and carbon 1 per cent., the proportions required to satisfy the equation—$2MnO + Si = SiO_2 + 2mn$—will be 142 of manganese to every 28 parts of silicon in the silicide, and sufficient earthy oxides to form a properly fusible slag with the silica produced. A further amount of manganese oxide will, however, be necessary, as a certain quantity is invariably taken up by the slag, and so escapes reduction. An experimental charge, containing;—

| | Lbs. |
|---|---|
| Ferro silicon (Si 10, C 1 per cent.) .. .. | 100 |
| Manganous oxide .. .. .. .. .. .. .. | 70 |
| Lime .. .. .. .. .. .. .. .. .. .. .. | 50 |

Yielded 128 lb. of an alloy, containing—

| | Lbs. |
|---|---|
| Iron .. .. .. .. .. .. .. .. .. .. | 70·0 |
| Manganese .. .. .. .. .. .. .. .. | 29·0 |
| Carbon .. .. .. .. .. .. .. .. .. | 0·7 |
| Silicon .. .. .. .. .. .. .. .. .. .. | trace |

Assuming that the permissible carbon in a manganese steel is 0·5 per cent., 100 lb. of such an alloy when added to 40 lb. of decarburised iron will give 140 lb. of manganese steel of the composition—iron 78·8, manganese 20·7, carbon 0·5, silicon trace.

In the preparation of manganese steel of the same carbon temper with ordinary ferro-manganese—80 manganese to 5·5 carbon—the resulting metal would contain 92·3 iron and only 7·27 manganese. On the basis of equivalent contents of manganese, 20·7 per cent. of manganese would bring in 1·4 per cent. of carbon, using ordinary ferro-manganese, while by the author's method, 7·7 per cent. manganese would correspond to only 0·18 per cent. of carbon. By using the oxides of other metals with ferro-silicon, iron alloys with more than 50 per cent. of nickel, with nearly 20 per cent. of chromium, and more than 50 per cent. of tungsten have been obtained, all being relatively low in carbon. Titanium has so far only given doubtful results. Alloys of copper with difficultly reducible metals may be similarly obtained by fusing their oxides with copper silicide.

H. B.

---

* "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*20th September*, 1894.

17,856. Apparatus for Drawing to Scale, A. G. Ashcroft, London.
17,857. Thief-proof Window Bolt, J. Goulson, Liverpool.
17,858. Muzzle for Race Horses, J. P. Byrne, Wicklow.
17,859. Metallic Buttons, B. Shorthouse, Birmingham.
17,860. Making Soap and Glycerine, J. K. Hill, Irvine.
17,861. Brakes for Velocipedes, V. Collinson, Lancashire.
17,862. Flushing Water-closets, C. Smith, Manchester.
17,863. Pin for Crimping, &c., Hair, W. McCrag, Glasgow.
17,864. Cycles, A. King, Nottingham.
17,865. Tippers of Water-closets, W. Whitaker, jun., Halifax.
17,866. Cycle Frames, C. E. Bell, F. W. Killingbeck, and H. L. Parkinson, Manchester.
17,867. Self-acting Mules, &c., R. Clegg, Manchester.
17,868. Making Paving Slabs, C. and A. Musker, Liverpool.
17,869. Furnaces, J. J., T. F., and J. W. Meldrum, Liverpool.
17,870. Cycle Steering Heads, C. Binks and The Central Engineering Works Company, Limited, York.
17,871. Rolling Axles, J. F. Johnson and E. Broadhead, Sheffield.
17,872, Cure of Phthisis, H. Pott, Birmingham.
17,873. Dowson Gas Enricher, H. T. Blake, Herefordshire.
17,874. Machining the Bevels of Stem Bars, D. Sheret, Hebburn-on-Tyne.
17,875. Radiators for Heating, W. H. Hargreaves and R. H. Dewhirst, Bradford.
17,876. Apparatus for Drying Wheat, H. Clarke, Burslem.
17,877. Conveyance of Petroleum in Ships, C. C. Murray.—(*J. D. Murray, Straits Settlements.*)
17,878. Automatic Railway Signalling J. Dennison, Newton.
17,879. Swings, F. Lockwood, Burnley.
17,880. Umbrella Suspender, A. G. Sadd, Ipswich.
17,881. Manufacture of Umbrellas, M. Tallefer, Liverpool.
17,882. Manufacture of Cut Nails, C. March, Glasgow.
17,883. Piston Pumps, C. P. H. Gzoon, Leipsig-Gohlis.
17,884. Sockets in Sanitary Pipes, W. Ingham and B. Langton, Leeds.
17,885. Calico-printing Machinery, M. McPhail, Glasgow.
17,886. Gas-meters, R. C. Williams, London.
17,887. Bed-pan, C. W. Surridge, London.
17,888. Tires for Cycles, J. W. Radford, London.
17,889. Advancing and Retiring Motion, H. L. Symonds, London.
17,890. Governing Speed of Steam, D. Parry, London.
17,891. A Rapid Cycle, A. Fasoli and O. Negri, Croydon.
17,892. Military Water-bottles, J. Menzies, London.
17,893. Valves, A. H. Mitchel-Jones, London.
17,894. Bellows for Cameras, A. H. Mitchel-Jones, London.
17,895. Cameras, A. H. Mitchel-Jones, London.
17,896. Apparatus for Washing Casks, R. G. White, London.
17,897. Umbrellas, W. A. Bindley and W. J. Gell, London.
17,898. Dress-holders, H. W. J. Cheffins, London.
17,899. Making Gloves, T. Billson and W. Partridge, London.
17,900. Knee-caps for Horses, J. J. Wilson, Birmingham.
17,901. Preserving Surgical Ligaments, C. Repin, London.
17,902. Lamps, H. B. Gurney, London.
17,903. Glasses and Shades for Lamps, M. Balson, London.
17,904. Sanitary Shell, J. Birch, London.
17,905. Imitation Whalebone, J. Baier, London.
17,906. Apparatus for Washing Wool, J. C. Walker, Bradford.
17,907. Apparatus for Washing Wool, J. C. Walker, Bradford.
17,908. Velocipedes, C. M. Linley, J. Biggs, and J. Archer, London.
17,909. Castor, A. Kirmse, London.
17,910. Cigar-lighter, T. Harris, Plymouth.
17,911. Apparatus for Treating Yarn, L. Wilson, Manchester.
17,912. Leg Guards, W. C. Nickels, London.
17,913. Frost Nail for Horses, C. Watkins and W. B. Healy, Birmingham.
17,914. Eyes for Stair-rods, W. Klinge, London.
17,915. Braces, G. W. Wernham, London.
17,916. Scarf-pins, A. Grollmann, London.
17,917. Hats, E. H. Andrews, London.
17,918. Boots, P. M. Hooper, London.
17,919. Matches, H. J. Köster, London.
17,920. Fireproof Floorings, W. Clark and A. W. Rammage, London.
17,921. Cooking and Roasting Utensils, I. Eades, London.
17,922. Arc Lamps, M. Immler, London.

*21st September*, 1894.

17,923. Preventing Robbery from Pillar-boxes, R. J Pleace, London.
17,924. Photographic "Blind Shutters," H. R. Cook, Cork.
17,925. Printing Textile Fabrics, J. G. Sanderson, Manchester.
17,926. Traction Power Multiplication, N. C. Lindsay and H. Stanbridge, London.
17,927. Starting Rods of Spinning Mules, J. Lees, Ashton-under-Lyne.
17,928. Knife Cleaner and Sharpener, H. C. Williams, London.
17,929. Hinges, D. Smith, Dundee.
17,930. Cleaning Knives, &c., H. and J. W. Bower, Keighley.
17,931. Cranks for Cycles, G. Pirnie, Dundee.
17,932. Wrenches, F. J. Burrell and J. A. Woods, Thetford.
17,933. Driving Chains for Cycles, W. Starley, Coventry.
17,934. Wheels for Road Vehicles, J. G. Harrison, Birmingham.
17,935. Tightening Clothes Lines, J. Pickford, Manchester.
17,936. Dredgers, J. Gillespie.—(*C. A. Marchant, India.*)
17,937. Extracting Juice from Canes, J. Drummond, Glasgow.
17,938. Spring Clip Holder, B. G. Fleming and I. Crawshay, Southampton.
17,939. Apparatus for Heating Liquids, R. W. B. Sanderson, Manchester.
17,940. Harness for Draught Animals, W. Luke, Birmingham.
17,941. Bearings for Wheeled Vehicles, F. Waters, Birmingham.
17,942. Artificial Limbs, C. W. Thompson, London.
17,943. Combination Implement, H. Searle, Bradford.
17,944. Surveying Chain, T. Trussell, Nottingham.
17,945. Brake Blocks, W. Hawley, Sheffield.
17,946. Rail Joints, A. Hoffman and H. W. Falk, Sheffield.
17,947. Red Bricks, J. and J. Ryder, Manchester.
17,948. Hair Curlers, S. M. Taylor, Birmingham.
17,949. Front Steering Bicycle, T. H. Harley and C. Saer, Malton.
17,950. Safety-valves, J. Keith, Glasgow.
17,951. Folding Tables or Seats, K. J. Wörrlein, Manchester.
17,952. Valve Gear for Engines, J. E. Wallis and Wallis and Steevens, Basingstoke.
17,953. Attachment of Stirrup Leathers, J. Selmes and J. Johnson, London.
17,954. Street Watering Carts, J. Smith, Barnard Castle.
17,955. Starting Tramway Cars, J. Lyle, Glasgow.
17,956. Mail-cart, G. L. Rothschild and H. V. Baker, Birmingham.
17,957. Perambulator, &c., H. V. Baker, Birmingham.
17,958. Valves for Pneumatic Tires, G. D. R. Bunting, London.
17,959. Opening Cans, J. Chapman and T. H. Jones, London.
17,960. Pyrotechnic Compound, A. Brock, London.
17,961. Extraction of Lead with Silver, H. R. Angel, London.
17,962. Poison for Rats and Animals, C. G. Stewart, London.
17,963. Steam Boiler, J. Westray, London.
17,964. Malt Kilns, A. Kinder, London.
17,965. Distilling Alcohol, F. W. Golby.—(*J. Puypeyroux, France.*)
17,966. Steam Generators, B. Willcox.—(*La Société Universelle des Emulseurs de Vapeurs, France.*)
17,967. Obtaining Precious Metals, J. Mactear, London.
17,968. Insulators for Electric Wires, L. S. Beardsley, London.
17,969. Preventing Cotton Slipping, R. C. T. Evans, London.
17,970. Bobbins, &c. J A. Sutcliffe and G. Paley, London.
17,971 Sliver Pans, J A. Sutcliffe and G. Paley, London.
17,972. Christmas and other Cards, T. C. Dobson, London.
17,973. Cape-skirt Combination, J. P. Thornton, London.
17,974. Refining Mattes, A. J. Boult.—(*A. L. Grant and C. G. Richardson, United States.*)
17,975. Fastener or Clip for Stair Rods, W. Mycock, London.
17,976. Purifying Sugar, W. P. Thompson.—(*H. A. J. Manoury, France.*)
17,977. Door Locks, G L. Barney and J. L. Clough, London.
17,978. Chlorine Acid Potash, &c., K. J. Bayer, London.
17,979. Trap for Catching Animals, E. H. F. Hemingsley, London.
17,980. File, C. S. Steel, London.
17,981. Game, H. J. Cropper and F. K. Kendall, London.
17,982. Tin Canisters, T. Jenner and H. A. Leverett, London.
17,983. Crushing Ores, C. A. Allison.—(*T. Pilkington, United States.*)
17,984. Lights for Use in Buoys, &c., R. Whitby, London.
17,985. Dress Eyes and Loops, M. F. Kent, London.
17,986. Excavating Tools, J. Macqueen, London.
17,987. Gaseous Fuel Apparatus, S. de la G. Williams, London.
17,988. Cycle Saddles, J. A. and H. A. Lamplugh, London.
17,989. Locks of Triple-action Guns, H. D. A. Laloux, London.
17,990. Outlet Grid for Discharge Pipes, E. Kramer, London.
17,991. Horseshoes, M. Willard and J. F. Leporcq, London.
17,992. Sprocket Chains, C. E. Fanning, London.
17,993. Cycle Saddles, P. Hamonic and P. Pansard, London.
17,994. Smokeless Explosives, H. S. Maxim, London.
17,995. Preventing the Waste of Soap, L. Heymann, London.
17,996. Locomotive Boilers, A. Socher, London.
17,997. Tills, J. C. Cox, London.
17,998. Preventing Water Freezing, W. H. Power, London.
17,999. Reflectors for Sconces, L. Kilner, London.
18,000. Apparatus for Watering Mines, J. M. Greenhow, London.
18,001. Steam Engine Indicators, M. J. Wayne, London.
18,002. Attaching Articles to Chains, C. W. Barrat, London.
18,003. Obtaining Precious Metals, H. L. Sulman, London.
18 004. Horseshoes, J. Bell, Belfast.
18,005. Dampproof Cardboard Soles, J. F. C. Pereira and A. Ribeiro, London.
18,006. Machine for Cutting Metal Bars, D. M. Bull, London.
18,007. Converting Movements, &c., J. A. Wilkin, London.
18,008. Operating Tramway Switches, P. R. J. Willis.—(*C. P. Bachelder, H. E. Watjen, and W. M. Robbins, United States.*)
18,009. Wire Fences, P. R. J. Willis.—(*H. Buck, J. C. Lahman, S. S. Young, L. H. Funk, and C. H. Hawbecker, United States.*)
18,010. Implement for Stoning Fruit, J. Boeri, London.
18,011. Hammers, W. A. Wiley and H. M. Richardson, London.

*22nd September*, 1894.

18,012. Disinfecting Apparatus, F. M. Woolcock, Torquay.
18,013. Pillows for Medicinal Purposes, J. M. Hassall, Liverpool.
18,014. Brandy, Whiskey, &c., F. W. Forbes-Ross, Liverpool.
18,015. Damping Zithers, W. P. Thompson.—(*M. Andorff, Germany.*)
18,016. Felt Hats, R. Stalker, G. Baty, and J. Johnston, Manchester.
18,017. No More Burnt Food, G. C. Waterfield, Aldershot.
18,018. Time-saving Egg Poacher, G. C. Waterfield, Aldershot.
18,019. Automatic Hair Curler, J. Heys, Birmingham.
18,020. Feeding Paper to Printing Machines, J. J. Allen, Halifax.
18,021. Cycles, R. Edgar, Glasgow.
18,022. Generating Steam, G. H. Jones, London.
18,023. Attaching Cuff Links to Cards, T. Morton, Birmingham.
18,024. Woven Diving Belt, W. Terry and F. Rawnsley, Halifax.
18,025. Roller or Rink Skates, W. Heatley, London.
18,026. Manufacture of Mattresses, A. Porritt, Halifax.
18,027. Cycles, S. J. Howells, Essex.
18,028. Cupboard Catches, P. E. Ayton, Birmingham.
18,029. Machines for Fancy Stitching, F. H. Dodson, Birmingham.
18,030. Velocipede Gear Chains, J. Baylis, Birmingham.
18,031. Bi-sulphide of Carbon, G. Millard, Manchester.
18,032. Stop Motions for Spinning Machines, E. and S. Tweedale, and J. Smalley, Manchester.
18,033. Tobacco Pipes, P. C. Jones, Guildford.
18,034. A New Advertising Medium, C. Goater, London.
18,035. Thread-cutting Apparatus, J. A. and T. A. Crawford, Newcastle-on-Tyne.

18,086. Cyclometers, R. O. Brown and C. H. Murray, Newcastle-on-Tyne.
18 037. Closing the Placquet Hole of Ladies' Dresses, E. J. Wildish, Essex.
18,038. Window Opener, L. L. J. Duncan, Lymington.
18,039. Convertible Cot, F. T. Edgecombe, Glasgow.
18,040 Drain Connections, B. R. Phillipson, Dublin.
18,041. Device for Cutting Tubes, F. J. Burrell, Thetford.
18,042. Cycle Saddle Covers, E. K. Mason, Birmingham.
18,043 Lowering Window Sashes, W. Davies, Birmingham.
18,044. Cheques, &c., W Webber, Plymouth.
18,045. Stoves, S. Watkins.—(*E. R Cahoone, United States.*)
18,046. Looms for Weaving Wire Cloth, W. Begg, Glasgow.
18,047. Gasholders, J. Dempster, Manchester.
18,048 Cycle Link Gear, W. Askham and W. Earp, Nottingham.
18,049. Atmospheric Gas Burners, D. McC. Gibb, Glasgow.
18 050. Anti-kicking Strap, T. E P. Gardner, London.
18,051. Pipe Cleaner, W. H. Boyles and A. J. Curnow, London.
18,052. Valve Apparatus for Sewers, T. H. Baker, London
18,053. Drainer for Laundries, W. C. Collins, Birmingham.
18,054 Hot-water Cylinders, A. E. Hodgson, Halifax.
18,055. Fishing Rods, S. Allcock and E Perks, Birmingham.
18 056. Fastening Cravats or Neckties, J. Hey, London
18,057. Arc Lamp Carbon Regulator, L. Zausmer, London.
18,058. Bed-pan, F. J. Mockler, London.
18,059. High-pressure Water Cock, C. Schmidt, London.
18,060. Device for Warming Beds, &c , F. Taylor, London.
18 061. Toy, W Ditchburn, London.
18 062. Ladies' Veiling, A. A Smith, London.
18 063. Belt Pulleys, W. O. Wood and C. Burnett, London.
18 064. Urinals, C. O. Haas, London.
18 055. Turning Over Music Leaves, E. A. Brown, Keighley.
18 066. Postal Letter Cards, &c., W. H. Harris, London.
18,067. Shoe Lace Gripper, J. Dartnall and H. Dartnall, London.
18,068. Cycle Driving Gear, G. F. and J. W. Bint, London.
18 069. Pneumatic Tires, J. L. Wiles, London
18.070. Obtainment of Precious Metals, J. Mactear, London.
18,071. Vice, H. Schwarz. London.
18,072 Washing Dolly Supports, A. S. Anderson and W. Patterson, Newcastle-on-Tyne.
18,073 Paper Fasteners, S. H. Crocker, London.
18,074. Bottle Labelling Machines, W. Fletcher, London.
18,075. Bottle Labelling Machines, W. Fletcher, London.
18,076. Pocket Books and Card Cases, W. Fletcher, London.
18 077. Colouring Matters, F. Anselm and the Clayton Aniline Company, London.
18,078. Gas Enriching Apparatus, P. Dvorkovitz, London.
18,079. Showing the Rate at which a Cycle is Travelling, J. Flynn, London.
18,030. An Improved Toy, W. G. B. Sweet, London.
18,081. Making Gelatine Pearls, &c., H. Nègre, London.
18,082. Pneumatic Valve, J. Winfield and H. Wilkinson, London.
18,083. Stages for Theatrical Performances, I. Kiralfy, London.

*24th September*, 1894.

18,084. Push buttons for Gloves, &c., J. G. Paterson, London.
18,085. Skin Ointment, A. Jamieson, Glasgow.
18,086. Lifts or Hoists, W. Terry and F. Rawnsley, Halifax.
18,087. Lamps for Velocipedes, G. W. Möhrstädt, Birmingham.
18,088. Spring Tire, P. J. Vetter, London.
18,089. Pin for Fastening Dresses, F. H. Weight, Birmingham.
18,099. Cycle Saddles, J. B. Brooks, Birmingham.
18,091. Purifying Coal, R. Clough, M. L. Mulholland, and R. Clough, jun., Stockton-on-Tees.
18,092. Protectors for Water Gauges, A. Dobson, Belfast.
18,093. Circular Saw Benches, T. N. Robinson, Manchester.
18,094. End Rails, W. Whiting and H. B. Tucker, Bath.
18,095. Tug Stops for Harness, W. Crudgington, Birmingham.
18,096. Steam Generators, G. V. Priestley, Leeds.
18,097. Stopper or Presser for Pipes, G. T. Neville, Birmingham.
18,098. Holding Sticks, J. J. Malone and J. N. Greensill, Birmingham.
18.099. Polishing Mops, T. H. Pearce and C. Taylor, Birmingham.
18,100. Casting Cable Chains, J. F. Hall, Sheffield.
18,101. Tire Covers, J. Moseley and B. Blundstone, Manchester.
18,102. Bedsteads, E. Woods, Liverpool.
18,103. Stretching Fabrics, J. Westley and A. J. Cunliffe, Manchester.
18,104. Ball Valves for Cisterns, W. Bevis, London.
18,105. Safety Window, C. Reid, Aberdeen.
18,106. Pocket Knives, O. Olson, Newcastle-on-Tyne.
18,107. Fastener for Railway Rails, W. Nicholson, London.
18,108. Dust Collector, H. Richter, Berlin.
18,109. Webbing for Pneumatic Tires, G. Hiller, Berlin.
18,110. Lawn Mowers, W. H. Luther and J. Cockburn, Glasgow.
18,111. Gang Needle Sewing Machines, L. H. Smith, Glasgow.
18,112. Air Compressors, W. B. Crichton, Bradford.
18,113. Copper Whiskey Measure, H. Rendell, Dublin.
18,114. Wheeled or Roller Skates, C. B. Crisp, London.
18,115 Combined Fireguard and Toaster, G. Brendon, Stratton.
18,116. Clips, H. W. Herbst, London.
18,117. Jointing Soft Metal Pipes, F. Garon, sen., Southend.
18,118. Seamless Steel Tubes, R. Wootton, Birmingham.
18,119. Worms for Conveyor Troughs, T. Taylor, London.
18,120. Oil Lighting, A. J. Riley and L. Whitehead, London.
18,121. Stopping Leaks in Boats, G. A. F. Wilson, London.
18,122. Cycle Driving Gear, P. Malicet and E. Blin, London.
18,123. Gearing for Cycles, A. E. Hodder, London.
18,124. Military Tents and Poles, A. S. Tomkins, London.
18,125. Drying Apparatus for Boots, &c., A. Bodde, London.
18,126. Jointing Stoneware Pipes, &c., J. Hall, London.
18,127. Lighting Household Fires, S. A. Johnson, London.
18,128. Time Register, F. G. M. Wetherfield.—(*C. K. Jardine, British Guiana.*)
18,129. Fastening Lids of Bottles, C. E. H. Greiner, London.
18,130. Rotary Engines, A. F. S. van de Laar, London.
18,131. Making-up Columns of Type, G. Eastwood, London.
18 132. Disintegrator and Pulveriser, S. Croasdell, London.
18,133. Sterilising Milk, E Edwards.—(*R. Lüders, Germany*.)
18,134. Baskets, E. Edwards.—(*E. Roesler, Germany.*)
18,135. Fastenings for Garments, E. Edwards.—(*The Sisters Hoffmann, Germany*.)
18,136. Confining Pens for Poultry, &c , J. M. Robb, London.
18,137. Studs Puzzle, J. B. Young, London.
18,138. Printing Machinery, &c , R. C. Annand, London.
18,139. Connecting Leather, G. F. Redfern.—(*H. C. Gros, Germany.*)
18,140. Toasting Forks, C. W. Durnford, London.
18,141. Address Labels, J. H. Bates, London.
18,142. Obtaining Infusions of Tea, W. Eisenmenger, London.
18,143. Pasteurising Apparatus for Milk, W. Paasch, London.
18,144. Drain Traps and Chambers, G. and F. Couzens, London.
18,145. Incandescent Gas Burners, F. Fischer, London.
18,146. Recovery of Metals from Ores, H. L. Sulman, London.
18,147. Venetian Blinds, M Boate, Liverpool.
18,148. Iron Bedsteads, T. Hilton. Manchester.
18,149. Postal Transmitters, I. Cizek and L. Maizner, London.

*25th September*, 1894.

18 150 Mackintoshes, P. H. Davy, London.
18 151. Extraction of Gold from Ore, F. C. May, London.
18,152 Bicycles, J. Harrison and J. Dodd, Nottingham.
18 153. Electricity Meters. J. Perry, London.
18 154 The Rule of Ten, F. Harrop and W. H. Boyles, London.
18,155. Iron, J. Green, Liverpool.
18,156. Manufacture of Nitro-cellulose, G. H. Hosie, Glasgow.
18 157. Signalling Apparatus, S. D. Williams, Newport, Mon.
18,158 Increasing Speed of Vessels, J. W. Senior, Dublin.
18,159. Machinery Brushing, &c , T. W. Robertson, Belfast.
18,160. Adjusting Seats in Dog-carts, &c., A. J. Pope, Frome.
18.161. Pillow Screen, M. Venning, Liskeard.
18,162 Steering Gear, H. G. Cameron, London.
18,163. Treatment of Furnace Gases, J. Patterson, Glasgow.
18,164. Safes for Preservation of Food, J. Mayer, Manchester.
18,165 Exercisers, A. A. Whitely. Glasgow.
18,166. Shuttle Guards, H. Mason and W. B. Firth, Bradford.
18,167. Peeling Potatoes, W. J. Gradwell, jun., and W. Wakefield, Manchester.
18 168. Checking Runaway Horses, J. P. Ottaway, Bournemouth.
18.169. Tobacco Pipes and Covers, F. O Ferguson, Ilfracombe.
18,170. Transmitting Rotary Motion, F. Westwood, Birmingham.
18,171. Combining Tea and Milk, &c., D. Pearman, London.
18 172. Extraction of Gold by Electrolysis, J. J. Maclean, London.
18,173. Method of Evaporating Liquids, R. Pearson, London.
18,174. Shuttles, I. Rushworth, London.
18,175. Boilers, J. Waite, Liverpool.
18,176. Horse Rugs, G. O. James, London.
18,177. Electrically-actuated Brakes, P. Auguste-Godchaux, Liverpool.
18,178. Window Fastener, A. R. Fairer, London.
18,179. Syphon Flushing Cisterns, W. G. Appleford, Birmingham.
18,180. Ladies' Veils, F. E., G. H., and C. C. Smith, London.
18,181. Shedding Motions of Looms, J. Fairburn, London.
18,182. Envelope, W. A. L. Bailey, London.
18,183. Whim, D. Peper and J. and H. B. Eggers, London.
18,184. Game, R. H. Carrell, London.
18,185. Bungs, L. Wagner and J. Marr, London.
18,186. Pumps, H. Birkbeck.—(*The Mining and Dredging Power Company, United States.*)
18,187. Twin-point Dress Pin or Brooch, R. J. Paul, London.
18,188. Electrical Fittings, E. Hungerbühler and the Electrical Company, London.
18,189. Automatic Money-changing Device, F. J. Johnson, London.
18,190 Photographic Dark Slides, &c , A. K. Page, London.
18,191. Machinery for Varnishing Paper, E. Bush, London.
18,192 Imparting Permanent Scent to Flowers, R. H. Bana, London.
18,193. Collapsible Case, P. Morgan, London.
18,194. Mail-cart, J. Mills, Gloucester.
18 195. Roasting Coffee, F. J. Warner.—(*L. Giacomini, Italy*.)
18,196. Electrical Conductors, Siemens Brothers and Co.—(*Siemens and Halske, Germany.*)
18,197. Perforating Presses, J. A. Allen, H. G. Smith, and E. Llewellin, London.
18,198. Voting Screens, J. A. Allen and H. G. Smith, London.
18,199. Cushions for Billiard Tables, A. C. Ives, London.
18,200. Compass, J. Sandeman, London.
18,201. Internal Combustion Motors, F. O. Prince, London.
18,202. Primary Batteries, H. V. Coad, London.
18,203. Braces for Wearing Apparel, H. C. Vinicombe, London.
18,204. Locking Devices for Valves, &c., W. Jopp, London.
18,205. Automatically Closing Barrier, C. Sevrin, London.
18 206. Utilising Residual Products, W. Walker, jun., and F. R. Wilkins, London.
18,207. Recovering Grease from Suds, A. J. Inston, London.
18,208. Pad for Shoulders of Garments, A. Faivre, London.
18,209. Valves of Pumps, H. E. Newton.—(*C. C. Worthington, United States.*)
18,210. Composition for Roads, &c., G. S. Cory, London.
18,211. Hook for Wearing Apparel, C. A. Bly, Birmingham.
18,212. Treating Heated Metals, G. A. Dick, London.
18,213. Sewing Machines, H. H. Lake.—(*W. M. House, United States.*)
18,214. Drying Substances, H. H. Lake.—(*R. Schicht, Austria.*)
18,215. Signalling Apparatus, H. H. Lake.—(*The Hall Signal Company, United States.*)
18,216. Hooks for Eye-glass Guards, H. A. Deraismes, London.
18,217. Transmitting Telephonic Messages, L. I. Blake, London.
18,218. Printing on Textile Fabrics, J. Bolet, London.
18,219. Propellers, W. E. Sanger, London.
18.220. Ventilating Brick, R. W. Ray, London.
18,221. Thermo-static Lubricator, A. Bergtheil, London.
18,222. Rotary Knife-cleaning Machines, J. W. Sutton, London.
18,223. Stud, M. Veit, London.
18 224. Hair-pin, J. W. Slater, London.
18,225 Dredging Apparatus, H. H. Leigh.—(*The Mining and Dredging Power Company, United States*.)
18,226. Heat Interchanger, W. Garden, London.

*26th September*, 1894.

18,227. Hinged Joint, R. J. Beale, London.
18,228. Radiators for Refrigerating Pipes, L. Sterne, London.
18,229. Tiles, J. N. Peake, Longport.
18,230. Wheel, R. Palmer, Manchester.
18,231. Making Leather Belts, G. E. Stead, Manchester.
18,232 Wheel-cutting Machines, C. and G B. Taylor, Birmingham.
18,233. Pavements, J. T. Pearson, Burnley.
18.234. Moulding India-rubber, H. B. and W. F. Bourne, London.
18.235. Picker for Looms. J. Taylor, Belfast.
18,236. Can Opener, W. E Morgan and G. E. May, Southampton.
18,237. Gas Generator, G. Threlfall and R. J. Hodges, London.
18,238. Balconies of Houses, H. T. G. Wybrow, Birmingham.
18,239. Portiere Rods, J. Harris, Birmingham.
18,240. Vehicles for Perishable Goods, J. E. Callow, Bristol.
18.241. Limestone Furnaces and Kilns, W. Deighton, Knaresborough.
18,242 Cased Tubings, C. Harvey, Birmingham.
18,243. Peptonised Bread, Peptine Maltine, Ld., and G. Bartlett, Leicester.
18,244 Tires for Cycles and Vehicles, W. Stevenson, Nottingham.
18.245 Protecting Watches and Articles, B. Barden, Dublin
18 246. Bosses for Picking Shafts, J. Taylor and B. Kay, Halifax.
18,247. Tubular Steam Generators, W. Scott, Newcastle-on-Tyne.
18.248. Hydrocarbon Oils, C. E. Parker-Rhodes and S. F. St Jermain Steadman, London.
18 249. Washing or Scouring Fabrics, J. Read, London.
18,250. Invoice and Memorandum Forms, R. Raynham, London.
18,251. Sanitary Pipes, W. Ingham and B. Langton, Leeds.
18,252. Frame for Shaving Toilet, T. F. Senior, Sheffield.
18.253. Propelling and Steering Vessels, J. Jopling, Sunderland.
18.254. Mashing and Extracting Machine, T. Cleminson. Liverpool.
18.255. Lavatories or Washhand Basins, J. Craig, Manchester.
18,256. Spun Glass, J. L. Wittwe, Bohemia.
18,257. Cigars, P. C. Sarapata and P. Souvazoglu, Manchester.
18,258. Printing upon Calico, E. Potter and Co., Ld., and J. Barr, Manchester.

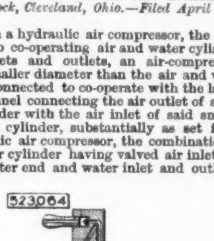
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**523,064.** Compound Hydraulic Air Compressor, *W. A. Babcock, Cleveland, Ohio.—Filed April 26th,* 1893.

*Claim.*—(1) In a hydraulic air compressor, the combination of two co-operating air and water cylinders having air inlets and outlets, an air-compressing cylinder of a smaller diameter than the air and water cylinders and connected to co-operate with the latter, and an air channel connecting the air outlet of an air and water cylinder with the air inlet of said smaller air-compressing cylinder, substantially as set forth. (2) In a hydraulic air compressor, the combination of an air and water cylinder having valved air inlet and outlet at its outer end and water inlet and outlet at its inner end, an air and water cylinder arranged in axial alignment with said other cylinder and having air inlet and outlet at its outer end and water inlet and outlet at its inner end, valve mechanism controlling the water inlets and outlets, an air cylinder of smaller diameter than the two cylinders and arranged in axial alignment with the same, and having valved air inlet and outlet at its outer end, connected pistons in the cylinders, and an air channel connecting the air outlet of the first air and water cylinder to the air inlet of the air cylinder, substantially as set forth.

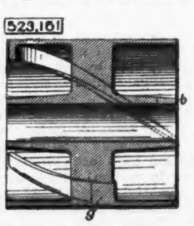
523064



**523,161.** Means for Ventilating Armatures, *T. C. Coykendall, Rondout, N.Y.—Filed October 17th,* 1893.

*Claim.*—(1) The combination with a dynamo-electric machine or motor, of a pulley having a hub *b*, radial arms *g*, air passages between the radial arms, and fan blades mounted upon the pulley between the radial arms, substantially as described. (2) The combination with a dynamo-electric machine or motor, of a pulley carrying fans consisting of blades extending spirally around the axis thereof, having one edge radial to the axis of the pulley shaft and the opposite edge inclined to such radius, the blades having a gradual inclination from the radial edge to the inclined edge, substantially as described.

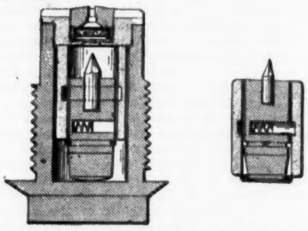
523,161



**523,110.** Percussion Fuse for Projectiles, *W. J. Dungan, Philadelphia, Pa.—Filed April 4th,* 1894.

*Claim.*—(1) The herein-described igniter plunger for percussion fuses for projectiles, consisting of a pointed spindle having an annular groove, in combination with an open ring spring seated in said groove, and a sleeve fitted on said spindle and projecting beyond its point and adapted to dislodge the ring from its seat, when the projectile is fired, as and for the purpose set forth. (2) In a percussion fuse for projectiles a pointed grooved spindle having a radial spring locking bolt, in combination with an open wire ring encircling said spindle and seated in the groove, and a sleeve with an annular interior recess fitted on the spindle in advance of the ring and extending beyond the point of the spindle, as and for the purpose set forth.

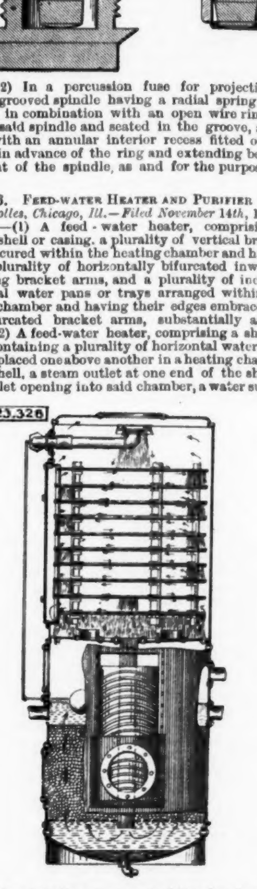
523,110



**523,326.** Feed-water Heater and Purifier *E. G. T. Colles, Chicago, Ill.—Filed November 14th,* 1893.

*Claim.*—(1) A feed-water heater, comprising a vertical shell or casing, a plurality of vertical bracket pieces secured within the heating chamber and having each a plurality of horizontally bifurcated inwardly extending bracket arms, and a plurality of inclined horizontal water pans or trays arranged within the heating chamber and having their edges embraced by the bifurcated bracket arms, substantially as set forth. (2) A feed-water heater, comprising a shell or casing containing a plurality of horizontal water pans or trays placed one above another in a heating chamber in said shell, a steam outlet at one end of the shell, a steam inlet opening into said chamber, a water supply pipe opening into the upper part of the chamber and provided with a discharge, and a downwardly and outwardly flared guard or shield interposed between the steam outlet and the water supply discharge, substantially as set forth. (3) In a feed-water heater and purifier, having a steam inlet and outlet, comprising a shell or casing, a plurality of vertical bracket pieces secured within a heating chamber in said shell, a plurality of water pans arranged within said heating chamber and supported by said bracket pieces, each of said pans being of less diameter than the said chamber, and each pan being cut away marginally to form a discharge opening, all substantially as set forth and described.

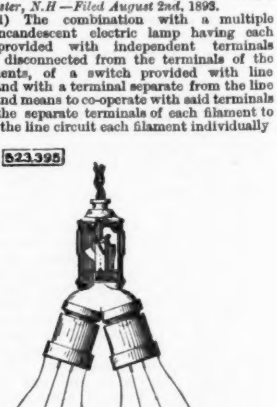
523,326



**523,395.** Multiple Filament Lamp, *A. L. Clough, Manchester, N.H.—Filed August 2nd,* 1893.

*Claim.*—(1) The combination with a multiple filament incandescent electric lamp having each filament provided with independent terminals electrically disconnected from the terminals of the other filaments, of a switch provided with line terminals and with a terminal separate from the line terminals, and means to co-operate with said terminals and with the separate terminals of each filament to connect in the line circuit each filament individually and also the said filaments collectively in series and in multiple, substantially as described. (2) In a multiple filament incandescent electric lamp, the combination with a base provided with a plurality of terminals, and a plurality of filament containing globes or bulbs attached to the said base, and each provided with separate terminals for its filament co-operating with corresponding terminals on the said base, and a single switch connected to the terminals of the said base and constructed to connect the said filaments in circuit in series, and in multiple, and also to connect the terminals of each filament in circuit independent of each other substantially as described.

523,395



## THE ENLARGEMENT OF LIVERPOOL STREET STATION, GREAT EASTERN RAILWAY.

### No. IV.

*Parcels Office.*—It is due to the fact that the terminus of the Great Eastern Railway is on the low level that the "Parcels Office," which we now proceed to describe and illustrate, appears, when viewed from the platforms of the station, to be upstairs, or on the first floor, whereas the entrance to it from Bishopsgate-street is readily effected by means of a pair of inclines, one for ingress and the other for egress, of easy gradient, shown in the "General Plan of Parcels Office" in Fig. 1, at C C, D D, and in elevation in Figs. 4 and 5. There is an incline in Liverpool-street, near its junction with Bishopsgate-street down to the entrance gates of the terminus of the Great Eastern Railway.

*General plan.*—The general plan in Fig. 1 represents, therefore, what may be called the ground floor of the Parcels Office, which consists of a pair of central spans of 30ft. each, a pair of covered approaches also of 30ft., situated on each side of the main portion of the building, and forming a continuation of the inclines from Bishopsgate-street, and a pair of wings or returns of the same span of 30ft. These dimensions are all measured in the direction of the lines of track—that is, in the direction of A A in Fig. 1. At the broad end of the office, the central spans are connected with the foot-bridge over part of the existing station by a fantail-shaped covered gallery. At the junction of the gallery or passage with the bridge at E E, there is another foot-bridge at right angles to the former, shown in section and elevation in Figs. 6 and 7. Longitudinally the bays or spans are situated between the cast iron columns, which form the two central spans, are double and spaced 5ft. apart from centres. These bays vary in width from 42ft. 3½in. to 51ft. 5½in. and 51ft. 11¼in. at the respective ends of the building. The inclined approaches already referred to are carried under arches which pierce the wedge-shaped site of the shops on the level of the street, shown in the Key Plan in our columns for June last, and thus form two gaps or breaks in the long line of shop frontage, above which are the offices of the company, constituting the real façade of the extension in Bishopsgate-street.

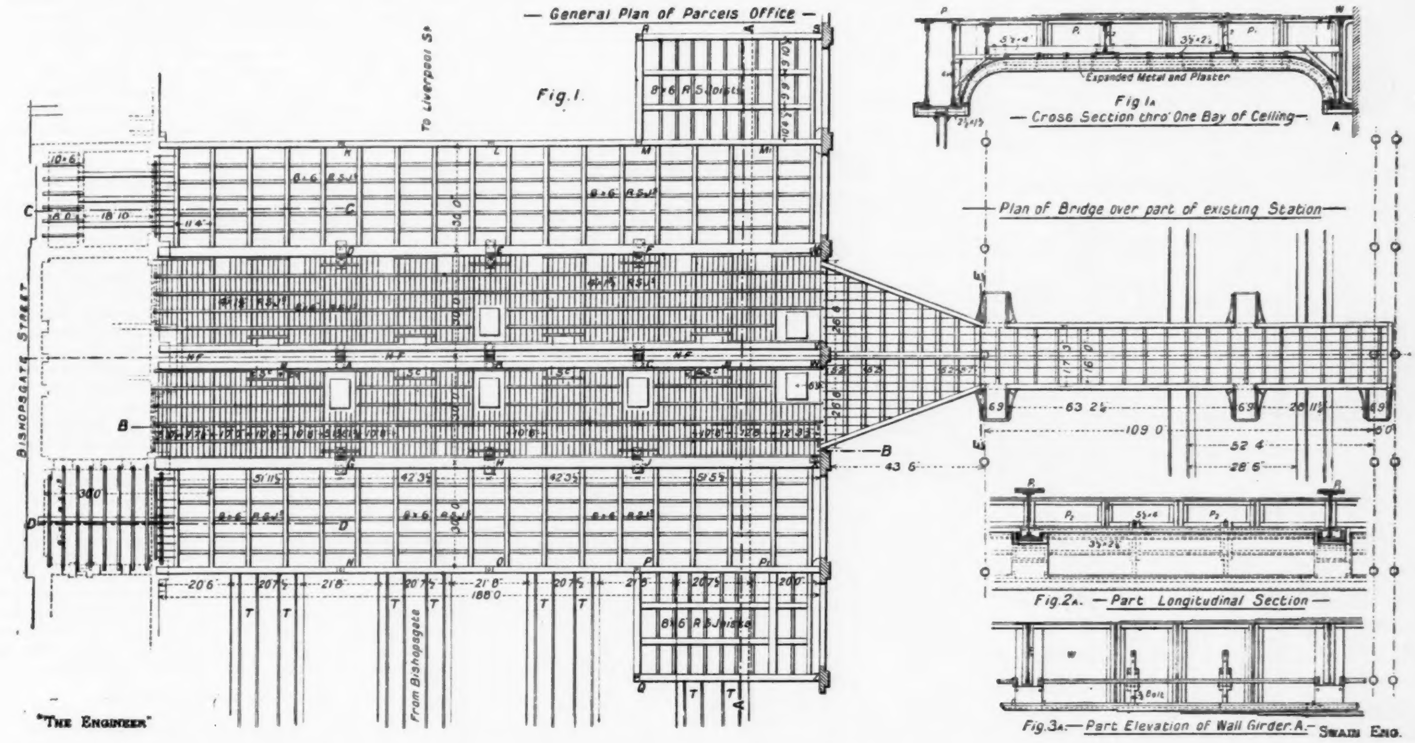


Fig 1A — Cross Section thro' One Bay of Ceiling —

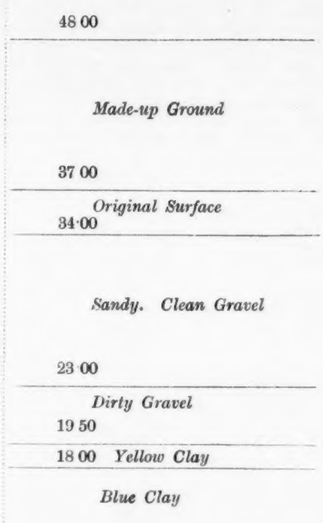
Fig. 2A. — Part Longitudinal Section —

Fig. 3A. — Part Elevation of Wall Girder A. —

*General design.*—From the general plan in Fig. 1, cross-section in Fig. 2, and longitudinal section in Fig. 3, the construction is as follows: Upon cast iron columns, double and single, are carried heavy wrought iron plate girders, unquestionably the best type to adopt for the support of a building, the maximum load upon which in actual practice is almost an unknown quantity, and one in which a very small crack or thread, in any of the arches or walls, might be a very serious matter. Anyone who has designed a warehouse for the storage of grain, especially if kept in a loose condition, that is, in bulk, has a very fair idea of the amount of the weight it is possible to pile up on the floor. Into the longitudinal plate girders are framed the cross girders, also of the plate type. Upon them rest rolled steel joists, 8in. by 5in., and weighing 31 lb. per foot run, and to them are riveted smaller steel joists or trimmers, 4in. by 1¾in., at 8½ lb. to the foot. We may now pass on to the details of the construction.

*Foundations.*—The strata passed through before arriving at the blue clay were composed first of made-up ground consisting of the usual miscellaneous description found under similar circumstances in similar localities, then a layer of earth, or the original surface of the ground. Underneath this there is a stratum of clean gravel, succeeded in downward progression by a bed of a somewhat dirtier description of the same material. A substratum of yellow clay underlies the gravel, and in its turn overlies the blue clay. In Fig. B the approximate respective depths and thicknesses of the different strata are shown, and are readily ascertainable from the levels given at each change in their composition. All the columns and heavier parts of the whole widening of the station were founded at the maximum depth, reaching down to the blue clay; but some of the walls and lighter portions of the buildings found a solid and secure resting place upon the gravel. Had this substratum been of a more rocky or harder character, and had it contained a smaller proportion of sand in it, a less depth might possibly have sufficed for some other parts of the structure.

Fig. B



*Cross section.*—A cross section of the Parcels Office along the line A A—in Fig. 1—is represented in Fig. 2, from which it will be perceived that the building itself consists of the two spans already mentioned, contained within its two side walls, and that both the ground and first-floor are intended to carry loads of the maximum amount. It is no doubt for this reason that the cross plate girders carrying these loads derive no support from—that is, do not rest in any degree upon the side walls, but upon cast iron stanchions, as seen in the cross section in Fig. 2. Above the first floor, where the weights to be provided for are comparatively of a small amount, the floor girders and joists are supported in the usual manner by the walls of the building. Both the side approaches and wings or returns are roofed in and protected by a parapet plate girder, shown at P P, in Figs. 2, 4, and 5. In order to carry the mains of the Gas Lighting and Coke Company across the site of the widening, it was necessary to build a subway for them, shown under one of the approaches in Fig. 2, which ran from the existing station to Bishopsgate-street, at a depth of 6ft. below that of the foundations for the rest of the work. In Fig. 8 is a part longitudinal section of the subway under the track and the platforms respectively, and Figs. 11 and 12 show the corresponding cross sections at A B and C D. In Fig. 12, which is a cross section under the rail level, the arch of the subway, which is 11½in. in thickness, when underneath the platforms, as in Fig. 11, is replaced by rolled joists 1ft. 6in. deep, and small jack arches 9in. in depth of brick, as shown also in Fig. 8. The invert has the same thickness as the arch, and is set on a bed of concrete 2ft. thick and 18ft. wide over all, including the side walls, which are each 3ft. in thickness. A vertical section in Fig. 9 shows the intake or connection between the subway and the gas mains, which are 4ft. in diameter, laid in duplicate, 18in. apart, and connected together as in Figs. 9 and 10. An enlarged plan of the iron grating, 12ft. by 6ft., is shown in Fig. 13.

Fig 8.

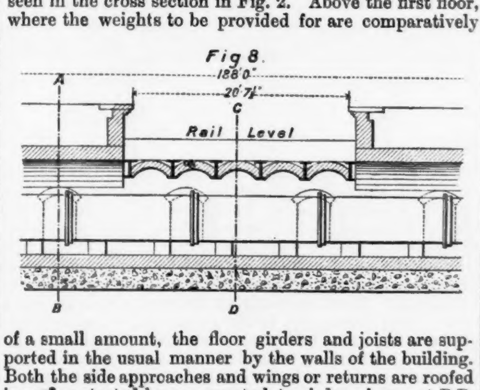
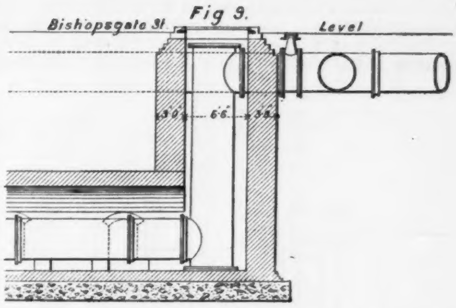


Fig 9.



*Concrete, mortar, and bricks.*—A bed of concrete 10ft. by 10ft. by 2ft., surmounted by four tiers of brick footings, upon which is placed the bedstone 5ft. square and 2ft. thick, forms the foundation for the single columns supporting in Fig. 2 the main girders belonging to the two side approaches and their returns. According to the nature and situation of the work, so does the composition of the concrete slightly vary. In the foundations generally it consists of one

Fig 10.

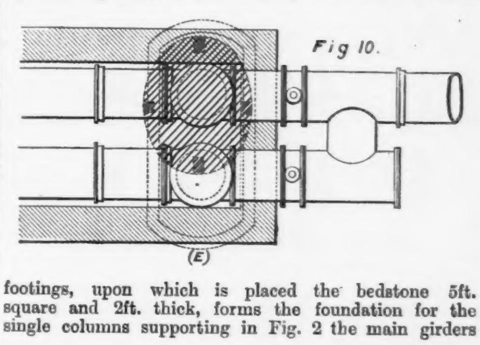
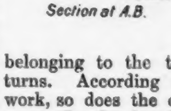
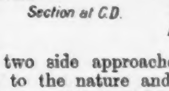


Fig 11.



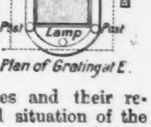
Section at A.B.

Fig 12.



Section at C.D.

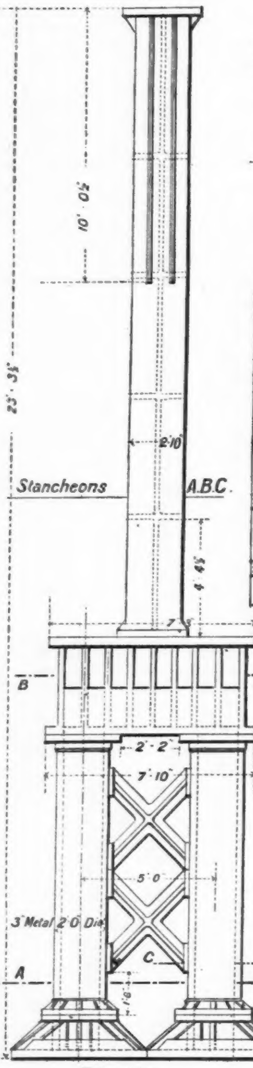
Fig 13.



Plan of Grating at E.

part of Portland cement to six or seven parts of mixed gravel and sand, but in "bad spots" the proportion of cement is increased. Three descriptions of mortar have been used on the works:—(1) Lime mortar composed of one part of blue lias lime and two parts of sharp clean sand. (2) Cement mortar of the same proportions, substituting Portland cement for the blue lias lime. (3) Black mortar in which the ingredients are, one part of sand, one of ashes, and one of lime. This last description of mortar was largely used in the construction of the heavy retaining wall reaching from the station extension to the bridge at Skinner-street, which we shall hereafter describe and illustrate. The wall was built of old bricks obtained from the demolition of houses, walls, sewers, and other ancient structural relics, during the clearing of the site, and the wall was faced with Brindle's bricks, which are of a dark colour. It was also coped with bull-nosed 14in. B B Staffordshire blue bricks, and so the colour of the mortar was made to match. All the bedstones are of the well-known Darley Dale stone.

Fig. 14.



Elevation.
Columns A.B.C.

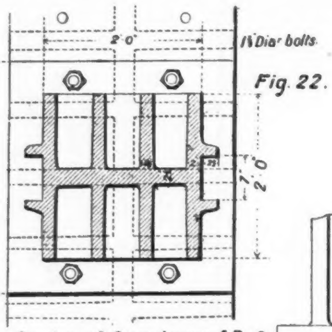


Fig. 22.

Section of Stancheons A.B&C & Part Plan of Top of Table Girder.

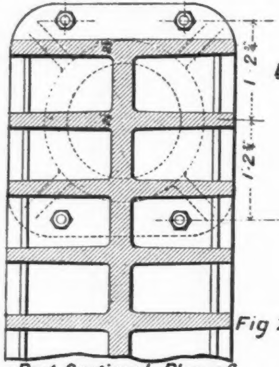


Fig 20.

Part Sectional Plan of Table Girder at B.B.

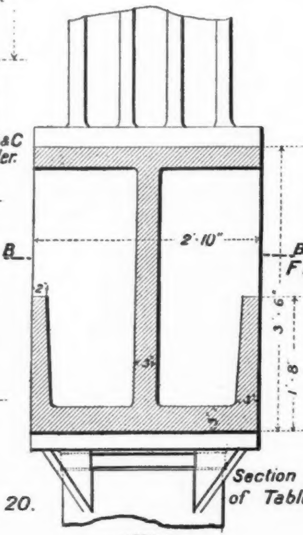


Fig. 21.

Section at Centre of Table Girder.

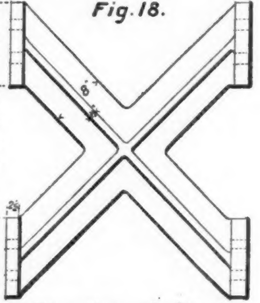


Fig. 18.

Elevation of Struts

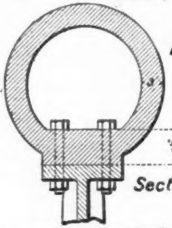


Fig. 19.

Section. at C.C.

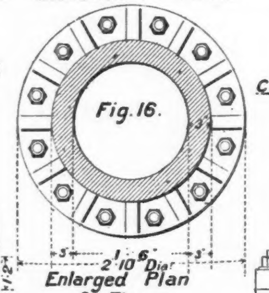


Fig. 16.

Enlarged Plan of Flange.

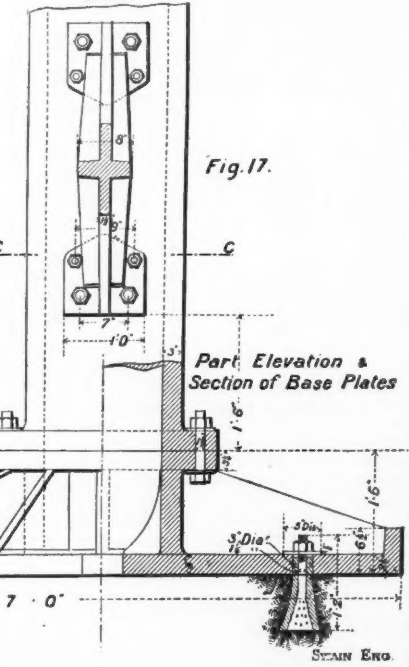


Fig. 17.

Part Elevation & Section of Base Plates

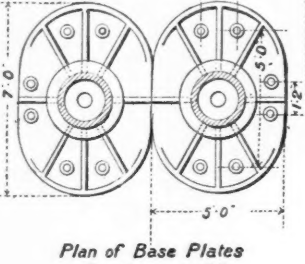


Fig. 15.

Plan of Base Plates Section at A.A.

"The Engineer"

Strain Eng.

*General construction.*—Of these single columns the two exterior of the returns or wings marked C C in Fig. 2 have a diameter of 18in. and a thickness of metal of 1¼in., while those lettered $C_1$ $C_1$ are increased to 2ft. in diameter, as they have a heavier load to carry. A reference to Figs. 2 and 3 will serve to indicate the general construction of the Parcels Office, the first floor of which stands upon twin cast iron columns, and the second floor on vertical centre and side stanchions of a particular section. These double columns rest upon bedstones having a superficial area in feet of 12 by 10 and a thickness of 1ft. 9in. Five footing courses of brickwork, with a total height of 3ft., transfer the weight of the superstructure to a solid mass of concrete 21ft. by 19ft. and 3ft. thick. For the footings in foundations, in the body or the backing of walls, ordinary stock bricks are used, but the description employed for the facing varies in different parts of the works. Thus, the walls of the Parcels Office are faced for a height of about 4ft. 6in. from the level of the side approaches with Staffordshire blue bricks, and above that level with Leicester bricks. Again, the two new side walls of the extension are built of stocks, faced for a height of 7ft. above the level of the platform with Ruabon bricks, and above that with Suffolk bricks. Ruabon bricks are also used for the rounded corners in the general offices fronting Bishopsgate-street. Suffolk bricks form the facing of that portion of the new buildings, relieved by ornamental stone dressings from the quarries of Portland, Monkspark, and Bosgrove. While generally all the work above ground is set in lime mortar, the bedstones are laid in cement, and in all cases where new walls have been joined on to old ones, cement mortar is used to bond them together with.

*Double columns and stanchions.*—An elevation of the double cast iron columns and vertical stanchions running down the centre of the building in Figs. 1, 2, and 3 is represented to a larger scale in Fig. 14. From base to capital the columns, which are 5ft. apart from centre to centre, are 9ft. 11½in. in length, or measured from top of the bedstone, 11ft. 5½in., have an external diameter of 2ft. and a thickness of metal of 3in. At the lower extremity each column is widened out so as to form a flange having a diameter of 2ft., and a thickness of 3¼in., and bolted down to the bed or base plate by twelve bolts spaced 12in. apart and of a diameter of 1⅜in.—Fig. 16. These base plates are of cast iron and oval in shape, with conjugate diameters of 7ft. and 5ft. respectively, as in Fig. 15. In Fig. 17 there is an enlarged plan and section of the base plates, which are 1ft. 6in. in total height, have a thickness of top flange of 3¼in., equal to that of the lower flange of the columns to which they are bolted, a thickness in the body of 3in., while in the lower flange the same dimension tapers from 3in. to 2½in. at the circumference, which has a rib or fillet 6½in. deep throughout. Six lewis bolts —Figs. 15 and 17—1¼in. in diameter and 1ft. 2in. long, hold down the base plate of each column to the concrete foundation, and are screwed home by a nut and washer 5in. in diameter and ⅝in. thick. Cast iron struts of the form and dimensions shown in Figs. 14—19 are used to brace the twin columns together in the figure of a couple of St. Andrew crosses, and are 8in. wide at the centre, 5½in. at the ends, and 1¼in. in uniform thickness. These braces are bolted to the columns by two bolts 1⅜in. in diameter and two of 1in. in diameter, spaced 7in. and 9in. apart, and where the attachment occurs the columns are thickened out from 3in. to 5¼in.—Figs. 17—19. The capitals of the double columns, which have a space of 2ft. 2in. between them, are surmounted and connected by a "table girder" of cast iron 3ft. 6in. in total depth —shown in elevation on Fig. 14, and in plan and section in Figs. 20 and 21. It is 8ft. in total length, 2ft. 10in. in width, and 3in. in thickness in the centre rib or web, and in both the upper and lower flanges, which are of very different forms—Fig. 21. The former is a simple horizontal flange, but the latter is provided with two vertical or side plates, as they would be called in girders of wrought iron, which have a depth of 1ft. 8in. and a thickness of 3in. at their junction with the horizontal portion of the flange, tapering at the open ends to 2in. Four bolts 1½in. in diameter connect the table girder with the capitals of the columns. Upon the vertical stanchions —Fig. 14—23ft. 3½in. in total height, is carried the second floor of the building. They have a plain base and capital, or, rather, an upper and lower flange, measuring 3ft. by 2ft. 10in., by 3½in. in thickness, and are 2ft. in outside dimensions on all four faces, as shown in cross-section in Fig. 22. The principal or centre rib is 2½in. thick, the two interior and two exterior ribs 2in. at the broader end, tapering to 1¾in. at the extremities. For a length of 10ft. of the upper part of the stanchions, two ribs or projecting fillets are cast 2½in. in depth and 7in. apart from inside edges. The stanchions are bolted to the upper flange of the table girder by four bolts 1⅜in. in diameter. It should be mentioned that all the flanges of the cast iron girder work, columns, stanchions, and in every instance in which two separate parts are bolted together, the surfaces are all accurately and truly planed, so as to ensure a uniform and even bearing area. In the erection of large workshops for the numerous branches of mechanical engineering, the advantages of employing twin columns has been long recognised. Strength, compactness, simplicity, durability, large bearing surface, and comparative cheapness, are among their principal characteristics. When several shops are erected parallel to one another, with or without partitions, the double columns can be connected by girders, as in the building under notice, which can further be made to act as rail bearers, or, in fact, as rails themselves, upon which gantries can run to hoist and shift whatever may be required in the shops below. All these operations can be carried on without in any way interfering with the single columns which support the roof principals.

## GERMAN EXHIBITS AT THE ANTWERP INTERNATIONAL EXHIBITION.

(*From our Special Commissioner.*)

Probably the largest makers of wire rope and electric cables on the Continent are Messrs. Felten and Guilleaume, of Mülheim. At Antwerp their exhibit of all classes of wire rope is not only larger than that of any other firm, but is one of the most important installations in the German section. Commencing with various gauges of iron and steel wire, plain and galvanised, they next show different sorts of copper and brass wire, including some specimens of high conductivity for telephones. Besides these, they exhibit two descriptions of a special make of wire. One of them, which they call "compound," consists of a core of steel and an outer covering of copper or brass. By this means a wire is obtained possessing the elasticity and tensile strength of steel with the conductivity of copper. The other special wire is made in the same manner, but of two different classes of bronze. The inner part consists of a wire capable of standing a great breaking strain, and this is covered with a metal of high conductivity. As there is very little difference in the composition of the metal in the two sorts of bronze, they are affected in the same manner by variations of temperature, and the result of this method of manufacture is a wire with qualities possessed by no homogenous wire of any description. The exhibitors say that it is more particularly noticeable for its extreme flexibility. Tests are given of the conductivity, elongation and breaking strain of the copper and brass wire which are exhibited. The breaking strain of the steel wires is also given; one of these, made of crucible steel, is stated to have supported a strain of 185 tons to the square inch. They also show some very fine brass and steel wire looking like silk. This is used chiefly for sewing silk neckties, and for making up fancy work.

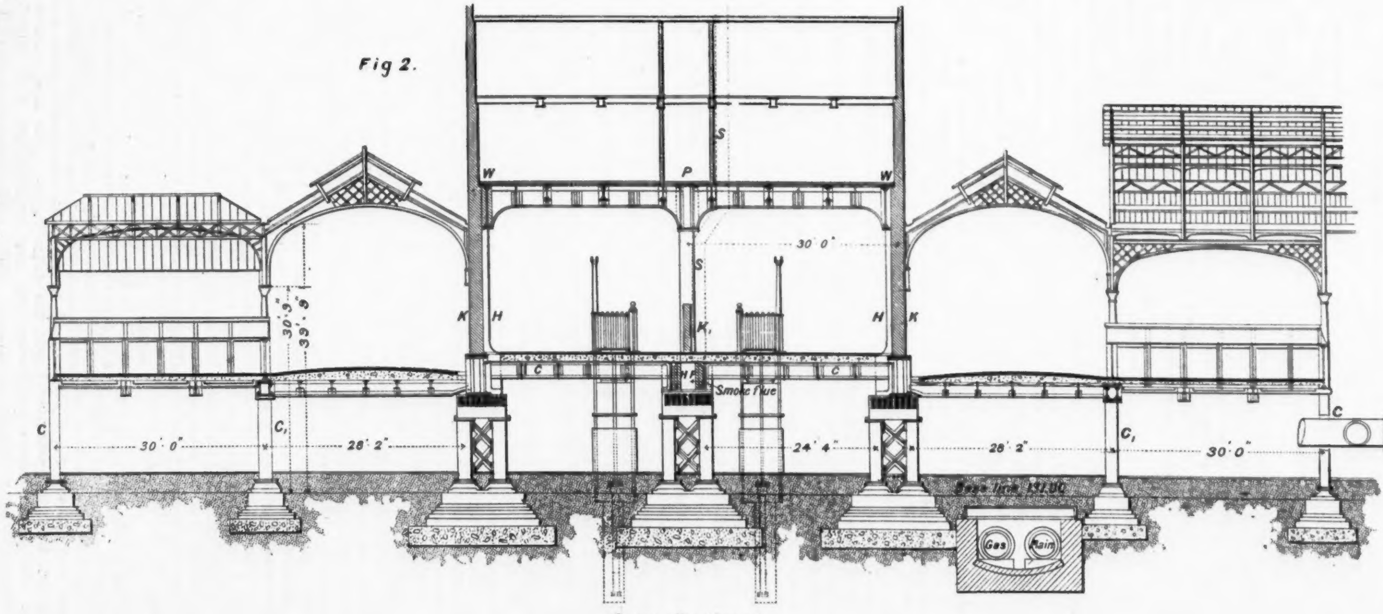
As this firm started the manufacture of galvanised iron wire in 1853, and had then for many years been engaged in making wire rope, they are able—from their own products—to show the changes and developments which

# THE ENLARGEMENT OF LIVERPOOL STREET STATION—PARCELS OFFICE

MR. JOHN WILSON, M. INST. C.E., ENGINEER

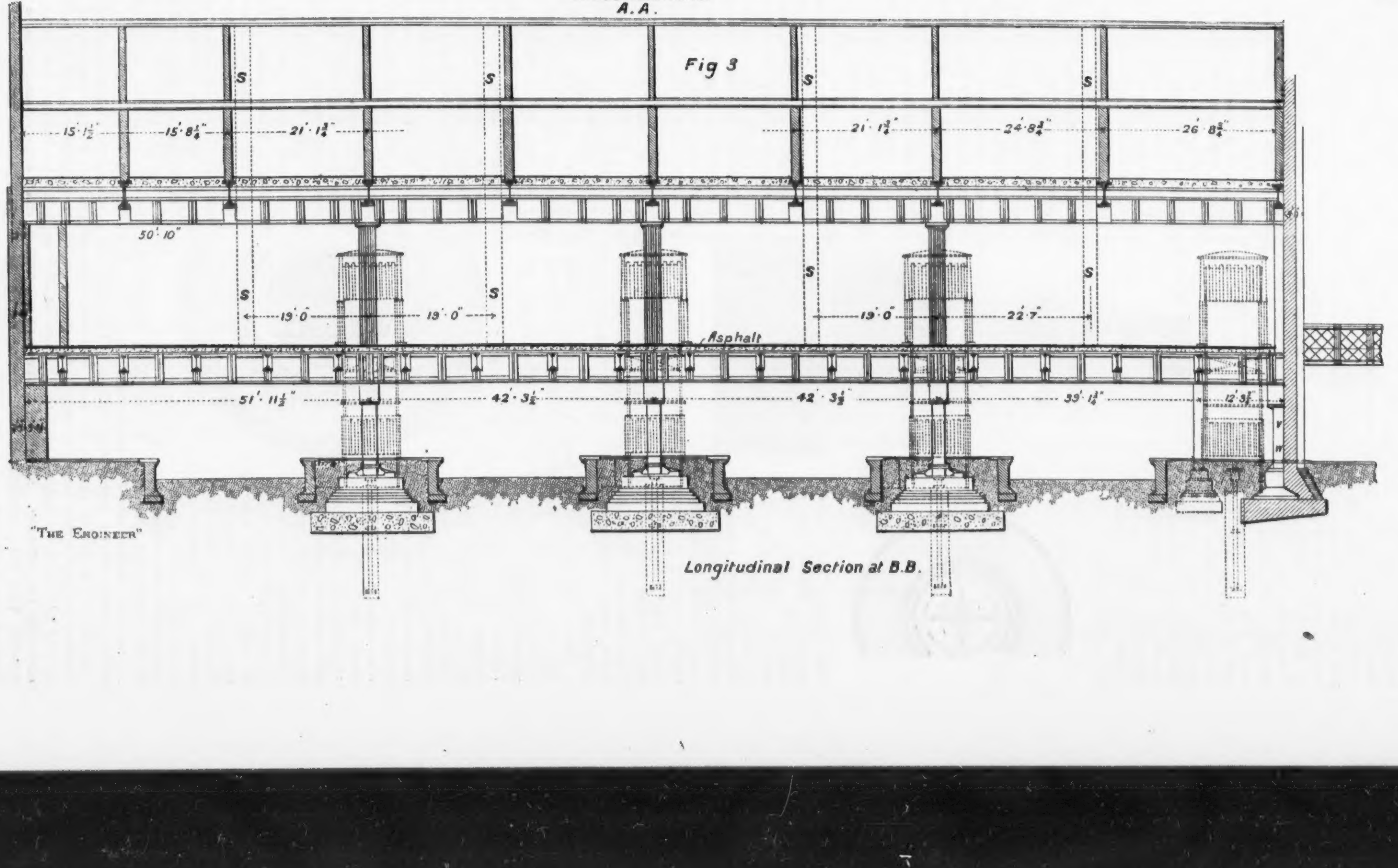
*(For description see page 313)*

Fig 2.


W
P
S
W
30' 0"
30' 9"
39' 9"
K
H
K,
H
K
C
C
Smoke Flue
C
C,
30' 0"
28' 2"
24' 4"
28' 2"
C,
30' 0"
C
Base line 131.00
Gas
Main

Cross Section at A.A.

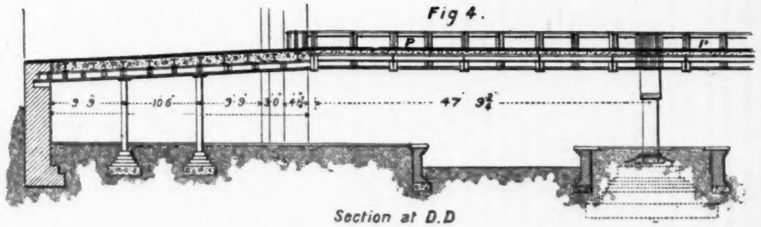
Fig 3


S
S
S
S
15' 1½"
15' 8¼"
21' 1¾"
21' 1¾"
24' 8¾"
26' 8¾"
50' 10"
S
S
S
S
19' 0"
19' 0"
19' 0"
22' 7"
Asphalt
51' 11½"
42' 3½"
42' 3½"
39' 1¾"
12' 3"

"The Engineer"

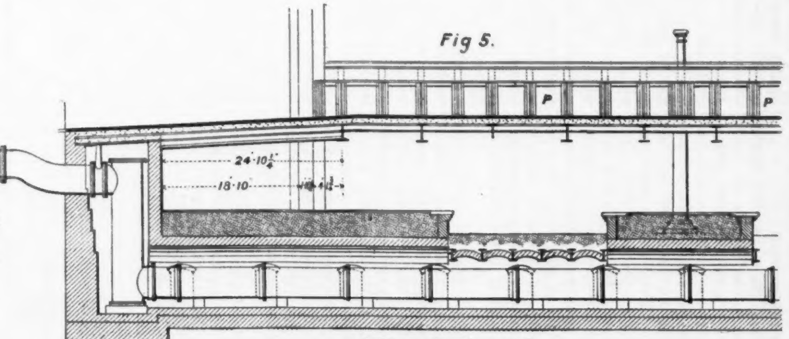
Longitudinal Section at B.B.

Fig 4.


P
P
3' 3"
10' 6"
3' 9"
3' 0"
4' 0½"
47' 9¾"

Section at D.D

Fig 5.


P
P
24' 10½"
18' 10"
18' 4½"

Section C.C.

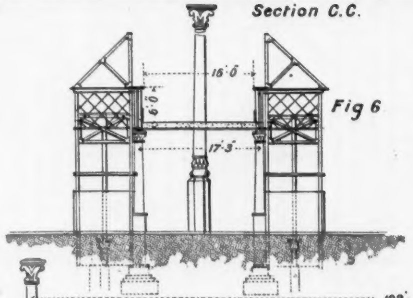
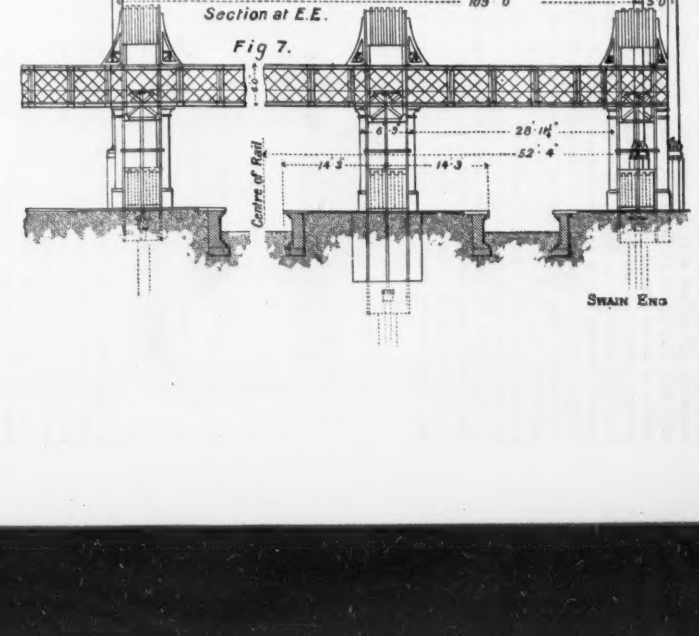


Fig 6

Section at E.E.

Fig 7.


109' 0"
5' 0"
6' 0"
28' 11¾"
6' 3"
52' 4"
14' 3"
14' 3"
Centre of Rail

Swain Eng

have taken place in all classes of wire cables. In those made of galvanised wire for shipping, &c., very thick wire was used in the earlier ones, and gradually finer in cables of more recent date. The same may be said of mining cables, of which—both round and flat—a good historical collection is shown. But the most interesting part of Messrs. Felten and Guilleaume's exhibit consists in their electric appliances. Commencing with single wires coated with india-rubber or gutta-percha, and not otherwise protected, they show how wires have been grouped; how steel wire has succeeded iron for sheathing, and how special preparations of caoutchouc—such as okonite, kerite, &c.—have been introduced as insulators. Their latest improvements consist in insulating by means of prepared paper, and using wire of Z section for sheathing. Fig. 1 shows two wires with a flat strip of paper between them, twisted together and then covered by a band of paper. In Fig. 2 the strip of paper is in the form of a cross; it serves to separate four wires, which are twisted and covered as in Fig. 1. These groups of wire are then made up into a cable, and covered with lead or other protecting material as may be desired. Besides lightness and cheapness, the use of paper has other advantages. The small quantity of air which is necessarily enclosed when the paper is twisted, helps to insulate and increases the conductivity of the wire; and by the use of different coloured paper, it is easier when making joints or repairs to distinguish to which circuit a wire belongs. Telephone cables of this description have recently been put down in Rome, Munich, and St. Petersburg. The Z-shaped wire was first introduced for wire rope tramways, but it is now used for other purposes. Figs. 3 and 4 show a submarine long-distance telephone cable. The group of four wires, insulated by paper, as described above, is enclosed in a leather sheath, and then covered with two layers of gutta-percha. Round this an asphalted ribbon is wound, and then the Z-shaped wire. As in this, each strips interlocks with the next one, an incompressible and impenetrable covering is formed. Finally it is covered with a water-tight composition. When using cables made with this special form of wire for aërial tramways, it will be seen that more than half of the outer covering must be worn away before one strand of the wire can become displaced.

FIG. 1.

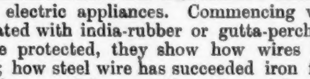


FIG. 2.

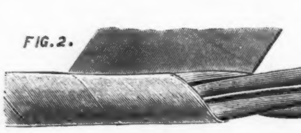


FIG 3

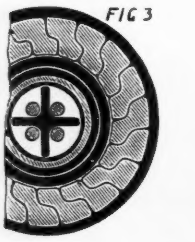
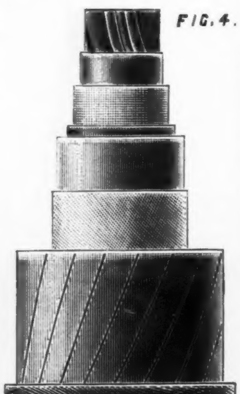
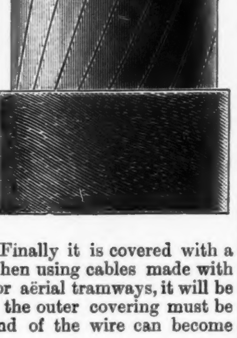


FIG. 4.



One of the latest cables made by this firm is shown on Fig. 5. It is for the telegraph from Goeschenen to Airolo, through the St. Gothard tunnel. It was put in place in October, 1893, to replace one by the same makers laid in 1882. As it has been found in the working of the tunnel that the sulphuretted hydrogen, sulphuric acid and ammonia, contained in the water which exudes from the walls of the tunnel, have affected the rails and sleepers, it was necessary to take special precautions. The cable is formed of seven groups of seven copper wires, each $\frac{1}{36}$in. in diameter, insulated by alternate layers of Chatterton's composition and gutta-percha till the diameter of the conductor was $\frac{1}{4}$in. Round this, impregnated ribbon was wound, and the seven conductors were then coiled, and covered with tarred ribbon. This was surrounded by a double sheath of lead, covered with an insulating composition, on which twenty-five strands of the special wire were wound, dovetailing into one another as shown on the drawing. A layer of a special composition outside this wire completed the cable, which when finished had a diameter of 2$\frac{3}{64}$in. The total length was ten miles, and it was supplied in half-mile sections, each section weighing approximately fifteen tons.

FIG. 5.



Another part of this exhibit consists of junction boxes. Small boxes are shown for the union of two or three cables, with joints made either by interlacing and soldering the wires, or by connecting them with two strips of copper held by set-screws. Besides these, there are two large distribution boxes, one for the three-wire, and the other for the two-wire system. They are in cast iron frames on brick foundations, and are provided with manholes and covers. The three-wire box is divided into eight chambers, for the reception of twenty-four cables, of which three are feeders, and twenty-one distributors.

There are several other exhibits at this stand showing different applications of wire, such as door-mats made of galvanised steel wire rolled spirally, and engine packing, formed of bundles of very fine iron or brass wire plaited together.

Another large German exhibit is that of the Phœnix Company of Laar. This firm show steel tram rails of every section used, as well as angle, T, Z, and many irregular sections of rolled steel. They also have bottles for containing liquid carbonic acid, and other liquefied gases, in all stages of manufacture. One steel bottle, which is intended for liquid hydrogen, is 8in. diameter, 4ft. 7in. long. It holds eight gallons, and has been tested to 4400 lb. on the square inch. Its weight empty, including valve and cover, is about a hundredweight. Besides these, they exhibit wheels, steel shells, and some hardened steel balls for mills.

The Mannesmann Tube Works of Düsseldorf have also a collection of steel bottles for liquid carbonic acid, oxygen, hydrogen, &c. The liquefied gas in these, exerts a pressure of about 1000 lb. to the square inch; but the bottles are all tested to 3700 lb., and are usually capable of standing a pressure of 7400 lb. before bursting. One of these bottles is exhibited which was filled with carbonic acid, and allowed to fall across a steel rail from the height of 23ft.: it is only slightly dented. Another speciality of this firm is the manufacture of drawn steel tube telegraph poles, One of those exhibited is 36ft. long, in one piece. Poles of this description are usually made with several offsets, and taper gradually to a point; for the sake of appearance the offsets are hidden by ornamental cast iron rings. Several special descriptions of steel tubes form part of this exhibit. Amongst them are boiler and refrigerator tubes, hardened tubes for soundings, and polished steel tubes for the frames of bicycles. They also show different sizes of steel shells.

A very fine display of copper pipes, bends, &c., is made by the Elmore's Metal Company, of Cologne. The largest piece is a pipe 17ft. long, 15in. external diameter, $\frac{1}{2}$in. metal. They also show examples of the application of the Elmore process in covering worn iron hydraulic press pistons, pump plungers, and other similar pieces with copper.

German machinery has mostly been kept in its proper place—the Machinery Hall; but there are two exhibits of machinery in the main building worth noticing. The first is that of Messrs Huck and Co., of Bielefeld. They manufacture various descriptions of lifting and traversing jacks, differential and other pulleys. One peculiarity in their lifting jacks is a safety brake, by which the pressure can be taken off immediately, or the object which has been lifted can be lowered at any desired speed. The lifting handle turns a small ratchet wheel on the outside of the machine; this wheel is hollow, and contains a strong spiral spring which presses against its inner circumference, whilst one end of it is solidly fixed to the main shaft. When the handle is turned, the pressure of the spring causes the ratchet wheel to revolve. On ceasing to turn the handle, the pawl prevents the ratchet wheel from going back, whilst the pressure of the spring is enough to keep the shaft from turning. A slight turn of the handle backwards lessens the pressure of the spring sufficiently to allow the weight to descend, but directly the handle is released, the spring tightens and the downward movement is arrested. In another form of jack, there are two tooth-wheels on the same shaft as the pinion which drives the rack. These tooth-wheels are turned by two four-toothed pinions on a counter-shaft, one set at 45 deg. to the other. By this means friction is lessened, the lifting is more regular, and jerks are avoided. The differential blocks shown by Messrs. Huck are powerful for their size. The gearing is of wrought iron, machine finished and case-hardened, and is all boxed in, the chain-wheel only being outside; the casing, however, is made to open for oiling or cleaning.

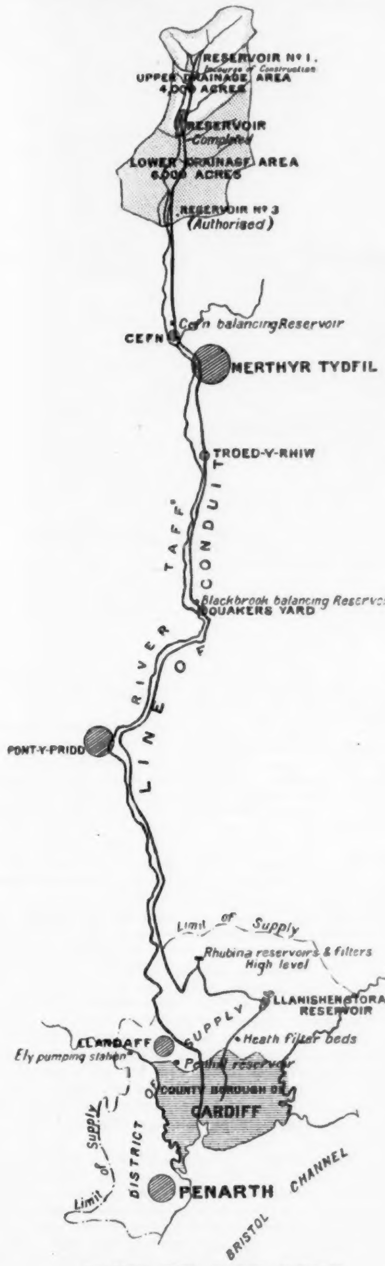
Another useful appliance in this section is a measuring machine exhibited by Mr. J. H. Ermbter, of Neuss. It is intended for measuring and marking all sorts of woven materials, felt, wall-paper, &c. The machine exhibited is constructed for metrical measurements, and will measure up to 1000 metres, showing also $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ metres, or 10, 20, 30, &c., centimetres. It resembles a small winch; the material to be measured is placed on a roll at one side, with one end passing over the main drum of the machine. A printing disc presses on this, and at each revolution stamps the number of metres. The colour, which dries immediately, can easily be removed, and will not injure silks and other thin textures of light shades. When marked, the material is rolled up at the other side of the machine. The marking disc can be put in and out of gear by a lever, or can in a few seconds be set back to recommence at No. 1. The motive power can be hand, foot, or steam. By employing this machine, the output of a cloth or linen factory can be measured by unskilled persons, and without fear of error; and it is especially useful as a check, for instance, in stock-taking.

A clever arrangement of sliding windows is shown by Mr. F. J. Schürmann, of Münster. On the Continent they usually object to sash windows, because they can only be opened half way, and also on account of the extra expense and trouble required for fitting sash lines, pulleys, and balance weights. But door windows have also their inconveniences. When they open inwards, a space must be kept clear for them; and they rarely shut tightly top and bottom. Besides this, they must either be wide open or entirely closed. An ordinary sliding window running in a groove would also have one of these defects; it would never shut tightly. The window exhibited is suspended; each leaf hangs from two pulleys, which run on a rail above. Either iron or wood can be used for the rail, and where there are shutters, as in the one shown, a bar of channel iron serves as a rail for both. Grooves are cut in the rail, and it is bent towards the casement, at the positions which the pulleys will assume, just before the window is closed. This causes the pulleys, and consequently the window, to make a three-fold motion; it drops the depth of the groove, moves laterally, and towards the frame. The edges of window and frame being cut on the level, this triple movement presses the window firmly against the frame, keeping out all rain or draught. When a strip of wood is used for the rail, the pulleys have india-rubber tires, to ensure their running noiselessly. To open the window, it is first lifted by a lever at the side, which moves the pulleys forward out of the groove; and there is then no trouble in sliding it. The exhibitor says that this window can be supplied cheaper than door or sash windows of the same size; and as it is easier to open, heavier glass can be used, thus keeping out the cold better. The same system can, of course, be adapted to warehouse doors, railway carriage windows, and tram car doors. It was originally devised for a wooden summer-house, but where used for a masonry building, a casing is required into which the panels can slide. This makes them more suitable for wooden buildings, such as are used in the United States, than for an average English or German brick-built house; though possibly some people may consider that they offer advantages which more than compensate for the disadvantage of having to provide a receptacle for the window, when open; and there are many buildings, such as stables and stores, where there is no occasion for the glazed panel to be concealed when the window is open.

Switzerland has only one exhibit of interest to engineers. It is an apparatus for the manufacture of condensed milk, shown by Messrs. Sulzer Brothers, of Winterthur, whose exhibits of brewery plant at other exhibitions have several times been described in THE ENGINEER. The milk is first warmed in an open copper pan, and the requisite quantity of sugar is then added to it. The second operation takes place in a closed copper, into which the milk is drawn from the open pan at a temperature of about 120 deg. Fah. by means of a vacuum pump, which exhausts the air in the copper. This vessel is egg-shaped, and the sides are lagged with wood. It is heated by steam passing through two independent copper worms, and also underneath a false bottom. The level of the milk is seen on a gauge glass, and steam is only admitted to those parts which are covered with milk, so as to avoid over-heating and burning. There are also small cocks through which samples may be drawn, as well as thermometers at different levels, pressure gauges, &c. When the milk is sufficiently evaporated, which requires four or five hours, it is drawn out by the vacuum pump and passes to the coolers. These are forty circular vessels 11$\frac{1}{2}$in. diameter, 26in. deep, in a wrought iron tank. Spur wheels at the bottom of the tank cause the milk pans to revolve, whilst fixed rousers —which are let down into them—stir up the contents and keep the milk from becoming lumpy. Water flows through the tank, and when the cooling—which takes about an hour and a-half—is complete, the milk is ready to pack.

## THE CARDIFF NEW WATERWORKS.

THE Cardiff Corporation, after some unfortunate experiences of the private contract system, resolved to take into their own hands the construction of the extensive chain of reservoirs which are now being rapidly proceeded with in the Breconshire mountains some forty miles northward of the town. A brief account of the opening of No. 2 reservoir was published in THE ENGINEER two years ago; but the work then accomplished represented the least difficult part of the undertaking. A recent visit to the scene of operations shows that great progress has been made in the interval with reservoir No. 1, and reveals at the same time a remarkable transformation in the face of the romantic Taff Vawr valley. Whatever differences of opinion there may have been as to the relative merits of the site, only one view now prevails among engineers and all other visitors to the works, and they have come from the United States and many parts of the Continent. The gathering ground dips down from the crest of the Brecon Beacons to a natural basin at the head of the old river channel. The mean rainfall of the watershed is about 60in. per annum, as compared with 61in. at Vyrnwy, the Liverpool works; 62in. in the valley the Birmingham Corporation are at work in; at Thirlmere, 81$\frac{1}{2}$in. in a dry season, 104in. in a wet year; and 53$\frac{1}{2}$in. at Woodhead, until now the main source of the Manchester supply. The capacity of the three reservoirs is:—No. 1, 335 million gallons; No. 2, 322 million gallons, and No. 3, 670 million gallons. No. 1 is expected to be completed in three years, and it is calculated that with No. 2 it will supply the needs of Cardiff, rapidly as the town is increasing, for ten years. But meanwhile the excavation and embanking of the third reservoir will be commenced with more or less rapidity in proportion as the population of the borough approaches the standard of 280,000, the estimated number in fifteen years time. The vast scheme, it should be added, has almost paid its own way, and as the town, and consequently the number of consumers, becomes greater, it will do so to an even greater extent. According to the chairman of the Water Committee—Mr. Alderman David Jones—it was anticipated that the cost of the undertaking would be met by a rate of 2$\frac{1}{2}$d. or 2$\frac{3}{4}$d. in the pound, and although, through unforeseen circumstances, No. 2 reservoir involved a much larger expenditure than was estimated, the rate has not exceeded 3d., which may diminish as time goes on and an advancing community makes greater demands upon the water supply. The most noteworthy features —see map, next page—of the work executed since last autumn, entirely by Corporation employés, under the personal direction of Mr. J. A. B. Williams, C.E., the water engineer, and the author of the whole design, are the main trench and the discharge tunnel. The main trench, undoubtedly the most important achievement so far, runs across the valley 1060ft. in the open, and 1300ft., including the drivings, into the hillsides. The excavation in some places dips to 75ft., and is now finished, with a concrete bed resting on the solid water-tight rock. At its base the embankment is 400ft. wide, narrowing to 30ft. at the top, and the stone toes may also be said to be practically completed. So with the discharge tunnel, an admirable piece of work, which at present is used to carry off flood water, and will ultimately serve its purpose of draining the reservoir, when it is necessary to cleanse the bed. No inconsiderable amount of engineering skill and costly work, not obvious perhaps to those unfamiliar with the scene of old, were involved in the diversion of two highway roads, one to Brecon and the other to Hirwain, in order to raise their level and widen the limits of the lake. The Corporation possess excellent limestone quarries close to the reservoirs, and the stone and gravel for the concrete is obtained from the old bed of the river and crushed on the spot. There is a complete establishment of engine repairing sheds, wagon-making shops, a fitting shop and smithy, and here all that is needed is done for the locomotives, the one hundred odd trucks, the eight portable engines, and sixteen cranes. Besides these are 7½ miles of Corporation railway to the village of Cefn, where many of the workmen live. For the accommodation of the remainder of the men a little township of well-built houses has arisen by the side of No. 1 reservoir, with a large general store, a post-office, a public reading-room, a schoolroom, a chapel, together with a missioner, who acts as schoolmaster on weekdays and a spiritual comforter on Sundays.



CAFDIFF NEW WATER SUPPLY

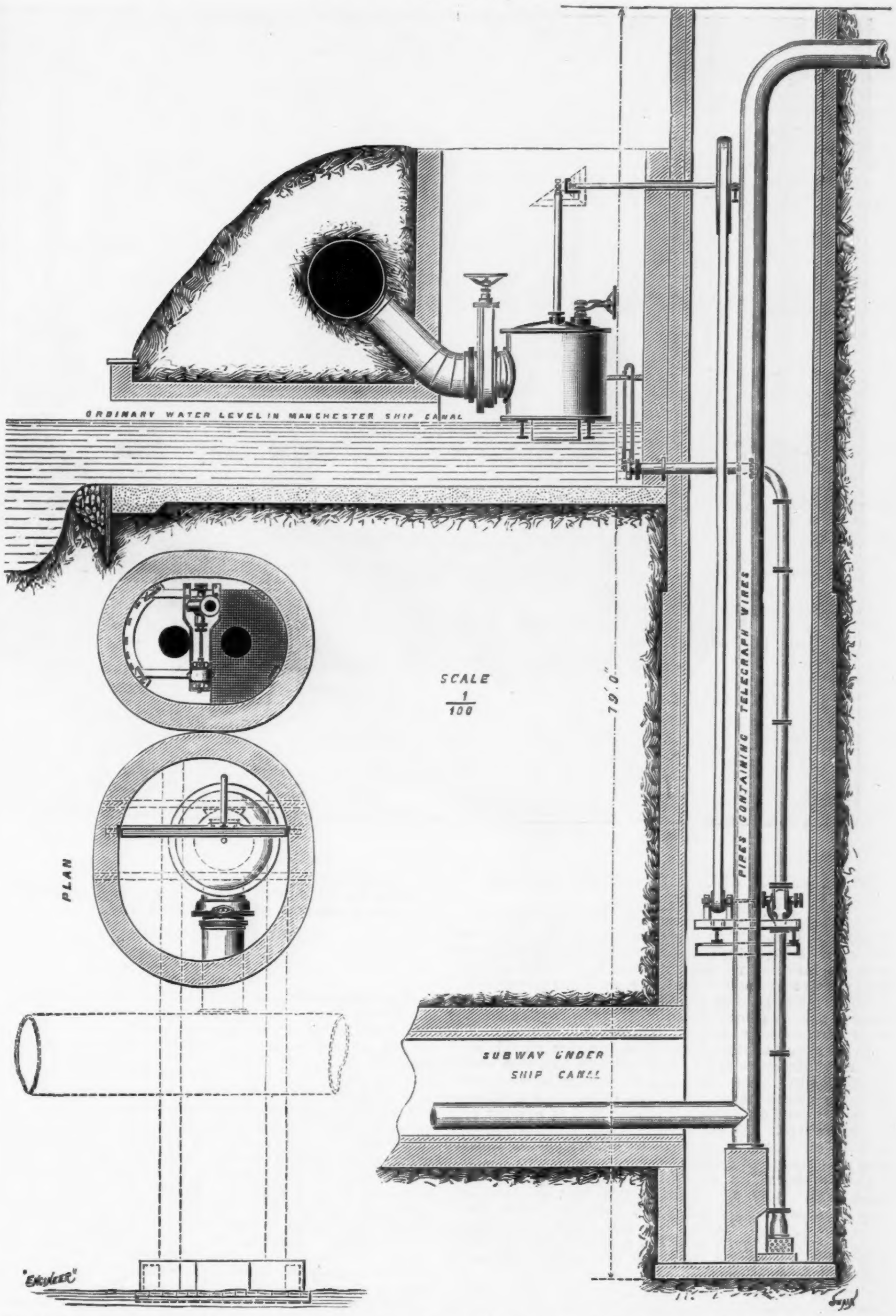
---

## HARBOURS AND WATERWAYS.

*Grand Canal.*—At the half-yearly meeting of this company, held at Dublin, the chairman reported that the net profits for the year amounted to £13,126, which allowed of the payment of a dividend of 3½ per cent. The receipts from the carrying trade showed an increase of £765 over the previous year. During the year the Barrow Canal had been purchased at a cost of £30,000 for the navigation and £2500 for the plant and steamers. It is intended to build ten additional steamers for the Shannon, to accommodate new traffic, and to fit up more barges with steam power. A suggestion was brought forward at the meeting for an extension of the system in order to complete the 750 miles of the canal, which would connect the system with Belfast, Newry, Dublin, Waterford, and Limerick. It was thought that this scheme was beyond the means of the company.

### TURBINE AND PUMP, MANCHESTER SHIP CANAL

MR. C. L HETT, BRIGG, ENGINEER


ORDINARY WATER LEVEL IN MANCHESTER SHIP CANAL
SCALE 1/100
79' 0"
PIPES CONTAINING TELEGRAPH WIRES
PLAN
SUBWAY UNDER SHIP CANAL
"ENGINEER"

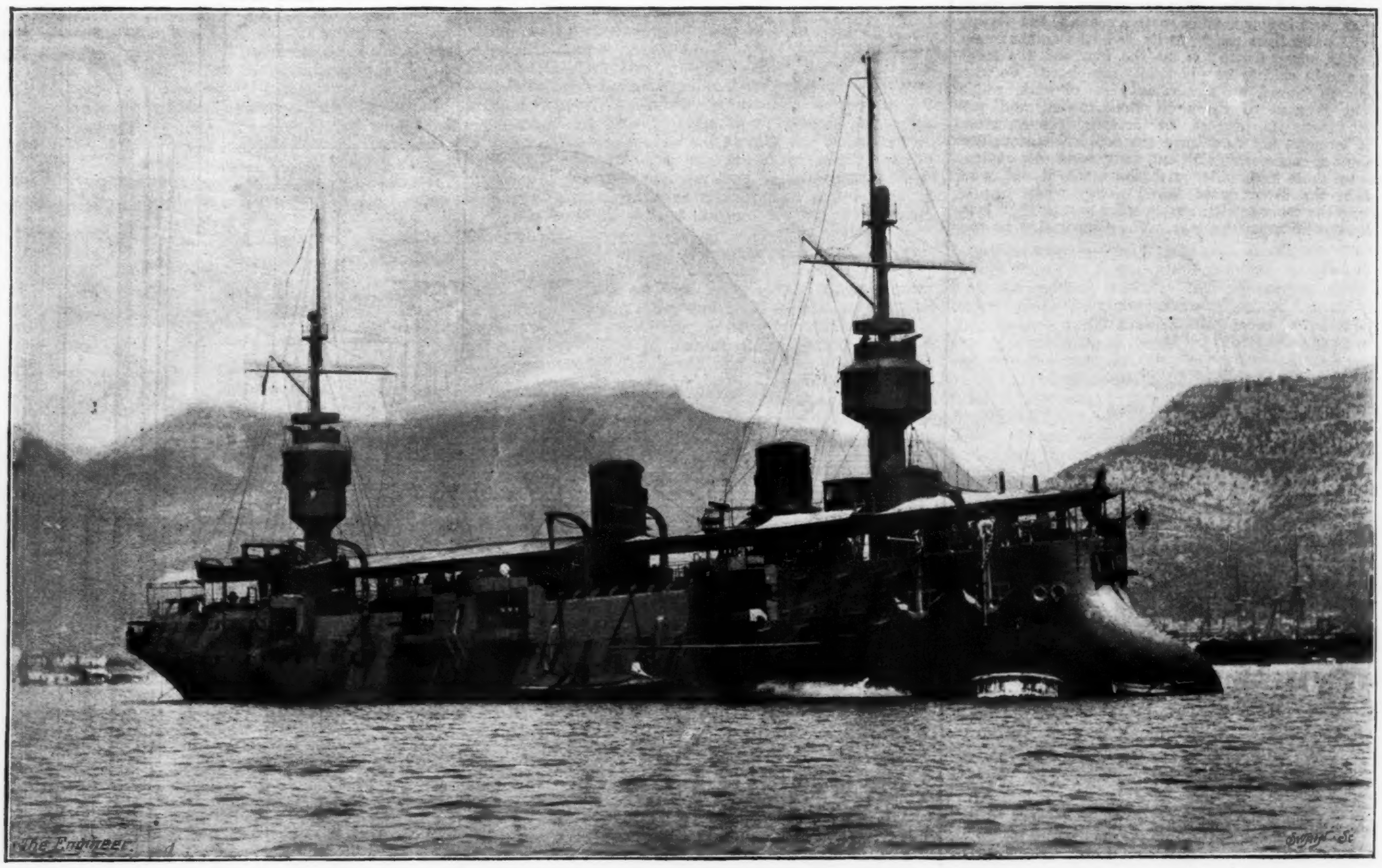
*The Danube.*—Shortly before the close of the last session a report was presented to both Houses of Parliament on the further improvements made in the navigation of the Danube between 1878—1893. The report states that since the final completion of the piers at the Sulina mouth, the depth of 20½ft. has been constantly maintained. At the close of last year it was determined to increase the depth to 23½ft. by constructing parallel dams between the piers to increase the scour and by dredging; a new powerful hopper dredger being now under construction for the purpose. When this increased depth is obtained vessels which at the present time have to complete their cargoes in the roads will be able to carry out their operations in the port of Sulina, and so avoid the delay which occurs when rough weather prevails and prevents the barges lying alongside the vessels. The cutting of a new channel between the eighth and eighteenth miles commenced in 1890, which has suppressed three difficult bends and shortened the course by 4¼ miles, was completed last December at a cost under the original estimate of £152,000. It has now been decided to undertake another cutting 3½ miles long between the thirty-first and thirty-seventh miles above Sulina, for the purpose of doing away with four bends and shortening the course of the river 1⅓ miles, at an estimated cost of £96,000. When the works were first commenced it was intended to secure a depth at low-water of 13ft., and this was attained by training and regulating the channel by groynes. In 1880 a new series of works was commenced with a view of securing 15ft. and removing some of the worst bends. These works were completed in 1889, and the depth of 15ft. was secured, the channel being shortened about two miles. These works were carried out at a cost of £384,000, which was £96,000 below the original estimate, and the advantages secured were very much greater than promised. The works now in hand, it is expected, will give a depth of 20½ft. along the whole of the Sulina branch when the river is at its medium height, and at a season when the shipping is busiest. All the loans effected by the Commission for carrying out the improvements have been paid off, the current income being sufficient to meet the expenses of the works now in hand in addition to the ordinary maintenance. The works have from the commencement been carried out under the direction of Sir Charles Hartley, Mr. Kuhl acting as resident engineer.

---

## MANCHESTER SHIP CANAL.—TURBINE AND PUMP AT TWENTY STEPS BRIDGE.

As promised in our issue of the 3rd of August, we now give an illustration and description of the pumping installation recently put down for the Manchester Ship Canal Company by Mr. Chas. Louis Hett, of the Turbine Foundry, Brigg. The plant is intended to keep the subways—which were made for the purpose of conveying the telegraph and telephone wires under the canal—clear of water, to enable the authorities to inspect the lines at any time. The motive water is obtained from a 48in. main, which connects two streams in the vicinity, from the level of which to the ordinary level of the Ship Canal there is a fall of about 9ft. The turbine is one of Mr. Hett's Hercules type, 60 c.m. diameter, with vertical shaft enclosed in steel case, and fitted with sluice valve for shutting off the water for examination or repairs. The regulating gear of the turbine is mounted on the top of the case. The pump is driven by a belt from the turbine, and is a 6in. Accessible type, designed to lift 600 gallons per minute, with 45ft. lift, at a speed of 1220 revolutions per minute. The presence of the large pipes in the pump well necessitated making a special pump suitable for placing between the pipes, as shown in the illustration. The tail water flows into the Ship Canal through a culvert 3ft. wide, and the pump also discharges into this culvert, the discharge pipe being fitted with a penstock and air pipe to enable the pump to be examined when desirable. On these occasions the water is drawn from the delivery pipe through a cock fitted in the body of the pump. The whole of the work has been carried out under the supervision of the company's engineers, and has been found to fulfil its purpose admirably.

# THE FRENCH CRUISER ALGER



## THE FRENCH CRUISERS ALGER AND ISLY.

The French Minister of Marine has this week ordered the despatch to China of the first-class cruisers Alger and Isly, the latter having actually started on Tuesday, in compliance with the instructions, and the Alger is to follow at once. Both vessels are complete in every respect, but present a very different appearance to that anticipated in their original designs, which was somewhat similar to the Tage—a heavily-masted cruiser, with large sail surface.

An engraving of the Alger, which we give on this page, is equally illustrative of her sister vessel the Isly, both having practically the same class and disposition of armament, almost exactly the same dimensions, and a like arrangement of sponsons and deck plan. The Jean Bart is another ship of similar type. The engraving is taken from a photograph obtained of the Alger, whilst she lay off, completing afloat—as is the custom—at Toulon.

The dimensions, &c., of the Alger are as follows:—Length, 346ft.; beam, 45ft. 3in.; draught, 19ft. 6in.; displacement, 4122 tons; indicated horse-power, 8254; maximum speed, 19·61 knots; coal capacity, 860 tons. The Alger has no vertical armoured protection, but a curved steel armoured deck runs from stem to stern, and this is 3½in. thick—far stouter than as allowed in our cruisers of equivalent displacement, the Astræa type. The armament of the Alger is, moreover, immeasurably more powerful than that of the Fox or Astræa. She carries four 16 cm.—6¼in.—and six 14 cm. —5½in.—quick-firing guns as a main armament, against two 6in. and eight 4·7in. of similar type in the British vessels, and ten smaller quick-firers, with ten machine guns and four torpedo tubes. But what adds very considerably to the effective gun power of the Alger and Isly is the fact that all their eight heavy broadside guns are in protected sponsons, so that an overwhelming end-on power can be obtained when necessary. It has been recently advanced that an effective broadside fire is of greater value than end-on fire, and this must certainly be admitted as regards vessels which are designed for fighting in line of battle, as the effect produced by broadside firing from ships advancing in "line ahead," or "in column," as it would be expressed by landsmen, is absolutely crushing. We assume that the enemy is practically motionless, and "in line abreast." But a cruiser is a free lance, and expected to act, as a general rule, independently, so that her axially directed armament—after her speed—is her great feature.

The Alger and Isly have a high freeboard, in this respect resembling the four large cruisers which are doing such excellent work for the Japanese at this moment, and her coal bunker divisions are so arranged as to add immensely to the security afforded by the armoured deck. The conning towers are thickly armoured, and shelter decks are over all the upper deck gun positions. The fighting masts are of large size, with double staircases, and search lights in the upper tops, as may be seen in the engraving. The Isly attained a speed of 16·8 knots with natural, and 18·1 knots with forced draught, whilst her trials were being made in an exceptionally heavy sea; hence she must be a good seaboat. The Jean Bart has already displayed excellent properties in this respect.

It is clear, then, that France is despatching a very powerful reinforcement to her already strong China squadron, and that if her interests in the East demand such prompt and effective action, Great Britain ought not to be behindhand. The European community in Hong Kong, Shanghai, Hankow, and Tientsin, &c., consists practically of Englishmen, with a few Americans only, except at Tientsin, where they are numerous. The German and French merchants might be counted upon one's fingers. It is, therefore, for us to see whether our naval strength in China is commensurate with our present interests. We do not think it is.

## THE DAIRY SHOW.

The nineteenth annual Show, held under the auspices of the British Dairy Farmers' Association, opened on Tuesday and closed to-day, and amongst the varied and miscellaneous exhibits we noticed as usual various mechanical appliances intended to improve, facilitate, and accelerate the production, treatment, transport, and utilisation of dairy produce. It is not necessary to chronicle the continued appearance of the time-honoured mechanical contrivances of the dairy, but rather to note the direction the mechanical mind has taken in the way of producing novelties for the betterment of the dairy industry during the past year. No great activity has been exhibited during this period in these matters, and what has been done is principally in the improvement of the separation of cream, &c., from milk, centrifugally. The Dairy Supply Co., London, in this direction have made the discs of their "Alpha" separator of a steeper angle, and claim thereby to increase the separating capacity without any increase in the power required for working; whilst to a small pattern of separator, the "Humming Bird," they have applied a strap and ratchet gear, the strap being alternately pulled and allowed to recoil as in some well-known toys, and a thorough separation of cream is rapidly effected with apparently a ridiculously small amount of exertion, the operator casually chatting and answering questions, while the stream of separated milk and cream run regularly from their respective spouts. The Dairy Outfit Co., London, now place within their separator a 1⅛in. thick metal cylinder or drum, for large sizes, made of aluminium. This cylinder is perforated with holes inclining upwards at an angle of 55 deg. in their passage from the outer to the inner surface of cylinder; the stream of milk directed in the usual way, passes up between the periphery of the revolving vessel and the cylinder, the cream passing through the perforations to the inner side of the cylinder, where four wings or blades, provided for the purpose, cause it to pass upwards to be discharged from the cream spout. The use of this honeycombed cylinder is stated to increase the efficiency to such an extent as to permit of seventy-five gallons per hour being separated by means of a small hand machine. This novelty is known as the "Empress" cream separator, and gained a silver medal. These and various modifications in centrifugal testing machines for stimating equality of milk, cream, and butter, are to be seen in number. In the latter graduated tubes containing the milk, cream, or melted butter are attached by their necks to a centrifugal machine, and are whirled round. When the separation is achieved the thickness of the various layers is measured, and the proportion of each constituent is determined. To avoid fracture of these tubes in some cases it is found advantageous to have them immersed in water when whirling. A churn, exhibited by S. Cheeld, of Chesham, consists of an open round vessel—a tub, in fact—which is made to revolve on a table whilst suspended in a socket in a cross piece. Resting on cast iron supports, is an iron rod which can be adjusted to any height and fixed by a screw. This rod at its lower end carries two or more vertical blades extending laterally so as to nearly reach the wall of the revolving vessel. The cream when run in is dashed against these blades, and is rapidly converted into butter or butter-milk. This is called the "E.C. churn." It makes butter with considerable rapidity and with a very small expenditure of power, and for this it gained an award in the butter-making contests. The same maker has also a butter dryer on the same principle, which, by changing the parts, can be readily converted into a testing apparatus.

Messrs. R. A. Lister and Co., of Dursley, Gloucester, exhibit a farmer's separator plant which they call the "Farmer's Rig." It consists of a steam generator, a steam turbine, and an "Alexandra" separator. The steam generator is an elaborated cauldron with fireplace and ash-pit below, and with a wrought iron flue-pipe. The boiler is very small and neatly arranged and the steam turbine makes a very compact arrangement possible. This arrangement is claimed to be more generally applicable than the ordinary arrangements involving the use of an engine, as it of course does away with the accessories inseparable from the establishment and sustaining of an engine, and therefore less space is required, less primary cost, less renewals, and besides no belting; by it, too, 1500 gallons of milk can be separated with the consumption of 28 lb. of coal; and the cauldron can be used for cooking cattle food, the steam for warming the milk as it passes to the separator, and sundry other purposes on a farm. For warming the milk a steam chamber is provided below the feeding cistern. Above this is a false bottom with an opening on the side farthest from the outflow tap; this false bottom rests on metal battens so arranged as to direct the milk over the top of the steam chamber on its way to the tap; hence the milk is only warmed as it flows to the separator, the mass of milk remaining unchanged in temperature, a desirable factor for successful working.

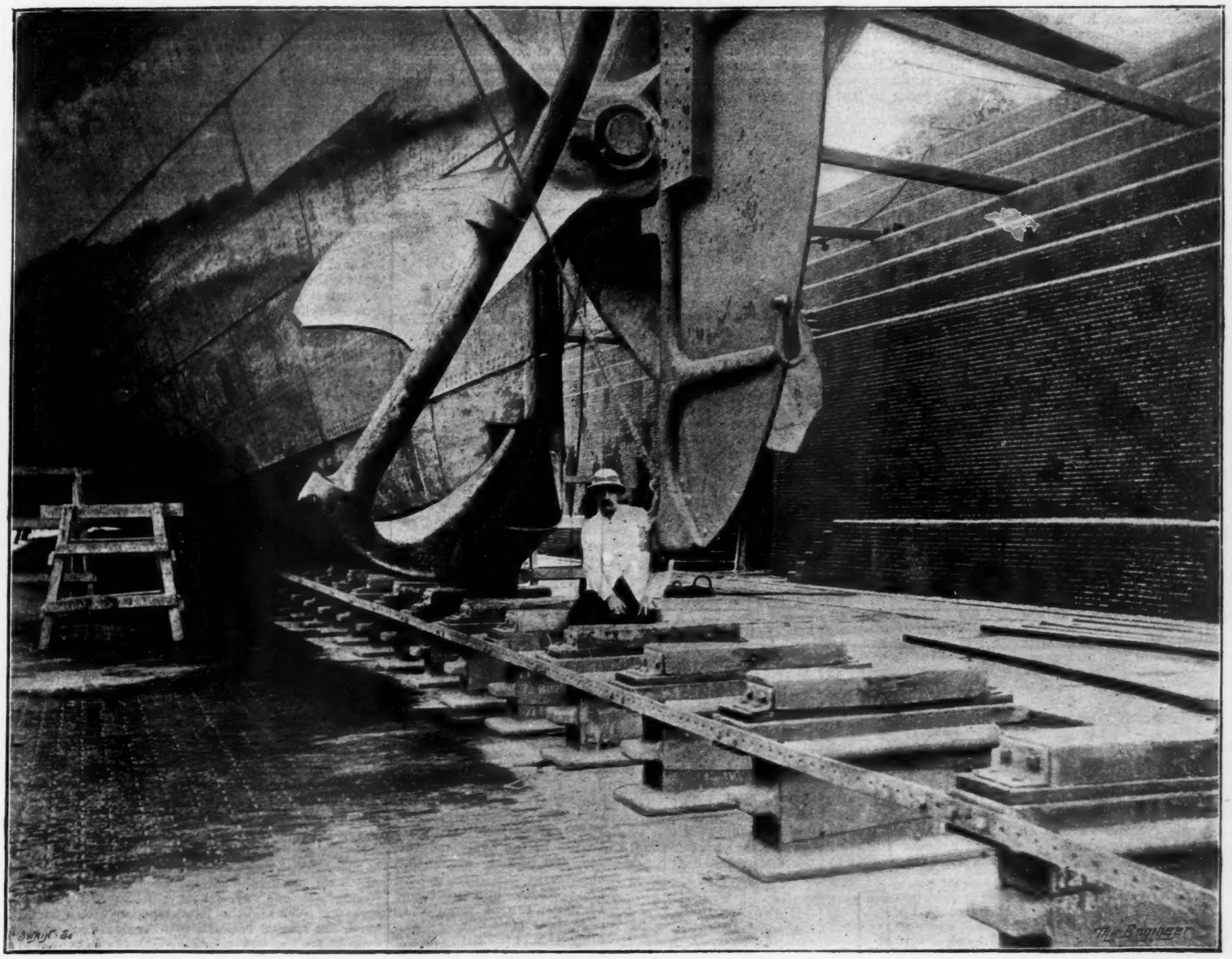
Thomas Bradford and Co., London and Manchester, exhibit a cast iron churn on their fish-back principle. This material was selected to overcome difficulties arising from expansion and contraction of wooden churns in warm climates, and it is stated, and has been verified at the Show, that perfect butter can be made in the cast iron churn, and curiously enough the more rusty the interior of the churn the more satisfactorily does it do its work, provided always that the rust is clean, the product of a good scalding rinse, with boiling water, after churning, with subsequent rusting, until the time for next churning, whether the interval be a day or a week. This exhibit obtained a silver medal.

Messrs. Pond and Son, London, obtained a bronze medal for a refrigerator, which consists of a series of superimposed horizontal tubes, so arranged that the cold water entering at the lowest traverses the whole length of each tube in succession until it leaves the apparatus at the end of the uppermost tube. The milk runs down the outside of these tubes, first encountering the upper ones, finally passing over the lowest and coolest tube before leaving the refrigerator.

There are various vehicles and other appliances that have received awards and attracted some attention, but for reasons already stated do not call for our special notice. The Disc Churn, for instance, is again somewhat prominent; is now mounted differently, and has obtained some successes in the butter-making contests.

We see that steam is making due progress in aiding dairy operations, and we are rather surprised not to see some exhibit illustrating the application of electricity in the dairy, more especially after the recent demonstration witnessed at Mr. James Blyth's dairy at Stansted, Essex. There the cream separator and various butter-making machines are driven by a shunt-wound 1-horse power motor, made by Messrs. F. H. Ruyer and Co., running at 1800 revolutions per minute; it is controlled by a multiple resistance switch. The shafting transmitting the power is coupled direct to the armature of the motor, is 1in. in diameter, and runs near the level of the floor. The power for driving the motor is derived from accumulator, which besides furnish light in various parts of the demesne; the accumulators are charged

# THE BENT STEEL STERN FRAME OF THE S.S. LINLITHGOW



from an Edison-Hopkinson shunt-wound dynamo, driven by one of Marshall's semi-portable compound engines, 12 nominal horse-power. The whole was installed by Messrs. Pritchetts and Gold, of London, and gives great satisfaction. At the time of our visit it certainly was working well, and therefore we are surprised not to see any electrical aids for the dairy at the Show.

## CAST STEEL STERN FRAMES.

The above engraving is from a photograph of the stern of the s.s. Linlithgow, and affords a remarkable illustration of the value of cast steel stern frames. The s.s. Linlithgow, owned by Messrs. Raeburn and Verel, Glasgow, is a vessel of 3137 tons gross tonnage. She was built by Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, and was fitted with a cast steel stern frame made by John Spencer and Sons. The vessel left Messrs. Swan and Hunter's yard in the early part of this year. On her voyage she went ashore at Gocanada, Bay of Bengal, and twisted her stern frame as shown in the photograph, after which she was towed to Calcutta, put into dry dock, and the stern frame was bent back about 8ft. into position, and the vessel is now returning to London with full cargo.

## PROGRESS OF BESSEMER STEEL.

Considering the general position of the trade of the country, it augurs well for the vitality of the Bessemer steel trade that the production during the first half of the current year should be about 3½ per cent. larger than in corresponding period of 1893. It is true the increase is by no means large, but it is decidedly better than the decline that might reasonably have been expected. The 784,712 tons of the closing half of last year have become 810,392 tons, or an augmentation of 25,680 tons. The details given by the British Iron Trade Association in their official report issued a few days back on this subject are, when examined, both instructive and suggestive. In the first place, it is clear that the material is already being used for much more than rails. In 1882 practically the whole of the ingots produced were made into rails, whilst at the present time considerably more than one-half the ingots are rolled or hammered for other purposes. Another point to be observed about the statistics is the small proportion of available steel-producing plant that is being utilised.

Of the 104 Bessemer converters built in the kingdom, only 60 were at work at the end of June. The relative positions of the various districts with regard to ingot productions are as follows:—1, North-East Coast; 2, South Wales; 3, West Cumberland; 4, Sheffield; 5, Lancashire and Cheshire; 6, Staffordshire and Scotland. The proportion of basic to acid ingots in the Bessemer or pneumatic process, which in the first half of 1893 was 127,938 tons to 656,774 tons, has risen in the corresponding period of the present year to the following:—178,736 tons to 631,656 tons. This being so, we should expect that the acid process should be in vogue where good hematite pigs are near at hand, or easily obtainable, than elsewhere, and this is indeed what the statistics show, for Wales has made 181,839 tons; West Cumberland, 158,930 tons; and Lancashire and Cheshire, 104,532 tons—all of acid. The presence of and proximity to good pig iron in the southernmost portions of Yorkshire is also reflected in the 107,214 tons of acid Bessemer steel ingots made in Sheffield and its locality. On the other hand, in the North of Yorkshire, the presence and almost exclusive use of inexpensive phosphoric ores is shown by the North-East production being 129,142 tons of basic steel ingots, against only 73,141 tons of acid.

The Institution of Civil Engineers.—The rebuilding of the Institution of Civil Engineers will not affect the place of meeting, as such arrangements have been made as will allow of the theatre and reception rooms under to be retained for use during the approaching session.

Port Manchester.—The result of a consideration of circulars issued by the Manchester Canal Company urging the advantages of chartering to and from Manchester has been to cause Baltic men, amongst others, to ask sundry questions, some of which are given in *Fair Play* as follows:—What advantage do merchants gain in sending consignments up the canal?—Was not the freight last year $\frac{1}{32}$d. per pound more than to Liverpool, although steamers paid no canal dues? Is not the carriage by rail from Liverpool to Manchester the same as this difference, *i.e.*, $\frac{1}{32}$d. per pound? (It was stated so some months ago.)—Does not an importer prefer to land at Liverpool and have the advantage of the market there if it cost him no more to send his goods on to Manchester eventually?—Does not the spinner prefer to buy in small lots in Liverpool?—What amount of combination is necessary to get such buying altered to induce people to import cotton they cannot see beforehand, and without the choice of an assortment, it may be?—If spinners buy in large bulks, where will they store them?—Can Manchester offer facilities with as low rates of insurance?—It must be remembered that an expensive equipment is necessary for storage warehouses to enable goods to be received in them and delivered out quickly.—What cargoes which usually come in bulk has Manchester a market for? Timber, grain, and cotton, perhaps.—Does she crush seed like Hull, refine sugar like the Clyde, or weave jute like Dundee?—Does she expect that general cargoes will be sent up to the canal and distributed thence when Liverpool has so many lines of steamers, railways, canals, &c., available, and does not need to send consignments for other ports up to Manchester and bring them down again?—As to outward business, has Manchester any bulk cargoes?—How many of coal has she shipped? Can she offer iron in the bottom of vessels loading general cargo, as many other ports do; or are her principal exports light rather than heavy cargo, which ought to go in last rather than first?—These are a sample of questions which Baltic men and others would like to have answered before they can estimate how many steamers can be chartered for Manchester—profitably, of course. The business might be done magnificently, like the Balaclava charge and the making of the Manchester Canal. But will it pay? That is the question.

## WAVERLEY STATION, EDINBURGH.

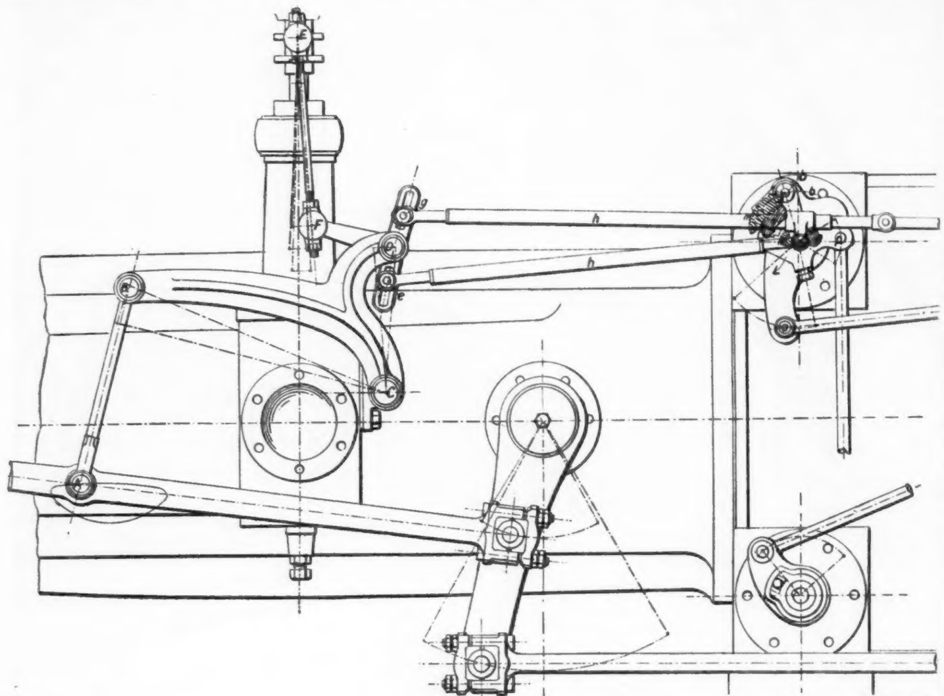
The completion of the tunnels under the Mound, in Edinburgh, which was recently accomplished, is another step towards the much-needed widening of the North British Railway Company's system in traversing the capital of Scotland. The opening of the Tay and Forth Bridges has led to great congestion of the traffic in Edinburgh, and the widening now in active progress is not being carried out a moment too soon. The piercing of the Mound has not been unattended with anxiety, for the material is "made" earth throughout, the Mound being an artificial bank connecting the northern and southern portions of the city, and carrying the valuable buildings of the Scottish Royal Academy, which had necessarily to be guarded from any possible damage from the excavations to be carried out beneath them. The widening has been accomplished by driving a single-line tunnel on each side of the existing double-line. Each new tunnel is lined throughout with cast iron segments having an external diameter of 18ft. 6in. The grouting has been performed with Arden lime, Greathead's patent grouting plant being employed for its injection.

Compressed air has been employed throughout the work, which was commenced in August, 1893. The maximum air pressure attained was 20 lb. per square inch above atmosphere, and the average working pressure may be stated at about 15 lb. per square inch above atmosphere. Thirteen rams of 4in. diameter operated the shield with a pressure ranging about one ton per square inch. Hand pumps were provided for giving pressure. The excavation was carried on in lengths of 4ft. 6in.—the average number of men employed per shift being about twenty. The air-lock, which served both for the passage of men and spoil, was a wrought iron cylinder 12ft. long and 6ft. diameter. The segments were lifted into position by hand, no tackle being employed. Each ring is composed of thirteen segments and a 9in. key piece, the segments being 1ft. 6in. wide, and 7in. deep over the flange. Both back and flanges of the segments are 1¾in. in thickness, and are connected and stiffened by fourteen stout brackets or feathers in each casting. The number of bolt holes in the long and short sides is six and three respectively, and 1⅜in. bolts are employed throughout. The brackets or feathers in the long and short sides are 1⅝in. and 1½in. thick respectively. A special feature to be noted in connection with these tunnels is that the segments are planed on every face, and that no recess is left on the inner edge for filling or packing. On completion the lower portion of the segments of each tunnel are filled with concrete flush to the full depth of the flanges. The faces of the tunnels are elliptical in form to correspond with those of the existing tunnel, and are built of handsome and substantial dressed freestone.

The work has long been looked for with interest by those who travel northward frequently, and especially since the accident which happened near the station about two years ago. It has been carried out by Mr. Geo. Talbot, under instructions from the engineers of the North British Railway Company.

## TRIPLE EXPANSION ENGINE—FRIKART'S SYSTEM.

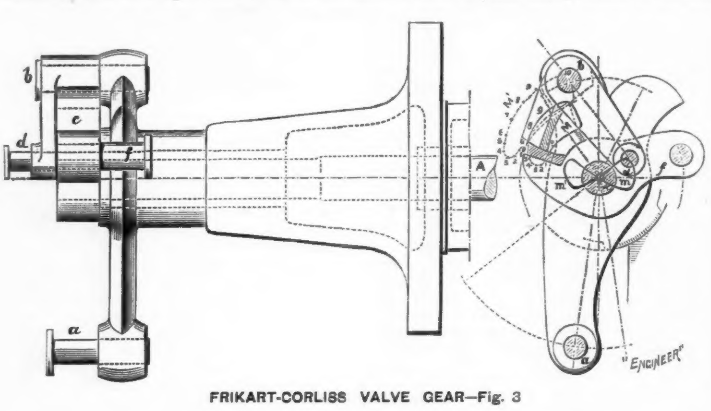
We illustrate on page 322 a triple expansion engine, which is now being shown by Messrs. John Cockerill and Co., at the Antwerp Exhibition. In no country has the rotary valve, which is the main feature of the Corliss system, found more favour than in Belgium. All the large horizontal engines exhibited at Antwerp have valves of the Corliss type, though each manufacturer has a different method for regulating the admission and cut-off which he considers superior to that adopted by rival makers. In Messrs. Cockerill's engines the system used is called the Frikart. They have for some time made single cylinder engines on this principle, and exhibit one of 100 indicated horse-power, with cylinder 1ft. 7¾in. diameter, and 3ft. 5¼in. stroke. This machine is used to drive a dynamo, and works very steadily under a varying load. The application of the Frikart valve to triple expansion engines is quite new, and the one exhibited at Antwerp is the first that has been made. It works at a pressure of 150 lb., and its principal dimensions are:—Diameter of high-pressure cylinder, 1ft. 3¾in.; intermediate, 1ft. 11⅝in.; and low-pressure, 3ft. 1⅜in. The length of stroke is 3ft. 11¼in., and the number of revolutions is eighty.



"The Engineer" Swain Eng

THE FRIKART-CORLISS VALVE GEAR—Fig. 2

The chief characteristic of the Frikart valve is that by it any degree of cut-off from 0 to 75 per cent., or even more if necessary, can be obtained with a single excentric, as the governor completely controls the admission. It is of the highest importance to be able to prolong the admission, as by this means the power of the machine to deal with extreme cases is greatly augmented. For instance, it may be required to exert increased power; or the pressure in the boiler may fall, either accidentally or because the fires are being allowed to burn down before stopping the works. If, as in many machines when the admission of steam extends over more than four-tenths of the stroke, the cut-off only takes place towards the end, this sudden increase in the admission will necessarily make a considerable, and possibly prejudicial, change in the speed. An arrangement by which the admission can be regulated so as to take place through any proportion of the entire length of the stroke, is especially advantageous for compound and triple expansion engines, where there may be a large amount of steam admitted into each cylinder.



FRIKART-CORLISS VALVE GEAR—Fig. 3

In the illustrations, Figs. 2, 3, and 4 show different parts of the back admission valve gear. The piston being at the back dead-point, the cast iron cut-off lever $a\ b$ is in the position shown. This lever works freely on the axle of the admission valve, and carries the part of the trip gear which the makers call the "active." This is in steel, and consists of a finger $b\ c$ and a lever $b\ d$. The "passive" part consists of a lever L, keyed to the end of the valve axle, and connected by a jointed rod to the piston of a dash-pot. The finger $b\ c$ has a tempered steel trigger $c$, bearing on the trigger-plate $k$—also in tempered steel—of the lever L; the piston being always supposed at the back dead-point.

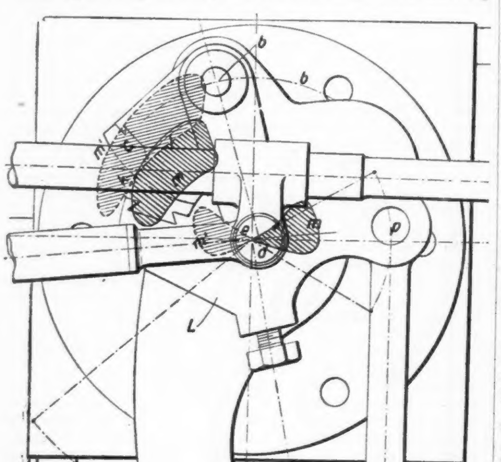


Fig. 4—ENLARGED VIEW OF PART OF Fig. 2

In this position the edges of the back admission valve, and of the orifice, are just touching. The radius to which the trigger-plate $k$ is curved, being equal to the length of the finger $b\ c$, the lead is constant. On leaving the described position, the admission valve will commence to open, and the orifice will be more and more uncovered. But the finger $c$ moves with the small lever $b\ d$; and during the oscillation of the point $b$, the point $d$, which is connected by levers with the excentric rod, will move also, and will follow the curve $m$; consequently the edge of the trigger $c$ will describe the curve M. If therefore from the centre O we strike an arc, passing through the edge of the trigger-plate $k$, the point where this arc cuts the curve M will be that at which the release takes place. At this moment the air piston, connected with the valve gear at the point $p$, brings the whole apparatus back immediately into its original position.

The points 0 to 19 on the curves $m$ and M, and on the arcs $a$ and $b$, correspond to a complete revolution of the crank-shaft; so that it will be seen that in its present position the release takes place at about 0 70 of the back stroke of the piston.

The manner in which the action of the excentric rod causes the point $d$ to describe the curve $m$ is as follows:—The point A of the excentric rod describes a sort of ellipse; its vertical movement is transmitted to the regulating lever B C D, oscillating at C; at the point D is connected a lever with three arms $e\ f\ g$, of which the arm $f$ is joined by a small connecting-rod to the sleeve of the governor. Let us suppose for a moment that this sleeve is fixed, and in its lowest position; the point $f$ will then describe a small arc round it, and the two extremities $e$ and $g$ will move in the same manner as the point D. It is this horizontal movement which, transmitted to the points $d$ by the rods $h\ h$, and combined with the circular movement round the pivot $b$, causes the curve $m$ to be described.

If the sleeve of the governor be raised to its highest position, the point $f$ will be raised also, and the points $e$ and $g$ will undergo a corresponding angular movement round D, whilst continuing to follow the horizontal movements of the same point, the consequence being that the point $d$ will now describe the dotted curve $m^1$, and the edge of the finger $c$ will describe the dotted curve $M^1$. The point 10 of this latter curve is exactly at the extremity of the trigger plate. The trip would therefore take place at the dead point.

For an intermediate position of the sleeve, the point $d$ will describe an intermediate curve between $m$ and $m^1$, and the finger $c$ will describe a curve between M and $M^1$; and thus, by the action of the governor, the admission will vary from 0 to 0·70. The admission of steam to the low-pressure cylinder is fixed and regulated by hand; the cut-off of the low-pressure is therefore constant.

Fig. 1 is from a photograph showing the high-pressure and intermediate cylinders, which are arranged as in a tandem engine. The low-pressure cylinder drives a crank on the opposite side of the fly-wheel from the other two. The condenser and air pump are behind the low-pressure cylinder, and in a line with it. All three cylinders are steam-jacketed; the steam for the jacket of the high-pressure cylinder is direct from the boiler, that for the intermediate from the reservoir or steam chest between it and the high-pressure, and that for the low-pressure cylinder from the other reservoir between the intermediate and low-pressure cylinders. These two steam reservoirs are under the floor, and the water which condenses in the jackets is drawn off by three separate pumps, and returned to the boiler. The engine has been designed for an effective horse-power of 600.

## THE "SIMPLEX" EMERGENCY GRIP, FOR CRANES AND WINCHES.

The engravings below illustrate a new form of self-sustaining device for application to cranes and winches to prevent the too-common accidents with the handles of these machines, or the unintentional and accidental running-down of the load. Fig. 2 of the engravings shows the grip as applied to a derrick or slate-quarry crane; and Fig. 1 shows the details of the grip. Upon the first motion spindle of the winch is fixed a friction wheel, into which gears an excentric friction roller or cam, carried by the handle shown in Fig. 1. The roller thus forms an excentric circular wedge, which will permit the friction wheel on the first motion shaft to run freely one way, but jams or fixes it in the other. The excentric roller and the lever, together with a friction clutch band, are carried between two cheeks, which are kept in a definite position by two links, which connect them to a cross-bar of the frame of the crane or winch. A—Fig. 1—is a cast iron sheave turned with friction grooves on the periphery. This is fixed to the first-motion or handle shaft, and into this friction sheave works the cam-shaped part of the friction lever H, which is held in position by side plates, see Fig. 2. By lifting the handle, the cam is taken out of gear, and the friction clutch band may be used for lowering the load. The "Simplex" grip is readily applied to existing winches, and is made, under the patent of Messrs. Beckett and Roberts, by Messrs. De Winton and Co., of the Union Ironworks, Carnarvon.

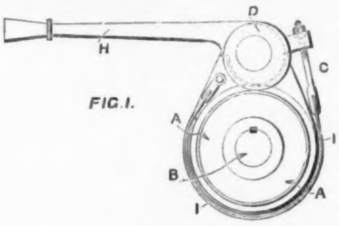
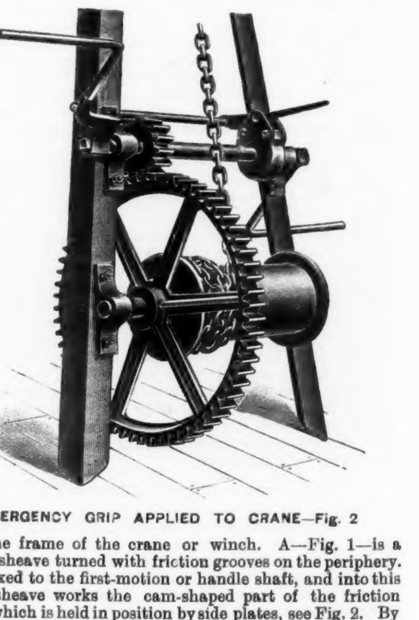


FIG. 1.



EMERGENCY GRIP APPLIED TO CRANE—Fig. 2

---

The Incorporated Association of Municipal and County Engineers.—The eighteenth voluntary pass examination of candidates for the offices of municipal engineer and surveyor to Local Board carried out by this Association was held at the Council House, Birmingham, on Friday and Saturday, the 5th and 6th of October. Eighteen candidates presented themselves for examination, the written portion of which was taken on the first day. The greater part of the second day was occupied with the *vivâ voce* portion of the examination. The examiners were:—(1) Engineering as applied to Municipal Work, Edward Pritchard, M. Inst. C.E., of Birmingham and London, past president. (2) Building Construction, W. George Laws, M. Inst. C.E., City Engineer, Newcastle-on-Tyne, past president. (3) Sanitary Science, A. M. Fowler. M. Inst. C.E., of Manchester, President. (4) Public Health Law, Joseph Lobley, M. Inst. C.E., Borough Engineer, Hanley, past president. The next examination will be held in London in April, 1895.

## RAILWAY MATTERS.

Railway construction in China is entirely suspended.

It is proposed to construct a new line of railway between Windsor and Henley.

The Philadelphia postal authorities are considering the question of operating postal cars on the electric railway lines in that city.

All of the bridges which were destroyed during the forest fires in Northern Wisconsin and Minnesota have been rebuilt, and traffic has been resumed on all the roads.

It has been decided to use petroleum as locomotive fuel on the Baltic railroad, which is significant, because this line is almost the most distant of any in Russia from the oil wells. Great reservoirs are to be built in St. Petersburg and Reval and three other stations, which will hold in the aggregate about 5,000,000 gallons.

The railway recently opened at Kiew, in Russia, is the first electric railway that has been constructed in that country. It is about two miles long, with grades as high as 9 per cent. The generators, which are two 30-kilowatt machines, are of German make, and are driven by Otto gas engines of 60-horse power. The track is laid with stringer rails.

Three new mogul locomotives for the Erie and Wyoming Valley Railroad, with 56in. drivers, weighing about 56½ tons, have recently been delivered from the Baldwin Locomotive works. They have three 17in. by 24in. cylinders, set on an incline, so as to allow the middle one to drive the main axle just inside the right driver, all being connected at 120 deg., to give continuous effort on account of the heavy grades on the road.

The Melbourne Tramways Company has been experimenting with tar as fuel. The tar is kept in a liquid condition by means of exhaust steam pipes, which are coiled in the tanks, and is pumped to the feed tanks, which are situated above the boilers. It is led from the tanks through a large strainer, before it is delivered to the furnaces through a 2in. pipe. The tar is mixed in the burner with steam, and both tar and steam pipes are provided with flexible joints at the furnace door-plate, so that they can be easily swung back as the furnace door is opened.

The official statistics of the working of French tramways in 1893 give particulars of the operations of light railways and tramways worked either by steam, electricity, or animal power. Of light railways guaranteed by the State there are 645 kiloms. in operation. The light railways not guaranteed by the State comprise 288 kiloms. of line. Of tramways proper there are 100 kiloms. worked by steam, electricity, compressed air, or cable, and constructed at an aggregate cost of 16,469,500f. Tramways worked by horses represent a length of 635 kiloms.

In a recent number of the *Revue Générale des Chemins de Fer*, the results of a number of tests to determine the steam consumption of locomotives per indicated horse-power per hour are given by M. Desdouits. In five trips the speed averaged from 37·2 to 40 3 miles per hour, and the average consumption of water 25 61 lb. per indicated horse-power per hour. M. Desdouits believes his experiments warrant him in concluding that in simple engines the best results are obtained with a working pressure of about 142 lb., with a cut-off at one-fifth the stroke, and with the valve given inside clearance.

Information from an American source reaches us of a novel method of removing rusty bolts from locomotive frames, viz., by gun fire. A special gun was made from an old crank pin 10in. long and 5in. diameter, bored with a 2in. hole about 8in. deep. The gun stood on the lower bar of the frame, being blocked up to bring it near enough to the bolt which was to be fired out. About 4in. from the muzzle, a ¼in. vent hole was bored to relieve the internal pressure when the projectile, which was in the form of a ram 8in. long, turned to an easy working fit in the 2in. bore, has done its work. With less than ½ oz. of gunpowder, a 1¼in. bolt was driven out with no more trouble than was entailed by the preliminary setting of the gun.

An appropriation of £30,000 has been made by the United States Congress for the preliminary work on a ship railway to be constructed through the Dalles, on the Columbia River, in Oregon. The car that will be used will be 40ft. or 50ft. in breadth, and long enough to carry vessels that can steam up the river, which in the spring months, when the water is high, will allow a draught of about 14ft. The car will be sunk under water and the vessel floated over it; the car will then be raised by a hydraulic lift some 70ft. above the water level to the height of the land track and the car run upon it. The *American Engineer* says this land track will consist of four or five railway tracks of standard gauges, and there will be no curves sharper than 2 deg.

Mr. Edmund Pearse Burd held inquiries at Nottingham and Leicester on Tuesday and Wednesday, on behalf of the Local Government Board, as to the demolition of houses by the Manchester, Sheffield, and Lincolnshire Railway Company in the construction of their line to London. At Nottingham Sir S. G. Johnson stated that some eight or ten years ago there arose an exceedingly wild building speculation in that town. Land went up in price, houses were placed upon it, and the town became so overbuilt that there were at one time fully 6000 empty houses. The line of railway, so far as it passed through the central parts of the town, would involve the destruction of a lot of insanitary property which had been condemned long ago. A large number of insanitary houses will also be demolished at Leicester.

The Berlin local authorities have decided to call upon the Grand Berlin Horse Tramway Company to proceed at once with the work of laying a tramway from Reichenbergerstrasse to Treptow, as otherwise the project will be passed over to another company. The *Electrical Engineer* says a tramway is also to be constructed in Berlin from the Wienerstrasse *viâ* Wienerbrücke and Köpenicker Weg to Treptow. The Berlin municipality have also sent a deputation to Dresden to see Mr. Langen's electric tramway there. The Berliner Elektricitäts-Gesellschaft has formulated a scheme for the erection of an electrical station at Harburg for working an electric tramway, as well as for the supply of current for lighting and motors. The Elektricitäts-Gesellschaft "Union," of Berlin, have been negotiating with the Elbing Municipality to build an electric tramway in that town.

The first town in Europe to substitute electricity completely for other methods of propulsion upon the tramways is Havre, where the new system of tramcars has lately been inaugurated. Three lines, of a total length of 14 kiloms., have already been constructed, and a fourth is now being laid down. The system employed is the overhead contact by copper wires carried at a height of 6 m. 50 cm. upon metallic posts placed at about 40 metres apart. There are 560 of these posts of tube steel, which are also utilised for carrying arc lamps, of which eighty-five have so far been erected. It is expected that lamps will be placed shortly over the whole length of the lines. This installation has been carried out by the Compagnie Thomson-Houston. The cars are forty in number, and are each capable of carrying fifty passengers. Some of the cars have two motors, while the majority have only one; these motors are geared directly on to the axle, and every care has been taken to protect them from the dust and damp. The power is supplied by the Société de l'Energie Electrique, whose station is situated in the centre of the town. Their plant includes at present three Thomson-Houston dynamos that are worked by a Farcot engine.

## NOTES AND MEMORANDA.

The mean density of the earth found by Professor Poynting is 5·49. Professor Boys' result is 5·53.

A rule given by Mr. Preece for comparing the costs of gas and electricity for lighting is as follows: "Gas at three shillings per thousand cubic feet equals electricity at sixpence per kilowatt-hour," or in other words the factor is about six.

In the city of Tokio and elsewhere in Japan wooden water-pipes have been in use for over 200 years. Pipes of 6in. internal diameter and less are made from tree trunks bored out; larger ones are usually square, and are formed of planks fitted together.

An attempt made in Sweden to produce an extra strong cast iron, in order to reduce the thickness of shrapnel shells, so that the capacity of the chamber within them can be increased, produced a series of castings giving an average tensile strength of 19 5 long tons per square inch, with ·38 per cent. extension in 4in. The firm which makes the castings guarantees a strength of 17·8 long tons per square inch.

In the return of the gas testings for the week ending 6th October, Mr. W. J. Dibdin, F.I.C., enters as the highest mean illuminating power that of the Tooley-street district supply, South Metropolitan Gas Company, which was 17 0 candles. The lowest being found at the Chelsea, Holloway, and Hampstead districts, Gas Light and Coke Company, and the Old Ford district, Commercial Gas Company, which were all 16·1.

Polished steel surfaces as saws, chisels, bits, &c., can be rendered rust-proof by making a preparation as follows: Take one-half ounce camphor, dissolved in one pound of melted lard, take off the scum, and mix in as much black lead—graphite—as will give it an iron colour. Clean the tools, and smear with this mixture. After twenty-four hours rub clean with a soft linen cloth. The tools will keep clean for months under ordinary circumstances.

A chromo-photographic camera, by which a quick succession of photographs can be taken, suitable for combining in a zoetrope apparatus, so as to give an animated reproduction of a moving figure, has been invented by M. George Demeny. The problem to be solved is the same as that of Edison's kinetograph, but M. Demeny's apparatus is much simpler than Edison's, besides being portable. The instrument can be seen at the Anglo-American Import Office, 368, Rue Saint Honoré, Paris.

In a paper recently read before the Paris Academy of Sciences M. Henri Moissan states that aluminium can be saturated with nitrogen by passing a current of the latter through a bath of the molten aluminium, and that such saturation has considerable effect upon the physical properties of the commercial metal, reducing the elastic limit from 4·76 tons—of 2240 lb.—per square inch to 4·13, and reducing the breaking stress from 6 98 to 6·10 tons per square inch. The elongation also drops from 9 per cent. to 6 per cent. The presence of more carbon than is ordinarily found in the commercial metal also reduced the tensile strength and the elongation.

M. Forster, of the Berlin Observatory, has communicated to the *Revue Scientifique* the result of a series of observations carried on simultaneously for twenty months past at Kasan in Russia, Marburg in Germany, and Bethlehem in Pennsylvania. The object was to study the question of the supposed oscillation of the axis of rotation of the earth. From about 10,000 observations it appears that the pole or end of the axis has an oscillation following a spiral traced from west to east. The rate of oscillation is variable; at the present time it is decreasing. It appears, however, that the actual extent of this movement is very small, not exceeding fifteen metres.

Professor Kennedy recently stated that before the Edison and Swan lamp patent expired, and when current was sold at 8d. per unit, an 8-candle power glow lamp cost almost ¼d. per hour of actual lighting, whereas at the present price of glow lamps, and taking current at 6d. per Board of Trade unit, the 8-candle power lamp costs ⅛d. per actual hour of lighting. Professor Kennedy estimates the average life of glow lamps at 500 to 600 hours of actual lighting. The earning capacity of lamps in private houses, hotels, and shops is, according to Professor Kennedy, inversely as the above order. The number of lamps of 8-candle power installed in London in 1893 was 9,666,000.

In a recent paper in the *Comptes Rendus* on "Geodesy and its Relations with Geology," by M. H. Faye, the author says:—Gravity has a greater numerical value in islands than in the midst of continents, as the constant is determined by pendulum observations; this is probably due to the more rapid cooling of the crust of the earth beneath extensive seas, as evidenced by the low temperature of water—1 deg. or 2 deg.—at depths at which the temperature is about 133 deg. in land. The greater average density owing to the lower temperature accounts for the higher value of the constant at sea, notwithstanding the replacement of so much solid matter by the specifically lighter water. The author then draws attention to the need of aid from geologists in the further elucidation of the reasons for variations in the constant of gravity.

An improvement in the manufacture of plumbago or graphite has been described in a recent patent specification. Graphite crushed and passed through a sieve of from 120 to 150 meshes per inch, is stirred into a saturated solution of alum or aluminium sulphate at 212 deg. Fah.; steatite is then added, and more water if required. After mixing, excess of water is evaporated until a consistency suited to grinding in a chilled steel or other mixer is obtained. More graphite may here be added; then, after thorough grinding, the material may be compressed into cakes for household use, or is ready for the manufacture of pencils or crucibles. The average formula for the mixture is: Graphite, 80; steatite, soapstone, or talc, 14; alum, 6; but this varies with the purpose to which the material is to be applied. When several different kinds of graphite have to be employed, the richest in carbon is first mixed into the alum solution. By this process graphites previously regarded as incapable of being compacted are utilisable, and are improved in polishing power; for pencils, the material may be hard without being brittle, and black without being soft; while crucibles made from the treated graphite are at once harder, more durable, and lighter.

A solution of copper sulphate does not conform rigorously to the form in which Faraday's law of electrolysis is generally expressed. It has been shown by Gray that the metallic deposit is heavier the higher the current density and the lower the temperature, an explanation being given in the fact that copper dissolves to a very appreciable, although variable, amount in solutions of copper sulphate. According to Schuster, it is probably the atmospheric oxygen present in the solution that causes this chemical corrosion. In view of this, W. Gannon has sought to discover whether there is any difference between the weights of the two deposits in two copper voltameters, one of which is placed in a vacuum. Freshly made neutral copper sulphate solution was employed, and the electrolysis in one case was conducted first under reduced pressure, with the result that a heavier deposit was thrown down than was the case in a similar experiment, the pressure being that of the atmosphere; but the percentage difference was not constant. The *Electrical Review* says the addition of a little sulphuric acid to the voltameters caused this difference to be constant within experimental error. Under this condition, for current densities above 0 01 ampère per square centimetre of active cathode, there is no practical difference in weight between the two deposits, but for lower densities the "vacuum deposit" is very appreciably higher than the "air deposit.

## MISCELLANEA.

A survey of the Sea of Marmora has been undertaken by the Russian naval authorities in consequence of the submarine disturbances supposed to have been produced in that sea by the recent earthquakes.

The first German ironclad built in the new Dantzic dockyards will be launched this month. It belongs to the Siegfried class, the armament consisting of three 36-ton guns. The indicated horse-power is 4800, and the displacement tonnage 3495.

Experiments with the Sims-Edison steering torpedo are to be made in the Bosphorus. This weapon gave such good results when recently tried at Toulon, that the Ottoman Government are thinking of adopting it for the protection of their waterway.

A new twin-screw steamer, named the Alma, built for the London and South-Western Company's fast passenger and mail service between Southampton and Havre, has been launched at Glasgow. Her length is 270ft., breadth 34ft., and gross tonnage about 1100.

We have received the second edition of Mr. L. B. Wells' canal map of England and Wales. The names of many junctions of canals owned by different companies have been added, and a few additional miles of waterways shown, bringing up the total to 3935 miles.

The Admiralty have directed that trials are to be made on the new torpedo boats and torpedo destroyers on their delivery from the contractors, to test the flaming of the funnels when steaming. It is expected that with careful stoking this evil, which would render a night attack impossible, can be prevented.

The French Government has decided to proceed with the construction of two great docks at Cherbourg—one for the use of those mail boats which will serve as auxiliary cruisers in time of war, and the other for the accommodation of ironclads of the largest size. The docks are to be built in the northern portion of the arsenal.

The Local Government Board have given their sanction to a loan of £11,500 for the sewerage and sewage disposal of Bracknell. The sewage will be purified by irrigation, on 22½ acres of land. There are to be two small pumping stations, worked by oil engines. The engineer to the scheme is Mr. W. H. Radford, C.E., Nottingham.

A curious accident has happened at Boston, U.S.A. A man, while cleaning an arc lamp at the top of a high mast, received the full strength of the current and was killed instantaneously. His body was suspended from the wires for half an hour. When men were put to work to remove it one of them came in contact with it, and was thrown head foremost on the sidewalk. He was dashed with such violence against the kerbstone that he died shortly afterwards.

The Halcyon torpedo gunboat, constructed at Devonport, and engined by Hawthorn, Leslie, and Co., has broken down seriously. A crack nearly a foot in length has been discovered in her high-pressure cylinder. The Admiralty had intended that she should represent her class in a series of experimental trials to ascertain the most suitable type of propeller for torpedo gunboats of the same tonnage. The vessel's machinery was only a few weeks ago accepted from the contractors.

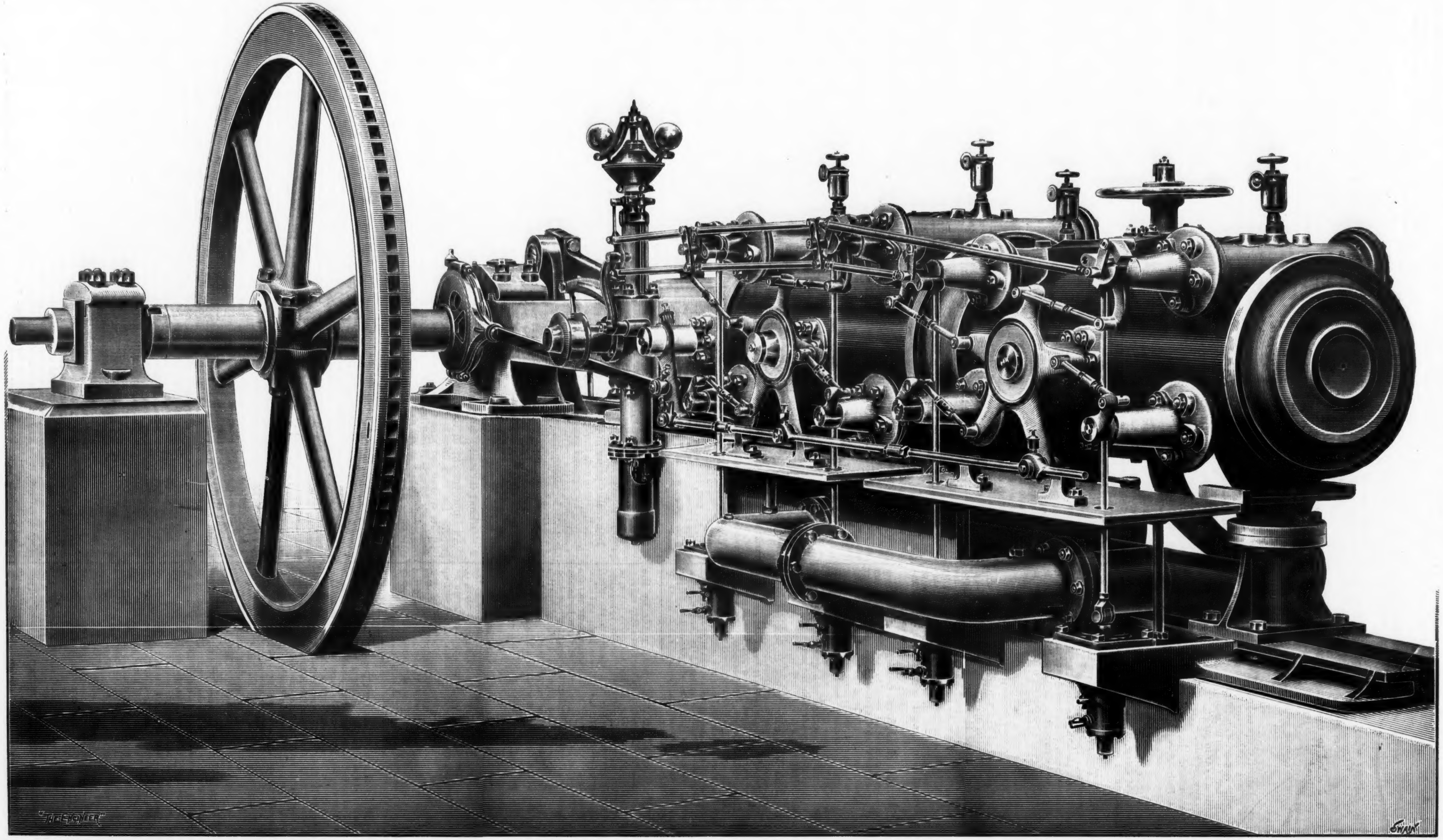
A statement to be taken *cum grano* is to the effect that two Russian engineers contemplate making an attempt to raise the sunken battleship Victoria, owing to their recently achieved success in raising, by means of air balloons, a vessel sunk in 30ft. of water near Varsovie. In the case of the Victoria, it is said, ten air vessels will be used, each of a capacity of 60,000 cubic feet. The question which immediately occurs to us is, how are these vessels to be attached to the ship? 30ft. of water is one thing, and 450ft. is another.

Messrs. John and Henry Gwynne, of Hammersmith, have entered upon a contract with the Mersey Docks and Harbour Board, Liverpool, to supply a set of their "Invincible" compound condensing pumping engines to raise the level of water in the Canada Huskisson dock system. This makes the fourth large installation fitted up by Messrs. J. and H. Gwynne for the same authority, which will have within the dock estate "Invincible" plant equal to a combined capacity of 4000 tons of water per minute when the new machines are at work.

A series of experiments is being conducted on board the first-class battleship Revenge at Spithead, with a view to determine the precise advantage obtained by the new bilge keels which are being fitted to all the vessels of the Royal Sovereign class. At the first trial, the vessel was given a degree of stability and steadiness by her double bottom being filled with water, and her bunkers with coal. The four barbette guns, each weighing 67 tons, were then trained at right angles, which gave the vessel a list of twelve and a-half degrees, and this was increased to fifteen when the crew were assembled on the side to which the guns were trained. It has been decided to subject the ship to a far more severe test, by removing both the coal and the water, and adopting the same method of carrying out the test. At the conclusion of the trials the Revenge will be docked, and bilge keels affixed to her bottom, and she will then undergo the same experiments as before.

We have received from Messrs. Edgar Allen and Co., Sheffield, a pamphlet containing particulars of, and reports upon, their dynamo magnet steel castings. The reports are by Mr. Gisbert Kapp, M. Inst. C.E., Professor Ewing, and Professor Jamieson. It has been for some time known that these steel castings were equal and now are superior to wrought iron forgings for dynamo construction. Mr. Kapp, very early in their history, tested their materials, and his great experience in dynamo design and construction enabled him to make use of this magnet steel, and to pronounce an authoritative opinion upon it. He found it better than wrought iron forgings in many cases, and some which he tested in April this year he speaks of as better than any magnet steel he had previously met with. The pamphlet we have received is accompanied by permeability curves by Mr. Kapp, and Professors Ewing and Jamieson, and will be found of considerable interest by those who are concerned with the construction of large magnets of any kind, and who are interested in the magnetic efficiency of materials to be employed.

The new German third-class cruiser, provisionally known as "F," will be launched and named on the 15th inst. at Wilhelmshaven. She is, according to the *Times*, 246ft. long by 33ft. 6in. broad, and at a mean draught of 15ft. will displace 1640 tons. There are twin screws, and engines working up to 2800-horse power, which will give the vessel an extreme speed of 16 knots. The hull is of steel and wood. The armament will consist of eight 3·96in.—40-pounders—quick-firers, four machine guns, and two torpedo-launching tubes. A few days later at the same yard the keel plates will be laid of the new first-class battleship which is to take the place of the now almost obsolete Preussen, a vessel twenty-one years old. The new ironclad will be a reproduction of the Wörth, with, however, slight modifications, and will be constructed to carry four 11in. breech-loading guns of 40 calibres, two 11in breech-loading guns of 35 calibres, six 3·9in. quick-firing guns of 35 calibres, eight 3·4in. quick-firing guns of 30 calibres, two 2·3in. boat guns, and eight ·31in. machine guns. Her extreme speed, with forced draught and at 111 revolutions, will, it is anticipated, be 17·2 knots, 10,230 indicated horse-power being developed.


"THE ENGINEER"
SWAIN

SIX HUNDRED HORSE-POWER TRIPLE-EXPANSION FRIKART-CORLISS ENGINE

MESSRS. JOHN COCKERILL AND CO., SERAING, ENGINEERS

(*For description see page 320*)

### FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, October 12th, 1894. Page
The Enlargement of Liverpool-street Station, Great Eastern Railway. No. IV. (Illustrated) .. .. .. .. .. .. .. 313
German Exhibits at the Antwerp International Exhibition (Illustrated) .. .. .. .. .. .. .. .. .. .. .. .. 314
The Cardiff New Waterworks. (Illustrated) .. .. .. .. .. .. 316
Harbours and Waterways .. .. .. .. .. .. .. .. .. .. .. 317
Manchester Ship Canal—Turbine and Pumps at Twenty Steps Bridge. (Illustrated) .. .. .. .. .. .. .. .. .. .. 317
The French Cruisers Alger and Islay. (Illustrated.) .. .. .. 318
The Dairy Show .. .. .. .. .. .. .. .. .. .. .. .. .. 318
Cast Steel Stern Frames. (Illustrated.) .. .. .. .. .. .. .. 319
Progress of Bessemer Steel .. .. .. .. .. .. .. .. .. .. 319
Waverley Station, Edinburgh .. .. .. .. .. .. .. .. .. 319
Triple-expansion Engine, Frikart's System. (Illustrated.) .. .. 320
The "Simplex" Emergency Grip for Cranes and Winches. (Ill.) 320
Railway Matters .. .. .. .. .. .. .. .. .. .. .. .. .. 321
Notes and Memoranda .. .. .. .. .. .. .. .. .. .. .. .. 321
Miscellanea .. .. .. .. .. .. .. .. .. .. .. .. .. .. 321
Leading Articles—Uncertainties of Science—Canalisation of Rivers 323
The Drought in Scotland—British Machinery in Russia—Shipbuilding in France .. .. .. .. .. .. .. .. .. .. .. .. 324
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. 324
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 325
The Late Mr. J. H. Osborne, C.E. .. .. .. .. .. .. .. .. 325
Permanent Way: Belgian States Railway. (Illustrated.) .. 326
On the Heating Power of Smoke .. .. .. .. .. .. .. .. 326
Lancashire and Yorkshire Railway. (Illustrated) .. .. .. .. 327
Rustless Coatings for Iron and Steel .. .. .. .. .. .. .. 327
Letters to the Editor—The Kinetic Theory of Gases: Maximum Molecular Velocity—Labour and Luxuries .. .. .. .. .. 328
Governing Electric Light Engines—Colonial Locomotives—Aluminium Torpedo Boats—Electrolytic Sanitation—Condition of the Thames .. .. .. .. .. .. .. .. .. .. .. .. .. .. 329
Midland Railway Carriage Steps and Fittings—The Theory of the Steam Engine .. .. .. .. .. .. .. .. .. .. .. .. .. 330
American Engineering News .. .. .. .. .. .. .. .. .. .. 330
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Lancashire 330
The Sheffield District—The North of England .. .. .. .. .. 331
Notes from Scotland—Wales and Adjoining Counties—Germany .. 332
American Notes .. .. .. .. .. .. .. .. .. .. .. .. .. 333
Launches and Trial Trips .. .. .. .. .. .. .. .. .. .. 333
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. 333
Selected American Patents .. .. .. .. .. .. .. .. .. .. 334

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

W. B. (Adelaide, S.A.) - *Consult the "Moulder and Founders' Pocket Guide," by F. Overman, published by Sampson, Low, and Company, London.*

A. E. (Stoke Newington).—*Make use of a little elementary geometry and wood splines to get parallel lines, project them upwards by means of plumb bobs hanging from the edge of a board or of a spline temporarily fixed overhead or from the piece of shafting to be set in position; use a spirit level, and with some practical experience and less reliance on cookery book engineering you will manage what you want.*

### ALUMINIUM BRONZE PIPES.

(*To the Editor of The Engineer.*)

Sir,—I shall feel much obliged to any reader who will tell me where I can obtain aluminium bronze pipes which will be safe at 600 lb. pressure, the diameter of the pipes to be 10in. or 12in. Americus.

October 6th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

Newcastle-upon-Tyne Association of Students of the Institution of Civil Engineers.—Wednesday, October 17th. Visit to the Consett Iron Company's works at Blackhill, Co. Durham.

Hull and District Institution of Engineers and Naval Architects.—Monday, October 15th, at 8 p.m. Paper: "Hull Steam Shipping," by the President, F. H. Pearson.

North-east Coast Institution of Engineers and Shipbuilders.—Tuesday, October 16th, at 7.30 p.m. Minutes of closing business meeting for last session. Ballot for new members. Adoption of tenth annual report and financial statement. Inaugural address of President.

### DEATH.

On August 31st, suddenly, at Buenos Ayres, S.A., W. H. Morrow, A.M.I.C.E., aged 50.

# THE ENGINEER.

*OCTOBER* 12, 1894.

### THE UNCERTAINTIES OF SCIENCE.

Some months ago we reviewed an important book, "The Science of Mechanics," by Dr. Ernst Mach, professor of physics in the University of Prague. That book gave sufficient evidence that its author is a very advanced thinker—a man with small respect for authority in science. In the *Monist* for October we find a lengthy paper by Dr. Mach on "The Principle of the Conservation of Energy," which will supply food for thought to everyone interested in physics. This paper is remarkable in various ways. Thus, at the outset, we have actually an attempt at a definition of the word Energy. "The most multifarious physical changes, thermal, electrical, chemical, and so forth, may be brought about by mechanical work," says Dr. Mach. When such alterations are reversed they yield anew the mechanical work in exactly the quantity which was required for the production of the part reversed. *This is the principle of the conservation of energy;* "energy" being the term which has gradually come into use for that "indestructible something" of which the measure is mechanical work. Thus then we see that an advanced physicist can find no better definition for a word in everybody's mouth than that it is an "indestructible something." It is *not* work, but work is its measure. It is not, however, with Dr. Mach's definitions that we are concerned, but with his methods. These appear to us to be altogether admirable. He is not content to state ideas, or to give definitions; he goes much further. He asks where did the ideas—or as we prefer to call them, concepts—of physics come from? and the result of his investigations casts a curious light into very obscure regions. As to the doctrine or concept of the conservation of energy, he asks where did it come from? And he proceeds to show that the answer is by no means so simple as it appears, and that indeed it is in no way easy to prove that energy is really always and at all times conserved. It is not our purpose to follow him through his arguments: for the present we are considering only his conclusions. Page by page we find the words, "Not proven." He takes argument after argument, authority after authority, and shows that there is a reason why each and all break down somewhere or in some point. He shows that one of the strongest arguments in its favour is based on the assumed impossibility of producing "perpetual motion," which assumption is in turn based on another, that all forms of energy are modes of motion, concerning which he says, "Intelligible as it is, therefore, that the efforts of thinkers have always been bent upon the 'reduction of all physical processes to the motion of atoms,' it must yet be affirmed that this is a chimerical ideal. This ideal has often played an effective part in popular lectures, but in the workshop of the serious inquirer it has discharged scarcely the least function."

We have said enough, perhaps, on this point to show what manner of thought Dr. Mach puts before his readers on one question. But he is much more audacious in his method of dealing with thermodynamics, and to his views on the subject we direct particular attention. Dr. Mach gives a most simple and lucid exposition of what Carnot did and did not teach, and he explains very clearly the nature and truth of the work done by the Thomsons, Joule, Mayer, and others. It having been shown that heat was not a substance, the question was asked—What, then, is it? The answer, as is well known, is that it is a mode of motion that has been accepted implicitly for years by students as demonstrably true. Dr. Mach hastens to prove that it is not demonstrably true at all, and, *more suo*, he asks: Where did the concept originate? "The generally accepted notion of a caloric, or heat-stuff, was strongly shaken by the works of Mayer and Joule. If the quantity of heat can be increased and diminished, people said, heat cannot be a substance, but must be a motion. The subordinate part of this statement has become much more popular than all the rest of the doctrine of energy. But we may convince ourselves that the motional conception of heat is now as unessential as was formerly its conception as a substance. Both ideas were *favoured or impeded solely by accidental historical circumstances.* It does not follow that heat is not a substance from the fact that a mechanical equivalent exists for quantity of heat. We will make this clear by the following question which bright students have sometimes put to me:—Is there a mechanical equivalent of electricity, as there is a mechanical equivalent of heat? Yes, and no. There is no mechanical equivalent of quantity of electricity as there is an equivalent quantity of heat, because the same quantity of electricity has a very different capacity for work, according to the circumstances in which it is placed; but there is a mechanical equivalent of electrical energy. Let us ask another question. Is there a mechanical equivalent of water? No. There is no mechanical equivalent of water, but there is a mechanical equivalent of weight of water multiplied by its distance of descent."

Dr. Mach here explicitly states a circumstance which must be taken count with in all attempts to identify heat and electricity. That is to say, our existing concepts and definitions based upon those of heat and electricity are fundamentally different. Once more Dr. Mach asks why this difference in conception? and he answers, "The reason is purely historical, wholly conventional, and, what is still more important, is wholly indifferent." This, he proceeds to prove, and concludes his argument with the following pregnant statement: — "When we wonder, therefore, at the discovery that heat is motion, we wonder at something that was never discovered. It is perfectly indifferent, and possesses not the slightest scientific value, whether we think of heat as a substance or not. The fact is heat behaves in some connections like a substance, in others not. Heat is latent in steam as oxygen is latent in water." We have quoted at considerable length, because without quotation we have found it impossible to do full justice to Dr. Mach's views. Even now we have left essentials unnoticed. The broad fact, however, to which we would direct attention, is that a man of Dr. Mach's attainments should advance opinions which are so directly opposed to a great deal of the teaching of the present day. He brings fundamental modern conceptions of heat to the test and he finds them unsatisfactory. The very root of thermodynamics becomes under his hands one of the uncertainties of science. Our readers will find in the remarkable letter by Col. Basevi, which we print this week, another example of the uncertain foothold which men find in this path of science. It has often been stated that though men believe in the kinetic theory of gases, they know it is not true. Col. Basevi advances arguments which make it more difficult to believe in it than ever. On all sides we find men inquiring, thinking, revising, and on all sides upsetting received theories and notions concerning the nature of things and processes. Such inquiries are no doubt distasteful to many persons, but they mean progress so long as they are conducted in a proper spirit. Yet the student of science will do well to bear in mind the words of a very eminent lecturer of physiology. "The statements I have made to you, gentlemen, I have every reason to believe to be wholly untrue, but you must learn them, because if you do not you will not be able to pass your examinations."

### CANALISATION OF RIVERS.

When in classic days a river conducted itself in such a manner as to become a source of danger to the people and lands adjacent to its banks, its behaviour was attributed to the offended majesty of its tutelar divinity. The hydraulics of rivers are assumed to be under similar control in China even now. Although the French have a proverb, *Rien n'est sacré pour un sapeur*, and it must also be admitted that the modern engineer has no particular regard for ancient fluvial deities, yet he is not indisposed to try gentle measures when dealing with their wayward changes. As a proof that the belief in a presiding genius prevails among eastern people, may be mentioned the statement that when the first railway bridges threw their shadows over the sacred streams of Hindustan, bouquets and garlands of flowers were freely dropped from the locomotive, as an offering to the river god, into the waters below. Apart alike from ancient mythology and Hindoo superstition, there is one fact, which in connection with our subject cannot be overlooked. It is the universal consensus of hydraulic engineers that in projecting works for the improvement of rivers, the natural physical features of the watercourse should be interfered with as little as possible. It matters nothing for what especial purpose the particular works may be undertaken, whether for irrigation, drainage, prevention of floods, canalisation or water supply. That rivers resent—so to speak—the alteration or diversion of their natural beds, has been shown by more than one example in India. There are not wanting instances in which, after a new cut has been made, bridged over, and the water let in, the river in one night has returned to its former channel and breached the embankment, leaving the new waterway high and dry. It is clearly preferable—in popular language—to coax than to force a river.

While engineering works belonging and even essential to the canalisation of a river are frequently common to other improvements, the distinguishing characteristic of that operation is that it is undertaken, if not altogether, yet always in the interest of navigation. A river may be considered to be canalised when its normal condition at low water has been so altered by the carrying out of works in its channel as to permit of its navigation by boats which were previously unable to ascend it. This definition applies more particularly to the tidal compartment of a river, but if least depth be substituted for low water, it will be sufficiently correct for the upper, or river compartment proper. Some engineers regard the term canalisation as inappropriate to the improvement of rivers unless executed under certain conditions. They do not consider it applicable to the improvement of a navigable stream in which the works undertaken to guide and regulate the channel are solely of a character which will allow of its contours being preserved by the scouring action of the water. A curious example of the self-canalisation of a river was afforded some years ago through the agency of flood waters, which ultimately culminated in the establishment of a new outfall for the Vistula. An accumulation of ice, attended by a consequent damming back of the water, led to the blocking-up of the stream leading to the existing outlet. The obstruction continued to increase, until the pressure became so great as to break through a protecting embankment. The result of this "directing the great sources of power in Nature" was, contrary to what generally obtains, eminently satisfactory. It constituted a self-made "river navigation," and, as will be seen, was in every sense conducive to "the use and convenience of man." It appears that, previously to this fortuitously favourable incident, the engineers of the Government had repeatedly recommended the execution of works the very *raison d'être* of which was, with the addition of other artificial measures, to secure the accomplishment of what Nature had so beneficently effected. This felicitous though somewhat forcible method of forming a new outfall for the river enabled a long reach of it to be canalised to great advantage. Subsequently lock gates were constructed near the junction of the main stream and the self-created branch leading to the new outfall, which now fulfils the duty formerly devolving upon the old outlet—namely, that of affording a passage to the ice, which, brought down by the waters higher up stream, finds its way eventually to the sea. In a strategic point of view the works thus opportunely thrust upon the Government have been equally productive of good, as they very materially contribute to a successful defence of Dantzic in the event of its being invested by a hostile army.

The chief difference between a canal and the canalisation of a river is that whereas the former, in the strict sense of the term, is wholly artificial, the latter is not. It is, however, rare that a canal, during its entire course from one end to the other, comes under this definition. In some parts of its route it usually utilises the services of stretches of rivers canalised to render them equally navigable, and also freely avails itself of the extensive area of waterway afforded by the lakes which intersect its path. A familiar instance is afforded by the Caledonian Canal, very much out of date at the present time, which has thirty-eight miles of lake navigation. Most of the principal French canals are constructed in order to effect a junction of two separate river systems—such as the Rhône and Rhine, the Loire and the Saône, the Scheldt and the Somme, and the Seine and the Rhône. In Italy we have the Cavour Canal uniting the Po and the Tessin. In America there are canals forming a continuous waterway between individual rivers, between separate lakes, and also between lakes and rivers—as, for example, between the Potomac and the Ohio, the Delaware and the Hudson, Lake Erie and the same river, and Lake Michigan and the Illinois. Lake Ontario, in Canada, joins the St. Lawrence at Montreal; and that magnificent stream is, by similar means, placed in communication with the Ottawa. This compound system of navigation is not restricted solely to inland or fresh water canals, but extends as well to those of a maritime character. The Suez Canal has a portion of its course through the Bitter Lakes.

As a rule the chief point to be attained in the canalisation of a river is to increase the available draught of water, and in nine cases out of ten it becomes necessary to attack the bed of the stream. Something, no doubt, can be frequently accomplished by collateral operations, which consist in training, regulating, widening, and otherwise generally improving the course of the river, but it is rare that even a combination of these ameliorating measures will of themselves be effectual in producing the highest possible degree of navigability. Given a channel of a certain width, depth, and velocity of current as sufficient for the purposes of navigation required, the object, after having once constructed it, is to maintain it. In those cases in which "collateral operations," assisted solely by the natural scouring power of the stream, are sufficient to ensure the constancy of the necessary conditions, the river, although rendered navigable by these means, is not, as has been already stated, considered to be canalised in the full and distinct signification of the term. It is evident, therefore, that the canalisation of a river goes far beyond the mere control and regulation of its course and current, and simply furnishing facilities for navigation. The channel of a river, in which the bed is of rock, or of any material unattackable by erosion, or one in which all natural erosion has ceased, can be rendered navigable to a certain extent by the construction of the somewhat minor engineering works already instanced. It is true that even with these favourable conditions of a regular and normal volume of water, and with an assured stability of channel, both in dimensions and configuration, the question of floods arises, which has more immediate relation, not to the lowest, but to the highest level, at which navigation can be kept open. This constitutes one of the three vertical data to be observed by the engineer engaged in works of the description under notice. The other two are the highest flood and the lowest drought level. Unless the process of denudation, or natural erosion has ceased to take effect the bed of the river channel remains unstable, and may shift at any time in obedience to local action. Under these circumstances, it is not advisable to trust to minor works to ensure the regular navigation of the waterway, as although successful at first, they are extremely unlikely to prove of any permanent value. The only method by which the navigation of a river can be improved, under these conditions, in a substantial and durable manner, is by canalisation.

Experience has determined, although the conclusion appears a little irrational, that straight reaches, except of comparatively insignificant lengths, are not to be recommended. As a consequence, therefore, in those examples in which the original shore lines are rectilineal, or nearly so, it becomes necessary to alter them. But in adopting a different system of setting out, it is, in accordance with the principle laid down at the commencement of our article, incumbent upon the engineer to retain, as nearly as circumstances will permit, the existing conditions of the banks. The chief feature of one of the new systems introduced on the Continent consists in the abandonment of the arc of a circle and the employment of a curve increasing in curvature from the tangent points towards the middle, and increasing again from this point to the following tangent.

In addition to the construction of the locks, dams, and other necessary works, the canalisation proper of a river is always accompanied by dredging operations, frequently upon a scale of considerable magnitude. When the inequalities have been levelled and a new channel created, in order that its course should be accurately maintained, the trace of it should be set out, not by straight lines and arcs of circles, which always present more or less abrupt changes of direction, but by arcs of a curve termed by French engineers *sinusoide*. The great extent in the variation of the radius of this curve, and the continuity which it presents in this variation, has been the cause of it having been very much adopted abroad in the canalisation of rivers, and in instances where the rectification of the normal configuration of the channels was concerned. It was so employed in connection with the works attending the improvement of the river Rhone. It may be noticed that this is also the curve which would graphically represent the variations in the currents, generated under certain conditions in a single coil.

It is unnecessary to mention examples of the canalisation of rivers. Our own Mersey, Weaver, and other streams were canalised, after a fashion, more than a century and a half ago. But there is one example which we shall quote, not merely on account of its importance and magnitude, but for the practical bearing it has upon the subject of our article, and the explicitness with which it corroborates the real meaning we have attached to the title. We refer to "The Danube Regulation Works," described and illustrated in The Engineer of June and July last. Without needlessly recapitulating, it may be stated that the twofold object in view was, first, to do away with the small depth at low water; and secondly, to check the high velocities, so as ultimately to ensure free navigation through the cataracts of the Lower Danube. To accomplish this result it is intended to deepen the navigation channel through the cataracts with a bottom width of 200ft. and a depth of nearly 7ft. below the lowest drought level. During the construction of the canal through the Iron Gate this depth was increased to 10ft. The manner in which the canalisation of this portion of the Lower Danube was effected, and the machines employed in executing the different works, point out unmistakeably that, both in extent and purpose, they far exceed those ordinarily applicable to the mere training or improvement of a river.

### THE DROUGHT IN SCOTLAND.

The past month of September has been the driest experienced north of the Tweed for over a century, particularly in the West of Scotland, where the total rainfall for the month averaged only seventeen hundredths of an inch. Such abnormal dryness, in a district notorious for a too abundant rainfall at all seasons of the year, has naturally had a potent influence on the water supply. The wet weather generally prevailing during the summer has enabled the large towns to face the autumn scarcity with full reservoirs, and such places have not suffered appreciably, but smaller towns in many parts of the country have been put to considerable straits, while the numerous residential places on the Firth of Clyde were almost without exception left without potable water. From Gourock to Stranraer on the one shore, and Kilkriggan to Campbelton on the other, an acute water famine prevailed, necessitating the departure of visitors, and entailing great hardship on the natives, who were reduced to carting scanty supplies from distant lochs and streams. Nothing approaching such an universal scarcity has been experienced since these towns and villages came into existence, though in 1887, and also last year, there were periods of remarkable drought, which tested the resources of the great towns and cities severely. It appears, then, that the dry spell of last month possessed some unusual features, causing it to be specially felt by places depending on a direct hill supply for water. On turning to the records of the Ben Nevis summit observatory, we find that last month had the smallest rainfall of any month since the observatory was built in 1883. Under usual conditions the rainfall at the summit of the mountain greatly exceeds that at the sea level, but during the past month it was for the first time on record less on the summit than at the sea level. This very unusual occurrence explainable by the continuation of north and easterly winds during the whole month, at once explains the rapid failure of the water supplies of Clydeside towns. These places are usually situated at the base of a range of hills with an elevation of from fifteen hundred to two thousand feet. The waters of some streams are impounded by banking across the mouth of the glen through which it flows, a first-class water supply, equal to all ordinary requirements, being thus obtained at a very moderate expenditure. During seven months of the year the mountain stream could supply five times the water required, and even in dry weather copious and frequent showers condensed on the hill tops from the Atlantic breezes keep the supply abundant. When, however, a continuation of dry winds is experienced, so that even on the top of Ben Nevis no moisture is condensed for weeks at a time, it is evident that the system of water supply described is extremely liable to failure, unless the storage capacity is large. This, for the reasons mentioned, it seldom or never is, so that when the feeding stream dries up the stored supply is speedily exhausted. The remedy is obviously increased storage capacity, and though such a phenomenally dry September as the last is not likely to recur speedily, the absolute failure of water supply, or even its probability, is so serious a calamity that the authorities of the places which have suffered cannot afford to disregard its possibility. The case of Helensburgh, the only residential town on the Firth of Clyde which has not suffered from water famine during the recent drought, shows the advantage of sufficient storage capacity. During the remarkably dry summer of 1887, this town suffered unpleasantly from the long continued dry weather. The main feeding stream of the supply system, the Ballyvoulin Burn, dried up completely, and the one reservoir above the town, in spite of a very restricted supply to the inhabitants, threatened to give out altogether, a contingency which would have necessitated the carting of water a distance of six miles from Loch Lomond. The magnates took the lesson to heart, and on the advice of Mr. Wilson, of Greenock, trebled their reservoir capacity, with the result that at the end of last month the engineer was able to report a full three months' supply still in store.

### BRITISH MACHINERY IN RUSSIA.

According to recent Foreign-office reports, the introduction of English cotton, spinning and weaving machinery into St. Petersburg in 1893 was considerably larger than during the previous year, and extensive orders for delivery during the present year were taken by English firms. It is generally supposed by those thoroughly competent to form an opinion on the subject, that the reduction of the duty on cotton machinery under the Russo-German Commercial Treaty is not likely to increase the demand for the same, the reduction being inconsiderable. As this kind of machinery is not made in Russia, it must be imported to the extent of local requirements. Owing to the comparative lightness, the duty does not bear very heavily on it, as in the case of boilers, paper-making machinery, steam engines, &c. Although all cotton spinning machinery came as formerly from England, the Mulhausen district of Germany secured orders for sundry dyeing, printing, and finishing machinery, which used formerly to go to England. One reason for this is the lower price of German machinery, but another and more important one is that German makers are ever ready to construct or alter their machinery to suit the convenience, and often merely the caprice, of the Russian buyer whenever they can possibly do so. Several new mills for spinning combed wool were built, but the machinery for them was ordered in Alsace instead of in England. The importation of paper-making machinery, now principally German, was somewhat checked last summer by the enormous increase in the duties levied differentially, when it was of German manufacture. The outlook for the present year under the reduced duties has stimulated the importation, and there is every appearance of a great increase in it. British threshing machines continue to be those most appreciated by the Russian farmers, and the demand for sets last year was so great and sudden, that intending buyers who came to Moscow, not only were unable to make any purchases, but could not get their orders executed in England. The general conclusions are that although British machinery makers fully sustain their reputation for high-class articles, Russia and Germany secure more business than they did previously. For mill engines, Switzerland, a new and dangerous rival, is coming to the front. Millowners who formerly bought exclusively in England, placed several orders with Swiss makers, and appear well pleased with the goods supplied. Prices, freight, and duty are about the same, whether the machinery comes from England or Switzerland, but Swiss makers guarantee the consumption of steam required by their engines for the work performed, which pleases Russian buyers.

### SHIPBUILDING IN FRANCE.

The new law which increases the premium upon vessels constructed in France is said to have given a very great stimulus to the native shipbuilding industry. We referred lately to a new yard that had been established at Rouen, where enough contracts have been entered into to keep the hands employed for several months to come, and now a similar success has been achieved at Nantes, where the construction of a maritime canal, and the deepening of the port, have allowed of vessels drawing more than 6 metres of water ascending thereto. Last week the launching of the cruiser Descartes, the first war vessel constructed at Nantes, was made the occasion of a general holiday, and in the speeches which followed the ceremony the directors and other officials of the Société des Chantiers de la Loire spoke of the great possibilities that were now opened up to Nantes as a shipbuilding centre. The Descartes has a length, over all, of 96 metres, and a displacement of 4000 tons. It will be entirely completed at Nantes before proceeding to Brest, where it will receive a powerful armament. Besides this vessel the Société des Chantiers de la Loire have other vessels in hand for the marine, including the armoured coast defence vessel Valmy, the first-class battleship Massena and the cruiser d'Assas. They have also building four large sailing vessels, of which three of 4200 tons each are to be constructed for MM. Bordes, of Bordeaux. The company expects to enter into several other contracts shortly, so that the 3000 hands employed at Nantes, St. Nazaire, and St. Denis will be kept busily engaged for a long time to come. This result is considered to be all the more satisfactory in view of the exceedingly low freights, and it is thought that as these become more profitable a still further impulse will be given to the native shipbuilding industry. According to the builders this result could not possibly have been attained if foreign-made vessels continued to receive the half premium, but the owners themselves entertain the contrary opinion, as they consider that the premium hardly compensates them for the increased cost of the vessels.

## LITERATURE.

*Ueber Vorkommen und Gewinnung der nutzbaren Mineralien in der Südafrikanischen Republik — Transvaal — unter besonderer Berücksichtigung des Goldbergbaues.* By Bergrath Schmeisser. Dietrich Reimer, Berlin. 1894.

The work now before us, which is practically an account of the gold mines and other mineral industries of the Transvaal, is certainly in many respects the most valuable contribution that has yet appeared to the already ample literature devoted to this subject. Besides the importance to which its intrinsic merits entitle it, it deserves special attention from Englishmen, seeing that it is fraught with a number of instructive and incisive lessons for us, which we should do well to take to heart.

It appears that the Prussian Government, having regard to the repeatedly expressed opinions of statisticians that the gold supply of the world is rapidly falling below its requirements, resolved to send a mining engineer to the Transvaal to investigate the position and probable development of the gold production of that country. Herr Schmeisser was accordingly sent out, and the book now before us is the result of his studies. Although British interests in the Transvaal are beyond comparison, more important than German, and the ties that bind us to South Africa are far stronger and further reaching than the somewhat indirect Prussian connections with that part of the world, yet we find the German Government freely taking upon itself the duty of studying this new goldfield, whilst our Government has never even thought of such a thing, and probably never will, all our knowledge of African gold mining being due to private initiative. It is evident that the German Government does not consider that it has done its whole duty to the mining industry of the country, when a local postmaster has been appointed inspector of mines; nor does it look upon a successful political canvasser as superior to a trained scientist for the carrying out of such duties. In England, however, we do things differently, and the attitude of our Government towards mining and manufacturing industries cannot but suggest the reflection that whilst party Government has its advantages, it has drawbacks that pretty well balance them.

Not only does Herr Schmeisser's book teach us a lesson in its mode of inception; it is equally instructive in its mode of execution, and is an admirable example of German thoroughness. The first chapter is of merely general interest, giving a brief account of the geography, history, and constitution of the Transvaal. With the second chapter, the geognosy and geological description of the country are commenced. The author gives a brief account of the various formations that occur in the Transvaal, and of their relations to each other. Although necessarily still very imperfect, this sketch gives an excellent outline of the broad geological features; and though errors of detail doubtless exist, the author's general conclusions will probably be found to be correct when fuller details are available for a systematic study of the subject. Herr Schmeisser has not only utilised the observations made by others, he has contributed largely to our knowledge of Transvaal geology by his own researches.

Commencing with the lowest sedimentary formation, the Swazischists, and the gold veins contained therein, it is worth while noting that he looks upon the Sheba reef as a true reef, whilst most previous writers on this subject seem rather to have held the view that it is an altered bed. His opinion on this reef may be gathered from the following quotations: "The footwall is sharply defined, the hanging wall less so, because the deposit is more or less united to the quartzite which forms the hanging wall. Midway between the two walls, a well marked fissure like a false hanging wall traverses the entire deposit. . . . . . Fragments of the country rock from the hanging wall side are of common occurrence in the body of the vein. . . . . The mode of occurrence of the Sheba deposit, its great width, and the presence of large horses of the hanging country rock, justify the inference that this is a composite vein, that is to say, a vein formed by the simultaneous opening of several fissures within narrow limits, and the destruction of a part of the rock-masses that separated them." The various other gold districts in which veins in the Swazischists are being worked, namely, Komati, Selati, Letaba, Molotsi, Houtboschberg, Marabastad, are all dismissed in a few words, commensurate with their present trifling importance, and then the gold districts of the Kaap series of rocks are approached, the first place in which is naturally taken by the Witwatersrand deposits. Herr Schmeisser is careful to point out that these are bedded deposits, although in describing each bed, he subjoins the name of the "reef" by which it is conventionally known. The entire "reef" series is fully described, and a capital table given of the various mining companies in the order in which they are situated along the main reef. For the first time we have a really exhaustive scientific description of the constitution of the famous Witwatersrand conglomerate. According to our author these are true quartz conglomerates, the pebbles being cemented by a mass of granules of the same quartz held together by a binding material of greyish-blue or green colour when undecomposed. The quartz pebbles consist but rarely of individual crystals; they are mostly rather coarsely crystalline, rarely microcrystalline aggregates, the granules showing no definite system of co-ordination. The quartz contains but few solid inclusions, but an extraordinary number of fluid ones, arranged in approximately parallel planes, so as to give sections of the quartz a streaked appearance. The microscopic structure of these pebbles, as well as their frequently flattened outlines, point to strong mechanical action, in all probability due to pressure, the effects of which are also seen in the cementing material. This latter contains, in addition to small grains of quartz, the following minerals:—Pyrites, magnetite, zircon, rutile, muscovite, chlorite, secondary quartz, and native gold. In one specimen tourmaline was found. The pyrites, the most abundant mineral next to the quartz, is a primary constituent of the conglomerate. The gold is a secondary component, and is not of alluvial origin, as is shown by its crystalline form, and the mode of its distribution in the conglomerates—it never occurs, properly speaking, enclosed in the quartz. When it is found in the pebbles it is always in a thin fissure or seam in them. It is evident from the above synopsis that the results of this research have given data of great value in determining the probable permanence in depth of the Witwatersrand auriferous conglomerate beds. Herr Schmeisser's calculations as to the probable duration of the working of, and the amount of gold available in the best known portions of the Witwatersrand goldfields were published in the German "Reichsanzeiger" for February, 1894, and were almost immediately translated into English. The results of these calculations will probably be fresh in the memory of our readers, and we need not therefore refer to them again.

The remaining goldfields of the Kaap formation, namely, those at Klerksdorp, Vryhied, and Lydenburg are briefly described; the latter perhaps not quite so fully as their geological, apart from their industrial, importance might seem to merit. There is also a brief account of the coal seams that are worked in certain of the Karroo formations, and a mention of other mineral occurrences—notably those of silver—closes this valuable chapter.

The third chapter comprises an account of the mode of extracting the various metals and minerals. It contains a short but fairly correct history of the rise and progress of mining in the Transvaal, and an excellent summary of previous legislation on the subject and of the existing gold law. The methods of mining are next described, and then the system of stamping and gold extraction. This is perhaps the weakest portion of the whole book, as many details of importance are omitted, and a few inaccuracies have crept in. It is interesting to note that the author estimates that during 1893 there were, on an average, 1955 heads of stamps at work in the Rand, and that their average crushing capacity was three tons per head per diem. He also refers briefly to other crushing machinery, concluding his paragraph on this subject with the pregnant remark that "the Huntington mill at the Wolverdon Gold Mines near Klerksdorp only ran for two days." A few pages are devoted to an account of chlorination and of the cyanide process. The description of the latter is good, but contains nothing novel. With regard to the machinery employed on these fields, our author states:—"The whole of the colossal requirements of the Transvaal as regards machinery is supplied by English and American manufacturers; but few German manufacturers or contractors are represented in Johannesburg. Hence, English and American makers are so busy *that they cannot themselves execute the orders, but are compelled to obtain assistance from Germany*. The Buckau Machine Works were lately building a 600-horse power driving engine to the order of Messrs. Fraser and Chalmers, of Chicago, for the stamp mill of the City and Suburban Gold Mines, near Johannesburg." The italics are our own.

The work concludes with a series of valuable tables, showing the output and financial position of the various Transvaal gold mines, and with a number of maps showing the general position and features of the various goldfields.

As we have already said, this is by far the best work on the subject we have yet seen, and perhaps the only one that can be considered as a serious scientific book. There are, nevertheless, one or two points on which we are not at one with the author. We cannot, for instance, admire his inclusion of all weathered rocks within the comprehensive term of Laterite, the same name being applied indiscriminately to weathered diorite and to weathered stratified rocks. It may be convenient to call the various deposits treated by hydraulicking at Spitz Kop, Rosshill, and Lisbon, Berlyn laterite, but it is certainly not scientific, and as regards the last-named property absolutely incorrect, even with the very elastic meaning here given to the word. Again, we cannot agree in the opinion here expressed that closer concentration by mechanical means—the German system of close dressing—is beyond doubt desirable. The author ascribes its absence to the influence of American mining engineers, who, he says, are not acquainted with such accurate dressing operations in their own country. We are not concerned in defending the American as against the German system of ore dressing; on the contrary, we hold the latter to be, generally speaking, the better. But in treating gold ores, too many dressing operations must be avoided if float gold is not to be lost, and we ourselves do not look for any improvement in the treatment of tailings in this direction. Nor do we agree with the condemnation of Frue Vanners, for the reason that they make only two classes and no middlings; this may not suit the ordinary concentrator, but it is, on the contrary, precisely what the gold miner wants. He only wants two classes—clean concentrates containing all the gold, and clean tailings containing none. Experience so far is against carrying dressing operations too far in the case of gold ore, although a certain degree of sizing would no doubt be found beneficial. We rather venture to think that the attention of gold-mining engineers will be directed in the near future to the question of treating all the tailings direct as they leave the plates by some chemical process that shall remove the gold left in them after amalgamation; and we believe that such a process is quite within the bounds of engineering science.

In conclusion, it remains only to say that all engineers are greatly indebted to Herr Schmeisser for having produced such an admirable work on a subject of general interest, as well as to the German Government for having given the incentive to it, and as we are not likely to get anything of the kind done for us in this country, we hope it will not be long before the work will appear in an English dress that will make it readily accessible to the mass of English engineers who would be glad of an opportunity of studying it. It is, however, to be hoped that any English translation will be furnished with a good alphabetical index; the absence of any index at all is a very serious blemish on the present work.

*Continuous Current Dynamos and Motors.* By Frank P. Cox. New York: The W. J. Johnston Co., Ld.

*Electric Light Fitting.* By John W. Urquhart. London: Crosby Lockwood and Son.

*Electro-Magnetism and the Construction of Dynamos.* Vol. I. By D. C. Jackson. New York and London: Macmillan and Co. 1894.

The work upon dynamos by Mr. Cox is intended as an elementary treatise for students, and is really a valuable book. It deals with no particular type of machine, but is a general consideration of the laws governing the design of direct-current dynamos and motors. The book is not burdened with cuts of the external appearance of machines, but discusses the principles which underlie the design of the separate parts. It is only assumed that the reader has a knowledge of algebra and of the elements of geometry. After describing the systems of measurement and the theory of the production of current, the author proceeds to calculations appertaining to the magnetic circuit, and deals first with the determination of the induction by the methods of Gisbert Kapp and of Drs. J. and E. Hopkinson, of which the author prefers the latter method. In the following chapter, the theory of winding, losses, &c., are discussed, and important use is made throughout of the system of plotting curves to represent results.

A good feature in the book is the practical application of the principles and formulæ which have been discussed to the actual design of dynamos and motors. The author supposes the case of a 200-light dynamo required to develope 110 volts at a speed of 1500 revolutions per minute, and very clearly explains his method of calculation. The last two chapters of the book are devoted to the action of steam in an engine, which is, of course, a subject which should be known for dynamo testing. In a table of belting, in the form of an appendix, we note that the author uses the word "strain" throughout where he means "stress." The book should be of considerable interest to young draughtsmen in the offices of dynamo builders.

Mr. Jackson is the professor of electrical engineering in the University of Wisconsin, so that we are able to compare two American methods of treatment with one another. This work has been developed from the lectures delivered by the author to his classes in dynamo construction. No special machines are described or illustrated, and only continuous current types are dealt with. Alternating work will be dealt with in a subsequent volume. A knowledge of the calculus and trigonometry is required to understand parts of this work.

In his description of experimental methods for the determination of the magnetic properties of iron the author alludes to a modification of the Hopkinson apparatus made by a Mr. Burton for the laboratory of the University of Wisconsin, the magnetising coil being placed upon the yoke instead of on the test piece.

Ewing's work is followed, and the results obtained are plotted. Both this work and that of Mr. Cox are very well printed. The author pays a great deal of attention to compensation for cross turns, and alludes to a number of different designs of winding. From the point of view of the Professor, he appears to desire to sort machines into families and species, and to fit each type with its special formulæ. Perhaps it is too much to say that some Professors are interested in the various types for the sake of the pleasure of producing formulæ, but the commercial aspect of the question is distinctly absent from the greater part of the work.

Mr. Urquhart has written several books upon electrical subjects; they are descriptive works, not dealing with formula or analysis at all. No mathematical knowledge is needed to read them, and the author writes for the intelligent workman engaged in electric lighting, or training for it; he claims the book to be the notes of a practical electrician. We see that the usual allowance of breadth of belt is said to be 1in. per horse-power, for belting moving at a speed of 1000ft. per minute. This is certainly on the safe side, as few belts come up to this requirement in practice. The rule is stated to apply to belts from 3in. to 12in. in width. The brush-moving device spoken of as suggested by a Mr. R. Tatham was patented some years ago by Mr. Druitt Halpin, and we believe was used in several cases. The practical directions concerning care of the dynamo and attention to the commutator, re-wiring, &c., are well written, and the notes as to attention to alternators are very valuable to dynamo tenders. In instructions for testing the insulation of electric wiring, the author alludes only to the Wheatstone bridge method, and describes in detail the method of using the Silvertown set. This is, of course, very useful for telegraph work and cases in which a low potential will eventually be used, but it is not nearly so satisfactory, in our opinion for circuits which will be supplied from the public mains, where a magneto machine and Evershed ohmmeter are distinctly preferable.

In his chapter upon the lighting of ships the author gives some useful hints, and recommends screw socket lamps. We have often thought it strange that in the United States the screw socket should be practically the only type in use, while here the pin socket is almost the only one employed. The explanation adduced by some electricians, that screw socket holders tend to slack back from vibration, can have little point if this pattern is considered best for steamships.

## *BOOKS RECEIVED.*

*Tramways, their Construction and Working.* By D. Kinnear Clark. London: Crosby Lockwood and Son.

*Recent Cotton Mill Construction and Engineering.* By Joseph Nasmith. Manchester and London: John Heywood.

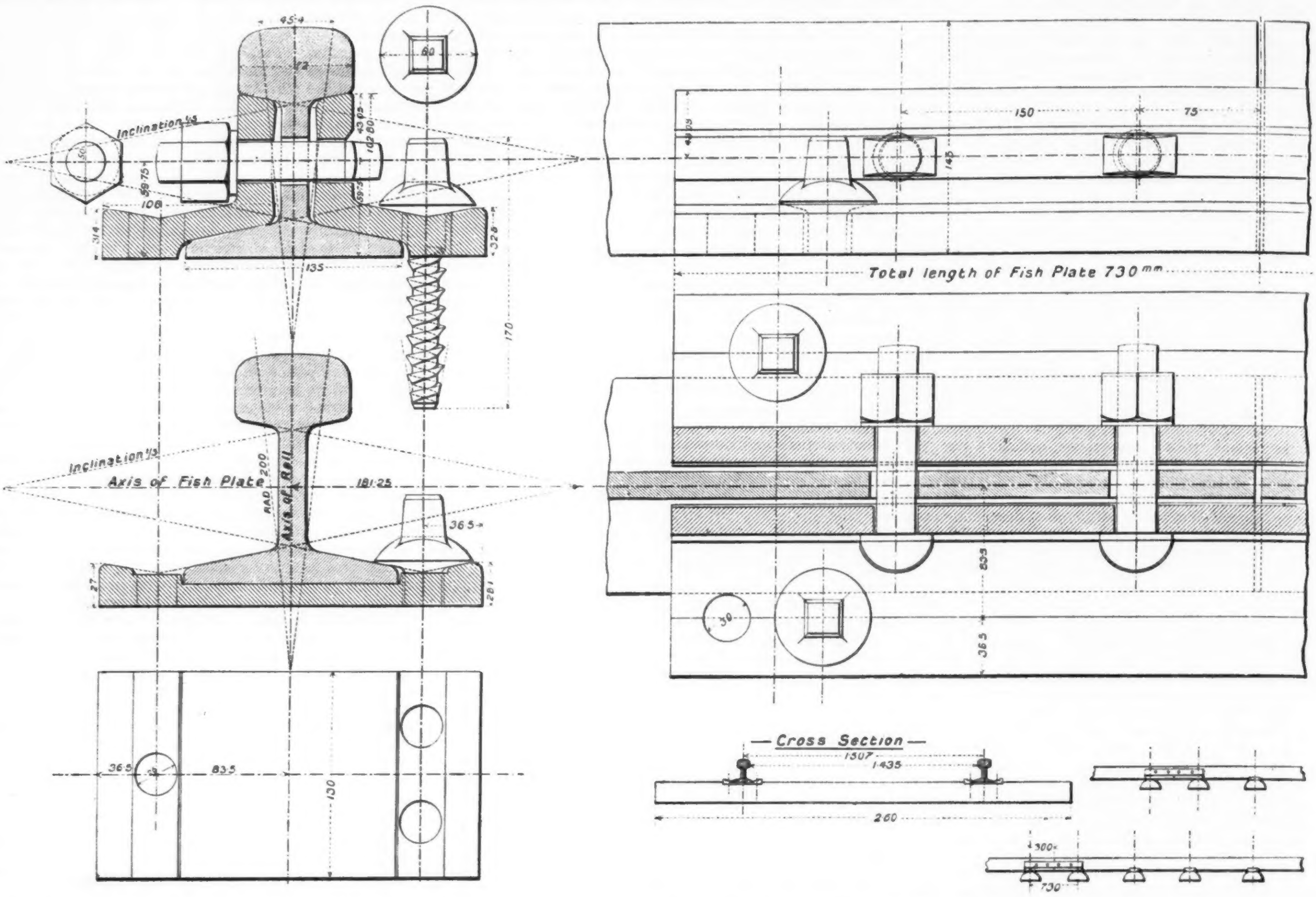
*What is Heat? A Peep into Nature's most Hidden Secrets.* By Frederick Hovenden, F.L.S., F.G.S., F.R.M.S. London: W. B. Whittingham and Company. 1894.

*Electric Light and Power.* Giving the result of practical experience in central station work. By Arthur F. Guy A.M.I.E.E. Illustrated. London: Biggs and Company.

*Electric Transmission of Energy and its Transformation, Sub-division, and Distribution.* A practical handbook. By Gisbert Kapp M. Inst. C.E. London: Whittaker and Company.

## THE LATE MR. J. H. OSBORNE, C.E.

The death is announced at his residence, Summerseat, near Philadelphia, of Mr. John Humfrey Osborne, who has been a prominent civil engineer in the United States for over half a century. He was born in Dublin, September 30th, 1818, being the second son of R. D. B. Osborne, barrister-at-law, and Lucy Caulfeild, only daughter of John Humfrey, of "Killerig," co. Carlow, and was a direct descendant of Sir Edward Osborne, of Ashford, Kent, Lord Mayor of London, 1583, and of his grandson, Thomas, first Duke of Leeds. Mr. Osborne was educated at Mr. Richard's school, Bathampton, and on leaving school travelled widely, visiting Australia among other countries. In 1839 he went to the United States, and became confidential secretary to Mr. Wirt Robinson, chief engineer of the Philadelphia and Reading Railroad. From that time he threw himself ardently into the profession of engineering, and rose to be chief assistant in 1843. Three years later he was appointed chief engineer of the Philadelphia and Reading Railway, but resigned that position later on to join with his brother, Mr. R. B. Osborne, in the construction of the Waterford and Limerick Railway. Returning to the United States in 1850, he was appointed to the Ogdensburg and Lake Champlain Railway, and the next year took charge of a portion of the construction of the Southside Railway in Virginia. From 1852-3 he was superintendent of the Richmond and Danville Railway, and on resigning that post, to become associate chief engineer and superintendent of construction of the Camden and Atlantic Railway, was presented with a massive service of plate as a mark of the affection and esteem in which he was held. After the opening of the Camden and Atlantic Railway in 1854 Mr. Osborne became its general superintendent, but resigned four years later, to take charge of the construction of the most difficult section of the Lebanon Valley Railway through the counties of Berks and Lebanon, Pennsylvania. In spite of great difficulties Mr. Osborne completed this work to the day and publicly received the congratulations and thanks of the president and board of directors. In 1858 he also rebuilt the Quakake Railway, uniting the Lehigh Valley, Black Creek branch, with the Catawissa Railway above Tamaqua, and with his brother, Mr. R. B. Osborne, made a survey for the continuance of this line into the Mahanoy coal fields. In 1873 he also undertook with Mr. R. B. Osborne an extensive barometrical survey for the Shenandoah Valley and Ohio Railway from Harrisonburg, Va., over the Great Northern and intervening mountains, crossing the Alleghanies into the Valley at the head waters of the Greenbriar River. Mr. Osborne continued from time to time to take an active part in his profession to which he was most devoted, but for the past twenty years practically lived in retirement at his country place Summerseat, between Philadelphia and New York—one of the oldest and most interesting residences in the United States. The house, built over a century and a-half ago by an English gentleman, Captain Barclay, was the headquarters of Washington before the battle of Trenton, and the rooms he occupied and in which he wrote many of his despatches are often visited for their historical associations.



CROSS SLEEPER PERMANENT WAY, BELGIAN STATE RAILWAYS

## PERMANENT WAY: BELGIAN STATE RAILWAYS.

Of the 2000 miles of line which form the system of the Belgian State Railways, 500 are called "International." There is probably no European country which has more through traffic than Belgium. Ostend has long been the rival of Calais for conveying English and American travellers to Germany and Austria; whilst Antwerp, as the chief commercial port of Central Europe, receives each year larger quantities of goods in transit for these countries. Traffic from Holland to France naturally passes through Belgium, and the railway through Luxemburg, which nearly served as as the pretext for a war between France and Prussia in 1868, has long been considered one of the main highways of Europe.

Before 1880, the rails used on all lines belonging to the Belgian Government weighed 76 lb. to the yard. The sleepers were of creosoted oak, half round, 10in. diameter, and 8ft. 6in. long, and there were ten of them to a 30ft. rail. Ordinary flat fish-plates were used, with four bolts. As the traffic became heavier, it was requisite to increase the strength of the permanent way. The section of rail was not changed, but in 1881 twelve sleepers were substituted for ten, and soon afterwards angle fish-plates, instead of flat. Meanwhile the weight of the locomotives necessary for express trains was continually augmented, till, in 1885, engines were being used in which the load on each pair of driving wheels was fifteen tons. It was then decided that the permanent way on the sections carrying international express trains would require to be completely reconstructed, and M. A. Flamache, Chief Engineer of the Belgian State Railways, was authorised to make an experiment, by re-laying two miles of the track between Antwerp and Brussels in whatever manner he thought best, using a rail which should weigh about 100 lb. per yard. He kept to the Vignolles section, but adopted a rail 5⅝in. high, 5⅜in. flange, with head 2⅞in. wide, and weighing 105 lb. per yard.

From experiments which he had been carrying on for some time, M. Flamache decided that screws were better than spikes, and that the form of screw shown in the drawing was the most suitable that he could adopt. It will be observed that the screw is cylindrical, not taper; that the pitch of the thread is ½in., which is unusually large for a screw whose diameter, measuring over the thread, is less than an inch; and that, instead of the upper and under surfaces of the thread tapering equally, the former is almost horizontal. M. Flamache's experiments led him to believe that this form of thread not only held better, but did less damage to the grain of the wood, than when both sides of the thread tapered equally. The conical shape given to the underside of the head, he also considered to be advantageous to the stability of the line. The diameter of the sleepers has been increased from 10in. to 11in., and their average distance apart is 2ft. 6in. centre to centre. This distance is diminished to 2ft. at the joints, whilst the fish-plates are 2ft. 5in. long. The rails are always vertical, and, except at the joints, there are plates between the rail and the sleeper.

Between Antwerp and Brussels the track is tolerably level; but on some parts of the system, and especially on the Brussels, Namur, Arlon, Sterpenich sections, there are inclines of 1 in 62, and even several of 1 in 55. On this branch, the weight of engine and tender is 83, and sometimes 88 tons; an increase of 40 per cent. over the weight of those formerly in use. It was calculated that a 95 lb. rail would be sufficient for these engines, but the 105 lb. was adopted to allow for rust, &c.

The first section of two miles was put down on the Brussels and Antwerp line in May, 1886. In 1888 another six miles was added to this, and as the new track was considered satisfactory, it has been substituted for the old, at the rate of 100 miles per annum. In the latter part of 1892 part of the permanent way laid down in 1886 was taken up and examined. Several of the sleepers which, as far as could be judged by external appearance, seemed the worst, were sawn through the screw hole. In all of them the thread was in a perfect condition, though it is calculated that 170,000 trains had passed over that section of the line since the new track had been laid, including fifteen express trains daily, and heavy goods trains, frequently with wheels on the brake-vans worn into flats. Altogether M. Flamache estimated that this test was equivalent to thirty years' work on any average continental line. M. Léon Bika, Chief Engineer of the Belgian State Railways, says that they continue to be thoroughly satisfied with the new road, and that the duration of the sleepers is much longer than they had expected.

## ON THE HEATING POWER OF SMOKE.

By R. R. Tatlock, F.R.S.E., F.I.C., F.C.S.

It appears to be generally understood that a large percentage of fuel is lost in the smoke which issues so abundantly from most chimneys, and random statements have been made to the effect that the loss in heating power due to this passing away of combustible matters in smoky furnace gases may reach as high as 30 per cent. of the whole. A little consideration, however, will show that the loss of any large percentage of combustible matter, and consequently of heating power, is quite out of the question. This may be proved in two ways (1) by calculation of the two sources of heating power as shown by an analysis of coal or dross used for steam raising; and (2) by actual analysis of the furnace gases for combustible solids and gases. In the following paper are given the results of these two methods of observation, the same dross being analysed and also employed as fuel in a works furnace, from which smoky gases were given off which were tested for combustible matters.

(1) The following is the analysis of the dross employed:—

| | |
|---|---|
| Gas, tar, &c. | 37·63 |
| Fixed carbon | 49·97 |
| Sulphur | ·40 |
| Ash | 2·72 |
| Water | 9·28 |
| | 100·00 |
| Heating power (practical) due to gas, tar, &c. | 1·16 |
| " " " fixed carbon | 6·49 |
| | 7·65 |

The points to be observed are the relative proportions of heating power—represented in the analysis by the number of pounds of water at 212 deg. Fah. capable of being evaporated to dryness by 1 lb. of the fuel—given out respectively by the combustion of gas, tar, &c., and by fixed carbon. These are calculated according to Playfair's well-known formula, which was practically tested on coals intended for the British Navy, and which shows that while 1 lb. of fixed carbon is capable, when burned, of evaporating 13 lb. of water at 212 deg. Fah. to dryness, 1 lb. of the gas, tar, &c., will only evaporate 3·1 lb. From these figures it appears that in this coal or dross the gas, tar, &c., only contributes 15 per cent. of the total heat given out during the combustion, and that the fixed carbon produces the remainder, or 85 per cent. In coals with less of the former ingredients and more of the latter, which is commonly the case, the proportion given out by the volatile constituents would be considerably reduced. It is thus perfectly clear that even though the whole of the volatile matters—which can alone be accountable for any loss of combustible material—escaped combustion, there could not possibly be a greater loss of heat than 15 per cent. of the whole, even in such an extreme case as this represents.

(2) An analysis was made of the furnace gases given off during the burning of the dross, of which the results are given above, with the following results:—

| | Gas very smoky. Per cent. by volume. | Gases almost free from smoke Per cent. by volume. |
|---|---|---|
| Carbonic acid | 5·0 | 3·5 |
| Carbonic oxide | None | None |
| Hydrocarbons | Trace | None |
| Nitrogen | 79·9 | 79·9 |
| Oxygen | 15·1 | 16·6 |
| | 100·00 | 100·00 |

It has been asserted that carbonic oxide is given off in considerable quantity when much smoke is being produced, but it does not appear in this case; and Hempel in his work on "Gas Analysis" comes to the conclusion that little or no combustible gases are present in furnace gases. In the volume referred to—page 205—Hempel says, "Furnace gases usually contain only carbon dioxide, oxygen, and nitrogen. All other gases are present in but very small amounts. In oft-repeated analyses the author has always found only traces of carbon monoxide, methane, and the heavy hydrocarbons." This is in complete accord with the analyses given above, and it may be taken for granted that the presence of carbonic oxide or other combustible gases in furnace gases is a most unusual occurrence. This is quite conclusive evidence that no appreciable loss of heat, even when the furnace gases are smoky, can be attributed to the passing away of the products of imperfect combustion in the gaseous form at least.

That there is loss of combustible matter in the smoke is an undoubted fact, but the quantity seems also to be greatly magnified in certain random statements. In the experiment referred to above the soot was also collected during 1½ hours with the following results:—

| | Grains per 100 cubic feet of furnace gases. |
|---|---|
| Carbonaceous matter | 30·81 |
| Ash or mineral matter | 20·65 |
| Total soot | 51·46 |

It will be observed that the soot collected consisted largely of mineral or incombustible matter. In several experiments to estimate the soot in furnace gases, similar results to these were obtained, and the average would come very close to the quoted results of this special test. To find how much carbonaceous matter was actually lost as smoke it will be necessary to know the number of cubic feet of furnace gases given off by the combustion of, say, one ton of the dross. If the percentage of carbonic acid in the furnace gases is taken at 5 per cent., the total volume of these given off from one ton dross would be about 940,000 cubic feet measured at the ordinary temperature and pressure, and this would contain 41 lb. of carbonaceous matter and 27 lb. of mineral matter. This would represent 1·83 per cent. of the volatile matters—gas, tar, &c.—given in the analysis of the dross, and if from this is now calculated the heating power according to Playfair's formula, it will only come to 0·057. This figure, compared with the practical heating power—7·75—of the dross, goes to show that the solid combustible matter of the smoke can only account for the very small percentage of 0·74 of the total heating power which can be obtained from the coal.

From the results of these experiments it is evident that the loss of combustible matters in smoke is very small indeed, and that the belief in immense loss by this cause is simply a fallacy, and is decidedly not corroborated by experiment. In adopting methods of removing the smoke nuisance it must therefore be borne in mind that there is little or no gain in burning smoke, and that other methods of dealing with the problem, such as Dulier's Smok Absorption process, ought also to receive consideration.

The Birmingham Association of Mechanical Engineers.—The opening meeting of the session of the above Association was held on Saturday last at the Grand Hotel, Colmore-row, Birmingham. The chair was taken by the president, Mr. E. Hazel, and there was a large attendance of members.

## LANCASHIRE AND YORKSHIRE RAILWAY WIDENING AT SALFORD.

To meet the demands of increased traffic, the Lancashire and Yorkshire Railway obtained parliamentary powers in 1890 for the widening of its line from Victoria Station, Manchester, to Hope-street, Salford, a distance of about a mile and a-half, and in April, 1893, a start was made with the demolition of existing house property which would require to be removed. As the route passes through a thickly-populated district, it has been found necessary to destroy about a hundred houses and shops, the old materials from which have been utilised in the foundations of the new viaducts. We give a plan showing the portions which are now being proceeded with, embracing about one-half of the projected undertaking. It will be seen that the Lancashire and Yorkshire Railway runs immediately alongside of the Manchester and Liverpool branch of the London and North-Western Railway, which latter has its terminus at the Exchange Station, while the Lancashire and Yorkshire principal station is at Victoria. Covering an area of 7½ acres, Victoria Station forms a busy nucleus of traffic; 1170 trains enter and leave it in one day, 350 of these by the lines which are now being widened. The original station of the Manchester and Leeds Railway, the forerunner of the Lancashire and Yorkshire, was at Oldham-road, the present site at Hunt's Bank being privately purchased by Mr. Sam Brooks, the vice-chairman of the company, and presented by him to the railway company in August, 1838. The station was opened on New Year's Day, 1844, and a junction with the Liverpool and Manchester line was soon effected. Between 1880 and 1884 various extensions were made, and there are now eight distinct platforms arranged in consecutive order from south to north, and dealing principally with traffic to and from the North of England and Scotland. The two chief arrival platforms are placed nearest the main approaches.

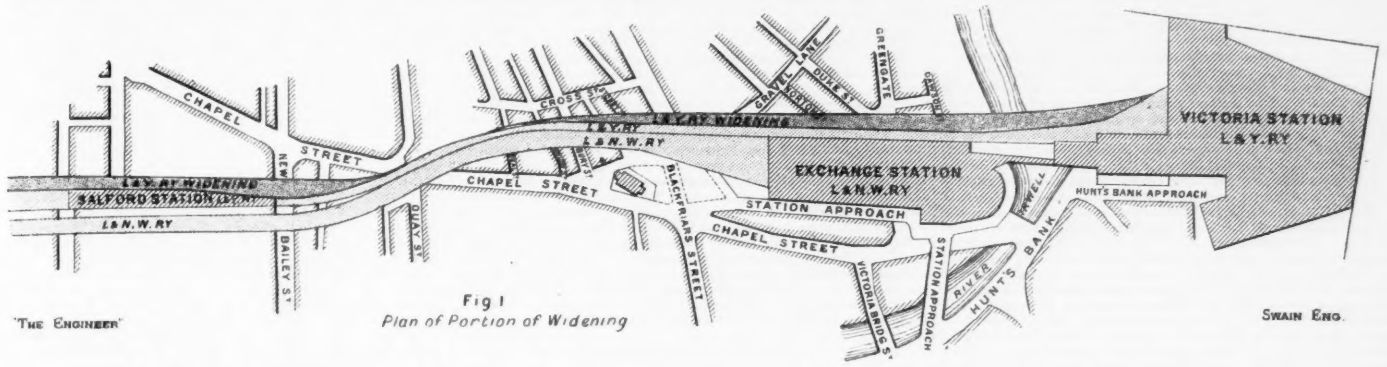


Fig 1
Plan of Portion of Widening

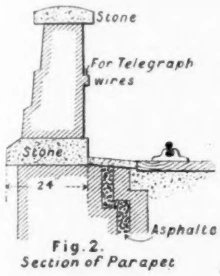


Fig. 2.
Section of Parapet

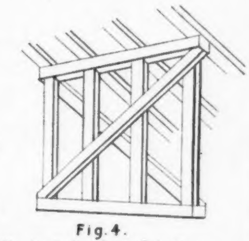


Fig. 4.
Shewing the Four Ribs of the Centre for Arch.

The present widening passes over a number of small streets, necessitating an expensive construction. Between Victoria Station and the crossing of Chapel-street, a distance of about half a mile, thirty-five brick arches have been built. They have generally a span of 28ft., with a rise of 10ft. The foundations are all carried down to the solid rock, which was found at depths varying from 20ft. to 4ft. below the surface. The piers are mostly lateral extensions of the old piers, and are built of common red bricks in lias lime mortar, or cement mortar, composed of one of cement to two of clean engine cinders. They are faced with blue bricks, and ashlar quoins are provided to the street abutments. The springers for the arches are specially made of blue brick, as recent experience has shown that in case of fire the blue brick is much less liable to damage than springers of stone, and, as most of the arches are closed in and glazed in the upper part to serve as stores, the danger of fire is one which it is necessary to guard against. The arches are constructed mostly in five half-brick rings, the two soffit rings being in blue brick, and the three outer rings in common brick. The spandrils are filled in with common brickwork, and the whole of the top surface is covered with 2in. of cement concrete and a layer of asphalte. A stone string course 24in. by 9in. runs the whole length of the face; above this the parapet wall is built, battered on the face, and having two plinth courses, as shown in Fig. 2. In order to prevent the brickwork from being damaged by drainage from the ballast of the line, a cavity is formed in the brickwork, as shown in the illustration, and run in with asphalte.

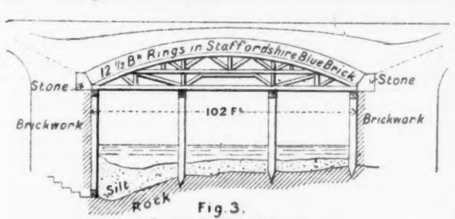


Fig. 3.
Centre for Brick Arch

There are several steel bridges included in the undertaking, the largest having a span of 63ft., and of the cantilever type. The others possess no features of special interest. One of the most interesting of the bridges is an unusually large segmental arch in brickwork carrying the railway across the river Irwell. It has a square span of 102ft., and a skew span of 105ft., with a rise in the centre of 13ft. 6in. The arch is composed of twelve half-brick rings of blue Staffordshire bricks, with springers of Derbyshire gritstone. The abutments are founded on the solid rock, which was dressed with the help of cofferdams. As the centreing alone for an arch of this size constitutes a work of some importance, it was determined to test its sufficiency by constructing a model of the centreing to scale, and applying various loads. A wooden model, one-twelfth natural size, was made, having four ribs, as shown in the Figs. 3 and 4. This was loaded with rings of blue bricks laid dry, with the interstices filled with sand; additional layers of bricks were added until thirteen rings were borne by the model without any excessive deformation, and no fears were felt that the actual centreing would not be strong enough for its work. This confidence was happily justified, and the bridge takes rank amongst the largest brick arches that have been constructed.

---

## RUSTLESS COATINGS FOR IRON AND STEEL.*

By M. P. Wood, New York City, Member of the Society.

(*Concluded from page* 308.)

One of the most trying situations for the protection of his work that the engineer has to deal with is in the exposure of wrought or cast iron water and gas pipes, through the cinder beds or fillings from blast furnaces, rolling mills, &c. Pitch compounds applied hot afford some measure of protection over that of the naked iron, but the creep of the pipes due to changes in the temperature of the fluids passing through them, and of the surrounding earth, the concentrated action due to the sulphur in the cinder or ashes, the porous nature of the covering over the pipe and in which it is embedded, allowing the ready access of air and moisture from the streets, ammonia, and other fumes and liquids due to the decomposition of a score or more of different bodies, all aided by the vibration caused by the passage of heavy trucks, railway trains, and kindred causes, combine to render the problem one not easy of solution. A thick puddle of good clay of a thickness all around of at least one-half the diameter of the pipe, and in case of pipes under 8in. or 10in. diameter, the thickness should be equal to the diameter of the pipe, if allowed to dry out well before covering in, gives a good protection and aids materially whatever compound is applied externally to the pipe. I do not know of any case where the pipes coated with magnetic oxide by the Bower-Barff or any other process has been tried, but it seems to the writer that if there was any situation in which the merit of the process could be demonstrated this is one, and it is not one of minor extent or importance. The rapid destruction of the wrought and cast iron mains, as well as the galvanised iron and lead service pipes of our water and gas distribution systems, by electrosis brought into action by the use of the system of pipes as a ready ground connection for our extended and fast multiplying lines of electrical service, is assuming so serious an aspect, particularly upon streets or locations where electrical railways are in use, as to call for serious consideration by all branches of the engineering fraternity for some method of protection other than now in use. So rapidly is the destruction progressing, that in many places the utter prostration of the water and gas systems may be looked for within the next decade. Pipes now affected, removed and replaced with new, but pass the corrosion further along to other and weaker points in the line, until the whole system is becoming honeycombed with points ready for failure on a little change in the ordinary working conditions. The return current from the single wire trolley system of electrical car lines appears to seek out and take for its passage back to the power house the pipe system contiguous to the line, instead of using the ground wire connections provided for it. The use of the electric motor now contributing so much to the comfort and conveniences of life in the form of electrically-driven ventilators, pumps, elevators, and other small powers, is rapidly extending the evil. The remedy, if not provided by the electric light, heat, and power companies in the form of taking better or sole care of their product from its generation to its extinguishment, will ere long be found in mulcting them for damages so heavy that the small margin now existing between the dividend point and a receiver will be wiped out.

Some experiments on a small scale of the Bower-Barff magnetic oxide application to pipes and iron exposed to electrosis action, appear to indicate its ample protective power. What it would develope upon an extended system of gas or water service remains to be tried. The iron pipes and connections, if protected by this process, would still leave the lead joints and lead service pipes exposed to attack. Cement joints might obviate part of the evil, but would render the main pipe line too rigid in withstanding changes of temperature, and expansion joints are not to be considered in pipe lines of hundreds of miles in extent. The electrical engineers as a body appear to have given this question only a sort of a happy-go-lucky, or after-me-the-deluge consideration; but the hour is not far distant when they will be walking the floor crying, "what shall we do?" instead of their water and gas brother who is now having his innings. The protective power of lime mortar and hydraulic cement to prevent corrosion in iron and steel under certain conditions has been demonstrated by centuries of actual use; yet the facts thus established are too often ignored by the engineer of to-day. We do not have to turn back many pages of the record book of success and failure to find a remarkable instance of the latter, in the utter collapse of the Bayliss patent wrought iron water pipe, that a few years ago was brought out as an indestructible, unperishable article with a hygienic annex, to take the place of cast iron pipe for water distribution. The pipe in question was made of wrought iron from $\frac{1}{16}$in. to $\frac{1}{8}$in. or more in thickness, according to the size and pressure to which it was to be subjected; formed and riveted together in the shop or worked to shape upon the ground from the sheets, by a portable lot of rolls, punches, and other tools needed, into sections about 5ft. or more in length; these sections being tapering, and if shipped were packed in nest form conveniently and cheaply so far as transportation was concerned. The tapering sections were laid in the pipe trench and lined *in situ* with hydraulic mortar, the large end of the section forming the bell for the small or spigot end, the joint being made with the cement, and the outside of the pipe was also covered with the cement mortar to the depth of an inch or more, all as far as possible at one operation, depending somewhat upon the size of the pipe, the location and the general conditions of the work, setting of the mortar, &c.

The advantages claimed were a continuous pipe from end to end, no matter what its size or length, of uniform strength, lined with a non-corrosive and protective, tasteless, and innoxious cement and guarded from external injury and corrosion from acids in the soil in which it was laid, and atmospheric influences by the same or a similar cement covering. The projectors wholly ignored the difference in the co-efficients of elasticity between the iron and cement, depending upon the integrity of the lining to protect the iron from the water; this lining once broken admitted the water pressure to the iron, the thin riveted joints of which it was impossible to caulk tight, the pressure thus reaching the external coating, which was unable to resist but a small head, cracked and flaked it off, and the destruction of the whole line of pipe followed rapidly, and as a matter of course after but a short period of service, most if not all of the lines being abandoned and relaid with cast iron pipes inside of ten years. In general no attempt was made to coat the iron with zinc or any coating, or to remove the scale of manufacture. When the pipe was thrown out of the trench finally and broken up, the outside coating came away, bringing with it the scale and oxidation under it as a porous plaster on removal takes away all over which it was spread. The connection of the house-service pipes with the main line gave no end of trouble to make and keep tight, and the whole system was a forcible illustration of the importance of those "next to nothings" that so often escape the attention of the best engineers, and bring no end of disappointment to those who are financially responsible for the introduction of the new idea.

Possibly the most extended application for a single purpose of the use of any process other than paint for the preservation of iron and steel exposed to atmospheric attack has been made at Philadelphia, Pa., in the construction of the iron work of the tower of the new City Hall, now under process of erection and nearly completed. I am indebted to Mr. F. Schumann, C.E., President of the Tacony Iron and Metal Co., Tacony, Pa., contractor for the work, for the following data. The *Scientific American* also describes and illustrates the process in the following issues, the data for which was also furnished by Mr. Schumann:—October 22nd, 1892, vol. lxvii., No. 17: "Aluminium Electro-Plating in Architecture." September 9th, 1893, vol. lxix., No. 11: "Electro-plating with Copper." This process is a double one. The first one is designed to protect the iron from rust by an electro-plating of copper of fourteen ounces per square foot of surface, and a finishing coat of an alloy of aluminium and tin of two and a-half ounces per square foot, for colour to harmonise with the stonework of the lower stories of the tower; also to prevent oxidation of the copper into a green coating of verdigris. The process was adopted as a substitute for paint, the periodical renewals of which would cost 10,000 dols. per annum, the primary coat of which was to be boiling linseed oil, in which all material was to be immersed until they had attained the temperature of the bath. The total weight of wrought and cast iron to be protected is about 500 tons, and comprises 100,000 square feet of surface, the largest single pieces being sixteen columns 27ft. long and 3ft. in diameter, weighing 10,000 lb. each. These columns received the copper coating inside as well as outside. The outside coating, being most exposed, is a double one, requiring two operations or baths, while the aluminium coat is given last as the protective coating to all beneath it. The cost of the whole process varies from forty cents per square foot to one dollar, depending upon the shape of the piece—simple plates, rods, angles, &c., costing the least, while curved pieces with large lugs, flanges with core holes, cost the most, the principal expense being the cleaning, the greatest care being necessary to ensure good work.

The capacity of the Tacony plant is about 250 square feet per twenty-four hours of from twelve to sixteen ounce per square foot coating; though some recent improvements by Mr. J. D. Darling, manager of the plating works, has nearly doubled the capacity of the plant, and avoids the trouble from "spit holes," blow holes and stodgy places, that give a great deal of trouble to search out and *solder up*. The electro-plating covering, in these cases, evidently follows the peculiarities of galvanising, where the smallest needle-hole will be coated, but will not fill up the crevice. The manipulation to apply the process necessarily varies with the shape and size of the piece. Suitable cranes, trolleys, hoisting gear, trucks, &c., being provided to handle one of the large columns referred to, the operation of coating it is as follows:—The column is first immersed in a tank containing a strong solution of caustic soda, heated by a steam coil, and is boiled a number of hours to remove all the grease and oil due to the machining process. It is then removed and thoroughly washed in water from a hose, then placed in a second tank and pickled with diluted sulphuric acid until all rust and scale are dissolved and loosened, then thoroughly cleaned with steel brushes and water and goes to the third tank containing the cyanide plating solution, and receives its first coating of copper. It is then removed from the bath and transferred to another tank and given a coating of paraffine wax *inside*, thence to the fourth tank containing an ordinary copper-plating solution, where it receives a heavy coating of copper, about sixteen ounces to the square foot of surface. The paraffin is then boiled off and the column enters the sixth or aluminium tank and receives a heavy deposit of aluminium, two to three ounces per square foot. It is then well washed with pure water and is ready for erection. The columns and other pieces are brought into the electric circuit by wires passing around them like slings, and attached to a conducting brass bar over the tank. In the cyanide tank a current density of 3 ampères per square foot is employed; in the acid tank, 10 ampères; and in the aluminium tank 8 ampères. Separate dynamos for the several tanks are necessary, the developments being 1000 ampères at 6 volts, 2000 ampères at 8 volts, and 4000 at 2½ volts.

Mr. Darling's improvements in the acid solutions enable copper to be deposited at the rate of twenty to twenty-five ounces per square foot in twenty-four hours, that is as malleable and almost as smooth as rolled copper; and copper deposits one-eighth of an inch thick, or ten pounds per square foot, have been made in twenty-four hours. For rolled sheet iron and steel, and in rods and shapes where the surface is free from sand-holes, eight to ten ounces of copper per square foot of surface will be sufficient, while on rough cast iron or steel work fourteen to sixteen ounces will be required. These amounts are greatly in excess of those given in books treating on electro-plating, but practical experience shows that the above amounts are necessary to give a protection that will prevent any appearance of rust, and will last as long as the structure will stand. For inside work when the plating is used more for effect than as a protection, zinc, tin, or aluminium is added to the copper bath to give a bronze appearance, and a coat of two or three ounces to the square foot will suffice. The new Bourse building, to be erected in Philadelphia, will have examples of both kinds of plating. The outside ironwork, windows frames, &c., will have a heavy protective coat of copper, while the inside work will be electro-bronzed.

---

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

In France, when copper plating to protect iron was first used, the copper was not deposited directly on the iron, but on a coating of varnish, rendered conducting with plumbago or powdered copper, applied to the iron surface and allowed to dry. This was done to avoid the difficulties of cleaning the cast iron and the use of two solutions in depositing the copper; as the article, after the varnish was dry and the plumbago applied, was placed directly in the acid solution. This method gives a coating that is not firmly attached, and is liable to be torn off by mechanical injury. The lamp-posts of Paris and the beautiful fountains of the Place de la Concorde and the Place Louvois are examples of this method. The method used in America deposits the copper directly on the iron, and the article so plated may be bent and twisted into any shape without detaching the copper deposit. As it is often asserted that aluminium cannot be deposited from an aqueous solution, the following information, furnished by Mr. Darling, may prove of interest:—"Although aluminium is generally credited with indestructible qualities, and high resistance to corrosion, it has but few qualities that would make it advantageous as an electro deposit upon other metals; for while in a massive state it resists atmospheric action and retains a certain brightness for a long time, when it is deposited electrically from an aqueous solution, which deposit is of necessity of a more or less porous nature, it soon tarnishes and assumes a dull, bluish-white colour, when exposed to the direct action of the elements. But for a protective coat, say for copper, for which use it is used on the city hall tower, it answers very well, as the slight superficial oxidation that takes place protects the metal underneath from further attack, and the neutral colour that it assumes harmonises well with the stone work of the tower. Aluminium is no doubt more difficult to deposit than any other of the common metals. This is because of the high voltage necessary to decompose aqueous aluminium solutions, and the tendency to redissolve after being deposited. We have not got the thermal data required to calculate the potential difference or electro-motive force necessary to decompose the different aqueous solutions of aluminium, but reasoning from analogy, it must be several volts in each case, and as water requires only a minimum electro-motive force of 1·5 volts to decompose it, it would seem at first glance that a compound which requires over two volts for its decomposition in aqueous solution would involve the decomposition of the water, and therefore would be impossible. But in reality this is not so, as may be seen in the case of the caustic soda, which requires over two volts. Yet sodium may be obtained by its electrosis if mercury be present to absorb it and protect it from the water. The fact is, that when two substances are present requiring different electro-motive force to compose them, if the electro-motive force is high enough to decompose the higher compound, the current is divided between them in some ratio decomposing them both, and I find by using a solution of aluminium that has but a slight dissolving effect on aluminium, with a density of current of eight ampères to the square foot, with a sufficient high voltage—6½ to 7—aluminium can be deposited on the cathode at the rate of one gramme per hour per square foot, in a reguline state, and with higher currents it can be deposited much quicker, but it will be in a pulverulent state, which does not adhere."

Recent improvements in this process form the basis of a patent for a proposed use of electro-copper plating for the protection of ships' bottoms applied quickly and cheaply in sections, by means of movable and portable baths, the deposits overlapping each other, the entire hull being thus treated during construction, or it may be applied to vessels already built. How effectual this application for the purpose named may prove is a matter of some doubt-owing to the difficulty of thoroughly cleaning the surfaces to be coated, and which appears to be an indispensable condition for success. The irregular contour of the immersed parts of the ship being plated *in situ*, as well as the porous nature of the copper deposit requiring a heavier coating than is absolutely necessary for protection, and whether some insulating or protective compound interposed between the copper and the metal of the ship will be required to prevent electrical action, all are questions to be settled by the slow test of time, which does so much to upset the best laid plans of mice and men. If effectual, the cost of application at even the highest price named by the Tacony people, one dollar per square foot of surface, would be small hindrance to its general adoption, it requiring only about 80,000 dols. to coat our largest war vessel on its inside surfaces, as well as the outside surfaces, joints in the armour, and all places not of ready access for the application of paint compounds.

*Japanese lacquer.*—The adaptableness of this natural vegetable product to the preservation of metallic surfaces, as well as those of wood, paper, and other fibrous bodies, has never received the attention of engineers that the industrial importance of this method of coating and protecting surfaces demands. The general idea that its application is one of art, and is only adaptable to *bric-à-brac*, is wholly erroneous. The Japanese use it for an infinite variety of purposes—acid tanks, coating the keels of ships, highly finished coach and decorative panels, and articles for domestic use, resisting hot water, soap, and alkaline solutions. It may be truly said that were it not for the bamboo and lacquer trees, life for the Japanese would hardly be worth living. There is no reason why the lacquer tree should not thrive in this country. Its sap, which is used as the material for all lacquer work, is a natural essence, and vastly superior to any varnishes used here. Unlike even copal, which is an artificial mixture of resin, fatty oils and turpentine, Japanese lacquer is a ready-made product of nature that hardens into a mirror-like smoothness, never splits nor cracks, and is of great durability. The art lacquer work of Japan is essentially individual, and ought not to be treated as an undistinguishable whole. The superiority of the art work is due not only to the special merit of the material, but also to the care and skill shown by the Japanese in the manipulation of it. There is as wide a distinction between the ordinary lacquer tray, or cabinet of commerce, and the exquisite lacs of the great Japanese artists as between a theatrical poster and a canvas of Raphael. Each of the great masters of lacquer has created a style of his own, and has founded a school of which the traditions have been kept alive by his successors for centuries. At the Centennial Exhibition of 1876, in the Japanese department, there were exhibited plates, pans, &c., evidently of a common quality of lacquer used by sailors and others for domestic purposes; also some samples of a finer grade in trays and cabinet work that had been sunk in the sea over fifty years, and though covered with barnacles and other marine growths, were practically unharmed, so perfectly had they been protected by the lacquer. It seems almost incredible that so valuable an article that can be produced as cheaply as maple sap has remained comparatively unknown in this country and Europe, at least so far as applying it to the palpable protective purpose that nature evidently designed it to be used for.

In conclusion, the whole question of how best to protect iron and steel from corrosion in all the varying conditions that the wants and usages of to-day demand, seems to resolve itself into a category of Don'ts, as the best method of answering it, to wit:—

Don't use anything but common iron. Don't have any scale on that. Don't use anything but the best iron and steel. Don't polish those. Don't paint it with anything but pure linseed oil and oxide of lead or graphite paints. Don't let the air get to it if it is damp. Don't keep it from the air if the air is pure and dry. Don't let sea air, sea water, acidulated or sulphurous, ammonial or other fumes and liquids have access to it. Don't think it unnecessary to protect it in any case, because swords, armour, and other bright articles of iron and steel have been found uninjured by rust after an exposure of over 500 years with no other protection than that afforded by the closed room in which they were placed. Don't think your own product would not under the same conditions last as long as the piece of iron that was walled into one of the burial chambers of the Pyramid, 3000 years ago. Don't put it into any location where it cannot be inspected and its true condition ascertained at any time, by anybody, your successor in the trust not excepted. Don't think that magnetic oxide, electro-plating, enamelling, or any other method of protection, will take the place of constant inspection, even if the coating is fired on by a Columbiad. Don't imagine because Cleopatra's Needle has had to have a coating of wax to protect it, that it is not a good material to apply to other substances than granite. Don't let the cost and interest accounts be the governing factors in the case of protecting any metal superstructure on whose continuity and strength human life and safety depends. The old story of "for want of a nail the shoe was cast, the horse disabled, a battle and kingdom lost," finds too many parallels in the engineering practice of to-day, until in some cases we seem to need protection from the engineer quite as much as from the decay of the materials in which he experiments. Don't imagine that Macaulay's New Zealander, who has sketched the ruins of England's power and greatness, and has come to the New World to see how we have fared from the gnawing teeth of time, will not recognise amidst the ruins of Our Statue of Liberty, Brooklyn Bridge and other monuments of our progress; the ominous streaks and strains due to the corrosion, not only of iron and steel, but that of the better class of metals, and will exclaim, "We are wiser in our generation, and fear not, and can control these forces that like the Arch. slumber not, nor sleep."

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### THE KINETIC THEORY OF GASES.—MAXIMUM MOLECULAR VELOCITY.

Sir,—According to the kinetic theory of gases, as at present understood, the velocities of the molecules of a gas vary from nothing to velocities inconceivably great. On this point, as least, all writers on the subject are unanimous. Maxwell's statement of the above theory is as follows ("Theory of Heat," page 316):—"It appears, then, that of the molecules composing the system some are moving very slowly, a very few are moving with enormous velocities, and the greater number with intermediate velocities." Two questions are naturally suggested by the foregoing statement, viz.:—(1) What is the meaning of the words "very few"; and (2) What is the limit, if any, to the velocity which may be acquired by a molecule?

Confining our attention in the first place to the latter question, imagine a cubic inch of gas at any given pressure and temperature to be isolated in a vessel of that capacity. Now, if all but one of the molecules contained in that cubic inch could by any possibility be brought to rest by their mutual collisions, then, by the law of conservation of energy, the total energy of all the molecules would be concentrated in this single one, and its velocity would become $\bar{v}\sqrt{n}$, in which expression $\bar{v}$ is the mean velocity of the molecules and $n$ their number. Now a cubic inch of hydrogen at 0 deg. C. and at atmospheric pressure is supposed to contain something like three hundred million million millions of molecules ($3 \times 10^{20}$) and the velocity of mean square is said to be about 6000ft., or rather more than a mile per second. From this it is easy to calculate that the velocity of this single molecule, if hydrogen is the gas selected, would be considerably more than seventeen thousand million miles a second, or more than eighty-five thousand times the velocity of light. If air instead of hydrogen had been selected for our illustration, the velocity of the single molecule would still have been, roughly speaking, twenty-one thousand times the velocity of light. Enormously great as is this velocity, yet according to the present theory, unless some qualification be introduced, it is not impossible, and indeed far higher velocities than this may very fairly be supposed to exist in an enormous body of gas like that of our atmosphere. Consider, for example, a thousand cubic yards of air, which is only a small volume when compared with the entire volume of the atmosphere. One thousand cubic yards contain 46,656,000 cubic inches. Hence in a volume of air of this magnitude, if only one molecule in every 46,656,000 lost all its velocity in the manner described, the mean velocity of all the others save one remaining unchanged, it would be quite possible, and in fact necessary, for that one molecule to have the enormous velocity above mentioned.

We will now pass on to consider these enormously high molecular velocities from another point of view, viz., that of the kinetic energy they represent. This is rendered necessary, since Lord Kelvin and others have demonstrated that molecules cannot be considered inconceivably small. A molecule moving with half or a quarter, or even with a much smaller fraction of the velocity given above must be considered as a missile having a measurable quantity of kinetic energy or stored-up work in it. The kinetic energy contained in a cubic inch of air at standard pressure and temperature, neglecting for the present the internal energy of the molecules, is, according to the usual estimate, about 1·8 foot-pounds. If the whole of this energy were to be concentrated in one molecule, as would happen if it were moving with the velocity above mentioned, it is curious to reflect on what the probable result of an impact from such a missile might be on the human frame, for example. Imagine the point to be broken off a needle and to be made to strike with the above-named energy. If the point weighed a quarter of a grain its velocity would be about 1800ft. a second. It is impossible to doubt that such a missile would penetrate a considerable distance into one's body, probably passing through the flesh and bone and whatever else came in its way. But a molecule of gas is far better adapted for penetration than even the point of a needle. For it is the concentration of energy on a very small surface, combined with hardness, that causes a needle point to penetrate with such facility. But the diameter of a molecule is quite insignificant when compared with that of the finest pointed needle; and hardness is one of the predicated characteristics of gaseous molecules. Can it be, as Sir Lucius O'Trigger is made to remark in "The Rivals," that "a ball or two may pass clean through your body and never do any harm at all"? Is it possible that one of these rapid-moving molecules may pierce through and through the whole length of a nerve without causing one the least inconvenience, even without our being aware that anything had happened, although the slightest touch of the same nerve by anything else would cause acute pain? If these questions can be answered in the affirmative, what are we to think of the effect of impact from such missiles on inanimate objects—the glass windows of our houses, for example, or the pictures on our walls? The mere framing of such questions, arising as they do of necessity from the kinetic theory of gases, should be sufficient to make one hesitate to admit its truth without some modification of a nature to render the existence of these high velocities either impossible or, at the very least, extremely improbable.

So far only the translational energy of the molecules has been considered. When, however, the vibratory energy of the molecules is also taken into account, the result is still more unfavourable to the theory. Clausius supposes that the vibratory energy of a molecule is proportional to its energy of translation. In the case of air the ratio is said to be 0 634—Maxwell's "Heat," page 327. But as I have already pointed out in a former letter—June 22nd, 1894, page 542—the vibratory energy of a molecule can be nothing else but its sensible heat or temperature. Hence molecules moving with the enormous velocity we have been considering must have a temperature many million times that of one standard temperature. Now it is well known that a mere spark will cause an explosion in a mixture of hydrogen and oxygen. The absolute temperature of such a spark, say, at red heat, or about 1100 deg. C., would be rather less than five times that of standard temperature. Now a molecule moving with rather more than double the mean velocity to a temperature of 0 deg. C., and atmospheric pressure, would have a temperature of about 1100 deg. C., and consequently whenever a molecule attained this velocity in a mixture of hydrogen and oxygen an explosion must inevitably take place. But such velocities as these must occur frequently in even very small volumes of gas; hence, under these conditions, spontaneous explosions must occur immediately gases of this nature are mixed. But this we know is contrary to experience. From considering explosions of gases, one's thoughts naturally turn to gunpowder and other explosives of a similar nature, the safe storage of which would be rendered quite impossible under such conditions. Enough has been said to show that there are strong chemical reasons for supposing that there must be a limit, and that by no means an extensive one, to the possible variations of molecular velocities above their mean value at 0 deg. C. But here at once we are confronted with a fresh difficulty: for if any variation at all is possible, that is, if on a collision occurring between two molecules, it is possible for the molecule moving with the greater velocity to have that velocity increased, what is to prevent this occurring again and again and so occasionally, comparatively speaking, giving rise to velocities inconceivably great? It seems to me that only one solution to this problem is possible, and that, in one word, is "dissociation." It may, however, be urged that a gaseous explosion is simply dissociation followed by recombination. That is certainly true, but it does not follow that the dissociation of the atoms of *a single molecule* of a mixture of explosive gases is necessarily followed by an explosion. It is obvious, for example, in the case of oxygen and hydrogen that at least one molecule of each gas in proximity to each other must have its atoms separated before two atoms of hydrogen can combine with one of oxygen.

If we suppose an explosion in a mixture of gases to spread from the atoms of dissociated molecules impinging against other molecules, causing these to be dissociated in their turn and so on, then it is evident that to start the explosion the dissociated atoms must have a sufficiently high velocity given to them in some way or other for the purpose, and this necessary velocity may be considerably higher than that caused by what may be termed the ordinary velocity of dissociation due to molecular collisions at ordinary temperatures. Considering this latter kind only, as no loss of energy admissible, the transational energy of dissociated atoms must be equal to the combined kinetic and vibratory energies of the molecule immediately before dissociation takes place. But this will be modified by the mutual attraction of the atoms tending to convert the translatory into potential energy, which will, of course, in its turn be available for reconversion into kinetic energy when favourable conditions occur.

If this view of the subject is correct a certain percentage of the total energy in a volume of gas must be always potential. Again, if the velocity of gas molecules is limited in the manner described, it at once accounts for the well-known fact that air or other so-called permanent gas cannot be made experimentally to radiate any light whatsoever when heated. Finally it would seem, if this theory is correct, that in a mixture of explosive gases, such as hydrogen and oxygen, a very slow combination might take place between them without any explosion occurring, the combination being so extremely slow as not to be observable, except in trials extending over long periods of time.

C. E. Basevi.

8, Norfolk-square, W.,
October 6th.

### LABOUR AND LUXURIES.

Sir,—Your correspondent "R. G. B." has yet to learn the very elements of political economy. In his letter of the 2nd instant he puts words into my mouth which I have not used, and mixes up ethics and morals with political economy. Now political economy knows nothing of morals. It takes no account of them in any way. Whether a Government clerk or any one else is morally right or morally wrong in spending a sovereign on a bouquet is a question which I have no desire to discuss; whether a man who does not work ought to have any money, or be left to starve, is also a question that is totally outside my contention. What remains, if we eliminate such considerations is pure political economy, and with that only in the first instance, at all events, will I deal.

I have never said that the wearer of a bouquet was a "benefactor to a whole army of bricklayers, carpenters, glaziers, flower girls, &c." There is no such word as "benefactor" in political economy. What I did say was, that so long as a sovereign was spent, it was a matter of no importance on what it was spent; whether the men were employed in making a sovereign's worth of cartridges, or a sovereign's worth of flowers, mattered nothing to those getting the sovereign; the result was the same.

The error into which "R. G. B." has fallen is a very common one. It is embalmed in socialist ethics. It is the assumption that absolute property can be possessed in money by anyone. The exceptions to the fact that it cannot are extremly few. A miser who buries sovereigns in a hole is an exception, but I do not think we need trouble ourselves with this gentleman. In the matter of money we are all distributors, and the most that can be said is that whoever holds money has, for the time being, the power of saying into what channels it shall flow. Thus, for example, our typical Government clerk, possessed of a sovereign, may decide to distribute it among gardeners; or he may prefer to distribute it among wine growers; or he may devote it to the farmers by buying meat and bread, or to the miners by buying coal. In any or either case the result is the same; the money has been distributed, and has to use words in a well-understood sense, given employment.

Let us take two men—one of these has one hundred pounds a-year, the other has one hundred thousand. The first distributes his money wholly among farmers, bricklayers, carpenters, tailors, &c. The second has a larger range, and distributes his money besides among coachbuilders, horse-breeders, florists, &c. The result to the community in the end is better than it would have been if the £100,000 had been spent by 1000 individuals with £100 each, because employment is given over a much wider range. I do not think it is necessary to dwell on this point at all. If "R. G. B." were right, luxuries so called should not be produced under any circumstances. I suppose he will not go so far as to say this, but if he once admits that a luxury may be produced and paid for then he concedes my whole case, which is, that so far as the worker is concerned it matters nothing what he produces. The result to him is gold in some form or other. Whether the world at large would or would not be better without certain so-called luxuries is a very wide question; that I am not called upon to discuss. I have heard it said that enormous sums are wasted on growing tea, and on silk. To the political economist, however, there is really no such thing as waste in the expenditure of gold. The spender may not get an adequate return for it, but the gold will do its work in the world, no matter by whom it is spent.

Your correspondent writes, "For the sake of our argument, let us assume a more extreme case, namely, that of a millionaire who has got his money by cornering pork, wheat, or cotton, and who gives a smart function at his West End house, in which in the course of an evening flowers are consumed to the extent of £1500. Let this sum be taken as representing the labour of thirty men—in the shape of the aforesaid bricklayers, carpenters, glaziers, &c.—for one year at 20s. per week. Then what really happens is that these thirty men have to do a year's work in order to get back from your millionaire the £1500 which he took out of the pockets of the public when he cornered his pork and raised the price on them, and to obtain which he not only did nothing in return towards assisting in the production of the commodities of which he is a general consumer, but actually taxed the public."

I have ventured to quote him at length, because it would not be easy to select a better example of the confusion of mind which exists among many worthy and excellent people on the subject of value. In the first place, I may point out that your correspondent scarcely knows what "making a corner in pork" is. He is evidently unaware of the fact that, generally speaking, the pork cornered never had any existence at all. This cornering business, as practised in Chicago, for instance, is purely gambling. It means nothing more than bulling and bearing the market; practically, it is betting that pork will be such and such a price on such and such a day, and settling means paying differences. But, for the sake of argument, I will admit that a man attempts to make a real corner in pork. To do this he must buy pigs, and to get all the pigs into his own hands he must pay more for them than his neighbours. The result is, of course, that he distributes more gold among the farmers than they would otherwise have got, and the most that can be said is that he has benefited the farmer at the expense of "the public," whatever that may mean. But this only for the moment. The farmer now having more money than he had before, proceeds at once to buy extra boots, or hats, or ploughs. In the end the result is just the same as though no corner had been made. In fact, all political economists know that it would pass the wit of man to devise a scheme by which one section or individual of a community is benefited without other sections sharing in the good. Surely, for instance, "R. G. B." will admit that cheap coal is a good thing. The miner suffers on the one hand, but on the other he is a direct gainer. His wages may be less, but the necessaries of life are all cheapened and made more plentiful, and the whole community is better off.

Let me quote one passage more:—"There is no escaping from the fact that since commodities, be they flowers, carriages, dress, or what not, are only produced by labour, those who consume them without assisting in the production—directly or indirectly—do so entirely at the expense in labour of those who produce them; and, in proportion as our social system permits of wealth being accumulated without equivalent labour, in precisely the same proportion is the labour of the working classes increased beyond what is requisite to produce the commodities they themselves consume, the balance between what they consume and what they produce going to the idle; this being the reason why idleness and luxury are invariably found side by side with poverty and overwork."

We have here something so vague and intangible that it is difficult quite to understand what "R. G. B." means. I do not quite know whether it is ethics or political economy. If it is the latter the deductions drawn are entirely wrong. No man works for another, that is one fallacy. He always works for himself, unless indeed he is a slave. The miner does not hew coal for me, he hews it that he may get gold to spend on himself and his family. The second fallacy is that every man who spends should give in labour the precise equivalent of what he spends. This fallacy comes of overlooking the part played as distributor by so many. Let us return to our bouquet, and ask ourselves two questions. First, is it right or wrong in a politico-economical way to grow flowers? Secondly, suppose that our Government clerk made for himself in his leisure hours a greenhouse, did all the bricklaying, painting, &c., and grew his own flowers, would he have done better to the community at large than he did by buying the flowers?

In this case he would have a sovereign in his pocket. If he buried it then it is clear that the growing of the flowers by himself would be a distinct injury to a number of his fellow-men. If he did not bury it, but spent it, say, on a pair of boots, would the community really be better off than it actually was when the money was spent on flowers?

Possibly it may be comforting to your correspondent to know that I am myself not a millionaire; on the contrary, I have to work in order that I and my family may live. Should he take up his pen again, is it too much to expect that he will so place his ideas on paper that we may know precisely what he wants to convey? I am still terribly puzzled to know what he means by the "public out of whose pockets, &c." Again, will he explain how the labour of the very few rich men who do no work would improve the lot of those who do work? Would the match girls at the East End of London be better off if all the girls at the West End spent their days in making matches?

Shall I be considered rude if I recommend "R. G. B." a severe course of Smith, Ricardo, and Mill before he writes again?

October 8th. Y. X.

---

Sir,—Will "R. G. B." explain what he means by labour? If he had had any experience of life in Chicago he would not talk so glibly about cornering pork. The mental and bodily work done by the man—or, rather, by the men—who make, or attempt to make, a corner in anything is incredible. The anxiety, the excitement, the wear and tear are so tremendous that if labour deserves payment under any circumstances, the pork man ought to win a fortune. Americus.

The Langham, October 8th.

---

### GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—Is it not the case that where high-speed direct coupled engines have been adopted, that the space occupied is of paramount importance, and quite apart from other considerations would determine the use of that type? No doubt high rotative speed conduces to good governing, but there are other types which find a large use, and in which first-class governing is equally essential.

In suggesting the use of the "hit-and-miss" type of governor, I think that both yourself and Mr. Robinson have overlooked some essential features of "alternator" driving, especially when the machine is one of high periodicity. In such cases to secure good parallel running, it is essential that the speed of all the alternators having the same number of field poles should be identical, and that the similar poles should occupy the same position with reference to the armature coils in each machine. Should one alternator's phase lag or advance with reference to the others, then a synchronising current will pass tending to quicken or slow the particular machine. A heavy fly-wheel, whilst tending to prevent changes of speed, would increase the difficulty of parallel running, because it would introduce a larger moment of inertia that the synchronising currents will have to overcome; unless, of course, the fly-wheel is of such enormous size and weight that the effect of variations of crank effort on speed is entirely nullified. If it is not, then although the two machines may give the same mean volts, unless the engines as well as the alternators are in phase, a larger or smaller synchronising current will pass between them at different points on the crank path.

Does not this point to two systems of governing each the best for an alternating station?

1. In a station having its units all of the same size. The governors on each unit to be as sensitive as practicable, and to be of sufficient power to control the steam on all the units in a group, and the other governors being disconnected thus one unit would be the "master" unit, the cranks being brought into unison and the loads adjusted by hand.

2. In a station having units of varying size, all the governors to be of the greatest sensitiveness possible, so as to control the speed closely when running separately, but having means by which they can be at will rendered sluggish. Then one governor, preferably on the largest unit, would be left sensitive, and the control of the fine adjustment of the station would be by the largest unit.

Of course I am assuming in case 2 that the rotative speed varies with the size of each unit, but from this point of view does it not appear that in any alternating station the speed of each unit should be the same irrespective of its capacity?

In short, I think that the governing arrangements of any particular station, especially if alternating, should be considered with reference to the whole plant as far as and including the switchboard arrangements.

Perfect governing of an alternating station would consist then not merely in the maintenance of constant or similar speed of each unit, but also in the maintenance of simultaneous and equal impulses on each alternator. Would not the system of group control by one central governor enable alternators to be driven in parallel by gas engines? G. T. P.

October 8th.

---

Sir,—We have read with considerable interest your article upon "Governing Electric Light Engines," and agree in the main with the conclusions you have arrived at, especially your statement that "what appears to be needed is a governor which the moment the speed drops or rises—say 1 per cent.—will open the throttle valve full or shut it absolutely, and will then by a series of very rapid alterations or oscillations, open and close it through smaller and smaller arcs, until the new position suited to the load has been attained."

We beg to state that these conditions are perfectly fulfilled by the "Richardson Electric Regulator," which has been used for some years, and that it will fully open the valve, or entirely close it, before there has been any change in speed of the engine, as it acts simultaneously with the turning on or shutting off of the lamps. These advantages cannot be obtained with any kind of mechanical governor, which must act after the change in speed has taken place. With the electric governor, it is also quite easy to run the engine faster with a heavy load than with a light one, its speed changing directly with the load, as it is increased or decreased. It can equally well, however, be used for maintaining a constant speed, if a constant speed is required by the dynamo, in order to maintain a constant current, or constant electro-motive force. This electrical governor is applicable to throttle valves for small engines, and to automatic expansion gear of large engines working with a current not exceeding that required for a 20-candle power lamp. Your suggestion of a piston driven by an engine producing hydraulic pressure, and working a throttle valve or automatic gear, was tried by us many years ago; but though it acted fairly well with slight changes of load, and could produce a constant speed of engine, it was much too slow in its action for great changes. Robey and Co., Limited.

Lincoln, October 5th.

---

### COLONIAL LOCOMOTIVES.

Sir,—As a locomotive contractor I have read with interest the leading article in your issue of September 28th on "Colonial Locomotives," the general tendency of which appears to be to show that the American knows better what class of engine to supply to Colonial roads than the English contractor. But, Sir, is it not the case that American contractors are allowed a very much freer hand in this matter than Englishmen?

Speaking from my own somewhat large experience, I can say that a Colonial road of any magnitude almost invariably retains a consulting engineer, who issues the detail specification and very generally the drawings of the engines which he may require, and in any case certainly retains the entire control of testing the material, passing the drawings, &c. In other words, the contractor has to do as he is told, and if the latter does venture to point out that in his opinion some modification should be made, he is apt to be told, of course in a most polite manner, to "mind his own business, and not pretend to know better than the consulting engineer." For example, you call special attention to the flexibility of the bearing springs which the Americans use suspended on compensating levers. It is absolutely useless to put in flexible springs and compensating beams when the play of the axle-box in the guides is limited and rigidly laid down, as it generally is by the specification. It is well known that the vertical play of the axle-boxes allowed by American builders is very much in excess of usual English practice; yet it is very rarely indeed that I have ever been permitted to alter a specification in this respect, though I know perfectly well that with a small amount of play, and therefore stiff springs, the engine is sure to ride rough on a bad road.

I believe that were the average English locomotive contractor allowed as free a hand as his American cousin, our Colonies would get engines very much better adapted to their wants. I do not mean to insinuate that consulting engineers do not know their business, but I think that locomotive builders are likely to know at least as much, considering the years of experience they have had solely devoted to this one particular class of engineering. Moreover, were they allowed a freer hand, so as to be able to utilise as far as possible their existing patterns and drawings, engines might be turned out of equally good design at a much lower cost and in much less time. So far as I have been able to find out, when a Colonial road buys American engines it buys the American builders' standard; whereas, as I have already pointed out, when it buys English-built engines it employs a consulting engineer, who issues elaborate specifications and drawings which must not be modified in any way.

There would be no difficulty in giving endless examples of the above, but I will content myself with one which occurred in my own works a short while back. I had in hand, at the same time, three different orders for locomotives, all the same type, size and gauge, but the cylinders were of the following sizes:—14in. by 18in., 14in. by 19in., 14in. by 20in. There was also a few inches difference in the wheel base, and a fraction of a square foot difference in the area of the fire grate. No deviations were permitted from any of the three specifications, which therefore necessitated preparing three complete sets of patterns, drawings, gauges, templates, &c., where one ought to have sufficed. You must therefore admit that the two opposing builders are not comparable one with another, and it is scarcely fair on your part to saddle the English contractor with faults of design with which probably he had little or nothing to do. I enclose my card, but for obvious reasons prefer to sign myself Kay-Fist.

October 4th.

---

### ALUMINIUM TORPEDO BOAT.

Sir,—The accounts of this speedy little vessel have been most interesting. It will be noticed that an additional speed of 3½ knots is claimed from the use of the new metal, and it is further stated that the speed of a similar boat in steel would be 17 knots only. But in your issue of December 11th, 1891, an account appears of an apparently precisely similar craft, namely, 60ft. long by 9ft. beam, and having a water-tube boiler, with triple expansion engines developing 300 indicated horse-power, also built by Messrs. Yarrow and Co., the mean speed of which, taken from six runs, is there said to have been 20·03 knots—the highest single run being given as 20 57; the difference in speed, therefore, between this craft and the new one of aluminium appears to be 0 528 only, or roughly speaking, ½ knot, and not 3½ knots.

Admitting that the figures 20 558 are obtained from two hours' continuous steaming, and 20·03 from the mean of six mile runs only, calculations based on the trials of a number of fast torpedo boats and "Destroyers" give us the difference between the average of the mile runs, and three hours' continuous steaming, and this difference reduced to 20·558 knots gives an increase of ·36 of a knot as the highest average mile speed above the longer time trial. It is, therefore, to be presumed that the new boat could have developed at the most an additional ⅓ knot if mile runs had been adopted. So that, assuming the most favourable possible terms, the total gain in speed works out at slightly over ⅞ of a knot, instead of 3½ knots.

Whatever, then, the advantages of aluminium may be, and doubtless it has some—when its price ceases to be practically prohibitive—a great increase in speed does not appear to be amongst them, assuming the above data to be correct, and a 40-knot aluminium Havock, as suggested in this week's daily press, is at present, at all events, quite chimerical.

It would be interesting to know what is the highest speed Messrs. Yarrow consider this little boat could develope, in light trim, and on a mile. Perplexed.

October 8th.

---

Sir,—As some of the statements that have been published in connection with the above subject are not quite accurate, and may, therefore, be misleading, I shall esteem it a favour if you will kindly give publication to this letter in your next issue.

The price of 3s. to 5s. per lb. does not represent the price of the metal itself, but that of angle irons, bars, castings, &c, of the suitable aluminium alloy used, which is quite a different matter. Aluminium in ingots is now sold in the market at 1s. 9d. per lb., and taking into consideration that the weight of this metal is one-third of that of the other metals commonly used in shipbuilding, this price really represents only 7d. per lb. if compared with them.

It is quite true that the prime cost of this torpedo boat, or of any other ship made of aluminium, will be somewhat greater than that of the same sized ship built of steel, but the former with engines of the same horse-power will attain much greater speed. With regard to the boat in question, a speed of 20½ knots was obtained in place of 17 knots, this being the rate of the ordinary steel boats. It is therefore evident that an aluminium boat, for the same rate of speed, will require less horse-power, which means considerable economy in the consumption of fuel, and this in a short time would fully compensate for the extra first cost. This is quite irrespective of the other advantages of aluminium for shipbuilding purposes, which are fully explained in your interesting article.

It has been stated that we are not equal to other countries in the production of aluminium, and that this is due to natural causes. It is quite true that none of this metal is now made in the United Kingdom, but there is absolutely no natural cause why it should not be produced here as cheaply as in other countries. In fact, the British Aluminium Company has been formed for this purpose, and is now completing arrangements for starting a large factory for the production of aluminium in this country by electricity. The raw material is to be found in Ireland in large quantities, and of good quality; water power for generating electricity can be obtained quite as cheaply and conveniently as abroad; and by using the same patented processes for the production of aluminium by electricity which have been so successfully used in France, Switzerland, and the United States of America, this company will be able to produce the metal as cheaply in this country as elsewhere.

For The British Aluminium Company, Limited.
(Charles F. Jones, Secretary.)

9, Victoria-street, London, S.W.,
October 9th.

---

### ELECTROLYTIC SANITATION.

Sir,—In your issue of September 28th we notice an article headed "Electrolytic Sanitation," in which you comment on the Hermite process of disinfection. We must request you to allow us a little of your valuable space for a few remarks upon this article. The commencement of the article promised an impartial review of the subject, and we regret that this was not adhered to in your subsequent remarks. We fear to take up too much space in mentioning all the points which might be brought forward, and will therefore point out only one or two of the most striking statements with which we do not agree.

The article says, "Seawater is a wasteful material to choose in the preparation of a bleaching and sterilising liquid," &c. We venture to suggest that it is not proved that the organic matter in the salt water is the cause of the reduction in strength of the electrolysed salt water when diluted. It is sufficient to our mind that seawater can be run up from no chlorine strength to ·7 grammes of chlorine per litre, with an average yield of 1 gramme per ampère hour, which, as you will see, is fairly good approximation of a theoretical yield.

We think the reference to "magical compounds" and "wand of the patentee" is not consistent either with proper treatment of this subject or of the absolutely public way in which everything connected with this process has been carried on. Mr. Hermite or ourselves have never made any claim for any magical compound, nor in fact have ever encouraged any mystery. Our simple statement is that we can produce a disinfecting liquid of sufficient strength to sterilise sewage absolutely by electrolysing sea water with a yield of one gramme of chlorine per ampère per hour, and that in our apparatus the necessary electro-motive force does not exceed 6 volts. Therefore with 1000 ampères × 6 volts, we produce 1000 grammes of chlorine per hour.

Anyone caring to work out the cost can do so from this data. The suggestion that a solution of bleaching powder could be distributed in the way that we propose to distribute our disinfectant is rather startling, and we do not think would be seriously considered by any engineer. We think it unnecessary to do more than point out that practically one-third of bleaching powder is all that is useful, the remaining two-thirds, consisting of lime, would have to be got rid of. Anyone familiar with the working of paper mills and bleach works will appreciate the difficulty of getting rid of the refuse. Imagine a large town supplied in this way, and using many tons of bleaching powder per day, two-thirds of which they would have to dispose of otherwise than in the sewers. No suggestion is made as to how this difficulty is to be overcome, nor indeed is any practicable method proposed as to either mixing and using this powder, nor of carrying on the proposed dioxydising process.

There is no possible comparison between the Hermite process and such a suggestion, because the one is workable and the other is not. What can be simpler than sea water flowing continuously through an electrolyser and into the sewers? Again, those connected with the chemical trade might ask, where would bleaching powder be found if such a demand were to arise?

Paterson and Cooper.

3, Princes-mansions, 68, Victoria-street,
Westminster, London, S.W.
October 10th.

---

### CONDITION OF THE THAMES.

Sir,—I am pleased to see that you have brought to the notice of your readers the condition of the river Thames at low water near Kew Bridge, which bridge will no doubt be removed shortly. The new bridge having fewer buttresses, will enable the water to flow out quicker than now.

In the year 1885 I was one of the competitors for the disposal of the London sewage; my scheme removed the sewage out of the way from London, and improved the Thames from Teddington to Coal House Point. Your illustration called to my memory a paragraph in my scheme. It runs as follows:—Residential property adjoining the Thames at Teddington, Twickenham, Richmond, Isleworth, Kew, Mortlake, and Putney are not healthy, owing to the river being nearly dry several hours each day in the summer time, the tide being much more swifter than of old. The first impediment to the tide flowing out was the removal of old London Bridge. At this old structure there was a fall of 5ft. from the upper side to the lower side, five arches being blocked up for the London Bridge Waterworks. The river on the upper side of the bridge presented the appearance of a lake—*vide* old prints. The next impediment to the flowing out of the Thames was the removal of old Westminster Bridge with its numerous arches. The next was the shoals at Waterloo Bridge. I have walked nearly across the river near the bridge many times when a boy. The paragraph goes on to say, now for the final, you have only to remove Old Battersea, Putney, and Kew Bridges, and the flats or shoals at Hammersmith, and you have done it. There will not be much water left in the river at the places indicated for several hours per day. This was written over nine years ago, and now it is a reality. If you lock the river at Putney, you will still have trouble lower down. HENRY SPORTON.

The Glen, Chase Side, Enfield,
Middlesex, October 9th.

### MIDLAND RAILWAY CARRIAGE STEPS AND FITTINGS.

SIR,—The Midland Railway Company is now running, on its express trains between Edinburgh and London, some carriages which would be a disgrace to even a small railway company. The steps are a positive source of danger to the public, being of thin iron barely the width of the carriage doors, so that should anyone slip between the carriage and the platform their legs must inevitably be cut off by these knife-like appendages. These small iron steps are slippery, and a continuous wooden footboard should be insisted on by the Board of Trade. The standard door handle adopted by the Midland Company is also about the worst that could possibly be designed, and appears to have been handed down from the old coaching days; it requires two forces to be expended in its use, one to lift up and keep steady the movable ring and another to turn it. This form of handle must cost more to make, and is not nearly so convenient as the cross handle in general use by other companies. It is strange that the Midland Company should have gone out of their way to adopt as their standard handle one so hideous in design and so inconvenient in use, and one which, moreover, is not even automatic in its action, and therefore dangerous, more especially when most other companies, even small ones, have adopted door locks which are both convenient and automatic in their action, so that when pushed to they automatically lock themselves.

Of the different kinds in use, Wethered's patent is perhaps the simplest and best. It is used on the Metropolitan Railway and also the new West Highland Railway, and I would suggest to the Midland Company that they adopt either this or some other automatic door lock as their standard pattern. One would not expect so influential and go-ahead a company as the Midland to be so far behind the times in the matter of carriage fittings.

Constitutional Club, London, PERCY CALDECOTT.
October 8th.

### THE THEORY OF THE STEAM ENGINE.

SIR,—Mr. Maurice Cross's letter in your last issue appears more explicit than his previous communications. In reply, first, as I have already stated, Rankine refers to experiments made by Mr. C. W. Siemens as the basis of his statement that steam freely expanded becomes superheated. Secondly, Mr. Cross seems to object to wire-drawing being employed in investigating the results of free expansion. At the same time he lauds Joule and Thompson's experiments on free expansion. This is highly inconsistent, since Joule and Thompson arrived at their conclusions by wire-drawing apparatus. Thirdly, he appears to regard steam, *i.e.*, the gaseous form of water, as not a "permanent" gas, whereas it is quite as much a "permanent" gas as air or carbonic anhydride or other such gaseous body.

I have my own opinions as to the manner in which the "efficiency" of a steam or other heat engine is most justly to be calculated. This part of the correspondence or controversy I have no wish to deal with, and will refrain from saying further than that I totally disagree with Mr. Cross's views in so far as I understand them. HENRY CHERRY.

21, Festing-road, Putney, S.W.,
October 10th.

## AMERICAN ENGINEERING NEWS.

*(From our own Correspondent.)*

*New passenger station.*—A handsome station is now being built by the New York Central Railroad at Syracuse, to replace the old station. As this is a through station the main building will be at the side of the tracks. This building will be 122ft. by 94ft. in plan, three storeys high, with a steep pitched roof, and the tower will be 20ft. square and 80ft. high, surmounted by a pyramidal roof. The exterior will be of dark red sandstone, quarry faced, with dressed stone facing, and the roof will be of Spanish tile. The main waiting-room will be 90ft. square; women's waiting-room and men's smoking-room 24ft. square, each with a toilet-room 12ft. by 14ft.; parcel-room, 15ft. by 20ft.; ticket office, 18ft. by 24ft., with one end partitioned off for ticket offices for the sleeping car companies; baggage-room, 57ft. by 50ft.; trainmaster's office, 14ft. by 18ft.; and a restaurant, 128ft. by 28ft. in the basement. From the main hall a subway passes under the tracks, with steps to the main platforms. The upper floors of the building will be occupied by railway offices. The building will be heated by fifty steam radiators, and lighted by 500 incandescent lamps, the light, heat, and power plant being located in a separate building. The train shed will cover seven tracks, four of which are through main tracks, and the three main platforms will be 25ft. to 36ft. wide, 1ft. above the rails. There will be ticket inspectors' offices at each end of the platform at the head of the stairways from the subway. The train shed will be 480ft. long and 128ft. wide, with main roof trusses 110ft. long, and a cantilever roof on the outer side opposite the station building. The interior decoration and fittings will be very complete and elaborate.

*Railway statistics (Chicago, Milwaukee, and St. Paul Railway).*—In former letters I have given details of the operating statistics of some of the important railways, and below are given similar details respecting the results of operation of the Chicago, Milwaukee, and St. Paul Railway—a system comprising 6147 miles—during the year ending June 30th, 1894. The dividends for that year aggregated 7 per cent. on the preference stock, and 4 per cent. on the common stock. The freight and passenger traffic and the total earnings were less than for 1893, but the freight and passenger revenue increased:—

| | |
|---|---|
| Gross earnings, dols. | 31,327,951 |
| Total operating expenses, dols. | 20,114,333 |
| Net earnings, dols. | 11,213,618 |
| Miles operated | 6,147 |
| Miles run by passenger trains | 7.848 438 |
| " " freight trains | 12,869,482 |
| " " mixed trains | 987,704 |
| " " revenue trains | 21,705,624 |
| " " switching trains | 4,411,146 |
| " " construction trains | 575,700 |
| Total train mileage | 26,692,470 |
| Passengers carried | 7,921,882 |
| Passengers carried one mile | 337,133,338 |
| Average journey per passenger, miles | 42 56 |
| Revenue per passenger per mile, cents | 2 169 |
| Revenue per passenger per train mile, cents | 90 320 |
| Tons of freight carried | 10,794,058 |
| Tons carried one mile | 2,077,869,479 |
| Tons per loaded car | 9 93 |
| Average haul per ton, miles | 192 50 |
| Revenue per ton per mile, cents | 1·037 |
| Revenue from freight per train mile, dols. | 1·5834 |
| Expenses per revenue train mile:— | |
| For repairs of engines, cents | 5·05 |
| For repairs of cars, cents | 7 05 |
| For station service, cents | 12·82 |
| For train service, cents | 7·34 |
| For locomotive service, cents | 8 87 |
| For train and station supplies, cents | 2·44 |
| For fuel, cents | 10·49 |
| For oil and waste, cents | 0·63 |
| For all other expenses, cents | 37 98 |
| Total operating expenses, cents | 92·67 |
| Percentage of operating expenses to earnings | 64 21 per cent. |

*Railway statistics (Wabash Railroad).*—The following detailed operating statistics are from the report for the year ending June 30th, 1894:—

| | |
|---|---|
| Miles per day per freight train | 85 |
| Freight train miles per day | 17,170 |
| No. of passenger trains per year | 46,092 |
| Miles per day per passenger train | 112 |
| Passenger train miles run per day | 14,112 |
| Cost of locomotives per 100 miles run:— | |
| Repairs (dols.) | 3·34 |
| Stores (dols.) | 0·29 |
| Fuel (dols.) | 4·75 |
| Enginemen and firemen (dols.) | 6·06 |
| Wiping and dispatching (dols.) | 0·89 |
| Total cost per 100 miles run (dols.) | 15·33 |
| Average mileage per engine per year | 43,116 |
| Average mileage per month per engine | 3,593 |
| Cost per ton of coal on tender (dols.) | 1·13 |
| Miles per ton of coal | 23·80 |
| Average number of loaded cars per freight train | 14·69 |
| Average number of cars per freight train | 21·57 |
| Average load per freight train (tons) | 175·39 |
| Average earnings per freight car (cents) | 8·33 |
| Average expenses per freight car (cents) | 7·24 |
| Average number of cars per passenger train | 4·79 |
| Average number of passengers per train | 40·96 |
| Expenses per passenger car per mile (cents) | 19·34 |
| Earnings per passenger car per mile (cents) | 12·91 |
| Miles operated | 1936 |
| Earnings per mile (dols.) | 6485 |
| Operating expenses per mile (dols.) | 5079 |
| Net earnings per mile (dols.) | 1406 |
| Tons of freight carried | 5,414,994 |
| Tons carried one mile | 1,097,585,279 |
| Rate per ton per mile (cents) | 0·698 |
| Expenses per ton per mile (cents) | 0·607 |
| Net earnings per ton per mile (cents) | 0·091 |
| Freight train mileage | 6,258,093 |
| Freight train earnings per mile (cents) | 122·35 |
| Freight train expenses per mile (cents) | 106·40 |
| Freight train net earnings per mile (cents) | 15·95 |
| Average load per car (tons) | 11·94 |
| Average freight train load (tons) | 175 39 |
| Number of passengers carried | 3,724,674 |
| Number of passengers carried one mile | 210,281,487 |
| Rate per passenger per mile (cents) | 1·877 |
| Expenses per passenger per mile (cents) | 1·508 |
| Net earnings per passenger per mile (cents) | 0·369 |
| Passenger train mileage | 5,133,272 |
| Passenger train earnings per mile (cents) | 92·61 |
| Passenger train expenses per mile (cents) | 61·79 |
| Passenger train net earnings per mile (cents) | 30·82 |
| Number of paying passengers per car | 11·49 |
| Number of paying passengers per train | 40·96 |

*Electricity for handling heavy guns.*—Successful experiments as to the use of electricity for moving heavy guns and revolving turrets on warships have been carried out by the Ordnance Bureau. Tests have been made on the double-turret monitor Montauk in turning the turrets and training the 10in. guns. A device has been perfected by Captain Sampson, of the Bureau, by means of which one movement of a lever enables the rotary motion of the turret and the vertical motion of the gun to be done at the same time, thus facilitating the work of training the gun, and the rapidity of action is quicker than where steam power is used. In the experiments on the Montauk, the old-fashioned turrets were moved easily and rapidly, and the guns were lowered or raised and turned in the direction of the target at the expense of little energy and without appreciable loss of time. The movements were more rapid than when steam is employed, and the accuracy was greater. The advantages noted for the proposed new system were many. Chief among them were the ease and economy of the plan. Wires can readily be attached to the dynamos of the main electric plant, and the power be thus transmitted to turrets and guns. Should a wire be shot away, it can be quickly spliced or a new one laid, and the firing go on without long interruption. There are no valves and other delicate gearing to get out of order and destroy the efficiency of the battery at a critical time. The present plan is to install the new system on the Iowa and Brooklyn. It is not intended to remove the steam motors on the vessels now in commission, or which have advanced in construction to such a stage as to make the change an expensive one.

*Automatic block signals.*—Automatic block signals showing "danger" as the normal position, which is a new feature in automatic signals, are now in operation on about eighty miles of double track road. The signals are on the Hall system, with a circular box or case having an 18in. circular opening, behind which appears a red disc for the "danger" signal. Over this large opening is a smaller one for the night signal. The electrical appliances are enclosed in the case, which is mounted on a post or upon an overbridge. A track circuit is used, and switches are interlocked with the block signals. The blocks are from a quarter of a mile to one mile long. There are no distant signals, but a train passing one signal sets it at "danger," but the signal behind does not show "safety" until the train has gone 1500ft. further.

*Swaging machines.*—Machines for cold swaging metal articles are being quite extensively used in the production of small pieces of which large quantities are required, the work being done by pressure between revolving dies, the outer ends of which touch intermittently the faces of a floating ring of rollers in a circular frame concentric with the dies. The stock does not revolve, but the dies revolve around the stock. One of its most extensive uses is in the manufacture of sewing-machine needles, which are swaged down to shape from blanks the diameter of the shank of the needle, the machine requiring only to be supplied with blanks. Tubes can be swaged without the use of any mandril. Amongst the smallest and most delicate work done are tubes for hypodermic syringes, which are of steel with a hole through them 0 015in. diameter when finished. Another example of small work is in making "rolled plate" wire for manufacturing jewellers. A cylindrical piece of base metal about 1½in. diameter is covered by a case of gold, which is drawn in a drawing press from a flat blank the same as cartridge shells are drawn. The gold case is soldered to the core, and the whole is then reduced by these swaging machines to such diameters as are suitable for eye-glass chains, &c., some of it being swaged down to 0·015in. diameter. The applicability of the process to tubing for bicycle frames, &c., is shown by the fact that steel tubing $\frac{3}{32}$in. thick, 1in. diameter, is reduced to $\frac{7}{8}$in. diameter, and when the straight reduced portion of the tube is 6in. to 10in. long, about five pieces per minute can be done. Tubes for bicycle frames are sometimes reinforced at certain points requiring extra strength, and this is done by simply inserting a short piece of smaller tubing at the desired point and swaging the outer tube down upon it. In the manufacture of bicycle spokes, the wire is taken from a coil, straightened, passed through the hollow spindle of a swaging machine and reduced to a proper diameter by swaging, but leaving unswaged sections at proper intervals, which, when sheared in two at the middle, leaves the spokes large at each end for heading, bending, and threading. All this is done continuously and automatically. Three tensile tests of swaged and unswaged wire—0·072in. and 0·092in., 0 083in. and 0·115in., 0·08in. and 0·105in. diameter—from the same coils, showed an increase for the former of 9, 14, and 15½ per cent. respectively, the two first being for crucible steel wire and the third for Bessemer steel wire.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Engineers: W. R. Lawton, to the Hebe, and Reginald W. Parry, to the Pembroke.

THE HERMITE ELECTRICAL SANITATION PROCESS.—The Ipswich Town Council decided at their meeting on Wednesday, the 10th inst., to adopt the Hermite process. This decision was unanimous, and resulted from the exceedingly favourable report submitted by the sewerage committee on the trials which have been made on the main sewers of the town during the last three months. We understand the permanent installation is to be proceeded with as rapidly as possible. We hope in our next issue to give further details.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

*(From our own Correspondent.)*

THE quarterly meetings of the iron trade have been held this week in Wolverhampton on Wednesday and in Birmingham to-day—Thursday. Taken altogether they have been fairly prolific of business, though many sellers would have liked to do more. A healthy demand was present for iron and steel of most descriptions, and improved prices were here and there secured. A good sign of the times is the accentuated demand for bar iron, and it is gratifying to hear makers declare that they have lately obtained larger orders. Marked bars were re-declared on the basis of £7 10s. for ordinary branded qualities, and £8 2s. 6d. for the L.W.R.O. production of the Round Oak Iron and Steel Company. Merchant bars were £6 10s., and common bars £5 10s. to £5 15s. The official prices of marked iron have not remained unaltered since January, 1893. Common bars as compared with a year ago are cheaper to the extent of 5s. to 7s. 6d. per ton, but this is explained by the circumstance that the coal strike of last autumn was the means of advancing prices of all iron. A more justified comparison is that with three months back, when common bars were quoted £5 10s.

An animated trade is being done in sheets, and it is not unlikely that before long prices will further rise. Galvanised corrugated qualities of 24 w.g. were to-day £9 15s. to £9 17s. 6d., but several makers would not entertain business at less than £10 for delivery Liverpool f.o.b., or £10 2s. 6d. delivery London. Galvanising sheets were strong at £6 12s. 6d. to £6 15s., doubles, and £7 5s. to £7 10s. trebles.

Sellers quoted cold rolled and close annealed sheets for japanners, £8 to £8 5s. doubles, and £8 15s. to £9 lattens, while the same sheets in steel were £8 5s. doubles, and £9 to £9 5s. lattens. Iron hoops were rather active at £6 10s., though makers stated that as yet no large orders had been received from the United States, as a result of the passing of the American Tariff Bill. Gas strip was rather slow at £5 15s., thin strip £6 10s., and locomotive boiler strip, either in iron or steel, £5 15s. A large demand was recorded for steel strip for bedstead tubes.

Pig iron sellers recorded a steady business, and in many instances contracts were concluded for delivery to the end of the year. Native all-mine hot-blast pigs were 55s. to 60s. per ton, medium qualities 42s., and common cinder 38s. upwards. Outside irons were in prominent request, and agents quoted the following prices: Derbyshires, 42s. 6d. to 43s.; Northamptons, 41s. 6d. to 42s., and Lincolns, 43s., the two former being delivered here less 2½ per cent. and the latter net. North Staffordshire grey forge of good make was 43s. 6d. delivered here, while foundry qualities were 50s. for No. 1; 47s., No. 2, and 46s. No. 3.

Official statistics issued this week show that the number of blast furnaces now blowing in the Midland and Staffordshire district is as follows:—Derbyshire, 26 out of 52 built; South Staffordshire, 22 out of 76 built; North Staffordshire, 13 out of 38; Leicestershire, 3 out of 4 built; Northampton, 12 out of 28; Lincolnshire, 14 out of 21; Nottingham, 3 out of 4; and Shropshire, 4 out of 10. These returns do not evidence much change on three months ago, but taking the entire furnaces of the United Kingdom, the returns are a decline of no fewer than 52 furnaces on three months back, the result mainly of the Scotch strike.

A spirited inquiry was noted for steel, and it is significant from the increasing number of orders that a larger consumption is at present taking place of this material than perhaps at any previous date. Bessemer blooms and billets were quoted this week £4 4s. net; Siemens qualities, £4 6s. 6d.; soft steel plates, suitable for bridge and other engineering purposes, £6; and boiler plates, £7. Steel bars, flats, strips, &c., used for stamping and pressing purposes, and rolled down in this district, were generally 10s. per ton above the price of iron.

The steps which mining engineers will have to adopt to maintain the prosperity of the collieries under a system of eight hours for miners were suggested by Mr. Alexander Smith, the new president of the South Staffordshire Institute of Engineers, in his inaugural address on Monday. More coal would have to be turned out for the same capital outlay, so as to spread the interest on fixed capital and standing charges over a larger tonnage. This could be done in one or two ways, such as working two shifts and improvements in machinery and other arrangements. Prominent among the possible improvements were the introduction of mechanical coal-cutting, more rapid haulage and drawing, and the provision of coal-washing and coal-picking apparatus, for making the best market possible of the coal raised. Whenever the eight hours system came into force greater pressure and responsibility would be thrown upon mining engineers, and prompt thought should be exercised by the profession as to how these new conditions were to be met.

The wages dispute in the wrought nail trade is likely to be settled by the masters paying the 1890 list, for which the men have been agitating. At least, the operatives believe that at the adjourned joint conference which is to be held the employers will be willing to concede these terms, and upon this understanding it has this week been resolved to resume work at once.

A company with a nominal capital of £75,000 has just been formed locally to take over the business of the Eagle Range and Foundry Company, Aston, near Birmingham, cooking range and heating apparatus engineers. The object of the new limited concern is to develope the present business, and it is said that the average profit for the last five years has been considerably in advance of any previous period.

The goodwill, registered trade marks, brands, &c., of the New British Iron Company, in liquidation, have been purchased by the well-known firm of Messrs. N. Hingley and Sons, Netherton Iron Works, near Dudley. Messrs. Hingleys' mines adjoin those of the North British Iron Company, and are situated in the same beds of coal and ironstone. It is their intention to continue the manufacture of "Lion" iron exactly as heretofore produced under that celebrated mark. "Lion" pig iron will also be made at Corngreaves' furnaces, and used in making bar and plate iron of the "Lion" brand.

The rating of machinery assessment appeals by the Wolverhampton manufacturers, and which were to have come before Quarter Sessions, have mostly been settled out of Court. Originally fifteen appeals were down for hearing, but only one of these, and that not relating to a manufacturing business, has actually come for trial. In the other cases arrangements agreeable to the appellants have been consented to by the Union authorities. It is stated that the actual result of the re-assessment of the borough will be a very large increase in the rateable value, and that although reductions have in numerous instances been allowed on the original re-assessments, the net results will be most satisfactory from a ratepayer's point of view.

## NOTES FROM LANCASHIRE.

*(From our own Correspondents.)*

*Manchester.*—The tone throughout the engineering and iron industries of this district continues one rather of depression than otherwise, and a very emphatic proof of the generally unsatisfactory condition of trade is the fact that notwithstanding the excessively restricted production of pig iron, as shown by the recent returns of the number of furnaces in blast and the almost complete absence of stocks of any weight, business seems to be impracticable on anything like a remunerative basis. If there were any confidence whatever with regard to a revival of trade, the present position of stocks and the large number of furnaces out of blast could not help but give a stimulus to some substantial advance; but there seems to be no confidence in buying, and business is again dragging on in the merest hand-to-mouth fashion, with prices tending in a downward direction. So far as the engineering industries are concerned, there is still no indication of any real improvement; here and there, of course, business fluctuates, and in isolated cases more activity is reported, but generally establishments continue but very indifferently employed, and new work generally is not coming forward in any increasing weight.

The Manchester Iron Exchange on Tuesday was but thinly attended, and only a very slow business was reported either in raw or manufactured material. For pig iron only the most restricted inquiry is coming upon the market, and merchants and consumers are in many cases only taking partial deliveries of the iron that was purchased during the rush of buying a few weeks back, with the result that makers, although well sold, are here and there having iron thrown on their hands, which they are showing rather more anxiety to sell, even where they have to take something under recent quoted rates. For Lancashire pig iron quotations remain nominally on the basis of 40s. for forge to 42s. foundry, less 2½ at the works, but at these figures there is practically little or nothing doing of any moment in local brands. For district brands prices are easier if anything, one or two of the Lincolnshire makers especially showing more disposition to entertain offers, and forge qualities could be bought readily at 39s., with foundry numbers scarcely averaging more than 40s. 6d., and quotations for foundry Derbyshire remaining nominally at 45s. up to 46s. net cash, delivered Manchester. With regard to outside brands offering here, the continued scarcity of Scotch iron keeps up fully late prices, Eglinton not being quoted under 49s. to 49s. 6d., and Glengarnock 51s. net prompt cash, delivered at the Lancashire ports; but Middlesbrough could be bought at lower figures, makers who still hold to 45s. 4d. net cash for good-named foundry brands, delivered equal to Manchester, finding these prices practically out of the market, as there are ready sellers at quite 6d. under this figure.

In finished iron new business still comes forward very indifferently, and it is exceptional where manufacturers are able to keep their forges running more than four days per week. Quoted prices remain unchanged, but the tendency is towards less firmness. Delivered Manchester or Liverpool, Lancashire and North Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random, to £6 2s. 6d. for special cut lengths. Nut and bolt makers report only a slow demand, the large users, such as bridge builders and boiler makers, being only quiet, and very low prices have to be taken to secure orders. With regard to bridge work, I may, however, mention that contracts have recently been secured by local firms, but these, I understand, have been taken at excessively low figures.

The steel trade continues very quiet, with ordinary foundry hematites not averaging more than 53s., less 2½; ordinary Bessemer basic billets, £4 net cash; and steel boiler plates £6 5s. per ton, delivered in this district.

In the metal market there is no change in quoted list rates for manufactured goods, but buying goes on very slowly from hand to mouth.

The Ashbury Railway Carriage Company, Manchester, have just secured orders for twenty-four complete bogie carriages of various classes for the Ceylon Government Railways, and they are just now busily employed upon another important order for ninety-two underframes, together with the ironwork and fittings, for various classes of carriages, for the Indian State Railways.

The Vaughan Pulley Company, of West Gorton, have just completed extensive additions to their works, and have laid down special machine tools for the manufacture of their wrought iron pulleys with steel rims, which will about treble their capacity for turning out their special class of work. I may add that the firm are very busy with orders, both on home account and for shipment to all quarters of the globe, the exceptional lightness, which is one of the special features of the Vaughan pulleys, rendering them particularly adaptable for export.

The fifty-sixth annual meeting of the Manchester Geological Society was held on Tuesday, Mr. W. Saint, Inspector of Mines, the president, occupying the chair. The report presented showed a continued increase of membership, and improvement as regards the financial position of the Society, the total membership being now 230, as against 222 last year. The report, in reviewing the work of the session, made reference to several important contributions on mining and geological subjects. The President had opened the session with a very practical address on "Recent Improvements in Mining Machinery and Appliances," this being followed by papers on ventilating and coal-cutting machinery, in which the desirability was set forth of a more extended adoption of mechanical appliances for the getting of coal, which so far had made very little progress in this country. On geological subjects, Professor Boyd Dawkins had contributed an important paper on the "South-Eastern Coalfield at Dover," and Mr. De Rance had given an interesting paper, with detailed sections, of a boring for coal on the Freeholders' Estate, at Hazel Grove, which had resulted in the finding of valuable seams of coal and proved the extension of the coalfield beyond the boundary previously assumed. A matter of some importance which had engaged the attention of the Council during the session had been the desirability or otherwise of the association joining the Federated Institution of Mining Engineers, but with regard to this, nothing had so far been definitely settled. Mr. W. Watts was elected President, and Messrs. G. Pearce, John Gerrard, H. Speakman, Mark Stirrup, vice-presidents; Messrs. R. Clay, S. Garside, George Wild, W. N. Atkinson, C. Cockson, R. Winstanley, S. Platt, J. Ridyard, H. H. Bolton, G. B. Harrison, D. H. F. Matthews, and G. C. Greenwell, junior members of Council; Mr. Clegg Livesey, hon. treasurer; Messrs. J. Tonge and Joseph Crankshaw, hon. secretaries; and Messrs. G. H. Hollingworth and H. A. Woodward, hon. auditors for the ensuing year.

No really material improvement can be reported in the position generally as regards the coal trade. In the better qualities of round coals, suitable for house-fire requirements, an increasing business is being put through, and pits have in isolated cases been able to run about full time, but in other descriptions of fuel, only a very indifferent demand is reported to be coming forward, and four days per week continues the general average that the pits are working, with supplies ample for requirements, even with this limited production. With regard to house coals, prices average about 11s. to 11s. 6d. for best qualities, 10s. to 10s. 6d. for seconds, and 8s. to 8s. 6d. for common house fire coals at the pit mouth, but the top figures still represent exceptional prices, although they are more readily obtainable, in some instances, than they have been recently. Only a very slow inquiry is coming forward for steam and forge coals, which are readily obtainable at 7s., although 7s. 6d. is quoted for some of the better qualities at the pit mouth.

Engine fuel continues more or less of a drug in the market, and in some cases extremely low prices are taken to effect clearance sales; common slack averages about 3s. 6d. to 4s., good medium sorts 4s. 6d. to 5s., and best qualities 5s. 6d. to 6s. per ton at the pit mouth.

During the past week there has been a falling-off in the weight of business put through for shipment, this being chiefly due to the cessation of inquiries for Scotland, and there is a slight giving way in prices, which do not average more than 8s. 6d. to 9s. per ton for ordinary qualities of common round coal, delivered at the Mersey ports.

*Barrow.*—There is still less activity to report in the hematite pig iron trade this week, and a distinct tone of depression has set in. Orders are very few, especially for forward deliveries, and prompt sales are from hand to mouth. There has been a further decrease in stocks this week amounting to 417 tons, and stocks now stand at 158,490 tons, or 63,867 tons more than in the beginning of the year. Prices are depressed at 44s. 6d. to 45s. for mixed Bessemer Nos., net f.o.b., with warrant iron at 43s. 6½d. cash sellers, buyers at 43s. 6d. Thirty-three furnaces are still in blast.

Iron ore is in slow demand, but Scotch smelters are again wanting deliveries, and some improvement in shipments may be expected. There is a quiet local demand. Late prices are maintained.

The steel trade is still very quiet, except in three departments. Some new orders are to hand for steel ship plates, and for heavy steel castings, and it is expected there will be a fair trade during the winter months in tin-plate bars, but rails, heavy as well as light, are in quiet demand, and there is but little doing in billets and hoops, while the trade is almost absolutely nil in blooms, slabs, and wire rods. The Bessemer departments generally are inactive.

The shipbuilding and engineering trades are fairly well employed, and much progress is being made with the Admiralty work in hand. The Naval Construction and Armaments Company have booked an order from the London and North-Western and the Lancashire and Yorkshire Railway companies for the building of a high-speed twin-screw passenger steamer for the Fleetwood and Belfast service. Recent additions to this fleet have been made by Laird's, of Birkenhead, and by Denny, of Dumbarton. In years gone by the Barrow Company built three vessels for the Fleetwood service, but they were of the now discarded paddle type. Greater economy in working is secured by the twin-screw steamers, and higher speeds are obtained.

Shipping returns show an improvement this week. The exports of pig iron from West Coast ports during the week amount to 6793 tons, and of steel 6599 tons, compared with 4080 tons of pig iron and 4781 tons of steel in the corresponding week of last year, an increase of 2713 tons of pig iron and of 1818 tons of steel. The aggregate shipments this year amount to 277,654 tons of pig iron and 313,183 tons of steel, compared with 208,663 and 383,950 tons respectively in the corresponding period of last year, an increase of 68,991 tons of pig iron and a decrease of 70,767 tons of steel.

The demand for coal and coke is quiet, and prices are, generally speaking, easy.

Throughout the district generally there is scarcity of employment, and many men coming into the district for work have to go elsewhere disappointed.

It is reported that a new company is about to be formed to produce, at a Barrow works, a new material to take the place of silk.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THIS has been a very dull week in the steel and iron trades. There has been practically no movement reported. In all the works visited during the last ten days the reply to inquiries has been one continuous note of depression. No signs whatever are perceptible of any improvement in the demand either for railway material or for shipbuilding. Shipowners are discouraged at the lowness of freights, which makes their business altogether unprofitable. As long as ship-carriage is thus so unsatisfactory it would be unreasonable to expect any new orders of consequence to be placed. Hematites run from 51s. to 52s. 6d. per ton, delivered in Sheffield; common forge iron, 38s. to 38s. 6d. per ton, but there is literally no business doing. Consumers have quite sufficient supplies for their requirements, and the absence of new work causes them to hold their hands and keep back orders. The position of affairs is exceedingly unsatisfactory and disappointing, as a decided change for the better, which was stimulated by the revival of a month ago, was expected. The quotations for hematites, already given, show a reduction of from 1s. to 1s. 6d. per ton, and in forge iron of about 6d. per ton. Derbyshire irons are also slightly reduced. Bessemer billets are at £5 10s., bar iron is quoted at a similar figure where the requirements reach any amount.

In the manufacture of locomotives and other engines, English makers, both in this and other districts, are finding German and Belgian competition get increasingly keen. Much of the work which used to be done in this country is now also turned out by native engineers in foreign markets. In several of our large railway material establishments orders are daily expected for material from India. Extensions of railways in that great Dependency are now contemplated, which will involve an outlay of over thirty millions sterling. Of this work a considerable share is certain to come to Sheffield. At the same time the prices of finished material have got to so low a point that it is doubtful whether in home industry they cover the cost. In general cases orders are said to be taken for no other object than to keep the machinery employed against better times, and to keep their men at work. The war between China and Japan has had the effect of suspending nearly all deliveries to these countries. Some pressing orders for buffers for the Japanese Government are now in course of execution in Sheffield, and when the war is over it is expected that both combatants will place heavy requirements not only in military, but in marine and railway material. The revival anticipated in the South American markets has not yet commenced, and the general opinion amongst our principal houses is that the season is too late now for the foreign markets to afford any great improvement this year.

In the coal trade 6d. to 1s. per ton advance has now been pretty generally obtained in household sorts. The long-continued mild weather led to the belief that no advance would be made this month, and merchants even yet are not buying to any extent, but owners are stubbornly requiring more money, and as the season advances they are certain to get it. Silkstone is now at 10s. to 12s. per ton; Barnsley House, 9s. to 9s. 6d. per ton; second qualities, from 8s. to 8s. 6d. per ton. In steam coal a full average tonnage is still being sent to the Humber ports, and the railway companies are taking good deliveries on account of contracts. Barnsley hards, 7s. 9d. to 8s. 3d. per ton; Parkgate and other qualities from 7s. per ton. Gas coal seems to be rather lower and in less demand. Manufacturing fuel continues very quiet, screened slack being quoted at 4s. 6d. to 5s. 6d. per ton; pit slack from 3s. 6d. per ton. Coke is in rather better demand at from 9s. to 11s. per ton.

Colliery extensions are proceeding briskly in South Yorkshire. On Monday last Mr. George H. Turner, general manager of the Midland Railway, cut the first sod of a new colliery at Griemthorpe, belonging to the Mitchell Main Colliery Company. The undertaking is on the property of Mr. F. J. Saville Foljambe, of Osberton Hall, who has granted a lease of about 3000 acres of coal, lying in such a direction that it will be connected with the workings of the Mitchell Main Colliery, Wombwell. It is expected to find the Barnsley thick seam at a depth of about 500 yards. The sinkings are to consist of two shafts, each of a clear diameter of 19ft. inside the tubbing. The coal is expected to be reached in about two years. With the two large pits already worked by the company, and the fresh enterprise in full operation, the output will be about one million tons per annum. The new colliery is connected with both the Midland and the Manchester, Sheffield, and Lincolnshire Railways. The sinking operations are in the hands of Mr. Charles Walker, of Darfield, under the supervision of Mr. Mitchell, the engineer.

On Wednesday, 10th inst., deputations of engine and boilermen from South and West Yorkshire had an interview with the executive of the South Yorkshire Coalowners' Association, the object being to require their wages to be restored to 30 per cent. above 1888 standard and to have the reductions returned. The men decline to submit to the reduction of one-fourth under the decree of the Conciliation Board, on the ground that not being represented on the Board they are not bound by its decisions. The executive are to report the result to a full meeting of coalowners to be held next week.

The return of coal sent to Hull from the Yorkshire collieries during September, issued by the Hull Chamber of Commerce and Shipping, shows that trade has been in a fairly good condition, with business as well up to what it usually is at this time of the year. The tonnage forwarded to that port last month amounted in the aggregate to 263,000 tons, as compared with 42,992 tons for the corresponding period of 1893, and 171,816 tons for September of 1892. The reason of course for the return for September, 1893, being so small was on account of the great coal strike, when practically no business was done with the Humber ports. Out of the 42,992 tons then sent, 39,552 tons came from Durham, and twenty-five Yorkshire collieries only sent 3440 tons. For the completed three-quarters of the year the tonnage forwarded to Hull was 1,591,800 tons, as compared with 1,049,480 tons for the same period of 1893, and 1,695,408 tons for the three-quarters of 1892. These figures, compared with those of 1893, exhibit an increase of half a million tons, but contrasted with those of 1892, a decrease of 103,000 tons is shown. The export trade has considerably advanced. Last month the figures were: coastwise, 19,945 tons; and to foreign countries, 147,838 tons; as against 75,607 tons in the same month of 1892. In September of 1893 no coal was exported coastwise, and only 624 tons sent away in all. The exports for the nine months of the year were:—1894, 665,462 tons; 1893, 349,807 tons; 1892, 635,089 tons. For the month of September the country which took the largest weight was Germany, with 45,458 tons. In the corresponding month of last year there was no coal sent to any foreign port except North Russia, and Sweden and Norway. Last month Sweden and Norway took 37,674 tons; North Russia, 29,680; Denmark, 12,411; and Holland, 6551 tons. For the nine months the largest weight was taken by Sweden and Norway with 215,644 tons, North Russia occupying second place with 140,158 tons, Germany being third with 117,872 tons, and Holland fourth with 37,105 tons. The highest individual tonnage sent by a single colliery was, as usual, from Denaby Main, with 23,456 tons. Peckfield, after sending moderate contributions, has sprung into second place with 16,472 tons. The third place is occupied by Manvers Main with 10,888 tons. Two collieries in West Yorkshire take fourth and sixth place, and the fifth is occupied by a South Yorkshire colliery.

During the month of September there has been the serious decrease of £20,298 in hardware and cutlery. The increasing countries for that month are Belgium, from £5937 to £8103; United States, from £12,987 to £25,314. This latter increase is due to the settlement of the tariff question. The markets which show a decrease include Russia, Sweden and Norway, Germany, Holland, France—from £8256 to £4606; Spain and Canaries, Foreign West Indies—from £3306 to £2509; Chili, from £3063 to £1291; Argentine Republic, from £3306 to £2825; British Possessions in South Africa, £12,736 to £11,577; Australasia, £24,027 to £18,868, and British Possessions in East Indies from £19,307 to £12,493. There is also a decrease reported on the exports for the nine months of £208,682. The only increasing markets are Russia—from £31,756 to £42,734; Sweden and Norway, from £28,181 to £30,477; Germany, from £82,426 to £82,905; Holland, from £56,642 to £69,336; Belgium, from £45,673 to £69,999. The decreasing countries are again very numerous, including France, from £71,008 to £55,862; Spain and Canaries, from £29,660 to £23,937; United States, £169,237 to £99,461; Foreign West Indies, from £37,706 to £28,704; Chili, from £35,134 to £14,053; Argentine Republic, from £45,866 to £35,215; British Possessions in South Africa, from £108,504 to £99,131; British Possessions in East Indies, from £167,300 to £123,842; Australasia, from £200,093 to £177,643; and British North America, from £75,295 to £52,225.

In steel unwrought there is a considerable improvement reported on the month's business. The increasing markets are Russia, from £17,660 to £39,115; Germany, from £17,834 to £30,158; France, from £6243 to £12,036; United States, from £11,704 to £32,361. Decreases are shown by the following countries:—Sweden and Norway, from £3112 to £2498; Denmark, from £3684 to £3645; Holland, from £12,815 to £7684; British East Indies, from £6394 to £3300; Australasia, from £4796 to £4593; and British North America, from £13,843 to £5995. An advance is reported on the nine months' working, the reviving markets including all except Holland, United States, and British North America.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THOUGH it is generally held that the trade of the country has entered upon a revival, and that prospects are more favourable to producers, yet in this district at present the tendency is rather the other way, and what little improvement has been gained is disappearing. Certainly the pig iron market has become very flat, and buyers are few, while plenty of sellers are coming forward, though it is but right to say that these latter are not the producers themselves, but are people who have been speculating and bought heavily when prices were advancing, in the expectation that the value of iron was going up still further. When, however, prices took a turn downward, there was the usual rush to sell out, and this prevented any recovery in prices, but rather helped them down until now they are at least 6d. per ton below the best price that has generally been realised. The unsettled state of foreign political affairs has made the speculators timid, and there is not nearly so much confidence in the market that there was a fortnight ago. Business in this district also is quieter, because less pig iron is required to be sent to Scotland, the miners' strike there having almost ended, seeing that forty thousand miners have gone back on the masters' terms out of the seventy thousand who came out more than three months ago, and coal being more plentiful the other nine of the blast furnaces have been relighted, making twelve at work altogether. There were nearly seventy in blast before the strike commenced. A good deal of capital has been made in commercial reports of the fact that between sixty and seventy furnaces could cease operations without causing any marked improvement in the demand for and prices of pig iron in other districts; but it ought to be taken into account that the consumption of pig iron fell off likewise, seeing that nearly all the finished iron and steel works in Scotland were stopped, and did not require the pig iron. If cheap and adequate supplies of fuel had been forthcoming so that they could have been kept going, a much greater improvement in the demand for and prices of pig iron in other districts would have resulted.

Cleveland pig iron makers have had to reduce their quotations, owing to the action of speculators, who have forced prices down in their anxiety to realise, and this though foundry qualities are admittedly scarce, so much so that only small lots can be furnished by the speculators themselves, and makers have little of which they can dispose for prompt delivery. Most of the business in No. 3 this week has been done at 36s. per ton for prompt f.o.b. delivery, but less than that will be accepted now—35s. 9d., and even 35s. 6d. was taken on Wednesday—as warrants all round have became so very weak, and this rules the general market, now that warrants are again coming more in competition with makers' iron. Not long ago Cleveland warrants could not be had under 36s. 6d., and at the close of last week were not below 36s., but on Tuesday they dropped to 35s. 8d., and on Wednesday to 35s. 6d. In the face of this and of as large a fall in Scotch and hematite warrants, it could hardly be expected that prices of makers' iron could be kept up. Very little iron is being taken out of the public stores, whereas a large quantity might have been expected, seeing that No. 3 is so scarce, and that large shipments are being made. The exports have considerably improved to the Continent, but as this is the last month of the northern navigation season, the despatch of the iron cannot be delayed, and those who need to get a stock in for the winter have to import it now. The pig iron exports from the Tees this month to Wednesday night were 30,035 tons, as compared with 21,050 tons last month, and 34,333 tons in the corresponding month of last year, all to 11th. No. 4 Cleveland foundry pig iron has declined to 35s., and grey forge—which has once more become almost a drug on the market, there being so much more offered for sale than is required—can be bought at 33s. 9d., a price which will not pay the producers. If the old differences in prices were maintained, grey forge should be only 1s. cheaper than No. 3, whereas it is 2s. 3d. cheaper; the expense of producing it is the same. East Coast hematite pig iron is also in better supply than demand, yet there are no signs of the output being reduced, though makers' stocks must be increasing considerably, and the cost of production increases. Mixed numbers can readily be bought at 43s. for prompt delivery, and even 42s. 9d. is said to have been accepted, Middlesbrough hematite warrants having fallen to 42s. 3d. buyers. Foreign ore is dearer, some sellers asking 12s. 3d. per ton for good Rubio delivered on the Tees. Messrs. Cochrane and Co. are dismantling a furnace at their Ormesby Ironworks, Middlesbrough, and they will have four built, of which three are now in blast.

The accountants certify that the average realised price of No. 3 Cleveland pig iron during the quarter ended September 30th was 35s. 1·96d. per ton, or 3·65d. decrease upon the previous quarter, a result which is disappointing, as most people had looked for an increase, seeing that the market quotations have been higher, being 35s. 6d. in July, 35s. 10d. in August, and 36s. 4d. in September, the average for the quarter being close upon 35s. 11d. It is evident that the makers must have had on hand a lot of low-priced contracts. Wages of blast furnacemen for the current quarter have been reduced half of 1 per cent. They looked for an advance, and thus they some time ago asked that the sliding scale, which would according to their notice have terminated at the end of September, should be prolonged to the end of the year.

Very little improvement can be reported in the finished iron and steel trades, but the prospects for rail makers are somewhat more promising, as orders are likely soon to be given out for India, as well as for railways at home. There seems also to be a brightening up in some of the markets abroad to which we have in past years sent large quantities of railway materials. The quotation for heavy steel rails is £3 12s. 6d. net at works. Steel billets are in good request, and several cargoes have been sent to the Manchester district by sea, it being cheaper to do that than to forward by train. The railway companies, however, rather than lose the traffic, have considerably reduced their rates, so that little more is likely to be sent by way of the Ship Canal. The chief market for steel billets is South Wales. The Darlington Steel and Ironworks have now been entirely closed, and 800 men thrown out of employment. Steel ship plates are quoted £4 17s. 6d.; steel boiler plates, £5 17s. 6d.; steel ship angles, £4 15s.; iron ship plates, £4 15s.; iron angles, £4 12s. 6d.; common iron bars, £4 17s. 6d.; and best bars, £5 7s. 6d.; all less 2½ per cent. and f.o.t.

A Staffordshire firm has been making inquiries about the Bowesfield Ironworks, Stockton. These were formerly well-known iron-plate mills, but have been idle for several years. The situation of the establishment is good, being on the left bank of the Tees, and close to blast furnaces, with shipyards not far away.

Messrs. Ropner and Sons, whose shipyard has been closed for three months, have this week recommenced operations, but have not yet found work for more than half the number they usually employ.

Mr. J. W. Willans, of Dolforgan Hall, Kerry, electrical engineer, has been accepted as the Liberal candidate for the Montgomery Boroughs. Mr. Willans was for many years engineering manager at the Tees-side Iron and Engine Works, Middlesbrough, and since then has had a good deal to do with the construction of the Liverpool Overhead Railway. The Skerne Steel and Wire Company, Darlington, is about to be reconstructed. It is being wound up voluntarily, so that the share capital may be reduced. The depression of trade and the moulders' strike in particular led the directors to consider the course now adopted to be desirable.

A meeting of promoters held at Manchester has decided that the Bill for the new through line between Manchester, Newcastle, and Glasgow shall be proceeded with in the parliamentary session of 1895, and Newcastle was chosen as the headquarters of the provisional committee. A very favourable report on the proposed line of route has been received from several engineers in the country. It is stated that the North-Eastern Railway Company is contemplating the extension of the Richmond branch up the Swaledale Valley as far as Muker.

The strike of patternmakers in the North of England—which has been in progress since April 5th—is not yet settled, and the men seem to be as loth as ever to recede from their demands. They decline to follow the example of the moulders, and allow their dispute with the employers to be adjudged by arbitration or conciliation; and nothing will content them but the full advance which they demanded half a year ago. Some of the masters have obtained men from Scotland, but the strikers have induced them to return. The district is suffering greatly yet from the effects of the late moulders' and engineers' strikes, and some steamers which might have been completed four or five months ago are still waiting for their engines.

The newly added south and west wings of the Durham College of Science at Newcastle were opened on Tuesday by the Mayor of Newcastle. It is twenty-three years since the College was opened. It was in 1887 that the first wing of the present building was erected, and the building will be complete when the north wing is opened, on which occasion the King of the Belgians is to be invited to perform the ceremony. On Tuesday an experimental engine of 200-horse power was presented to the College on behalf of the Worshipful Company of Drapers, by Mr. Robert Thompson, past-president of the North-East Coast Institution of Engineers and Shipbuilders.

On Tuesday, at the invitation of the Bishop of Durham, a number of gentlemen representing labour and capital met at Auckland Castle to talk over the limitation of competition with regard to the "living wage" and cognate subjects. The conference was private, but it is stated that Professor Marshall, who takes a great interest in these subjects, gave those present the benefit of his advice.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been a fair business in pig iron warrants, but the tone of the market has been easier, and the tendency of prices downward. As the miners' strike has now practically collapsed, there is no chance of the prices current of late for pig iron being maintained, and holders are understood to have been selling. Scotch warrants have further declined about 6d. per ton. The price of Cleveland iron is also down 5d. per ton, and Cumberland hematite has fallen in proportion. Only a small business has been done in hematite, although it is certain that the consumption will henceforth increase.

Since last report three furnaces have been put in blast at Gartsherrie Ironworks, and the prospect is, that in a short time a further considerable increase will be made.

The prices of makers' pig iron are as follows:—G.M.B. f.o.b. at Glasgow, No. 1, 44s.; No. 3, 42s. 6d.; Monkland, No. 1, 48s.; No. 3, 42s. 6d.; Carnbroe, No. 3, 46s.; Summerlee, No. 1, 59s.; No. 3, 52s.; Coltness, No. 1, 59s.; No. 3, 51s. 6d.; Calder, No. 1, 58s.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 54s.; No. 3, 49s. 6d.; Eglinton, No. 3, 43s.; Shotts at Leith, No. 1, 58s.; No. 3, 52s.

The shipments of pig iron from Scottish ports in the past week amounted to 2236 tons, compared with 5035 in the corresponding week of last year. India took 25 tons, South America 50, Australia 15, Italy 150, France 15, Germany 220, Holland 216, Spain 65, other countries 20, the coastwise shipments being 1460, against 1105 tons in the same week of 1893.

The stocks of Scotch pig iron are reduced to very small proportions at the ironworks, and those in the warrant stores show a decrease for the week of about 1000 tons.

Work is now being gradually resumed at the malleable iron and steel works, the managers proceeding with caution, as they are obliged to have cheap fuel. The prices obtainable will not afford anything else. It is a matter of uncertainty as to the amount of employment to be immediately available in finished iron and steel. The interruption to shipbuilding during the strike has been only partial, because supplies of steel were always to be had from the North of England, and merchants were thus able, wherever it was absolutely necessary, to carry out their engagements. Prices are not very regular, but they may be expected to equalise themselves in the course of the next two or three weeks.

The shipments of iron and steel manufactured goods from Glasgow in the past week embraced sewing machines to the value of no less than £10,825, of which the greater proportion went to the Continent; other machinery, £7743; steel goods, £2456; and miscellaneous iron goods, £11,792.

The coal market is now assuming something like its usual appearance, although a few weeks must still elapse before the full supply of coal will be attainable. Orders for cargoes from the North of England are now no longer given. On the other hand, the shipments of Scotch coals are on the increase, and the prices are receding. In the Glasgow district the best all-round coal is quoted at 9s., second quality 8s., and dross 5s. per ton.

The colliers' strike has quite collapsed in Lanark and Ayr. Fife and a part of Stirling and the Lothians still hold out, but the men must now be fully aware that their cause is utterly hopeless.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE colliers, having given in their notice, have now put aside, apparently, all discussion for a time, and continue working very regularly, with the exception of a few partial strikes. The General Federationists are, however, not inclined to let the opportunity slip by, and it may be taken for granted that the coming winter will see a lot of platform work, the agents of the English organisation making every effort to annex the Welsh colliers. I have spoken to influential men amongst the local colliers, and though they cannot guarantee the action of the hauliers, they think the middle-aged and common-sense colliers will strongly oppose any union with England.

The coal trade has entered upon the fourth quarter in a way to arouse very satisfactory comments. It is evident that war rumours, and the necessity of keeping the British fleet on the alert and ready to protect our interests abroad, tells favourably on the steam coal trade, and coaling stations are being well supplied. Some large tonnages went out this week. The total last week from Cardiff ports, notwithstanding the monthly holiday, was 280,000 tons. I note that the great steamship and other companies are beginning to make their arrangements for next year's contracts. The P. and O., as usual, are moving, and invite tenders for 120,000 tons.

On 'Change Cardiff the prominent topic of conversation of late has been the prominent figure at which contracts will be entered into, and from all I can glean, seeing what prices are had, and the firmness of the market, and noting also the prospects and the possibilities of the future, a likely price will be from 11s. to 11s. 6d. A good authority on 'Change agrees with this, though if the Foreign-office became actively disturbed during the next week or two, the higher figure might be exceeded.

The latest quotations this week, Cardiff, are as follows:—Best steam, 11s. 9d. to 12s., demand good; seconds, 11s. to 11s. 6d.; best Monmouthshire, 10s. 6d. to 11s.; dry coal, from 10s. f.o.b. House coal continues in a vigorous condition, and home and outside demand is good. Best continues at 11s.; No. 3, Rhondda, 10s. 3d. to 10s. 6d.; No. 2, Rhondda, 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 9d.

Newport and Swansea coal exports remain good, and prices firm. Swansea quotes best steam at 11s., and anthracite from 8s. 9d. to 12s. 6d., according to quality. For this class of coal, and for the kind which yields a useful blending of bituminous and anthracite, the inquiry is good, and I hear, in respect of the latter, that developments are likely at Hirwain on a large scale.

Coke remains tolerably firm, and I note that the closed steel works of Tredegar and Rhymney are busy in that direction. Cyfarthfa in the fulness of its requirements lending a helping hand.

Present quotations, Cardiff, are:—Furnace, 15s. to 16s.; foundry, 17s. to 18s.; special foundry, 20s. to 20s. 6d. Patent fuel is on steady demand at last prices, 11s. to 11s. 6d. Swansea price, 10s. 6d. to 11s. Pitwood, 15s. 6d. Cardiff; 17s. Swansea.

There has been little change from the ordinary rut in the iron and steel trades, and the activity one meets with here and there is more of the nature of preparing for briskness than meeting increased demands. The quantity of ore coming in and stocked at the principal works continues very large. So also in the make of tin bar, which has been heavy, particularly at Cyfarthfa. On two occasions this week the despatch sent, principally to the Great Western sidings, has been unusually large. On one day 50 wagons, principally ten tons each, were sent away.

I note that at these works the storing of pig iron has been immense of late, and every available corner utilised. Several hundred tons of refinery iron, which had been stocked for years, have also come under the Cyfarthfa tactics of putting everything to good purpose. This iron was of excellent brand, and to bring it to account a short railway was put down, and the whole rapidly cleared.

Pig iron continues to come in from Middlesbrough and Millom. Only two cargoes of rails have been despatched this week—one of 750 tons to Spain, and another, Great Western rails, to Highbridge, 110 tons.

Market quotations, Iron and Steel Exchange, Swansea, were as follows, midweek:—Glasgow warrants, 42s. 6½d.; hematite, Middlesbrough, 42s. 7½d.; Welsh bars, £5 to £5 2s. 6d.; steel rails, heavy, £3 15s. to £3 17s. 6d.; quotation at Cardiff, £3 12s. 6d. to £3 15s.; light, Swansea, £4 10s. to £4 15s.; steel sheets, £6 5s. to £6 7s. 6d.; sheet iron, £6 to £6 10s.; Bessemer steel tin-plate bars, £4 to £4 2s. 6d.; Siemens best, £4 to £4 2s. 6d. Tin-plates: Bessemer cokes, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; ternes, per double box, 28 by 20, 20s., 21s., 22s., 24s.; best charcoal, 12s. to 12s. 6d., according to finish of brand; wasters, 6d. to 1s. less than primes.

Block tin is down to £69 5s. There have been large clearances of tin-plates against Swansea; but tonnage has not come in as expected, or they would have been heavier. The total received from works last week amounted to 66,167 boxes; total shipped, 57,766 boxes, leaving stocks at 235,712 boxes.

The shipments of September were very satisfactory, 13,882 tons to the United States and 4374 tons to Russia, as against 9906 tons to the States and 3817 to Batoum for September, 1893.

A good deal of satisfaction is felt at the healthy state of the Swansea harbour trade. September beat the record. In imports there was an increase of 23,408 tons, and in exports 35,216 tons. During the month, in iron ore and in iron and steel, the increase in imports was large. Last week Swansea imported 1516 tons pig and 290 scrap steel, and a large quantity of tin-plate from the Monmouthshire district. In patent fuel there would have been a large clearance had tonnage come in. As it was exports were confined to 2470 tons to France, 1200 to Roumania, and 1000 tons to Algeria.

The great question now "on" at Cardiff is, Shall the Corporation acquire the Bute Docks and Penarth, possibly Barry, and form a harbour much the same as Swansea; but it would seem likely that while the Council are discussing payment to experts, and ways and means generally, the opposition will grow stronger. Some of the moderate men hold, that with a costly waterworks scheme, carrying out electric lighting, and acquiring tramways, they have enough on their hands at present. On Wednesday it was stated on good authority, that the Taff Vale Railway Company has decided to withdraw from the scheme, and up to the date of my despatch this has not been corrected. The impression in Cardiff is, that if the statement is right—and it seems reasonable, as without Penarth the Taff would have no sea outlet—the Corporation will retire from the undertaking.

In Swansea a water action, for which a claim of £60,000 was made, has been settled for £10,833 by arbitration in London.

The first main line train was run by the Rhondda and Swansea Railway directors over the new extension into Swansea on Tuesday, they having first inspected the whole work of the railway, including the swing bridge over the Neath river. The connection from the Rhondda is now unbroken with the exception of a few yards at Briton Ferry.

The Llanelly Harbour Commissioners held an important meeting this week, and comments were passed on the dilatory character of the Board of Trade in not sanctioning the improvements desired. Doubtless this will take a practical form next week.

A conference of collier delegates is to be called to enter into the question of the use of carbonite instead of compressed gunpowder in blasting operations. It is contended that though the use of carbonite is safer than powder, the miners are not able to earn so much, and that in consequence they should have compensation.

The formation of a transport company for the Severn Navigation is proceeding vigorously, and Sir W. T. Lewis has announced to the promoter that the Bute Docks Board are prepared to support, financially and otherwise, the scheme of a water transport company. In this, traders at Cardiff and Worcester are benefited, and the building of suitable steamers will be one of the earliest efforts.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE position of the iron and steel trade over here has in no wise altered since last week, a limited business being done in most departments, while quotations are rather fluctuating, and certainly anything but satisfactory. Quietness still prevails in most branches of the Silesian iron trade. Pig iron is in particularly weak request, and the blast furnace works justly complain of the decreasing tendency in prices, which has been very keenly felt in some instances. In malleable iron very little is done just at present, and for the few orders that are being secured here and there extremely low quotations have to be accepted.

With reference to the Austro-Hungarian iron trade, nothing of interest can be reported to have occurred since last week. Makers and manufacturers, on the whole, are well employed, though here and there a slackening off in demand has been noted lately. Pig iron continues to be scarce, and there is generally much firmness exhibited in prices. Few orders are coming in for bars, which may be accounted for by the exceptionally brisk demand that was coming forward for that article in last quarter, when dealers as well as consumers were anxious to profit from the low prices then ruling; for the present there is little chance for an improvement in demand, unless stocks should begin to decline. The steel trade is altogether in a poor condition, owing to the scarcity of orders for rails and railway rolling stock. The machine and wagon shops are in comparatively fair employment, twenty express locomotives having been ordered by the Austrian State Railways.

In France a rising demand can be noticed for almost all sorts of iron, though orders of weight are, as yet, rather scarce, but downward movements have not been reported for some time past. On the contrary, there is a very firm tone perceptible in most departments. A hopeful feeling generally prevails, and in many quarters the belief is entertained that a fairly good winter's business will be done.

The Belgian iron trade begins to show slight signs of a revival, and a firm tendency is generally reported. For the present, however, makers "live in hope," the business actually done being of small weight, but the more sanguine persons are of opinion that the worst is past, and that a general and lasting improvement is about to take place. Up to date both the raw and the finished ironworks are but moderately engaged; export trade continues uncommonly weak, and there are very few works that can boast of any forward orders. The Company Cockerill has been fortunate in securing a pretty fair order for fish-plates for the Roumanian Government at 147·50f. p.t. at works.

There is nothing new to note with regard to the Rhenish-Westphalian iron and steel industry. Some branches are tolerably well employed, and the fact that prices are rather firmly maintained is generally considered as a symptom of lasting improvement. The quietness in the iron trade cannot fail to have a strong influence on the iron ore market, and there is but little activity to be noted at the iron ore mines. Since previous letters no alteration in quotations can be reported to have taken place, nor is it at all likely that there will be any material change so long as the weakness in the pig iron department continues. From the malleable iron market tolerably good accounts have been coming in upon the week, though little actual business is done in most branches; but a good number of inquiries have come in for bars as well as for hoops, and buyers appear to be just a little less reserved than formerly. In girders not much has been done lately. A good activity continues at the plate and sheet mills, but makers find it impossible to carry an advance in quotations. Foreign inquiry is dull, sheets only meeting with a pretty strong request. Drawn wire and wire nails still show no sign of improvement, either in price or demand; and there is likewise a very weak tone to be noticed in the rivet business. The ironfoundries and machine factories are only poorly employed, while a good activity continues at the wagon shops.

A concession for the building of a locomotive wagon and rail shop in Russia has been granted by the Russian Government to an American syndicate, under condition that twenty-four foreigners, at the most, are to be employed, and that only Russian raw material is to be consumed.

The following figures, showing the average prices of pig iron in the different countries, may perhaps be of some interest. The highest prices for raw iron are quoted in Italy, where 161f. p.t. is paid for common foundry pig. In Russia 104f. p.t. is quoted; in Austria, foundry pig is paid with 92f.; in Hungary, 90f. p.t. In Japan, 84f. p.t. is quoted; in Spain, 69f. p.t.; in Norway, 69f. p.t. In Luxemburg, 45f. p.t. is the price quoted; in Belgium, 51f.; and in Bavaria, 57f. p.t. is paid. In the United States 71f. p.t. is the average price for foundry pig, Prussia and France each quoting 61f. p.t.

STATUE TO SIR WILLIAM PEARCE.—A memorial statue of the late Sir William Pearce, Bart., the eminent shipbuilder, who died in London, December 18th, 1888, was unveiled at Govan, Glasgow, on Saturday, the 6th inst., by Lord Kelvin. The event took place in presence of a large concourse of spectators for most part composed of the trades' societies belonging to Govan, and of employés in the shipbuilding works. Besides Lord Kelvin, there were present, Lady Kelvin, Lady Pearce, Sir Wm. George Pearce, Lady Roberton, Sir James Bain, the Provost and Council of Govan, and Rev. Dr. John MacLeod. The statue, which has been erected at a cost of some £2000, defrayed by public subscription, occupies a commanding and central position near the cross of Govan, the site having been given by Lady Pearce. The statue proper is from the design of Mr. Onslow Ford, of London, while the massive and lofty pedestal on which it stands is of polished Peterhead granite, supplied by an Aberdeen firm. The pedestal alone weighs about 25 tons, and is 12ft. 6in. high. On the upper base dado are four sunk moulded panels for inscriptions and memorial tablets. The statue represents the late baronet examining the plan of a ship, and the likeness fully maintains the reputation of the sculptor. A glass vase deposited inside the base of the pedestal contains drawings of some of the famous steamships built under the deceased baronet's management, including the Arizona and Alaska, together with a full list of the vessels built during his time; a pamphlet entitled "The Building of a Ship;" a map of the borough of Govan, photographed by the late baronet; current coins of the realm, copies of newspapers, &c. In unveiling the statue, Lord Kelvin gave a lengthy biographical statement regarding the late baronet, and said that by the statue now unveiled they would be kept in remembrance of what Sir William Pearce had done for Govan, for the Clyde, and for the world. Sir W. G. Pearce followed Lord Kelvin, and formally handed over—on behalf of his mother—the title deeds of the ground on which the monument had been erected.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, October 5th.

The expectation of the early placing of large orders for billets, pig iron, bridge plate, steel rails, and cast pipe has had a favourable effect on the pig market. Pig iron production is increasing at the South, and large sales were made this week of mill irons at Ohio River points. Specifications for considerable bridge workers expected in a few days. The anxiety for winter orders is leading to the shading of prices. Wire rods and barb wire are in good demand. The rush for nail orders led to another cut of 5 cents. Sheet iron and boiler plates are doing better than for two months. Work will be hurried through on projected tin-plate mills, and despite the refusal of the workmen to accept a 25 per cent. drop, a sufficient cut will be made to protect the bulk of the home trade, especially in ternes. Several large users of billets made offers this week for three months' supplies, but acceptances have not been announced. Girder rails are active. The railroad demand for structural material will soon improve. The money markets are easy. For shop and factory work there is a gradual increase of orders, but no great expansion of trade is probable until the opening of spring.

## LAUNCHES AND TRIAL TRIPS.

The s.s. Turret Bell, turret deck steamer, was taken on her official trial on Thursday, the 4th inst., when a mean speed of 11¼ knots was registered, her total deadweight capacity being 3800 tons on 19½ft. draught. She has been built by Messrs. William Doxford and Sons, of Sunderland, to the order of the Turret Steam Shipping Company, Newcastle—Messrs. Petersen, Tate and Co., managers—and has received the highest class in both British Corporation and Bureau-Veritas Registries.

## EXPERIMENTS ON THE DISINFECTION OF TOWN SEWAGE WITH SULPHURIC ACID.[*]

By Dr. M. Ivanoff.

The fact that the cholera-bacillus displays an intense susceptibility to the action of acids was known to its discoverer, for Dr. Koch pointed out that in the acid secretions of the stomach these bacilli speedily lose their vitality. The subsequent experiments of Kitasato have shown that very minute additions of sulphuric and hydrochloric acids to bouillon cultures destroy cholera germs in the course of a few hours; and, lastly, Messrs. Stutzer and Burri have studied exhaustively the effect upon these organisms of very dilute solutions of sulphuric acid. At the suggestion of Professor Pfuhl, the author undertook to investigate the action of dilute sulphuric acid upon cholera-bacteria when present in sewage water. From the inception of his experiments he surmised that under these conditions the acid must be used in a more concentrated form than in the above cases, because the sewage water invariably contains substances which would combine with the acid, and would thus, to some extent, neutralise its effects. It was, however, ascertained that the additional amount of acid rendered necessary on this account was but trifling. The samples of sewage water were derived both from the Berlin and the Potsdam sewers, and were infected alternately with pure cultures of the cholera-bacillus and with the fresh dejections of a cholera patient. The acid in the case of the Berlin sewage water was used in three degrees of strength: (1) as a 0·02 per cent. solution; (2) as a 0·04 per cent. solution; and (3) as a 0·1 per cent. solution. The conditions under which the analyses were made are fully described, and the author availed himself of microscopic observations, as well as bacteriological tests. Four parallel series of experiments were carried out, and the results were in every case identical. The Potsdam sewage, which is three times as concentrated as that of Berlin, was treated with stronger acid, viz., with 0·04, 0·06, 0·08, and 0·12 per cent. solutions. It was found that in the case of the Berlin sewage the 0·04 per cent. solution of acid was fatal to the cholera-bacilli, but that with the stronger sewage water of Potsdam the amount of acid needed was that present in the 0·08 per cent. solution. It is pointed out that, whereas previous to treatment the sewage water was faintly alkaline, the sample to which 0·08 per cent. of acid had been added had a strongly acid reaction on being tested with litmus paper, and that such reaction may be regarded as an indication that the necessary dose of acid has been employed. This treatment is, with the exception of the use of lime, the cheapest system that can be adopted.

Siemens Brothers' Electrical Works. — The last vacation visit of the Society of Engineers for the present year was made on Tuesday, when the president, Mr. G. A. Goodwin, and about 70 members, inspected the electrical engineering and submarine cable works of Messrs. Siemens Brothers and Co., at Charlton. The first department visited was the new dynamo shop, which is fitted up with all the latest appliances for turning out this class of work. Much interest was shown in the cable shop where deep sea and electric lighting cables are made. Some of the cables for the latter purpose are very heavily armoured for laying in the ground in Edinburgh without pipes or protecting channels. The central power and lighting station attracted considerable attention, as nearly the whole of the works are now being driven by motors instead of scattered engines, and the engines have been taken out. The station contains engines and dynamos for producing the current for driving machinery and lighting the works. The driving is done by 54 electric motors distributed through the works. We shall refer more at length to this in another impression.

---

[*] "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

---

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*26th September*, 1894.

18,259. Producing Printing Surfaces, H. Dade, London.
18,260. Full-sized Body Baths, A. Boots, Eastbourne.
18,261. Boot, &c., Lace Fasteners, A. E. Muller, Germany.
18,262. Improving the Colour of Raw Skins, J. Baird, London.
18,263. Warp Flushing Threads, A. F. Craig and R. Millar, Glasgow.
18,264. Treatment of Scrap Iron, W. R. Renshaw, London.
18,265. Whisks, E. Goodwin, Glasgow.
18,266. Spring Mattresses, O. Ransford, Glasgow.
18,267. Scissors Sharpener, W. S. Freeman and J. Turvey, Kent.
18,268. Gas Engines, J. W. Hartley and J. Kerr, London.
18,269. Substitute for Caoutchouc, J. Schmid, London.
18,270. Paint Brushes, J. L. Thomasson, Worcester.
18,271. Reading Desks, J. Ballinger and J. Henshaw, Cardiff.
18,272. Obtaining Pure Phenols from Mixtures, L. Lederer, London.
18,273. Electric Motors, J. Imray. — (*La Société Anonyme pour la Transmission de la Force par l'Electricité, France.*)
18,274. Arc Lamps, J. Brockie, London.
18,275. Vessel for Travelling on Ice or Water, E. E. Dulier, London.
18,276. Brake, A. Bucsanszky, London.
18,277. Machines for Kneading Dough, T. Kade, London.
18,278. Typewriters, G. Royle, London.
18,279. Extracting Metals from Ores, A. E. Morgans, London.
18,280. Check Tills, R. Zabel, London.
18,281. Automatic Fire-arms, F. R. von Mannlicher, London.
18,282. Sensitising Photographic Paper, C. Beadle, London.
18,283. Fastener for Ladies' Dresses, G. McDonald, London.
18,284. Valves for Pumps, A. W. and Z. W. Daw, London.
18,285. Process for Treatment of Milk, G. Gaertner, London.
18,286. Disc Engines, W. G. Kent, London.
18,287. Safety Stirrup, J. Cope and H. Taylor, London.
18,288. Secondary or Storage Batteries, C. Riordon, London.
18,289. Electric Motors, J. H. K. McCollum, London.
18,290. View Finder for Photographic Cameras, H. Ransom and A. D. Thornton, London.
18,291. An Improved Tooth Brush, C. Feldman, London.
18,292. Advertising on Bicycles, &c., G. G. White, London.
18,293. Typewriting Machines, N. W. Hartwell, London.
18,294. Mariners' Compasses, J. Morton, London.
18,295. Decorated Looking Glasses, E. M. Philz, London.
18,296. Improved Truss, C. Lange, London.

*27th September*, 1894.

18,297. Apparatus for Striking Bells, D. Mathieu, London.
18,298. Inking Ribbons for Typewriters, L. H. Vaughan, London.
18,299. Disinfecting Ventilators, F. Park, London.
18,300. A Vermin Trap, G. F. Griffin, London.
18,301. Kettles, A. King and A. C. Oakes, Nottingham.
18,302. Rotary Swings, C. Merington, London.
18,303. Apparatus for Swing Exercise, C. Merington, London.
18,304. Toy, T. F. Edgeworth and J. F. Parsons, Bristol.
18,305. Billiard Table Adjuster, G. C. Waterfield, Aldershot.
18,306. Tapestry Carpets, W. Wallace and R. Barclay, jun., Glasgow.
18,307. Detachable Lids of Jugs, A. Martin, Staffordshire.
18,308. Range and Position Finders, W. M. Huskisson, London.
18,309. Mantles for Incandescent Gas Lights, H. Blücher, Manchester.
18,310. Weaving Apparatus, W. Simpson and the Duplex Weaving Appliance Company, Manchester.
18,311. Machine for Extracting Vegetable Fibres, N. Ismaljee, Manchester.
18,312. Cutting Wood, W. Whitley, Keighley.
18,313. Marine Signalling, J. Wall, Liverpool.
18,314. Casks, J. W. Mellor, Oldham.
18,315. Storage Buildings for Coal, T. Wrigley and T. Taylor, Manchester.
18,316. Cotton Reels for Holding Needles, G. Grigioni, Liverpool.
18,317. Art Decoration, M. English, near Clevedon.
18,318. Reciprocating Motions, J. Sturrock, Dundee.
18,319. Passenger Guard for Omnibus, E. Pink, London.
18,320. Machines for Digging Potatoes, J. Holt, Cheshire.
18,321. Apparatus for Tilting Casks, P. S. Lawless, Dublin.
18,322. Separating Cream from Milk, J. V. Geary, Dublin.
18,323. Close-jointing Chair Frames, J. Gaymond, Manchester.
18,324. A Pneumatic Billiard-table Cushion, J. C. Murray and W. McI. Valentine, Breccin.
18,325. Hydraulic Cranes, J. A. Saner, Liverpool.
18,326. Hydrocarbon Lamps, B. Cars, London.
18,327. Steam-generators, J. J., T. F. and J. W. Meldrum, Liverpool.
18,328. Duplex Telegraphy, G. E. Fletcher, Stockport.
18,329. Domestic Filters, W. H. Barr, Manchester.
18,330. Reversible Cloth, W. Buchanan, Glasgow.
18,331. Rotary Water Meters, H. J. Rohlf, Glasgow.
18,332. Attaching Inflators to Cycles, J. Stradling, Newbury.
18,333. Driving Gear of Rear-driving Cycles, W. J., E. Freeman and R. Thompson, London.
18,334. Window Lock, J. Wharfe, London.
18,335. Boots and Shoes, F. Kennel, London.
18,336. Utilising Tidal Power, W. J. Roberts and J. R. Jones, Liverpool.
18,337. Frozen Meat, J. Atherton, Liverpool.
18,338. Soldering Irons, J. R. Cooper, Birmingham.
18,339. Carbons for Electric Lamps, E. G. Acheson, London.
18,340. Trousers, J. M. Forster, London.
18,341. Soles of Boots, F. Leigh and G. Padmore, jun., London.
18,342. Saddles, P. Taaffe, London.
18,343. Bridles, P. Taaffe, London.
18,344. Horse-collars, E. E. Kelsey, London.
18,345. Filling Stoppered Bottles, E. Butes, London.
18,346. Apparatus for Supplying Fluid, O. Beck, London.
18,347. Hinge Folding Splashboard, C. Irvine and G. Dyer, Belfast.
18,348. Spring Bottoms for Beds, &c., T. A. Stoll, London.
18,349. Felt Handles for Cycles, F. G. Bensly, Birmingham.
18,350. Trays of Wardrobes, G. W. Raikes, Birmingham.
18,351. Starting Gear for Vehicles, J. B. Lee, London.
18,352. Indicating the Names of Stations, G. P. and E. A. Wadsworth, and H. I. Hankin, London.
18,353. Focussing Images in Cameras, L. H. Chase, London.
18,354. Motive-power Engines, E. Edwards.—(*O. Pick, Belgium.*)
18,355. Cycles, W. E. Corrigall, London.
18,356. Station Indicators for Waiting-rooms, A. A. Jeenel, London.
18,357. Pneumatic Cushion in Boot Soles, J. H. Betteley and F. W. Phillips, London.
18,358. Treatment of Starch, H. C. E. Wilmot, London.
18,359. Elevating Mechanism, B. Wilcox.—(*The Eisenwerk, Germany.*)
18,360. Blocking and Cutting Presses, N. J. Hill, jun., London.
18,361. Plates for Printing, G. Isaac, London.

*28th September*, 1894.

18,362. Spur Protector, D. J. Coyne and T. Christian, London.
18,363. Earthenware, R. Jackson and J. H. Carter, Sheffield.
18,364. Hinge for Doors of Cesspits, &c., G. Waller, London.
18,365. Boilers, L. P. Perkins and G. F. Buck, Manchester.
18,366. Machinery for Making Felt, C. Aris, London.
18,367. Box with Powder Puff, A. W. Shirley, London.
18,368. Envelope Book, E. H. Wilson.—(*J. H. Hunter, Argentine Republic.*)
18,369. Gas Producer, G. Threlfall and R. J. Hodges, London.
18,370. Buttons for Gloves and Dresses, J. Paterson, London.
18,371. Mechanical Counter or Indicator, C. Jost, Manchester.
18,372. Minimising the Effect of Shots, W. Powell, London.
18,373. Buckle for Animal Harness, E. Roberts, Longport.
18,374. Tacking Machines for Boots, W. H. Dorman, Stafford.
18,375. Internal Combustion Engines, W. J. Crossley, Manchester.
18,376. Rotary Pumps, G. Marty, Manchester.
18,377. Nut Locking Plate, H. J. Fuller, Dublin.
18,378. Safety Watch-holding Glove, H. Robinson, Bradford.
18,379. Cooking and other Ovens, H. J. B. Holland, Blackburn.
18,380. Wind and Rain Excluder, W. Walks, Bradford.
18,381. Boot Protectors and the like, A. Smith, Glasgow.
18,382. Gas Fires, J. J. Wilson, Glasgow.
18,383. Couplings for Railway Wagons, A. and H. Ingram, Liverpool.
18,384. Ventilating Apparatus, W. J. Thomas, London.
18,385. Brake for Vehicles, J. R. Kyme.—(*G. Kyme and P. G. Williams, Australia.*)
18,386. Velocipedes, H. W. D. Ingram, Birmingham.
18,387. Ladies' Hair Dressing Pin, G. A. Morgan, Cardiff.
18,388. Railway Carriage Seats, J. J. Duffy, Dublin.
18,389. Wheels for Vehicles, S. T. Richardson, A. Smallwood, and R. Price, Birmingham.
18,390. Chain Wheels for Cycles, J. Appleby London.
18,391. Feeding Bottles, H. Hermann, Liverpool.
18,392. Controlling Water Supply, A. Campbell and W. C. Sim, Bristol.
18,393. Grates of Looms for Weaving, J. W. Banister, Halifax.
18,394. Disinfecting Cisterns, C. O. Williams and J. Stotter, London.
18,395. Vehicle Wheels, W. Pain and L. Sargent, London.
18,396. An Improved Dress Holder, E. S. Collins, London.
18,397. Fictile-ware, The Worcester Royal Porcelain Company, Ld., W. M. Binns, and G. H. Hancock, London.
18,398. Classifying Ores, J. Hosking, London.
18,399. Elastic Wheels, R. Thom and J. Watt, Aberdeen.
18,400. Chairs, A. E. Carrie, London.
18,401. Gas Pliers, J. R. Cooper, Birmingham.
18,402. Fly-wheel, G. Sharman, Birmingham.
18,403. Clutch Pulleys, W. P. Chapman, Birmingham.
18,404. Chimney Cowls, T. Schröder, London.
18,405. Frizzling Hair, H. T. Turner, London.
18,406. Weighing Apparatus, E. Maibaum, London.
18,407. Preventing Ladders Slipping, J. Arnott and J. Skirrow, London.
18,408. Tobacco Pipes, R. V. Burt, London.
18,409. A New Game, M. L. Dorrington and J. S. Trott, London.
18,410. A New Cartridge Belt, A. M. E. Summer, London.
18,411. Dress Fasteners, A. Turner, London.
18,412. Cigar Tray, H. Ost, London.
18,413. Rope Horseshoes, M. Müller, London.
18,414. Locomotive Gear, J. F. Toomer and G. C. Morton, London.
18,415. Car Couplings, J. Shearn, London.
18,416. Drawing Off Beverages, A. Soames, London.
18,417. Gasholder Guide Carriages, S. Cutler, London.
18,418. Automatic Self-opening Umbrellas, G. Ross, London.
18,419. Tires, W. Dodd, London.
18,420. Securing or Holding Persons, J. J. Wilson, Birmingham.
18,421. Drying and Airing Clothes, C. Holmström, London.
18,422. Washing Powder, S. Rasenblum and F. Bartelt, London.
18,423. Ledger Markers, G. C. Marks and E. Ellisden, London.
18,424. Washing Machines, W. Gibbins, Leytonstone.
18,425. Extracting Metals from Ores, J. Mactear, London.
18,426. Lamp Shade and other Wire, J. Wright, London.
18,427. Electric Traction, M. Hutin and M. Leblanc, London.
18,428. Cans for Conveyance of Milk, W. Cooper, London.
18,429. Preparing Diazo Salts for Dyeing, A. Feer, London.
18,430. Bobbins and Reels for Weaving, W. Webster, London.
18,431. Lock-nut, J. Newns, London.
18,432. Pocket Calendar or Indicator, E. S. Cadman, London.
18,433. Tackle Blocks, A. J. Boult.—(*F. X. Rousseau, United States.*)
18,434. Disinfectors, A. B. Reck, Liverpool.
18,435. Purification of Beer, A. J. Boult.—(*A. Delhaise, Belgium.*)
18,436. Lighters, W. J. Chambers and R. Williamson, Liverpool.
18,437. Weaving Shuttles, A. J. Boult.—(*W. Wagenknecht, Germany.*)
18,438. Stirrups, W. E. Schenk, London.
18,439. Signalling Apparatus, L. B. Stevens, London.
18,440. Gas Washing Apparatus, S. Hersey and Kirkham, Hulett, and Chandler, Ld., London.
18,441. Gas Washing Apparatus, Kirkham, Hulett, and Chandler, Ld.—(*F. D. Marshall, Denmark.*)
18,442. Colour Printing Apparatus, J. Bachelerie, London.
18,443. Apparatus for Using Liquid Fuel, S. H. Terry, London.
18,444. Safety Mechanism for Lifts, J. S. H. Drew, London.

*29th September*, 1894.

18,445. Gas Generating Plant, B. H. Thwaite, London.
18,446. Rope Grip, J. W. and J. J. Taylor and F. Broadbent, Oldham.
18,447. Extinguishing Lamps, W. Pearce and A. J. Mason, Birmingham.
18,448. Washing Bottle Stoppers, F. A. Bird, Birmingham.
18,449. Braces Attachments, T. Walker and J. J. Glasgow, Birmingham.
18,450. Cycle Brake Attachments, A. Blackwell, Birmingham.
18,451. Funnel, G. F. Fitter and J. Burley, Birmingham.
18,452. Oil Engines, P. P. Bedson and J. C. Hamilton, Glasgow.
18,453. Arm Chairs and Appliances therefor, A. Plant, Glasgow.
18,454. Manifold Books for Use as Post Cards, A. H. Megson, Manchester.
18,455. Preventing Scratching of Polished Surfaces, F. Smith and H. T. Heath, Bristol.
18,456. Window Blind Furniture, W. Lowe and C. Britton, Birmingham.
18,457. Coupling, &c., Railway Vehicles, C. Wright, London.
18,458. Door Lock, W. Anderson and S. Stott, West Hartlepool.
18,459. Appliances for Curling Hair, G. H. Twigg, Birmingham.
18,460. Refrigerators, T. Sharratt, Derby.
18,461. Valve, W. E. Bryan, Lyndhurst.
18,462. Taps for Chemical Fluids, T. W. F. Cherry, North Shields.
18,463. Method of Advertising, H. R. Dixon, Manchester.
18,464. Cycle Lamps, F. Powell and F. Hanmer, Birmingham.
18,465. Pneumatic Tire Covers, R. W. Edlin and R. Green, Birmingham.
18,466. Bamboo Bicycle Frames, R. W. Smith, Birmingham.
18,467. Bicycles, J. Talbot, Wellington, Salop.
18,468. Making Felt Forms for Toys, T. M. Cockcroft, Leeds.
18,469. Manufacture of Linoleum, &c., J. Igleby, Leeds.
18,470. Soles of Boots, Shoes, and Slippers, W. L. Dash, London.
18,471. Flushing Water-closets, D. Mitchell, Dundee.
18,472. Damping Appliances for Letter Copying, M. S. Stevenson, Glasgow.
18,473. Lamps, M. S. Stevenson, Glasgow.
18,474. Nose-bags for Horses, R. Wright, Glasgow.
18,475. Chip Cutting Machinery, R. T. Heselwood, London.
18,476. Opening Window Sashes Inwards, T. Black, Glasgow.
18,477. Automatic Delivery Machines, E. P. Wicke, London.
18,478. Casements, W. Youlton, London.
18,479. Fixing Castors to Chair Legs, W. G. Tubb, London.
18,480. Electric Gaslighters, W. N. Jaskey and E. S. Else, London.
18,481. Motors Driven by Compressed Air, C. Bono, London.
18,482. Steam Pressure Indicators, J. Beswick, London.
18,483. Boot, Shoe, and Corset Laces, D. G. Lewis, London.
18,484. Apparatus for Unloading Ships, W. Parr, London.
18,485. Watering Cans, E. T. Gamble, London.
18,486. Door Bolts or Fastenings, O. H. Steed, jun, London.
18,487. Teat, H. Carter, Horwich.
18,488. Pneumatic Swing Razor Strop, T. Reynor, Dublin.
18,489. New Fire Escape, S. Simpson, Blackburn.
18,490. Underground Railway Construction, H. Grauel, London.
18,491. Book Protector, G. Barnes, Birmingham.
18,492. Horse Shoes, A. S. Walker, London.
18,493. Flower Trays, T. M. Ellis, London.
18,494. Surface Exhibitors, V. P. de Knight, London.
18,495. Picture Frames, G. M. Dodshon, London.
18,496. Explosive, F. W. Bawden, London.
18,497. Polishing Tools, A. J. Boult.—(*C. Bruart and L. Lombot, Belgium.*)
18,498. Protector for Pins, C. J. Gerry, Liverpool.
18,499. Chain for Cycles, M. Boudard and H. A. Shelton, London.
18,500. Movable Partitions, G. Thornborough and J. Wilks, Manchester.
18,501. Incandescent, Electric Lamps, W. T. Kerr, London.
18,502. Crutches, B. B. Moss, Liverpool.
18,503. Lantern Slide Carriers, F. Bartlett, London.
18,504. Enemas, E. J. Lambert, London.
18,505. Revolving Chair-actions, E. Warren, London.
18,506. Advertising on Cycles, C. L. Lamare, London.
18,507. Electric Lampholder, C. O. Duetschmann, London.
18,508. Band Saws, A. J. Boult.—(*J. Leclerq, Belgium.*)
18,509. Manufacture of Ethers, M. Otto and A. Verley, London.
18,510. Apparatus for Enriching Gas, W. Kemp, London.
18,511. Fruit Presses, E. Edwards.—(*C. Heinle, Germany.*)
18,512. Knife Cleaner, L. A. Fidge, Gravesend.
18,513. Anchors, F. Grosvenor, London.
18,514. Oil and Gas Engines, J. N. Aronson, London.
18,515. Coating Creams with Chocolate, D. M. Holmes, London.
18,516. Manufacture of Alkylrhodonates, A. M. Clarke.—(*A. Edinger and A. Müller, Germany.*)
18,517. Ink Reservoir for Pens, C. Smith.—(*J. F. S. Wallace, China.*)
18,518. Knitted Fabrics, T. Hill and A. D. Whitehead, London.
18,519. Manufacture of Cyanides, J. Pfleger, London.
18,520. Manufacture of Alkaline Metals, J. Pfleger, London.
18,521. Churns, T. Bradford, London.
18,522. Electric Arc Lamps, W. S. Pendleton, London.
18,523. Vehicle Wheels, H. H. Lake.—(*F. Myers, United States.*)

*1st October*, 1894.

18,524. Soil-pipes for Water-closets, F. Walsh, Halifax.
18,525. Celestial Globe, R. Huntley, South Shields.
18,526. Sodium Chlorates, J. Hargreaves and T. Bird, Farnworth-in-Widnes.
18,527. Toilet Apparatus, A. M. Cadell and Z. E. Gardiner, Dublin.
18,528. Pneumatic Pads for Cricketers, G. Hodson, Dublin.
18,529. Ships' Water Draught Indicator, A. Corner, South Shields.
18,530. Carrying and Stacking Bottles, H. Slingsby, Bradford.

18,531. Emptying Bottoms of Bottles, H. C. Slingsby Bradford.
18,532. Adjusting Beer Barrels, &c , H. C. Slingsby, Bradford.
18,533. Carriage for Beer Barrels, H. C. Slingsby, Bradford.
18,534. Curtain Poles, W. G. McMaster and J. Sinclair, London.
18,535. Furnaces for Destroying Refuse, J. Gill, Bradford.
18,536. Springs for Weighing Machines, W. H. Penning, Henfield.
18,537. Liquid Drawing-off Apparatus, J. J. Clark, Cardiff.
18,538. Fire Doors for Furnaces, D. B. Morison, Hartlepool.
18,539. Toy, J. W. Wood, Nottingham.
18,540. Handles of Cycles, &c., F. Bartlcet, Birmingham.
18,541. Liquid Heating Apparatus, H. P. Miller, London.
18,542. Telegraphs, H. W. C. Cox and R. J. Crowley, London.
18,543. Lighting Pipes, G. E. Seymour and W. C. Hunniball, Thetford.
18,544. Rubber Stamp for Marking Goods, J. Howarth, Sheffield.
18,545. Fasteners for Belts, A. Dickson —(*R C. Dickson, Ceylon* )
18,546. Raising Pies, E. Frost and G. Holbrook, Longport.
18,547. Tire Valves, W. Bown, G. Capewell, and H. W. D. Ingham, Birmingham.
18,548. Additions to Toe-clips, J. Harrison, Birmingham.
18,549. Mattress to be Used as a Table, B. Franke, Manchester.
18,550. Cartons, C. N. Rickinson, London.
18,551. Exhaust Displacer, F. M. and E. J. Davis, Birmingham.
18,552. Automatic Pot for Coffee, &c., C. Martin, London.
18,553. Pipe Joints, F. W. Kent, London.
18,554. Box or Package for Butter, &c., E. Pontin, London.
18,555. Billiard Tables, H. H. Greaves and J. Salisbury, Manchester.
18,556. Slate Frames, D. Macdonald, London.
18,557. Parallel Rulers, J. Thomas, London.
18,558. Copying Presses, C. J. Davison, London.
18,559. Electric Conductors, &c., A. W. Gamage, London.
18,560. Chain-wheels, W. F. Taylor and G. J. Philpott, London.
18,561. Pudding Basin or Mould, J. W. Bray, jun , London.
18,562. Busk Steels and Whale-bones, J. Koehlhofer, London.
18,563. Metal Bedsteads, J. W. Hoyland and W. H. Sturge, Birmingham.
18,564. Gearing Chains, C. J. Chubb and R. H. Seaton. London.
18,565. Levers and Turning-bolts, H. Carmont, London.
18,566. Horse Collar, N. C. Lindsay and H. Stanbridge, London.
18,567. Boxes for Preserving Butter, J. P. Boyd, London.
18,568. Wirework Grating for Stoves, W. L. Clark, London.
18,569. Apparatus for Treating Ores, J. Harris, London.
18,570. Spark Destructors for Engines, F. V. Hawley, London.
18,571. Pasteboard Boxes, P. M. Justice.—(*H Inman, United States* )
18,572. Caps, M. Schneiders, London.
18,573. Printing Machines, C. Pollard and G. Brayshaw, London
18,574. Lubricating Device, A. J. Boult.—(*E. Raikem, Belgium* )
18,575. Gas-fired Boilers, G. H. Taylor and C. B. Waller, London.
18,576. Cycle Driving, H Osborne and J. W. Gaffney, London.
18,577. Making Continuous Hair Felt, J. Newton, London.
18,578. Production of Colouring Matters, H. E. Newton.—(*The Farbenfabriken vormals F. Bayer and Co., Germany* )
18,579. Driving Gear, W. Smith and H. Morriss, London.
18,580. Making-up Hair for General Purposes, S. Lichtenfeld, London.
18,581. Combined Thread Cutter and Thimble, M R. Gray, London.
18,582. Opera Glasses, &c , W. Edwards and G. A. Reid, London.
18,583. Driving Gear for Cycles, &c., S. Smith, London.
18,584. Saddles for Horses, &c , J. W. H. Bleck, London.
18,585. Ball Bearings, E. Fries and W. Höpflingèr, London.
18,586. Ploughs, W. H. Sleep, London.
18,587. Pedals for Cycles, C. Saugster and R. L. Philpot, Coventry.
18,588. New Condensation Products, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
18,589. Colouring Matters, O. Imray.—(*The Society of Chemical Industry in Basle, Switzerland.*)
18,590. Driving Mechanism for Velocipedes, F. V. Mégret, London.
18,591. Cooling and Freezing Machines, T. Hewitt, London.
18,592. Extraction of Precious Metals, H. L. Sulman and F. L. Teed, London.
18,593. Steam Boilers, A. J. Boult.—(*C. W. Baker, United States.*)

*2nd October*, 1894.

18,594. Mouthpieces of Tobacco Pipes, C. H. Smith, London.
18,595. Baskets for Oil Lamps, W. J. Charles, Birmingham.
18,596. Power Transmitting Apparatus, G. J. Altham, Manchester.
18,597. Gulley Traps, R. Greenwood, Manchester.
18,598. Hair Curler, E. Hales and F. G. Hales, Birmingham.
18,599. Fixing Buckles, W. Plowman, London.
18,600. Gripping Material, A. Pulbrook, London.
18,601. Golf Carrier, W. Simpson, Edinburgh.
18,602. Grease Separating Apparatus, W. J. Baker, Scarborough.
18,603. Construction of Oil Lamps, E. J. Shaw, Walsall.
18,604. Show Stands, T. Pearson, Nottingham.
18,605. Match Striker, G. M. G. Partridge, Seacombe, Cheshire.
18,606. Inner Soles of Boots and Shoes, W. Freeman, Leicester.
18,607. Cleansing Foul Casks, O. Tilley, Leicester.
18,608. Mill Furnace, W. Thompson, Gateshead.
18,609. Vehicle Tires, R. Robinson and W. I. Smith, Sheffield.
18,610. Postal Wrapper and Card, W. G. Thompson, Sheffield.
18,611. Looms, G. O. Draper, London.
18,612. Lamps, J. W. White, Widnes.
18,613. Escutcheons, P. C. Jones, Guildford.
18,614. Gas Engine Construction, W. Clark, Newport, Mon.
18,615. Detachable Cycle Handle, H. Waterson, Birmingham.
18,616. Sanitary Drain Trap, G. Francis and S. Rumboll, Leeds.
18,617. Double Eyeglasses, R. A. Rossborough, Glasgow.
18,618. Machine for Washing Gravel, W. Cooper, Dublin.
18,619. Razor Sharpening Apparatus, R. Howarth, Wolverhampton.
18,620. Device for Opening Envelopes, P. Menzies, Glasgow.
18,621. Expansion Driving Clutches, H. Kitson and J. Evans, Bradford.
18,622. Cornice Pole and Curtain Rings, C. Hide, Worthing.
18,623. Bottling and Corking Machines, E. W. Jenkins, Swansea.
18,624. Wagons, J. Roberts and P. Shone and Son, Liverpool.
18,625. Stop Motion for Power Looms, T. Blackhurst, Darwen.
18,626. Cigarettes, S. Bright, London.
18,627. Opening Windows, P. Burt, Glasgow.
18,628. Cycle Brake, E. Cross, London.
18,629. Disinfecting Apparatus, H. Barling and S. Broomhead, London.
18,630. Apparatus for Preparing Fodder, A. F. Davis, London.
18,631. Amalgamator, W. Tarrant, Liverpool.
18,632. Laundry Machine Tapes, A. Conkling and T. S. Wiles, London.
18,633. Bottle Stoppers, J. C. Grout, Liverpool.
18,634. Knitting Machines, G. J. J. Hoffmann.—(*J. A. House, United States.*)
18,635. Flanging, &c , Machine, W. P. Thompson.—(*F. A. Kirby, United States* )
18,636. Fixing Long Handles to Broomheads, G. R. Compton and C. F. Cooper, London.
18,637. Cuff, T. G. Boulton, London.
18,638. Apparatus for use in Brewing, T. R. Todd, London.
18,639. Velocipedes, G. Turner and J. M. H. Venour, London.
18,640. Safety Linen Dryer, C. W. Spong, London.
18,641. Anchors, T. S. Forster, Sunderland.
18,642. Ammunition for Air, &c., Guns, B. R. Banks, Croydon.
18,643. Covers for Pneumatic Tires, H. Paulsen.—(*C. Maret, Germany.*)
18,644. Show Cards, &c., H. Goldenfarb, London.
18,645. Baiting Needles for Worms, B. Blanikmeister, London.
18,646. Game of Billiards, N. Redler, London.
18,647. Hydraulic Thrust Bearing, T. Smalley, Essex.
18,648. Engine Actuated by Explosion, E. M Foot, London.
18,649. Pneumatic Separator for Ores, S. S Allin, London.
18,650. Hydraulic Motors, W. Carter and the Hydraulic Engineering Company, London.
18,651. Binding Pattern-cards, V. Dard, London.
18,652. Grab or Bucket for Dredging Sand, J. Batty, London.
18,653. Manufacture of Oilcloths, C. Hopkinson, London.
18,654. Fastenings for Doors and Windows, A. W. Adams, London.
18,655. Bow Saw, G. Rushbrooke, London.
18,656. Drying and Heating Machines, A. G. Paul, London.
18,657. Heating Apparatus, A. G. Paul and W. P. Skiffington, London.
18,658. Ball Bearings, H. H. Lake —(*A. C. Farnsworth, A. D. Kelley, H. G. Lee, and L. M. Sendelbach, United States* )
18,659. Angle-measuring Instruments, G. A. Rung, London.
18,660. Rims for Wheels of Cycles, W. J. Goddard, London.
18,661. Electric Fuses, The Acme and Immisch Electric Works and E. F. Moy, London.
18,662. Electric Switches, The Acme and Immisch Electric Works and E. F. Moy, London.
18,663. Apparatus for Lighting Buildings, J. S. Roblin, London.
18,664. Heating Systems, A. G. Paul, London.
18,665. Writing Pens, W. Moseley and J. Lewis, London.
18,666. Hanger for Shafting, J. O. Donner, London.
18,667. Type-writers, J. C. Fell.—(*Messrs. Wyckoff, Seamans, and Benedict, United States.*)
18,668. Covering for Earthenware Vessels, W. Gibson, Manchester.
18,669. Potato Harvesters, J. N. Cocker, London.
18,670. Bath-room Soap-dish, H. F. Robinson, London.
18,671. Disinfecting Apparatus, V. B. Lennard, London.
18,672. Door Latches and Locks, J. McLachlan, London.
18,673. Electric Mechanism for Winding Clocks, H. F. Mouquin, London.
18,674. Hollow Rivets, H. Dowler, London.
18,675. Cycle Saddles, H. A. Lamplugh, London.
18,676. Rug Straps, H. A. Lamplugh, London.
18,677. Apparatus for Producing Letters on Bread, R. M. Shaffer, London.
18,678. Manufacture of Curtains, R. C. Wills, London.
18,679. Burning the Vapour of Mineral Oil, S. Pitt. —(*La Compagnie International pour l'Exploitation des procédés Adolphe Seigle, France* )
18,680. Wheels of Cycles, A. C. Lebaupin, London.
18,681. Excluding Dust from Drawers, C. A. Grant, London.
18,682. Fulminating Compounds, H. Maxim, London.
18,683. Process of Nitrating Cellulose, R. C. Schupphaus, London.
18,684. Mud-guard for Cycles, G. G. M. Hardingham, London.
18,685. Binding Cases, H. R. Jones, London.
18,686. Gear-chains for Cycles, J. B. and J. P. Dunlop, jun., London.

*3rd October*, 1894.

18,687. Protectors for Folders, L. B. Phillips, London.
18,688. Automatic Bell for Cycles, T. F. Gunter, London.
18,689. Reversible Hinge, W. M. Tudman and J. Pedley, Birmingham.
18,690. Automatic Grain Weighers, H. Richardson, Lichfield.
18,691. Machinery for Spinning, J. and R. S. Dawson, Bradford.
18,692. Pneumatic Tires, W. A. Rothwell, Manchester.
18,693. Chimney Pot, J. Fielden, Halifax.
18,694. Construction of Wheel, W. Ives, Halifax.
18,695. Advertising Arrangement, S. J. Henochsberg, Liverpool.
18,696. Instantaneous Switches, F. H. Starling, Nottingham.
18,697. Cycles, A. King, Nottingham.
18,698. Gear Cases for Cycles, S. A. Newman, Birmingham.
18,699. Sack-hoist for Thrashing-machines, F. J. Burrell and T. Hibberd, jun., Thetford.
18,700. Door Springs, W. A. Gill and P. E. Ayton, Birmingham.
18,701. Combination School Desks and Seats, A. Bruce, Dundee.
18,702. Pneumatic Razor Strap, C. A. Moon and J. McCullagh, Dublin.
18,703. Mantelboard, A. Travis, Burnley.
18,704. Steam Generators, E. P. Plenty, jun., and J. W. Davis, London.
18,705. Dredger Rake, J. Hansard, Llanelly.
18,706. Safety Valve for Boilers, J. and H. Parker, Bradford.
18,707. Securing Cycle Pedals, W. H. Toussaint and W. E. Ginder, Birmingham.
18,708. Making Iced Drinks, H. W., S. M., and P. Chinnery, Walthamstow.
18,709. Axes, W. Smith, Birmingham.
18,710. Non-slipping Boot Protector, W. C. Phillips, Bradford.
18,711. Creating Draughts for Fires, R. C. Sayer, Bristol.
18,712. Casks, A. J. Twyford, London.
18,713. Whist Marker, C. J. Dury and W. B. Marchington, London.
18,714. Treadles for Railway Signals, J. G. Dixon, London.
18,715. Fuel-saving Compound, A. W. Summers, Bristol.
18,716. Pipe Barrow, R. Malabar, Liverpool.
18,717. Taps, S. Plumbly, Leicester.
18,718. Stretchers, J. Leemann, London.
18,719. Propelling Apparatus for Ships, T. Armstrong, London.
18,720. Portable Easel, J. Ashford and H. A. Terry, Birmingham.
18,721. Ornamenting Wood, J. Jones and A. Leach, Manchester.
18,722. Firing Off Flashing Signals, J. G. W. Berckholtz, London.
18,723. Pieces for Ladies' Dresses, F. Nüsken, Germany.
18,724. Copying Apparatus, W. M. Williams, London.
18,725. Bicycles, J. W. Adams, Liverpool.
18,726. Driving Gear for Cycles, H. A. Skinner, Manchester.
18,727. Distilling Sulphuric Acid, G. Krell, Liverpool.
18,728. Combing Machines, T. Kitson and A. Smith, London.
18,729. Chicken House and Run, H. P. Boscher, Twickenham.
18,730. Braces, F. W. Duerdoth, London
18,731. Curved Tubes, J. and G. H. McDougall, Birmingham.
18,732. Construction of Roofs, A. Föppl, London
18,733. Duplex-fronted Picture Frame, J. Webb, London.
18,734. An Improved Fire-grate, A. Chappell, London.
18,735. Cycle Wheels, W. Pirrie and M. J. Manning, London.
18,736. Cradles for Children, W. McAuslan, Glasgow.
18,737. Flyers for Spinning Machines, J. P. Dalby, Leeds.
18,738. Bicycles, F. Mitton, Keighley.
18,739. "Plumb Rules," W. Bryden, London.
18,740. Fastening Garments, N. S. Arthur, Edinburgh.
18,741. Injectors, W. Brierley, Rochdale.
18,742. Internal Combustion Engines, W. L. P. Webb, Cheltenham.
18,743. Collectors for Electric Conductors, A. H. Bagnold, London.
18,744. Fixing Stereo Plates, &c., A. S. Coghill, London.
18,745. Reaction Turbines, A. C. E. Rateau, London.
18,746. Self-feeding Device for Boilers, G. Eustace, London.
18,747. Caps, M. Schneiders, London.
18,748. Lamps for Burning Paraffin, J. G. Bowerman, London.
18,749. Advertisements, S. Robson and B. Tottenham, London.
18,750. Mechanism for Propelling Cycles, H. O'Shea, London.
18,751. Suspenders, E. A. Gordon and E. G. Kerr, London.
18,752. Rail Fastenings, T. H. Green, London.
18,753. Transmitting Telegraph Signals, J. M. McMahan, London.
18,754. Transmission of Signals, J. M. McMahan, London.
18,755. Closing Electric Circuits, J. M. McMahan, London.
18,756. Detachable Outer Cover for Tires, W. Moss, Manchester.
18,757. Insulators, W. Parrott, A. Essinger, and T. Harden, London.
18,758. Water-tight Joints, H. H. Lake.—(*F Krupp, Grusonwerk, Germany.*)
18,759. Solitaire and Shear Sharpener, W. S. Freeman, London.
18,760. Cover for Boilers and Furnaces, A. E. Adams, London.
18,761. Fastening for Miners' Lamps, L. Lhoneux, London.
18,762. Toilet Mirrors, A. F. White, London.
18,763. Mudguard for Trousers, R. Raffety, London.
18,764. Cocks, H. L. Doulton, London.
18,765. Purifying Sewage, W. E. Adeney and W. K. Parry, London.
18,766. Attaching Fasteners to Clothes, E. G. Fuller, London.
18,767. Switches, D. Bates, T. Harden, and O. L. Peard, London.

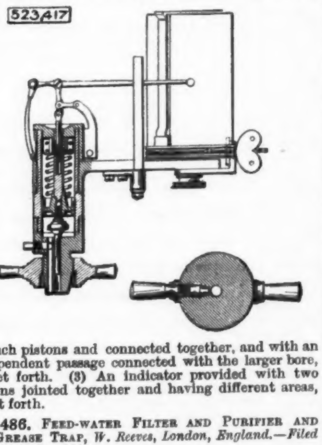
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**523,417.** Steam Engine Indicator, *H. A. Spiller, Boston, Mass.—Filed November 4th*, 1892.

*Claim.*—(1) An indicator provided with two pistons having different areas, as set forth. (2) An indicator provided with two pistons connected together and having different areas, with a cylinder having bores to fit such pistons and connected together, and with an independent passage connected with the larger bore, as set forth. (3) An indicator provided with two pistons jointed together and having different areas, as set forth.

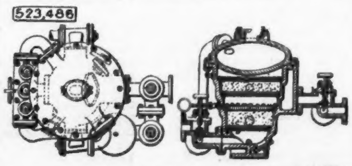
523,417



**523,486.** Feed-water Filter and Purifier and Grease Trap, *W. Reeves, London, England.—Filed March* 1st, 1894.

*Claim.*—(1) In a filter, the combination of a filter chamber a reservoir for receiving new charges of filtering material, a charging door for said reservoir, a communicating thoroughfare between said filter chamber and reservoir, and another thoroughfare independent of the filter chamber between the reservoir and the inlet pipe of the filter, substantially as described for the purpose specified. (2) In a filter, the combination of a filter chamber having its influx and efflux sides formed by strong grids covered on that side which faces the flow of the liquid with gauze or the like of fine mesh and filled with absorbent filtering material, a reservoir for receiving new charges of filtering material, a charging door for said reservoir, a communicating thoroughfare between said filter chamber and reservoir, another thoroughfare independent of the filter chamber between the reservoir and the inlet pipe of the filter, a chamber containing a layer of zinc balls situated below said filter chamber, a by-pass communicating with the inlet and outlet pipes of the filter, and a filter chamber in said by-pass, substantially as described and for the purpose specified.

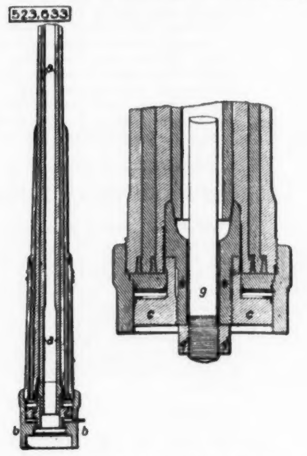
523,486



**523,633.** Device for Inserting or Removing Tubes in Ordnance, *M. Gledhill, Manchester, England.—Filed July 21st*, 1892.

*Claim.*—(1) The combination, with a built-up gun, of a hydraulic apparatus comprising a cylinder *b* screwed on the breech end of the outer tube or hoop of the gun, a piston *c* working in said cylinder, a socket *e* secured to the said piston and to the breech end of the liner, and a withdrawing rod *g* engaging the piston *c* at its rear end and the liner at its forward end, substantially as described. (2) The combination with a built-up gun, of a hydraulic apparatus comprising a two-chambered cylinder *b* screwed on the breech end of the outer tube or hoop of the gun, a piston *c* working in one of said chambers, a socket *e* for coupling said piston *c* with the rear end of the liner *a*, a piston $c^2$ working in the other of said chambers, and a rod *g* extending through the bore of the gun, said rod having a head *g'* at its forward end engaging the muzzle end of the liner and a liner $g^2$ at its rear end for connecting the rod with the piston $c^2$, substantially as described for the purpose specified.

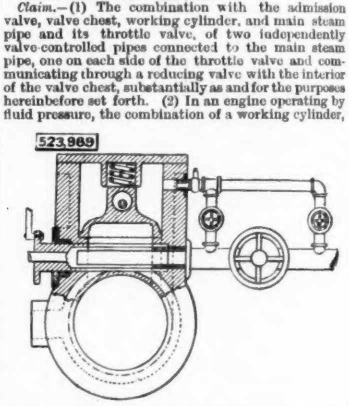
523,633



**523,969.** Balanced Valve, *J. A Bourgeat, New York, N.Y.—Filed October 29th*, 1890.

*Claim.*—(1) The combination with the admission valve, valve chest, working cylinder, and main steam pipe and its throttle valve, of two independently valve-controlled pipes connected to the main steam pipe, one on each side of the throttle valve and communicating through a reducing valve with the interior of the valve chest, substantially as and for the purposes hereinbefore set forth. (2) In an engine operating by fluid pressure, the combination of a working cylinder, an admission valve, a pressure chest surrounding and covering the admission valve, a throttle valve, two pipes, one on each side of the throttle valve and connected to the main pressure inlet pipe, in each of which pipes is located a hand valve, said pipes being joined together beyond said valves, and a reducing valve, through which the pipe joining the two pipes before mentioned passes into the pressure chest, substantially as described.

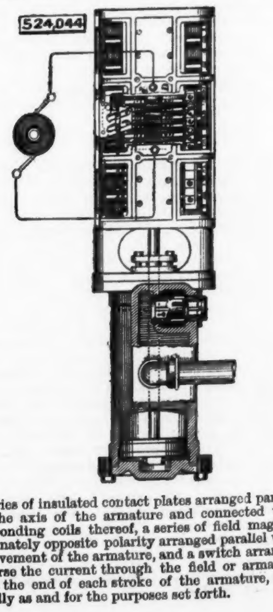
523,969



**524,044.** Electric Pump, *F. W. Merritt and A. R. Roe, Duluth, Minn.—Filed November 6th*, 1893.

*Claim.*—The combination of a pump cylinder provided with a reciprocating piston, a bar armature attached directly to the piston-rod and provided in the direction of its length with a number of coils, a commutator carried by said armature and consisting of a series of insulated contact plates arranged parallel with the axis of the armature and connected with corresponding coils thereof, a series of field magnets of alternately opposite polarity arranged parallel with the movement of the armature, and a switch arranged to reverse the current through the field or armature coils at the end of each stroke of the armature, substantially as and for the purposes set forth.

524,044



## THE ENLARGEMENT OF LIVERPOOL STREET STATION, GREAT EASTERN RAILWAY.

### No. V.

*Double and single stanchions.*—The arrangement of double columns carrying single vertical stanchions, shown in Fig. 23, is continued throughout the whole length of the Parcels Office until the end walls are reached, when a modification of the former design is adopted. Restricting our attention for the present to the far, or railway end wall of the office, where the fantail gallery and approach from the first part of the terminus joins on to the building, we find that at the junction the double cast iron columns are replaced by twin stanchions, and an upper single one of the same material ranged in both the first and second storeys flat against the wall, something after the manner of a pilaster, or considering the depth of the projection, more like an interior counterfort or buttress. An elevation of these double stanchions, and supports for the first and second floor, is shown in Fig. 23, together with cross sections of the longitudinal plate girders, which will be subsequently referred to. While the general disposition of the various parts is similar to that already described for the twin columns, and includes a table girder, it is to be noticed that the cast iron bed or base-plate is in three parts, and consists of an upper wedge-shaped polyribbed girder, 4ft. deep at the centre, 2ft. 6in. deep at the ends for a length of 3ft. over the bearing plates, and 3ft. in width, as shown in Figs. 23—25. In the last figure it is seen in cross section through D D in Fig. 23, and is practically of almost the same dimensions and form as the table girder, surmounting the twin columns with a trough lower flange 3½in. thick in the horizontal part, and 3in. in the vertical sides, tapering to 2½in. at the upper end. Both the middle rib and the upper flange are 3in. in thickness, diminished in the flange to 2½in. at the horizontal edges. This upper bed-plate is supported by two others, that is, it virtually rests upon a pair of hollow cast iron abutments which stand upon a solid foundation of concrete, as represented in Figs. 23, 24, and 26, and is thus in the position of a girder with a clear span of 11ft. 4in. Each of the under bed-plates consists of a hollow casting measuring over all 8ft. by 6ft. 8in. It has a depth of 1ft. 6in., with flanges 3in. thick, a vertical rib, and sloping faces 2½in. in thickness, and is secured to the concrete by six slotted wedges or bolts. Upon the upper bed-plate or girder, as it virtually is, are bolted the double stanchions shown in elevation in Fig. 23 and in section in Figs. 24 and 28, where they have the appearance of a very large channel iron 2ft. by 1ft. 10½in. by 1½in. thick, and provided with a central rib of one-half the depth of the sides. They are bolted down to the base girder by a pair of bolts 1⅜in. in diameter. To the capitals of the double stanchions is bolted the table girder, Figs. 23 and 26, which is a polyribbed double flanged horizontal cast iron girder, 7ft. long, 3ft. deep, 2ft. 6in. wide, 3in. thick at junction of flanges and web, 2½in. at edges and in the web, and is shown in section at C C in Fig. 26, which also contains an elevation of the single stanchion shown in section in Fig. 27. It is of the same form and of the same dimension in elevation as the pair which support it; but, instead of being 1ft. 10½in. in cross section, it is reduced to 1ft. 4in., and is ⅛in. less in the different thicknesses. It will be evident that where the double columns and single vertical stanchions are placed at right angles to the side walls of the building, some alteration must be made in the relative position of the different members of the supports. It is no longer possible to carry the load or adjust the centres of the box girders in a line with the vertical axis of the columns, so that the *ensemble* of the especial arrangement is represented in Fig. 29, and a section through the centre of the table girder in Fig. 30. The proportions, thicknesses of metal, and general sections are similar to those already described and illustrated.

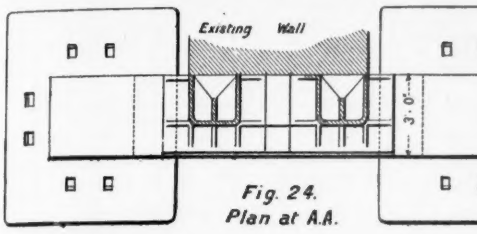


Fig. 24.
Plan at A.A.

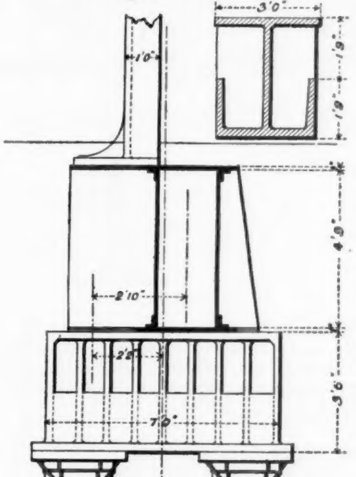
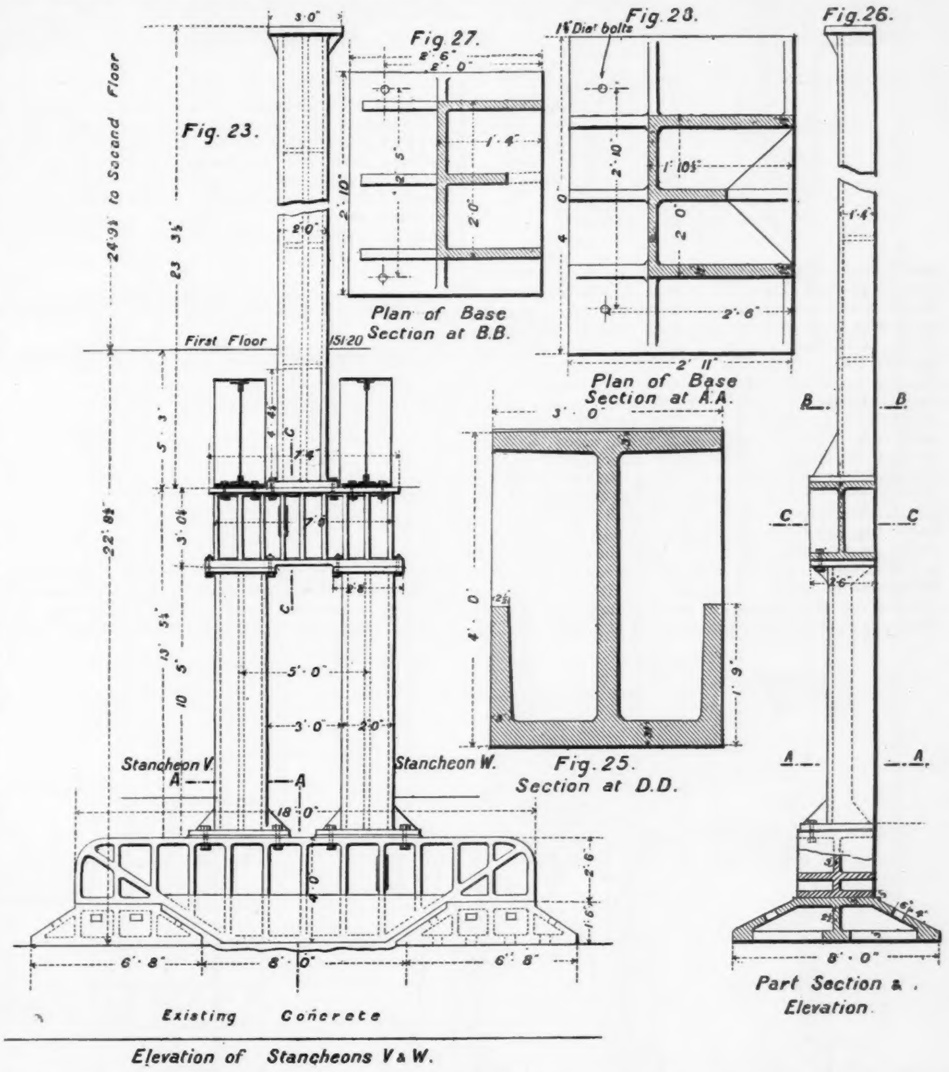


Fig. 29. Fig. 30.

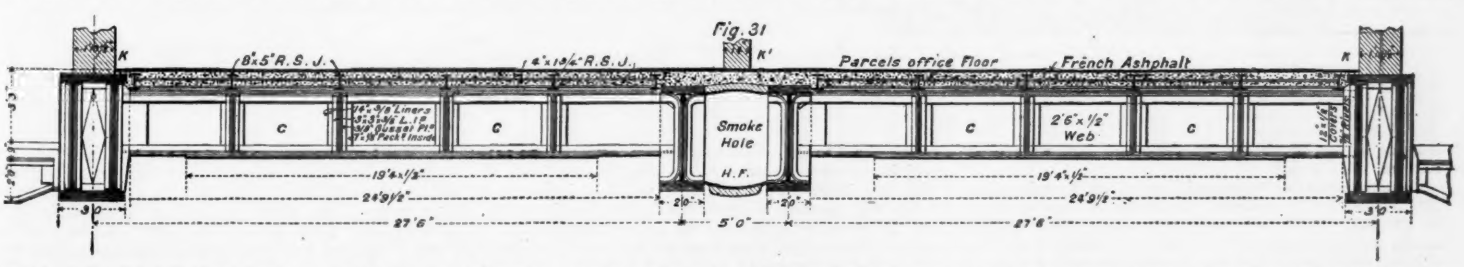
*Box girders.*—An enlarged cross section at floor level of the two central spans of the Parcels Office is given in Fig. 31. It is taken through the line of the tracks, and contains details of the construction which are not shown in the former figures. Each side wall K of the building is carried upon a box girder of great strength, of which the sections at the centre and ends respectively are seen in Figs. 32 and 33. At the centre the girder is 5ft. 7in. in depth over all, which dimensions includes a cover-plate ½in. thick in both the upper and lower booms. These cover-plates are each 14ft. in length, and designed so as to cover collectively the separate joints in the different plates, and thus avoid the multiplication of individual wrappers and cover plates of shorter proportions. There are nine plates, 3ft. in width, which quantity is constant throughout the entire length of the girder, which is 51ft. 11½in., and all ½in. in thickness at the centre, diminishing to two plates of the same thickness at the ends over the columns as in Fig. 33, which also shows a portion of the stanchion of the table girder over the twin columns. Of the ½in. flange plates the maximum length is 30ft., which gives rather more than a quarter of a ton for the weight of a single plate. What may be regarded as the common or constant part of the section of the box girder consists, therefore, of two plates 3ft. by ½in. each flange, of four angle irons 4in. by 4in. by ½in., of a maximum length of 34ft. 5in., and a pair of sides or webs placed 2ft. apart from out to out, and varying in thickness from ½in. at the centre to ⅞in. at the ends. In the flanges, the rivets passing through the plates and angle irons, are 1in. in diameter, but only ⅞in. elsewhere, unless otherwise specified. All bearing surfaces are flush riveted, and the rivets are pitched 4in. from centres. At distances of 10ft. 8in., where the transverse floor girders are placed, the webs of the main longitudinal box girders are stiffened by double angle irons 3½in., by 3½in. by ½in. Figs. 32 and 33.

*Plate girders.*—Dividing for a portion of the height the two spans of the Parcels Office, is a partition wall K, shown in Fig. 31, and 14in. in thickness. Here the longitudinal box girders carrying the side walls are represented by a pair of plate girders whose vertical axes are in a line with those of the twin columns, supporting the table girder upon which they rest. Each plate girder—Fig. 34—is 4ft. 6in. deep at centre, has flanges composed of six plates ½in. in thickness and 2ft. wide, diminishing to one at the ends. Angle irons 4in. by 4in. by ½in. rivet the horizontal flange plates to the web, which has a varying thickness from ½in. at centre to ⅝in. at the ends. An exception to this otherwise uniform width of flanges occurs on the inner side of the girders or those facing each other. The plates—Figs. 31 and 36—next the angle irons in both flanges are 2ft. 3in. in total width, the additional projecting 3in. serving to carry the cast iron flue plates of the smoke chamber, which will be subsequently alluded to. Passing on to the transverse floor girders C C—Fig. 31—they are also of the plate description, as shown in cross-section in Fig. 35, where they are riveted at their junction with the main longitudinal plate girders.



Elevation of Stancheons V & W.

Part Section & Elevation.



*Floor girders and joists.*—The general arrangement of the floor of the Parcels Office will be apparent from an inspection of the two Figs. 31 and 36. Upon the cross girders C are riveted at intervals of 5ft. apart the rolled steel joists F F, which have a depth from out to out of 8in., a width over both flanges of 5in., and a weight of 31·25 lb. per foot run. To the lower flanges of these are attached smaller rolled steel joists, spaced 1ft. 6in. apart, and having a section of 4in. by 1¾in., and a weight per running foot of 8·5 lb. Between and around this skeleton steel gridiron flooring framework is well rammed and thoroughly consolidated a mass of concrete composed of coke breeze and Portland cement in proportions of about 5 of the former to 1 of the latter. It will be seen in Fig. 36 that there is a depth of 2in. of this concrete over the larger sized rolled steel joists, and a depth of 3in. below them, forming a kind of ceiling to the under storey. While in process of ramming and consolidation the lower surface of the concrete was supported by temporary sheeting boards and props. Over the concrete is spread a layer of French asphalt 1in. in thickness, A different description of flooring is adopted for the side approaches to the Parcels Office, as will be seen on referring to the details in Figs. 37 and 38. The smaller rolled steel joists are dispensed with, and their place occupied by cast iron plates. These latter vary slightly in their dimensions, which are on an average 4ft. 8in. by 4ft. 3in. They have a dip of 2½in. and a uniform thickness of ⅝in. metal. The plates are in two lengths, Fig. 39, and are bolted together by three bolts ⅝in. in diameter. A section of the joint is given in Fig. 40. Over the cast iron plates is laid a bed of concrete, and upon it are bedded wood blocks 5in. in depth. A similar description of flooring obtains for the ramps or inclined approaches from Bishopsgate-street, but the rolled steel joists are a little heavier in section, being 9in. deep and 7in. wide over flanges.

Fig. 32

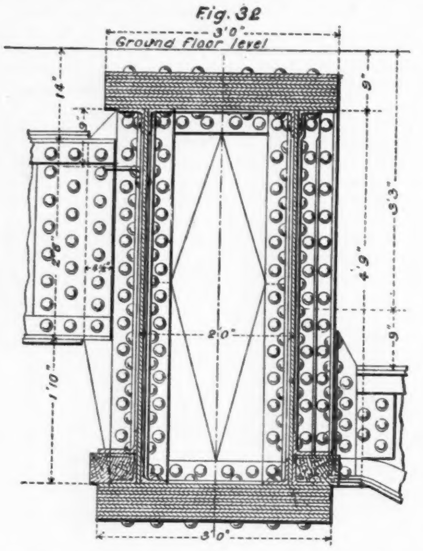
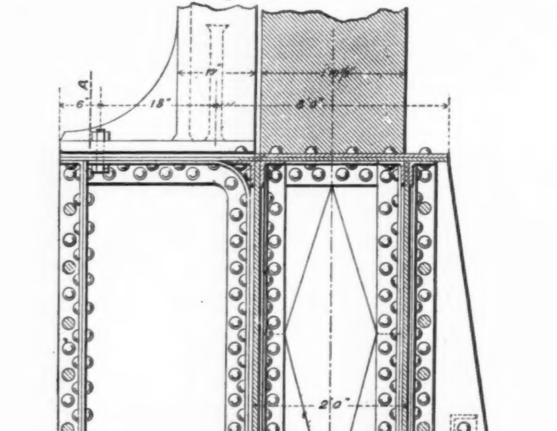


Fig. 33



*Smoke flue.*—In the general plan of the Parcels Office the letters T T T indicate the lines of track—eight in number, which all pass underneath the building at the entrance to the station, and as at certain times the engines are passing, and also standing beneath the same spot, it becomes necessary to make some provision for carrying off the smoke, waste steam, and other gaseous vapours emitted by locomotives, which we shall now proceed to describe. It must be premised that a horizontal flue, H, F—in Fig. 31—is carried the whole length of the Parcels Office, between the double longitudinal plate girders, and is built of side walls of brick, with top and bottom curved cast iron plates. This flue or smoke-hole is connected with four smoke stacks S, which are continued right up through the building to a height of about 4ft. above the ridge of the roof. In case the draught should not be sufficient to keep the station and the area below the building clear of smoke, fans can be used; but hitherto there has been no necessity for their employment. Each stack has an opening in the clear of 2ft. 3in. by 2ft., and consist of a series of cast iron plates bolted together through external flanges. Between each pair of tracks, at or near the point where the locomotives would stand underneath the Parcels Office, is constructed a smoke chamber, shown in detail in Fig. 41. There are consequently four altogether, shown in section to a larger scale with the main longitudinal girders M, the cross girders C, and the rolled steel joists V and $V_1$, Fig. 41. Each smoke chamber is therefore built parallel to the main longitudinal plate girders of the Parcels Office, and occupies a space equal to the distance 10ft. 8in. between the pair of adjoining cross girders C C. Along the steel joists V, which are 14in. deep by 6in. in width, at intervals of 1ft. 2in. are rivetted tee irons 4in. by 3in. by ½in. Concrete temporarily supported as before mentioned, is rammed all round, so as to form the floor of the chamber and one wall of the smoke passages P P, in Fig. 41. The other side wall consists also of a bed of concrete 14in. deep, which connects the cross girders C C with the rolled steel joists V, having a section of 12in. by 6in. The passages P P are open to the air, and through them passes the smoke and steam of the locomotives into the chamber. From hence they find their way over the top of the main girders M into the smoke-hole, Figs. 36 and 41, from which they gain access to the horizontal flue, and finally reach the open by means of the respective smoke stacks.

Fig. 34

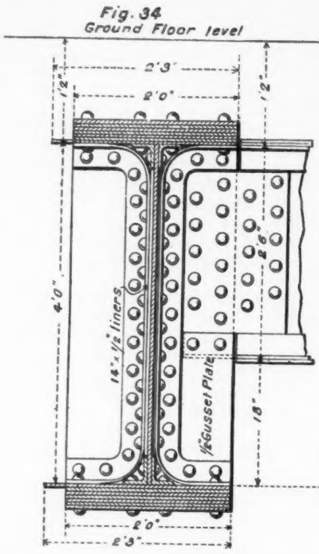
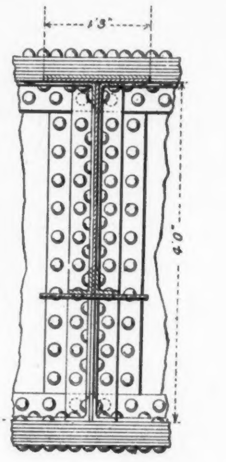


Fig. 35



*Second storey.*—Although it is possible that the second storey of the Parcels Office may not be subjected to loads of quite the same weight as that immediately below it, yet it is constructed in a similarly strong and substantial manner, which will appear on inspecting the general cross section and Figs. 1A—6A. The first of the last three figures is a cross section to an enlarged scale of one-half, or one span, of the girders and ceiling of the first storey of the building. To the top of the central stanchion is bolted a box girder P, the details of the construction of which are very similar to those already described and illustrated, for the girders carrying the flooring of the office. The girder P, a portion of which is shown in elevation and plan in Fig. 4A, has a depth of 6ft., a width over flanges of 3ft., and two webs ½in. thickness each. All the flange plates, the longest of which is 30ft., which vary from two to seven in number, are ½in. thick, and are riveted to the webs by rivets 1in. in diameter through the horizontal angle irons, 4½in. by 4½in. by ⅝in. Rivets in other parts of the girder are ⅞in. in diameter, with a pitch of 4in. Plate girders W, supported like the box girder P by cast iron stanchions, carry the cross-girders $P_1$ at the side walls. They have the same depth of 6ft., but are only 1ft. 8in. in width, while the thickness of flange plates, angle irons, and web is ½in. throughout, but the sides of the angle irons are reduced to 4in. by 4in. The junction of the girders W and the cross girder $P_1$ is shown in Fig. 6A, and needs no further description. An elevation of the cross girders $P_1$ and a section of them are given in Figs. 1A, 2A, and 3A. They are spaced, as a rule, 21ft. 2in. apart, although this distance varies in

Fig 6A

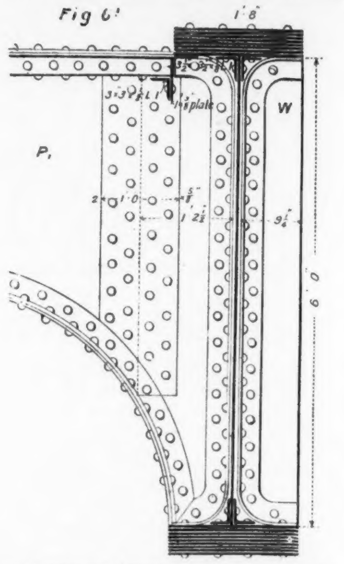


Fig. 36.

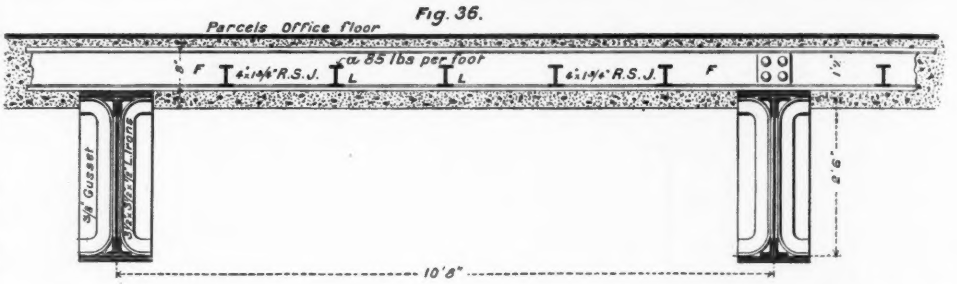


Fig 37

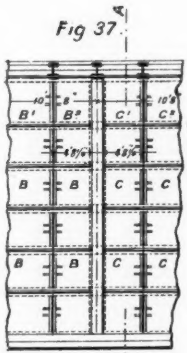


Fig. 40.

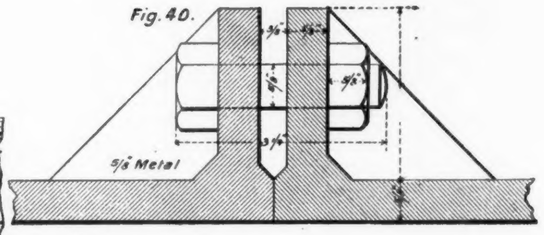


Fig. 38.

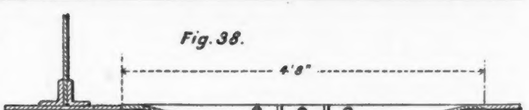
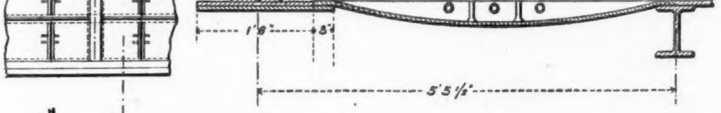


Fig. 39.



some of the bays, are 3ft. 6in. deep at centre and 2ft. in uniform width. These distances correspond with the spans of the smaller plate girders $P_2$, which carry the ceiling joists of timber 5½in. by 4in. To these are bolted the runners 3½in. by 2¼in., to which the sheathing and layer of expanded metal and plaster are attached, as shown by the strong dark line in Figs. 1A and 2A. Upon the upper storey are situated the offices appropriated to the use of the officials and employés of the company, the whole back and front ranges being divided by a corridor running the entire length of the handsome façade erected along the north side of Bishopsgate-street.

The whole of the heavy ironwork in connection with the new building was constructed and erected by the well-known firm, Messrs. Head, Wrightson, and Co., of the Teesdale Ironworks, Thornaby-on-Tees, and of 5, Victoria-street, Westminster. We are indebted to the courtesy of Mr. S. Young, of the firm, for some particulars respecting the work. In the columns, stanchions, and floor plates there were some 620 tons of cast iron used, and the box and plate girders and their accessories accounted for 1230 tons of wrought iron. The heaviest box girders weighed as much as 40 tons, and 100 tons were taken up by the footbridge. They were riveted up complete by machine riveting in the workshops, sent by special train to their destination, and hauled up bodily to their permanent site by a couple of powerful derricks. Some riveting was done necessarily on the premises, all by hand. About 130 tons of steel floor joists were fixed in position. The whole of the materials and workmanship was English, and the contract occupied about sixteen months, the work being carried out from beginning to end without a hitch or accident of any kind whatever. The six hydraulic lifts were provided from the Elswick Works.

Fig 5a.

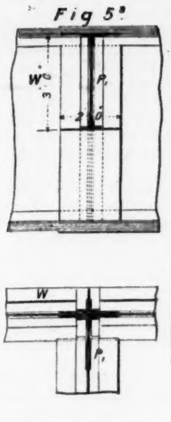

W
P₁
3' 0"
2' 0"
W
P₁

Fig 4a.

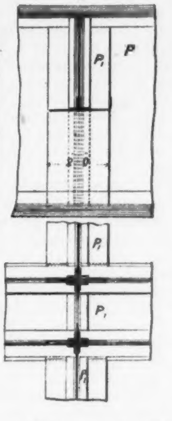
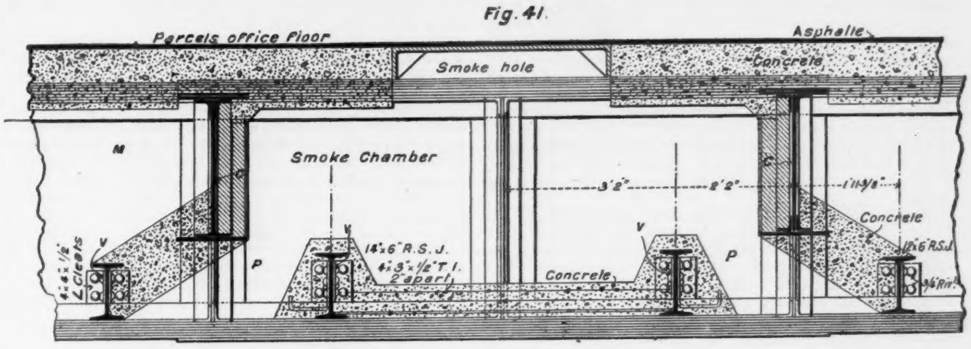
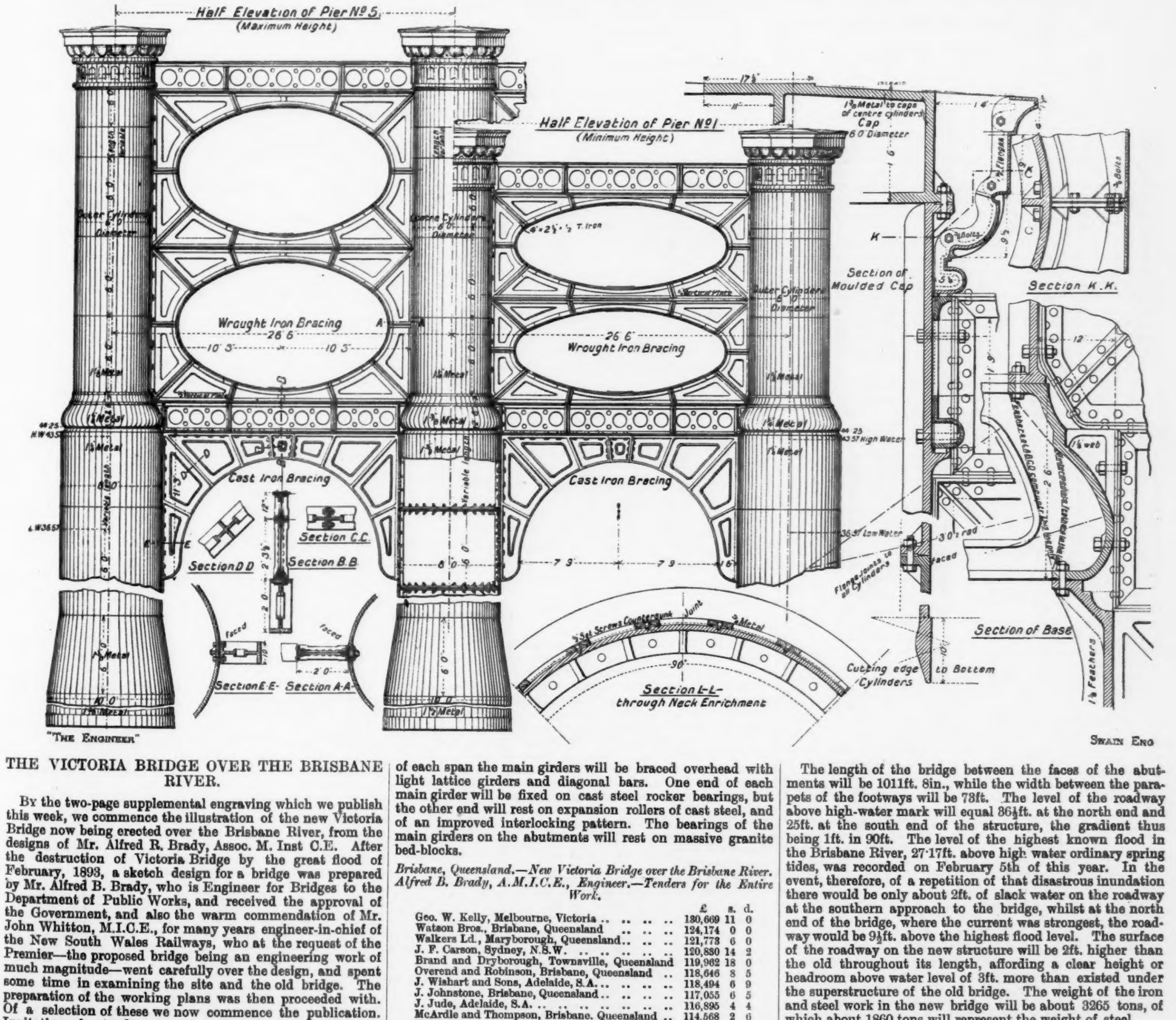

P₁
P
3' 0"
P₁
P₁
P₁

Fig. 41.


Parcels office floor
Asphalte
Smoke hole
Concrete
Smoke Chamber
M
C
3' 2"
2' 2"
1' 11⅛"
Concrete
14"×6" R.S.J.
4"×3"×½" T.I. 2' apart
Concrete
P
P
V
V
V
12"×6" R.S.J.

## NEW VICTORIA BRIDGE, BRISBANE—PIERS AND PIER BRACING—DETAILS


Half Elevation of Pier No 5.
(Maximum Height)
Outer Cylinder 6' 0" Diameter
Wrought Iron Bracing
26' 6"
10' 3"
10' 3"
A
1⅛ Metal
1⅛ Metal
1⅛ Metal
H.W. 43.57
L.W. 36.57
Cast Iron Bracing
Section C.C.
Section D.D
Section B.B
E
2' 3½"
12"
2' 0"
faced
faced
2' 0"
Section E.E.
Section A-A
10' 0"
Half Elevation of Pier No 1
(Minimum Height)
Centre Cylinder 6' 0" Diameter
4"×2½"×½" T. Iron
Wrought Iron Bracing
26' 6"
Outer Cylinder 6' 10" Diameter
Cast Iron Bracing
Variable length
8' 0"
7' 9"
7' 9"
6' 0"
⅝ Set Screws Countersunk
Joint
Metal
90"
Section L-L- through Neck Enrichment
17½"
11"
1⅜ Metal to caps of centre cylinders
Cap 6' 0" Diameter
1' 6"
1' 4"
Flanges
Bolts
Bolts
K
K
9½"
5½"
Section of Moulded Cap
Section K.K.
C
C
12"
1' 9"
2' 6"
1½ web
44.25 43.57 High Water
36.57 Low Water
3' 0" rad
faced
Flange joints to all Cylinders
Section of Base
Cutting edge to Bottom Cylinders
10"
1⅛ Feathers

"The Engineer"

Swain Eng

## THE VICTORIA BRIDGE OVER THE BRISBANE RIVER.

By the two-page supplemental engraving which we publish this week, we commence the illustration of the new Victoria Bridge now being erected over the Brisbane River, from the designs of Mr. Alfred R. Brady, Assoc. M. Inst C.E. After the destruction of Victoria Bridge by the great flood of February, 1893, a sketch design for a bridge was prepared by Mr. Alfred B. Brady, who is Engineer for Bridges to the Department of Public Works, and received the approval of the Government, and also the warm commendation of Mr. John Whitton, M.I.C.E., for many years engineer-in-chief of the New South Wales Railways, who at the request of the Premier—the proposed bridge being an engineering work of much magnitude—went carefully over the design, and spent some time in examining the site and the old bridge. The preparation of the working plans was then proceeded with. Of a selection of these we now commence the publication. Invitations for tenders were issued, and a large number received by the 28th March last. The selected tender was accepted on the 10th of April last, the contract time being thirty months for completion.

The bridge will consist of six 170ft. spans, with three main longitudinal girders in each span, the whole carried upon five piers of three cylinders each. The girders will be of the hog-backed-lattice type, 22ft. deep at the centre and 10ft. at the ends, and constructed of mild steel. The cylinders will be of cast iron, and the bridge will have abutments of masonry, backed with concrete. For about half the length of each span the main girders will be braced overhead with light lattice girders and diagonal bars. One end of each main girder will be fixed on cast steel rocker bearings, but the other end will rest on expansion rollers of cast steel, and of an improved interlocking pattern. The bearings of the main girders on the abutments will rest on massive granite bed-blocks.

*Brisbane, Queensland.—New Victoria Bridge over the Brisbane River. Alfred B. Brady, A.M.I.C.E., Engineer.—Tenders for the Entire Work.*

| | £ | s. | d. |
|---|---|---|---|
| Geo. W. Kelly, Melbourne, Victoria .. .. .. .. | 130,669 | 11 | 0 |
| Watson Bros., Brisbane, Queensland .. .. .. | 124,174 | 0 | 0 |
| Walkers Ld., Maryborough, Queensland.. .. .. | 121,773 | 6 | 0 |
| J. F. Carson, Sydney, N.S.W. .. .. .. .. .. | 120,830 | 14 | 2 |
| Brand and Dryborough, Townsville, Queensland | 119,962 | 18 | 0 |
| Overend and Robinson, Brisbane, Queensland .. | 118,646 | 8 | 5 |
| J. Wishart and Sons, Adelaide, S.A.. .. .. .. | 118,494 | 6 | 9 |
| J. Johnstone, Brisbane, Queensland.. .. .. .. | 117,055 | 6 | 5 |
| J. Jude, Adelaide, S.A. .. .. .. .. .. .. .. | 116,895 | 4 | 4 |
| McArdle and Thompson, Brisbane. Queensland .. | 114,568 | 2 | 6 |
| H. McKenzie and Sons, Prahran, Victoria .. .. | 112,007 | 16 | 6 |
| Chamberlain and Wylie, Brisbane, Queensland .. | 111,312 | 2 | 7 |
| J. McCormick, Melbourne, Victoria .. .. .. .. | 109,932 | 2 | 0 |
| Engineer's estimate.. .. .. .. .. .. | 111,987 | 6 | 5 |

*Alternative Tender for Piers and Superstructure only.*

| | £ | s. | d. |
|---|---|---|---|
| J. McCormick, Melbourne, Victoria (accepted) .. | 92,952 | 6 | 0 |
| Engineer's estimate.. .. .. .. .. .. | 94,768 | 1 | 0 |

*Alternative Tenders for Abutments and Approaches only.*

| | £ | s. | d. |
|---|---|---|---|
| Chamberlain and Wylie, Brisbane, Queensland .. | 19,309 | 7 | 1 |
| A. Midson, South Brisbane, Queensland (accepted) | 16,373 | 16 | 7 |
| Engineer's estimate.. .. .. .. .. .. | 17,354 | 14 | 5 |

The length of the bridge between the faces of the abutments will be 1011ft. 8in., while the width between the parapets of the footways will be 73ft. The level of the roadway above high-water mark will equal 36½ft. at the north end and 25ft. at the south end of the structure, the gradient thus being 1ft. in 90ft. The level of the highest known flood in the Brisbane River, 27·17ft. above high water ordinary spring tides, was recorded on February 5th of this year. In the event, therefore, of a repetition of that disastrous inundation there would be only about 2ft. of slack water on the roadway at the southern approach to the bridge, whilst at the north end of the bridge, where the current was strongest, the roadway would be 9½ft. above the highest flood level. The surface of the roadway on the new structure will be 2ft. higher than the old throughout its length, affording a clear height or headroom above water level of 3ft. more than existed under the superstructure of the old bridge. The weight of the iron and steel work in the new bridge will be about 3265 tons, of which about 1860 tons will represent the weight of steel.

*Cylinder piers.*—Every cylinder, three of which form a pier, will be sunk to a hard rock foundation, each pier in the direction of the stream having a base of 63ft. Judging from borings made after the February floods, the depth to which it will be necessary to sink the cylinders will vary from 60ft. to 90ft. below high-water mark. The diameter of the cylinders from the foundation to some distance above the level of the river bed will be 10ft. At that level the diameter will be reduced to 8ft. by a tapering cylinder, and again at high-water mark a strong moulded base casting on the cylinder will reduce the diameter to 6ft. From the moulded base to the cap the cylinders will be 6ft. in diameter. The outer cylinders will be $1\frac{3}{8}$in. metal at the base, reduced to $1\frac{1}{8}$in. metal above high-water mark. The centre cylinders will be of $\frac{1}{8}$in. thicker metal throughout, in order to sustain the extra weight thrown upon the centre girders. The cylinders will be filled to the top with Portland cement concrete, and finished with ornamental cast iron caps and bases in keeping with the architectural treatment of the stone abutments and arches to same. Wrought iron riveted diaphragm bracing of great strength will connect the cylinders, each pier having four elliptical panels above high-water level, with girder ties at top and bottom. The web-plates will be pierced with ornamental design. The cylinders will be further braced with heavy cast iron spandrils firmly bolted to them below high-water level. In fact, the whole of the bracing, apart from the greatly increased dimensions of the piers, is calculated to give a strength that was entirely wanting in the light diagonal bar-bracing of the old bridge piers.

*Masonry abutments.*—The bridge will gain considerably in beauty and finish by having massive and architecturally treated masonry abutments and arches over the footways at each end. The abutments will be faced with O'Connelltown purple hard stone, rock-faced with margin drafts and V joints, and surmounted by heavy moulded and bracketed cornices of brown freestone. There will be solid piers and archways, the latter of a clear width of 9ft. to each footway, and lamp pillars, built in white and brown stonework, to cover the ends of the centre girder. For the wing walls a quadrant form has been adopted. The walls will run outwards from the archway piers, and terminate with square lamp pillars. The wing walls will be entirely of brown freestone, with heavy moulded copings. The lamp pillars and piers to archways will have alternating bands of brown and white stone upon O'Connelltown-stone plinths, with rusticated joints and moulded bases, copings, and seats for lamps, and moulded imposts under the arches. The arches and the piers at the arch level will be entirely of white freestone, with rusticated joints and moulded panels in the soffits and piers, the latter filled with slabs of polished ornamental granite. Surmounting these will be an entablature treated in the Doric style, enriched with details and triglyphs, and heavy splayed blocking on top. The abutment at the north end will be founded on rock, while the southern abutment will be carried upon a foundation of driven piles.

*Roadways and footways.*—There will be two road or carriage ways and two footways. The centre girder will divide the roadways, which are each to be of a clear width of 24ft. Cantilevers springing from the outer main girders will carry the footways, each 9ft. wide in the clear. The decking of the bridge will be constructed of steel trough plates 12in. deep, laid transversely between the main girders and riveted to the flanges of the same. This decking will be covered with tarred blue metal, finished on the surface with a layer of mineral asphalt $\frac{3}{8}$in. thick, on which a pavement of hardwood blocks 6in. deep, with $\frac{3}{8}$in. asphalt joints, will form the carriage-ways. It is intended that vehicles and animals approaching the north side of the river shall use one roadway, and those leaving the city the other, a similar arrangement being made with regard to foot passengers on the footways. The flooring of the footways will consist of corrugated steel plates laid longitudinally, riveted to the cantilevers, levelled with tarred blue metal screenings, and the surface covered with Val de Travers or Seyssel's asphalt 1in. thick. The parapets of the footways will be of wrought iron lattice work with a moulded hardwood handrail, and ornamental wrought iron brackets on the ends of the cantilevers, the brackets being finished at the top with ornamental cast iron finials.

*Approaches.*—The increased width of the bridge will require a corresponding increase in the width of the approaches. On the north side the lamp pillar at the corner of the Queen's-road and William-street will be moved back a distance of 18ft. That much of the retaining wall will be taken down and the necessary levelling done to give a better approach from William-street. At the South Brisbane approach the shops on the west side of Melbourne-street will not be affected save by the slightly-raised level of the approach roadway, but the building on the east side, known as the People's Cash Store, will have to be removed. The land on which the store is built, together with the right-of-way alongside, will be acquired by the Government and thrown into the approach, making a total width of 132ft. On the north side the tram lines will take an easterly sweep on to the bridge.

*Fender piles.*—For the purpose of protecting the bridge against contact with floating *débris* during flood time, fenders will be provided opposite each pier on the upstream side. Each fender will be of Λ shape, and will consist of five piles driven to a hard foundation, and being of the height reached by the 1893 flood, and sheathed with muntz metal up to high-water mark. The piles will be strongly braced together, and sheathed on the outside, above high-water mark, with 9in. by 3in. hardwood planking. The nosing of the fenders will be protected with $\frac{1}{2}$in. wrought iron plates, 2ft. 6in. in breadth. The width of the fenders across stream will be 10ft., and their length in the direction of the stream 20ft. In order to reduce the contraction of the waterway to a minimum, the fenders are to be placed in crescent form, the clear space between them and the bridge varying from 28ft. to 68ft.

*Lighting of the bridge.*—Gas fittings are to be provided for the lighting of the bridge, but if it should at any time be decided to employ the more modern illuminant, they will be suitable for carrying electric lights. The lamps to be used will vary from 20 to 50-candle power. The approaches will be lit by a four-light lamp on each pillar, carried upon ornamental cast iron standards, and on each side of the archways there will be two lanterns fixed to the walls with ornamental wrought iron brackets. At each intersection of the outer girders, over the piers, there will be three-light lamps on ornamental cast iron standards for the lighting of the roadways and footways. In addition, in the centre of each span in each roadway will be suspended a 50-candle power lamp, attached to the overhead lateral bracing by means of an ornamental bracket. Gas will be supplied to the lamps by service pipes from the companies' mains, half the supply being drawn from the city side and half from the south side of the river.

*Water pipes, tram lines, and telegraph and telephone cables.*—Provision is made to carry water across the bridge by means of two riveted steel 12in. pipes suspended beneath the decking on each side of the centre girder. The Brisbane Board of Waterworks will supply the pipes, which for the sake of convenience will be placed in position by the contractor for the bridge. In the same way the contractor will put down the tram lines, the Metropolitan Tramway Company providing rails and all other necessary material. The tram lines will be laid in each roadway alongside the centre girder. The cost incurred under these heads by the Bridge Board will be refunded by the board of waterworks and the tramway company. Close to the parapets and below the surface of the footways will be wooden troughs, in which the electric telegraph and telephone cables will be laid. The unsightly overhead system of telegraph wires will thus be done away with so far as the bridge is concerned.

*Building.*—The bridge is being built in two sections. Two of the three cylinders required for each pier will be sunk on the east or down-stream side of the existing bridge. This will carry one-half of the new structure, and by fixing two of the girders of each span in position and laying down the flooring, a roadway and a footway will be ready for traffic. The completed half may then be availed of by the public, the remaining old bridge and the temporary structure removed, and the remaining or up-stream half of the new structure erected. The centre line of the new bridge is only 32ft. down stream from the centre line of the old one. The parapet of the up-stream footway of the new bridge will be 18ft. removed in a down-stream direction from the up-stream parapet of the old bridge. Although the work is to be completed in two and a-half years, it is expected that the first section of the bridge will be ready for traffic in twenty-one months from the date of the contract.

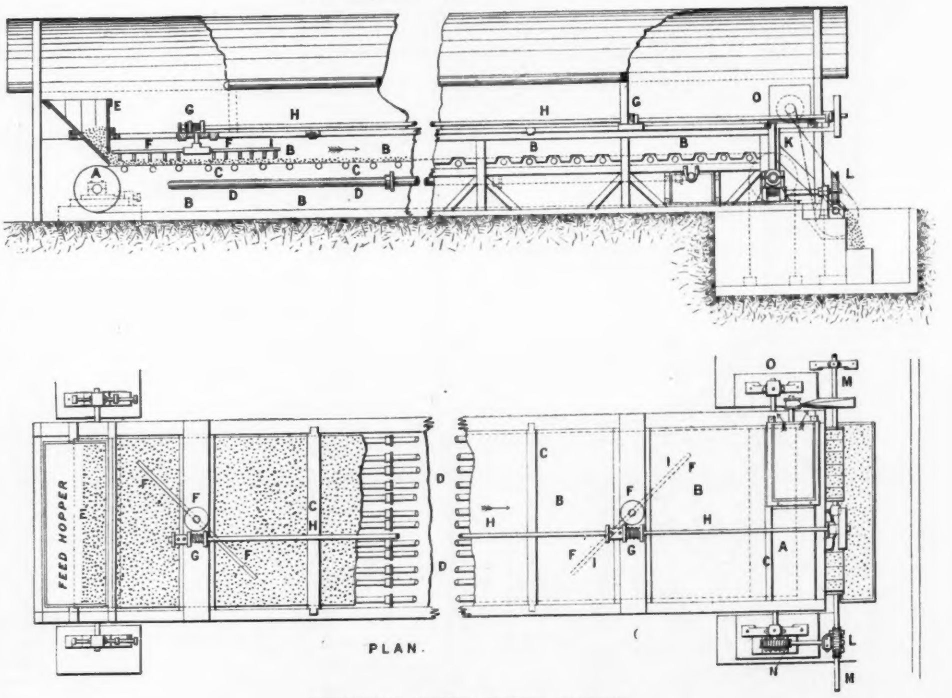
## COFFEE AND CACAO DRYING MACHINERY.

The preparation for market of many items of tropical agricultural production differs materially in several important respects. Those the harvesting of which is in the leaf may usually be subjected without injury to rapid and intense heat, while such as are of the character of beans need to have their moisture expelled far more gradually. Partaking of the nature of these last are the fruits of the coffee and cacao trees, from the second of which the ordinary so-called cocoa of commerce is prepared. Not alone does the difference in the required treatment to which we have above referred exist, but the method of applying it varies in the different countries producing the same plants. Both coffee and cacao, for instance, grow freely in Ceylon, but it is exceptional in respect to that island to have to resort to artificial heat for their preparation. Sun heat in the eastern colony is only interrupted by rain at comparatively regular intervals, and the beans of both the plants named can be safely given the exposure to it necessary to efficiently dry them. Irregular rainfall, however, deprives other countries of this advantage. Notably is this deprivation felt in some of the provinces of South America, wherein the cultivation of coffee and cacao is widely carried on. None of these provinces, perhaps, suffer more seriously from this irregularity than does that of Ecuador, and it is a machine designed by a planter of that province that we were recently afforded an opportunity of seeing in action. Its object, as may be inferred from the foregoing remarks, is to cure the beans, both of coffee and cocoa, by artificial heat, so as to avoid the risk of damage during the drying process which would arise from unanticipated rainfall.

The machine illustrated is one of six that have been constructed in this country for shipment to Ecuador by Messrs. Bowes, Scott, and Western, of the Phœnix Wharf Works, Battersea, upon the design of Mr. Juan Gamarra. Its total length is 60ft., and its width 7ft. In its main feature it is a box of these dimensions, built of light iron plates fastened on a framework of either wood or iron. This box is without any internal divisions throughout. Over the drums A A, and given motion to by them, passes an endless band B B B B of woven copper wire of the full width of the containing box or casing. The band is supported at frequent intervals upon transverse rollers C C, while its edges pass along grooved slides extending for its whole length. These slides serve to keep the beans from falling off the band. Below this last a system of hot-water pipes D D is provided. The beans are fed on to the band while in motion through the transverse hopper E, which has its lower orifice so arranged as to ensure delivery of a uniform thickness of charge—usually some 2in. to $2\frac{1}{2}$in.—upon it. The band carrying this layer of beans moves forward in the direction shown by the arrows. During its passage the beans are kept stirred by the stirrers F F, there being six of these throughout the length of the machine. A slow circular motion is imparted to these by the worm gearings at G G G, driven by the shafting H H. The prongs upon the radial arms I I are so disposed throughout the system as to ensure that the whole mass of beans should be repeatedly turned over during its travel to the point of its discharge at K, and so permit the free permeation throughout it of the heat from the pipes, ensuring uniformity in the drying. One of the drums over which the band passes is driven at very slow speed by the screw and pinion gear at L upon the main driving shaft M, the power being transferred to the drum by similar gearing at N. On the intermediate shaft is provided a coupling, whereby it may be disengaged from the main driving shaft and the machine actuated by a handle worked by manual power. A circular fan is provided at O to withdraw the damp heated air arising from the beans during the process of drying.

As has been above remarked, the motion given to the carrying band is extremely slow. It is computed that four hours should be occupied by the beans to be dried from the time of their falling on the band from the hopper E to that of their delivery at the other end of the machine. This time is calculated as sufficient exposure to the heat of the hot-water pipes to thoroughly dry them. It is approximately estimated that each machine can so prepare two tons of beans per day, so that the output of the whole battery of six machines, equal to 12 tons daily, would suffice for the production of a very large estate indeed. The inventor prefers the use of hot-water pipes to that of heated air for a very sufficient reason; this being that having to trust largely to unskilled labour, less risk is run of excessive heating by this method than might result from the employment of that second-named. The power required to drive this seemingly heavy piece of machinery is singularly small. On trial we found this to certainly not exceed half a horse-power, and it was manifest that manual labour could be readily availed of if necessary. We believe it to be Mr. Gamarra's intention to work the whole battery of six machines in line, motion to be given to the driving shafts when coupled up by a mule whim.

From what we heard, these machines are, relatively to their size, very inexpensive, though we have not obtained data sufficient to enable us to estimate their cost with full accuracy. The design appears calculated to afford a large amount of efficiency, while its freedom from any complicated machinery will ensure almost entire immunity from breakdown. In the journey to Eucador, the machines will have to be transported for the last twenty miles of it on mule-back. It was this necessity, no doubt, that induced the adoption of wood for the frames of these particular machines instead of iron. The light roofing shown is designed to guard against the cooling effects of the heavy rains we have named to be so constantly and unexpectedly experienced in Ecuador.


SECTIONAL ELEVATION.

PLAN.

GAMARRA'S COFFEE DRYING MACHINE

**The Development of Field Artillery Fire.**—Major Hughes. Royal Artillery Instructor in Field Artillery, read a paper on October 11th, in the theatre of the Royal Artillery Institution, at Woolwich, on "Oakhampton Experiences in 1894," followed by a discussion, in which Colonel Marshall, Chief Instructor of Field Artillery, Colonel Ollivant, R.H.A., and others took part. Without going into the question of fire discipline, which has of late years been developed to an extent which makes artillery fire under service conditions much more formidable than in former years, we may notice one or two features. Success in hitting has been naturally greatly increased, not only by competition and prizes, but by the adoption of various devices to enable the guns to be fired under known conditions as to range and length of force, such as the deliberate advance of officers and markers under favourable circumstances, to take up position for each gun, and ascertain all possible data before the guns come into action, as well as the use of range finders, and of systematic trial firing, not independently, but for the benefit of the battery. On the whole, it has been felt latterly that we have fallen into the mistake of giving too much weight to the effect of infantry fire at long ranges. Tables showing the results of experiments made as to modern infantry fire at dummy guns and men certainly bore out the conclusion that at ranges over a thousand yards it would be absurd for guns to sacrifice any advantage obtained by exposing themselves to infantry fire. As compared with continental Powers, it appears that both the French and Italian field artillery fire more quickly than our own, owing to the circumstance that they carry shells forged, but in the still more important matter of success in hitting under service conditions we appear to compare favourably with them.

# GREAT NORTHERN RAILWAY WIDENING WORKS, KING'S CROSS

(*For description see page 342*)

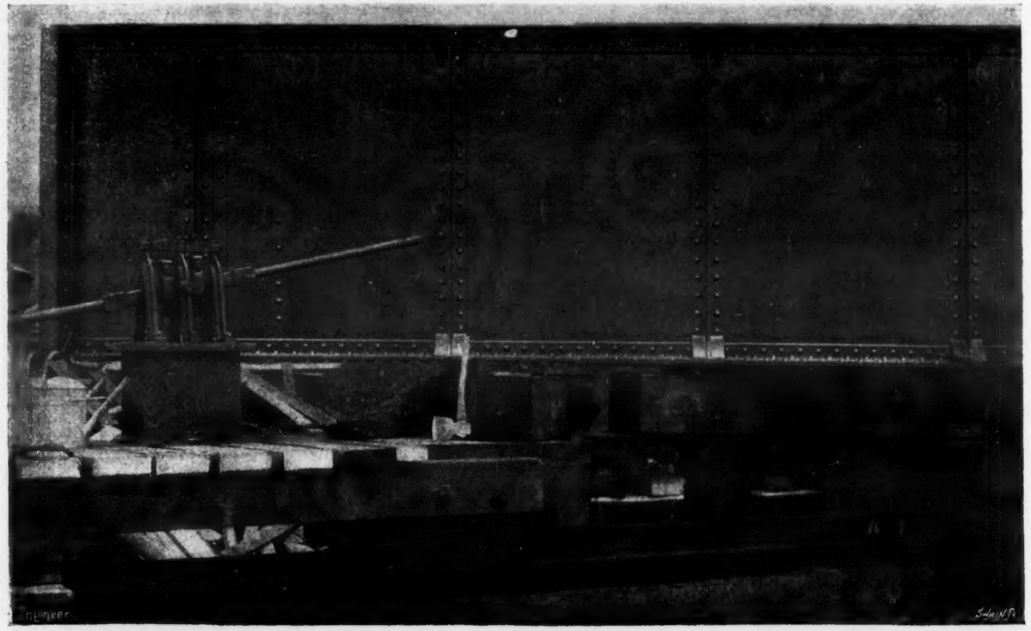


Fig. 5—VIEW OF STEEL TROLLEY AND ONE PUMP

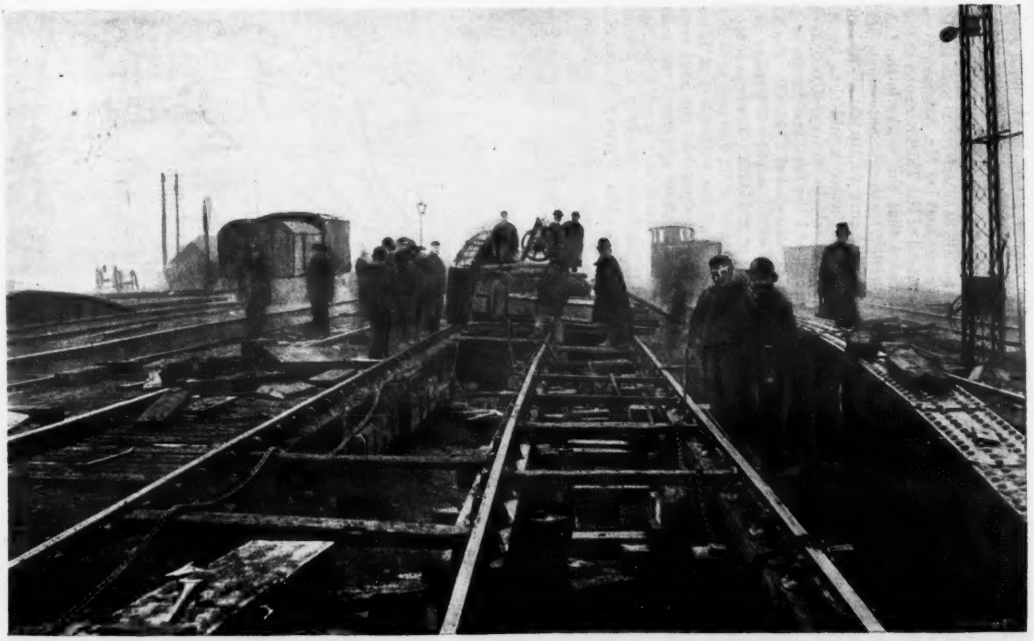


Fig. 3—HAULING SECTION OF BRIDGE TO ITS BEARINGS—SHOWING TRENCH PREPARED TO REVERSE STEELWORK

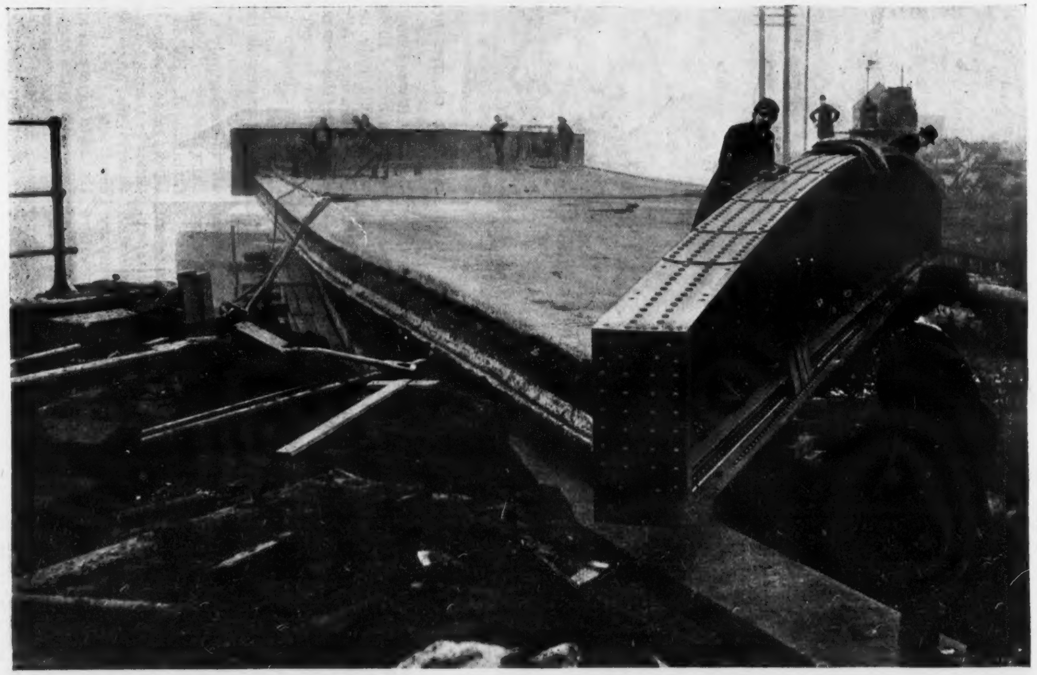


Fig 4—THE EASTERN SECTION BEING HAULED INTO POSITION

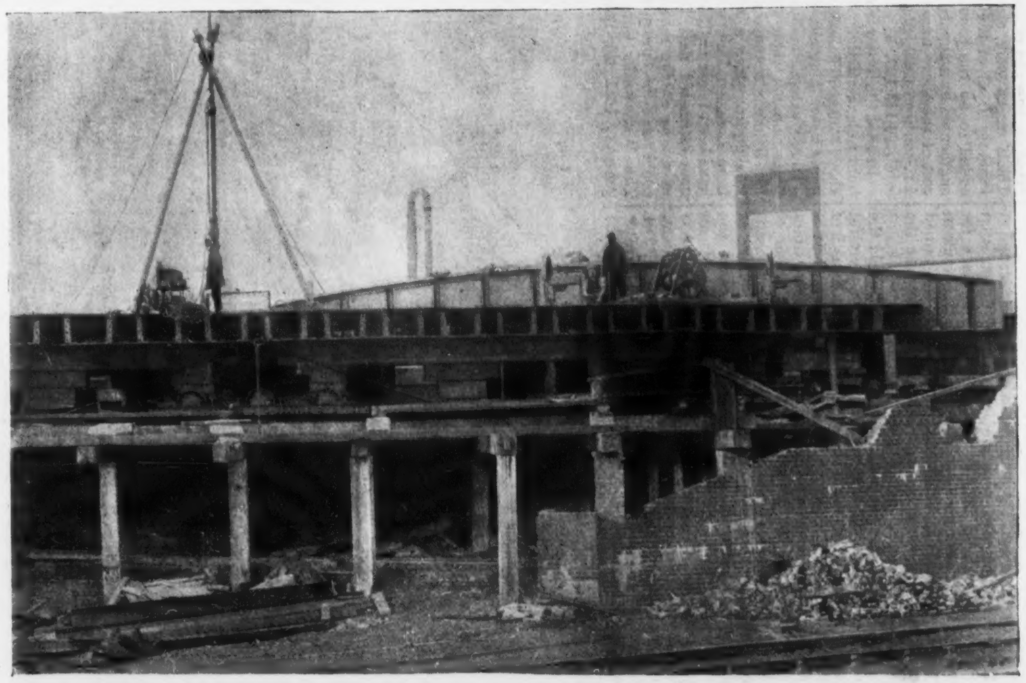


Fig. 2—PART VIEW OF GANTRY AND SECTION OF FLOORING

## THE MANCHESTER THIRLMERE WATERWORKS

### No. I.

ON the 13th inst. the inhabitants of Manchester, and of the district supplied with water from the Corporation reservoirs, entered into possession of the heritage for which they have been working for the last seventeen years. On that day the water from Thirlmere was turned on through a fountain in Albert-square, opposite the Town Hall.

Dr. Tatham, the late Medical Officer of Health, told the Corporation that, "if they would give the city a plentiful supply of water he would be responsible for the health of its inhabitants." Seeing that Manchester is now in a position to command at will a supply of water three times as large as she has hitherto enjoyed, the position of Medical Officer of Health must either be a very pleasant or a still more onerous one for the present holder; at any rate, the Council and ratepayers have placed the responsibility on his shoulders. To accomplish this an immense amount of work has had to be done. As is well-known to our readers, the late Mr. J. F. Bateman, F.R.S., was for many years the chief engineering adviser to the Corporation of Manchester on the question of water supply. He it was who designed and carried out the extensions to the waterworks, and made the Longden Dale Valley the chief source of supply. The Act for this scheme was obtained in 1847, and the works commenced in the following year. The original works have been added to from time to time, and a service reservoir in connection with them was completed only ten years ago.

The valley lies about twenty miles east of Manchester, and the drainage area covers 19,300 acres on the western slopes of the Pennine Range, varying from 500ft. to 1900ft. above Ordnance Datum. From this source Manchester was enabled to draw some 25,000,000 gallons daily, in addition to providing the compensation water demanded.

From these sources the city of Manchester has drawn its supply up to the present, and, in addition, has supplied the inhabitants of Salford and many other suburban towns, as well as the North Cheshire Water Company. The whole area, extending to upwards of eighty square miles, is supplied by gravitation. The total population provided for amounted to about 1,000,000 persons. The authorities outside the city were charged 7d. per 1000 gallons.

Prior to 1847 the water supply of Manchester was obtained from the limited sources of the Manchester and Salford Water Company, who had works on the river Medlock, now one of the foulest streams in the kingdom. These works were obtained from Sir Oswald Mosley, formerly Lord of the Manor of Manchester, and were added to by the construction of works at Gorton, and augmented by a supply from the Stockport Canal. The cost of the above works, including land, reservoirs, pipes, &c., has been £533,561; Longden Dale Works, £2,610,126; total, £3,143,126.

In 1851 the water was first delivered to Manchester from Longden Dale. The supply from the old works was about 3,500,000 gallons a day; but need for a supply of purer water in ample quantities was soon manifested in a largely extended demand, so that in a few years three times as much water was required. So long ago as 1868, Mr. Bateman sounded a note of warning, stating that the time during which a sufficient supply could be obtained from Longden Dale was limited. No action seems to have been taken until 1874, when, in a report, Mr. Bateman estimated that the annual increase and demand would be at the rate of 1,000,000 gallons a day, and could not be procured in the Derbyshire district. The Waterworks Committee and the Town Council generally took the matter up vigorously in 1875. At that time it was found that in dry weather the consumption was nearly 10,000,000 gallons a day, whereas the supply could only be reckoned at from 24,000,000 to 25,000,000 a day. Allowing for but little annual increase, before long the demand would exceed the supply. This was a serious matter, and required dealing with without delay. Mr. Bateman was called upon to report. He found that the districts east of Manchester had been absorbed to provide for the requirements of the populations near them, and advised that there was no district which could supply a sufficient quantity nearer than the Lake district of North Lancashire, Westmoreland, and Cumberland. He in the first instance recommended Ullswater as the head of the supply, and it being known that the town of Liverpool was in want of additional water, it was proposed that a single aqueduct should be constructed from Ullswater to Chorley, branching from thence to Liverpool and Manchester.

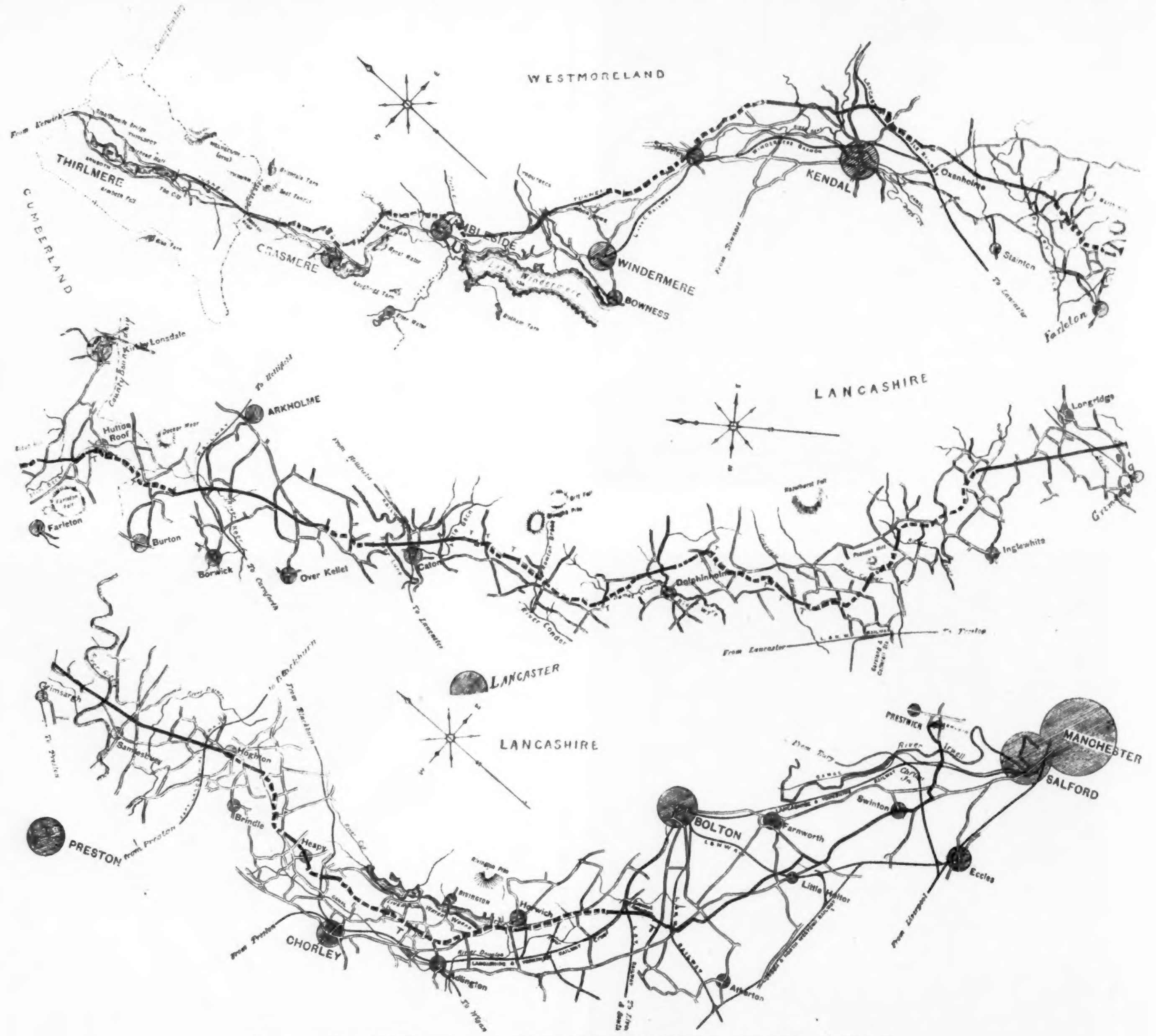
By adding the area of Hawes Water to that of Ullswater, it was estimated that a supply of 80,000,000 gallons a day could be obtained. To provide storage capacity it would only be necessary to vary the level of Ullswater 12ft., viz , 5ft. above, and 7ft. below the ordinary level of the lake. Hawes Water would have required raising 25ft. It would not, however, have been necessary to interfere with Hawes Water until the supply reached 55,000,000 gallons a day. The distance from Ullswater to Chorley is seventy-nine miles, the latter place being eighteen miles from the service reservoirs at Salford. No doubt it was the slight interference with the land on the margin of Ullswater that led Mr. Bateman to recommend this scheme instead of the Thirlmere one at the onset.

It was estimated that the works in the Lake district, and as far as Chorley, for the ultimate supply of 80,000,000 gallons a day, would cost £2,210,000. The half share to be incurred by Manchester would thus be £1,105,000, and the further works, to convey 40,000,000 gallons a day for ten miles, and the first instalment of 10,000,000 gallons a day was estimated at £346,000. Each additional 10,000,000 gallons would require 29½ miles of pipes, at an estimated cost of £352,000. The area of the Ullswater Lake is 2243 acres, and of its drainage area 36,000 acres.

It is understood that the authorities of Liverpool and Manchester had this proposal for the joint water supply under consideration, but no agreement was reached. On economical grounds this is very much to be regretted, for in the interval it has been necessary to construct large works for each city. The Vyrnwy Works of Liverpool are second only to the Thirlmere Works of Manchester, in the length of the conduit, and in both cases large costs have had to be incurred at once, in order that an increased supply may be obtainable in time to come when required. Had this capital expenditure been divided between the two cities, the present saving to the ratepayers would have been considerable. When it was found that the scheme was required for Manchester only, Thirlmere was selected as being a more suitable lake, and in every respect better fitted for the purpose. It is 56ft. higher than Ullswater, namely, 533ft. above O.D., is 335 acres in extent, and has a drainage area of 11,000 acres.

Mr. Bateman's report states that the ground is "exceedingly steep, yields beautiful water, and lies close to, if not in the heart of the heaviest rainfall. In the same year in which 65in. of rain fell at Hawes Water, 81½in. fell at Thirlmere"—an increase of 80 per cent. The estimated cost of Thirlmere to supply Manchester only was £170,000 less than if the supply was drawn from Ullswater.

On this page we give a map of the route of the Thirlmere Manchester Aqueduct. To enable us to give this map to a useful scale, it has been necessary to divide it



MAP, IN THREE LENGTHS, OF THE ROUTE OF THE MANCHESTER THIRLMERE AQUEDUCT into three lengths. The three parts are accompanied by cardinal point indicators, so that the direction of the parts forming the ninety-five miles of aqueduct made of tunnel, pipe, and cut and cover work, may be seen. To show the relative positions of the first, second, and third parts the name of the towns Farleton and Grimsargh are repeated.

The reservoirs in connection with Longden Dale are as follows:—

*Collecting and Storage Reservoirs at Longden Dale.*

| Name of reservoir. | Area | Capacity. | Depth. | Height of top water level above Ord'nce Datum. |
|---|---|---|---|---|
| | Ac's. | Gallons. | Ft. | Ft. in. |
| Woodhead ... ... ... ... | 135 | 1,181,000,000 | 71 | 782 0 |
| Torside... ... ... ... ... | 160 | 1,474,000,000 | 84 | 651 3 |
| Rhodes Wood ... ... ... | 54 | 500,000,000 | 68 | 574 6 |
| Vale House... ... ... ... | 63 | 343,000,000 | 40 | 503 0 |
| Bottoms ... ... ... ... | 50 | 407,000,000 | 48 | 486 0 |
| Arnfield ... ... ... ... | 39 | 209,000,000 | 52 | 540 3 |
| Hollingworth ... ... ... | 13 | 73,000,000 | 52 | 554 9 |

*Service Reservoirs Supplied from the Storage Reservoirs*

| Name of reservoir. | Area | Capacity. | Depth. | Height of top water level above Ord'nce Datum. |
|---|---|---|---|---|
| | Ac's | Gallons. | Ft. | Ft. in. |
| Godley ... ... ... ... ... | 15 | 61,000,000 | 21 | 478 0 |
| Denton, No. 1 ... ... ... | 7 | 30,000,000 | 20 | 321 6 |
| ,, No. 2 ... ... ... | 6 | 23,000,000 | 20 | 321 6 |
| Audenshaw, No. 1 ... ... | 80 | 528,000,000 | 27½ | 340 0 |
| ,, No. 2 ... ... | 69 | 371,000,000 | 22½ | 323 0 |
| ,, No. 3 ... ... | 102 | 542,000,000 | 22½ | 323 0 |
| Gorton Upper ... ... ... | 34 | 123,000,000 | 26 | 259 0 |
| Gorton Lower ... ... ... | 23 | 100,000,000 | 29 | 244 0 |
| Prestwich ... ... ... .. | 4½ | 20,000,000 | 22 | 347 0 |
| Total ... ... ... ... ... | 854½ | 5,985,000,000 | | |

A table was appended to the report giving the levels of various English lakes as under:—

*Levels of English Lakes.*

| | ft. | |
|---|---|---|
| Hawes Water ... ... ... ... | 694 | above O.D. |
| Thirlmere ... ... ... ... ... | 533 | ,, ,, |
| Ullswater ... ... ... ... ... | 477 | ,, ,, |
| Buttermere ... ... ... ... ... | 331 | ,, ,, |
| Crummock Water ... ... ... | 321 | ,, ,, |
| Derwent Water ... ... ... ... | 236 | ,, ,, |
| Bassenthwaite ... ... ... ... | 226 | ,, ,, |
| Grasmere ... ... ... ... ... | 208 | ,, ,, |
| Wast Water... ... ... ... ... | 204 | ,, ,, |
| Rydal Water ... ... ... ... | 181 | ,, ,, |
| Coniston Water ... ... ... ... | 147 | ,, ,, |
| Windermere... ... ... ... ... | 134 | ,, ,, |

WATER-TUBE BOILERS.—Mr. James Howden, of forced draught reputation, has challenged all makers of water-tube boilers to a thirty hours' trial, conducted by neutral experts, of the respective merits of cylindrical and water-tube boilers. The points to be determined are:—(1) Weight; (2) space occupied; (3) evaporative power; (4) economy, and 5th, waste of heat. The challenge is particularly directed at the Belleville boilers. The stakes are to be the expenses and cost of the boilers.

THE GREAT WESTERN RAILWAY AND THE SOUTH-WEST.—The Great Western Railway has arranged to run on and from Thursday, 1st November—Wednesday midnight—a new train from London to Plymouth for the accommodation of passengers, parcels, horses and carriages. The train will leave Paddington at 12.1[illegible] a.m. midnight daily, Sunday midnight excepted, and reach Exeter at [illegible]5 a.m. and Plymouth at 8.25 a.m, calling at Reading, Didcot, Swindon, Bath, Bristol, Taunton, and Newton Abbot, where it will connect with the 7.30 a.m. train, thence to Torquay and the [illegible]mouth Branch. The facilities thus afforded will enable business men to reach the West of England with the least possible expenditure of valuable time, the journey being performed during the night, and the new train will no doubt be largely appreciated, particularly as it has been decided to provide sleeping accommodation for first-class passengers. Passengers for Truro, Falmouth, and intermediate stations to Penzance, will proceed from Plymouth at 9.25 a.m., and the time allowed at that station will enable them to have breakfast before completing their journey. A through coach for Oxford will be provided on the new train from Paddington, and will be attached to a new train for Oxford, which will leave Didcot at 1.50 a.m. An additional train will leave Oxford at 1.10 a.m. for Didcot, where it will connect with the new midnight train from Paddington for the West. On and from the 1st November, the company will also run a new express merchandise train from Penzance to London, which will provide for the delivery of merchandise traffic from Cornwall in the metropolis on the day following dispatch. The new train will leave Penzance about 4.0 p.m. daily, Sundays excepted, and it will convey, either from the stations direct or from Truro and Plymouth—to which places feeder trains will be run—traffic from all intermediate stations and branches.

THE HULL AND DISTRICT INSTITUTE OF ENGINEERS AND NAVAL ARCHITECTS.—The first meeting of the present session, 1894-5, was held on Monday evening, the 15th inst., at the Parochial offices, Bond-street, the President, Mr. F. H. Pearson, being in the chair. After the usual preliminary business, which included the election of several new members, was completed, the President delivered a short inaugural address. During the course of his remarks, Mr. Pearson alluded to the extensive adoption of water-tube boilers for marine purposes, especially in vessels now being built for H.M. Navy. Though this type of boiler has only recently been introduced into British boats, it has been extensively used by the French for some years, nearly 100 of their war vessels being thus fitted, and at the present time twenty-four more vessels for that Navy, as well as nine for the Russian Navy and seven new Messageries Maritime steamers are being fitted with them. The British Government has given orders for upwards of thirty of the new vessels to be fitted with water-tube boilers, and several private firms are also trying them, so that it almost seems as if this type had come to stay, although the old tubular or Scotch type will die hard. The use of aluminium in shipbuilding was also commented upon, but the present cost of production is almost prohibitive. The prolonged and costly strikes that have taken place in different parts of the country during the year, the changes that have recently taken place in Hull shipping firms, and the present condition of the engineering and shipbuilding trades, were also dealt with. Following on his address, Mr. Pearson read a further paper on "The History of Hull Steam Shipping," the period being 1840 to 1850. The various descriptions of the vessels, launches, accidents, time of passages, rates of freight and passage money, wages, steamship companies, and the trade of the port in general during this period being most interesting and in many cases amusing, the whole showing that an immense amount of time must have been spent in research to secure such a complete record. The meeting closed with a vote of thanks to the President for his paper and address, moved by Mr. J. Spear and seconded by Mr. F. Somerscales.

## THE PARIS METROPOLITAN RAILWAY.

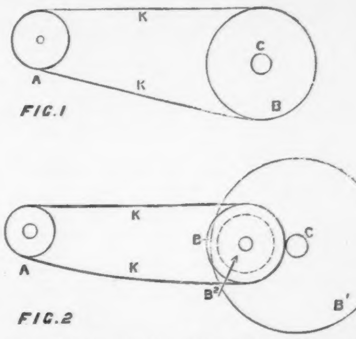
THERE seems to be little doubt now but that the underground railway in Paris will soon be put in hand. After being discussed for twenty years past, it has become absolutely necessary that something should be done to improve the facilities for passenger traffic in the city, since, unless the work is at once entered upon, it will be quite impossible to deal with the enormous traffic that is expected to take place during the period of the Exhibition of 1900. So far, the difficulties have arisen chiefly from the conflicting interests which seemed to place the project beyond the pale of settlement. The Government was in favour of the railways in Paris being constructed and worked by the great companies whose lines already serve the capital, while the municipal council insisted upon the metropolitan being taken over by a separate syndicate. It was only upon condition that the lines should be purely local that the council approved of the extension of the Sceaux Railway to the Place Medicis, which will be put in service in a few months, and the prolonging of the Moulineaux line to the Esplanade des Invalides, of which the works are now being carried out. The council likewise approved of the project for constructing the Berlier tubular tramway from the Bois de Boulogne to the Bois de Vincennes, and this project is now being considered by the Railway Commission of the Chamber of Deputies. If therefore the Government and the Municipal Council could come to an understanding there was every probability of the scheme being carried out, and it seems, indeed, as if the difficulties in this respect have been overcome. After having examined the systems at work in England, M. Barthou, the Minister of Public Works, has drawn up a plan which has just submitted to the Municipal Council with a view of securing from that body a free grant of land necessary for the building of the lines, and an exemption from octroi duty upon the material used in their construction. The project of M. Barthou seems to be the more serious, as it is less ambitious than the schemes previously under consideration. He does not propose to carry out the whole scheme at one operation, but is in favour of constructing two lines, one from north to south, and the other from east to west. When these are completed, it is expected that no difficulty will be experienced in a further extension of the system. The line traversing the city from north to south will leave the northern railway which communicates with the Ceinture, and passing the Nord and Est stations, will touch the Central Markets and will emerge from the tunnel at the Hotel de Ville; it will then take an easterly direction to cross the Seine, and, after passing the Halle-aux-Vins, will enter the tunnel under the Boulevard Saint Germain, and on reaching Cluny will turn to the right to join the Sceaux extension at the Place de Medicis, by which it will be again in communication with the Ceinture. The railway from east to west will utilise the high level line from Vincennes as far as the Gare de Lyon, and, passing by the Gare d'Orleans, will communicate with the north to south line at the Halle-aux-Vins. The section to Cluny will be used in common by both transversal railways, and from Cluny the east to west line will go by another tunnel to the Esplanade des Invalides, whence it will use the Moulineaux line as far as the Champ de Mars Station, at which point it will be connected with the Auteuil line near Muette. The total length of new lines to be constructed will be 15 kiloms, without counting the existing lines that will be used in the system. The cost of carrying out this work is estimated at four millions stetling. The railway companies are to have control of those connecting lines that already exist, but a separate syndicate is to be formed for working the railways to be constructed. As showing the utility of the proposed system, it may be mentioned that since the Compagnie du Nord connected its terminus with the Ceinture the number of passengers travelling between the Ceinture and the Gare du Nord during seven months has increased from 184,000 to 1,060,000.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—The usual monthly meeting of this society was held in the K-room of the Cannon-street Hotel on Saturday, the 3rd inst., at 7 p.m., when, in the absence of the president, the vice-president, Mr. R. J. Cook, occupied the chair. After the usual financial and general business was over a paper was read by Mr. H. A. Parker, past-president, on "The City and South London Electric Railway."

BRISTOL CHANNEL INSTITUTE OF MARINE ENGINEERS.—A few years ago, mainly owing to the exertions of Prof. A. C. Powell, D.Sc., and the hospitality of the local University College, a branch of the Institute of Marine Engineers was established in Cardiff—the first branch, it is claimed, set up outside London of any of the professional societies which have the metropolis for their home. Under the title of the Bristol Channel centre, the new association gathered members from Newport, Swansea, and the neighbouring ports, held periodical meetings for the reading and discussion of papers of the same character as those presented to the parent Institute, and in course of time succeeded in making itself a place among the institutions of the district second only to that of the South Wales Institute of Engineers. On Saturday the winter session was opened with the annual dinner, at the Royal Hotel, and members and their guests reached the large and unexpected number of 350. Dr. Elliott, president of the Bristol Channel centre, was in the chair, and there were present the principal and several of the professors of the University College, a large number of engineers, marine and mechanical, and representatives of the shipping interest, together with Board of Trade and Lloyd's surveyors, and Mr. James Adamson, hon. sec. of the Marine Engineers' Institute in London. Dr. Elliott gave an interesting account of the growth and prosperity of the local centre, in responding to "The Institute of Marine Engineers," proposed by Dr. Maccormack, who claimed for this branch of engineering science that it had progressed fifty per cent. more than any other department, and that with the diffusion of knowledge by the papers and discussion of societies like these, it was no longer possible, as in 1867, for a man like Randolph, the maker of compound engines, to say to Mr. Denny, when asked for information, "Go and find out for yourself, and pay for it." A tribute to the services rendered to the Institute by the University College was paid by Mr. Adamson, the London honorary secretary, who mentioned that the local centre was increasing at such a rate that it was possible next year they would have a home and dining hall of their own. Principal Viriamur Jones, who replied for the College, claimed that technical education was being pressed forward in Glamorganshire and Monmouthshire, and particularly in Cardiff, in a manner which would compare favourably with any other part of the kingdom, while the engineering department of the College was being rapidly developed, and the practice of the profession taught to a large number of students. Next week the College would receive the great testing machine, which had cost £3000, and if only a fine building were given them, the authorities would soon challenge comparison with anything that had been done in any part of the world. An adequate building would require a quarter of a million sterling, and it was their intention to ask Government for a grant of £100,000.

## BICYCLE MECHANICAL ENGINEERING.

THE makers of the modern "cycle" have afforded mechanical engineers some useful hints in the construction of wheels and small bearings, and perhaps on other points in the construction of light machinery and the machine tools used for the purpose, but every now and then some of the bicycle makers do things and make things which detract very much from their reputation as mechanicians, and make us forget their services. Not long since some firms brought out an elliptical chain wheel for the crank spindle, and it was said that somebody or some shareholders paid a good deal for the patent for this beautiful device for obtaining a variable radius coincident with the variable push on the pedal. When we were explaining the fallacy of this thing to an ardent young cyclist but learner of mechanics at one of the cycle exhibitions, the exhibitor, who loudly claimed for the invention the advantages of greater speed and easier work, seemed to think we were anticipating the adverse proof which was later to be afforded by experience. He did not like the explanation. The last new cycling invention, for which very great things are claimed, is also to secure greater speed with less labour. The claims appear to have about as much to support them as the oval wheel had, and we would not mention this latest mechanical offence were it not that the names of one or two firms usually associated with well accepted machines are mentioned in connection with it, and a parent company is now to be formed for the development and working of the patents for this thing. It is known as the Boudard gear, and our readers will be almost sufficiently informed to satisfy themselves of the validity of the extraordinary claims made for it, when we tell them that the ordinary single chain wheel on the crank spindle of a bicycle is to be replaced by an internally geared wheel which drives a pinion on a second spindle, the other end of which carries the still necessary chain wheel, but reduced in size. The following diagrams will illustrate the difference. Fig. 1 represents the ordinary simple arrangement with a chain wheel B on a crank spindle C, and by the chain K driving a pinion A on the driving wheel hub. This is about as far as simplicity and directness can go. The Boudard gear neither wants nor has either of these qualifications usually regarded as so desirable in mechanics. In this remarkable device greater mechanical efficiency is obtained by adding to the mechanism by which a given end has hitherto been attained. Fig. 2 shows the arrangement. The chain wheel B of Fig. 1 is replaced by an internally toothed wheel $B^1$, which gears into the pinion $B^2$, shown by the dotted circle in the diagram, Fig. 2. It is on a spindle which carries the chain wheel B. Thus the friction of the internal toothed wheel B and the pinion $B_2$, and of the bearings of the spindle carrying the pinion $B^2$, and wheel B is all additional to that of the old common patentless arrangement shown in Fig. 1. To acquire this extra friction, there are introduced as extra parts, the internal cog-wheel, the pinion gearing into this wheel, the separate extra spindle, and one extra bearing or pair of bearings or ball races. Why these additions are to make the propulsion of a bicycle easier is not shown, although numerous statements are made, none of which are better than those which are usually used in the ordinary company prospectus. One ingenious supporter of the cause shows that internal gear should run with less friction than that of the ordinary forms of externally cogged gearing, but as that which is to be displaced by the new gear contains neither internal nor external gear, and as the internal gear of the new thing is altogether additional, the proposition as to more or less friction has not to be considered. It seems incredible that such things can be put forward, not only seriously, but in the expectation of attracting large sums of money from the public.

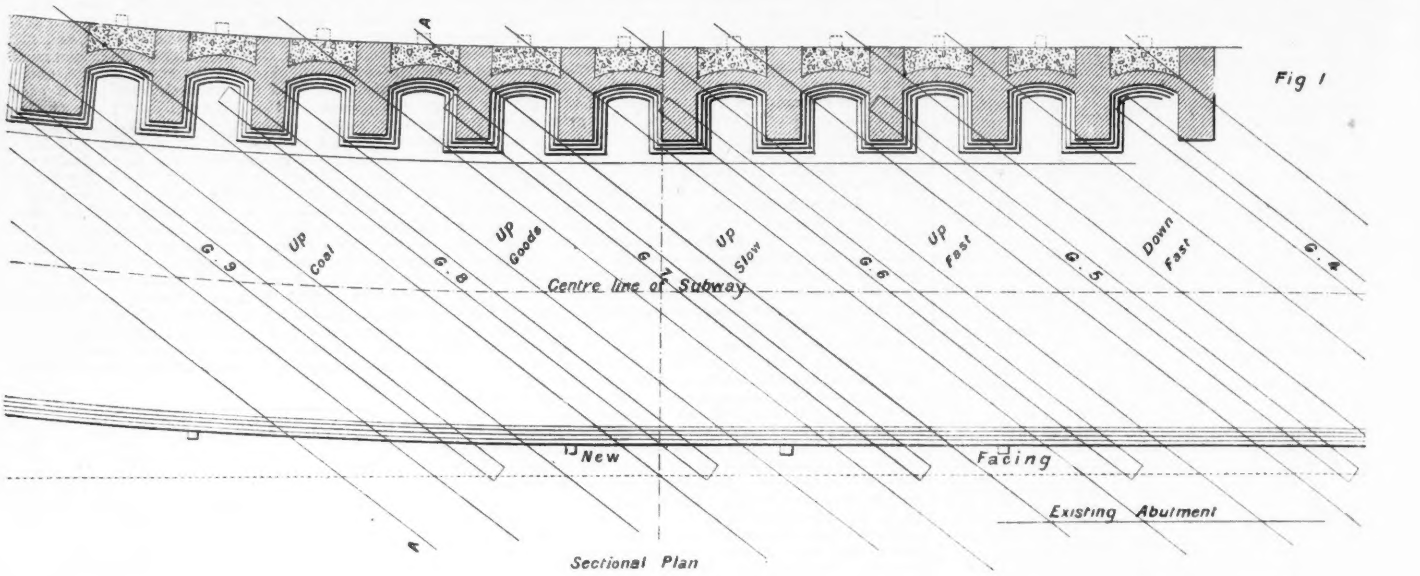


THE ORDINARY AND THE NEW CYCLE GEAR

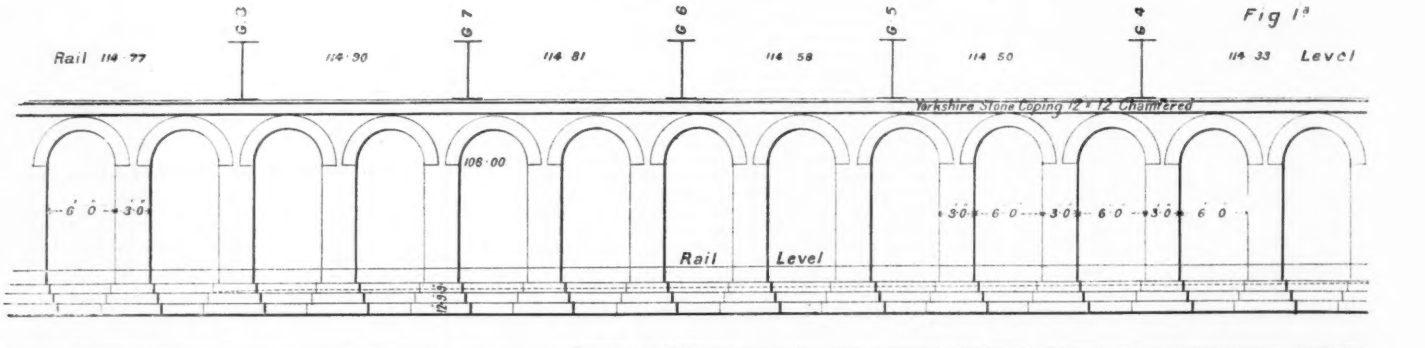
## GREAT NORTHERN RAILWAY.—WORKS IN CONNECTION WITH THE WIDENING OF THE LINE AT KING'S CROSS.

IN consequence of the extensive alterations the company have made to their terminus at King's Cross in the way of extra platforms and offices, it has been found necessary through the same occupying room used as sidings, to provide accommodation at Holloway for purposes of making up trains, storing and cleaning coaches, and other work incidental to the general passenger traffic formerly done at the terminal station. In order to carry out the new arrangement, trains of empty coaches have to be taken from the terminus and returned, after being cleaned, &c., at the new sidings. This, as a matter of course, increases the number of trains going to and from the points mentioned above. As the ordinary passenger service is already very heavy, any blocking of the line to enable a train to pass from the down to the up side on the same level would be a serious inconvenience to the working of the trains, and in misty weather, not unattended with some risk. To avoid any such inconvenience, the company have determined to cross from the one side to the other by means of a short subway, parallel with one already existing, and which is used for the service between the North London and Great Northern Railways. It was difficult to construct this subway, and still keep the traffic going without interruption, the most difficult being that part on the eastern side, and forming the approach to the goods and coal shunting sidings.

The means adopted to meet the different requirements were as follows: Before doing any part of the permanent structure a

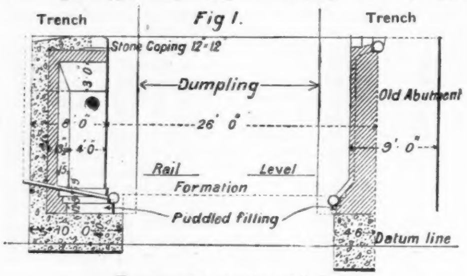


Sectional Plan

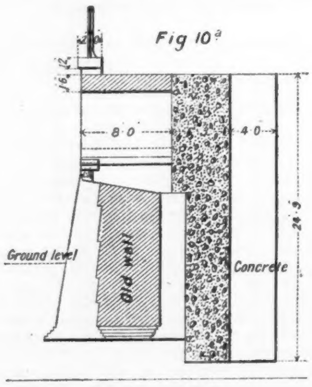


"The Engineer" Elevation of Abutment Swain Eng

platform of timbers, 8in. by 8in., with an average length of 14ft., was laid under the rails, forming the approach to the sidings directly over the line of the new abutment and also the pier, and some 15in. square longitudinal timbers under each of the main lines. In addition to the longitudinals, cast iron girders were put between the roads with cross timbers under the 15in. longitudes, placed 8ft. apart, as in consequence of the angle of skew, the bearing of the timbers would have been 21ft., although the width of the trench on the square only measured 12ft. In executing the work this proved a great convenience, as no propping of timbers under the lines of way was required, thus enabling the walls, Fig. 1, to be carried up to bedstone level without any stoppage. The trenches for the new abutment and strengthening the existing one were then proceeded with and the wall built to coping level. The new abutment is a combination of brick and concrete, the strengthening of the old one being all in brick. They are both faced throughout with Staffordshire blue brick, and all the work is set in Portland cement mortar. On the completion of the masonry, the timbers carrying the rails were packed on to the walls and all the cast iron girders removed and trenches cut to receive the permanent steelwork.



Transverse section at A. A

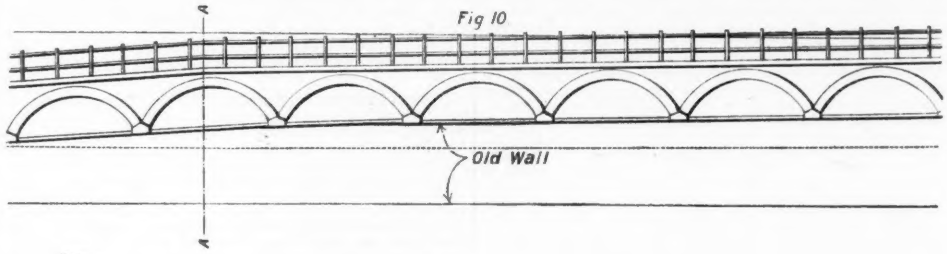


Section at A. A.

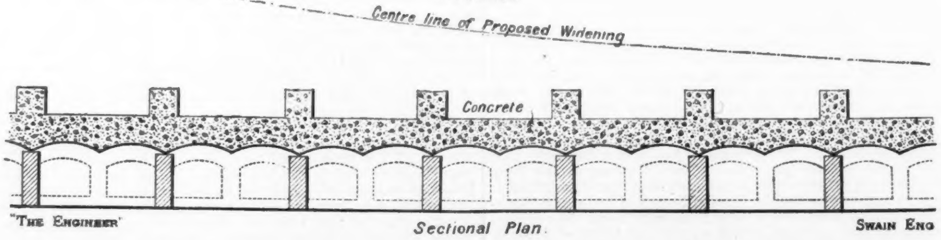
As the lines forming the approach to the shunting sidings could not be closed for many hours, and then only on Sunday, a gantry was constructed on the east side of the line—as shown on the plan between A and B. On this eight steel trollies, each carrying two hydraulic jacks, were placed, four on a side, and trussed bearers laid on the jack heads, to form a continuous bed for the steel flooring, as shown by the Figs. 2 and 3. The set of eight jacks were connected with a hydraulic pipe worked from one pump fixed on the end trolley—a view of one of these pumps is given in Fig. 5. The steelwork was then put together, and all riveted up, painted, and asphalted. This portion has an average length of 110ft. by 29ft. wide, and weighs about 200 tons. The time for running it into its final position was fixed for a Sunday, between 8 a.m. and 5 p.m. The heaviest part of the work was taking up the temporary timber flooring, which amounted to 1500 cubic feet, and excavating 300 cubic yards of earth, the materials to be removed representing 500 tons nearly, exclusive of permanent way. The new steelwork was drawn forward by three winches, the earth and timber being removed as the bridge came forward. When in position for lowering on to its bed the pressure was applied, the wedges on which it rested removed, and the whole thing lowered on to the bedstones. The ballast was then distributed, and the rails laid ready for the early Monday trains. The cost of this portion of the superstructure amounted to £18 16s. per ton of steel work fixed.

The remaining section carrying the eight main lines is constructed with ordinary plate girders, with flooring formed with steel troughing. Three methods of erection had to be resorted to in carrying out this part. The first line dealt with was a siding, which could be given up for some days without much inconvenience. The girders for this, together with the flooring, were erected *in situ*—no special feature in the operation presenting itself. The second line being a through goods could not be closed for many hours, therefore this section was put together by the side of the line at C, and when completed the lines were removed and the earth cleared away down to bedstone level, and the steelwork drawn into position and bolted to the part already fixed. This work was performed between 8 a.m. and 1 p.m. The third, fourth and fifth, being the down slow, down fast, and up fast passenger lines, had also to be done quickly. These sections were put together by the side of the line, as shown by Fig. 6, and drawn across to their respective lines, as shown by Figs. 7, 8, and 9, and then transferred to their bearings, the lines being taken up and the ground being excavated, while each portion of bridge was being transferred from the site of erection. The remaining three sections, consisting of the up slow passenger and the two up goods lines, were put together *in situ*, but as the lines could not be stopped for many hours, they could only be erected by degrees, the main girders being put on to their bearings on one Sunday, and the trough flooring in between fixed on succeeding ones. The cost per ton of steelwork fixed in the first portion was £18 4s.; for the second, £17; for the third, fourth, and fifth, £16 12s.; and the sixth, seventh, and eighth, £18; so that building the bridgework by the side of the line and hauling it into position proved to be the less costly, and interfered with the traffic the least.

The whole of the bridge-work is steel, the main girders being plate and I section. The flooring is made with corrugated troughing, 8½in. deep and ½in. thick. The troughs are filled in with asphalte concrete, with the upper surface covered with J. Cliffe's patent fibrous asphalte. All the bridge-work was made and erected by Messrs. A. Handyside and Co., of Derby.



Elevation



"The Engineer" Sectional Plan Swain Eng

After passing through the subway described above the lines take a sharp curve to the south, and join the main lines on the up side where it crosses the Hornsey-road. To enable this to be done an old retaining wall had to be strengthened and raised—an elevation and section of which is given in Fig. 10. The raised portion of wall is made with Portland cement concrete, in the proportion of one of cement to eight of Thames ballast, and Fletton brick faced with pressed blue Staffordshire bricks, all set in Portland cement mortar. The banks and filling behind the raised retaining wall and ballasting of permanent way is made of burnt clay ballast obtained from surplus earth from the excavations in trenches, &c.

The whole of the work has been carried out under Mr. R. Johnson, M. Inst. C.E., Mr. H. Lovatt being the contractor.

# GREAT NORTHERN RAILWAY WIDENING WORKS, KING'S CROSS

*(For description see page 342)*

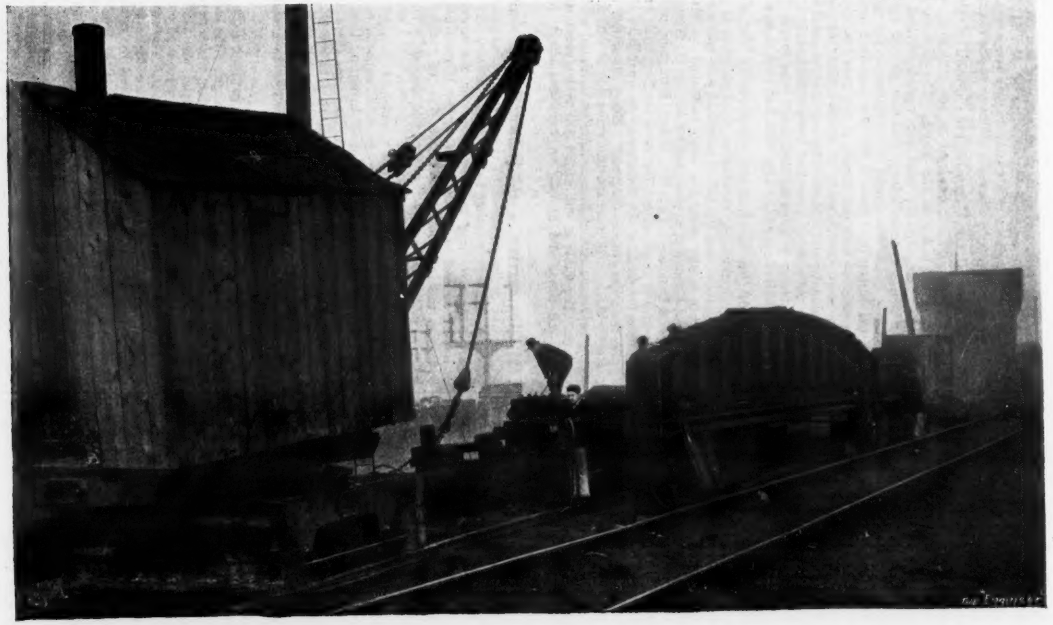


Fig. 6—BUILDING SECTION OF BRIDGE BY SIDE OF LINE

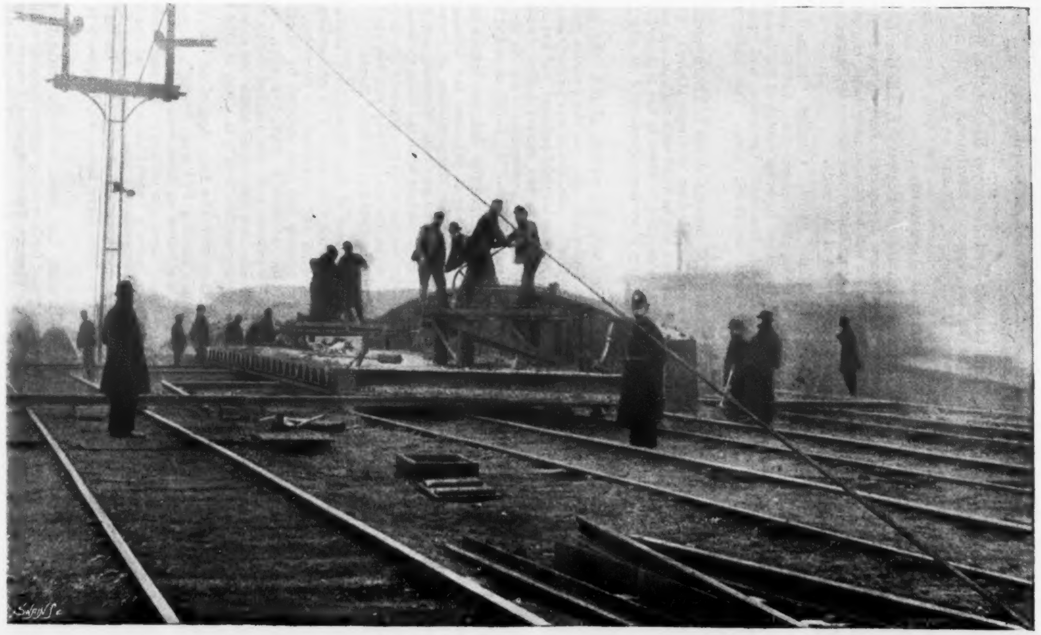


Fig. 7—HAULING A SECTION OF THE BRIDGE TO ITS BEARINGS, FIRST OPERATION

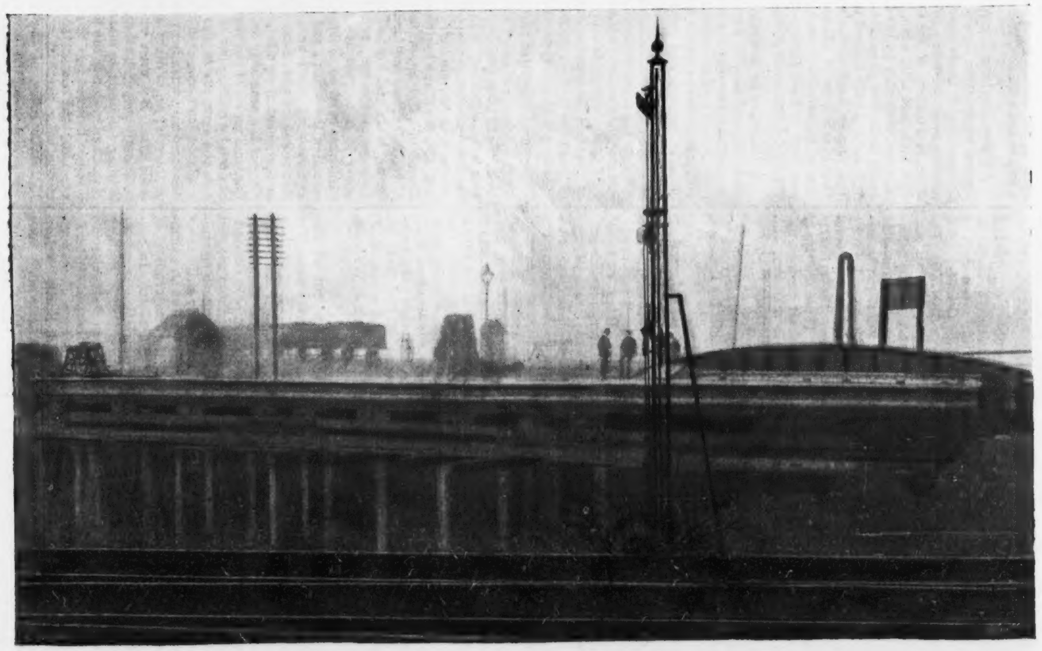


Fig. 8—GENERAL VIEW OF EASTERN SECTION READY FOR MOORING TO ITS FINAL BED

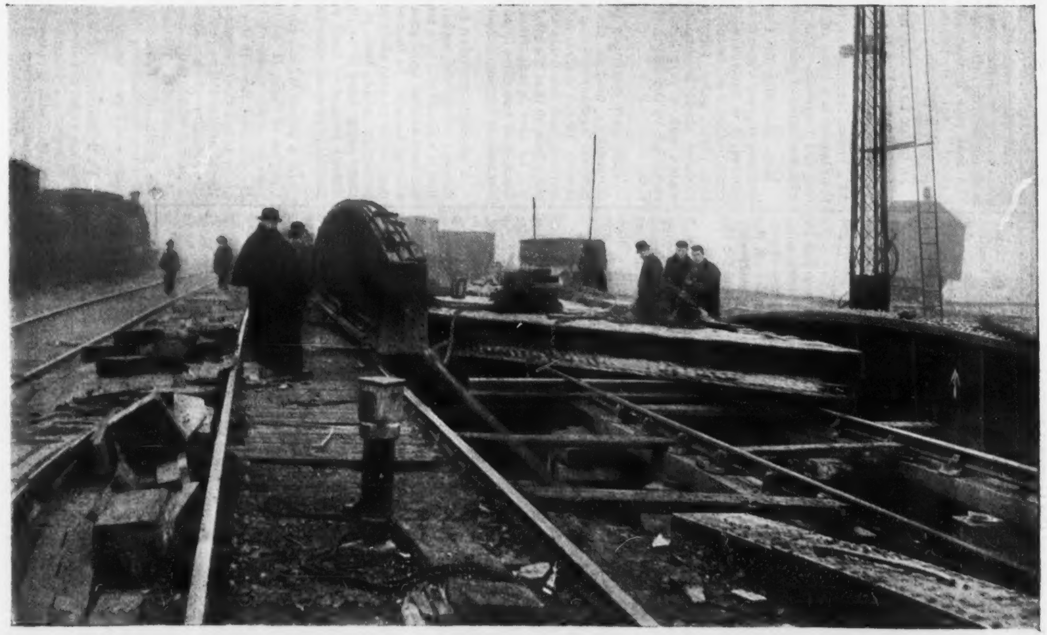


Fig. 9—HAULING A SECTION OF THE BRIDGE TO ITS BEARINGS, SECOND OPERATION

## RAILWAY MATTERS.

Fifteen miles of the German railway at Zanzibar have been completed, and the line will shortly be opened for traffic.

The Brooks Locomotive Works have received an order for thirty freight and thirty passenger locomotives for the Central Railroad of Brazil, fifteen of which will have Belpaire boilers. All will have copper fire-boxes, and all the wheels will have Krupp steel tires.

Two new strategic railways, which are to be shortly taken in hand, one leading from the Duchy of Baden into France, and the other from Rufach to Seheim, are calculated to faclitate the concentration of German forces opposite Belfort, which is regarded as a point threatening the whole of South Germany.

The Port Talbot Railway Act, obtained last session in Parliament, provides for making a line of railway sixteen miles long and serving three mineral valleys in Glamorganshire at present served only by the Great Western Railway. Miss Talbot, the owner of the docks at Port Talbot—which are to be considerably improved and enlarged—and of a large portion of the land for the railway, herself provides a large portion of the capital.

A short while ago the mail train on the Bengal and Nagpore Railway ran into a wild elephant which was straying along the line near Guilkhera Station. The engine having carried the animal about a hundred yards, then left the rails with the first five carriages. The elephant was thrown down a bank 60ft. high and was found dead at the bottom. No one in the train was injured, and no damage was done to the rolling stock or to the line. This was "bad for the coo."

A contract has been placed with Mr. Woolley, of Wrexham, for the construction of about eight miles of the Vale of Glamorgan Railway, which portion of the proposed line is at the Bridgend side of the route, and will provide employment for a year or two for a large staff of hands. Messrs. Pethick Brothers, the main contractors, are also approaching completion of the preliminary work at Barry, with a view of commencing the excavation of the large tunnel in Porthkerry Park.

Work on the proposed new line to compete with the Pennsylvania Railroad—the Loyalhanna and Youghiogheny—is to be vigorously pushed. The line, according to the *Railway News*, will run from Mehaffey, in the Clearfield coal region, to Sewickley, on the line of the Pittsburg, McKeesport, and Youghiogheny Railroad, and will connect with the Buffalo, Rochester, and Pittsburg line at Punxsutawney, and with the Shenango and Lake Erie road at Butler, and will make connection with Pittsburg over the Pittsburg and Erie, giving an outlet from the Connellsville region to the seaboard, the Lakes, and Canada.

A new carriage, of a class not in use before on the Great Northern (Ireland) Railway, or any other of the Irish lines, has been completed in the central workshops, Dundalk, and tried. It is constructed on the Pullman system, the outside framework of the carriage being of mahogany, 45ft. in length, and resting upon four couple of bogie wheels, with automatic brakes to all the wheels. The interior of the carriage is divided into five sections, the largest occupying about two-thirds of the space as a drawing-room car, and is fitted throughout in superb style. This carriage is for immediate use on the Dublin and Belfast limited mail.

The new railway from Uppingham to Seaton, 3½ miles long, on the Stamford, Peterborough, and Market Harborough branch of the London and North-Western Railway, at last connects the town of Uppingham, possessing an important public school, and having a weekly cattle market, with a railway system, all traffic having hitherto been by road to Seaton Station, on the London and North-Western Railway, or to Manton, on the Stamford and Oakham section of the Midland Railway. Owing to the altitude of the town, many cuttings and embankments were unavoidable, and in one case a long viaduct has been built. The total cost of construction was £30,000.

Another cable tramway has been recently completed in Australia, namely, the Ocean-street Cable Line at Sydney. A communication from that town, of August 25th, mentions it as about to be tested. The line was commenced in October, 1892, and has, it appears, cost altogether something like £160,000. The line has many curves upon its 2½ miles of length, and it is considered to be one which tests the system very severely. The cables altogether weigh 150 tons, and the working of the several lengths of cable, even without any car upon the lines, will require something like 250-horse power. The engines have been built by Messrs. Hudson Bros., of Granville, and are horizontal compound surface-condensing Spencer-Inglis Corliss engines. The cylinders are 24in. and 45in. diameter, with 5½ft. strokes. There are two of these engines, one being a stand-by. The main shaft carries a fly-wheel weighing 25 tons, and a rope drum, 7ft. in diameter, with thirty-six grooves for 2in. cotton ropes. The boilers are described as three multitubular under-fire boilers, each rated at 250-horse power, and working at 150 lb. per square inch pressure. Mr. Fischer, of the Department of the Engineer-in-chief for Railways, is the engineer of the undertaking.

Since the Dutch-Rhenish railways were transferred to the State on October 15th, 1890, the lines worked by the Maatschappij tot Exploitatie van Staatspoorwegen are the following:—Rotterdam-Dordrecht-Esschen, Amsterdam-Utrecht-'s Bosch-Breda-Esschen, Amsterdam-Gouda-Rotterdam, Den Haag-Voorburg (locaald.), Rotterdam-den Haag, Amsterdam-Breukelen-Utrecht, Amsterdam-Utrecht-Arnhem-Emmerik, Utrecht-Gouda-Rotterdam, Utrecht-Leiden, Rotterdam-Venlo, Moerdijk-L.-Zwaluwe-'s Bosch, Utrecht-'s Bosch-Boxtel, Vlissingen-Breda, Nijmegen-Tilburg, Nijmegen-Maastricht, Eindhoven-Luik, Nijmegen-Arnhem (voll. dienst), Arnhem-Zutphen-Deventer-Zwolle, Arnhem-Zutphen-Zwolle-Leeuwarden, Meppel-Groningen, Groningen-Delfzijl, Zutphen-Salzbergen voll. dienst, Zwolle-Gronau, Harlingen-Nieuweschans. This company was founded in 1863 for working the Dutch State Railways, and the head offices and works are at Utrecht. The office of Rijks Commissaris, or Government Commissioner, is at present vacant; but the Assistant-Commissioner is Mijnheer P. J. Breedveld. The general manager is M. J. L. Cluysenaer; the secretary, M. J. N. Nivel. Superintendent of the line, M. E. J. B. H. M. Engeringh; engineer-in-chief for permanent way and works, M. J. Kalff; and chief engineer for rolling stock, Mijnheer J. W. Stous Sloot.

It is stated that there is now every prospect of the scheme for the construction of an electric railway to the summit of Snowdon being carried out in a very short time. There are two companies formed, and, as owner of the land, Mr. Assheton-Smith, will take a leading part in the promotion of the project. The services of Mr. Duncan Fox, the engineer, have been secured, and his plans will probably be formed on the lines of those adopted for similiar railways on the Continent. Unless unforeseen circumstances arise, it is, says the *Liverpool Post*, confidently anticipated that with the advent of next season this railway will be an accomplished fact, thus adding considerably to the importance of Llanberis as one of the starting points for Snowdon. In conjunction with this interesting project the suggestion is pretty generally made that the North Wales Narrow Gauge Railway Company should extend their line from Rhyddu to Beddgelert, so that people making the ascent of Snowdon on the Llanberis side might descend on the Beddgelert side, and so have direct communication with all places on the London and North-Western Railway. A Bill for the extension of this line has already been passed, and it only requires a like enterprise on the part of the promoters to give to this picturesque district a boon which both the inhabitants and visitors have long looked forward to.

## NOTES AND MEMORANDA.

A method of connecting metal to earthenware is given in *The Scientific American* as follows:—The portion of the earthenware with which connection is to be made being unglazed, or the glaze having been removed, it is coated with plumbago, and placed in an electrolytic bath, whereby a firm metallic coating is obtained. The lead pipe is then soldered to this coating by a plumber's "wiped" joint. By this means are avoided the imperfect joints made with india-rubber sleeves, washers or putty.

In order to obtain incandescent lamp filaments which will stand a very high temperature, M. Baum proceeds as follows:—Organic fibres are treated with phosphate ammonia, hydrochlorate of ammonia, calcium chloride and magnesium chloride. At a known temperature, the salts of ammonia are volatilised, and the filament is formed of the precipitated porous phosphates of lime and magnesia. The filaments are afterwards strengthened with a solution of gelatine and dilute carbonate of lime.

Mr. Mondit, of Caen, has published a process for bronzing copper, which is briefly thus:—After the metal has been scoured, it is covered with the following mixture by means of a brush:—Castor oil, twenty parts; alcohol, eighty parts; soft soap, forty parts; water, forty parts. The mixture is left on till the required shade is obtained, then dried with hot sawdust, and coated with a very dilute varnish. The depth of tone can be regulated by the length of time the metal is exposed to the solution.

The new sextuple photographic telescope in the Yale Observatory, used in photographing meteoric displays, has six cameras together covering a field equal to 2400 full moons. Each camera carries a plate covering a space of 10 deg. square in the heavens, and the fields are so arranged as to touch each other at the edges, so that the total field will cover 600 square degrees. It will be used in connection with two single telescopes placed at a distance of two miles from the sextuple instrument, with electrical connections for simultaneous photography.

A recent Austrian patent for insulating material is as follows:—Ozokerite, asphalt, and amber are subjected to distillation in a closed still to a temperature of 400 deg. After the mass has been heated until gases, vapour, or oils cease to escape, it is allowed to cool. In that condition it is of pliable consistency, and may either be used alone or incorporated with other substances for insulating cables, such as resins, fats, or oils, the proportions of these being from 30 to 70 per cent. By this method those substances present in fossil resins which prejudice or deteriorate the insulating properties are removed.

In a paper which he recently read before the Scientific Congress at Paris, M. de Lapparent expressed the opinion that all mountains will vanish off the face of the earth in course of time. He declared that, if the actual natural forces at work upon our globe retain their present intensity, in 4,500,000 years all inequalities of surface will be levelled. He instanced as a striking example the reduction of the Ardennes, which were once a chain of the Alps, but which had already shrunk to their present dimensions at the outset of the Tertiary epoch. The Alps, he said, exemplified the youth, the Pyrenees the maturity, and the mountains of Provence the declining years of mountain ranges, while the central plateau of France was typical of their death and dissolution.

Two methods of covering aluminium with metallic films are given as follows in the *Journal* of the Chemical Society:—"Aluminium becomes covered with a hard film of copper on rubbing it with tin dipped in copper sulphate solution, the deposit increases in thickness if the coated metal is suspended in a dilute copper salt solution. Aluminium is covered with tin by rubbing it with brass moistened with solutions of certain tin salts, such as ammonium stannichloride, $SnCl_4 2NH_4Cl$; in this case, too, the deposit increases in thickness when the metal is suspended in a tin salt solution of suitable concentration. Aluminium which has been coated with copper as above described, when suspended in a solution of a tin salt, receives a coating of tin over the copper."

At the Angleur Company's Steel Works at Sclessin, on the left bank of the Meuse, the *American Manufacturer* says, coke for smelting is made on the ground from the small coal of the neighbouring collieries, partly washed and partly in the rough state, in a battery of 100 Coppee Menier ovens, about 30ft. long, 4½ft. high, and 17in. wide. The use of such very narrow ovens is rendered necessary by the deficient binding properties of the coal, owing to the low proportion of volatile matters present, so that a high heat quickly applied is required to produce a coherent coke. The surplus heat of the ovens is utilised in the firing of seven De Nayer boilers of 200-horse power each, which together with a similar series of Galloway boilers with outside combustion chambers fired by blast furnace gas, supply the whole of the steam for the blast furnace and Bessemer blowing engines.

A method of preparing hematite artificially is the introduction of Mr. H. Arctowski, who proceeds as follows:—"A current of ammonium chloride vapour when passed over oxide of iron, heated to dull redness, converts the oxide into crystalline hematite. Ferric oxide heated at 350 deg. absorbs ammonium chloride vapour, and melts to a black mass, from which ferric chloride soon distils. The residue absorbs water from the air, and is a mixture of ammonium chloride and ferric chloride. At 600 deg. the ferric oxide is partially converted into small crystals, and then mechanically absorbs ammonium chloride without melting. At 700 deg. the ferric oxide becomes crystalline. The crystals are of the same form as the hematite crystals from Elba. The gases of fumaroles contain ammonium chloride, and the fissures in the vicinity are generally covered with crystals of hematite."

In an address delivered before the American Association for the Advancement of Science, at its Brooklyn meeting, August 16th, the retiring president, Mr. William Harkness, said:—"Those who are not familiar with practical astronomy may wonder why the solar parallax can be got from Mars and Venus, and not from Mercury or the sun itself. The explanation depends on two facts—firstly, the nearest approach of these bodies to the earth is for Mars 33,874,000 miles, for Venus 23,654,000 miles, for Mercury 47,935,000 miles, and for the sun 91,239,000 miles. Consequently for us, Mars and Venus have very much larger parallaxes than Mercury or the sun, and of course the larger the parallax the easier it is to measure. Secondly, even the largest of these parallaxes must be determined within far less than one-tenth of a second of the truth; and while that degree of accuracy is possible in measuring short arcs, it is quite unattainable in long ones. Hence one of the most essential conditions for the successful measurement of parallaxes is that we shall be able to compare the place of the near body with that of a more distant one situated in the same region of the sky. In the case of Mars, that can always be done by making use of a neighbouring star, but when Venus is near the earth she is also so close to the sun that stars are not available, and consequently her parallax can be satisfactorily measured only when her position can be accurately referred to that of the sun; or, in other words, only during her transits across the sun's disc. But even when the two bodies to be compared are sufficiently near each other, we are still embarrassed by the fact that it is more difficult to measure the distance between the limb of a planet and a star or the limb of the sun, than it is to measure the distance between two stars; and since the discovery of so many asteroids, that circumstance has led to their use for determinations of the solar parallax. Some of these bodies approach within 75,230,000 miles of the earth's orbit, and as they look precisely like stars, the increased accuracy of pointing on them fully makes up for their greater distance, as compared with Mars or Venus."

## MISCELLANEA.

E question of the formation of a Chemical Department for India will be submitted to the Secretary of State during the current season.

The torpedo-boat destroyer Rocket, the first of three building for her Majesty's Government by Messrs. J. and G. Thomson, of Clydebank, attained on her preliminary trial, on Tuesday last at Skelmorlie, on the Clyde, a mean speed of 28¼ knots, equal to 32 53 statute miles.

The sixteenth annual Brewers' Exhibition and Market opens in the Islington Agricultural Hall on the 22nd inst. The number of exhibits will be exceptionally large, and will comprise the many kinds of machinery and various appliances for facilitating the carrying on of the trade.

Three Sheffield firms, Charles Cammell and Co., John Brown and Co., and Vickers, Sons, and Co., have received orders for the citadel and barbette armour of the first-class battleships Mars, Jupiter, Hannibal, Victorious, and Prince George. The total weight is 12,500 tons. The plates are to be Harveyed.

On Tuesday last Messrs. John I. Thornycroft and Co. launched the new torpedo-boat destroyer Ardent. She is 200ft. long, 19ft. beam, and will be fitted with engines and boilers of the same type as those supplied by them to her Majesty's ship Daring—which we recently illustrated—guaranteed to give her a speed of 27 knots.

In accordance with the wishes of the late Mr. Henry Faija, Mr. D. B. Butler will carry on the practice in his name for the benefit of the family. Mr. Butler was formerly associated with Mr. Faija for ten years as his chief assistant, but had subsequently held responsible positions in two cement works. At Mr. Faija's invitation and for the last three months of his life Mr. Butler had the entire charge and conduct of Mr. Faija's office and business.

Upon the completion of the defence works for the protection of the river Medway at Sheerness the Admiralty propose to also construct booms for the protection of Portsmouth and Devonport Harbours. The gunboats Mistletoe and Firm, which are being utilised in connection with the boom at Sheerness, have been completed for service, and arrangements are to be made for testing a section of the boom as early as possible, the boom being constructed of wire hawsers and baulks of timber.

The upper reservoir of the Swansea Waterworks was formally opened on the 12th inst. This undertaking was commenced in May, 1886, and completed by December, 1891, since which time the opening has been delayed by litigation. The water area of the reservoir is thirty-five acres, the contents being 305,464,770 gallons, and the greatest depth 68ft. This important work has been carried out under the superintendence of the borough engineer, Mr. Wyrill, at a cost of £101,185.

In connection with the new American liners St. Louis and St. Paul, now building by Cramp Brothers, it was originally intended that the boilers of these vessels should be fitted with Purves' furnaces. American sentiment, however, with regard to the ships being entirely built at home asserted itself, with the result that corrugated furnaces have been supplied by American makers at what must have been a losing price. On the other hand, the St. Paul is to have Serve tubes, which appears to us a little inconsistent.

An application has been recently made to the Local Government Board for borrowing powers for some additions to the Ossett Sewage Works. Their inspector, however, reported that the sewage was being merely treated with lime, the land filtration having been discontinued. Consequently, the sanction to the loan was withheld, and the Ossett Town Council were requested to submit comprehensive proposals for the improvement of the works. The sewage is one of the very worst in the kingdom, being largely woollen trade refuse of a most changeable and refractory kind. The Council have engaged the services of Mr. M. Paterson, of Bradford, the engineer who nearly twenty years ago carried out the sewage works, with the main drainage of the district.

A meeting of the Consultative Council of the Building Trades Exhibition, 1895, was held on the 12th inst., Mr. Banister Fletcher, F.R.I.B.A., in the chair. The honorary secretary, Mr. T. Freeman, F.G S, read the report on last year's exhibition, which was satisfactory, and the council agreed that the forthcoming exhibition should be continued on the same lines. It was stated during the course of the meeting that architects were perfectly satisfied with the display at last year's exhibition, and the exhibitors were unanimously of opinion that their exhibits had proved eminently advantageous from a business point of view. The council for the ensuing year had been considerably added to, and it was confidently anticipated that next year would prove one of the finest exhibitions of the kind that had ever been held.

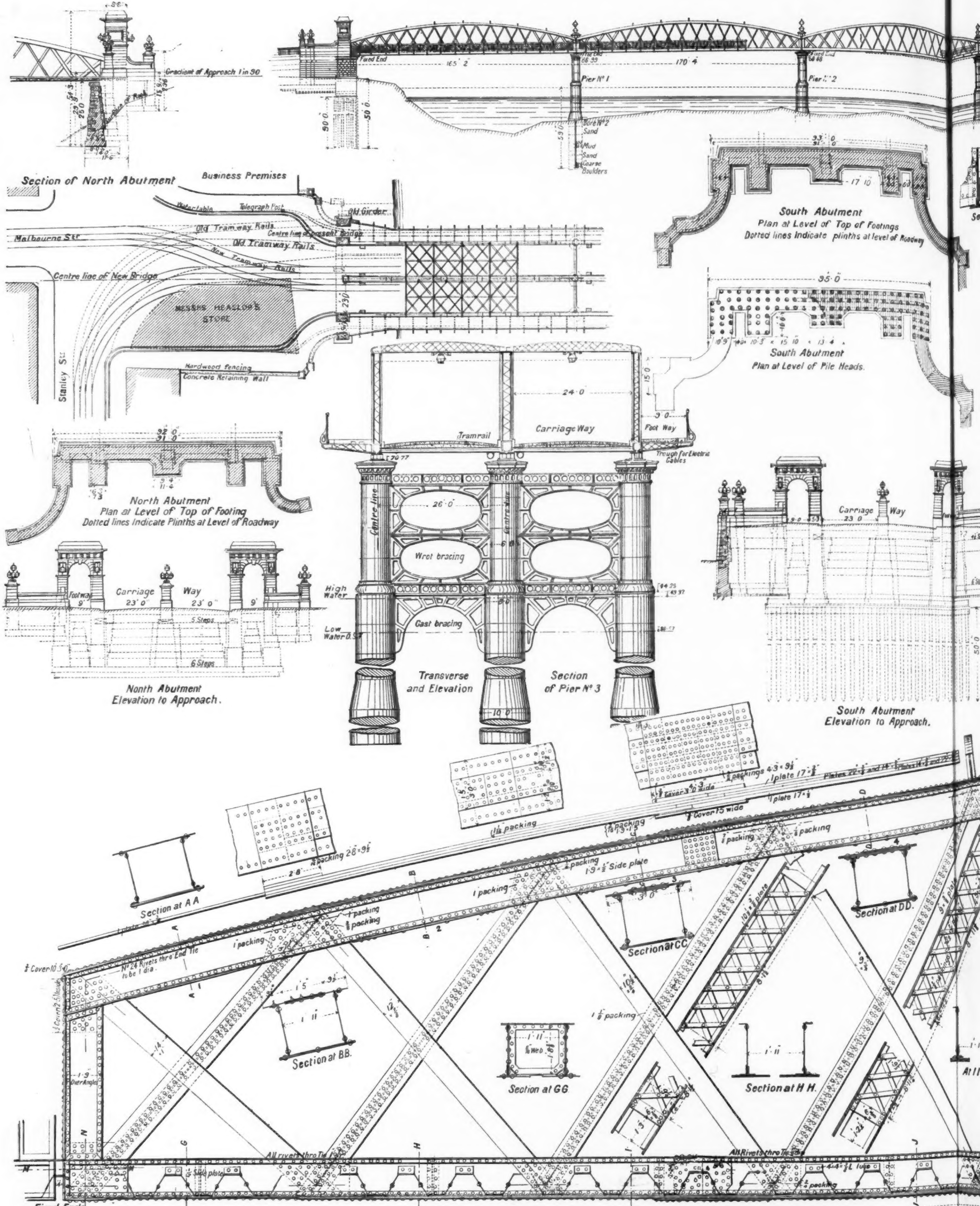
A useful table, showing graphically the dimensions, equivalent conductors, resistances, and weights of pure copper wires and cables, and the fall of potential and approximate rise of temperature of any wire, has been published by Messrs. W. T. Glover and Company, as designed by Mr. A. H. Howard. Messrs. Glover and Company, *i.e*, Mr. Henry Edmunds, accompany the table, which is large enough for easy reading, with the necessary directions for reading the dimensions or quantities obtainable in figures from the graphic diagram. Every direction seems to be perfectly clear, with perhaps the exception of that for the curves which represent rise of temperature of insulated wires in wooden casings. The table is one which will save a great deal of calculation and time, and affords an excellent check on calculated values.

M. Hospitalier, a well-known French electrician and writer, has drawn attention to the errors of language in French public documents relating to scientific matters. Thus, says the *Globe*, in Acts relating to the sale of land, the superficies is given in metres instead of square metres; the Bureau des Longitudes expresses the value of acceleration due to gravity in a falling body in metres instead of "metres per second." The word force is used for "work," and work for "power." All nations exhibit the same confusion in the use of scientific terms, which are often imperfectly understood, even by so-called experts, and all nations adopt foreign expressions instead of inventing their own. It is nevertheless true that in scientific language there should be no synonyms; one word should be dedicated to one thing, and have a perfectly definite meaning. It is poverty rather than wealth of words that science demands. Where compound words are required, they should be formed according to a strict rule, and always used in their entirety.

After many breakdowns, H.M. cruiser Fox has at last made a successful trip under forced draught She indicated 9063-horse power, or 63 beyond the specification, which gave a mean log speed of 20 knots. During the run a trial was made of Messrs. Cutmore's system for effecting audible voice-pipe communication between the bridge and the engine-room. The orders, notwithstanding the noise of the machinery, were distinctly heard. In this invention the sound is magnified first by means of a cone fixed in the mouthpiece, and secondly by silver tongues placed in every angle and bend of the voice pipe. Various subsidiary inventions have been utilised, such as by means of a commutator, which works on the pistol-revolver principle, converging orders from twenty different points of the ship to the engine-room; but the primary advantage of the apparatus is that the sound of the human voice can be transmitted with certainty. It is probable that this system will now be generally adopted in H M. ships.

# THE NEW VICTORIA BRIDG OV

MR. A. R. BRADY, ASS M. IN


8.6
Gradient of Approach 1 in 30
Fixed End
165' 2"
170' 4"
Pier No 1
Pier No 2
Fixed End
50' 0"
Bore No 2
Sand
Mud
Sand
Coarse Boulders
Business Premises
Telegraph Post
Old Girder
Centre line of present Bridge
Old Tramway Rails
New Tramway Rails
Melbourne St
Centre line of New Bridge
MESSRS HEASLOP'S STORE
Hardwood fencing
Concrete Retaining Wall
Stanley St
32' 0"
31' 0"
17' 10"
35' 0"
15' 0"
24' 0"
Tramrail
Carriage Way
Foot Way
Trough for Electric Cables
Centre line
26' 0"
Wrot bracing
High Water
Low Water
Cast bracing
10' 0"
Footway
Carriage Way
23' 0"
9'
5 Steps
6 Steps
Carriage Way
23' 0"
Plates
Cover 15 wide
packing
Side plate
Cover 10. 3/4
No 24 Rivets thro End Tie to be 1 dia.
All rivets thro Tie
All Rivets thro Tie
Fixed Ends
Side plate
2 Plates 16 x 3/8
Cover strips
Ends of Lsts take Rivets of top Boom
Rivets at Intersection

Section of North Abutment

North Abutment
Plan at Level of Top of Footing
Dotted lines Indicate Plinths at Level of Roadway

North Abutment
Elevation to Approach.

Transverse and Elevation

Section of Pier No 3

South Abutment
Plan at Level of Top of Footings
Dotted lines Indicate plinths at level of Roadway

South Abutment
Plan at Level of Pile Heads.

South Abutment
Elevation to Approach.

Section at A A

Section at BB.

Section at CC

Section at DD.

Section at GG

Section at H H.

Diagram of Bottom flange plates

"THE ENGINEER" Half Plan of overhead bracing for one Span.

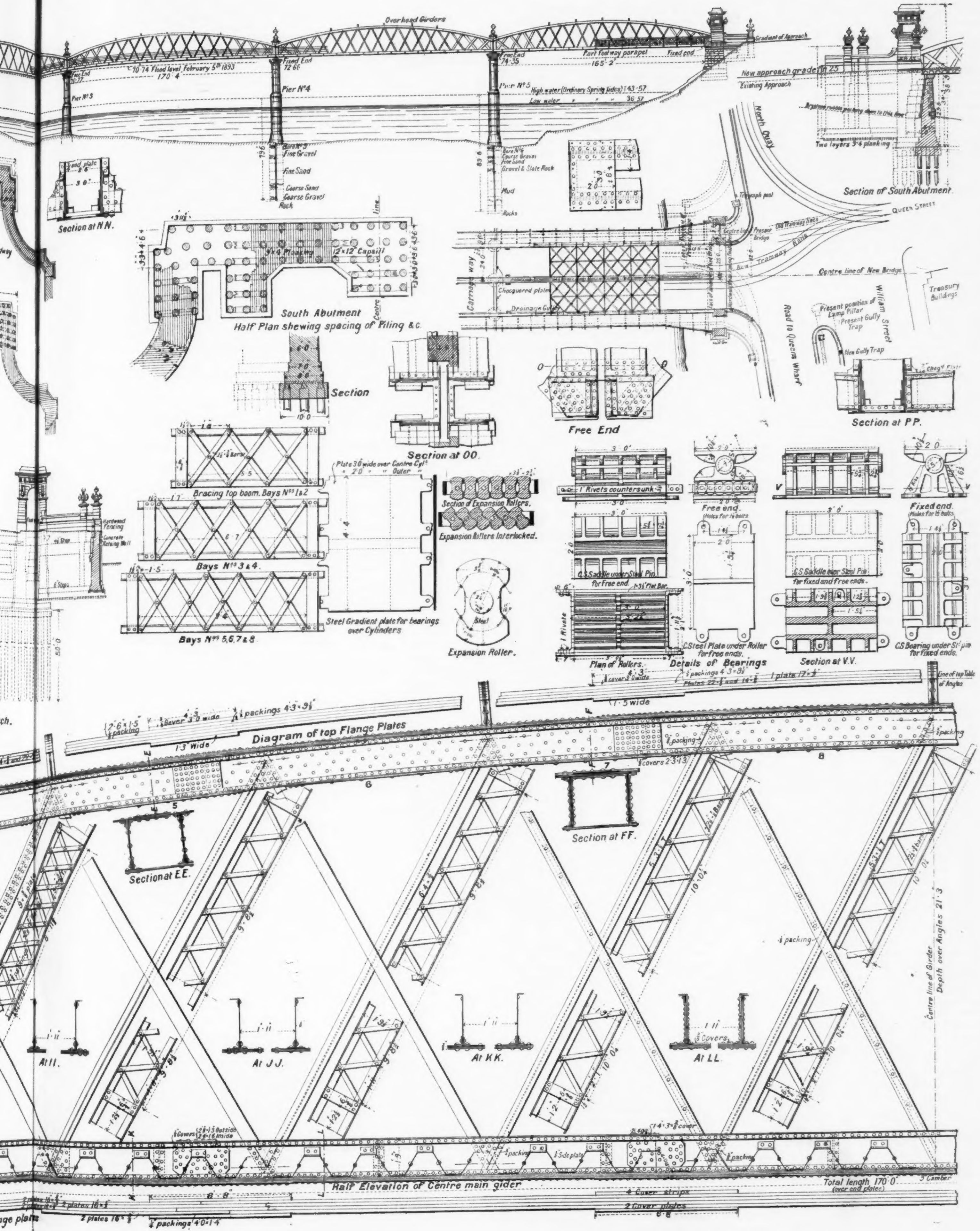
Detail at R

Detail at Q

Detail at U.

# DGE OVER THE BRISBANE RIVER

DY, ASSO M. INST. C.E., ENGINEER


Overhead Girders
70' 14 Flood level February 5th 1893
170' 4
Pier No 3
Fixed End
Pier No 4
Pier No 5
Free End
High water (Ordinary Spring tides) 143·57
Low water
Part footway parapet
165' 2
Fixed end
Gradient of Approach
New approach grade 1 in 25
Existing Approach
Bore No 3
Fine Gravel
Fine Sand
Coarse Sand
Coarse Gravel
Rock
Bore No 4
Course Gravel
Fine Sand
Gravel & Slate Rock
Mud
Rocks
Two layers 5x4 planking
Section of South Abutment
North Quay
Queen Street
Telegraph post
Old Tramway lines
New Tramway Rails
Centre line of Present Bridge
Centre line of New Bridge
Treasury Buildings
Carriage way
Chequered plates
Drainage Gully
Road to Queens Wharf
William Street
Present position of Lamp Pillar
Present Gully Trap
New Gully Trap
Section at NN.
9x4 Planking
12x12 Capsill
South Abutment
Half Plan shewing spacing of Piling &c.
Section
Section at OO.
Free End
Section at PP.
Bracing top boom. Bays Nos 1 & 2
Bays Nos 3 & 4.
Bays Nos 5,6,7 & 8.
Plate 3' 0 wide over Centre Cyls
2' 0 " " Outer "
Steel Gradient plate for bearings over Cylinders
Section of Expansion Rollers.
Expansion Rollers Interlocked.
Expansion Roller.
Hardwood Fencing
Concrete Retaining Wall
6 Steps
1 Rivets countersunk
C.S. Saddle under Steel Pin for free end.
Flat Bar
Plan of Rollers.
Free end. (Holes for 1½ bolts)
C.Steel Plate under Roller for free ends.
Details of Bearings
C.S. Saddle over Steel Pin for fixed and free ends.
Section at V.V.
Fixed end. (Holes for 1½ bolts)
C.S. Bearing under St. pin for fixed ends.
Diagram of top Flange Plates
1' 3 wide
Cover 3' 0 wide
packings
1' 5 wide
1 plate 17' 3
Line of top Table of Angles
Section at E.E.
Section at FF.
At II.
At J J.
At K K.
At L L.
Covers
packing
Centre line of Girder
Depth over Angles 21' 3
Half Elevation of Centre main gider
Total length 170' 0 (over end plates)
5 Camber
2 plates 16' 8
4 Cover strips
2 Cover plates
packings 4' 0x1' 4
ge plates
Detail at S.
Detail at W.
Packing
Detail at T.
75' 0 Radius
Overhead Girder.
SWAIN ENG.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—BOYVEAU AND CHEVILLET, *Rue de la Banque.*
BERLIN.—ASHER AND CO., 5, *Unter den Linden.*
VIENNA.—GEROLD AND CO., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—INTERNATIONAL NEWS COMPANY, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement a Two-page Engraving of the Victoria Bridge over Brisbane River. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it.*

## CONTENTS.

THE ENGINEER, October 19th, 1894. PAGE
THE ENLARGEMENT OF LIVERPOOL-STREET STATION, GREAT EASTERN RAILWAY. No. V. (Illustrated.) .. .. .. .. .. .. .. 335
THE VICTORIA BRIDGE OVER THE BRISBANE RIVER. (Illustrated.) .. 337
COFFEE AND COCOA DRYING MACHINERY. (Illustrated.) .. .. .. 338
THE MANCHESTER THIRLMERE WATERWORKS. No. 1. (Illustrated.).. 340
THE PARIS METROPOLITAN RAILWAY .. .. .. .. .. .. .. .. .. 341
BICYCLE MECHANICAL ENGINEERING. (Illustrated.) .. .. . 341
GREAT NORTHERN RAILWAY—WORKS IN CONNECTION WITH THE WIDENING OF THE LINE AT KING'S CROSS. (Illustrated.) .. .. .. 341
RAILWAY MATTERS—NOTES AND MEMORANDA—MISCELLANEA .. .. 344
LEADING ARTICLES—Railways and the Board of Trade—The Inspection of Railway Bridges in India .. .. .. .. .. .. .. .. .. 345
Coal Mining Machinery—The Water Scheme for Edinburgh—Mild Steel for Structural Engineering—The Mirabeau Bridge .. .. 346
RAILROADING IN AMERICAN. (Illustrated.) .. .. .. .. .. .. 347
LETTERS TO THE EDITOR—The Port of Manchester—The Theory of the Steam Engine—Governing Electric Light Engines—Oil-fired Steamers for Harbour Use .. .. .. .. .. .. .. .. 349
Labour and Luxuries—Aluminium Torpedo Boats—Modern Locomotives in the Recent Collision—French Cruisers .. .. .. 350
THE IPSWICH SEWERS AND ELECTROLYTIC SANITATION .. .. .. 350
LETTERS FROM THE PROVINCES—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. .. .. .. .. .. .. .. .. .. .. .. 350
The Sheffield District—The North of England .. .. .. .. .. 351
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. 352
AMERICAN NOTES .. .. .. .. .. .. .. .. .. .. .. .. .. 353
LAUNCHES AND TRIAL TRIPS .. .. .. .. .. .. .. .. .. .. 353
THE PATENT JOURNAL .. .. .. .. .. .. .. .. .. .. .. 353
SELECTED AMERICAN PATENTS .. .. .. .. .. .. .. .. .. 354
TWO-PAGE SUPPLEMENT—THE NEW VICTORIA BRIDGE OVER THE BRISBANE RIVER..

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. W. H. (Brixton).—*(1) The engines are identical save in the cylinders. (2) Yes.*

J. D. AND CO. (Traction Engines).—*The author of the letter to which you refer gave his name and address—see page 275.*

T. E.—*You do not require any piping. If you turn down the end of your exhaust pipe over the water in the tank so that the exhaust steam blows down on it, you can heat the water 180 deg. to 200 deg.*

B. (Blomfield-street).—*Have you considered the cost? Have you considered what would happen to the plates of a boiler into which you pumped a strong saline solution as feed? The idea is wholly unpractical from first to last.*

ENTROPY.—*Many persons have wasted money in forcing air into boilers. There is no economical advantage to be obtained even in theory, and practice has in this case always proved the truth of theory. There are references to the subject in back numbers of* THE ENGINEER, *which are out of print.*

### CORROSION OF BOILERS.

(*To the Editor of The Engineer.*)

SIR,—Can any correspondent refer me to any case of boiler corrosion due to sulphate of soda in water taken from a river?

London, October 10th. HIGH-PRESSURE STEAM.

### FISH HOOK MAKING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged to any reader who will tell me where I can obtain the necessary machinery for making fish hooks. S. F. O.

October 17th.

### CHROME ORE.

(*To the Editor of The Engineer.*)

SIR,—Would any correspondent kindly answer the following questions?—(1) Who are the best firms who purchase chrome ore? (2) What is the present current price landed c.i.f for chrome ore showing from 65 per cent. to 78½ per cent. of chromite? (3) Is there a good demand? (4) What ores are the chief constituents in (*a*) yellow metal, (*b*) anti-friction metal? W. C. W.

Wellington, New Zealand, August 27th.

## SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)*.. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*A complete set of* THE ENGINEER *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* THE ENGINEER *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| THIN PAPER COPIES— | |
| *Half-yearly* .. .. .. .. .. .. .. .. | £0 18s. 0d. |
| *Yearly* .. .. .. .. .. .. .. .. .. | £1 16s. 0d. |
| THICK PAPER COPIES— | |
| *Half-yearly* .. .. .. .. .. .. .. .. | £1 0s. 3d. |
| *Yearly* .. .. .. .. .. .. .. .. .. | £2 0s. 6d. |

READING CASES.—*The Publisher has in stock reading cases which will hold thirteen copies of* THE ENGINEER. *Price 2s. 6d. each.*

## ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* THE ENGINEER.

### MEETINGS NEXT WEEK.

INSTITUTION OF MARINE ENGINEERS.—Wednesday, October 24th. Formal opening of the extension of premises by the President. Members will assemble at 7.30 p.m. in the Lower Room, where the inaugural address will be delivered.

INSTITUTION OF MECHANICAL ENGINEERS.—Wednesday and Thursday, October 24th and 25th, at 25, Great George-street, Westminster, at 7.30 p.m. Papers: "The Manufacture of Standard Screws for Machine-made Watches," by Mr. Charles J. Hewitt, of Prescot, on Wednesday; "Drilling Machines for Cylindrical Boiler Shells," by Mr. Samuel Dixon, of Manchester, on Thursday.

# THE ENGINEER.

*OCTOBER* 19, 1894.

### RAILWAYS AND THE BOARD OF TRADE.

RIGHTLY or wrongly, many persons traders and others, hold that the action of the Board of Trade in all that relates to railways, their construction and working, is prejudicial to commerce, oppressive and unsatisfactory. Such charges are made by persons of sufficient influence to give them importance. The railway companies and their officials hold their peace and refuse to express an opinion. It is worth while to consider some of the facts which are more or less beyond dispute, and so arrive at the reasonableness or emptiness of the charges in question. These charges imply that the Board of Trade or its inspectors insist on an unnecessary and costly method of working branch and narrow gauge lines; that hard-and-fast rules are applied without intelligence or discrimination; and that there is no sympathy between the Board on the one hand, and the railway companies and trading community on the other. There are besides questions concerning bye-laws, terminal charges, rates, and other money matters, with which it would be to some extent beyond our province to deal. We propose to confine ourselves to the consideration of the action of the Board of Trade in what may be termed matters mechanical, and we may say at the outset that while we are very far from echoing the complaints so freely made, not unfrequently by wholly irresponsible persons, we hold on the other hand, that it is advisable that the position as it stands should be examined and revised.

The action of the Board of Trade is mainly exerted by its inspectors. A line cannot be opened for traffic until it has been passed by one or other of these gentlemen; and it seems to us beyond doubt that they demand for a small branch line the same general excellence that is needed on a main road. Dozens of examples of this might be cited—as, for instance, a case in which there was only one engine and train used on a branch line. This had been worked for years, without accident and with perfect success, with three trains each way per day, until one day an inspector insisted that the little terminal station should be provided with an elaborate system of signals at a very considerable expense. When the signals were completed and had been passed, they were fixed at "danger," and no one ever troubled his head about them subsequently. Roads on which the speed is never intended to exceed thirty miles an hour have to be sleepered and ballasted and made with all the heavy expenditure needed on a main line over which express trains thunder at sixty miles an hour. The result is that the cost of a railway becomes prohibitive. In other countries—notably in the United States—cheap lines are made which serve an excellent purpose; but there is no Board of Trade there to interfere. It may be that the officers of the Board have no choice. On the other hand, it is possible that they exert their authority just as they please, without the smallest consideration for the wants of the country. They virtually tell farmers and traders, "You shall have a first-class line or no line at all." Whether a line is to cost £5000 a mile or £15,000 is all one to them. They care nothing for the outlay. All that they demand is the nearest approach to perfection. With nothing less will they be satisfied. In its way no doubt this is all very well, but it is carrying the demand for excellence so far that it may be ruinous. It is as though Government insisted that we should all use Turkey carpets or go without carpets altogether. After everything has been said that need be said about the rules and the Acts of Parliament under which the Board of Trade discharges its functions, the whole ground is far from having been covered. Beyond question a great deal of power rests in the hands of the inspectors. To all intents and purposes they are all-powerful. No railway company thinks of appealing against the decision of any one of these gentlemen—possibly because it is so difficult to know to whom the appeal can be made. Ultimately we suppose it could be addressed to Parliament, which is tantamount to saying that it cannot be made at all. Now it so happens that for some reason not very easily comprehended all the inspectors are Royal Engineers. They rank as majors, colonels, or generals. In a word, they are military men with a military training, and not possessed of any special knowledge of railways or railway working other than that which they pick up in the course of the discharge of their functions. It goes without saying that they are one and all highly honourable men. What they think, and the general nature of their methods of reasoning about railway matters and railway men, can easily be gathered from the published reports of inquiries into railway accidents. Reading them as they come out for a series of years teaches the reader a good deal about those who wrote them. We learn, for example, that whenever a railway accident occurs, some one must be in fault. The preconceived idea is that a species of crime has been committed, and the criminal must be sought and found. In some of the reports we find it admitted now and then in a very hesitating fashion, that it is possible a man may make a mistake without being guilty of aggravated manslaughter; but such a concession to public opinion is rare. Again, it will be found that one inspector always takes it for granted when a collision occurs that an engine driver has been in fault; another throws the blame on a signalman. We have, indeed, before reading a report only to look at the signature to be able to say what the drift of the inquiry will be, and what the verdict. When it is obviously impossible to say that either a driver or a signalman is in fault, then the railway company must be blamed, and the blame is not infrequently absurd. Not long since a collision occurred of no great importance. It arose from a number of small causes all contributing to the same end. The inspector was hard up to find anyone in particular to blame, so he laid the fault on a lofty distant signal, which had been in work for more than twenty years, and "advised" its instant removal to another place. The fact that the existing position had been sanctioned by the Board of Trade, and that no complaint had been made for twenty years, went for nothing. Recently some of the inspectors found in long hours an excuse for everything. This long hour idea is worked in a most unintelligent way. An express driver takes his engine 120 miles down the country in the morning. The run accomplished, he has little or no further work to do until the evening, when he takes an up train to town with the same engine. From the time when he came on duty until he signs off is, say, ten hours, his actual working time is not five hours. If an accident occurs towards the end of the day we are told directly, or by implication, that it was brought about by the fatigue of the overworked driver. As regards the question of continuous brakes nothing can be more unsatisfactory than the attitude assumed by the Board of Trade. The continuous brake is evidently still regarded, after twenty years of service, as something dangerous and untrustworthy, and an absurd regulation is in force that no driver shall ever use the continuous brake on entering a terminal station. At first sight it seems that the Board of Trade inspectors believe that a hand brake on a tender, and two or three others in guards' vans, can do that which the automatic brake applied throughout a train cannot do. This, however, is not really the belief of the inspectors. What they mean to say is that trains should not be allowed to enter terminal stations at high speed, but for some inscrutable reason they prefer to use the elliptical method of phrasing, and say that only the hand brake shall be used to stop a train in a terminal station.

The railway companies assert, and not without reason we think, that the action of the Board of Trade is often vexatious, and that it entails a great and useless outlay. We have no reason to doubt that the accusation is largely well founded. We do not see how it can be otherwise. Officers in the Royal Engineers however considerable their professional attainments and keen their sense of duty, can scarcely be in touch with either traders' or railway companies. They may, and no doubt do, insist on taking care of the public to an extent which is not wanted or warranted by the facts. They are apparently impressed with the notion that a railway company is a more or less dangerous and wicked institution, which, unless carefully watched, will destroy immense quantities of it own property by gross or even criminal carelessness. They hold that signalmen are as a class so vicious that unless watched with precaution they will rather wreck a train than lose their supper. Engine drivers are so depraved that they think nothing of running past signals, even though they thereby incur the imminent risk of a dreadful death. In a word, the theory of the railway department of the Board seems to be on all fours with that of the marine department, which holds that the shipowner can do no good thing. We in no way blame the Royal Engineer officers who now look after our railways. They represent a system, and the system is bad, but they are not in fault. They act conscientiously according to their knowledge and training. That their influence is repeatedly exerted for good is quite beyond question, but we hold that the time has arrived for inquiry into the relations of the railway companies and the Board of Trade. There is a clamour for greater facilities of transport, and it is asserted that the Board of Trade stops the way. The truth or falsehood of the statement ought to be made plain by inquiry and investigation. Select committees are the rule. Let us have one to inquire into the relations of the railways and the Board of Trade. For ourselves, we hold that a large infusion of the civilian element would prove of great advantage. In the natural course of events, most of the officers now acting as inspectors will have to retire within the next few years, full of years and of honour. They should be replaced by those possessing experience in railway working, and able to discriminate between what is necessary for the safety of the public and that grandmotherly carefulness which insists, as we have said, that it is better to have no railways whatever than incur such risks as no other nation on earth hesitates to face.

### THE INSPECTION OF RAILWAY BRIDGES IN INDIA.

LAST year the Government of India issued rules as to the strength and loading of iron and steel bridges, for the guidance of officers entrusted with the duty of inspecting new railways. These rules were adopted after prolonged consideration, and were submitted for criticism to all the principal railway engineers in India as well as to the Secretary of State's advisers at home. They deserve the attention of English engineers both because Indian bridgework will have to be built under these rules, and also because some move in the same direction will probably be made on the part of our Government sooner or later. The present Board of Trade rules are so antiquated as to be practically useless. The new Indian rules are as follows:—(1) For any member of a railway bridge of wrought iron or steel, the total working load is to be taken as the greatest moving load, multiplied by a coefficient and added to the actual fixed load. (2) The coefficient to be used for this purpose is 2·0 in all cases, except for the upper and lower booms of triangulated girders, for which a coefficient of 1·5 may be used. (3) The stress per square inch, either in tension or compression, due to the total working load thus calculated, is not to exceed the following:—Wrought iron, 7 tons; steel, 9 tons. (4) The working stress per square inch given above, whether for tension or compression, is to be taken on the net available area at the weakest part of the member of the structure to which it is applied, after deducting all holes for rivets, pins, bolts, &c. (5) For members in compression, the working stress given above is subject to such reduction as may be necessary according to column formula. (6) For the purposes of this rule, "fixed load" is to be taken to mean the weight of the structure itself, with roadway, flooring, ballast, permanent way, &c., complete. (See also "wind-pressure" below.) "Moving load" to be taken as follows:—(*a*) A train load for each line of rails calculated as specified under "train load" below. (*b*) If there be a road or footway in addition to, and distinct from, the railway, an additional moving load of four tons per 100 sq. ft. of such road or footway. For the purpose of calculating the train load to be allowed for on each line of rails, the "type train" is to consist of two engines with a train of loaded wagons taken at a uniform weight per foot run on the 5ft. 6in. gauge, 1·2 tons; on the metre gauge, 0·8 tons. The engines are to be taken as running either in the ordinary way or coupled head to head, and occupying any position in the train. To facilitate the determination of the stresses which may be produced by the "type train," a diagram of a "type engine" is given in an appendix. It is to be understood that this diagram does not represent any actual engine, but an imaginary engine so designed as to produce on a bridge the most severe effect practicable under the specification. The amount of wind pressure on a railway bridge is to be calculated on the assumption that the maximum normal pressure may be one and a-half tons per 100 square feet of surface exposed, the surface exposed to be reckoned as follows:—(*a*) A train surface calculated on a height of 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge, multiplied by the total length of the girder. (*b*) The actual surface—as seen in elevation—of that portion of one girder which may be below rail level, or at a height above rail level of more than 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge. Also (*c*) In the case of triangulated girders, the actual vertical surface—as seen in elevation—of that portion of the leeward girder which may be below rail level, or at a height above rail level of more than 13ft. 6in. on the 5ft. 6in. gauge, or 11ft. on the metre gauge. The total wind pressure thus calculated is to be provided for by a proper system of wind-bracing or floor-plating, and its effect taken into account as forming a part of the stress on the chords of the main girders. Proper arrangements must also be made at the girder ends to secure sufficient stiffness to resist racking action, where diagonal stiffeners are not used. Wind pressure is to be treated as "fixed load," and its effects on the different members of the structure is to be allowed for as provided in the rule for "Maximum Permissible Stress."

In the appendices following the rules, particulars are given of the engine loads allowed, and a "type" tank-engine is represented, which is to be used for the purpose of calculation. For the 5ft. 6in. gauge this engine has eight coupled wheels, with 15 tons on each axle; it measures 32ft. over buffers. For the metre gauge the engine has eight coupled wheels with eight tons on each axle, and measures 24ft. over buffers. It would facilitate calculation, without any sacrifice of accuracy, if a uniform load per foot extending over a given distance, corresponding to the length of two engines, had been prescribed instead of definite axle loads. Cross girders would then have required a specification of the load they should be designed for to vary with the spacing. No one can say what the distribution of loads on engine wheels will be twenty years hence, and it is a useless pretence to imagine an exact distribution of the load on axles at definite distances. Assuming, for the moment, that it was the right policy to issue rules laying down hard-and-fast maximum limits of stress under given assumed loads, and that these rules had to be compressed within the compass of so many lines, we are inclined to think that the rules above quoted are about as reasonable and clear as such conditions would allow. This, we take it, is the meaning of the approval expressed by a large majority of the engineers consulted on the subject. We may observe, in passing, however, that this approval should not be made too much of. A set of draft rules were drawn up by the Government, printed, and sent round for remarks. The criticisms and proposed amendments were not, so far as we know, submitted to the same body of engineers for consideration, but the approval of the rules as originally drafted was inferred from the fact that, taking the rules one by one, each rule was approved by a large majority. It does not follow, however, that some of the amendments would not have been carried if they had been submitted in the same way. The most important questions raised by these rules, to our mind are, firstly, whether it is wise to lay down definite limits of stress and load applicable to all railways independently of the nature of the traffic, the nature of the iron or steel employed, and other circumstances; and secondly, whether, if such rules are necessary, they do not need, for efficiency, to be much more elaborate and particular.

We do not intend here to enter on the very wide question of whether Government inspection of such structures is a desirable thing. For good or evil it exists, and is likely to continue. We should like to see it made more of a real safeguard to the public, and less of a harassing and expensive burden to railways of small traffic. These two objects are not, we believe, incompatible, but such rules as these now in force in India serve neither one purpose nor the other. A bridge might fully comply with these rules, and yet be dangerously weak in a dozen different ways. On the other hand, a bridge might be absolutely safe for the traffic it was built to carry, and yet require a large additional expenditure to bring it up to the standard of the rules. India is the last country in the world where extravagance in railway expenditure is justifiable, and a policy which compels every line to be built and equipped on a standard only really required by the most important roads involves extravagance of the most serious kind. We quite admit, however, that inspecting officers are not to be left to their own devices in such a matter as bridge stresses. The rational way, it seems to us, of securing the safety of the public would be to establish some such requirements as the following:—(1) Before a railway is opened for traffic, copies of the working drawings of each bridge, with complete calculations of stress, copies of tests of materials, and all other necessary data, shall be supplied to the Government, and certified as correct by the chief engineer of the railway, and shall be verified by the inspecting officer, who shall also make such tests as may be desirable. (2) Before the work on any bridge is commenced, the drawings may be submitted for approval, so that it will only remain, when the work is finished, to verify that it has been properly carried out in accordance with the approved design. (3) The permissible loads and speeds on any new railway will be determined before sanction is given to the line; and for the guidance of the engineer in preparing bridge designs the Government will, if requested, decide beforehand what stress, as a fraction of the breaking strength of the material, will be sanctioned for the various parts of the bridges on the line, under the loads agreed on at the maximum permitted speed.

For the purpose of carrying out these regulations the Government should have a competent officer specially deputed to the task of making a really effective and independent examination of the designs submitted. It would not be his business to criticise or amend in any way, unless where there was actual demonstrable weakness. His task would be immensely simplified by being able to call on the railway engineer to provide him with stress diagrams and calculations, since it is far easier to check the correctness of such calculations than to make them afresh. If, however, each of the many railway inspectors in India is to calculate the strength of each bridge on the line he inspects and certify to its strength, and if rules for stress and loads are to be given him, such rules, in our opinion, should go much more into detail than do these Indian rules. The author of them appears to make the common mistake of confounding brevity with simplicity. Suppose, for instance, some separate rules had been given for plate girders, would the rules then have been less simple? Not in the least. The plate-girder rules would simply be non-existent for the purpose of inspecting triangulated girders. If the inspector had to carry these rules in his head we could understand the sacrifice of efficiency to brevity, but we understand it on no other ground. These rules govern the design of all railway bridges in India—where bridgework forms a larger item in railway construction than it does in most countries—and one would have thought that the object of securing the most efficient bridges at the lowest cost was far more important than that of cutting down the rules to as few words as possible. To pick out one or two of the most conspicuous disadvantages of this process of compression, we observe, first, that nothing is said about the strength of fastenings. The inspector, we presume, will have to examine the bridge as regards the proper design of joints if he examines the design at all. Why is it more necessary to give him a rule for the stress on bars than to give him one for rivets? Then Rule 2 seems to us much too rough-and-ready. It draws an unjustifiable distinction between, say, the end diagonal of a triangulated girder and the adjoining length of boom. The cross-girders and the end diagonals of the main girders are assumed by it to be in the same condition as regards the dynamic effect of moving load, which is far from being the case. The materials of which the bridge is built are not alluded to at all except as "wrought iron" and "steel." To be effective, such rules ought to be a complete specification such as is issued by an American railway company in inviting designs and tenders for a bridge. Such detailed rules would assist and not hamper the inspector. The present rules may probably be regarded as a step in that direction.

◆

### COAL MINING MACHINES.

In the reports of the State Inspectors of Mines for Illinois there are some facts given that should be of interest to this country, and that carry further forward the figures we gave a year ago in The Engineer. They refer to the use of mining machines in the coal mines of the State named. Last year it appears that the number of the mining machines in use in the coal mines of Illinois had increased to 310, or an increase of 69 in the two last years. There are seven kinds of machines in use, the Harrison type being by far the most numerous, and next the Ingersoll-Sergeant seems to be numerically preferred. These machines are in use in forty-one mines, so that there are on the average more than thirteen machines in each of the mines. The yield of coal was just about one-fourth of the total produced in the State—over 4,595,000 tons in the year, so that there was an output that is now large enough to give at least some idea of the relative cost of machine mining. The first of the facts that are given is that the number of men employed at the machine-operated mines was last year 4314, and the percentage being taken, there is the further fact that whilst a little over 12 per cent. of the total men employed in the coal mines of Illinois were thus employed, yet the output, as we have just said, was 25 per cent. of the total—a very striking contrast. A table is given of the average production of each kind of machine, which shows that they vary in output from 6239 tons to 17,784 tons. But the number of the men employed in operating the machines varies—some kinds needing 6·4 men on the average, and others up to 20·1 men each, so that the actual yield is not to be taken from the mere average only. For the whole number of machines in Illinois, there is now need for an average of 14·2 men each, which is an increase on the number in the previous year, possibly due to the variation in the types of the machines. It is to be observed that the yield of the machines was on a working that on the average was a fraction over 250 each per year; and taking the mines where machines are exclusively employed, it is found that they vary in size, one producing only 21,000 tons in the year, whilst other collieries rise in output to as high as 304,000 tons, which is produced by 206 men in 255 working days, about eighteen Harrison machines being in use. Differences in the kind of seam, the nature and working of the coal, and other variations may influence the use of machine or hand labour, but the facts that are above summarised are of interest, and may have value to those who have the oversight of coal mining in this country.

### NEW WATER SCHEME FOR EDINBURGH.

For many years an improved water supply for Edinburgh and the district has been regarded as highly essential, and if the increase in population of the capital had been anything like as rapid as in the case of Glasgow, definite steps to this end must have been taken long ago. As far back as 1871 an attempt was made to appropriate the waters of St. Mary's Loch in Selkirkshire. A strong opposition to any utilitarian tampering with a lake of such historic and poetic interest immediately arose, and speedily attained such strength that the scheme had to be abandoned; and the whole matter of water extension was allowed practically to rest. Within the last few years, however, it has been made abundantly evident that a large extra supply of water must be obtained somewhere, and without much delay. The members of the Edinburgh and District Water Trust accordingly bestirred themselves, and have now, after due deliberation, fixed upon what is called the Tweed scheme. This practically means the utilisation of the water of a Dumfriesshire tributary of the Tweed, known as the Talla-waters. The only other source of supply seriously considered was the Manor water, a stream flowing through the Manor Valley in Peeblesshire and entering the Tweed about two miles above Peebles. This was reported upon and strongly recommended in 1891 by Messrs. Hill, Gale, and Mansergh, as being ten miles nearer Edinburgh than the Talla, and as affording a remarkably pure supply. However, borings with a view to the necessary embankments showed in some places a depth of 150ft. before rock was reached. The expense and risk which such a depth of soil entailed caused the engineers to withdraw their recommendation, and finally they advised the Trustees to adopt the Talla supply, boring in the valley having proved rock at an average depth of 28ft. The Talla water rises in three head streams in Dumfriesshire, and is also fed by the Gameshope Loch. After a course of seven miles in a northerly direction it runs into the Tweed at Tweedsmuir Church. The stream will afford an abundant supply of excellent water, and the full scheme proposed by the Trustees provides for the construction of tunnels and aqueducts to convey 24 million gallons per day to the capital, a distance of thirty-six miles. Application for parliamentary powers accordingly will be made. As a first instalment it is proposed to lay pipes capable of conveying 10 millions of gallons per day. This is estimated to cost about £646,000.

### MILD STEEL FOR STRUCTURAL ENGINEERING.

Whilst, as we last week showed, Bessemer steel is gaining ground as a material for use in manufacture outside steel rails, great progress can also be recorded of Siemens-Martin steel. This, indeed, has been gaining ground in the steel race during the last few years, and it has now passed its Bessemer rival, the output of open-hearth steel in the first six months of 1894 being not less than 1,026,469 tons, while the make of Bessemer steel was only 810,392 tons. We may observe, by the way, that the combined output of the two sorts is at the rate of 3,673,722 tons per annum, or higher than any annual total ever yet registered in the history of the British steel trade. Our chief concern lies, however, with the fact that open-hearth steel has for the first time gained the ascendancy. There has, in fact, lately been a greatly increased consumption of mild steel for all kinds of bridge and roofing, gasometer, and pier, and other departments of constructive engineering, also in the machinery trades, and among the steam boiler engineers, the tube firms of the kingdom, and other large consumers. One of the drawbacks to the use of steel in these trades is still asserted by some engineers to be its increased liability to corrosion, as compared with iron, particularly when exposed to the atmosphere or in damp or wet situations. The recent reports of some of the railway companies concerning the behaviour of steel bridges erected on British lines afford further evidence in support of those who have contended that this increased corrosion does occur, and some engineers are also seriously opposed to putting steel into piers for sea and ocean work. It is in steel designed for high tensile stresses that this corrosion is said to be most rapid. This fact is being increasingly recognised by engineers in some directions as regards both home and foreign contracts, and this tendency to prefer soft steel is likely to become more marked.

### THE MIRABEAU BRIDGE.

The work of constructing a steel bridge across the Seine at Paris, between Grenelle and the Pont du Jour, is making satisfactory progress. This bridge is interesting from the fact that it is of an entirely new type, and is intended to overcome the difficulty of facilitating traffic over the river without interfering with the passage of vessels underneath. It is to be built level with the embankment on either side, and the centre of the bridge is to be 7·50 metres above the water level. Its total length is to be 170 metres, with a central span of 100 metres. In building the two piers, a great deal of trouble has been met with owing to the shifting character of the river bed at this point. The caissons employed in sinking the piers were supplied by the Compagnie de Fives-Lille, whose system has been much improved since the accident which took place some years ago at Nantes, when a workman was blown thrown through the discharge pipe. Before reaching a solid foundation of chalk, at a depth of 16·20 metres, it was necessary to dig through layers of sand and marl, and this work was made difficult by the presence of heavy flint blocks. A great quantity of this material had to be raised before the foundation could be laid. At the present moment both piers are completed, and work has been in progress during the past three months upon the superstructure on the left bank of the river. The steel used in its construction is supplied by the Anzin Works, in the Nord, and the Imphi Works, in the Nievre, and about 2500 tons of this material will be employed. It is not expected that the bridge will be finished before the middle of 1896, owing to the difficulty of employing many hands at a time. The cost of the bridge is estimated at £140,000. Designed by M. Résal, chief engineer of the Ponts et Chausées, the new bridge is not only interesting from an engineering point of view, but is likely to prove one of the most picturesque erections across the Seine.

# RAILROADING IN AMERICA.

By An English Railway Engineer.

## CARS.

In my previous article comparison of English and American practice in locomotive building was avoided as being undesirable; but when dealing with the subject of cars or rolling stock, one cannot help remarking the great difference in the two prevailing systems, and at times comparing the comforts and conveniences of the relative styles. The American car in its own country is a vastly different article to the "corridor" imitations attempted on this side of the Atlantic. and must at once be acknowledged superior in many respects; one of the greatest helps to its successful adoption in the States being, no doubt, the practical employment of one "class" only. In America, as probably many of your readers are aware, the holder of an ordinary ticket has a free run of the entire train, notwithstanding the provision of the superior accommodation of the Pullman and Wagner Company. It is also pretty generally known that the ordinary fare is about one penny per mile, or equal to our third class for accommodation in many cases equal to that given at home as first class, the additional charge for "sleepers," drawing-room cars, or limited trains, being about one farthing per mile extra.

It is often urged in this country that American cars are heavier and more costly than carriages for a given carrying capacity; but there are several points to be considered in favour of the cars which only become apparent upon closer acquaintance. For instance, in English trains the heavier carriages are usually hauled with few passengers, the first and second classes being often practically empty. With carriages, too, some may be crowded whilst others in the same train and of similar class lack passengers. In the American train all are utilised, and each car takes its fair proportion of passengers. Here lavatories are provided for first and second-class and perhaps a few favoured third-class passengers, but although there may be possibly a dozen lavatories in the train, they are only available to the occupants of twice as many compartments—unless fitted in corridor carriages—out of perhaps a total of over sixty. The lavatories, moreover, are awkwardly placed, are liable to affect the sanitary conditions of the compartments, and are rarely used when passengers of both sexes are present. Here then is a typical example of maximum weight and cost with the minimum of convenience. In the American cars seating sixty, and in some cases eighty passengers, two lavatories are provided, available for all the passengers, and being located at the ends of the car, and not under the continual notice of the passengers, more general use is made of them. Another important advantage of a continuous passage is apparent on "through" trains when a dining car is attached at meal-times and run for those times only, being detached at the first convenient stopping place. In the carriage system, on the contrary, kitchen and saloons are run continuously, and form a useless augmentation to the weight of the train during a considerable portion of the journey, and in cases where the saloon is not connected by a gangway with the other carriages, the passengers in America have not the privilege accorded them universally of changing cars after dinner has been served. Before quitting this part of the subject, I should like to say a few words on a point often urged in this country as being an advantage possessed by the carriage system over that of the cars, viz., that greater facility exists for ingress and egress by a door being provided for every ten passengers, against only one for thirty in America. This may be substantially correct in theory, but it makes no allowance for the only too familiar old lady who sometimes keeps a whole train waiting whilst she runs from one end of the platform to the other to select a suitable compartment, or for a group of passengers waiting at the wrong portion of the platform for the particular class of carriage they require. One trip on the Chicago Elevated Railway is sufficient to cause one to modify this opinion considerably. On this line the average speed attained is fifteen miles per hour from terminal to terminal, including stoppages at the rate of three per mile; while on the underground railway in London the average speed is only twelve miles per hour, including only two stops per mile, similar service engine requirements being involved in each instance. On the cars the passengers are directed by the conductors to alight at one end while newcomers enter at the other, thus preventing delay on the platforms by passengers in search for vacant seats, distribution taking place largely *en route*. There is, moreover, no alighting from or entering the train while in motion, as the conductors control the gates on the car platforms in a manner similar to that employed on the South London Railway. There are, however, exceptions to the car system, even in America. On the Brooklyn Bridge, and at Chicago during the Exhibition period on the Illinois Central Railroad, the carriage style was adopted. But in both these cases crowds had to be carried between two points only, and consequently the side doors were used to great advantage.

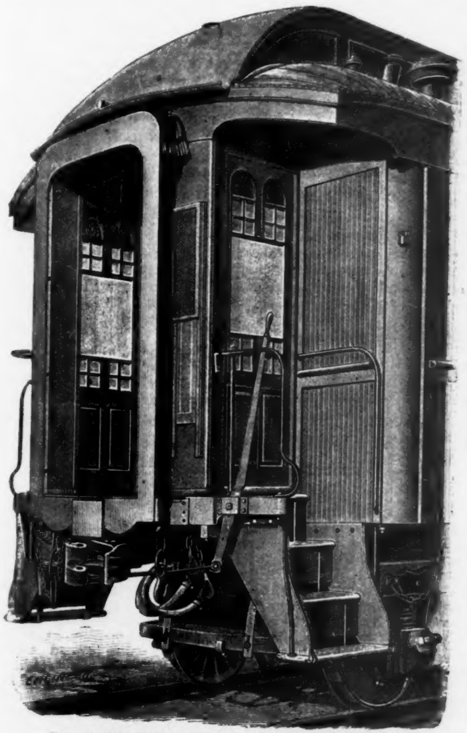


Fig. 3—GENERAL VIEW OF BARR VESTIBULE

As regards the construction of American cars, these differ from our carriages in having no separate body and underframe. The sides form the frame and approximate two girders, strongly braced and trussed, resting on trucks at either end. In modern cars the framing is of timber and iron or steel combined. The sides present a flat furface about 10ft. wide, and have no projecting handrails or steps. As there are no raised platforms at main line stations, a miniature staircase is provided at each end, leading on to the platform. The plan, Fig. 1, gives the arrangement of an ordinary day car. The seats have reversible backs, usually reversed by the conductor or train men, and locked, so that all passengers face the engine. They are comfortable, and when "reclining" chairs are used, are very easy. The seats are of braided wire, upholstered in brown or crimson plush. The windows are large, and are invariably clean, many ingenious little contrivances being employed for raising and lowering them. Each car is provided with iced water, and also glass-fronted cupboard containing a number of useful tools in case of mishap, such as an adze-saw, hammers, &c.

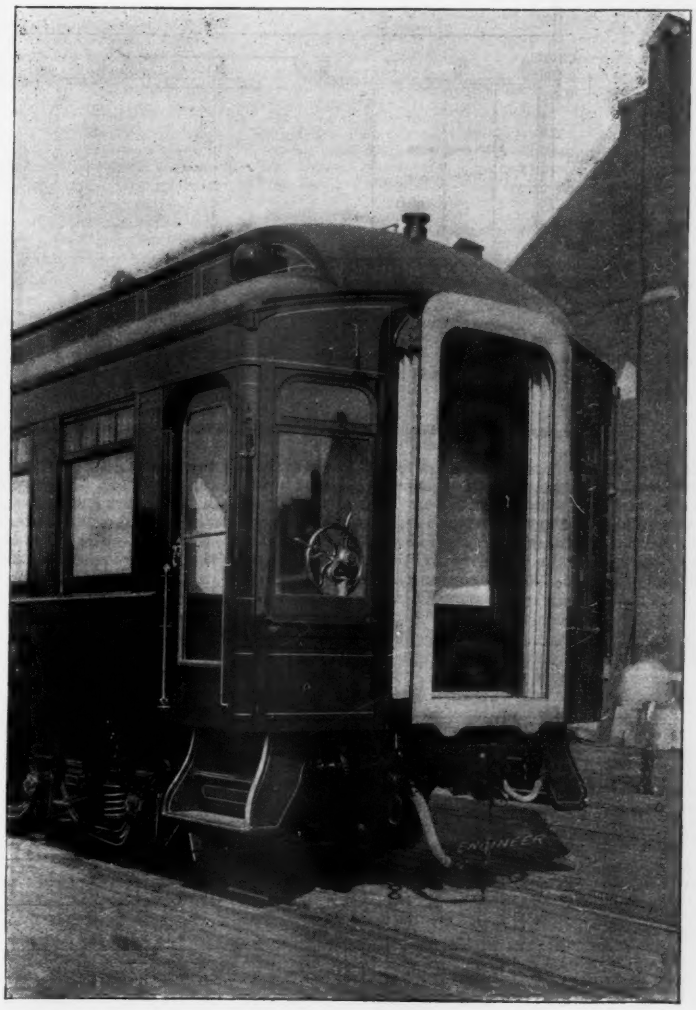


Fig. 5—VIEW OF PULLMAN CAR "MAUD"

Vestibules are rapidly becoming universal, and have received considerable attention. Apart from the convenience of affording a covered communication between the cars, doubtless a good vestibule as constructed in the States offers very considerable resistance to telescoping, and this has been recognised to such an extent that in some cases a cast steel frame is placed at the rear of the engine tender to receive the first vestibule, thereby ensuring a continuous connection throughout, and a few words describing them may prove acceptable. The "strings," bolts, and catches of the English gangway are unknown features of the American vestibule. Two vestibules can be simply "bumped" together as they couple up automatically, while one movement of a lever on the platform of the car is generally sufficient to uncouple them. The framework of the car end has provision for four buffing springs. The spindles passing through these are attached to a strong flat iron frame faced with rubber, the connection between this frame and the car body being made with a rubber bellows. The folding doors of the vestibule open on to a stairway on most cars, but as tramps have been found to make use of these for free transport, in later practice the vestibule is brought out to the full width of the car, and the steps are covered by a trap door opening upwards by means of a handle. A sketch of such an arrangement is shown in Fig. 2 herewith. In the Barr vestibule timber is used exclusively, the joints only being provided with a rubber cover. In Fig. 3 is depicted a general view of one of these vestibules, and Fig. 4 shows a plan thereof.

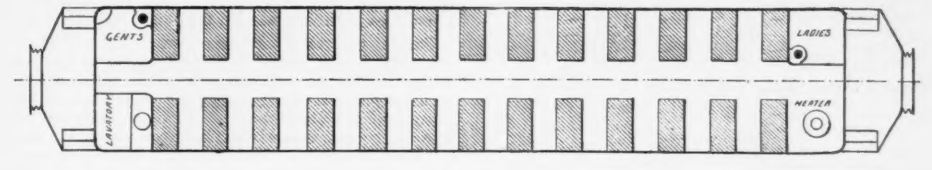


Fig. 1.

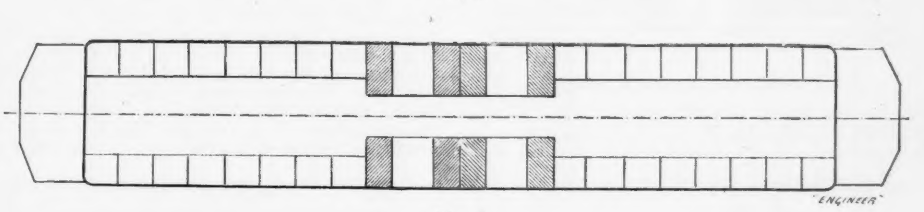


Fig 6.

A train shown by the South Pacific Railroad Company at Chicago had the Krebel vestibule. This is a connection the full width of the cars, so that the train is practically one width from end to end, with flexible joints. Pullman cars appear to be run on nearly all "through" trains; and as they are well patronised, the attendance, cuisine, and conveniences are excellent. Each car has five sections on each side, or seats for forty, and a state-room for four—some without the state-room accommodate forty-eight passengers, berths being provided for the same number. The lower berths are formed by drawing out the opposite seats—in the Pullmans all seats face each other—and the upper are pulled down from above; these when closed and occupying a slanting position have sufficient space to contain all the bedding for both upper and lower berths. A wooden panel fits in between the back of each seat and the car roof, and effectually divides the berths, whilst curtains are provided to secure privacy. Hooks are conveniently placed in each, and a net may be slung for loose apparel. At one end of the car a small smoking-room either adjoins the lavatory or forms one apartment, and at the other a ladies' dressing-room is provided. Fig. 5 shows a view of the Pullman car Maud.

Returning to the railway companies' cars, the New York Central have recently built for their famous Empire States Express some very large cars, 80ft. long and 10ft. wide, just over 9ft. inside, on six-wheeled trucks with wheels 36in. diameter. Seats are provided for eighty-four passengers, and the weight of each car is 95,400 lb.

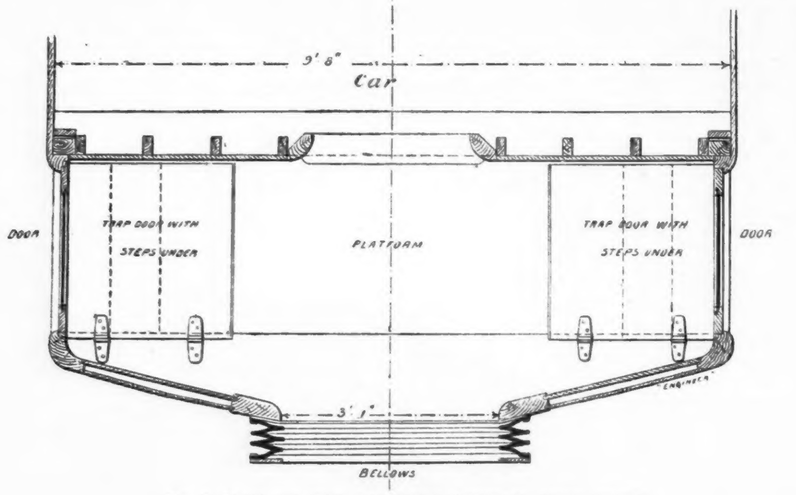


Fig. 2—PLAN OF CAR VESTIBULE SHOWING TRAP DOORS

Private cars are much used in the States, very magnificent vehicles being owned by some wealthy families, while on trains running into New York and other big cities from outlying suburbs, club cars are attached subscribed for by parties of city gentlemen resident in the district. The train exhibited by the Canadian Pacific Railway Company at Chicago was one of their standard patterns, used on the trans-continental services, and consisted of five vehicles as follows:—

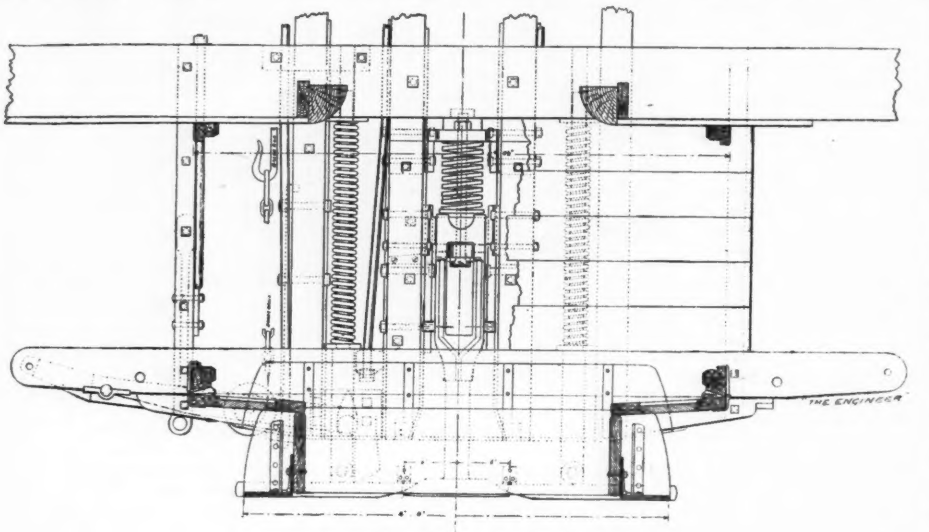


Fig. 4—PLAN OF BARR VESTIBULE

| | Length. ft. in. | Weight in pounds. | Seating capacity. Persons. |
|---|---|---|---|
| Baggage car ... ... | 63 8 | 59,600 | — |
| Second-class car ... | 64 4 | 65,500 | 64 |
| First-class car... ... | 64 4 | 65,300 | 56 |
| Dining car ... ... | 70 10 | 85,000 | 44 |
| Sleeping car ... ... | 77 2 | 94,000 | 44 |

Second-class vehicles are provided for emigrants on the Canadian and Pacific, Grand Trunk, and a few Western American railroads; but Pullmans are usually placed in the rear and dining cars at the extreme end of the trains in America. Fig. 6 represents a plan of one of the cars employed on the Chicago Elevated Railroad. It is 46ft. long, 8ft. 6in. wide, weighs 28,000 lb., has a double door at each end, and accommodates forty-eight passengers. These cars are lighted on the Pintsch system, and the trucks have wrought iron wheels. The cars employed by the Illinois Central Railroad for exhibition traffic were convertible into their standard freight cars, 35ft. long, and supported on two four-wheeled trucks. They had seats arranged transversely, with panels and windows at the sides but no doors, sliding bars only being provided across the doorways, and could be moved from either end by the conductor. Each vehicle had eight compartments or sixteen seats, and carried eighty passengers.

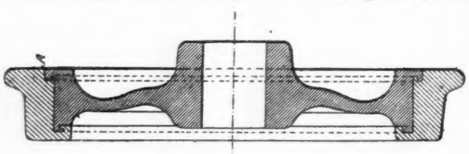


Fig. 7—SECTION OF BOIES WHEEL

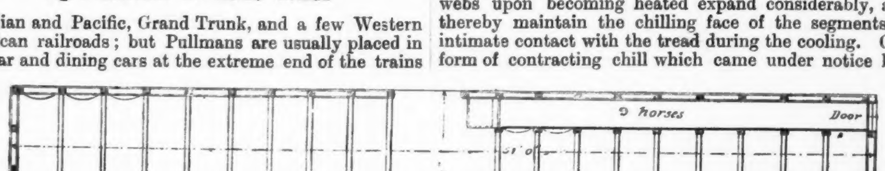


Fig 8—PLAN OF BURTON HORSE CAR FOR 18 HORSES

A type of vehicle which is coming into very general use in the States is the Harrison postal car. In this car the floor space can be utilised as required, as the tables can be raised, lowered, or detached at will. Part of the racks are simply portable, and each section, as a whole or in part, may be taken down or folded away in a very brief space of time. In the design of these vehicles special attention has been devoted to their lighting and ventilation, while the arrangement of the fittings is such that a larger number of persons can be employed in a given area than with the old-fashioned style of van.

Turning now to the running gear, it may be stated that pressed steel frames for the trucks appear to be gaining ground, while the wheels, springs, &c., employed, differ so largely that it would occupy too great a space to allow of only a brief description of all the varieties employed. The chilled cast iron wheels, however, which are largely in use, deserve a few words. These wheels are usually 33in. diameter, and are cast by some makers in contracting chills, wherein the chilling ring in contact with the tread of the wheel is made up of segmental blocks connected by thin radial webs to the outer ring or frame of the mould, which ring preserves the true cylindrical form. These thin webs upon becoming heated expand considerably, and thereby maintain the chilling face of the segments in intimate contact with the tread during the cooling. One form of contracting chill which came under notice had three surrounding rings, alternate segments of the chill surface being connected by webs to the first and second, and second and third rings alternately. Fig. 7 represents a transverse sectional elevation of the Boies wrought iron wheel, with steel tire. The retaining lip A is headed down into the groove shown after the pressed iron body is dropped into position in the tire, and to remove the tire the wheel is placed in a lathe and this ring turned out. Couplers offer an immense field for invention, and the varieties appear to be legion. They are all made to couple in the vertical plane, and have suitable arrangements for working with a link and pin if required. A defect, however, is apparent on many roads where the coupler head takes all buffing as well as draft stresses. Some companies provide their cars with cast iron buffer blocks, so that as soon as the jaws are attached these blocks come in contact.

In the description of the locomotives attention was called to the air communication means between the cars and engine in use on many of the chief trains. This comprises a small ¾in. air pipe, which runs the entire length of the train, and is charged with air under pressure from the locomotive. On the latter is placed a "signal valve," which is so constructed that a reduction of pressure in the train pipe, caused by opening cocks in any of the cars, opens a passage leading to a miniature whistle, through which air is allowed to escape, thereby giving an audible signal to the attendants.

In no country, probably, has the heating of railway cars received more attention than in the States. On some of the small roads old-fashioned stoves prevail, but on trunk roads some form of steam heater is generally used. In the Baker steam-heating system each car is rendered independent of its neighbours, a small stove being fed with coal from a hopper arrangement, and causes hot water to circulate through radiating pipes. In the Gold system, steam is conducted from the locomotive through storage heaters in the cars, charged with brine. These retain their heat for a considerable time after losing their steam supply.

In the external finish of the cars there is as great a variety as at home, the colours ranging from cream of the "ghost" train to dark blue of the Wagner cars. The Pullmans are uniformly painted a dark green and black, lined in gold, and each car is named for convenience of recognition. They are well kept, and present a fine appearance. The Pennsylvania Railroad favour a chocolate brown colour for their cars, but other roads use yellow and brown chiefly. The Canadian Pacific Railroad imitate English practice in adopting varnished wood.

Freight cars are of large size, usually running on two four-wheeled trucks, while 25,000 lb. to 30,000 lb. is a customary tare for a car of 60,000 lb. capacity. Box cars are more extensively used than in this country, but a "sheeted" truck is never seen. For mineral traffic open cars or "gondolas" are provided, whilst many roads having a large coal traffic provide hopper cars for this purpose. The Baltimore and Ohio Railroad have some unique cars, which require a few words of description. The body is made up of three intersecting cylinders, with hopper bottoms, on two four-wheeled trucks. All cars are furnished with brake blocks on each wheel. These are operated by means of a hand-wheel on the top of the car, or are brought up on a spindle 3ft. or 4ft. long in the case of platform and "gondola" cars. The brakesmen under the orders of the conductor manipulate these brakes when the train is not fitted with continuous air brakes. These men travel in the "caboose"—equivalent to the English guard's brake van—and which has a kind of conning tower or raised deck with doors opening on to the roof of the cars, suitable stairways being provided for reaching this. When approaching down grades or upon the receipt of the engineer's audible signal the "crew" of brakesmen emerge from these upper doors and run down the train on a platform arranged along the centre line of the roofs, each man braking a certain number of cars. The roofs of all freight cars are of gable pattern, not curved. For horses and cattle several car companies have special cars on hire which have suitable provision made for feeding, watering, and attending to the stock *en route*. The Burton Palace Horse Car Company provides very good equipment in this respect. The horses are placed across the car, as shown in Fig. 8, each horse being railed off from its neighbour, while a manger running along the side of the car is accessible to the men in charge by a passage between it and the car side. Special cars are also provided for fruit, meat, &c., the arrangements for refrigerating, &c., being excellent. For ballasting purposes plain platform cars are used, which can be unloaded with mechanical unloaders, resembling a snow plough drawn along the train of cars by the engine or by a winding appliance worked from it.

PUBLIC WORKS IN ALGERIA AND TUNIS.—Five miles of a line constructed by a French society for working the phosphate beds at Tebesah, a town situated on the frontiers of Algeria and Tunis, have been recently opened for traffic. At this distance from its starting point it joins up to the existing branch line, which connects Bône-Guelma with Ain-Kissah, the principal locus of the whole undertaking, although the greatest quantity of phosphate is procured at Ain-Dibah, to which place the present railway will be subsequently extended. At Mustaphah, fifteen thousand pounds are to be expended in the building of workshops and other premises attached to the Arsenal. Towards the end of last month the first line in Algeria, constructed by the company of Algerian railways, was inaugurated, and the first train run between El-Affroun and Marengo. Since then the traffic in both passengers and goods has been constantly and regularly maintained. It is stated that notwithstanding the advanced condition of the marine works, the new town at Bizerta is not provided with any water supply, nor with any buildings of the character absolutely indispensable to the welfare of the place. The sources of the water supply of Ain-Bourras sink away into the sand. Public edifices, such as schools, post-office, law courts, town hall and others, promised since last April, are still in the clouds. Great delay attends the sale of the lands belonging to the Harbour Company, and the period of stagnation presses severely upon all branches of local trade and commerce, without taking into consideration that the present state of uncertainty and indicision may exercise a very injurious effect upon the future prosperity of the port. It is satisfactory to be informed that the inauguration of the Bizerta-Djedeidah railway will probably take place at the end of the present month although that event in itself is a reason for hurrying up with the water supply.

# LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

## THE PORT OF MANCHESTER.

Sir,—In your issue of the 12th instant you quote from "Fair Play" a series of questions which, you say, Baltic men and others have been led to ask on consideration of circulars issued by the Ship Canal Company. The tone of these questions, and the evidently hostile spirit in which they are propounded, might lead one unacquainted with the subject to suppose that they were indeed very awkward posers for the supporters of the canal, and that it would be impossible to answer them save in the damaging sense which is suggested by the questions. Lest any of your readers should be thus deceived, allow me very briefly to deal with the "series" seriatim, with the object also of imparting to "Baltic men and others" the information of which they stand in need.

First, then, with regard to the saving to importers to Manchester direct, as compared with *viâ* Liverpool. It is evident that in his remarks the questioner has in mind the cargoes of cotton which arrived in the Manchester Docks in the early part of the year. I may remark that the canal was not open for traffic last year, so I am at a loss to understand what is meant by "the freight last year."

It is quite true that on the cotton cargoes imported in January and February last there was not a very great saving as compared with cotton brought from Liverpool, owing principally to the railway companies not having then fixed a shipping rate between the Manchester Docks and inland towns, charging inland rate on the imported cotton, and owing partly to the backward state of the arrangements for storing and handling the cotton. Now, however, these initial difficulties have been overcome, and a through rate has been fixed inclusive of all charges from the ship's hold to the mill, which shows a considerable saving on cotton brought to Manchester direct, as compared with cotton ex warehouse at Liverpool, in the case of over 90 per cent. of the Lancashire cotton mills. As a further proof that there are substantial advantages in importing cotton to Manchester direct, comes the fact that at the present moment steamers are loading cotton in America and the Levant for this port, and this in spite of the alleged failure of the experiment last season. As to goods other than cotton, one instance will suffice. The Wholesale Co-operative Society, which has invested a large sum in the undertaking, stated within a few months of its opening that even though it was never to see a penny of their investment back again they would be no losers, in view of the amount they had saved by importing direct to Manchester.

Secondly, as to warehousing. The impression that Manchester is unable to warehouse cotton and other cargoes is entirely erroneous. The Canal Company has ample warehouse accommodation within easy reach of the docks, to which cargoes are easily and cheaply conveyed by barge from the ship's side, in addition to the extensive storehouses owned by private warehousemen. These are equipped with every facility for handling goods in bulk.

Thirdly, "What cargoes which usually come in bulk has Manchester a market for? Timber, grain, and cotton perhaps." Yes, timber, grain, and cotton; and, to name only some of those which have already arrived in full cargoes in the few months during which the canal has been open: Iron pyrites, ore, pig iron, boiler-plates, stone, china clay, dyewoods, wood pulp, paper, oil, green fruit, dried fruit, and fish. An excellent wholesale market, second to none in the country, exists in the city for cattle, dead meat, provisions, &c.; and Manchester does expect, and the experience of the past months proves it a reasonable hope, that general cargoes will come freely to her docks for distribution amongst the enormous population of seven millions of which she is the natural centre and nearest seaport, and to serve which she is already provided with a system of railway and canal communication with all parts of the kingdom which will bear comparison with that of London itself.

Fourthly, as to outward business: Manchester can find coal cargoes for an unlimited number of vessels, being the nearest shipping port for the collieries of Lancashire, Yorkshire, and Derbyshire; and coal can be shipped either in the Manchester Docks or at the coaling basin at Partington more cheaply than either at Liverpool or Garston. There are already a number of colliers trading regularly between the canal and English, Scotch, and Irish ports, besides numerous vessels which bring timber and other cargoes, and take out coal. Salt cargoes can also be readily obtained in the canal, one vessel having taken out 4000 tons of this mineral to Calcutta from Saltport, whilst as an instance of bulk cargoes of another kind, one of the continental lines running from Manchester has at present a contract for some 10,000 tons of carbon refuse.

Manchester, one of the greatest engineering centres in the world, can find plenty of heavy cargo for the bottom of ships' holds, and can fill them up with press-packed bales of cotton goods, &c., the most sought after and profitable cargo which shipowners can obtain.

It has been characteristic of the two cities during the past decade, that whilst Liverpool has been bragging and scoffing, and showing to her own satisfaction the utter impossibility of making a ship canal from Manchester to the sea, her elder sister has quietly gone to work and proved to the world that it could be done, by doing it, *solvitur ambulando*. Now Liverpool, trying to forget all the foolish things said about engineering impossibilities, still talks in a complacent way about the inevitable failure of Manchester's efforts to create a traffic. The latter, however, is less concerned to notice such windy verbosities than to disprove them by results, and can already point, after nine months' work, to established regular lines of steamers to British, European, Asiatic, African, and American ports, whose sailings aggregate over 100 per month, increases being announced nearly every week, and this without taking into consideration the large number of specially chartered vessels which enter the canal weekly.

T. M. Y.

Manchester, October 16th.

## THE THEORY OF THE STEAM ENGINE.

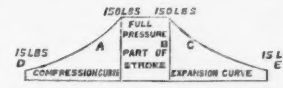
Sir,—It would be waste of time to discuss thermodynamics with a gentleman who holds that there is no difference between a permanent gas and steam, so I take leave of Mr. Cherry.

It is worth while to state more clearly than is usually done, the reasons why so much is lost in the making of the working fluid, steam. Dr. Lodge, I think, has even said that there is no loss at all. To settle questions of this kind by algebraical formulæ is only to mislead. A numerical example goes straight to the root of the matter. I shall take one pound of steam at 148 lb. absolute pressure, and consider the work which it would do with expansion between two limiting temperatures. Mrs. Glass told us long since that, before you can cook a hare you must catch it; in the same way, before you can expand steam you must make it. Let us see what the manufacture of one pound of this kind of steam involves. I will assume that we make it from feed-water at 100 deg.; then we must supply 1122 units, representing 866,184 foot-pounds. The steam is caused to work a piston loaded to 148 lb. on the square inch. The piston has 144 square inches of area, and 1 lb. of 148 lb. steam occupies precisely 3 cubic feet, consequently the piston 1 square foot in area must rise 3ft., and 150 × 144 × 3 = 64,800 foot-pounds. That is to say, we get less than $\frac{1}{13}$ of the whole heat expended in making the steam returned.

In my last letter I showed that when the steam made under these conditions was supposed to expand down to 15 lb. on the square inch, we got back about 21 per cent. of all the heat expended in producing the steam. This, of course, includes the $\frac{1}{13}$ mentioned above, and we shall then have left about ⅘ of a pound of steam, and ⅕ of a pound of hot water, the two together containing the rest of the heat, and this is to all intents and purposes thrown away in the condenser. It is the enormous quantity of heat expended in converting water into steam that is the main source of loss in the steam engine.

I do not know what the latent heat of air is. I do not suppose that any one does, but I imagine it must be pretty high, because the volume of a vapour or a gas depends largely on the latent heat. Thus the steam of ether is small in volume as compared with that of water, but the latent heat of ether vapour is less than half that of water. Whatever it is, it is supplied by Nature ready to our hands. The weight of the working fluid in a gas engine remains the same throughout a stroke; it diminishes as the stroke proceeds in a steam engine.

Two points occur to me here as claiming further elucidation. A correspondent of The Engineer whose name I forget, raised a question a year or more ago about the work done during the making of steam. He was not very clear, but I think I know what he meant. His idea was that as steam falls in pressure by expansion, giving out work, so it must rise in pressure as it is made in a reverse curve, and the work expended by the heat in compressing it ought to be all got out during expansion. Thus, then, we should have a diagram like this.



The area of A should be identical with that of C, and the full pressure part speaks for itself. Now, it seems to me that this result could only be got by starting with boiling water at D, and say 15 lb. pressure, and ending with E 15 lb. and boiling water. How this could be worked out in practice I do not quite see, nor does it matter. The only point I want to raise is this:—Would such a mode of working possess any advantage? And what is much more interesting, supposing that we generate steam under a pressure of 150 lb., what occurs to the feed-water before it changes into steam? Its temperature runs up. I suppose that as it runs up some force of repulsion is developed among the molecules. Could this force be graphically depicted by a curve?

The other question of interest is this:—Supposing it was possible to generate a pound of steam at 150 lb. pressure, without doing external work. Less heat would be required than is needed to generate it in the normal way. Is this taken account of in the normal steam tables? Do the figures in the normal steam tables give the quantity of heat which can be got back by condensing a pound of steam, or the quantity expended in producing it? Obviously, the two quantities cannot be identical.

October 15th. Maurice Cross.

Sir,—Writers on thermodynamics are much to blame for misrepresenting the teaching of Carnot. Either through ignorance or through carelessness, they lead their readers to understand that Carnot intended his "reversible cycle" as one to be aimed at and approximated to in actual heat engines. That he did not so intend is made quite clear by the following extracts from his work:—"The question has often been raised whether the motive power of heat is unbounded, whether the possible improvements in steam engines have an assignable limit—a limit which the nature of things will not allow to be passed by any means whatever; or whether, on the contrary, these improvements may be carried on indefinitely. . . The phenomenon of the production of motion by heat has not been considered from a sufficiently general point of view. We have considered it only in machines the nature and mode of action of which have not allowed us to take in the whole extent of application of which it is susceptible. In such machines the phenomenon is, in a way, incomplete. It becomes difficult to recognise its principles and study its laws.

"In order to consider in the most general way the principle of the production of motion by heat, it must be considered independently of any mechanism or any particular agent. It is necessary to establish principles applicable not only to steam engines, but to all imaginable heat engines, whatever the working substance, and whatever the method by which it is operated.

"Machines which do not receive their motion from heat, those which have for a motor the force of men or of animals, waterfall, an air current, &c., can be studied even to their smallest details by the mechanical theory. All cases are foreseen, all imaginable movements are referred to these general principles, firmly established, and applicable under all circumstances. This is the character of the complete theory. A similar theory is evidently needed for heat engines. We shall have it only when the laws of physics shall be extended enough, generalised enough, to make known beforehand all the effects of heat acting in a determined manner on any body."

This states quite plainly, that what Carnot proposed to do was to find out the theoretical principles of thermodynamics, not their practical application to actual heat engines. His cycle of operations he uses as a new mathematical mode of investigation. That he never could have intended it as a model for the actual working of heat engines will be made quite clear from the fact that the operations of no actual heat engine can possibly be subject to the following conditions assumed in Carnot's cycle:—(1) The working body must, at every instant, have the same temperature throughout all its parts. (2) The working body must, at every instant, have the same pressure throughout all its parts. (3) The transformations through which the working body passes must take place so slowly, that the densities of all its parts may, at any instant, be the same as they would be if the temperatures and pressures of the parts at that instant were constant. (4) The transformations must take place so slowly, the visible kinetic energy of the working body be so small as to be negligible.

These are quotations from page 26 of my treatise. It will therefore be evident that the efficiency $\frac{T - t}{T}$ of Carnot's ideal heat engine cannot be attained to, nor even closely approximated to, by any actual heat engine unless it be permitted to work so slowly as to waste time of much more value than the heat we are attempting to economise.

With regard to the superheating of steam by free expansion, Rankine—"Steam Engine," section 253—says that it has been proved experimentally by Mr. C. W. Siemens.

Glasgow, October 13th. Peter Alexander.

## GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—I do not know whether there are any electric light engines fitted with the Proell or other single-valve automatic trip-expansion apparatus of like construction, but if there are, I fancy I can account for some of the difficulties of governing likely to be encountered in their use. There is a peculiar feature in the action of these apparatus that is never mentioned in the published descriptions of them, and that is, that for a certain period of the stroke, these apparatus exercise no control over the engine, and "hunting" of the governor is the only feature that makes regulation of any sort possible.

I am not aware whether this peculiarity has been pointed out previously or not, but it will be easily understood from the following:—Suppose the apparatus in its mid position, and that tripping takes places there. Then at the same instant the active trip edges clear each other, the idle trip edges will line with each other, and it is only a question of condition of the edges how far the apparatus will have passed its mid position before the falling valve will be arrested by the idle edges, and only allowed to close when these edges have travelled sufficiently far in that direction. If the edges are sharp and in good condition a movement past mid position of the apparatus equivalent to 3 or 4 per cent. of the stroke may be the position at which, when tripping takes place, the falling valve will be arrested by the idle edges, and prevented from closing until the period determined by the excentric motion. If, on the other hand, the edges are somewhat blunted, 6 to 8 per cent. may represent the movement past mid position at which the valve is arrested, but the period of closing will be as before. When tripping occurs later than the period of closing by the excentric motion, the engine is again under control.

The extent of this lapse in the control of the engine may be ascertained thus:—The angle of the crank from the commencement of the stroke until the trip apparatus is in mid position is equal to the negative advance angle, and the angle of the crank from the commencement of the stroke at which the valve, when arrested, closes by the excentric motion in that direction, is equal to twice the negative advance angle plus the lead angle. The apparatus are generally stated to have an automatic range of cut-off from 0 to ¾ of the stroke, which allowing 6 per cent. for clearance of trip edges, is equal to 38 deg. negative advance angle. The apparatus is therefore in its mid position when 10 per cent. of the stroke is completed, and allowing 6 per cent. for condition of edges, &c., any trip that takes place at 16 per cent. of the stroke will not be followed by a cut-off until (2 × 38 + 6) = 43 per cent. of the stroke is completed, that being the position at which the valve closes by the excentric motion. Nor will any trip between 16 per cent. and 43 per cent. of the stroke be followed by any other cut-off but 43 per cent. of the stroke, as between these positions the valve will be arrested at every trip. Instead, therefore, of the range of automatic cut-off being from 0 to ¾ of the stroke, it is only from 0 per cent. to 16 per cent. and from 43 per cent. to 75 per cent., and the "hunting" of the governor is relied on to cross the interval between 16 per cent. and 43 per cent., during which no control can be exercised.

If the range of cut-off were limited to 55 per cent., and with the allowance of 6 per cent. for condition of edges, the negative advance angle for this range would be such that there would be no break in the control throughout; but 35 per cent. of an automatic range may be obtained from a positive advance excentric, and it is questionable whether the extra 20 per cent. is worth an independent negative advance excentric, when the positive advance slide valve excentric is ready at hand for the lesser range.

240, Wallgate, Wigan. Jas. Dunlop.
October 13th.

Sir,—I have read with much interest what has appeared in The Engineer on this subject. The letter of Mr. Robinson may be taken as an example of the difference in method of treatment which exists between the engine builder and the electric light engineer. Mr. Robinson evidently does not grasp what it is we want. A heavy fly-wheel may help us in some respects, but in others it is just the thing we do not want; everything depends on the system of working employed.

I know by experience that the average engine builder goes on the "one man one vote" system, to have one engine drive one dynamo and work one circuit, and provision must be made for variations in the demand for current in that circuit. I devoutly wish that this was the case. Without going into minute details, I may give Mr. Robinson and others of your readers a comparatively elementary case, and ask how they would deal with it. There are two engines and two dynamos; each will indicate, say, 600-horse power. During the daytime one of these supplies current, and works up to 250 or 300-horse power; as the night comes on more and more load is put on, until the power reaches 600-horse power. Then the second engine is started, and its dynamo has to send current into the same main. Obviously it must run at such a speed that the voltage shall be the same in both. At the proper moment the switch is thrown over, and both engines are now doing the work that a moment before was done by one. But the total work wanted from the two is for the time only 600-horse power, not 1200. What does Mr. Robinson suppose a governor has to do then? How would the heavy fly-wheel help?

Messrs. Robey and Co. are nearer the solution of the difficulty than any other of your correspondents, but it is easy to see that they have not quite got it. The use of current to regulate a throttle valve has been tried over and over again, and it has never yet achieved permanent success. I think the best chance lies in combining an electro-magnet with a governor of the Pitcher type, using the magnet, in fact, to hurry up the governor, and also to establish a definite relation between the engine, the current, and the number of revolutions. The centrifugal governor takes no account of current, but only of revolutions. The current ought to have a voice in the matter.

I may say incidentally that all your correspondents talk of throttle valves. What about governing Corliss engines? There is something peculiar about their action which I do not quite understand. There seems to be a considerable range of speed at certain ratios of expansion when they do not govern at all. Thus a governor will do very well at ranges between no admission and 14 or 15 per cent. and within 50 and 63 per cent., and very badly indeed at other ranges. I should like to have this point cleared up. It has something to do with the trip faces, I fancy.

Bolton, October 16th. P. K.

## OIL-FIRED STEAMERS FOR HARBOUR USE.

Sir,—I have read with much interest your leader which appeared in your issue of 21st ultimo in relation to "Oil-fired Steamers for Harbour Use;" the only objection I take to it is that it stops short at the advantages and utility to "steamers for harbour use," and therefore I now propose to demonstrate that this is only a very restricted sphere for oil fuel, inasmuch as all that you have written is equally applicable to ocean-going steamers.

I proceed to analyse the possible objections which "vested interests" may see in this assertion. Firstly, it will be asked by those in opposition, Can the oil fuel be obtained in sufficient and easily procurable supplies at the respective ports of call? My answer is emphatically "yes;" for from the moment that a regular demand for oil fuel manifests itself contractors for delivering the same at any desired point or points can be found in the same manner as is done with coal now. Anybody who has studied the question of the possibilities of the oil production of the world can determine for himself that eventually the supply would be equal to any demand the markets might make on it, subject only to ordinary trade fluctuations in price. It is a well-known fact that large tracts of country in various parts of the world are known to be oil bearing, and only require the stimulus of a commercial demand to enable these new fields to come into actual working. Secondly, it has been widely asserted that, so far, no system of working has been discovered which would bear the daily wear and tear of a long ocean trip; ample proof to the contrary is available.

Now I come to the question — Will the underwriters of the hull or the cargo raise any difficulties, or in any manner penalise the oil system as against coal?

From all the inquiries I have made from responsible quarters, I can with safety answer this in the negative. All that will be required is that the oil system of firing be carried out under proper rules and regulations, which will be formulated by the recognised insurance authorities to meet the case; and, from what I have ascertained, such would in no way be drawn up so as to make the adoption prohibitive or in any way disadvantageous in competition with coal. Doubtless, on the other hand, at the first set-off, merchants' minds would have to be set at rest as to a possible prejudice to their cargoes from the new system of firing, and this factor, no doubt, weighs heavily with the shipowner, who otherwise has an open mind on the subject.

I am confident that the prejudice existing on this score would very soon vanish by practical experience, inasmuch as it has already on various occasions been demonstrated that it has no existence in fact. For example, it is well known to all concerned in the oil trade that oil tank steamers have carried cargo—such as sago and other fine freight—in their empty tanks without any damage or injury which would be ascribed to their mode of carriage.

The comfort of all on board, be they passengers or crew, would under all conditions be greatly enhanced. As a professional man, I can only hope that some far-seeing commercial mind will grasp and vitalise what appears to me so patent as this superseding of coal by oil fuel in ocean steamers and in other important trading and industrial enterprises. That it must come about, notwithstanding all opposition, I feel sure.

EDWIN N. HENWOOD, N.A.

22, Great St. Helen's, London,
October 13th.

### LABOUR AND LUXURIES.

SIR,—I was much amused by the letter of your correspondent, "X. Y.," published in your issue of the 12th inst. In it he defines the science of political economy, a science intimately connected with human affairs, as "knowing nothing of morals."

Such a science may be interesting as a curiosity, but it can be of no practical value. It is as if an engineer were to propound a theory of boiler furnaces which took no account of the draught. Further, I would ask "X. Y." to consider whether it is employment that men desire, or whether it is food, clothing, and the means of developing their minds and bodies to the full. I think he will agree with me that man cannot live by work alone. In fact, all the tendency of recent improvements in machinery is to reduce the amount of human labour required by the world. If, then, food, clothing, and the development of mind and body is what men want, any labour spent otherwise, which might have been employed in obtaining these, is a dead loss to the community.

Again, as to low wages. Let us, for example, take a collier and a distributor of coal, each of whom receives one-half of the price of the coal paid by the consumer. Now, suppose that the collier's wages are reduced by 50 per cent., the cost of the coal to the consumer, and therefore, arguing on the lines of "X. Y.," the cost of all commodities to the collier will only be reduced by 25 per cent. Thus he is very distinctly a loser.

Finally, shall I be considered rude if I recommend to "X. Y." a careful study of the writings of Carlyle, Ruskin, and Solomon before he writes again on "Labour and Luxuries." HIRN.

Owens College, October 15th.

SIR,—It is difficult to reconcile "X. L.'s" views with the writings of the authorities he names. Perhaps none of them use the actual noun *benefactor;* but in treating of a similar question, Adam Smith uses the word *generous*. Ricardo speaks of sympathy with, and desire to benefit the working man, and Mill speaks of doing good to the labouring classes. Indeed, the Woolwich labourer might gather powerful arguments from Mill.

"For practical purposes, political economy is inseparably intertwined with many other branches of social philosophy. Except on matters of mere detail, there are perhaps no practical questions—even among those which approach nearest to the character of purely economical questions—which admit of being decided on economical premises alone. And it is because Adam Smith never loses sight of this truth—." But I need not extract the rest of Mill's praise of his predecessor from his eloquent preface, for no more is needed to show that both regarded political economy as the study of man's well-being. So far nothing has been advanced to show that the labourer's economics were hazy, however shaky he may have been as to matters of fact. W. A. S. B.

October 16th.

### ALUMINIUM TORPEDO BOATS.

SIR,—Referring to the letter which appeared in your last issue regarding the aluminium torpedo boat, lately constructed by us for the French Government, in which a comparison is made with a similar type of boat also built by us—described in your issue of December 11th, 1891—we have the pleasure to explain what seems to be a discrepancy in the results. The speed obtained in the earlier-constructed boat was 20·03 knots, being the mean of six runs on the measured mile; and the trial was conducted in light trim, while in the case of the French boat a load of three tons was carried, and the trial for speed was the mean obtained during a continuous run of two hours, consequently the earlier boat was tested under much more favourable conditions—partly due to the shorter duration of the trial, and partly to the lesser weight carried. If the aluminium boat had been tested in the same manner as the earlier boat, as regards the load carried and duration of trial, there would have been no difficulty in obtaining 22 knots. The gain of 3½ knots—referred to in your recent description—has reference to a comparison between the latest boats of the same class built by us for the British Government, which were furnished with locomotive boilers. These boats obtained 17 knots, under the same conditions of load and duration of trial as the aluminium boat; therefore, in comparing the two, the statement is quite correct that the aluminium boat is the faster to the extent of 3½ knots. This gain is due partly to the adoption of aluminium, partly to the superiority of the water-tube over the locomotive boiler, and partly to the correct balancing of the machinery. We trust this explanation will make the facts clear to your readers.

Poplar, October 13th. YARROW AND CO.

### MODERN LOCOMOTIVES IN THE RECENT COLLISION.

SIR,—The statistics given as to weight of train in the recent collision seem to show, either that the six-wheeled rolling stock still used by the East Coast lines run with more friction than the bogie carriages as running all over the Great Western and Midland railways, or that the ponderous compound locomotives recently built by the North-Eastern Railway cannot haul a train of only fourteen coaches over easy gradients without a pilot engine. The approximate weight of train was as follows:—

| | Tons. | |
|---|---|---|
| 1st engine .. .. .. .. .. .. | 40 | 162 t., engines and tenders. |
| Tender .. .. .. .. .. .. .. | 35 | |
| 2nd engine .. .. .. .. .. .. | 52 | |
| Tender .. .. .. .. .. .. .. | 42 | |
| 13 6-wheelers .. .. .. .. .. | 169 | 194 t. train. |
| 1 Pullman .. .. .. .. .. .. | 25 | |
| Total weight .. .. .. .. | 356 | |

There is no doubt whatever that one of Mr. Macdonnel's engines, weighing 39 tons, and tender with pick-up, weighing 15 tons, altogether weighing 54 tons—equal to only 28 per cent. of carriage weight instead of 84 per cent. as above—would easily have hauled the train in question.

I venture to think that some information from railway men as to the above question would be of interest, not only to shareholders, who are annually met with the tale that increased working expenses have more than swallowed up all profits from increased traffic, but also to that constantly increasing class of travellers who, like your humble correspondent, follow eagerly all that appears in the press as to railway developments, &c. F. BOWLES.

34, Queen-street, London, E.C., October 15th.

### FRENCH CRUISERS.

SIR,—The French cruisers you illustrate excel British cruisers of the same displacement in armament and armour. Surely there is something *per contra*; is it such as a naval officer would prefer to the heavier guns? Also, I note, comparing your notices of the Antwerp Exhibition with that of the late sea fight, that the Japanese had at least three very heavy guns. I presume that they made worse practice than the Royal Sovereign did the other day. W. H. E. B.

October 16th.

## THE IPSWICH SEWERS AND ELECTROLYTIC SANITATION.

AT the meeting of the Ipswich Town Council, held on the 10th inst., the Sewerage Committee, in the course of a lengthy report, remarked that to lessen the danger of the escape of deleterious gases from the sewers, they had been obliged to pursue a policy of closing the old sewer gratings, and erecting at considerable expense ventilating shafts and columns. A report presented on the 1st of March last by the Borough Surveyor showed that the sum provided for flushing and ventilating the sewers, by a loan raised in October, 1889, was exhausted, and that in all £963 had been spent. The surveyor considered that it would still require some 200 or 300 shafts and columns to deal with those yet unenclosed, at an expenditure of about £1000. Having these facts before them, the Committee deemed it desirable to make a trial of the Hermite process. The drain selected for the trial was the old sewer discharging itself by the Great Eastern Railway Company's bridge over the river approaching the main station, and running from the Cattle Market. This sewer has connected with it twenty-nine water-closets, and it also receives the drainage of a number of houses, the drainage and washing of the Cattle Market, a slaughter-house, and a malting and brewer's store, besides the condensing water of the Grey Friars'-road Foundry and the Mineral Water Co.'s Works. At various times samples were taken, and on each occasion a distinct improvement in the condition of the sewer was traceable. On the 6th of September it was deemed unnecessary to continue the experiment further, the whole of the drain having been purged of offensive odour and disinfected. As a result of the experiments, the Committee were able to state:—(1) That the fluid known as electrolysed sea water has proved itself to be a most valuable agency for the disinfection and deodorisation of sewage; and (2) that it could be produced at a smaller cost than any other disinfectant or deodoriser.

It was computed that the average daily dry weather flow of sewage for the borough amounted to about one million and a-half gallons, and it was estimated that it would be necessary, in order to deodorise this quantity of sewage, to electrolyse about 23,000 gallons of sea water to the strength of 2·25 grammes of chlorine = 35 grains of chlorine per gallon. This quantity would, in fact, suffice to deal with a population and its manufactories of 57,000 inhabitants at the rate of 1 gramme of chlorine = 15·5 grains per head of the population per twenty-four hours; but the population of the borough using the sewer was only estimated to be some 45,000, showing a large excess of electrolysed sea water to the actual head of population. The committee were of opinion that the electrolysed sea water should be allowed to fall into the main sewers, at all events for a few months, at different points along the line by means of pipes which can be laid within the sewer itself. It was fully to be expected that after a short period had elapsed, say six months, the power of the present accumulations in the sewers would have become so paralysed, if not sterilised in regard to their germ, and consequently gas-producing power, that the chlorine of the solution would travel greater distances, and in time it might be unnecessary to have more than one or two points of discharge into the sewer. It was believed that in the adoption of this process and its proper application, considerable sums would be saved which were at present expended on disinfection in other forms, and that the necessity for any further expenditure on the erection of ventilating columns or shafts would be entirely removed, and that the cost of water for flushing by lessened consumption would be very largely diminished.

The committee anticipate that the final question of dealing with the solid matter at the outfall would be very considerably assisted by the adoption of this process. It was believed that not only will disagreeable odours not be traceable at the outfall tanks and works, but that, on the contrary, chlorine would be found to be present there, and that all discharges into the river at the outfall will be absolutely inodorous within a reasonable period. The question of dealing with the solid matter had not escaped the committee's attention, and suitable screens are now in course of erection to intercept it at the outfall. From experiments which had been made it had been proved that the animal life in salt water could not be affected by the discharge into it of electrolysed sea water.

The committee reported that the total cost of the plant for Hermite disinfection would be £2000, the annual expenditure would be £443, with an annual saving under other headings of £147, making the net annual expenditure £296. Mr. Napier presented a lengthy report, giving as his conclusions:—(1) That sewage is instantly deodorised when mixed with a sufficient quantity of Hermite electrolysed solution. (2) That the decomposition of the sewage is retarded by the said mixture for a length of time, depending upon the strength and quantity of solution added, and that during this time no offensive smell is given off. (3) That if this solution, giving 40 grammes of active chlorine per minute, is discharged into the main and various arterial sewers, the offensive smells at present escaping from the manholes will be prevented, and the sewage made sterile—as far as consumption goes—for several days, sufficient for it to get well out to sea before becoming offensive. (4) That if the proposed installation produces more active chlorine than is required to oxidise the sewage, a portion of the excess chlorine will be in the form of gas, and, escaping into the air, will form an aërial disinfectant, and where sewers and drains are not properly trapped, instead of offensive sewer gas going into houses, there will be this chlorous gas acting as a disinfectant. (5) That of the processes for treating sewage that I know of, all do so at the outfalls, the object being to utilise the precipitates from the sewage, or to keep, say, a river free from pollution. A process may be adopted at an outfall for precipitating objectionable matter, or for preventing pollution, but no benefit from that will be derived by the town; but with this Hermite process the solution is distributed in the arterial sewers, the disinfection takes place there, and the sewage rendered inoffensive on its passage through the town, and is kept so for a number of days, sufficient for it to get through the whole system of sewers into the Orwell. I am of opinion that if this process is adopted, and a sufficient quantity of solution manufactured, Ipswich will benefit greatly, because by having the drains and sewers disinfected, and a flow of deodorised—perhaps sterilised—sewage through the town, the health of the inhabitants will be considerably improved.

Alderman E. R. Turner moved the adoption of the report, which he said he did with very great pleasure and satisfaction. They had had a full report, he said, from the surveyor as to other systems, but none of them were thought so applicable to the town as the Hermite process.

Mr. Goddard was surprised that a matter which had previously provoked so much difference of opinion should have provoked so little discussion that morning. He supposed that the Council had come to the conclusion that the Sewerage Committee had thoroughly investigated the matter, and placed confidence in their report. As to the cost, the previous information before the Council was that a capital expenditure would be required of from £8000 to £9000, and an annual expenditure of £1200, and the cost of the Hermite process was very considerably less. This process was said to be a speculation, and it was to a certain degree a speculation, but one which had been as highly tried as any system could be tried. First of all, it had been tried experimentally by many experts, and there were sheafs of information by those experts. As a means of dealing with sewage, he believed this process compared most advantageously with anything else that had ever been suggested. He should be very sorry to lead anyone to expect that if they adopted this process there would never be any unpleasant smell from the river, for he believed that in a river so full of weeds as theirs was this was impossible. He thought this process had this great advantage over all other processes he had looked into, namely, that of being a liquid process. Only a small labour would be involved in removing what was caught on the screens at the outfall. Besides dealing with the main sewer, the process would give the advantage of providing the borough with a powerful disinfectant which they could, at a small cost and very little trouble, convey to any part of the town. The resolution was adopted.—*East Anglian Daily Times.*

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

A NEW application of steel in this district is just now being made by Messrs. Lysaght Limited, of Wolverhampton. The step they have taken is considered hereabouts one of great importance, as signifying the successful attempts which are being made to adapt steel to purposes which have hitherto been carried out by the utilisation of iron. For some time past it has been an open secret that a firm who are one of the largest galvanised sheet producers in the Midlands have been experimenting with the newer metal, with the result that in the future they will most probably entirely abandon the use of iron for galvanised sheet manufacture. To provide for the new departure, one of the finest steel rolling plants to be found in the country has been laid down. It is found that greater economy is secured by the lower cost of the steel as compared with iron, and the lessened quantity of spelter absorbed on account of the closer grain and extra smoothness of surface. Whether or not other galvanised iron concerns will generally follow the example which has been set them by Messrs. Lysaght remains to be seen. Certain it is, however, that ironmasters recognise the increased prominence with which steel is now coming to the front, and to keep abreast of the times it is not unlikely that they will consider it desirable to early alter their present mode of production.

Business is unaltered on the week at last week's prices. The only new fact to communicate is, that preparations are being made to restart some of the blast furnaces at the Corngreaves Ironworks almost immediately.

An electrical engineering undertaking that has cost between £45,000 and £50,000 has been opened at Worcester. This is the new electric lighting works which have been erected by the Worcester Corporation. Water power is derived from a fall on the Teme at Powick, and is developed by four inward flow turbines of the Victor pattern, two 54in., one 48in., and one 30in., the total turbine power being 500-horse power. There is also sufficient steam plant to generate the whole of the electricity, should the water supply fail. There are three vertical compound engines of the marine type, the cylinders being 15in. and 25in., and the stroke 16in., each of 290 indicated horse-power. The turbines and engines are connected by cotton driving ropes with the four Mordey Victoria alternators, each having a capacity of 125,000 watts, and absorbing about 200-horse power. The engine-room has a travelling crane, lifting 12 tons. In the boiler-house are four Babcock and Wilcox water-tube boilers, equal to about 900-horse power, fed with the river water by two duplex feed pumps. The current is taken to Worcester by two pairs of copper mains, at a pressure of 2000 volts. The Brush Electrical Engineering Company is the contractor for the machinery and electrical plant, and Messrs. Rowbottom for the building of the generating station; Mr. Leonard Wigan, A.M.I.C.E., being clerk of the works. Mr. Preece is the expert who has advised the Council. Worcester is the only municipal body supplying electricity by water power, and the new station is the largest water-generating station in the kingdom.

Railway engineering schemes continue to increase in number. The latest is a movement to induce the Midland Railway to extend its system in the immediate neighbourhood of Birmingham. The railway authorities at Derby have before them a proposal. It is suggested that, using the present rails to Water Orton, the Midland Company should from that place construct a line to skirt the town of Coleshill, and then proceed through Maystoke to Meriden and Allesley, and enter Coventry on its western side. From Water Orton to Coventry is 21 miles, as against 18½ from Coventry to New-street. It is proposed that the line should go thence to Rugby and on to Northampton, where there are Midland branches, and that to Bedford could be used as the line to London. The Midland journey from Birmingham to London would thus be shortened by 30 miles. The matter is, however, so far a suggestion only.

It is rumoured that a large consignment of guns and ammunition, all of the latest improved type, has been purchased and sent away from the Midlands by a roundabout route to Japan, being first consigned to another country in order to evade the Foreign Enlistments Act. The same firm is said to have been approached by emissaries of China for a similar purpose almost at the very time that Japan was negotiating.

Messrs. G. Kynoch and Co., Witton, Birmingham, are understood to have obtained a contract from the Government for the supply of 600 tons of cordite, the delivery to extend over three years. The firm have mills in Yorkshire, but will probably also erect new ones in another part of the kingdom. Hitherto cordite has been manufactured exclusively at the Government works at Waltham Abbey, and this obtaining of a portion of their supplies from the trade is a new departure.

Local engineers express satisfaction at the announcement that the Government has decided to spend 520 lakhs of rupees this year and 500 in each of the following two years on railway construction and irrigation works.

Birmingham manufacturers of copper wire have good reason for their complaints this week of the rapid development of French competition in this country. Several leading French companies, acting as a syndicate, recently effected extensive contracts with American firms for copper at £3 per ton below existing rates. Fortified by this advantage, the agents of the syndicate's firms are now offering copper wire for telegraph and other purposes wherever needed in England at less money than Birmingham manufacturers can produce it, and contracts are being accepted for the whole of 1895.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—A continued absence of any improvement in the position throughout the engineering and iron trades of this district is again the general report, and any hopeful prospect would seem now to have disappeared altogether, so far as the present year is concerned. For the immediate future a slow dragging trade is all that is looked forward to; but, there are apparently some sanguine expectations that the spring of next year may bring forward a revival of activity. In the meantime, makers and manufacturers of iron are finding it difficult to secure business to keep them even partially going at anything like remunerative rates, and the present position is about as unsatisfactory as it could well be. The coal trade also continues in a depressed condition, so far as all descriptions of fuel for general manufacturing purposes are concerned, and the tendency as regards these would seem to be rather in the direction of even still lower prices, owing, not only to the excessive local supplies, but to the keen competition from other districts.

Only a very slow business continues to be reported on the Manchester Iron Exchange, and although there was a full average attendance at the market on Tuesday, a dull, depressed tone prevailed generally. For pig iron business continues to be restricted to the smallest possible quantities, consumers and merchants being in most cases more than sufficiently bought for present requirements, and the tendency of prices—where there is business offered to really test them—is in a downward direction. Lancashire makers still quote nominally on the basis of about 39s. 6d. and 40s. for forge to 42s. for foundry, less 2½ at the works; but the business they are doing at these figures is restricted to only occasional small parcels, sold to regular customers. District makers are generally in the position that their books are practically full for the next month or two; but in some instances iron is being thrown upon their hands, owing to customers not taking their full deliveries, and consequently they have to seek for orders in the market. Makers who prefer to go on simply with contracts are, of course, holding firmly to full recent quotations, but where they do come upon the market they have to give way to secure orders, and 39s. now represents the full average selling figure for forge Lincolnshire, with foundry quoted about 40s. 6d. to 41s., and Derbyshire foundry about 45s. up to 46s. net cash delivered Manchester. Outside brands offering here are decidedly easier; good foundry Middlesbrough can now be bought readily at 44s. 4d., with good-named brands quoted at 44s. 10d. net cash delivered Manchester, whilst as regards Scotch iron, it is difficult to get more than 48s. net prompt cash for Eglinton, delivered at the Lancashire ports.

The position in the finished iron trade still shows no improvement, very few forges having work sufficient to keep them running more than about four days per week, and although makers still quote late rates, these are difficult to maintain where new business is concerned. The very small orders just now coming upon the market offer, however, no inducement to give way, but if anything like good specifications were put forward there is little doubt some concessions would be forthcoming to secure them. Delivered in the Manchester or Liverpool district, quotations for Lancashire and North Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and for Lancashire hoops, £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths. With regard to hoops, I may mention that a fairly large South American order, which it was generally anticipated would be placed in this district, has been secured by German manufacturers, and this has given rise to the question whether the Association list rates should be made binding only as regards home trade, leaving makers free to compete for foreign business. Nut and bolt makers report only very few orders giving out, and these are competed for at very low figures, the effect of foreign competition being also complained of in this branch of industry.

In the steel trade only a very quiet business continues to be reported with low prices ruling. Ordinary foundry hematites do not now average more than 52s. 6d. to 53s., less 2½; ordinary basic billets, £4 net cash; steel bars, £6 to £6 2s. 6d.; and boiler plates, about £6 5s. per ton, delivered in the Manchester district.

In the metal market list rates for manufactured goods remain unchanged, but buyers continue to purchase only in the smallest possible hand-to-mouth quantities.

The position as regards the engineering industries still shows no indication of improvement; in the locomotive building trade especially the outlook is most discouraging, and I hear that one of the largest firms in Lancashire may possibly have to close altogether before very long, owing to the entire absence of new orders coming forward.

The reports of the engineering trades union organisations show no appreciable change in the position, except that the returns of unemployed members are rather more favourable than they were last month. The returns issued by the Amalgamated Society of Engineers show a slight decrease in the number of members in receipt of donation benefit, but there are still very nearly 9 per cent. of the total membership in receipt of out-of-work support. In the Manchester district there has been a steady but small decrease in the number of unemployed members during the past fortnight; the position is, however, still anything but satisfactory, as very nearly 10 per cent. of the local membership continue in receipt of out-of-work support.

The Steam Engine Makers' Society also reports a slight decrease in the number of unemployed members, although not sufficient to have any appreciable effect, as there are still over 5½ per cent. of the total membership in receipt of donation benefit. With regard to the general condition of trade, the reports from the various districts continue very unsatisfactory so far as any immediate prospects of improvement are concerned; in some important districts the tendency is even towards a further decline, and it is only here and there that any increasing activity is reported. The general conviction amongst the leading officials of the trades union organisations is that no improvement in the engineering industries can be looked forward to, at any rate during the present year, but the executive of the Amalgamated Society of Engineers are, I understand, in possession of information which is regarded as of a very trustworthy character, that with the ensuing spring there is every probability of decidedly improved conditions.

The winter discussion session of the Manchester Association of Engineers should prove an attractive one for the members, as the syllabus contains a number of specially interesting papers. Mr. J. Holliday, of Dublin, is to contribute a paper on "The Cost of Steam Raising," and this will be followed by a contribution by Mr. James Atkinson, M.I. Mech. E., on the "Modern Development of the Gas Engine." Mr. Joseph Nasmith will deal with the recent considerable developments of "Prepayment Meters," which are now so largely adopted by gas-users in small dwellings. A specially interesting paper will be one by Messrs. D. Selby-Bigge and G. H. Firth on "Electricity as the Future Motive Power in the Textile Industries." Mr. J. West, M.I.C.E., of Manchester, who is an authority on all questions connected with the application of gas, is to read a paper on "Gas-lighting for Workshops," and Mr. R. H. Tweddell, M.I.C.E., will contribute a paper on "Hydraulic Machine Tools," with regard to which he is also a well-known authority, whilst one evening is set apart for an open discussion, to be opened by a communication from Mr. A. Saxon, on "Steel Castings."

The coal trade still shows no appreciable improvement, except so far as the season of the year brings forward the usual increased demand for housefire consumption. This is enabling many of the collieries to get into more regular work, and tending to stiffen up prices for the better qualities of round coal, but there is no really upward move, except that list rates are being more firmly adhered to, best Wigan Arley now fetching 11s. up to 11s. 6d., with Pemberton four-foot and seconds Arley quoted at 10s. to 10s. 6d., and common house-fire coals about 8s. to 8s. 6d. at the pit mouth. Other descriptions of fuel for iron-making, steam, and general manufacturing purposes still meet with only a very slow sale, with supplies plentiful, engine fuel being if anything even more of a drug upon the market, owing to the increased production of slack, resulting from the larger inquiry for house-fire coals. Steam and forge coals at the pit mouth do not average more than 7s. to 7s. 6d. per ton, and the outlook with regard to this class of fuel is anything but encouraging, as there would seem to be a probability when the shipping season to the Baltic ports is closed that a considerable quantity of common round coal from the Yorkshire district may be forced upon this market, and already there are indications that some of the Yorkshire coalowners are seeking for inland business at prices under their current quoted rates. There are also large supplies of engine fuel coming in from other districts at extremely low figures, Derbyshire slack being offered at as low as 1s. 6d. to 1s. 9d. at the pit mouth, and prices generally show a weakening tendency. At the pit mouth, Lancashire slack averages 3s. 6d. to 4s. for common sorts, 4s. 6d. to 5s. for medium, up to 5s. 6d. for the best qualities, and to effect clearance sales specially low rates are frequently quoted.

In the shipping trade a moderate business is still reported, with ordinary Lancashire steam coal ranging from about 8s. 6d. to 9s. per ton, delivered at the Garston Docks or the High Level, Liverpool.

*Barrow.*—During the past week smelters of iron in North Lancashire have not done a very big business; in fact, rather the reverse is the case. Although there has been a certain amount of firmness in the market towards the end of the week, there has been no appreciable difference in the demand. Consumers on every hand have few requirements, and are only placing small orders. Steel makers are using fair supplies, and are likely to want more; in the meantime, however, the trade doing is small, and the same inertness that has been so noticeable for so long is very prominent. Prices are much about the same, being easy. Makers are asking 44s. 6d. to 45s. 6d. per ton for parcels of mixed numbers of Bessemer iron, and in the warrant market holders are asking 43s. 4d., with buyers offering 43s. 3d. per ton, net cash. Thirty-three furnaces are blowing, and their output is quite sufficient to cover the wants of consumers, for the stores of iron had been added to during the week to the extent of 20 tons, making the total held 158,510 tons.

The steel trade is still quiet. The demand for steel shipbuilding material continues to be small. Some fair orders are held for Barrow and Belfast builders, and the mills at Barrow are likely to be fairly employed for a while yet. In the meantime there are some orders in the market. Ship-plates are at £5 7s. 6d., angles at £5 10s., and boiler-plates at £6 per ton. The inquiry for rails is without change, and little is doing. Heavy sections are at £3 15s., light rails at £5 5s., and colliery sections at £5 10s. per ton. There is a fair demand for tin-plate bars, and it is expected that this inquiry will be considerably strengthened in the immediate future. The current quotation is £3 17s. Other sections are very poorly inquired after, and next to nothing is doing.

There is a fair amount of activity noticeable in the shipbuilding and engineering trades. Shipowners are, however, not very much disposed to place orders just at present.

The demand for iron ore is quiet, especially on general account. Average sorts are at 8s. 6d. to 9s. per ton net at mines.

East-Coast coke is in fair demand at 17s. per ton delivered.

The shipments of iron and steel from West-Coast ports for the past week reprecent 9100 tons, as compared with 13,325 tons in the same week of last year, a decrease of 4225 tons. The shipments to date stand at 591,086 tons, as compared with 596,167 tons last year, a decrease of 5080 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE variable weather we have had during the last ten days has unfavourably affected the house coal trade, but there are now evidences of its becoming firmer. The advance of 6d. to 1s. per ton has been generally obtained, and at the date of writing the cold has set in, accompanied with damp, which is certain to cause householders to complete stocking for the winter. Although the demand in the Barnsley district has fluctuated considerably, business has now become somewhat steadier, and a considerable number of collieries are working the full time. New sinkings are being proceeded with at Hickleton Colliery, which, with the commencement of the work at Grimethorpe, will materially increase the output of the district. The Mitchell Main Colliery Company, to which the new workings at Grimethorpe belong, has taken over the Darfield Main pits, and when the new collieries at Grimethorpe are completed, the company's operations will extend to an area of underground work of three miles. With a yearly output of marketable coal increased to one million tons, the Mitchell Main Company will take its place in the front rank of English collieries. Other owners are at present employing colliery engineers to test the coal boundary of their land with a view to extension. These investigations are mainly confined to the Silkstone bed. The metropolitan demand is reported to have been merely moderate. Silkstones fetch from 8s. 6d. to 11s.; Barnsley House from 8s. 9d. to 9s. 6d. per ton; second qualities, from 7s. per ton upward—all prices at the pit. In steam coal values continue steady, Barnsley hards making 7s. 9d. to 8s. 9d. per ton; inferior slacks from 7s. 6d. per ton. Heavy deliveries are being made to railway companies on account of contracts. Gas coal is quoted at from 7s. to 8s. 6d. Manufacturing fuel is somewhat depressed, owing to the small demand in the textile districts. Good slacks are from 4s. 6d. to 5s. 6d. per ton; pit slack, from 3s. 6d. per ton.

The position taken up by the colliery enginemen, boilermen, and firemen is not quite so acute as it was last week. Although their Union, which is not associated with the Miners' Union, had decided to adhere firmly to their demands, and to stand by the notices they sent out a fortnight ago, a more conciliatory attitude prevailed at the last conference with the coalowners held at Sheffield on Monday. It was then arranged that the notices which would have expired this week should be withdrawn and work continue, pending another meeting of the coalowners to be held a fortnight hence at Sheffield. Had this arrangement not been made, and the men still adhered to the position taken up at Barnsley, a serious rupture was inevitable at the Yorkshire coalfield, for the pits could not possibly go on working without the colliery enginemen and their colleagues. It is not expected that the difficulty will lead to any stoppage in the coalfield.

A better demand for crucible steel is reported from the Continent, but the fresh business is not evenly distributed, several firms being well employed, while others complain of want of work. Taken all round, however, the crucible steel trade is reported to be more active than in the corresponding period of 1892. Last year, of course, very little was doing owing to the stoppage of the collieries.

Bessemer billets are quoted at £5 10s.; bar iron, £5 10s. to £5 15s.; wire rods, £5 5s.; and rope rods and high carbon rods, £8 8s. per ton. The iron market is very much as last reported, hematites being at 50s. to 52s. 6d. per ton, according to brand; while common forge iron is quoted at 38s. 6d. per ton in Sheffield, with supplies considerably in excess of the demand.

An important order for armour-plates was received in Sheffield this week from the British Admiralty. If these orders for armour-plates were followed by a revival in the shipbuilding yards and some signs of activity in the construction of foreign railways, Sheffield would soon be extremely busy. As it is, the war material branches are about the only departments in which full employment is given. No doubt the low freights for cargoes militate against shipowners adding to their fleets, and the unsatisfactory traffic returns are responsible for the holding back of orders for railway material. A good deal of wagon work has been locally placed, but the facilities for production are so great that even large orders are soon completed. Engineering firms report that business is not as good as it ought to be. Boilermakers, on the other hand, are well off for work, and there is, perhaps, no branch of our heavy trades in which more progress has been made of late years.

In the lighter industries both the silver and cutlery trades are feeling the season demand for goods adapted for Christmas and New Year. With the setting-in of the winter demand many novelties in electro-plate, silver and Britannia metal have been placed upon the market. Some of the leading firms are working extra time, and will continue to do so up to the end of the season. A distinct feature of the silver trade is the demand for sterling silver goods. The low price of silver narrows the difference between these goods and the best quality of electro-plated nickel. Customers therefore prefer to pay the extra cost to have their table appointments of silver. There is more doing in cutlery, and the next returns of the United States Consulate will maintain, if not exceed, the satisfactory increase reported on the 30th of September last. It is said that the American market is taking an unusual quantity of second-rate cutlery from Sheffield. This is rather against the usual way of the Americans, and may probably be but a temporary feature of the trade. Orders are undoubtedly coming in very freely, and prospects are decidedly more encouraging. The Tariff favours the commoner grades of cutlery more than the expensive brands, and this probably accounts for purchases running so much in the cheaper qualities. There is more doing in our own home markets, season orders having come to hand earlier than in previous years.

In addition to the Antwerp awards already announced, Messrs. William Lockwood and Co., Ocean Works, St. Mary's-road, Sheffield, have been awarded two silver medals for their patent flangeless piston rings. This is the highest and only award for piston rings.

The Liverpool ivory sales have been held this week. There were only about seventeen tons on offer. The American buyers were present in force, and purchased freely. Prices went up from £10 to £12 per cwt.

Mr. Emerson Bainbridge, J.P., of the Nunnery, Blackwell, and other collieries, and who is also chairman of the East to West Coast Railway, has contributed a thoughtful and effective article to the *Contemporary Review* this month, bearing on the eight hours question. Mr. Bainbridge, since its publication, has received a number of letters on the subject. One is from Mr. Henry Simon, of Mount-street, Manchester, who informs Mr. Bainbridge that amongst the instances which he gives of foreign, especially Belgian work, introduced into this country, there is omitted what he—Mr. Simon—considers to be the most glaring instance of this foreign competition, viz., the fact that the comparatively new railway station at Middlesbrough is, as a local ironmaster told him some time ago when there, "every pound of it Belgian iron." "What are we to say," asks Mr. Simon, "if the capital of that iron district which produces the cheapest gets its station ironwork from Belgium?" Mr. Simon adds that while his personal inclinations, wishes, and moral feeling are distinctively in favour of allowing the labouring classes, and everybody else, the largest possible share of the comforts of this life, he cannot but entirely admit, with Mr. Bainbridge, that the way in which this eight hours movement is now progressing is simply hastening the inevitable moment at which England's pre-eminence in trade will begin to rapidly decrease. "All large strikes," he holds, "are so many invaluable helps to foreign industries. Considered from a continental and humanitarian standpoint, the advantage may probably be seen in this policy; but do the working classes really intend thus unselfishly to help their foreign competitors?" Most people will think with him that they do not; the explanation being their utter incapacity to see the folly which they are perpetrating. They have some capable, intelligent men amongst their leaders, and surely the time cannot be far distant when the more thoughtful of these people will declare the doctrine of sound business plainly to their constituents, whether it offend them or whether it please them.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

MORE cheerful reports are this week given by iron and steel manufacturers relative to the state of trade, and certainly there is not that amount of pressure to sell that has been shown hitherto this month and for a part of September. The speculative fraternity, who have been operating in iron, appears to have recovered confidence, and are not disposed to further depress prices by putting so much iron upon the market. It is pretty well recognised that there has been no change in the condition of trade to justify the relapse in prices that has recently taken place, and that if speculators had not rushed their iron upon the market, prices might have been kept up. Trade is undoubtedly better than it was last year, as may be seen from the railway traffic returns, and the production and shipments of pig iron; indeed, it may be said that this year's production and exports of pig iron exceed those of any previous year, while the increase of stock has been only small, and is very much less than it was in almost every year of the past ten; in fact, in one year at the end of September North of England pig iron makers and the warrant stores held four times as much iron as they do at present—nearly 730,000 tons. The average quoted price of No. 3 Cleveland pig has also this year exceeded that of last year by fully 1s. per ton, being this year no less than 35s. 10d., which is considerably above the figure that has ruled in at least half of the last ten years. The finished iron and steel trades have not been anything like so good this year as they might have been if business had not been hampered by the strikes of the engineers, moulders, and patternmakers, which has seriously affected the output of the shipyards, and consequently of the plate and angle mills, which in this district depend upon them for the bulk of their work. Work has been thrown back so much that there are now vessels that have been waiting for their engines four months or more.

Sales of Cleveland pig iron have been more numerous this week than they have been for some time past, the chief demand being for No. 3, which is scarce, and which is needed for export. In this month the shipping demand is always extra brisk, as it is the last of the northern navigation season, and consumers abroad who get their supplies through Baltic ports have to get in what they will need in the winter. But the exports are not nearly so good as they were last year; thus this month to Wednesday night the pig iron exports from the Tees reached 46,310 tons, as compared with 37,915 tons last month, and 58,142 tons in the corresponding month last year to 17th. Makers have generally this week been quoting 36s. per ton for prompt f.o.b. deliveries of No. 3 Cleveland pig, and some of the leading firms whose stock is almost *nil* have asked and secured even 3d. more. But merchants and some producers have been selling at 35s. 9d., and they were ready to accept 36s. for forward delivery. Cleveland warrants have not been largely offered, and the extent of the fluctuations in price this week has only been 1½d. per ton.

The stock of Cleveland pig iron held by Messrs. Connal and Co. on Wednesday night was 89,067 tons, or 678 tons decrease this month.

No. 4 Cleveland foundry pig has shown considerable improvement in demand, and as the supply is hardly equal to the requirements the price has advanced 3d. per ton, thus restoring the ordinary difference between the prices of No. 3 and No. 4 foundry, which is 6d. per ton, but which difference has not existed for a very considerable period, the commoner quality being relatively cheaper than No. 3, as it has been more plentiful. Forge qualities have not advanced because the supply is in excess of the requirements, and these qualities have again become "a drug upon the market." Grey forge can be bought at 34s., and is thus 1s. 3d. cheaper than No. 4 foundry pig, though the usual difference is no more than 6d. The supply of East Coast hematite pig iron is greater than the consumption, and the price of mixed numbers has dropped to 42s. 9d. per ton, though ore prices are tending upwards, and it does not appear likely that any reduction in the cost of production will be effected.

At the quarterly meeting of the Middlesbrough Chamber of Commerce a communication was read from Mr. Jeremiah Head, of Middlesbrough, which showed that in a certain district in the United States pig iron was being produced at less cost than in Cleveland, and was sold at a lower price than has ever been touched for Cleveland iron, 29s. being the lowest ever reported for No. 3. Mr. Head has been in the United States for some time on professional business, and has visited the region in question. It is in Alabama, and Mr. Head says of it that it is the "Cleveland" or cheap common iron centre of America. Pig iron containing half the phosphorus that there is in Cleveland pig iron is being made there at a cost price at works, including all except debenture interest, of 24s. 2d. per ton, and is being sold at from 26s. to 29s. per ton on trucks at works; 28 lb. per ton extra over 2240 lb. is allowed for sand. This pig iron is finding its way into every part of the United States, even into Pittsburg. As yet it has not been used for steel. Large cast iron pipes up to 60in. diameter are being made and sold at £3 15s. 6d. per ton at works, and are forwarded to all parts of America. They are not quite so well finished as Ormesby pipes, but are good enough. Under circumstances like these there does not appear much chance for England exporting pig iron or pipes to the United States, notwithstanding the more favourable Tariff Act that has been passed.

A rather better demand is reported by some of the finished iron and steel manufacturers. It is satisfactory that Messrs. Dorman, Long, and Co. have this week recommenced operations at their West Marsh and Britannia Iron and Steel Works, Middlesbrough, after a stoppage of about two months, during which they have added considerably to their plant. On the other hand, the Dar lington Steel and Ironworks have been entirely closed, and the directors, at their meeting on Monday, stated that the condition of trade did not encourage them to look forward to an early resumption of operations. It is, therefore, thought advisable to realise the floating assets of the company, without, however, disposing of any of the loose plant or tools, which would be needed to re-start the works. Out of the money thus obtained the liabilities will be met, and the meeting was adjourned for a month to permit this to be completed. Ship-plate makers are fairly well employed, notwithstanding the dulness in the shipbuilding industries. At the shipyards on the Tees and at Hartlepool at least 40 per cent. of the men usually employed at the shipyards are idle, and a hard winter is looked for; as Lloyd's returns show there is much less work booked now than there was in the early part of the year. Thus on the Wear there are only 32 vessels of 85,653 tons, against 43 vessels of 112,025 tons a year ago; on the Tyne 53 vessels of 131,773 tons, against 51 of 121,956 tons; on the Tees, 21 vessels of 45,252 tons, against 25 of 65,170 tons; and at Hartlepool and Whitby, 13 vessels of 37,259 tons, against 18 vessels of 47,630 tons. Still at present the steel-plate and angle makers are fairly well employed, and maintain their prices. The same figure is quoted for iron as for steel plates —£4 17s. 6d., less 2½ per cent. f.o.t.—as it costs more now to produce iron plates than to roll steel plates. Iron ship angles are £4 12s. 6d., and steel ship angles £4 15s., both less 2½ per cent. and f.o.t. Heavy steel rails are at £3 12s. 6d. net at works, and a rather better inquiry is reported. Many of the moulders who have been on strike are still unemployed, the masters being unable to find work for them, as orders have been driven to other districts. A considerable proportion of the engineers are likewise unable to work.

Some of the ironmasters are again, as is usual in the autumn season, being put to inconvenience owing to lack of trucks, and the question has been under the consideration of the Middlesbrough Chamber of Commerce, who have asked the firms to keep a record of the short supplies, together with details of delay, loss, and expense incurred, so that definite evidence may be forthcoming in case an appeal has to be made to the Railway Commissioners. The North-Eastern Railway managers have asked some of the firms to give them an idea as to what they will require in the way of goods wagons over the next five years, and other questions as to the probable lives of their collieries, &c.

At the meeting of the North-East Coast Institution of Engineers and Shipbuilders, held at Newcastle on Tuesday, the Council reported that the number of members was 954. The President—Mr. Thomas Richardson—delivered his inaugural address, in which he dealt with the question of economical production and the competition of foreign countries. He deprecated the doctrine which is so often made use of, as to our superior capacity as handicraftsmen, and stated that the extended and universal adoption of machinery had enabled the foreigner to compete with us—and especially was this so in the engineering industry. The President also touched upon the application of electric driving of machinery at home and abroad, and showed that there was a large saving in steam power by the use of the electric system of working, as well as a considerable reduction of labour.

The coal trade continues active, notwithstanding that there is less required for Scotland, but the export demand is strong, and merchants are anxious to get as much coal away as possible this month. Wages in the Northumberland coal trade are not to be changed this quarter, as the Conciliation Board has found that though trade was so brisk last quarter, prices were not materially raised. The Northumberland collieries generally are working eleven days per fortnight, which is full time, and in Durham there are very few pits which are not in full operation.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE is a rather better feeling in the iron market, with still much room for improvement. Scotch warrants have been fairly steady, with only a moderate business. Buyers are acting with caution, for although the miners' strike is now practically over in the West of Scotland, it is not yet quite clear whether business is likely to come away with anything like activity. Transactions have taken place at 42s. 6½d. and 42s. 6d. cash. There is very little inquiry for Cleveland warrants, which are worth nominally 35s. 5½d. cash. Cumberland hematite has been weaker, declining from 43s. 5½d. to 43s. 3½d. cash.

The blast furnaces are now being steadily relighted, about twenty having been added to the active list within the last ten days; the number blowing is, however, still much smaller than at this time last year. Several weeks must elapse before the furnaces now going in will be in a position to make their full complement of pig iron. Several brands continue very scarce, and the prices of these are fairly steady, but the general tendency of values is downwards, some brands having fallen from 6d. to 2s. 6d. per ton in the course of a week.

The following are the current prices of makers' pig iron:—G.M.B. f.o.b. at Glasgow, No. 1, 44s. per ton; No. 3, 42s. 6d.; Monkland, No. 1, 47s. 6d.; No. 3, 42s. 6d.; Carnbroe, No. 1, 47s. 6d.; No. 3, 46s.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie, No. 1, 52s. 6d.; No. 3, 48s. 6d.; Calder, No. 1, 53s. 6d.; No. 3, 49s. 6d.; Summerlee, No. 1, 55s.; No. 3, 50s.; Coltness, No. 1, 56s.; No. 3, 51s.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 49s. 6d.; Eglinton, No. 1, 48s.; No. 3, 46s.; Shotts at Leith, No. 1, 57s. 6d.; No. 3, 51s. 6d.

The market for hematite pig iron is a little more active as far as regards business done direct with the producers; while there seems no inducement to speculation, it is evident that the requirements of consumers are bound steadily to increase. The import trade in Spanish ore has been resumed, and freights are very moderate, enabling smelters to obtain supplies at comparatively easy rates.

The pig iron shipments are extremely small, amounting in the past week to only 1859 tons, compared with 3455 in the corresponding week. Of the total there was sent to Australia 155 tons, Germany 128, United States 100, Canada 80, Italy 100, Holland 50, Belgium 10, Spain 20, other countries 30, and coastwise 1186, against 1022 same week of 1893.

The finished iron and steel branches are getting into a rather more encouraging attitude, the works are being put in operation more fully, and makers are preparing for any demand that may arise; meantime business is on a restricted scale, and prices are nominal.

The export trade in manufactured goods is quiet. The past week's shipments from Glasgow embraced sewing machines worth £256; other machinery, £5321; steel goods, £3943; and miscellaneous iron goods, £13,952.

Reports with reference to the locomotive engineering branch are favourable, the principal firms have good orders in hand both for home and foreign railways. General engineers are but moderately employed. In the tool making branches business is irregular, some houses doing next to nothing, while others are fairly busy.

The strike of miners in the West of Scotland may now be said to be over, for although companies of men here and there still hold out in expectation of obtaining support from the English Federation, the great majority of the men have given up the struggle as hopeless, and made a rush for employment. This many of them are unable to find, owing to the roads and workings of the collieries being out of repair. While the quantity of coals raised is still limited, it proves more than equal to the demand, so that a further reduction has taken place in prices. The fall in the retail price of household coals in Glasgow in the course of the last three weeks has been about 40 per cent. Of course, by-and-bye, the public works will absorb much larger quantities, and the shipping trade is likewise expanding gradually. A fair demand is springing up for the Mediterranean from Glasgow, the clearances there in the past week amounted to about 22,000 tons. The loss in exports, owing to the strike, amounts to upwards of 2,000,000 tons, and this, it need hardly be said, will never be made up.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A SIGNIFICANT fact of the week is that steamers in the course of a day or two will be loading no less than 5000 tons of tin-plates at Swansea, principally for the United States. This is not only encouraging for the great tin-plate centres, notably, Swansea, Llanelly, Briton Ferry, and the Newport district, but also for the iron and steel works. Ironmasters are quite satisfied that until new countries are opened out rails must play a very secondary part; and it is to tin-plates and to the increasing uses of steel in the country that they look for business. I lately saw in Radnorshire terne plates adroitly used as garden fences, and reported to be cheaper than brick or stone masonry. The artisan placed them himself, and saved the labour of mason.

Last week the Swansea shipment of tin-plates was 60,469 boxes, make received from works 69,201 boxes, showing a good deal of activity, and proving that a more settled condition of things exists amongst the workmen. So far prices have not moved, but a few consignments such as will be recorded next week will leave stocks much below an ordinary level, and lead to improved quotations.

In the Newport district a better tone prevails amongst tin-platers, and I note that in the Briton Ferry district a good average make is recorded. This week the Earlswood Tin-plate Works, Briton Ferry, which have been idle for a year or so, were re-started. These give employment to 140 hands.

Dowlais steel works this week were as busy as I have seen them for some time, both the upper and lower works, and at Cardiff not only is a good make of pig maintained, but steady progress made in completing the works. Probably in two or three months this will have been accomplished.

There has not been much doing in rails, with the exception of some despatches to Highbridge. The make of steel bar has been moderately good. Blaenavon, Cyfarthfa, and Ebbw Vale maintain fair activity in mills and furnaces. Tredegar and Rhymney are putting forth their best efforts in coal development, and in the manufacture of coke; and as I note this week but few arrivals of pig iron—only one small one coming in from Ardrossan—there is a prospect that the heavy stocks I saw lately at various works will have a chance of being lessened. Swansea imported this week 200 tons steel scrap, and 2600 tons of iron ore. Of the latter Ebbw Vale and Dowlais also received large cargoes.

Swansea quotations this week are only slightly altered from those of last week. Glasgow pig is a little improved, 42s. 5½d. to 42s. 6½d.; Middlesbrough, 35s. 5½d.; Middlesbrough hematite, 42s. 4½d. Welsh bars remain at £5 2s. 6d.; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s. Cardiff quotation for rails, heavy, is £3 12s. 6d.

Other Swansea quotations are:—Sheet iron, £6 to £6 10s.; steel sheets, £6 5s. to £6 7s. 6d., with usual extras for higher gauges; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens tin-plate bars, £4 to £4 2s. 6d.; tin-plates, makers' quotations, Bessemer, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; ternes, per double box, 28in. by 20in., 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; wasters, 6d. to 1s. less in each class. Block tin £69 7s. 6d. to £69 10s. Anthracite coal, 8s. 9d. to 12s. 6d., according to quality.

The coal trade continues vigorous, and shipments have been considerable at all ports. Good healthy vitality is very noticeable in the Newport district. Some labour troubles have affected the output of certain collieries, and perhaps kept prices up more firmly. On Saturday best steam was quoted at 12s.; the latest quotation now is 11s. 6d. to 11s. 9d., Cardiff. Other prices are:—Seconds, 11s. to 11s. 3d.; best Monmouthshire, 10s. 3d. to 10s. 9d.; dry sorts, 10s. to 10. 3d.; small, 4s. 9d. to 5s. 3d. House coal has kept up remarkably well, and now a good season is evidently before this class of coal. Even now, before the autumn has disappeared, there is a pressure of business, and prices may be expected to advance. Best household commands 11s. to 11s. 3d.; No. 3, Rhondda, 10s. 3d. to 10s. 6d.; brush, 8s. 6d.; small, 6s. 6d. No. 2 Rhondda, 8s. 6d. to 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 6d. to 4s. 9d.

Cardiff quotations for pitwood are 15s. to 15s. 3d., demand good, but market glutted. Patent fuel active, 11s. to 11s. 6d. Coke tolerably brisk; furnace, 15s. to 16s.; foundry, 17s. to 17s. 6d.; special, 21s. Swansea exports of patent fuel only moderate; principal cargoes last week were, 2470 tons to France, 1300 to Italy, 1290 to Algiers. Iron ores quieter, prices remain—Cardiff, 10s. to 11s. 3d., according to quality. Swansea to 12s.

A new labour difficulty has cropped up amongst the tin-plate men, not this time against employers, but against their doctors, who are agitating for increased fees. Present rates are, men, 8d. per month; boys, 4d. The doctors now demand 1s. adults, and 6d. boys, and the ballot box is to be brought into requisition to settle the dispute.

The prominent subject at Cardiff of late has been the probability of the Bute Docks being acquired by the Corporation and then of the formation of a Harbour Trust. A leading official of the Docks is reported to have said that the "one man rule" is coming to an end. With all respect for the official I do not believe it. The Taff Vale Railway objection to join has to be considered, and leading authorities at Cardiff urge that the amount required by the Bute Docks Company is such that in borrowing money to meet it no limited liability company could float. A few weeks will see whether anything will come of it. The Barry Docks' directorate have written to inquire the particulars of the Harbour Trust, as suggested by the Corporation.

The Birmingham water scheme continues to make good progress amongst the Radnorshire hills. Over 600 men are now comfortably hutted for the winter, and in the spring this number is to be increased considerably. The district is well wooded, and one of the initiatory steps is being taken in levelling the trees, many of which are very fine. Nantgwilt, where the principal engineer resides, was surrounded with a belt of wood, which is nearly cleared. Shelley the poet made this a place of exile, and we see that a local contemporary has suggested that Birmingham—in keeping with her traditions—should utilise some of the timber in making mementoes of the poet.

The dispute of the National Colliery Company, Wattstown, has been brought to trial. A fortnight ago the company summoned twelve of its men for absenting themselves without notice. The men's contention was, that the company had introduced new method of screening, and the result was one thousand men left work. The summons of twelve of these was an initiatory step. On Monday the trial took place before the stipendiary magistrate, Mr. Ignatius Williams, at the Tonypandy Police Court. Employers and men were ably represented, and at the close the magistrate ruled that the employers had violated a clause of the sliding scale agreement —No. 20 A—and that the men were entitled to refuse to work under the new system. Verdict for men, with solicitors' fees and costs.

Four hundred men at Rudry are at stop, but it is hoped that the slight difficulty will soon be removed. The Llanbradach men, No. 2 seam, continue to refuse filling trams until there is a revised price list.

The Llancriach Collieries Company has been registered with a capital of £15,000 in £10 shares.

The Institute of Marine Engineers, Bristol Channel Centre, had their annual gathering in Cardiff on Saturday. There was a large attendance, Professor A. C. Elliott in the chair. Capt. Pomeroy, responding to the toast of the port of Cardiff, said that imports and exports were advancing. The former now totalled two million tons per annum.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

A MODERATE business continues to be done on the continental iron market, and prices are fluctuating, with a downward inclination here and there. The position of the iron and steel trade in Silesia has not in any degree improved upon the week. Offers are being made at extremely low quotations, but still buyers show little inclination to come forward with their orders. The bar trade forms an exception to the rule, being in comparatively good activity, and there is also a tolerably fair business done in tubes.

Since previous letters very slight changes only can be noticed on the Austro-Hungarian iron market. In pig iron prices have stiffened a little, owing to the scarcity of that article. The rolling-mills are, as a rule, in fair employment, merchant bars meeting with a satisfactory demand. The girder trade is tolerably lively, while makers of steel plates and rails complain of a poor employment. Quotations for the different sorts of iron and steel are the same as last given.

The returns as to the condition of the French iron trade generally continue quite satisfactory. There is an undeniably increasing demand coming in for most sorts of iron, though several large contracts which had been counted upon as quite certain have not been given out at all; but there is, nevertheless, a sufficient amount of new work offering to keep the works in fairly regular activity. The tendency of prices is firm, but makers have, as yet, not ventured upon an advance, because they fear to be met with a strong resistance on the part of consumers. In the Department Nord the situation of the iron business is less hopeful, and some firms even fear that they will have to reduce quotations, at least for some articles. Hardware is generally neglected. In the Department Meurthe et Moselle pig iron is well maintained in spite of the exceedingly firm quotations for coke. Forge pig meets with a particularly good inquiry, while foundry pig is but weakly called for.

Business on the Belgian iron market has slightly increased in firmness, pig iron, as well as most sorts of malleable iron, meeting with a tolerably fair request. Prices of pig iron are rather easy on account of the large quantities of Luxemburg forge pig that is still thrown on the Belgian iron market, but for most sorts of finished iron quotations are well maintained, and a pretty confident tone generally prevails.

On the Belgian coal market prices have not altered for several weeks, only in the Liége district an upward inclination was to be perceived. With regard to the Belgian coal trade during the first eight months of last and of present year, import in coal is reported to have been 869,079 t. this year, against 865,810 t. for the same period the year before. Of these 397,082 t. were imported from Germany, against 366,462 t. in 1893. French and English import, on the other hand, has decreased. In coke, 214,862 t. were imported, against 162,959 t. for the same period the year before, which shows an increase of 52,000 t. This may chiefly be accounted for by the increasing import of coke from Germany, which was 158,460 t. in 1893, against 208,376 t. this year. Export in coal amounted to 2,748,820 t., against 2,735,237 t. in 1893, of which 141,187 t. were sent to Germany, against 149,877 t. in the year before; 2,166,830 t. were exported to France, against 2,161,075 t. for the same period in previous year. In coke, 577,161 t. were exported, which, compared to 605,062 t. in last year, shows a decrease of about 28,000 t.

There is no change, generally speaking, in the Rhenish-Westphalian iron business. The demand remains quiet, and quotations are still far from satisfactory, but makers show a fair confidence in the future, and are, for the present, content if they can secure sufficient work to keep their concerns going. The position of the iron ore trade is not favourable, most sorts being in very moderate request. Prices are the same as formerly quoted; for spathose ore M. 7·40 to 7·70 p.t. is given, while roasted ditto is paid with M. 10 to 11·20 p.t. at mines; inferior sorts cost M. 9·80 to 10 p.t. net at mines, and for Nassau red iron ore the old price of M. 9·20 p.t. is given. In Luxemburg and Lorraine, minette, 40 p.c. grade, is still to be had at M. 3·20 p.t., while for minor qualities M. 2·40 to 2·60 p.t. is quoted. On the pig iron market prices are, without exception, very firm. In the Siegerland the demand for present quarter is pretty regular; from abroad there has also been quite a fair inquiry experienced lately, and a large contract for forge pig has already been secured for the first two quarters of 1895. Spiegeleisen, 10 to 12 p.c. grade, still stands at M. 52 p.t., forge pig No. 1 is paid with M. 46 to 47 p.t., while for No. 3, M. 40 p.t. is given. Siegerland, good forge quality, quotes M. 44 p.t.; hematite, M. 63; foundry pig, No. 1, M. 63 p.t.; No. 3, M. 54 p.t. Basic is still paid with M. 45 p.t., while German Bessemer fetches M. 49 to 50 p.t. at works. Luxemburg forge pig costs M. 48 p.t. free Luxemburg. So far as prices are concerned, the situation of the malleable iron trade is less favourable than that of the pig iron business. Prices continue extremely depressed, and if an actual reduction does not take place, it is simply because prices have reached the very lowest point, covering not even the cost of production. Some works will have to suspend operations altogether unless an improvement in quotations sets in. The bar trade is in poor employment generally. If it was not for orders previously booked, the mills could hardly be kept going. Girders are in tolerably good demand, and so are hoops, for which a rising tendency in prices can be noted. Plates are still without improvement, and sheets have in some instances even decreased in demand. From abroad next to no orders are coming to hand. The state of the wire business continues extremely unfavourable. Only a small number of the iron foundries and machine factories are in good employment, the majority of the mills complaining of an almost total absence of fresh orders.

The following are the latest list prices per ton at works:—Good merchant bars, M. 105; rivet iron, M. 125; angles, M. 120; girders, M. 90 to 95; hoops, M. 108 to 115; billets in basic and Bessemer, M. 87; heavy plates for boilermaking purposes, M. 150; tank ditto, M. 130 to 135; steel plates, M. 125; tank ditto, M. 115 to 120; sheets, M. 140; Siegen thin sheets, M. 125 to 130; iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 103 to 120; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 115; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; light section rails, M. 95.

NEW BRIDGE OVER THE WELLAND—AN ENGINEERING FEAT.—The new bridge which has been built for the Midland and Great Northern Railway Companies by Messrs. Handyside and Co., of the Britannia Ironworks, Derby, and London, was on Sunday, the 7th inst., placed in position over the river Welland at Spalding. The line being a single one, it was necessary to keep the old bridge in position for the working of the line up to the very last moment, and the new bridge had therefore been erected by the side of the old one. The last train passed over the old bridge at 9.30 a.m., and it was then lifted by hydraulic jacks and moved bodily away in seven minutes. It was shifted in the direction of Spalding Town by steam power, being run along a set of rails placed on either side of the river bank. The new structure, which is of three steel lattice bar girders, was then wheeled into its permanent position. The new bridge weighs over 200 tons, has a total span of about 111ft., is 34ft. wide, and was shifted into its present position in five minutes. The new bridge was tested by two fully loaded engines, each weighing about 80 tons, and about 4.30 a cattle train from Lynn passed over. The whole of the work was completed, and the roadway made good, within four hours. The bridge was designed by Mr. Richard Johnson, M.I.C.E., and its erection was carried out under the supervision of Mr. C. A. Kirby, M.I.C.E., of Boston.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, October 11th.

The business situation is discouraging. Bank clearings are 22 per cent. below last year at this date, and 28 per cent below 1892 for same nine months. During the past three weeks there has been a fall in iron, steel, lumber, cotton, cloth, wool, coal, and coke. Numerous wages reductions have been made. The banks are overloaded with money, and speculation is at a standstill. Manufacturers are slow to contract for raw material. Consumers are covering present requirements. For iron there is increased activity at lower prices for girder rails, sheet and bar iron, but makers regard it only as a spurt. A steady improvement is not anticipated until after November 15th. New work of all kinds is freely projected for prosecution next year, and money is liberally subscribed under conditions. The improvement in trade and manufacturing will probably be slow during the winter, but an expansion of demand to unusual proportions is regarded as the inevitable result of prolonged restriction.

## LAUNCHES AND TRIAL TRIPS.

On Saturday Messrs. Caird and Co., of Greenock, launched a large new passenger steamer, built to the order of the Peninsular and Oriental Steam Navigation Company. The steamer, which is named the Simla, is intended for their India, China, and Australia mail services. She has a gross register tonnage of nearly 6000 tons, and, besides having accommodation for 145 saloon passengers, has a large cargo capacity.

On the 15th inst., Messrs. Ropner and Son launched a steel screw steamer of the following dimensions:—Length over all, 328ft.; breadth, 42ft. 10in.; depth moulded, 20ft. 11in. The vessel will be classed 100 A1 at Lloyd's, and carry over 4000 tons deadweight on Lloyd's freeboard. She has been built off the part awning-decked rule, with break poop and raised quarter-deck; cellular bottom for water ballast. Her triple-expansion engines are by Messrs. Thos. Richardson and Sons, Hartlepool, of 1100 indicated horse-power, with two large steel boilers working at 160 lb. She has been built for Bristol owners, and the name of Dovedale was given to her by Miss Ropner, of Preston Hall.

On Saturday last the steel screw steamer Kirkwall, recently launched by Messrs. the Blyth Shipbuilding Company, of Blyth, for the Kirkwall Steamship Company, of Cardiff, Messrs. Stephens, Mawson, and Goss being the managing owners, was taken to sea for her official trial trip. On the speed trials the machinery gave every satisfaction. The Kirkwall is designed to carry a large cargo on a light draught of water, and is fitted with the latest machinery for working both vessel and cargo. The Kirkwall will be commanded by Captain Hesketh, and has been under the supervision of Mr. Brewer, superintendent engineer to the company, during construction. The engines are of the triple-expansion type, and have been fitted by Messrs. the North-Eastern Marine Engineering Company, of Wallsend-on-Tyne. This is the fourth ship the Blyth Shipbuilding Company have built for Messrs. Stephens, Mawson, and Goss.

There was launched on Monday afternoon from the West Yard of Messrs. C. S. Swan and Hunter, of Wallsend-on-Tyne, a fine cargo steamer of special type and well-known design, being an improved description of partial awning deck steamer. The dimensions of the vessel are 324ft. by 41ft. by 23ft. 1½in. moulded, and she has been designed by builders to carry a deadweight cargo of 4350 tons on a moderate draught. She will also carry an exceptionally large measurement cargo, rendering the vessel very suitable for Indian trade. The steamer has been built to the order of Messrs. J. J. and C. M. Forster, of Newcastle-on-Tyne, and is the fourth vessel which has been built by Messrs. C. S. Swan and Hunter for the same owners. On leaving the ways the steamer was named the Newlyn by Miss Dorothy Forster, of Newcastle, and was then taken down to the works of the Wallsend Slipway and Engineering Company to receive her propelling machinery, which will be of the latest type, cylinders 23in., 38in., 51in., by 39in. stroke. During the construction the vessel has been surveyed by Captain Sarah on behalf of the owners, who, together with a large party, witnessed the launch.

On the 15th inst. Messrs. Irvine and Co., West Hartlepool, launched a steel screw steamer of about 4000 tons deadweight carrying capacity, built to the order of Messrs. Evan Thomas, Radcliffe, and Co., Cardiff. The vessel will take Lloyd's highest class, and has been built under special survey. Her dimensions are 315ft. by 42ft. 6in. by 20ft. 9in. The deck erections consist of poop, quarter-deck, and partial awning deck. The saloon and cabins for captain and officers are fitted up in the poop. The engineers are berthed in house at after end of bridge, and the crew at fore end. The hull is built on the web frame principle, and besides being fitted with ordinary water ballast tanks in cellular double bottom, she is fitted with a new arrangement of deck water-ballast tanks, which is a patent of Mr. M. Hill's, of Newcastle-on-Tyne. With this arrangement the difficulty of getting sufficient ballast into vessels of this class, without displacing cargo space, is got over. The construction of these deck tanks also forms an effective means of strengthening such vessels having a break in their decks, and the top of the tank forms a means of communication between the bridge and poop, thereby obviating the necessity of going into the well. Large hatchways are fitted, five steam winches, steam steering gear amidships, screw gear aft, one large multitubular boiler, and direct steam windlass. The boats are placed on beams overhead, and appliances will be specially fitted to comply with the Grain Carrying Act. Engines of the triple-expansion type are being supplied by Messrs. Blair and Co., Stockton-on-Tees. The hull and machinery have been built under the supervision of Mr. Maxwell Hill, Newcastle-on-Tyne. The vessel was named Ethel Radcliffe by Miss Clarice Radcliffe.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*4th October*, 1894.

18,768. Parallel Ruler, W. H. L. Mariner.—(*W. Pigott, England*)
18,769. Roller Axle, J. Phelan, Mountrath.
18,770. Tires, H. Smith, Nottingham.
18,771. Twisting Fibrous Material, &c., C. Briggs, Bradford.
18,772. Railway Carriage Doors, T. Hobson, Manchester.
18,773. Mitre-cutting Machinery, W. G. Gass, Great Lever.
18,774. Hot-water Boilers and Pans, R. Crowther, Halifax.
18,775. Washing and Wringing Machines, J. Thornton, Halifax.
18,776. Water Regulator and Valve, H. Watson, Devizes.
18,777. Cycle Gear, T. Staines, J. Leadbeater, and A. Preston, Leeds.
18,778. Preventing Abstraction of Letters, H. Bessell, Bristol.
18,779. Improved Case for Pencils, J. Greaves, Oldham.
18,780. Stoppers for Bottles, E O. Loach, Birmingham.
18,781. Holder for Roller Window Blinds, H. P. Miller, London.
18,782. Door-closing Appliances, F. Dakin, London.
18,783. Indestructible Cone Castor, J. E. P. Proud, Dublin.
18,784. Trouser Guards for Cycles, G. D. Sampson, London.
18,785. Hat and Bonnet Protector, E. H. Höbling, London.
18,786. Hingeing the Picking Arms of Looms, J. Dodds Galashiels.
18,787. Non-twisting Ribbon Bodkin, E. Yates, Manchester.
18,788. Bag Fastenings, J. G. Beddoes and T. Allen, Birmingham.
18,789. Regulating Street Lights, M. Cummings, Glasgow.
18,790. Appliances for Clipping Hair, W. Bown, Birmingham.
18,791. Ammonia, W. McD. Mackey and J. F. Hutcheson, Glasgow.
18,792. Ammonia, W. McD. Mackey and J. F. Hutcheson, Glasgow.
18,793. Windows, H. Kerr, Glasgow.
18,794. Gas Fires, J. F. Brown, Glasgow.
18,795. Manufacture of Pneumatic Tires, P. Mercier, London.
18,796. Line Screens, G. G. Ward and M. Cohn, Belfast.
18,797. Fire-screen and Trivet Combined, S. S. Crisp and H. Grice, London.
18,798. Cork Separators, L. W. Sutcliffe, Manchester.
18,799. Attaching Pneumatic Tires to Rims, H. Kesterton, Manchester.
18,800. Valve Mechanism for Atmospheric Hammers, E. Skinner, Sheffield.
18,801. Construction of Trunks, &c., W. H. Eyre, Sheffield.
18,802. Letter Files, W. H. Morden, London.
18,803. Lock for Photographic Dark Slides, H. Ransom, London.
18,804. Beetle Trap, J. Pollock, London.
18,805. Lifts, &c., C. Musker and A. Musker, Liverpool.
18,806. Syphon for Water-closet Cisterns, C. H. Kitching, London.
18,807. Rotary Engine, L. Vojacek, London.
18,808. Cars for Roundabouts, F Collins and F. W. Savage, Birmingham.
18,809. Electric Storage Batteries, F. King, London.
18,810. Letter Cards, H. Jones, London.
18,811. Figures for Decorations, A. Tuck and W. H. Ellam, London.
18,812. Control of Lifts, J. S. Stevens and C. G. Major, London.
18,813. Rulers, A. Benda, London.
18,814. Electric Batteries, B. A. Balasny, London.
18,815. Steam Engine, J. D. Gray, W. B. Price, and A. Sharp, London.
18,816. Railway Car Wheels, J. Printz, C. F. Anderson, and V. H. Stromberg, London.
18,817. Lining for Hats, P. F. Allen, London.
18,818. Lamp Extinguisher, C. W. Cummings, Birmingham.
18,819. Typewriting Machines, C. Coote, London.
18,820. New Hoisting Apparatus, H. George, London.
18,821. Method of Stoppering Bottles, J. Spring, London.
18,822. Cutting Patterns, H. H. Lake.—(*C. E. Reed, United States*)
18,823. Ink-wells, H. H. Lake.—(*S. O. Johnson, United States.*)
18,824. Cartridges, J. G. Accles and J. Pinfold, London.
18 825. Rope Grips, J. Whitall, London.
18,826. Manufacture of Spoons, &c., A. Alexandre, London.
18,827. Tubes for Fishing Rods, &c., J. Thomas, London.
18,828. Apparatus for Condensing Fluids, E. Theisen, London.
18,829. Automatic Machine Gun, H. T. Ashton, London.
18,830. Fastening Spurs to Boots, H. Hardtke, London.
18,831. Manometers, W. P. Thompson.—(*The Maschinen and Armaturenfabrik vorm. C. L. Strube, Aktiengesellschaft, Germany.*)
18,832. Injector for Steam Engines, &c., L. Deprez, London.
18,833. Private Postcards, J. S. Morriss, London.
18,834. [No Application so numbered.]
18,835. Lining of Piece Goods, A. Kenealy, Watford.
18,836. Measurement of Piece Goods, A. Kenealy, Watford.
18,837. Water-tube Boilers, F. T. Marshall, London.
18,838. Water-tube Boilers, J. I. Thornycroft, London.
18,839. Lubricating Cups for Axles, C. W. Brown, London.
18,840. Fastening for Door Handles, G. McCarthy, London.
18,841. Game, W. May, London.
18,842. Preventing Destruction of Vessels by Torpedoes, D. Grant, London.
18,843. Seats for Cycles, G. Butwell and E. Roberts, Birmingham.
18,844. Treatment of Iron and Steel, &c., R. Stone, London.
18,845. Device for Securing Scarf Pins, A. Oldcorn, London.
18,846. Suspending Brushes in Bottles, G. Musgrave, London.
18,847. Sash Fastener, C. Patient, London.
18,848. Lamp Globe, W. T. Woolley, London.
18,849. Cooking Utensils, A. M. Pinks, London.
18,850. Fastening Boots and Shoes, W. E. Page, London.
18 851. Table Leg, &c., Castors, G. N. Witkowski, London.
18,852. Signalling Apparatus, L. B. Stevens, London.
18,853. Driving Gear for Cycles, G. White, London.
18,854. Ascertaining the Description of Leads, &c., C. W. G. Little, London.
18,855. Manufacture of Tickets, M. Vezzosi, London.
18,856. Locks, C. Shaw and F. J. J. Gibbons, London.
18,857. Construction of Hats, F. M. Rogers.—(*J. T. Todman, Ceylon*)
18,858. Umbrellas, Z. Wirt, London.

*5th October*, 1894.

18,859. Roundabouts, W. Parker, Bury.
18,860. Automatic Connection of Conductors, G. K. Chambers, London.
18,861. Construction of Padlock Cases, W. Wakelam, Willenhall.
18,862. Safety Appliance for Paraffin Lamps, F. A. Jackson, Leeds.
18,863. Roll-up Spring Mattress, C. Newey, Birmingham.
18,864. Charging Liquid into Bottles, G. Dawson, Barnsley.
18,865. Measuring, &c., Liquid into Bottles, G. Dawson, Barnsley.
18,866. Machines for Cleaning Knives, J. M. Sellers, Keighley.
18,867. Rain Shields for Cycles, H. Frankenburg, Manchester.
18,868. Vegetable Masher, R. Heaton, Birmingham.
18,869. Wheel Tire for Road Vehicles, A. Strange, Chippenham.
18,870. Ice Manufacturing Machine, J. C. Parminter, Dublin.
18,871. Wheels for Road Vehicles, W. Bowden, Manchester.
18 872. Water-heating Apparatus, A. H. Smith, Bristol.
18,873. Carriage Wheel Construction, W. Swain, London.
18,874. Boot Wiper, A. M. H. Walrond and J. Row, Exeter.
18,875. Tea-pots, W. Wade, Burslem.
18 876. Hand Protector for Bottles, W. C. Miles, Wolverhampton.
18,877. Inflator Clip for Cycles, L. Frankenburg, Manchester.
18,878. Hair Clasps or Binders, E. Moore, Birmingham.
18,879. Grain-drying Apparatus, W. Holland, Birmingham.
18,880. Tab for Braces, G. Buckley and F. Buckley, Halifax.
18,881. Oil Lamps, A. Eckford, Leith.
18,882. Sliding School-room Divisions, W. F. S. Holt, Wakefield.
18,883. Wad, W. D. Hawdon and J. T. Hawdon, Newcastle-on-Tyne.
18,884. Cartridge Cases, W. D. Hawdon and J. T. Hawdon, Newcastle-on-Tyne.
18,885. Construction of Pneumatic Tires, A. Maltby, London.
18,886. Appliances for Washing Clothes, F. J. Money, London.
18,887. Fire-arms, C. Stier, Glasgow.
18,888. Cleaning Tobacco Pipes, C. R. Hughes, Longsight.
18,889. Machinery for Making Fuel into Blocks, R. Middleton, Leeds.
18,890. Saddle Connections, J. and H. J. Brookes and P. L. Renouf, Smethwick.
18,891. Detergent Compounds, R. Armstrong, Lancashire.
18,892. Stand for Warming Stoves, J., J., and J. D. G. Lind, Liverpool.
18,893. Pipe Appliance, T. S. Forbes, Glasgow.
18,894. Advertising Tablets, J. Forrest, Glasgow.
18,895. New Parlour Game, B. J. Millar, Glasgow.
18,896. Atmospheric Gas Burners, T. Fletcher, W. Russell, and Fletcher, Russell, and Co., Mancester.
18,897. Edge-setting Machines, R. W. and L. H. Bateman, Halifax.
18,898. Spiral Wire Spring Mattress, T. M. Hewitson, Birmingham.
18,899. Cement for Dental Purposes, T. R. Reddeholm, Derby.
18,900. Pliable Spatula, B. Cunningham, Belfast.
18,901. Rollers for Furniture, H. Berg, Germany.
18,902. Folding Boxes and Fastening Them, M. Pohle, London.
18,903. Cabinets, &c., for Stationery, T. B. Vernon, London.
18,904. Treating Fibrous Peat, G. A. Cannot and J. Burke, London.
18,905. Internally-stoppered Bottles, F. J. Tolchard, London.
18,906. Composition with India-rubber, P. Mercier, London.
18,907. Arrangement for Tires of Cycles, L. P. and R. A. Vogt, Glasgow.
18,908. Fire-arms, P. Sheckler, London.
18,909. Trap for Beer-engine Nozzles, A. G. Thatcher, London.
18,910. Vessels for Electrolytical Purposes, P. Jensen.—(*H. and D Cappelen, Norway.*)
18,911. Apparatus for Knife Cleaning, F. W. R. Anderson, London.
18,912. Fitting for Umbrellas, E. Dance and D. Lambert, Birmingham.
18,913. Cycles, T. Cresswell, Birmingham.
18,914. Ratchet Brace, T. Bass, London.
18,915. Horse Collars, A. J. Boult.—(*V. van Damme and P. Michiels, Belgium*)
18,916. Apparatus for Setting, &c., Type, A. E. Vorreiter and E. Müllendorff, London.
18,917. Apparatus for Sweeping Streets, T. Glazebrook, Manchester.
18,918. Balanced Slide Valves, J. Cooper, London.
18,919. Manufacture of Steel, B. Talbot, London.
18,920. Scarf-pin and Brooch Grip, E. Eglington, London.
18,921. New Explosive, O. Imray.—(*F. C. Glaser, Germany*)
18,922. Hydraulic Capstans, W. Carter and The Hydraulic Engineering Company, London.
18,923. Distributing Advertisements by Post, J. Bear, London.
18,924. Velocipedes, G. L. Morris, London.
18,925. Electric Lamp Holders, F. C. B. Robinson, London.
18,926. Gas and Air Burning Apparatus, J. Armstrong, London.
18,927. Mounting the Gear of Cycles, J. Holcroft, London.
18,928. Emulsifying Machine, W. B. Cowan, Ontario, Canada.
18,929. Indicator for Railway Stations, G. Wehe, Berlin.
18,930. Marking Linen, T. O'Neill, London.
18,931. Door or Gate Closing Device, A. Jenner, London.
18,932. Egg-carrying Boxes, S. Cropper, London.
18,933. Breaking Electric Currents, H. T. Harrison, London.
18,934. Economising Power in Bicycles, G. Wilton, London.
18,935. Range Finder, H. H. Lake.—(*The American Range Finder Company, United States.*)
18,936. Driving Mechanism of Cycles, H. H. Lake.—(*J. Marty, France.*)
18,937. Cycle Saddle Springs, R. C. W. Duerre, London.
18,938. Castor, J. McEwen, London.
18,939. Treating Clays for Aluminium, J Y. Johnson.—(*N. Basset and W. de Baranoff, France.*)
18,940. Separation of Arsenic, W. Whitehead and C. Gelstharp, London.
19,941 Steam Engines, E. S. Ross, London.
18,942. Typewriters, G. P. Harding, London.
18,943. Propellers for Ships, G. M. and E. A. Hoyland, London.

*6th October*, 1894.

18,944. Type-setting Machines, G. C. Downing.—(*J. Salomon, Germany.*)
18,945 Picking Bands and Pickers of Looms, W. H. Blood, Manchester.
18,946. Mooding and Tanging Files, J. and A. Powell, Sheffield.
18,947. Removable Curtain Hooks, I. Robinson London.
18,948. Cycle Fittings, J. M. and W. Starley, London.
18,949. Hydraulic Forging Machines, D. Clerk, London.
18,950. Screw Propellers, The Hon. C. A. Parsons, London.
18,951. Curtain Rods, E. Dorman, Stafford.
18,952. Advertising on Umbrella Ribs, R. S. Mason, Birmingham.
18,953. Advertising, M. E. Steedman, Glasgow.
18,954. Tug Stops for Shafts, H. H. Dixon, Birmingham.
18,955. Brake, J. Jackman, Bradford.
18,956. Safety Point-and-Crossing Block, H. J. Fuller, Dublin.
18,957. Box for Mineral Water Bottles, J. Samson, Bolton.
18,958. Seamless Metallic Tubes, R. F. Hall, Birmingham.
18,959. Illuminating Buoys and Beacons, J. Wigham, Dublin.
18,960. Ornaments, H. T. Parr and C. E. Parr, Birmingham.
18,961. Heating and Cooling Buildings, R. Pye, Halifax.
18,962. Traveller's Rest, F. S. Balls, Cambridge.
18,963. Locking Gear for Hydraulic Lifts, J. P. Annett, London.
18,964. Spinning Machine, W. Fisher and W. E. Duckworth, London.
18,965. Spinning Machine, W. Fisher and W. E. Duckworth, London.
18,966. Metal Grinding Machines, C. Oxley, Sheffield.
18,967. Hollow-ware, J. Ridge.—(*E J. Smith, United States.*)
18,968. Perpendicular Whistle, W. J. Rawson, Radcliffe-on-Trent.
18,969. Forced Draught System, A. M. Lawson, Newcastle-on-Tyne.
18,970. Turning Lathes, R. Wagner, Glasgow.
18,971. Centrifugal Machines, F. Hugershoff, Glasgow.
18,972. Nails and other Small Articles, G. B. Parkes, Birmingham.
18,973. Tapping Barrels, M. Morton and E. Morton, Birmingham.
18,974. Corrugated Plates for Floors, S. Strickland, Derby.
18,975. Weaving, C. Berisford, D. Birchenall, H. Berisford, W. Gorton, and C. Wood, Manchester.
18,976. Eyed Hooks, A. Morriss, Redditch.
18,977. Water Waste Preventer Cisterns, T. Atkins, Wolverhampton.
18,978. Candlesticks, J. and H. Smith and T. W. Hemingway, Sheffield.
18,979. Pneumatic Tires, J. Clinch, Manchester.
18,980. Detecting Imitation Diamonds, T. Thorpe, Whitefield.
18,981. Elevator Safety Appliances, S. G. Bennett, Smethwick.
18,982. Foot Brakes for Velocipedes, N. E. Craig, Plymouth.
18,983. Cannon or Guns, F. L. Tulip and J. H. Link, London.
18,984. Pneumatic Tire, E. J. Delday and H. C. Adams, Scarborough.
18,985. Covering for Football Fields, J. T. Seddon, Manchester.
18,986. Pencil-point Protector, M. Illfelder, Birmingham.
18,987. Hot-water Heating Apparatus, J. T. Softly, London.
18,988. Envelopes, E. S. and E. S. d'Odiardi and M. and E. Marx, London.
18,989. Scaffold-board Binder, J. M. Kimber, London.
18,990. Chandeliers for Burning Oil, D. Lambden, London.
18,991. Calendars, H. Grueber, London.
18,992. Softening Waters, H. L. Doulton and A. W. Manger, London.
18,993. Heating Calender Rollers, G. E. Payne, London.
18,994. Cycle Handles, M. B. Ryan, London.
18,995. Pen-wipers and Pincushions, W. H. Jackson, Liverpool.
18,996. Brush Mechanism for Dynamos, A. Ramsay, Liverpool.
18,997. Railway Carriage Windows, M. E. Elder and R. Bell, Liverpool.
18,998. Evaporating Soda Solutions, J. J. Crosfield and K. E. Markel, Liverpool.
18,999. Electric Fuses, W. P. Thompson.—(*La Société M. Gaupillat and Co., France.*)
19,000. Collapsible Boats, L. Höhnke, London.
19,001. Station Indicators, H. H. Leigh.—(*J. F. O'Brien, Canada*)
19,002. Hair Waving and Curling Pins, E. M. Gaskell, London.
19,003. Making Illuminating Gas, A. W. Pickering, London.
19,004. Burner Galleries of Lamps, O. Wollenberg, London.
19,005. Slate Frame, J. H. Rudolph, London.
19,006. Flue Cleaners, D. W. Dart, London.
19,007. Prevention of Lamp Explosions, J. Hall, London.
19,008. Railway Signalling, S. A. Varley and R. Burn, London.
19,009. Making Mosaic Floorcloth, W. Mather, London.
19,010. Making Mosaic Floorcloth, W. Mather, London.
19,011. Buffer Springs, A. G. and A. Spencer, London.
19,012. Mail-carts and other Vehicles, W. Legge, London.
19,013. Measuring Curved, &c., Lines, W. Ule, London.
19,014. Washing Fabrics, L. Crosset and J. Debatisse London.
19,015. Stovepipe Elbow Machine, R. W. Barker.—(*E. Blix and W. N. Gunderson, United States.*)
19,016. Window Fasteners and Latches, T. R. Wing, London.
19,017. Regulating Furnace Draughts, W. Magoolagham, London.
19,018. Rail Joints, J. W. Thomas, London.
19,019. Fastening for Boots and Shoes, C. H. Moulds, London.
19,020. Horse Collars and Saddles, D. S. Turner, London.
19,021. Velocipedes, J. Barratt, London.
19,022. Locks and Latches, W. Elder.—(*J. W. McKee, United States.*)
19,023. Toy, E. Savor, London.
19,024. Holder, &c., for Golf Clubs, T. Walters, London.
19,025. Material for Buildings, D. Young.—(*La Compagnie des Constructions Démontables et Hygiéniques, France.*)
19,026. Synchronising Attachment, J. W. Paige, London.
19,027. Album, J. Hutson.—(*E. W. Smith, United States.*)
19,028. Home Trainer for Cyclists, J. Hutson.—(*E. W. Smith, United States.*)

*8th October*, 1894.

19,029. Hydraulic Intermittent Motors, G. Threlfall, London.
19,030. Tubulous Steam Generators, E. White, Isle of Wight.
19,031. Horse Bridles, J. Emmett and H. Emmett, Dukinfield.
19,032. Ball and Socket Castor, &c., M. W. Dent, Blackburn.
19,033. Kettles for Lamps, J. E. Whiting, Bombay Presidency.
19,034. Braid or Binding, A. Nicholson and J. Hall, Leek.

19,035. Skirt Suspender, A. Nicholson and J. Hall, Leek.
19,036. Music Holder, S. Liddiard and T. E. Rickerby, Cheltenham.
19,037. Preventing Food Destruction, J. Pumphrey, Birmingham.
19,038. Traction Engine Wheels, F. J. Burrell, Thetford.
19,039. Self-basting Vessels, C. Livesey and E. W. Banner, Southport
19,040. Pantographic Carving Apparatus, W. Merl, Manchester.
19,041. Wagon Tarpaulin Cover, A. and W. Purvis, Glasgow.
19,042 Heat Non-conductors, J. C. S. McLay, London.
19,043. Inking Apparatus, A. Watkinson and F. W. Musgrave, London
19,044. Watch Keys G. Bottely, Birmingham.
19,045 Game, F. G. Paynter Newcastle-on-Tyne.
19,046. Regulating Water Supply, W. P. Theermann, Manchester.
19,047. Heating Soldering Irons, &c., G. Skinner, London.
19,048. Method of Braking Cycles, W. Saunders, Bristol.
19,049. Tops, J. Linkleter, Tynemouth.
19,050. Mounting Trays, J. C. Bailey and H. Podmore, Longport.
19,051. Frames for Sawing Machines, A. Smith, London.
19,052. Brakes for Wheeled Vehicles, W. E. Kay, Manchester.
19,053 Pneumatic Tire Inflators, H. Frankenburg, Manchester.
19,054. Chimney Water Heaters, &c., J. Syme, Monastereven.
19,055. Athletic Horizontal Bars, T. B. Sharp, Birmingham.
19,056. Curing Smoky Chimneys, W. J. and P. C. Wheeler, London.
19,057. Securing Fish-plates on Rails, J. T. Drew, London.
19 058. Pulley Blocks and other Lifts, W. T. Eades, London.
19,059. Button Fastener for Clothing, W. Halliday, London.
19,060. Window-blind Pulleys, A. F. Borradaile, London.
19,061. Cycle Handles, J. W. McEwen and T. B. Richards, London.
19,062. Uppers for Boots and Shoes, C. C. Eisenberg, London.
19,063. Blower for Fire-grates, R. Rose, London.
19,064. Milk Sterilisers, E. Leslie, London.
19,065. Producing Electricity, H. A. Tobias, W. H. Cadman, and R. J. Crowley, London.
19,066. Dough Mixing Machine, J. T. O'Callaghan, London.
19,037. Anchors, W. T. Honess, London.
19,068. Sel-acting Window Fastener, E. Seaman, London.
19,069 Hat Bands, F. W. and B. Franklin and P. E. Taylor, Birmingham.
19,070. Velocipedes, E. A. Jeffreys, London.
19,071. Tobacco Pipe, W. B Wallace, London.
19,072. Screw nuts, F. F. Ganly, Manchester.
19,073. Steering Lock, W. F. Taylor and G. Philpott, Croydon.
19,074. Method of Repairing Slating, R. J. Spreadbury, Bournemouth.
19,075. Jewel Fastenings, E. T. B. Woodley and H. E. Humphry, London.
19,076. Bicycles and Tricycles, A. L. Bricknell, London.
19,077. Knitting Machines, E. Buxtorf, London.
19,078. Stoppering of Bottles and the like, J. Jones, London.
19,079. Domestic Water Supply Apparatus, J. Bark, Liverpool.
19,080. Constructing Transparent Walls, G. Falconnier, London.
19,081. Writing Device for the Blind, D. Goldsmith, London.
19,082. Eating Buttered Bread, H. M. Conrad, London.
19 083. Small-arms. J. Courrier, London.
19,084. Bearings, H. Kirschbaum and A. Schnitzer, London.
19,085. Absorption of Gases by Liquids, A. Müller, London.
19,036. Implements for Cultivating Land, J. E. Ransome, London.
19,087. Apparatus for Purifying Sulphur, R. Tervet, jun., London.
19,088. Syphon Cistern, T. B. Jack, London.
19,089. Eye-shades, H. Reichardt, London.
19,090. Wedding Cake Boxes, &c., E. Guttentag, London.
19,091. Purification of Iron and Steel, S. Trivick, London.
19,092. Churns, T. Bradford, London.
19,093. Fastening Device, A. Wood, J. S. Walter, and W. M. Walter, London.
19,094. Fireplaces, J. Clemence, H. A. Leverett, and T. H. L. Bake, London.
19,095. Water-lift and Bucket, M. S. M. S. Bahadur, India.
19,096. Feeding Bottle, F. W. Edridge-Green, London.

*9th October*, 1894.

19,097. Garments, A. G. Brookes.—(*M. M. Dunn' United States*)
19,098. Fuses for Projectiles, A. G. Brookes.—(*W. J. Smith, United States*)
19,099. Water-level Indicator, R. H. N. Lindley and F. J. Mudford, London.
19,100. Cots, J. E. Hoskins, Birmingham.
19,101. Stopper or Plug for Bottles, A. D. Jackson, Portsmouth.
19 102. Artificial Lighting Apparatus, G. Houghton, London.
19 103. Rubber Hose, T. Sutcliffe, Lancashire.
19,104. Dish for Holding Meat, &c., F. G. Wallis, Kettering.
19 105. Shield for Protecting Garments, F. Hughes, London.
19 106. Making, &c.. Chains and Bridle Fronts, J. Richards, Birmingham.
19 107. Framings of Velocipedes, R. F. Hall and R. H. Anderson, Birmingham.
19,108. Simple Crank Motion, H. W. Nickson and A. E. A. Edwards, Birmingham.
19,109. Non-conductor of Heat, C. Clarke, Birmingham.
19,110. Wheels for Railway Vehicles, J. A. Craven and T. Foster, Sheffield.
19,111. Toy Saving Banks, R. B. Roll, South Shields.
19,112. Oil Motor Engines, D. Clerk and F. W. Lanchester, London.
19,113. Paper for Catching Flies, &c , J. W. Dougal, Glasgow.
19,114. Lifting Apparatus, R. Middleton, Leeds.
19,115. Broiler, C Coleman. Welford, near Rugby.
19,116. Woven Belting, W. M. Martin, Glasgow.
19,117. Fire-extinguishing Apparatus, H. B. Barlow.—(*C. R. Macomber, United States*)
19 118. Employe's Time Recorder, J. S. Morse, London.
19,119. Pulley Casing for Window Frames, J. H. Foote, London.
19,120. Clamps for Pipes, C. Hall, London.
19,121. Electric Arc Lamps, J. E. Woolverton, Glasgow.
19,122. Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States*)
19,123. Letter Files, W. O. Gottwals, Canada.
19,124. Letter Files, W. O. Gottwals, Canada.
19,125. Knitting Machines, G. W. Beach, London.
19,126. Construction of Golf, &c., Bats, B. J. Maloney, Edinburgh.
19,127. Production of Ozone, J. T. Donovan and H. L. Gardner, London.
19,128. Hydrometers, W. Hood, London.
19,129. Railway Signalling Apparatus, A. G. Evans, London.
19,130. More Perfect Combustion of Coal Gas, R. H. Courtenay, London.
19,131. Adjusting the Seats of Carriages, F. W. Milligan, London.
19,132. Brick Kilns, W. A. Wilford, Birmingham.
19,133. Novel Eyed Fly Holder, J. Richardson, London.
19,134. Sewing Machines, W. H. Harrop, London.
19,135. Tie, C. Cox, London.
19,136. Boots, C. Cox, London.
19,137. Toy Shooting Galleries, A. W. Carley, London.
19,138 Lift for Sashes of Greenhouses, A. C. Bright, London.
19,139. Manufacture of Socks, H. T. Hines, London.
19,140. Sprocket Wheels, P. D. Murphy and E. Kolb, London.
19,141. Apparatus for Cable Tramways, E. Neil, London.
19,142. Hat-stretching Machines, G. Atherton.—(*R. Eickemeyer, United States.*)
19,143. Machines for Dressing Type, W. W. Farmer, London.
19,144. Securing the Corners of Boxes, A. A. Wood, London.
19,145. Valves, H. H. Lake.—(*F. C. Weir, United States.*)
19,146. Mechanism for Looms, J. T. Bolton and G. Grime, London.
19,147. Advertisements, G. F. Zimmer and J. Hutson, London.
19,148. Exhibiting Figures, Pictures, &c., M. Vollmer, London.
19,149. Fastenings for Trousers, &c., R. L. Weiss, London.
19,150. Electro-deposition of Metals, W. H. Beck.—(*C. R. Fletcher, United States.*)
19,151. Fastenings of Brooches, Pins, &c , R. Synge, London.
19,152. Speed Apparatus for Swimmers' Use, L. Pedrazzolli, London.
19,153. Spinning Mechanism, J. Neale and W. O. Shadbolt, London.
19,154. Tobacco Pipes, W. E. Trott, London.
19,155. Arc Lamps, A. J. Boult.—(*P. Laminne, Belgium.*)
19,156. Pencil Sharpener, W. P. Thompson.—(*J. Deutschbein, Germany.*
19,157. Electric Battery Plates, H. Le R. Bridgman, London.
19,158. Railway Fences, &c., A. Stevenson, Liverpool.
19,159. Pneumatic Tires, G C. Nesbitt, London.
19,160. Harvesters, W. P. Thompson.—(*B. F. Stewart, United States*)
19,161. Calking Vessels, A. J. Brooks, London.
19,162. Cotton Gloves, &c., J. E. Cowell.—(*G. Neuhaus, Germany*)
19,163. Calendar Clocks, C. W. Feichtinger and S. Shearer, London.
19,164. Oil Stoves, E. Rippingille and W. Porter, London.
19,165. Apparatus for Cutting Coal, J. B. Alliott, London.
19,166. Treating Peat, A. McLean, London.
19,167. Hooks and Eyes, A. Clorius and C. Schwartz, London.
19,168. Tooth Brushes, H. Besson and G. H. Kent, London.
19,169. Preventing Incrustation in Boilers, G. L. F. Edeline, London.
19,170. Apparatus for Rousing Liquors, H. Prince, London.
19,171. Textile Fabrics for Pneumatic Tires, J. F. Palmer, London.
19,172. Retaining Corks in Bottles, J. W. and F. H. Butler, London.
19,173. Tree for Boots, The Honourable R. T. D. Brougham, London.
19,174. Treatment of Natural Phosphates, D. Levat, London.
19,175. Paper Coated with Celluloid, A. Gray, London.
19,176. Telephone Annunciators, L. M. Ericsson, London.
19,177. Apron Holders, L. Byron-Peters and W. McLaren, London.
19,178. Means for Cleaning Rice, &c , E. Kallsen, London.
19,179. Gas Chimney Protector, F. A. Seigel and F. A. Solbrig, London.
19,180. Fireproof Floors, C. A. Balph and E. P. S. Wright, London.
19,181. Submerged Roads, &c., M. A. de Palacio, London.
19,182. Pipes, &c., for Water-closets, H. I. Dakin, London.
19,183. Lathing, E. F. Stimson, London.
19,184. Electric Heaters, J. R. Davis, London.
19,185. Electric Switches, F. Stevens and R. R. Kesteven, London.
19,186. Electric Fire-alarms, L. G. Rowand, London.
19,187. Alkyl-ethers, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany.*)
19,188. Lactyl-*p*-Phenetidine, J. Y. Johnson.—(*C. F. Boehringer and Soehne, Germany*)
19,189. Chlorate of Soda, T. T. Best and G. Brock, London.
19,190. Dust-trap, W. H. Steel and W. H. Steel, London.
19,191. Securing Battery Wires, F. A. and N. von Alimonda, London.
19,192. Fixing Fastenings for Boots, J. G. Paterson, London.
19,193. Floats for Fishing, &c., J. R. Richardson, London.
19,194. Brace Buttons, J. O'Rorke, London.
19,195. Securing Laces of Boots, &c., W. Thomas, London.
19,196. Suspending Hooks, R. D. Moody, London.
19,197. Railway Car Couplings, R. D. Moody, London.
19,198. New Match Holder, J. Richter, London.
19,199. Fermenting Apparatus, A. D. Currie, London.
19,200. Setting Printing Type, G. C. Downing.—(*J. Salomon, Germany.*)
19,201. Distributing Printing Type, G. C. Downing.—(*J. Salomon, Germany.*)
19,202. Syruping Aerated Liquids, E. S. Chavasse, Birmingham.

*10th October*, 1894.

19,203. Pneumatic Tires, T. R. Piner, London.
19,204. Cleansing and Polishing Soap, C. J. Goodland, Bridgwater.
19,205. Self-closing Bag Frame, P. B. Hollick, London.
19,206. Graining Machine for Oil Colours, H. J. Probyn and T. Wood, Gloucester.
19,207. Releasing the Backs of Watches, J. S. Wilday, Birmingham.
19,208. Pneumatic Tires, A. Maltby, London.
19,209. Cycle Gear, F. W. Briggs. London.
19,210. Splitting Cottar Pins, T. W. Lench, M. A. and T. Robson, Birmingham.
19,211. Profiling Machines, R. F. Hall and C. Taylor, Birmingham.
19,212. Commercial Blotting-pad, T. M. Markham, Manchester.
19,213. Chimney Ventilators, R. Morris, Gateshead-on-Tyne.
19,214. Cranes, B. B. Dadley, London.
19,215. Constructing Entree Dishes, R. Stevenson, Sheffield.
19,216. Lathes for Polishing, &c , A. Davidson, Sheffield.
19,217. Pneumatic Tires for Carriages, J. Hopper, London.
19,218. Flexible Hose Pipe, E. L. Pease, Stockton-on-Tees.
19,219. Fastening for Hats, W. Stevenson, Nottingham.
19,220. Electric Ship Logs, W. D. Whyte and D Muirhead, Glasgow.
19,221. Protecting Pneumatic Tires, J. Alverti, Cheshire.
19,222. The Safety Hair-curling Pin, R. Glossop, Redditch.
19,223. Photographic Plate Carriers, A. J. Mason, Birmingham.
19,224. Billiard Table Cushions, J. R. Jackson, Manchester.
19,225. Boots and Shoes, R. W. and L. H. Bateman, Halifax.
19,226. Machinery for Dyeing Yarn, W. H. Thorpe, Halifax.
19,227. Flushing Appliances, J. Shanks and A. Burnside, Glasgow.
19,228. Gas Engine, &c , Connecting-rods, J. Mills, Manchester.
19,229. Glove Fastener, K. Gengnagel, St. Leonards-on-Sea.
19,230. Vehicle Wheel Construction, H. H. Mulliner, Birmingham.
19,231. Supporting Gas, &c., Shades, W. Beal, Birmingham.
19,232. Air Valves for Pneumatic Tires, J. Cockburn, Glasgow.
19,233. Heating and Ventilating Radiators, J. Keith, Glasgow.
19,234 Hot Water Boilers, J. Keith, Glasgow.
19,235. Dyeing Mixed Woven Fabrics, T. Ingham, Manchester.
19,236. Water-tube Boilers, J. A. McKie, Glasgow.
19,237. Sealing Jars, R. Karges, Manchester.
19,238. Anti-slipping Tire-grappler, W. Clark, Newcastle-on-Tyne.
19,239. Movable Calendar or Date Case, H. Vereker, Glasgow.
19,240. Spring Mattresses, O. Ransford, Glasgow.
19,241. Collapsible or Folding Wardrobes, W. H. Vaughan, London.
19,242. Collapsible, &c., Furniture, W. H. Vaughan, London.
19,243. Preparation for Curling Hair, G. H. Hill, London.
19,244 Mudguards for Cycles, W. Cunningham, London.

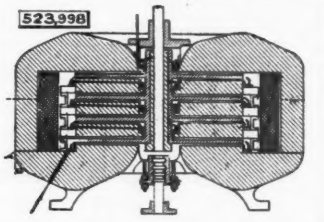
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**523,998.** Dynamo-electric Machine, *G. Rennerfelt, Lynn, Mass.—Filed March 6th*, 1894.

*Claim.*—(1) The combination of a magnet with a divided core, a series of rotating conductors interposed between the parts thereof, and means for electrically connecting said conductors in series, substantially as described. (2) The combination of a magnet with divided core, a series of rotating conductors interposed between the parts thereof, and means for electrically connecting said conductors in series, consisting of a series of suitably connected liquid collectors, substantially as described. (3) The combination of a magnet with a divided core, a rotating conductor interposed between the parts thereof, and annular vessels containing mercury suitably arranged for collecting the current generated on said conductor, substantially as described.

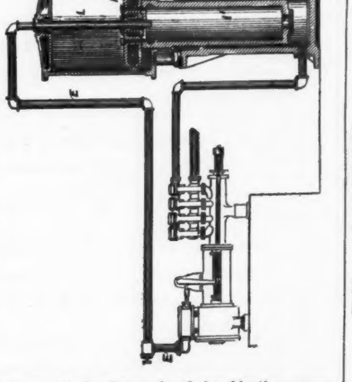
523,998



**524,013.** Pressure Accumulator, *C. C. Worthington, Irvington, N.Y.—Filed February 26th*, 1894.

*Claim.*—The combination with a steam engine, of a steam accumulator forming part of the steam connections between the steam supply and engine, and means for varying the supply of steam to the engine in accordance with the movement of the accumulator piston, substantially as described. (2) The combination with a pressure accumulator having a differential piston I, I′, the piston I′ being hollow, of perforated exhaust pipe L passing through the piston I into the hollow piston I′, closed pipe O in said hollow piston I′, and a non-heat-conducting packing about said pipe O, substantially as described. (3) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E connecting with the accumulator chamber by a series of openings arranged in the line of movement of and opened and closed by the accumulator piston, substantially as described. (4) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E, and exhaust pipe L connecting the accumulator chamber with the pipe E and having a series of openings opened and closed by the movement of the accumulator piston, substantially as described. (5) The combination with a pressure accumulator connected with an elastic fluid supply, of pipe E, and perforated exhaust pipe L in the accumulator chamber connecting with the pipe E and passing through the accumulator piston, whereby the perforations in the pipe are opened and closed by the piston, substantially as described.

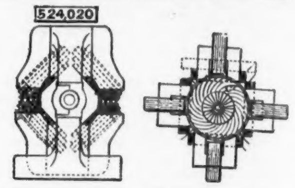
524,013



**524,020.** Dynamo-electric Machine, *R Eickemeyer, Yonkers, N.Y.—Filed October 7th*, 1891.

*Claim.*—(1) In a dynamo-electric machine, the combination with an armature, of separate electro-magnets arranged with their similarly polarised cheeks closely adjacent to each other, but separated by narrow spaces, parallel with the armature winding, and counterfield coils in circuit with the armature winding, but receiving electric current, in a direction opposite to that in the adjacent portion of said winding, and having portions of said coils located at said spaces parallel with said adjacent portions of the winding, the air spaces affording resistance in those magnetic circuits which are induced by said adjacent portions of the armature winding, and the counterfield coils inducing a magnetic flow, opposite to that which is induced by said portions of the armature winding. (2) In a dynamo-electric machine, the combination, substantially as hereinbefore described, of an armature, separate U-shaped electro-magnets, each having its own field coil or coils, and provided with appropriate cheek pieces, and having the several similarly magnetised cheeks located closely adjacent to each other, but separated by air spaces parallel with the armature winding, and a counterfield coil on each magnet, in circuit with the armature winding, and having portions thereof located in said spaces, and parallel with the armature winding.

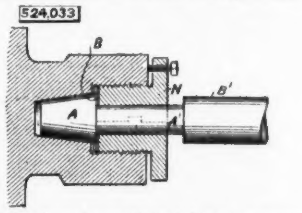
524,020



**524,033.** Device for Securing Piston-rods to Crossheads, *C. G. Turner, Wilmington, Del.—Filed May 3rd*, 1894.

*Claim.*—The combination of a crosshead having a socket therein, of a piston-rod having a head A and a reduced portion A¹ behind the head whereby shoulders B and B¹ are formed, a nut N divided into two or more segmental parts adapted to embrace the reduced portion of the rod and engage with threads on the crosshead so that by screwing or unscrewing the nut the head on the rod can be forced in or out of the socket in the crosshead.

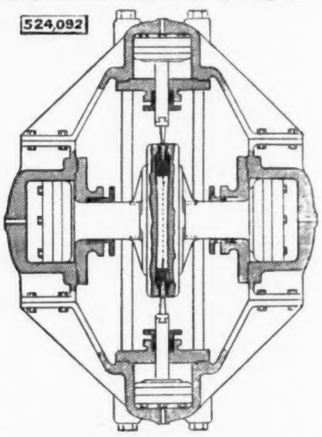
524,033



**524,092.** Machine for Making Axles, *C. Mercader, Braddock, Pa.—Filed July 6th*, 1893.

*Claim.*—In a machine for making axles, the combination with a pair of matrix dies for forming and clamping the axle blank, of two piercing dies at right angles to the matrix dies and arranged to enter the open ends thereof, and force the metal laterally to form the collars, and mechanism for operating said dies, substantially as described.

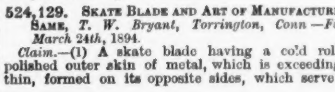
524,092



**524,129.** Skate Blade and Art of Manufacturing Same, *T. W. Bryant, Torrington, Conn—Filed March 24th*, 1894.

*Claim.*—(1) A skate blade having a cold rolled polished outer skin of metal, which is exceedingly thin, formed on its opposite sides, which serve as cutting edges for the intervening metal of the tread, substantially as set forth. (2) The method of manufacturing skate blades, which consists in cold rolling a metal plate, thereby forming thereon an exceedingly hard and smooth outer skin, then cutting or punching the blank from the plate, and finally finishing the tread by grinding, substantially as specified.

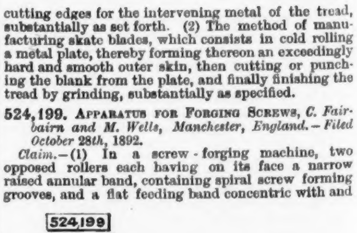
524,129



**524,199.** Apparatus for Forging Screws, *C. Fairbairn and M. Wells, Manchester, England.—Filed October 28th*, 1892.

*Claim.*—(1) In a screw-forging machine, two opposed rollers each having on its face a narrow raised annular band, containing spiral screw forming grooves, and a flat feeding band concentric with and adjacent to said raised groove band, substantially as described. (2) In a screw-forging machine, a roller having on its face a narrow raised annular band, containing spiral screw forming grooves and having bevelled edges, and a flat feeding band concentric with said raised band, substantially as described.

524,199



## PIVOTED ARCHED BRIDGES.

The general or abstract principles which govern and distinguish any particular type or design of engineering structure are theoretically immutable. Among the more universally applicable of these may be mentioned the laws of the lever, the relation between action and reaction, the resolution of forces, the pull in tension, and the thrust in compression. In practice, that is, in the designing and actual construction of girders, bridges, trusses, and roofs, these general principles are nearly always more or less liable to modification. In fact, there are not wanting instances in which the original principle has been subjected to so many alterations, and even violations, that it would puzzle the most experienced professional expert to determine to what especial type the example does belong. Omitting abnormal and exceptional cases of this nature, it may be nevertheless fairly inferred—and we shall adduce ample evidence of the truth of our remarks—that the principle or type of design which, while retaining its own peculiar characteristic, yet admits of the greatest amount of modification, will be more generally adopted than others. In a word, the principle which is susceptible of the greatest adaptability to different purposes, or to the same purpose, under different conditions, will, without any metaphor, rank as the survival of the fittest.

There are, without referring to simply solid girders or examples of a primitive and insignificant description, two types of design which will, we submit, sufficiently support the inference we have drawn. They are the tubular and the suspension bridge, the former being at present absolutely obsolete, and the latter in a fair way to become so. It is a little curious that the Britannia tubular bridge was, with the exception of two or three imitations on a smaller scale so far as length of span was concerned, the first and last of its kind. It was certainly not due to any defect or failure of the structure itself, for at the present day within its iron walls run the heaviest and fastest trains of the London and North-Western Railway. The cause of its disuse is due to the reasons we have already alleged. Its sphere of action was too limited. Its principle was not capable, consistently with collateral unavoidable conditions, of adapting itself to the more general requirements of bridge construction, and engineers consequently abandoned it. The suspension bridge, so far as mere length of span is regarded, stands on a more favourable footing; but, on the other hand, it is completely deficient in those very necessary qualities for which the tubular type is pre-eminently distinguished. Flexibility is the essence, the very life of the suspension principle, and all endeavours to obviate it, that is, to so modify the principle as to render it capable of being applied to purposes where the maximum amount of rigidity is indispensable, have proved abortive, as in Lambeth Bridge and other structures of a similar character. Apart from this incurable defect, suspension bridges are fast being superseded, even in their own country, by the modern cantilever or continuous girder bridges, more elegantly termed by French engineers *poutres équilibrées*, and we say these things while taking account of the fact that under exceptional circumstances, as at Niagara, the suspension principle has been used in railway bridges.

It does not necessarily ensue that an alteration or innovation in the design or construction of a bridge interferes in any degree with its governing principle. It may, on the contrary, conduce to a more accurate application of it, and enable a more exact determination of the nature, amount, and direction of the resulting stress to be arrived at. It is admitted in connection with the subject of our article, that the pivoting or hinging at one or more points of the ribs of arched bridges tends to bring about—theoretically—a more accurate adjustment of the resulting stresses; but whether in actual practice this desirable result is fully obtained, is not by any means a matter of absolute certainty. At any rate, we shall quote some very recent examples, in which both solid and open-web arched ribs are fixed at both springings, continuous over or through the crown, and as rigid throughout as a stone arch, making due allowance for the difference of the material employed. There is a difference between the theoretical linear arch, and the practical application of it in modern iron and steel structures of the same form. While fully able to sustain all the compressive stresses to which it is subjected, the linear arch is powerless to resist moments of flexure. On the other hand, the iron or steel arch not only withstands successfully both these descriptions of stresses, but under peculiar conditions, those of a tensile character as well.

A distinction must be drawn between a solid and an open web arched rib, with respect to the number of pivoting points permitted. We have not been able to find any example of a plain solid arched rib hinged or discontinuous at the crown, and at the same time hinged or pivoted at the springings also. On the other hand, there are numerous instances in which braced arches which are not under the same conditions as the solid arch, or arch proper, or generally arches with open webs, are hinged both at crown and at each of the springings. The practice among engineers of hinging the ends of solid arched ribs is comparatively very modern. We may look in vain from Pimlico railway bridge, old Vauxhall, Westminster, Blackfriars, down to Southwark, all of which are solid arched ribs, for any such evidence of discontinuity. Telford, also, in the Tewksbury bridge, built over the Severn, having a span of 170ft., constructed the cast iron arched ribs solid throughout. In France the largest cast iron arched bridge, the Pont Saint Louis, has a span of 210ft., or 30ft. less than the centre span of old Southwark. It carries a public road over the Seine, and is continuous at the crown and fixed at the springings. In the two railway bridges over the Trent, of 200ft. each in span, the ends of the cast iron ribs are rounded, and fit into shoes; but they do not turn at the joints, and the arches rise and fall with the varying temperature. It is no doubt due to the fact that the adoption of braced and open web arched ribs in the construction of bridges did not take place until long after the solid arch was extensively employed, that we find the newer type more generally hinged or pivoted than the older.

All open web arched ribs may be subjected to three particular modes of treatment. They may be hinged at both the springings and at the crown also, a condition to which we have already stated solid ribs have not yet been rendered amenable. Secondly, they may be pivoted or hinged at the ends or springings only and continuous at the crown; and thirdly, they may, as in the examples alluded to, be continuous at the crown and fixed at the abutments, that is, fixed throughout. Examples of open web arched ribs are not very numerous, and those of the braced form still less so, although there is no doubt considerable economy in the employment of that particular design. When an arched rib is pivoted at both abutments, and at the crown as well, it obviously can be fairly represented by a pair of curved rafters braced together so as to constitute an ordinary triangular roof truss, held together at the ends by the thrust against the abutments in the place of the usual tie. Thus, the arch exists really more in form than in principle. The stresses can then be ascertained without any great difficulty, so long as there are not more than two unknown forces acting at any apex. In the event of redundant members, whether at the abutments or elsewhere, one set of the diagonals must be discarded, or the calculation of the stresses becomes well nigh impracticable. When the bracing is correctly arranged, which is not always the case, the centre of pressure in an arch, hinged at crown and abutments, will, under any condition of loading, pass through the three given pivoted points, and will thus accurately determine the position of the polygon of equilibrium. The absolute stresses will depend, as in other examples of similar construction, upon the nature, whether symmetrical or unsymmetrical, live or dead, and the amount of the loading. If the load were completely uniform in character, little or no bracing would be required, as occurs in a bowstring girder under similar circumstances. The effect of contraction and expansion in this type of braced arch is simply to produce a rise and fall at the crown. There is an example of a wrought iron braced arch of this description about 70ft. in span in Philadelphia, in America.

Instances in which the second mode of treatment is adopted, or that in which the arch is hinged at the springings, and continuous at the crown, form the most numerous of the three, in both railway and road bridges. The accurate determination of the stresses in this case becomes exceedingly difficult, although approximate calculations can be arrived at, sufficient for all practical purposes. Examples of braced arches of this system are to be found in a railway bridge over the Theis, consisting of eight arches of 136ft. in span each, and in the Paris and Creil railway bridges. Again, the Douro Bridge, which is a lattice arch of 525ft. span is continuous at the crown and pivoted at springings, so also is the railway bridge over the Rhine at Coblentz. The Harlem River structure in America is also a fine example, with a pair of solid cast steel arched ribs of 510ft. each, provided with steel pins to pivot on over the piers. As a recent instance, which is barely three years old, the "Pont du Midi" may be quoted. It consists of three solid steel arches, of which the centre span is 225ft. At the centre the depth of the rib is 3ft. 6in., and at the springings 4ft 9in., where it rests upon steel pins nearly 8in. in diameter. When the ends of an arch are hinged at the springings, the points of support are supposed to be situated at the mass centre of the cross section of the rib, and the end sections must pass through these points, and if the arch be free to move at those points the bending moments vanish.

In the third category are to be included all those examples of arched ribs, whether of the open or solid web system, which are fixed both at the abutments and continuous at crown; in fact, as already stated, fixed throughout. While this case presents the greatest difficulty in the exact determination of the stresses, yet it affords all the advantages which can be derived from the strength or elasticity of that particular form of rib. Existing examples, some of very old and some of very recent date, point incontestably to the fact that solid, substantial, broad bearings have answered well and sufficiently for their work, and without denying the merits, chiefly with regard to an assumed economy of material, claimed for the pivoted system, it is doubtful whether these merits are equally conspicuous in the actually constructed design. As a convenient example we may select the lattice arched rib, 240ft. in span, carrying the roof of the terminal station of the Midland Railway at St. Pancras. It is true that this arch is self-contained, but if ever an open web arched rib was securely fixed at the ends, this one ought to be, for it is solidly riveted to heavy cross girders which pass underneath the platforms and permanent tracks, and constitute a subterranean tie to the whole of the roof ribs. The bridge over the Mississippi at St. Louis, and another over the Elbe, near Hamburgh, on the Paris and Hamburgh line, are without any articulations, as is also one built only two years ago over the Cerveyrette at Briançon in France. These arched ribs have a span of 169ft., are 2½ft. deep at the crown, and 6½ft. at the springings. As a concluding instance the two bridges erected last year over the Rhone, at Lyons, may be quoted, having a central span equal to 221ft. Each span is composed of eight arched ribs of steel of a box section, and each rib abuts on cast iron skewbacks by means of three pins, one of which is fixed in the line of the axis of the rib, and each of the others takes up the bearing at the upper and lower booms respectively. A sheet of lead ⅛in. in thickness was placed between the stonework and the cast iron skewback. It is stated, with respect to these two bridges, that 30 per cent. of the metal in them would have been saved if they had been hinged both at the abutments and crown, and 10 per cent. if at the former points only. This great sacrifice, which must have been a sore trial to the engineer, was incurred on account of fear of excessive vibration.

The stresses resulting from the effects of temperature upon arched ribs solidly fixed, as just described, are very considerably greater than in articulated ribs; and there is no doubt that it is in great measure with the object of reducing these that pivots have been introduced. Some engineers have estimated this proportion as high as six to one, and attended with a corresponding augmentation of the stresses in the web. On the other hand, although the fixed arch is subjected to a greater shearing stress near the abutments than the articulated example, it has to carry less at the centre, and requires a smaller sectional area in the booms or chords. It also possesses the great advantage claimed for the *poutre equilibrée*—that is, of transferring a large portion of the working load to or near to the abutments, and thus relieving the more central portion of the arch. We think, from the examples up to date we have adduced, it may be fairly concluded, as has been the object of our article, that while engineers possibly may agree respecting the abstract theoretical economy of the articulated rib, they are by no means prepared to adopt it to the total exclusion of the fixed type.

## A MODERN NAVAL BATTLE.

The following description of the great Japanese naval battle, given by a young Englishman, who was the supervising engineer on the Chinese cruiser Yang-Wai, and who went to the United States for treatment for injuries he received in the battle, appears in the United States *Army and Navy Journal*. Our readers must take the sensational statements for what they are worth. What is said about the surgeon's treatment of the wounded must be a mistake. The Yang-Wai is a cruiser of 1350 tons displacement, carrying two 25-ton Armstrong 10in. guns, and four 4·7in. quick-fire guns, besides smaller ordnance. She was launched in 1881. It was quite impossible that she would have attained a speed approaching 20 knots, as her maximum trial trip speed was but 16 knots:—

The Chinese Admiral received word from Pekin, July 12th, to watch the Japanese without making any aggressive move. The Yang-Wai was accordingly detailed to proceed to sea and keep an eye on the Japanese. She overtook the Japanese fleet eighty miles to the southward, passing through their lines in defiance of the Japanese Admiral's orders to stay away, and making a spurt, led the Admiral's flagship a swift race. When the rest of the fleet had been left out of sight in the distance, the Yang-Wai suddenly turned and planted a 10½in. shell out of a 38-ton forward gun in the port bow of the Metsuchima. It tore an enormous hole in her upper deck, and disabled three of her 8in. guns. Passing the Metsuchima on the return tack, her secondary battery was fired broadside into the Japanese vessel, and as she passed astern her 25-ton gun came to bear on the Japanese vessel's after barbette. Several of the Japanese guns were disabled before she was able to return the fire.

Some clever manœuvring followed, and both vessels proceeded to pour broadside after broadside into each other. The battle lasted from 11 30 o'clock in the morning until three in the afternoon. After the Yang-Wai had been disabled, with the exception of the big gun forward, she managed to cripple her opponent by a shot which struck the conning tower of the Japanese vessel, killing the Japanese admiral and several of his officers. This completely disabled the Japanese ship.

Shortly after the Metsuchima ceased firing, and while we were busy ascertaining the extent of our own injuries, we sighted the other Japanese vessels approaching, and the Yang-Wai's commander gave orders to make a run for it to Weipaiwei.

The scene aboard the Yang-Wai after she had withdrawn from the unequal conflict was simply hideous. There was but one gun left in fighting trim, and that being the big bow gun, it was useless in flight. The six Japanese warships pounded away at us as we ran, and we were devoutly thankful that our speed was great enough to soon get out of range. The Yang-Wai was simply a floating wreck. Above the water-line everything was ruin. The pilot-house, bridge, and conning tower had gone early in the fight; the boats were shot into splinters, and the superstructure was in a hopeless, shapeless tangle. The funnel had been shot away to within 4ft. of the deck, and as we were running under forced draught we rigged a jury stack of sheet iron and canvas supported by a derrick. A hose was kept playing constantly on this makeshift funnel to prevent it from taking fire or melting.

The captain directed his crippled craft from a jury bridge of empty liquor casks and soap boxes, using a boat's compass, as the binnacles had been shot away. The masts were gone and the rudder too, but steering with the twin screws was comparatively easy. The Yang-Wai had been in commission nine years, but we got twenty knots out of her, or two knots better than she did on her trial trip.

The junior officer was sent down to take charge of the stokeholds, where naked coolies were shovelling coal for dear life. He had several cases of gin, which he gave to the sweating stokers as often as they asked for it. In one hand he held a thick club made of a section of thick rubber belting, and whenever a man lagged he beat him with it until he picked up his shovel again. The draught that was produced was so fierce that a continuous sheet of flame poured from the jury funnel. Below, the cruiser was a huge butcher shop. Holes 14ft. square yawned in her side, marking the place where the Japanese shells had entered. These war engines in bursting had blown the upper deck into fragments. On the main deck was the worst of all. It was simply a lake of blood fully an inch deep in the shallowest part. Writhing in this and floating in the deeper parts were heads, arms, and legs, with here and there the fragment of a man still alive tangled among the fragments of timber and steel torn from the cruiser's sides and decks. There were only two white men aboard the cruiser, myself and the surgeon.

As soon as the vessel was out of danger from the shells of the Japanese gunboats, he and I, with a corps of the surgeon's assistants, set about clearing up the terrible mess on the main deck.

Wherever we found a man hopelessly wounded, the surgeon gave him instant relief from his agony. He carried an atomiser filled with prussic acid, and as soon as his hasty examination of a hopeless case was finished, he sprayed the poison into the man's mouth and nostrils. The dying men craned their necks forward eagerly in their desire to escape from the torture they suffered. There were very few of the wounded who were not put out of their misery by the surgeon's atomiser.

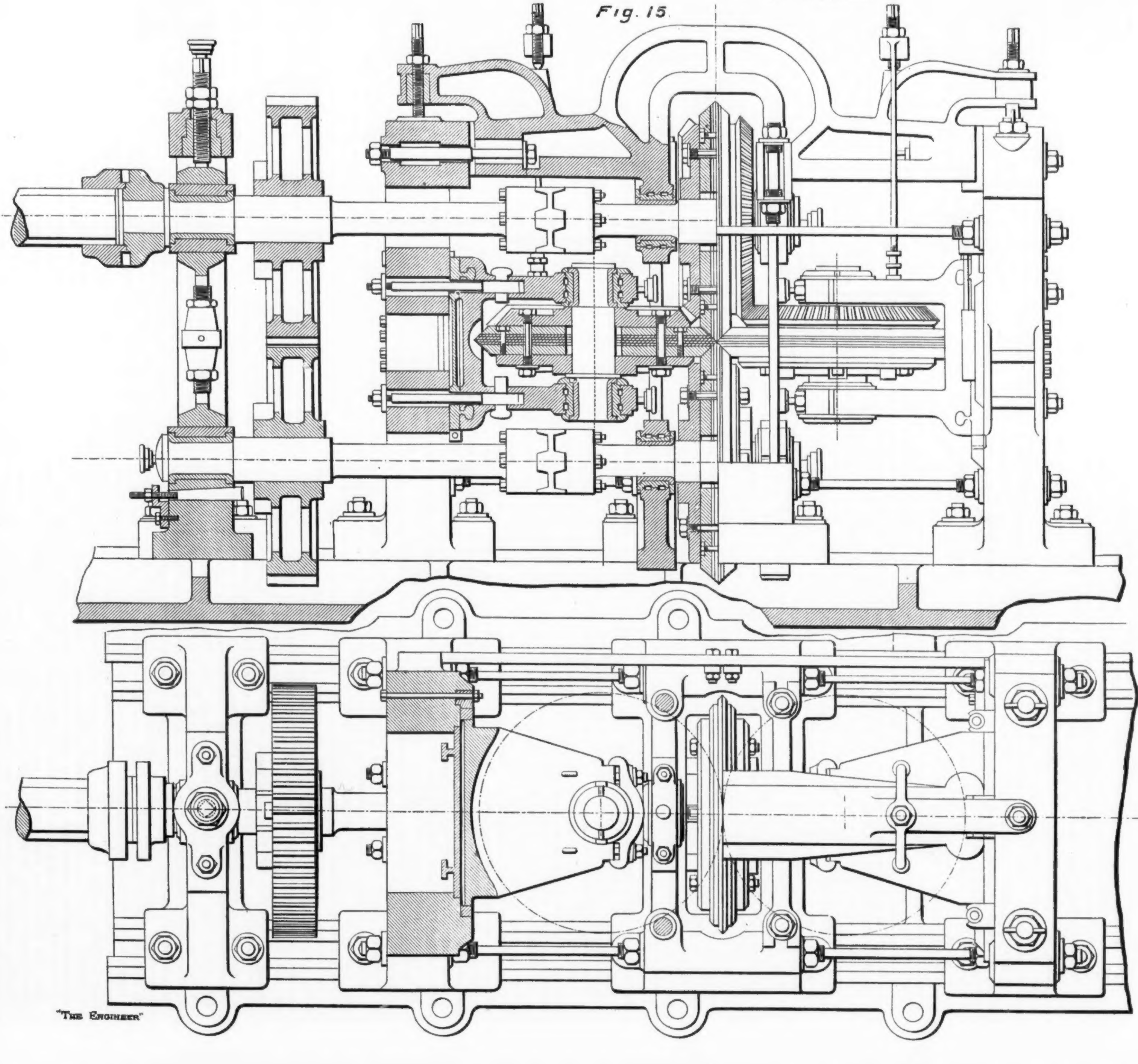
One of the most distressing features of an engagement like this is the terrific noise aboard a modern man-of-war fairly in action. The Yang-Wai fought all the time with one screw turning slowly, her fires raked clean, and the steam blowing off like the shrieking of a gale. The scream of the shells, the thud and the vibration as they struck the cruiser, the terrific roar as they burst, and the deafening noise and concussion of our own guns, made it utterly impossible for anything else to be heard aboard the vessel. To my dying day I shall remember that July 12th, and, most of all, the horrible noise and the scene on the bloody main deck. We broke the record, I think, on our run to Shanghai, where we arrived at four o'clock on July 13th.

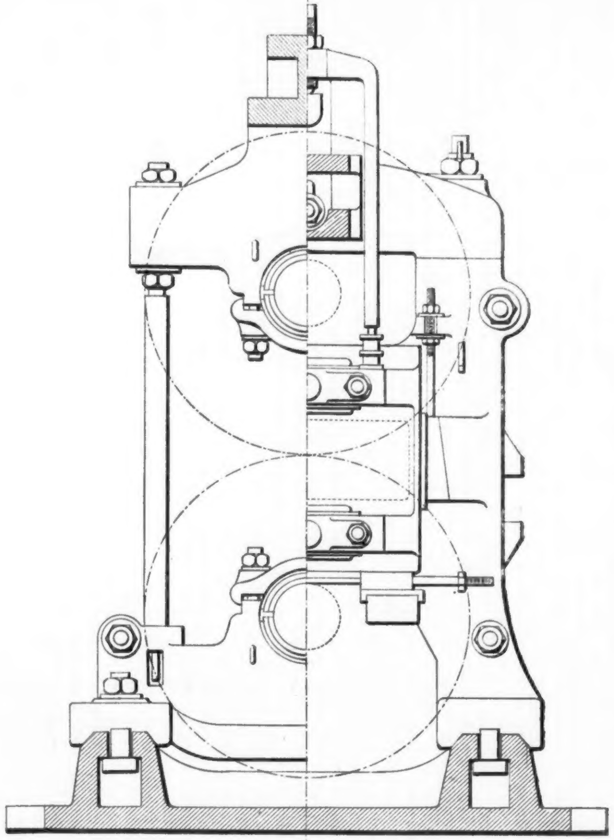
# MACHINERY FOR ROLLING CHAINS FROM THE SOLID BAR

THE WALZWERK GERMANIA, ENGINEERS

(*For description see page 361*)

Fig. 15





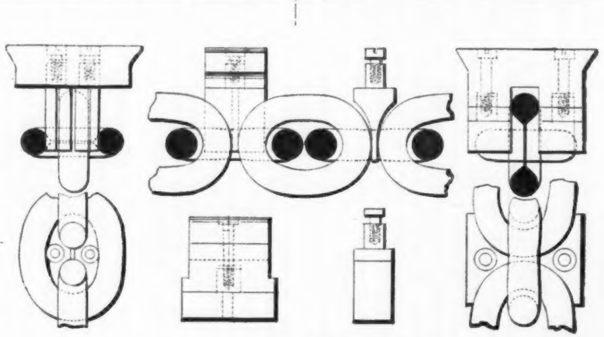


Fig. 12

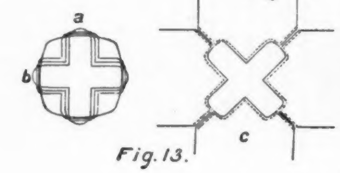


Fig. 13.

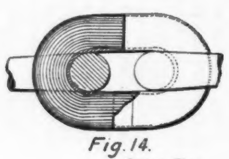
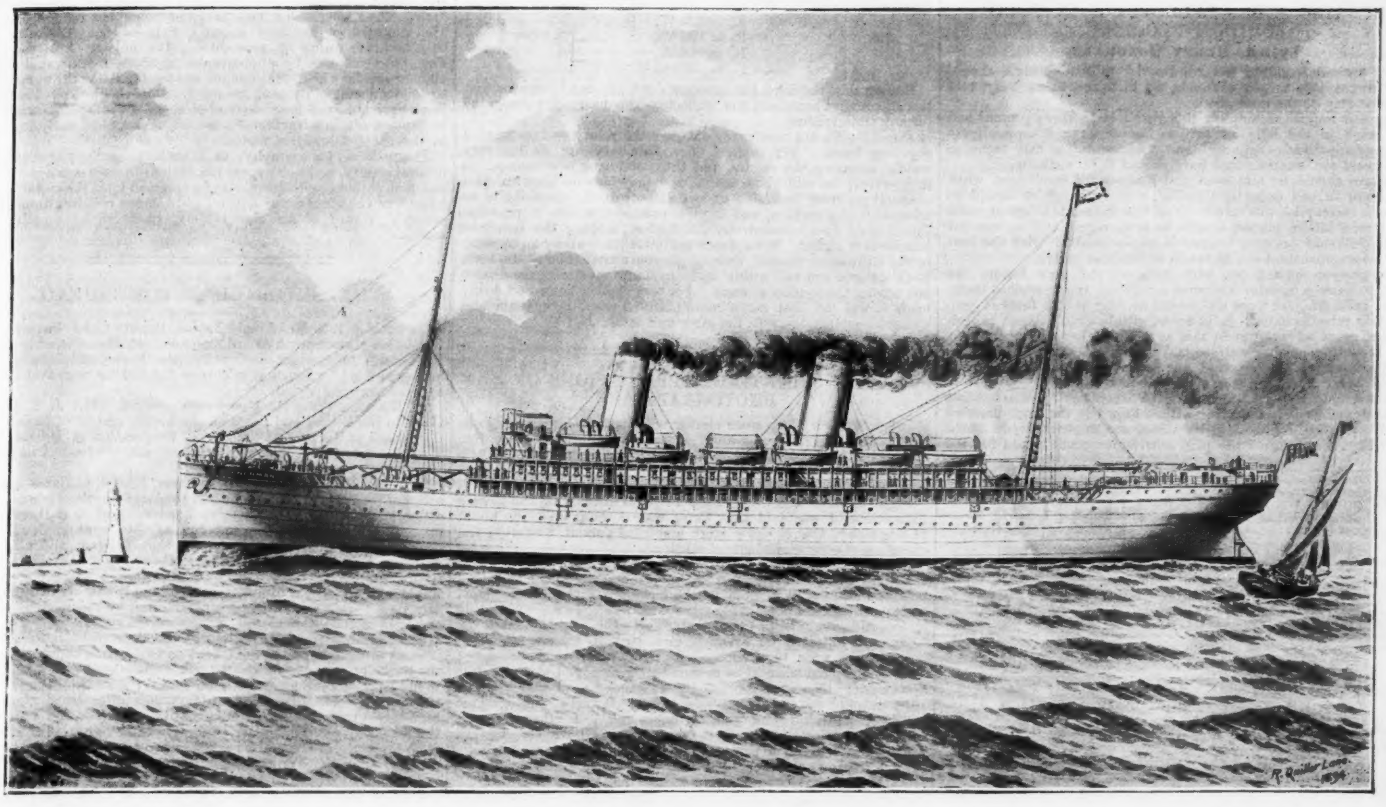


Fig. 14.

Swain Eng.

# THE UNION STEAMSHIP NORMAN

MESSRS. HARLAND AND WOLFF, BELFAST, BUILDERS AND ENGINEERS



## THE NEW SOUTH AFRICAN STEAMER NORMAN.

We illustrate above the latest addition to the Union Steamship Company's fleet. In our issue of July 27th we gave an illustration of this vessel as she appeared on the stocks, at the same time giving particulars. Consequently little remains to be said. We may, however, repeat that her length between perpendiculars is 490ft.; moulded breadth, 53ft.; depth, 37ft. 6in.; and gross tonnage 7392. The steamer leaves Southampton on her first voyage on the 10th November, and will leave Cape Town homewards on the 19th December. We anticipate that by early record breaking, she will prove herself worthy of her eminent builders, Messrs Harland and Wolff.

## THE BREWERS' EXHIBITION.

The sixteenth annual exhibition of machinery, appliances, and produce used by brewers, maltsters, distillers, &c., was opened at the Agricultural Hall on Monday, the 22nd inst., and will close to-morrow evening. As this Exhibition is always held in the same building, many exhibitors retain the same position year after year; and this is perhaps one reason for the creditable state of advancement on the opening day. With few exceptions all were ready, and the machinery at work; and, judging by the attendance on that day, the show is likely to be very successful. The principal feature this year is the number and variety of cooling apparatus; but other necessary appliances for breweries, from well-sinking to cask-making and cleaning, are all represented; and the manufacturers of aërated water machinery are increasing in number and in the size of their largest machines.

On entering the main building, the first stand observed is that of Messrs. Le Grand and Sutcliff, who exhibit the various appliances for sinking Norton's Abyssinian tube wells. They also show cores from diamond and steel drills, from depths up to 1100ft., and a set of boring tools up to 17½in. diameter. Another of their exhibits is a "spun" gun-metal pump-barrel for deep well pumps. This barrel is 12in. diameter; the spinning process is intended to ensure a homogeneous metal, free from flaws or air bubbles.

Well-sinking machinery is also shown by Messrs. C. Isler and Co., of Southwark, who have an interesting collection of cores from diamond drills, ranging from 1½in. to 9in. diameter. In a perforation of the smaller size through oolite, the rate of progress was only 1ft. per day, whilst a 9in. boring was put down through marble for 460ft. at Plymouth, at a daily average speed of 5ft. The exhibitors show photographs of a 13in. boring at Spalding, and of other water works constructed by them. Both these firms also exhibit turnstiles.

Artesian well plant is also exhibited by Messrs. A. Williams and Co., of Great Eastern-street, who show steel tube shear-legs and other fittings for artesian borings, as well as appliances for driving tube wells when it is expected to meet water at shallow depths. Steel socketed well casing, with the points set in so as to be flush on the outside, a Curtiss single and double-action pump, and gun-metal deep well pump valves, also form part of this exhibit. A drawing of a well bored by this firm at Messrs. Salter's Brewery, Caledonian-road, in which the pump is 215ft. below the surface, is interesting as showing the various strata through which the boring passed. Messrs. Williams also exhibit the Halliday windmill, which has not undergone any modification since it was described in The Engineer.

At the next stand to Messrs. Williams may be seen an ingenious little machine for corking in vacuo, which certainly seems to possess several advantages over the ordinary corking machines. It is the invention of Mr. Bathgate, and is exhibited by the Vacuum Corking Machine Company, of Edinburgh. By the ordinary method of corking, the air in the neck of the bottle is compressed by the insertion of the cork, necessarily causing great internal pressure. In this system, the air is extracted just before the cork is driven in; this renders corking easier, and greatly diminishes the risk of breakage. Besides this, the vacuum between the cork and the contents of the bottle serves to draw the air out of the latter, and thus to check any tendency to fermentation, and prevent the growth of mould on the surface. The bottle, as in other machines of this description, is placed on a stand, which can be raised by a foot lever, bringing the neck of the bottle against the india-rubber washer contained in a cap. A tube connects this cap with the middle of the barrel of a small vacuum pump, which is on the pedestal of the stand. A hand-lever turns an irregularly toothed wheel, gearing into two racks, of which one works the piston-rod and the other the corking rod. On pulling the lever the corking rod first descends and forces the cork into the upper end of the cork tube, thus rendering the joint air-tight. This rod then stops, and the outer one commences to raise the piston, and create a vacuum in the cylinder. When the piston has travelled more than half way the end of the tube connecting the vacuum cylinder with the cap, and consequently with the neck of the bottle, is uncovered. The air in the neck rushes through it into the cylinder, and whilst the piston is travelling the rest of its course the corking rod continues to descend and drives the cork home. A disc on the hand-lever serves to set the machine for any size of cork, so that, whatever its length may be, the top is always just above the neck of the bottle.

Messrs. Buxton and Thornley, of Burton-on-Trent, are exhibiting their automatic variable cut-off gear for a horizontal engine. The engine is a 15-horse power nominal, with single cylinder, 12½in. diameter and 24in. stroke. The expansion excentric-rod works a lever with a straight slot in it. The fulcrum on which this lever turns is connected with the governor, and this, by raising or lowering the fulcrum, can shorten or lengthen the stroke. This firm also exhibit a malt mill, fitted with a magnetic separator for removing iron, and with a rotary screen for dust, stones, &c., and a set of steam pumps from 4in. by 2in. up to 12in. by 8in.

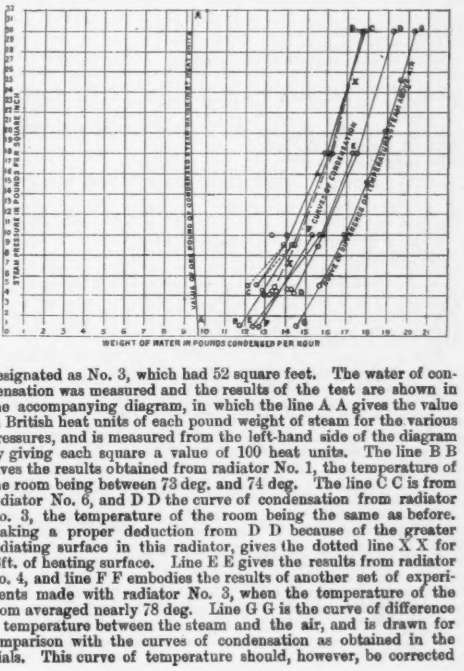
Brewers are said to be ultra-conservative, but in some respects they have taken kindly to new appliances, as this Exhibition and its predecessors show. One apparatus, which, though by no means new, has only come of late years into general use, is "Steel's mashing machine." A number of these are exhibited by different firms, all similar in general design. The one at Messrs. Buxton and Thornley's stand is entirely of copper, 18in. diameter, 60in. long. The malt, on leaving the grinding mill, is fed into a hopper at the top of the machine, whilst hot water enters by a pipe at the side. Gun-metal rakes are turned, either by hand or steam power, from a shaft which passes up the middle of the machine; and these serve both to mash the malt and to propel it forward. Brewers do not agree as to the speed at which these rakes should revolve. Some prefer a velocity of 300 to 400 revolutions per minute, whilst others think a rate of about 150 sufficient. The mash, on leaving the Steel's machine, goes straight to the mash tun, and the saving of time by this preliminary mixing is considerable. They also show a mash tun 14ft. diameter, 5ft. 9in. deep, with gun-metal false bottom and ten rows of cast iron revolving rakes. The right material for the teeth of mash tun rakes does not seem to be definitely decided. In this machine they are cast with the rake, in others they are of wrought iron. Many makers prefer gun-metal; in fact, some go so far as to make the whole mash tun of gun-metal and copper. Wood, which was formerly the usual material for these teeth, has apparently been quite abandoned, as it is not used on any which are shown at this Exhibition.

Another change of late years is in the method of making the perforations of the false bottoms. Formerly circular holes were drilled in these, but now long narrow slots, cut with saws, are generally used. Iron and gun-metal plates with these perforations are shown by several exhibitors, amongst others by Messrs. Llewellins and James, of Bristol. This firm also show another method of making perforated plates. Cast iron plates are drilled conically on each side at distances about 2in. apart, and into these apertures, copper discs, which have each been pierced with nine holes $\frac{1}{32}$ of an inch in diameter, are inserted and riveted over. By this means the advantage of a strong and rigid plate can be combined with that of having a large number of fine perforations. There are several other firms who have interesting exhibits of new machinery or appliances, but a description of them must be postponed till next week.

## CONDENSATION IN CAST IRON RADIATORS.

In the July "Proceedings" of the American Society of Civil Engineers there is an interesting paper on "Tests of Condensation of Cast Iron Radiators," by William J. Baldwin. In the course of his professional work Mr. Baldwin has occasion to test a number of good cast iron radiators to determine the amount of condensation occurring in them during ordinary conditions. These radiators were tested after the following manner:—Four radiators were placed in the same room and each enclosed in a frame covered with muslin but open at the top and bottom. The muslin was in all cases 6in. from the sides and ends of the radiators and was about 6in. from the floor, so as to permit an uninterrupted flow of air to the radiators, while preventing the radiators from transmitting heat to each other. Steam at 90 lb. pressure was employed and led through a reducing valve which was regulated to various pressures during the test. Precautions were taken to insure the steam being dry when it entered the radiators.

Each radiator had 48 square feet of surface except the one designated as No. 3, which had 52 square feet. The water of condensation was measured and the results of the test are shown in the accompanying diagram, in which the line A A gives the value in British heat units of each pound weight of steam for the various pressures, and is measured from the left-hand side of the diagram by giving each square a value of 100 heat units. The line B B gives the results obtained from radiator No. 1, the temperature of the room being between 73 deg. and 74 deg. The line C C is from radiator No. 6, and D D the curve of condensation from radiator No. 3, the temperature of the room being the same as before. Making a proper deduction from D D because of the greater radiating surface in this radiator, gives the dotted line X X for 48ft. of heating surface. Line E E gives the results from radiator No. 4, and line F F embodies the results of another set of experiments made with radiator No. 3, when the temperature of the room averaged nearly 78 deg. Line G G is the curve of difference of temperature between the steam and the air, and is drawn for comparison with the curves of condensation as obtained in the trials. This curve of temperature should, however, be corrected



according to curve A A before comparison is made. Several of the small circles on the diagram which do not coincide with any curve, indicate data that were obtained from the same radiators under different conditions of humidity and temperature.—*Railway Engineering and Mechanics.*

## STRAINS AND DEFLECTIONS IN SOLID BRIDGE FLOORS.*

By Mr. Henry Goldmark.

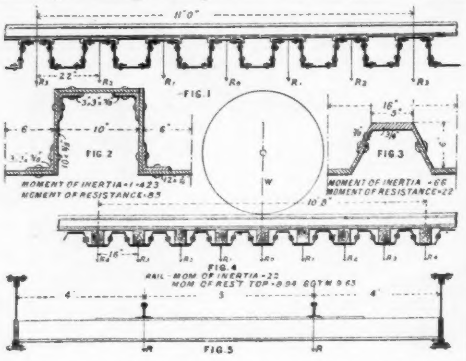
The present tendency towards heavier railroad bridges should be directed into proper channels, so that the extra weight of material may do the most good.

The best way to accomplish this result is to study present and past work in the field as well as the office; and especially to analyse such "bridge failures" and "accidents" as may occur, so as to avoid constructions that have proved to be weak.

Bridges should be safe even under untoward conditions, when trains are in bad order or derailed, and every effort should be made to accomplish this result. For this reason the use of plate and strong lattice girders should be encouraged, and an increase in the clearance between trusses is also advisable. But the best field for improvement can be found in the floor system.

Our present open floors, with stringers and floor beams, are likely to cause a disaster whenever a derailed truck reaches them. Guard rails, &c., are mere makeshifts as long as this form of construction remains in use. Solid floors, with or even without ballast, present great advantages in this as well as other respects. They give a continuous floor surface, take up little "depth," form an excellent lateral bracing, and are not unduly expensive. They should be far more generally employed than they are.

Of several forms in use in the United States two types are shown in the drawings presented herewith. Fig. 4 is the floor used by the Ill. Central Railroad in its street crossings in Hyde Park, while Figs. 1 and 2 give the plan now under construction for the Lake Shore and Rock Island companies on their elevated tracks. In both cases, the troughs act as cross-beams, and the rails as longitudinal beams in distributing weight.



If we know what proportion of the wheel load is carried by each trough, we can calculate the strains and deflections by the usual methods for beams. Hence this distribution must first be found. Though involving the elastic theory, the method of calculation used is logically correct, and should give true results.

*Method of calculation.*—If W = a wheel load over a trough—Fig. 4—then W will be distributed by a certain number of troughs, so that

$$W = R_o + 2 R_1 + 2 R_2 + 2 R_3 + 2 R_4.$$

By the principle of least work, the distribution of the loading will be such that the work of bending the troughs and the rails will be a minimum.

By a general formula dating back to Euler's time, the work of

$$\text{bending any beam} = \frac{1}{2 E I}\int M^2 d x \ldots \ldots \ldots \ldots \ldots \ldots \quad (A).$$

Where E = modulus of elasticity.
Where I = moment of inertia.
And M = moment of external forces at any point.

Applying this formula to our case—Fig. 4.

Work of bending one trough under two loads R

$$= \frac{1}{E I}\int_0^{48} R^2 x^2 dx + \frac{1}{2 E I}\int_{48}^{108} 48^2 R^2 dx$$

Which by integration and reduction

$$= 1606 \frac{R^2}{E}$$

Hence if $U_T$ = work of bending all the troughs

$$U_T = \frac{1606}{E} (R_0^2 + 2 R_1^2 + 2 R_2^2 + 2 R_3^2 + 2 R_4^2)$$

Or, by substitution,

$$U_T = \frac{1}{E} (1606 W^2 + 9636 R_1^2 + 9636 R_2^2 + 9636 R_3^2 + 9636 R_4^2 + 12{,}848 R_1 R_2 + 12{,}848 R_1 R_3 + 12{,}848 R_1 R_4 + 12{,}848 R_2 R_3 + 12{,}848 R_2 R_4 + 12{,}818 R_3 R_4 - 6124 W R_1 - 6424 W R_2 - 6424 W R_3 - 6424 W R_4).$$

Again from formula (A):—

If $U_R$ = work of bending the two rails,

$$U_R = \frac{2}{E I} \left(\int_o^l M_1{}^2 d x + \int_o^l M_2{}^2 d x + \int_o^l M_3{}^2 d x + \int_o^l M_4{}^2 d x.\right)$$

Where $M_1$, $M_2$, $M_3$, and $M_4$ are bending moments in the different panels of the rail.

By reduction this gives:—

$$U_R = \frac{1}{E} (3972 R_4^2 + 1676 R_3^2 + 497 R_2^2 + 62 R_1^2 + 1738 R_2 R_3 + 497 R_1 R_3 + 310 R_1 R_2 + 5027 R_3 R_4 + 2483 R_2 R_4 + 683 R_1 R_4).$$

Hence if $U = U_T + U_R$ = total work done,

We can write:—

$$U = \frac{1}{E} (1606 W^2 + 13{,}608 R_4^2 + 11{,}312 R_3^2 + 10{,}133 R_2^2 + 9698 R_1^2 + 13{,}158 R_1 R_2 + 13{,}345 R_1 R_3 + 13{,}530 R_1 R_4 + 14{,}586 R_2 R_3 + 15{,}331 R_2 R_4 + 17{,}875 R_3 R_4 - 6424 W R_1 - 6424 W R_2 - 6424 W R_3 - 6424 W R_4).$$

This is a function of $R_4$ $R_3$ $R_2$ and $R_1$, and will be a minimum when all the partial derivatives are equal to zero.

Differentiating we have:

$$\frac{d U}{d R_4} = \frac{1}{E}\left(27{,}216 R_4 + 17{,}875 R_3 + 15{,}331 R_2 + 13{,}531 R_1 - 6424 W\right)$$

$$\frac{d U}{d R_3} = \frac{1}{E}\left(17{,}875 R_4 + 22{,}624 R_3 + 14{,}586 R_2 + 13{,}345 R_1 - 6424 W\right)$$

$$\frac{d U}{d R_2} = \frac{1}{E}\left(15{,}331 R_4 + 14{,}586 R_3 + 20{,}265 R_2 + 13{,}158 R_1 - 6424 W\right)$$

$$\frac{d U}{d R_1} = \frac{1}{E}\left(13{,}531 R_4 + 13{,}345 R_3 + 13{,}158 R_2 + 19{,}396 R_1 - 6424 W\right)$$

Equating these to zero and reducing we have:

$$424 R_4 + 279 R_3 + 239 R_2 + 210 R_1 = 100 W.$$
$$279 R_4 + 352 R_3 + 227 R_2 + 208 R_1 = 100 W.$$
$$239 R_4 + 227 R_3 + 316 R_2 + 205 R_1 = 100 W.$$
$$210 R_4 + 208 R_3 + 205 R_2 + 302 R_1 = 100 W.$$

These equations may be readily solved and give

$$R_0 = \cdot 192 W.$$
$$R_1 = \cdot 173 W.$$
$$R_2 = \cdot 120 W.$$
$$R_3 = \cdot 080 W.$$
$$R_4 = \cdot 031 W.$$

Solving our problem by the same method we get for the second type (Figs. 1 and 2):—

$$R_0 = \cdot 39 W.$$
$$R_1 = \cdot 26 W.$$
$$R_2 = \cdot 09 W.$$
$$R_3 = - \cdot 045 W.$$

Having thus obtained the greatest load any one trough carries, the maximum fibre strain and deflection can be readily computed for any train loading.

*Results.*—We can now easily compare the relative advantages of our two floors. The shallow floor distributes its loading very widely, reducing the strains, and thus conducing to economy. It is, however, less stiff under trains, and may become loose in rivet connections from excessive deflections. Still, its elasticity is an advantage as a cushion, and it gives excellent results in practice. The deeper floor concentrates its loading, making the structure heavier but stiffer. Both floors are strengthened by an increase in the stiffness of the rail, causing greater distribution of the load. Both designs are well within ordinary limits of strain, the deeper one having the smaller stresses. For very shallow floors and heavy loads it will not cost much more than the usual floor beam and stringer construction with the same unit strains.

## THE SCIENTIFIC APPLICATIONS OF PHOTOGRAPHY.*

It is not so very long since photography occupied a very subordinate position in the world alike of science and of art. Scientific men looked on photography as a mere art, artists regarded it as a mere science. About twenty years ago, when I suggested that some improvement in a photographic process—I forget now which—ought to be brought before the Physical Section of the British Association, I was told that there was nothing scientific about photography, that it was a mere empirical pursuit, unworthy the attention of serious students of science.

And to a large extent the reproach was well deserved. Though the list of the earliest workers in photography contains many illustrious names, yet it is true that a large proportion of the most important contributions to photographic knowledge were not made by scientific workers, or by men who worked in scientific methods. They were obtained by practical men, seeking for results, often indeed seeking for them successfully by methods which could not have commended themselves to men better equipped with scientific knowledge. Of course this was the consequence of the fact that photographic science was early associated with photographic practice, and the same remark holds good of other sciences, electricity for instance, in which theory and application to practical use advance with equal steps; but I think it applies more to photography than to any other.

At the present time we have indeed reached a very different condition of things. All the most striking of the recent advances in the science are the result of elaborate scientific research. The most recent improvements in lenses were the fruit of long and laborious investigation into the optical properties and the chemical nature of certain sorts of glass. The increased speed of modern plates, and their improved power of rendering colour values more truly, have only been obtained by minute knowledge of the condition of the problem to be solved, and by careful application of the most recent results of chemical and physical research. If the old photographic crux—the reproduction of colour—has been solved; or, at all events, if a possible method has been indicated for its solution, it was not by haphazard experiment, but by careful adjustment of means to secure an anticipated result. Now-a-days we can only hope for improvement by utilising the advance of scientific knowledge.

But if the present position of photography is due to progress in the kindred sciences, how amply has she repaid the debt. There is not a single branch of science in which photography is not largely used. There are many whose progress is now absolutely dependent on the power of the camera to observe more accurately, more independently, more minutely, more rapidly, more permanently than the human eye. If, as appears to be the case, we have reached the limits of human vision, aided by the most delicate instruments that can be constructed, it is difficult to imagine what limits need be set to photographic vision, can we but construct instruments of accuracy sufficient to allow its full powers to be utilised.

The advantages of the "retina which never forgets," and, it might be added, which never tires, which accumulates weak impressions and stores them up till they become one strong one, were long since recognised by De la Rue, and I suppose it will not be very long before, for astronomical purposes, eye observations are entirely superseded by photographic. The photographic camera is now an indispensable adjunct to every large telescope, if indeed it would not be equally correct to say that the telescope is an adjunct to the camera, since the astronomical telescope tends more and more to assimilate to the form adopted long since by Mr. Rutherford, in which the visual rays are of but slight importance, and the chief attention is given to the accurate utilisation of the more chemically active rays at the violet end of the spectrum.

When we are told that a photographic plate has recorded 10,000 stars in an area not containing a single visible star, one may be excused an expression of wonder as to how the human mind is ever to grapple with problems of such infinite complexity, to turn to useful account observations dealing with such enormous multitudes. As an automatic recorder of scientific observation, photography seems to have been utilised in the Royal Observatory about 1847, under the superintendence of the venerable ex-president of the Society, Mr. Glaisher, who has been kind enough to furnish me with particulars of the methods originally devised by Mr. Charles Brooke, and successfully worked for many years by Mr. Glaisher and his staff.

The method was first applied to record magnetic variations, and the movements of the barometer and thermometer. In the case of the former, a ray of light reflected from a mirror carried by the magnet was focussed on the surface of a cylinder covered with sensitised paper. The cylinder was rotated by clockwork, the result being of course—in the way now commonly employed for such automatic records—to give, when the image was developed, a record of the movements of the magnet. A base line was given by an invariable spot of light, and by intermissions of this light a time record was provided. Similar results were obtained in the case of the barometer, by using a float with a small perforation through which the light passed, and with the thermometer by simply allowing the mercury itself to screen the light from the sensitive surface.

Later on, in 1865, similar means were used by Mr. Glaisher for the automatic record of earth currents, and they have, consequently, been continuously observed since that date at Greenwich.

To the best of my knowledge, but little alteration has been made in the original system, the only improvement being in the sensitive surface employed. When gelatino-bromide paper was introduced, it was tried and adopted at Greenwich, and by its means superior results were obtained.

Numerous instances will occur to many of you in which photography has been or might be applied. I will only refer to one, because it appears to me so excellent an instance of the delicacy of the method. At the last, the Oxford, meeting of the British Association, Mr. Burch showed to the newly-formed Physiological Section photographic records taken with the aid of the capillary electrometer of electric currents produced by speaking into the telephone. The letter z produced a complicated curve in which oscillations of current lasting only $\frac{1}{3000}$ sec. were visible with a lens.

The meteorologist has been enabled by its aid to study the form and nature of clouds, the shape and character of the lightning flash. The zoologist has been taught much about animal motion. The microscopist has long learnt to rely on the camera as the only accurate means of reproducing the objects of his studies. The physicist has by photographic methods investigated many phenomena in which the changes are too rapid for the human eye to follow them. By such means Lord Rayleigh and Professor Boys have obtained long series of pictures of occurrences which all took place within a fraction of a second, thus almost analysing time as the chemist analyses matter.

The uses of photography, in ethnology, geology, geography, natural history, archæology, are too obvious to need mention. They, and many other applications, may be summed up in the remark, that whenever the observer of natural phenomena requires to make an accurate record of his observations, photography supplies the means.

## THE SEWERAGE OF PORTISHEAD.

On October 19th Mr. Arnold Taylor, Deputy Chief Inspector to the Local Government Board, attended at the Assembly Hall, Portishead, to conduct an inquiry, the Portishead Local Board having applied for sanction to borrow £14,000 for works of sewerage and sewage disposal.

All the members of the Board were present. Mr. J. C. Clyde, Clerk to the Board, said there was no proper system of drainage at Portishead at the present time. The Corporation of Bristol were the largest owners of land at Portishead, and they raised no objection to the proposed scheme.

Mr. Moss Flower, of Carlton-chambers, Bristol, engineer for the scheme, read a report which he had prepared on the present condition of sewers at Portishead, and pointed out that there were many ill-constructed sewers and drains. He went in detail into the sewerage arrangements such as they existed, and said the drainage was as bad as it could be. He thought that if typhoid fever, diphtheria, or any other infectious disease broke out, there would be a very great difficulty in stamping it out. The report of Mr. Moss Flower was subsequently endorsed by the medical officer of health of the district.

The engineer having gone through the defective features of the present sewerage system, next went on to describe the character of the works proposed to be carried out. He stated that in all there would be about eight miles of pipe sewers; that the sewage from the low level would be lifted at two points automatically into the high-level gravitating sewer, and that the whole of the sewers on the low level would be made perfectly water-tight. The sewage from the high level would be taken out to sea, and would be discharged at all times on the top of ordinary high water.

The outfall would be constructed of 15in. cast iron pipes, supported on lines of elm piles, and taken out to a point below lowest neap tides. It was calculated that this outfall would suffice for a very large increase in population, as all rain and storm water would—as far as possible—be taken to water courses, or into the existing system of drains, which were to be repaired, cleansed, and extended where necessary. There would be manholes at every change in line and gradient, flush tanks at the top of all sewers, and disc valves on the outlets of nearly all the manholes. Some of the manhole covers would be blank, and the remainder would be of such form as could be quickly opened and closed at will. A large number of ornamental columns and ventilating shafts up the sides of the houses would be erected throughout the system. He said the gradients from one end to the other were excellent; the smallest gradient was a very short length of the main sewer, and here it was 1 in 250. Some of the ratepayers thought some of the existing sewers were good, that the sewage might cause a nuisance from the outfall, that the scheme was too expensive, and that some more modified scheme might be adopted; that they were afraid the work could not be done for the money, and that the payment of the rate would prove a hardship to small ratepayers, &c.

The Inspector remarked that if a bit here might be good, and a bit there good, it was improbable that the good part would work into the other system, and they were going to adopt a general system of sewerage, and no doubt it was an expensive scheme, but could they have an efficient scheme for less money? That he had not to pay salaries or increase them or reduce them, but as they had to raise the sewage from the low level it would necessitate expense in working; he further said it would concern cottages and castles, but they did not want an *ad captandum* appeal to the poor, the small renters would have their rates compounded for. The Inspector also remarked that they might take it from him there would be a large sum required for private house drainage in addition to the £14,000.

The Inspector, after closing the inquiry, had a private interview with the members of the Board, and pointed out the desirability of the Board enforcing the proper reconstruction of the defective house drains under close supervision, as he—the Inspector—said it was useless to put in a new system of sewers and leave the house drains as they were, or for them to be altered imperfectly. The Board at once saw the necessity of giving effect to the Inspector's suggestions. Subsequently the Inspector, in company with Mr. Moss Fowler, inspected the district, and he—the Inspector—expressed his opinion that the district, without a doubt, badly required draining, and it appeared to him that the scheme proposed well met the requirements of the case.

**Glasgow and West of Scotland Technical College Scientific Society.**—The opening meeting of the third session of the above Society was held in the Technical College Buildings, on the evening of Saturday, the 6th inst. The new President, Mr. H. Osbourne Bennie, Wh. Sc., delivered his inaugural address, the chair being occupied by Professor McLay. The title of Mr. Bennie's paper was, "Progress in Mechanical Engineering." He treated the subject in a most interesting and entertaining way, calling attention to the rapid advance made during the last twenty years, and emphasising the fact that this progress was not due to the application of recent scientific principles, but to great improvements in the methods of working, and a more exact scientific knowledge on the part of the workers. Having briefly traced the lines of progress in the departments of marine engineering and boilermaking, locomotive building, land engines, hydraulic machinery, and gas and petroleum engines, the lecturer proceeded to state that although progress was due in great measure to competition, it was also due in greater measure to the acquisition of a thorough scientific knowledge on the part of the younger members of the profession, and the careful application of the same to everyday problems. Having touched on the subject of design, dwelling particularly on the great departures which had been made when necessary from stock designs, and commonly-accepted ideas, the lecturer proceeded to deal with the decrease of cost which had characterised engineering practice of recent years, which he attributed to the greatly extended use of machine tools, and the greater cutting power and higher speed of the same. Having compared the arrangement of a modern workshop with one of thirty years ago, Mr. Bennie concluded a most useful paper by insisting on modifying and regulating the design of a machine, in order to obtain the maximum of efficiency with the minimum of cost. An interesting discussion followed, which was taken part in by Professor McLay, Professor Watkinson, and several members of the Society.

---

* Read before the Western Society of Engineers, Chicago, September 19th, 1894.

* Extracted from the address of the President—Sir Henry Trueman Wood—to the Royal Photographic Society, 9th October, 1894.

## RAILWAY MATTERS.

For want of funds the works on the construction of a section of the East Coast Railway, in India, are at a standstill, and, for the time being, the staff have been sent away to other railways and departments.

It may interest some of our readers to learn that the Glasgow and South-Western Railway Company require the services of a superintendent of the line. Proposed salary £500 per annum. Applications, marked "Superintendent," to be sent to the Secretary, St. Enoch, Glasgow, not later than Monday, the 5th proximo.

The Quebec Central Railway Company notifies the completion of the first twenty miles of the Tring and Megantic branch, which, when finished, will be sixty miles long, and will form, with the Canadian Pacific Railway—Halifax line—a shorter route by 160 miles from Quebec to St. John, New Brunswick, and Halifax, Nova Scotia.

Details of the new railway from Bristol to London, *viâ* Bath and Andover, were submitted to a private meeting of influential citizens of Bristol the other day. A committee was formed to further the project, and substantial financial support was promised. The scheme provides for a central station at Bristol, with access to the docks.

A new line from Birmingham to Coventry and on to Rugby and Northampton, joining the existing Midland Railway in the latter town, or making a direct cut to Luton, is being considered. The Midland journey from Birmingham to town would thus be shortened by at least thirty miles, and the further advantage of opening several branch lines which are now blocked would be obtained.

The Kuhlmann counter-weight cable system of operating electric railways on steep grades is to be adopted for an extension of the electric railway system of Providence, R.I., over College Hill. The *Engineering News* says the extension will have a maximum grade of 17½ per cent. and an average grade of 14 per cent. The system was illustrated and described in the above journal for June 29th, 1893.

During the twenty-seven working days of August, 301,521 double wagons of coal and coke were sent away by railway from the Ruhr district, against 285,824 wagons in the corresponding month of last year, showing an increase of 5·5 per cent.; while from the Saar district 43,543 double wagons were sent away last month, against 39.498 in August, 1893, and from Upper Silesia 118,981 against 116,333 wagons respectively.

The Agricultural Department of New South Wales has received applications for supplies of Australian hardwood sleepers for trial, namely, from the London, Brighton, and South Coast Railway for 1000 ironbark sleepers, and the Great Eastern Railway Company 2000 cut red gum. Mr. Foxlee, the engineer for existing lines—N.S.W.—states that Australian hardwood sleepers should last eighteen years, which is three times the life of the pine sleepers now in use on the English railways. The cost is, of course, higher, but beside the longer life there is a saving on the labour of re-fixing chairs and changing the sleepers.

Recent advices announce that the Brazilian Government have granted an advantageous concession for the construction of two new lines of railways. One of these starts from Faiy de Serra and terminates at Forto dos Coixas, and the other commences at the town of Itaipava in the province of Petropolis, and connects it with the flourishing district of which the chief town is Therezopolis. The construction of these lines will be of great advantage to Brazil, a country which is by no means too well provided with facilities for internal communication, considering that it stretches from 5 deg. north to 35 deg. south latitude, and occupies on a map of South America very much the same prominent position that Russia does on a map of Europe.

The liquid fuel burners of the engine Petrolia on the Great Eastern Railway burn during a month's average of over 3000 miles as follows:—Coal for lighting up, standing, &c, 11·8 lb. per mile; liquid fuel, running, 10 5 lb. per mile; total 22 3 lb. per mile. This is compared by the *Railway News* with a consumption of 34 lb. per mile of coal on similar engines on same service. On June 15th last, as we mentioned when we illustrated the fuel-burning apparatus in The Engineer, the engine Petrolia ran through from London—St. Pancras—to Scarborough and back, with a special train of saloons, dining car, &c., weighing 200 tons. The total distance is 534 miles, and consumption of fuel 11·5 lb. of coal per mile and 11·25 lb. of liquid fuel per mile, total 22 8 lb. per mile. The fire was not cleaned, and the only stoppages made were those required for water and oiling the engine.

The engineering operations in connection with the New-street London and North-Western Railway extensions in Birmingham are proceeding satisfactorily. The object is to so widen the tunnel as to allow a separate means of entrance for all Midland trains. Messrs. Holme and King, the Liverpool railway contractors, who have the work in hand, are really engaged in building a tunnel quite distinct from the one at present in use. There are at present about 120 men engaged, but as time proceeds more will probably be taken on, and operations will be continued in several places at once. The approach to the tunnel will necessitate the process of boring beneath the Great Western Railway, but this portion of the work has not yet been entered upon. With regard to the changes some distance outside the north tunnel, Mr. J. T. Firbank, the contractor, has successfully bored through the Landor-street embankment into Garrison-street. With the completion of the new arrangements, the Midland Derby line will be transferred to the Garrison-street side of the railway until just before reaching Gloucester Junction, when it will go beneath the London line and ultimately join the old route at Saltley Junction. The London and North-Western main line will at the same time be pushed over towards Landor-street until it rejoins the old line beyond Gloucester Junction, and ultimately its new course will be continued from Landor-street, and forward to the mouth of the tunnel.

In concluding a Board of Trade Report on the fatal collision which took place on the 2nd August at Newtonmore station on the Highland Railway, Major Marindin says: "In this case the 11.50 a.m. down passenger train from Perth, consisting of two engines and tenders, and sixteen—equal to seventeen—vehicles overran the down home-signal at about 3.10 p.m. and, running on to the up loop line, came into collision with the 10.40 a.m. up goods train. I must here remark, that I do not see how it can be expected that the signalling work at stations with so long loops as that at Newtonmore, where the two cabins are nearly 500 yards apart, will be carried out properly, unless there be a separate man to attend to each cabin, especially when the one man at present employed has all the duties of a porter to attend to, and I trust that the company will see the necessity of increasing their staff at this and other stations of the kind. The hours both of the station master, and of the pointsman, or porter-signalman, under the present arrangements are too long, and the employment of an additional man would enable the work to be adjusted so as to give them some relief. No time should be lost in either clearing the view from the south cabin of the down distant-signal at Newtonmore by lopping the trees which now obscure it, or providing an electrical repeater for this signal. In conclusion, I must draw attention to the long hours of duty of driver Bowie on the day before the accident, viz., from 11 a.m. to 11.45 p.m., with an interval of rest of only 1½ hours at Grantown." This labour leader sort of recommendation is very like that proposed by a recent jury, which recommended that two more men should be employed at a South London station because a child ran into the station after a ball and was killed on the line.

## NOTES AND MEMORANDA.

The rainfall during September over the Thames Valley has been deficient to the extent of nearly 1in. The actual amount falling at Oxford was 1·74in., the average for twenty-five years being 2·66in.

The following method, which may be taken for what it is worth, has been suggested for the preparation of a substitute for white lead:—Sulphate of lead is used instead of the carbonate, and is ground in oil to which from one-half to one per cent. of borax or other borate has been added.

The number of pounds of zinc consumed in the best battery, per horse-power hour, is about equal to the weight of coal required to give the same amount of energy in a steam engine; and, says *Power*, since zinc costs about fifty times as much per pound as coal, it is obvious that the primary battery is far more costly than steam in the generation of power.

The Registrar-General's returns show that Leicester has not yet been affected by the short supply of water. The deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 17 per 1000 of their aggregate population. The highest rates were those of Burnley 24·3, and Liverpool and Sunderland 22 9 and 22 6, the rates for Leicester and Plymouth being 11·9.

The following formulæ for acid-resisting cements are given in the *Bulletin Technologique*:—(1) Silicate of potash—30 deg. Baume; powdered pumice. (2) Powdered asbestos, 2; sulphate of baryta, 1; silicate of soda—50 deg. Baume—2. This resists strong sulphuric and nitric acids; for dilute acids the silicate should be 130 deg. Baume. (3) Silicate of soda, 2; sand, 1; asbestos, 1. This is the best to resist hot nitric acid.

Out of 3341 ships which passed through the Suez Canal in 1893, 92 per cent. used the electric light, thereby saving nearly eleven hours in the transit, the time occupied in passing through being with the electric light 19 hours 52 minutes, and without the light 31 hours 24 minutes. The number of British vessels included in the above total was 2405, besides thirty-nine men-of-war, and only nine casualties were registered at the British Vice-Consulate at Suez of vessels having grounded or collided.

An alloy having the appearance of silver, receiving and retaining a high polish, and which can be rolled into sheets or drawn into wire, can be chiefly obtained by the following composition:—Mixture number one is first prepared by melting 78 lb. of copper and adding first 20 lb. of nickel and afterwards 12 lb. of spelter, 1 lb. of antimony, and 1 lb. tin. Sixty-four pounds of the mixture is then melted, and 32 lb. of spelter, 2 lb. of tin, and 8 lb. of lead are added, thus forming the alloy.

In their report on the water supplied from the river Thames to London during September, Professors Crookes and Dewar say:—In spite of unfavourable conditions, usually prevailing during the winter months, the composition of the Metropolitan waters has been very satisfactory. The oxygen required to oxidise the remnant of organic matter left is slightly less than that required in August, and the organic carbon is a shade higher, but only by an amount equal to one part in seven millions.

In London 2516 births and 1326 deaths were registered last week. Allowing for increase of population, the births were 181, and the deaths 275, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 15·3, 15·4, and 15·5 in the preceding three weeks, further rose last week to 15 9. During the four weeks ended on Saturday last the death-rate averaged 15 5 per 1000, being 2 2 per 1000 below the mean rate in the corresponding periods of the ten years 1884-93. In greater London 3372 births and 1670 deaths were registered, corresponding to annual rates of 29·6 and 14·6 per 1000 of the estimated population.

At a recent meeting of the Paris Academy of Sciences, a paper was read on the "Influence of Low Temperatures on the Laws of Crystallisation," by M. Raoul Pictet. The author shows the essential difference in the manner in which the crystallising body loses heat at the moment of solidification in the two cases where the substance is (1) adiathermanous and (2) diathermanous. All substances become diathermanous below −70 deg., and hence the true temperature of crystallisation is only obtained when the surrounding medium is maintained at a temperature very slightly below the solidifying point. Hence an explanation of the anomalies occurring in determinations of the crystallisation point of such substances as chloroform.

In a recent number of the *Comptes Rendus* is a paper on the automatic transmitter of steering directions, by Lieut. H. Bersier. The alternating current from a Ruhmkorff's coil passes from the pivot of a compass through the aluminium pointer, and leaps from the extremity of this needle to one of six vertical plates placed at intervals round the inside of the compass box. This alternating current has no effect on the magnet, but serves to work six corresponding relays, and hence to cause the illumination of corresponding signal lamps placed in various parts of a vessel, and to set in motion the steering apparatus. The least deviation from the set course is automatically and immediately corrected in this way. The course is altered by simply rotating the drum carrying the plates.

Professor Carpenter, of the Sibley College, U.S., has found that in testing for the moisture in steam by the calorimeter method, erroneous results will be obtained if the calorimeter supply is drawn from a horizontal pipe. Experiments made at Cornell showed that when flowing in a horizontal pipe, the steam at the bottom of the pipe contains much more water than that at the top. He states in a letter to the *Engineering Record* that when the moisture exceeds 1 per cent. it collects in the form of drops on the sides of the pipe, and when more than 2 per cent. is present it flows along the bottom of the pipe in a separate stream, the steam being clear and transparent, but if more than that amount of moisture is present the steam became hazy and foggy. The best place from which to draw off steam for a calorimeter determination is from a vertical pipe.

The tides of Hoihow are, according to Mr. Consul Parker, of Kiungchow, as hopeless a puzzle as ever. Though the customs authorities have now four years' records, there is absolutely no rule to be deduced therefrom. The tides outside the spit are regular enough, but those inside elude the wit of man to account for, and the level of the water outside is positively said to be often several feet above that inside. There is a tidal creek near the Consul's house, over which he can rarely walk during the day in summer, but he had walked over it every day but two at 6 p.m. during the past two months—close of last year and beginning of this—a fact which of itself renders the inner tide question inexplicable. Perhaps, says the *Indian Engineer*, the best explanation given is that of a Chinese naval commander, who says that, owing to the conformation of the spit, it is impossible for the water to flow into the mouth of the creek when the north-east wind blows and the tide is rising. That would appear to explain why, during the day, the winter tides are almost invariably low inside the spit, whilst during the night, when the wind usually drops, they have an average height. Perhaps also the blowing of the wind from the south-west direction explains why, during the typhoons of the end of September and beginning of October, Hoihow was completely under water, and the tides were 4ft. above the highest ordinary mark; but the Consul is not able to say from what direction the wind was actually blowing when the floods took place—it appeared to blow from all quarters.

## MISCELLANEA.

A complete report on the Gohna Lake is to be prepared at once by order of the Government of India.

The first meeting of the Cleveland Institution of Engineers for the session 1894-5 is to be held on the 12th prox.

The first meeting of the Institution of Civil Engineers takes place on Tuesday, the 13th prox., in the theatre of the Institution as hitherto.

The London Electric Supply Corporation, Limited, announce that the offices of the Corporation have been removed to 25a, Cockspur-street, S.W.

The Franklin Institute of Philadelphia has awarded the John Scott Legacy and medal to Mr. Ralph Hart Tweddell, M. Inst. C.E., in recognition of his inventions in connection with the system of hydraulic machine tools with which his name is is associated.

The lectures at the Morley Memorial College, Waterloo Bridge-road, which are being given at a nominal charge, began on the 5th inst., including a course of ten familiar lectures, by Professor Pritchard, on "The Care of Horses." The remaining lectures will be given on Friday evenings.

A new American rifle will soon be distributed to the United States troops and militia. It carries a small bullet, covered with a nickel-plated steel jacket, and designed either to kill instantly, or to wound without causing great suffering from blood-poisoning and other complications. The theory is decidedly humane.

At the Worcester electric light installation the day supply of current is maintained by water power, a feature which makes the station unique. Great economy will be doubtless insured thereby, as steam need only be kept up during the dark hours. A fall of 12ft. is obtained from the waters of the Teme, the turbines being 300-horse power, so arranged that part or the whole of the plant can be utilised at pleasure.

It is proposed to engage three survey parties during the coming season in determining the difference of longitude by telegraph between Karachi and Greenwich. The work will consist in the telegraphic measurement of certain arcs of longitude taken *viâ* Teheran, Odessa, and Lowestoft. The operations will probably extend over at least a year, and the subsequent calculations are not expected to be completed until the end of March, 1896.

The American Committee of Naval Construction has recommended for adoption a submarine boat according to the designs of Mr. J. P. Holland. This boat is of the usual cigar shape, 90ft. long and 10ft. 10in. greatest diameter. She is capable of descending to a depth of 70ft., and when submerged her storage batteries will drive her motor at a rate giving eight knots for a period of sixteen hours, her surface speed being 16 knots. Submersion is secured by the admission of water.

The efforts often made to induce the United States Government to devote the Naval Observatory at Washington exclusively to scientific work has at last resulted in an order from Secretary Herbert to Professor William Harkness placing him as astronomical director in charge and responsible for the publication of all work purely astronomical performed at the Naval Observatory. Professor Harkness will have power to call into counsel all the talent and experience possessed by his subordinates.

Electricity has been applied to the spinning of rope and cordage by Mr. John Good, of Brooklyn, well known as having revolutionised the manufacture of rope in the United States. Until Mr. Good took out his first patent in 1869 rope was made in the ropewalks, much after a fashion that had prevailed for centuries before. Since that time he has taken out about fifty patents for rope-making machines. Mr. Good was born in Ireland in 1844, and was brought to the United States by his widowed mother in 1851. He was early thrown upon his own resources; began to invent and rented, but did not sell, his machines.

Changes in the internal arrangements of H.M. first-class battleship Royal Sovereign are under consideration at Portsmouth. It has been suggested that the bulkheads on the belt deck should be carried up water-tight to the main deck, and that light water-tight doors should be fitted to the doorways in the armoured screens. It has also been recommended that the uptake near the small-arm magazine should be made to enter the steering compartment and form an uptake and escape from it. In addition to these proposed alterations, it is urged that something should be done to improve the ventilation of the store-room passage and the electric workshop.

Mr. J. Bowen, A.M.I.C.E., Borough Surveyor of High Wycombe, Bucks, has been recommended by a committee of the Reading Town Council for the appointment of Borough Engineer. The other candidates selected and interviewed by the Council—out of a total number of 111 applicants—were Mr. Thomas Reader Smith, A.M.I.C.E., of Kettering; Mr. Campbell, A.M.I.C.E., of Stratford-on-Avon; Mr. Witts, of Leeds; Mr. F. W. Howard, of Reading; and Mr. W. Jane, of Reading. Mr. Jane acted as Borough Engineer during the period of about three months, since the appointment of the late Borough Engineer, Mr. Collins, A.M.I.C.E., to the City Engineership of Norwich.

For the accommodation of the transatlantic cattle trade of the Mersey, the views of the steamship owners in favour of the extension of the existing lairages at Woodside, Cheshire, have been finally adopted as the most feasible way out of the difficulty. Tidal difficulties have caused the rejection of the Hornby Dock scheme, which, if carried out, would have involved the partial removal of the cattle trade from the Cheshire to the Liverpool side of the Mersey. Even the proposed extension scheme at Woodside, Cheshire, will interfere with the working of the Morpeth Dock, Birkenhead, where are located two or three lines of steamers, which have permanent berths there.

Eight of the Torquay Corporation workmen went into the main sewer, late on Friday night, at Meadfoot, to execute some repairs. At about two o'clock on Saturday morning a thunderstorm came on, and within a few minutes the water in the sewer rose about 4ft. The men were overtaken by the sudden flood, and one John Callicott, aged sixty, was carried away and drowned. The other men held on to the chains at the side of the sewer, and remained thus breast high in water until ten o'clock on Saturday, when they were drawn up in a critical condition by a rescue party organised by Mr. H. A. Garrett, the borough surveyor. It is reported that the leader of the rescue party, William Raymond, acted most courageously, going down the sewer to a depth of 220ft. and making fast the helpless men to a rope, by which they were hauled up.

The reservoirs for the water supply of Leicester present an extraordinary appearance, the water having receded a hundred yards from the bottom of the overflow weir. The post with the feet and inches painted on it to measure the depth of water is also left high and dry, and the water is now 22ft. under the overflow weir. The frost has, however, killed the small vegetable growth which prevented the water being filtered, and thus has enabled the water to be run lower than calculated. Great efforts are still being made in securing further auxiliary supplies, and the water committee hope ultimately to have auxiliary supplies of nearly two million gallons of water per day. Melton Mowbray and Ashby-de-la-Zouch are now only supplied with water eleven hours per day. Very little rain has fallen, and day by day the water in the reservoirs falls lower and lower.

# MACHINERY FOR ROLLING CHAINS FROM THE SOLID BAR

THE WALZWERK, GERMANIA, ENGINEERS

(*For description see page* 361)

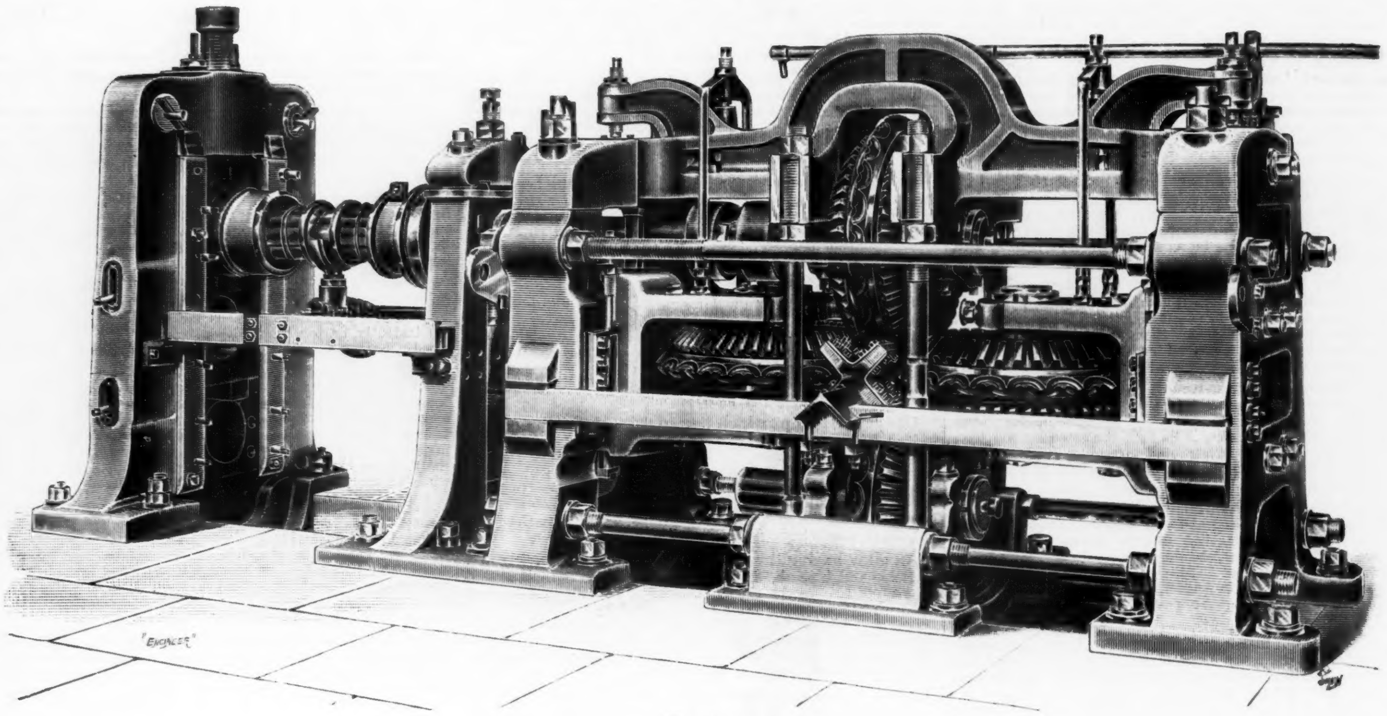
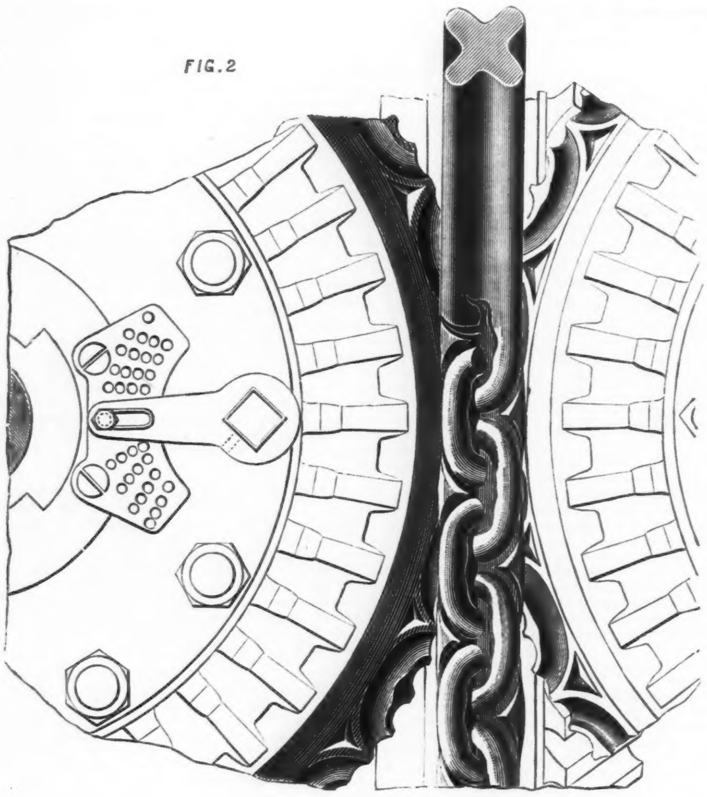


Fig. 16

FIG. 2



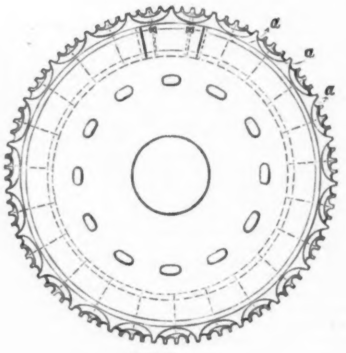


FIG. 3.

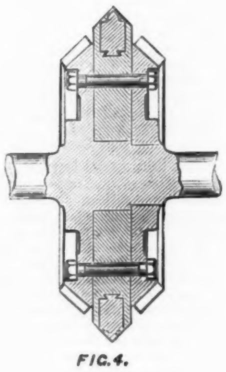


FIG. 4.

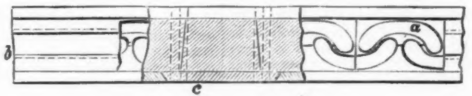


FIG. 5.

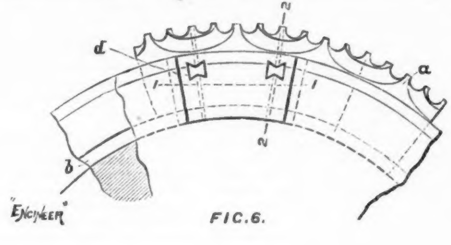

d
2
1
1
2
a
b
"ENGINEER"

FIG. 6.

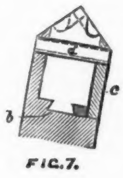


FIG. 7.

FIG. 10

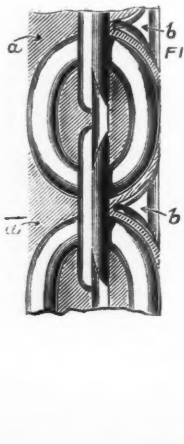
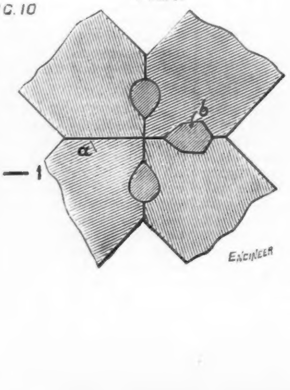


FIG. 11


b
a
ENGINEER

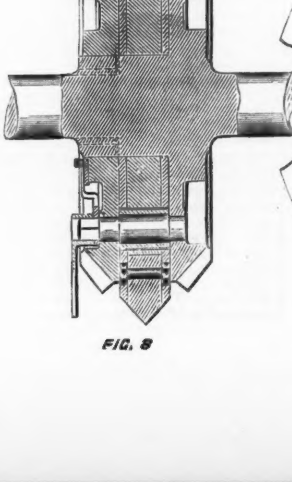


FIG. 8

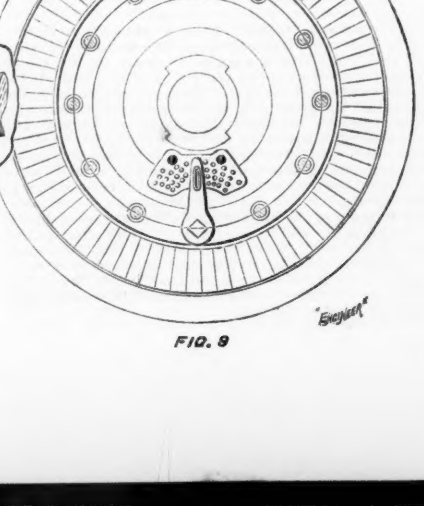


FIG. 9

## ROLLED WELDLESS CHAINS, KLATTE'S PROCESS.

The problem how to produce weldless chains is one which has taxed the ingenuity of inventors for years. The credit of having set about the solution of this problem in a practical manner belongs to Monsieur Oury, of the Cherbourg Arsenal, whose first patent dates from the year 1881. The process devised by Oury consists in the conversion of cruciform bars into weldless chains by means of boring, punching, and forging in dies, both in a cold or heated state, according to circumstances. Later, in place of punching, pressing and forging were chiefly resorted to.

In the Paris International Exhibition of 1889, samples of Oury's chains, manufactured at the French iron works of La Massardière—Department Loire—were exhibited. The first published description of these appeared in the *Eisenzeitung* of December 4th, 1890; further articles on the subject appeared in *Engineering*, of May 1st, 1891; *Stahl und Eisen*, 1891, No. 8, and 1893, No. 7; *Strasburger Anzeiger für Berg-, Hütten-, und Maschinenindustrie*, of December 1893; and some other journals.

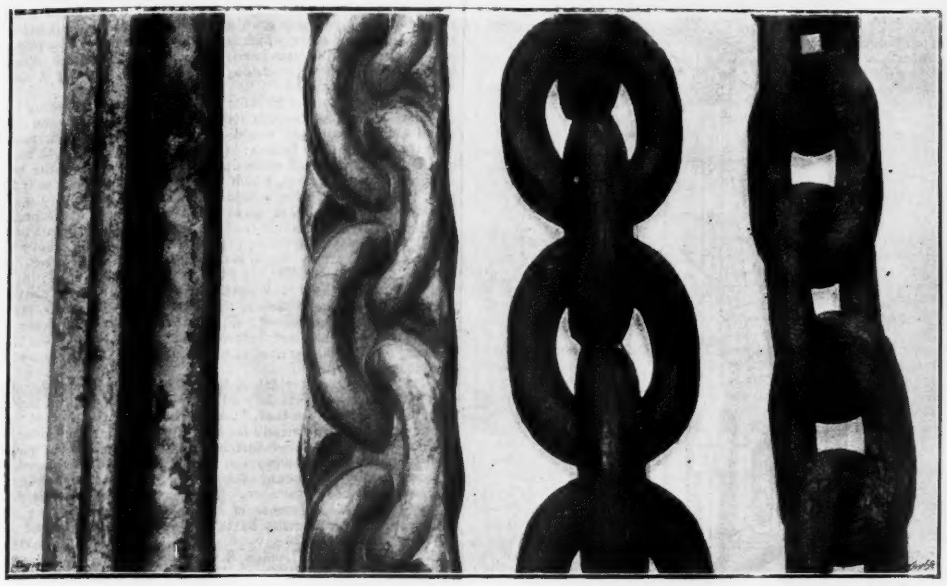


Fig. 1—THE DEVELOPMENT OF THE CHAIN FROM THE BAR

A process similar to that of Oury was patented in 1889 by Hippolyte Rougier, of Birmingham, for the production of stud link chains, which Oury had omitted to include in his patents. The manufacture of Rougier's chains was taken up by the Patent Weldless Chain and Cable Company, of Birmingham. Both Oury's and Rougier's processes involve a long series of operations, during which the metal is several times reheated with intermediate manipulations while cold. Mr. O. Klatte, the manager of the Walzwerk Germania, at Neuweid-on-the-Rhine, has recently successfully worked out a system of manufacturing weldless chains in which all the tedious operations of repeated heating, forging, and punching are avoided. This is effected by simply rolling the chains. As in Oury's and Rougier's processes, the original form is a cross bar. This is passed between four rolls, of which the working circumferences are bevelled, so that the lines of contact when brought close together are at right angles to each other. By means of these rolls the material is squeezed, where not required, inside and between the future links, into a thin web, and what, for convenience, may be called the chain bar is formed, having the shape illustrated at *b*, Fig. 1, in which *a* shows the original cross bar.

The arrangement of the rolls will be best understood by reference to Fig. 2, in which a bar is shown during its passage through the rolls with the top roll removed. The conversion of the cross bar into the chain bar is carried out in one heat. After leaving the rolls the chain bar is passed through a punching machine, with automatic feed, by means of which the webs are removed. This is done while the material is still slightly warm. In Fig. 12 the forms of the punches employed are shown. As rolled, the width of the chain links is somewhat greater, and the length consequently somewhat less, than is required in their finished state. In order, therefore, to give them their final shape, the chain bar, of which the links are still connected by a slight web where inaccessible to the punches, is reheated to a red heat and passed under a press, by which the links are reduced to the specified width. The same end can also be attained by the use of finishing rolls, which stretch the links to the necessary extent. In either case the links are finally separated during the operation. The velocity with which the chain bars are rolled depends of course upon the dimensions, and ranges from 10ft. to 20ft. per second.

Having given the general outlines of Mr. Klatte's process, we now come to the details, upon which, as in every similar case, the success of the invention depends. The detailed construction of one of the rolls is shown in Figs. 3 to 7. It consists of a central disc—secured as shown in Figs. 3 and 4 between two bevel wheels—to the circumference of which are dovetailed and keyed a number of sectors constituting the working portion of the roll in which the dies or matrices are formed.

By removing the key-piece *c* an opening is uncovered, through which one sector after another can be inserted and pushed into its proper position on the circumference. When all the sectors are in place, the piece *c* is again inserted, and the two keys *d* driven in; the latter secure the sectors against displacement. The sectors are in the first place rolled as bars, with the necessary cavities—or matrices—impressed in them. These bars are afterwards cut to the required lengths and fitted, while the finishing of the matrices is effected by cutters, on a machine specially designed for the purpose, of a type similar to those employed in the manufacture of small arms. It has been found that steel with a tensile strength of from 32 to 38 tons per square inch is a suitable material for the sectors. Instead of sectors a complete ring may be used, but for faciliting the renewal of worn or damaged parts sectors are very convenient. Experience has proved that the rolls do not appreciably suffer by use, as with all the trials which have been carried out with one set of rolls, no measurable wear has been observed. This is due to the large diameter of the rolls—from 3ft. 3in. to nearly 5ft.—and also to their high velocity.

If any supplementary shaping of the matrices is necessary, the rolls are supported on pedestals and the circumference heated to a red heat and annealed. Hitherto, no distortion has been found to result from this treatment. Damaged or defective sectors can easily be replaced. Instead of being fitted together in the manner already described, the sectors may be dovetailed together; there is no difficulty about this. In order to facilitate the adjustment of the four rolls relatively to each other, the device illustrated in Figs. 8 and 9 is adopted. This consists of an excentric fitting the central disc of each roll, and having its bearings in the wheel plates or webs between which the roll is secured. The excentric is turned by a spanner, and when adjusted is kept in place by means of a lever and set-screw, as clearly shown in the illustrations Figs. 2, 8, and 9. In the construction of the matrices many points have to be considered, not only with regard to the durability and strength of the projecting portions—or teeth, as they may be termed—but also as to the important part which is played by these teeth in displacing the material of the crossbar. The form of the teeth also depends on the shape of the links, whether long or short. As the corresponding matrices for each link on the four rolls come together, the process of rolling is in reality interrupted, and room must therefore be provided for the lateral displacement of the material. This is effected by means of a suitable distribution of space in the cavities of the rolls, and the inventor has, for instance, in the case of one set of rolls, provided for the "spreading" of the material during the process of rolling by giving the links a larger section at the points of contact, where they are subject to the greatest strain and wear.

As regards the general method adopted, the bloom is rolled in the usual manner into a bar of suitable section for the production of cross steel, having a length of about 50ft. This bar is reheated in a furnace of corresponding length, and then passed automatically through a series of quadruple rolls, arranged in line one behind the other, and calibrated as shown in Fig. 13, *b* and *c*. On leaving these rolls, the length of the bar will have increased to between 98ft. and 130ft., and it is transferred directly in the same heat to the chain-rolls, in which it is finally stretched to from 164ft. to 197ft. When longer chains are required, special wire chain links are provided for connecting several rolled lengths. The construction of such a wire link is illustrated in Fig. 14. Each of these links has a strength very much in excess of that of the normal rolled links, and is protected by a mantle or sheath of sheet steel.

Fig. 15 is a working drawing of the general arrangement of the rolls, while a perspective view of the latter is shown in Fig. 16. The cost of production by Mr. Klatte's process compares favourably with that of the old method of chain-making, and advantages over the latter in other respects are claimed. The accompanying table gives the results of official tests, carried out at the Royal Experimental Institute at Berlin, with "Klatte" chains of different kinds of steel, and also with an ordinary welded chain. The machinery as described is being introduced into this country by Mr. G. R. Bodmer, of 30, Walbrook, London.

*Results of Official Tests at the Royal Mechanical Experimental Institute at Berlin.*

| Description. | Mark on test piece. | Weight of test piece. | No. of link. | Thickness of chain. | | | | Mean bearing section. | Total breaking load. | Breaking stress. | Outside length of links. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | At ends. | | In middle. | | | | | Before the test. | After the test. | |
| | | | | Front. | Back. | Right | Left. | | | | | | |
| | | lbs. | | in. | in. | in. | in. | sq. in. | Tons. | Tons p. sq. in. | in. | in. | |
| "Klatte' basic steel chain. 6 | *a* | 9·349 | 1 | 1·12 | 1·14 | 1·016 | 1 02 | 1·659 | 42·312 | 25·52 | 5·556 | 6·274 | Fracture in link 2; front; fine-grained to fine-scaled. |
| | | | 2 | 1·172 | 1·14 | 1·044 | 1·016 | | | | 5·568 | — | |
| | | | 3 | 1·124 | 1·172 | 1·02 | 1·02 | | | | 5·542 | 6·178 | |
| | *b* | 9·327 | 1 | 1·160 | 1·172 | 1·008 | 1·044 | 1 646 | 41·830 | 25·40 | 5·600 | 6·178 | Fracture in link 3; front; fine-grained to fine-scaled. |
| | | | 2 | 1·124 | 1·140 | 1·020 | 1 020 | | | | 5·546 | 6·270 | |
| | | | 3 | 1·192 | 1·132 | 1·040 | 0·980 | | | | 5·600 | — | |
| "Klatte" basic steel chain. 7 | *a* | 9·195 | 1 | 1·128 | 1·156 | 1·016 | 1·026 | 1·634 | 42·312 | 25·90 | 5·542 | — | Fracture in link 1; back; fine-grained crystalline. |
| | | | 2 | 1·152 | 1·136 | 1·020 | 1·004 | | | | 5·542 | 5·976 | |
| | | | 3 | 1·156 | 1·116 | 1·016 | 1·020 | | | | 5·564 | 5·864 | |
| | *b* | 9·261 | 1 | 1·000 | 1·156 | 1·020 | 1·048 | 1·653 | 41·830 | 25·33 | 5·584 | 5·852 | Fracture in link 2; back; fine-grained crystalline. |
| | | | 2 | 1·108 | 1·152 | 1·022 | 1·000 | | | | 5·576 | — | |
| | | | 3 | 1·164 | 1·164 | 1·012 | 1·020 | | | | 5·584 | 5·828 | |
| "Klatte" Siemens-Martin steel chain. 9 | *a* | 9·283 | 1 | 1·168 | 1·132 | 1·016 | 1·036 | 1·671 | 42·814 | 25·65 | 5·564 | 6·338 | Fracture in link 2; in the middle, right; dull grey, short to fine-scaled, conical (crater-shaped). |
| | | | 2 | 1·140 | 1·164 | 1·040 | 1·028 | | | | 5·534 | — | |
| | | | 3 | 1·140 | 1·172 | 1·024 | 1·020 | | | | 5·534 | 6·378 | |
| | *b* | 9·239 | 1 | 1·124 | 1·172 | 1·008 | 1·012 | 1·604 | 38·384 | 24·13 | 5·552 | 6·032 | Fracture in link 2; back; partly fine-scaled, partly fine grained. |
| | | | 2 | 1·156 | 1·156 | 1·012 | 0·984 | | | | 5·596 | — | |
| | | | 3 | 1·168 | 1·128 | 0·984 | 1·020 | | | | 5·540 | 6·060 | |
| Wrought iron welded chain. | *a* | 9·724 | 1 | 1·160 | 1·180 | 1·136 | 1·144 | 2·018 | 28 540 | 14·09 | 5·486 | — | Back portion of link 1 broken away. Fracture partly coarsely crystalline, partly fine-grained, partly scaly, and partly laminated with faults. |
| | | | 2 | 1·176 | 1·128 | 1·136 | 1·160 | | | | 5·620 | 5·668 | |
| | | | 3 | 1·120 | 1·132 | 1·124 | 1·104 | | | | 5·519 | 5·824 | |

## NATIONAL FREE LABOUR CONGRESS, LONDON, 1894.

The following agenda of business to be considered at the forthcoming second annual Congress of the National Free Labour Association, to be held at the Forester's Hall, Clerkenwell-road, London, E.C., the week commencing Monday, October 29th, 1894, has just been issued:—(1) Reception of provincial delegates; (2) examination of credentials; (3) election of a chairman of Congress; (4) call on general secretary for yearly report of Executive Council, and correspondence by the secretary; (5) chairman's opening address.

The following resolutions will be submitted to the Congress:—

*First resolution.*—That in the opinion of this Congress the senseless and abortive strikes which have occurred in many branches of industry throughout the country have had a most disastrous effect upon the living standard of the wage-earning classes, and are mainly the cause of the present stagnation of trade and consequent want of employment.

*Second resolution.*—That the Congress declares the time has arrived when the law relating to picketing should be so amended that some clauses may be included which shall abolish picketing, and that in lieu thereof, it may be lawful, when a dispute arises, for both sides to put outside the works affected a printed notice giving their different versions of the points in dispute. *Amendment:* That while recognising the legal right of workmen to picket during strikes for the *bonâ fide* purposes of giving and receiving information, picketing in such numbers as must inevitably terrorise those who may be willing to work shall be prohibited.

*Third resolution.*—That this meeting, representing the vast majority of the working classes in the United Kingdom, enters a most emphatic protest against the re-introduction of an Employers' Liability Bill containing a clause forbidding "contracting out," and calls upon all workmen by their individual influence to support the House of Lords in throwing out a measure which deprives working men of their undoubted right to make better terms as to insurance against accident than the law now permits them to do, and one also which forces a workman to the expense of a doubtful and expensive lawsuit in order to obtain a smaller sum than would be awarded to him free of expense by his mutual insurance society.

*Fourth resolution.*—That this Congress of the National Free Labour Association rejoices to learn that the free labour principles are making steady and certain progress amongst the industrial classes of the country, who recognise the necessity for the permanent maintenance of a free labour party so as to resist the ever-encroaching tyranny and dictation of the Socialistic trade unions.

*Fifth resolution.*—That this Congress, taking into consideration the aggressive tactics of the various unions connected with the printing and allied trades, recommend the executive to at once open a registration bureau in the City for the registration of non-union printers' workmen.

*Sixth resolution.*—That in the opinion of this Congress the time has arrived when it is absolutely necessary that some restriction should be placed upon the immigration of pauper aliens to this country, and is pleased to note that the Trade Union Congress has at last accepted the views that this Association has so long advocated in the matter. And further, that this Congress earnestly hopes the Bill restricting pauper immigration, recently introduced in the House of Lords, shall be allowed to become law, and that a copy of this resolution be forwarded to the leaders of both political parties.

The chair will be taken at 6 p.m. each evening, and the Congress will sit until 10.30 p.m. Any representative attending the Congress, and being desirous of submitting any special resolution bearing upon the labour question to the consideration of the Congress, is requested to send a copy to the secretary, Mr. William Collison, National Free Labour Association, 79, Fenchurch-street, London, E.C., on or before the morning of the meeting.

**Sell's Directory.**—We have received the third and last supplement of Sell's "Directory of Telegraphic Addresses for 1894," which brings the volume up to date. Mr. Sell draws attention to the unauthorised attempts of some directory publishers by the aid of Sell's Directory to incorporate in present directories matter which has been compiled at great trouble and expense in the past by him. We trust that their attempts will only meet with the failure they deserve.

# LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### THE THEORY OF THE STEAM ENGINE.

Sir,—In my last letter I gave Mr. Cross three "nuts to crack." Your readers who take an interest in the matter will note his failure to reply justifying his statements as regards any one of these distinct and clearly defined points, and should hence know at what value to assess the value of such other parts of his communications as—to avoid entering on a wider field than was necessary to my purpose—I have elected not to deal with.

I presume I need say nothing further in substantiation of my statements of fact. Henry Cherry.

21, Festing-road, Putney, S.W.,
October 19th.

Sir,—I am glad to notice Professor Peter Alexander's letter in your pages protesting against the mistaken teaching in nearly all modern text-books on heat-mechanics, and against the unfairness of fathering these mistaken notions upon Carnot.

It cannot be too distinctly stated that Carnot's closed isothermal-adiabatic indicator diagram was invented solely for the purpose of giving a mathematical demonstration of an all-important law in thermodynamics. But to put it forward as the diagram of an engine having any special claim, either theoretical or practical, to the title "perfect," or as the diagram towards which engineers should strive to make their engine diagrams approximate, is a pure absurdity. Also to imagine that an engine giving this diagram would be in any special degree "reversible" beyond other engines is a simple delusion.

The common definition of the "absolute efficiency" of a thermodynamic engine is "the ratio of the work done to the heat supplied," the heat being supplied by conduction or radiation or electric current. This is meant to be generally and universally applicable to all heat engines; but, being general, it can hardly be correct, because under certain conditions no such supply of heat is required in order to obtain mechanical power by the heat action of the working substance. I do not allude to the evident fact that adiabatic expansion under pressure results by itself in work being done. I allude to the further fact that under tension, in order to increase the work done beyond that obtainable by adiabatic contraction, it is necessary, not to supply, but to abstract heat from the working substance. No doubt, if the "cycle" be closed, both conductive supply and abstraction of heat are necessary; but then the cycles of real working subtances never are and never can be closed. In the case of pieces in tension, it is the abstraction, not the supply, of heat that is really effective in producing extra mechanical power. Robert H. Smith.

Mason College, Birmingham,
October 20th.

Sir,—I have read Professor Alexander's letter in your last impression with very great pleasure. It is an ample endorsement of the soundness of my views. But may I not ask how it comes to pass that admissions of this kind have had to be wrenched, so to speak, from writers on thermodynamics by humble engineers like myself? Even now there is no universal admission of the truth. Take, for example, Dr. Lodge's papers on "Carnot and Modern Heat." There is nothing in these papers to show that Carnot's views and propositions have anything whatever to do with the steam engine.

The philosophers, with a great blowing of trumpets and beating of drums, told the engineers that they—the philosophers—would draw the line for them beyond which it was impossible to go in developing the heat engine. Why should it be left to me and such as I to prove that the philosophers' line had nothing to do with steam engines or heat engines of any kind recognisable as such by engineers? Does it not strike Professor Alexander that he is just a little late in the field? However, he has a chance still of doing good service. Let him demolish another text-book fetish. We are continually told that the efficiency of a heat engine is independent of the nature of the working fluid or substance. This is possibly quite true of a mathematical formula. Anything can be proved to be true by mathematics, if only certain postulates are granted; but it is not in any sense or way true of a real heat engine. No one, for example, can say that steam is as good a working fluid as Dowson gas; no one can prove that air is not from the purely economical view a better working fluid than steam—the difficulties in the way of its use being purely mechanical. If Professor Alexander will boldly use his influence, and instead of saying that all fluids and substances are equally efficient, will explain why and how it is that some fluids and substances are better than others, he will do excellent work. Errors die hard, but it must, I think, be admitted that it has not been the engineers but the physicists who have been in error. It has been once said in your pages, Sir, that Carnot did absolutely nothing in the development of heat engines, that his investigations have been entirely barren, that the deductions drawn from his utterances have been misleading. It has remained for Professor Alexander to prove the truth of these propositions by showing the reason why. Maurice Cross.

October 22nd.

### GOVERNING ELECTRIC LIGHT ENGINES.

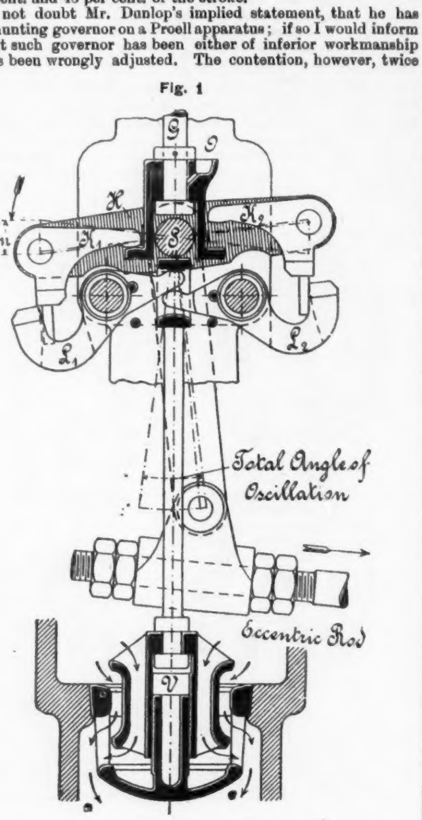
Sir,—I have refrained from entering into the correspondence about governing electric light engines, as I had no wish to appear desirous of advertising the Proell inventions, which I represent, in your correspondence columns. The unwarrantable attack which Mr. James Dunlop, in your issue of 19th inst., levels against the Proell apparatus leaves me, however, no option but to ask you to insert the following explanation and contradiction.

Mr. Dunlop would have done much better to put his signature under the first four words of his letter. He parades a fact before your readers, makes a high-sounding analysis of the same, draws sweeping and condemnatory conclusions, coupling them with some sinister insinuations about the function of the governor, and all this in delightful ignorance that the fact on which he bases his charge has been for a very long time simply non-existent. He does not know that the two valve lifters are perfectly independent of one another, as the two illustrations herewith prove. In Fig. 1 the mechanism is shown immediately before the release of the valve, the idle lifter $L_2$ has remained during the whole stroke of the active lifter $L_1$ at rest in the position shown, viz., the identical position in which it is still left in Fig. 2, where the valve is tripped off and has come to its seat. I trust Mr. Dunlop will either show how it is possible that under such circumstances the idle lifter can in any position of the governor-rod G he chooses "arrest the falling valve," or else he will apologise to your readers for having made such misleading statements.

Mr. Dunlop possibly only knows an obsolete and discarded construction of the Proell apparatus, and I think he has committed a great indiscretion by rushing into print with allegations of a serious nature against an invention about which he knows so little; if the reputation and success of the same were not happily above misrepresentations of this kind, great harm might have been done to it. Mr. Dunlop's erroneous contentions, as they stand, strike at the present construction of the Proell apparatus as well as at the earlier one. That they are totally wrong as regards the former, I have shown; as regards the latter, it is rather late in the day to point out alleged faults of the same, as no apparatus have been made to that design with my approval for years. Still, as a matter of mere historical interest, I would point out that Mr. Dunlop's calculations and conclusions are equally misleading as regards the obsolete construction. To explain this graphically would take up more space than you would grant me for such a matterof limitted interest. I think, however, that the enclosed original indicator diagrams, taken from an engine under the control of the first Proell apparatus set to work in this country ten years ago, will prove that even that comparatively primitive execution of the leading idea secured for an engine what was claimed for it, viz., automatic variable cut-off at any point of the stroke, and not as Mr. Dunlop's mistakes pretend to make out, "no control between 16 per cent. and 43 per cent. of the stroke."

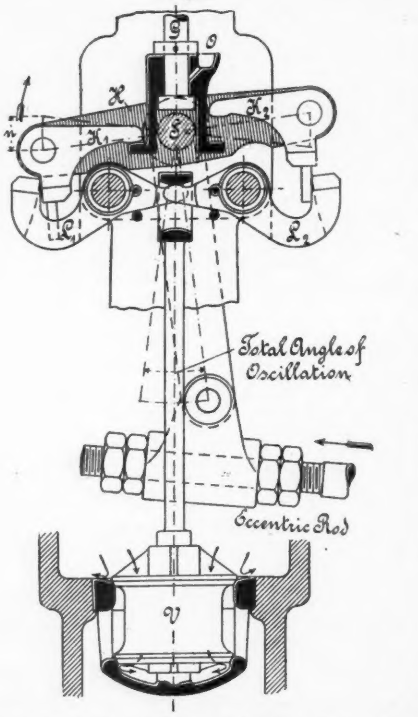
I will not doubt Mr. Dunlop's implied statement, that he has seen a hunting governor on a Proell apparatus; if so I would inform him that such governor has been either of inferior workmanship or it has been wrongly adjusted. The contention, however, twice repeated in Mr. Dunlop's letter, that such hunting is intentional, and the Proell system relies on a hunting governor to cross the interval between 16 per cent. and 43 per cent., I can only characterise as a piece of gross ignorance or culpable negligence in drawing conclusions. It is nothing short of an insult to the intelligence of thousands of users of the Proell apparatus to insinuate that the advantage they have actually derived from the same during the last ten years has been a delusion, and that they have been deceived by a worthless device; and that from a critic whose knowledge of the subject is evidently superficial.

Fig. 1



Mr. Dunlop says he does not know whether there are any Proell apparatus engines driving electric light. I can refer him to more perfectly successful installations of this kind than he would care to inspect. Factories where such engines drive sawmills with circular saws, big rifling lathes for ordnance and other heavy machinery simultaneously with the dynamos for lighting, and without the use of accumulators. And that is what Mr. Dunlop calls "regulation of any sort."

Fig. 2



Into the controversy of regulating engines driving this or that kind of dynamo I have no desire to enter. I shall, however, be glad to place Proell apparatus for a free trial at the disposal of any *bonâ fide* applicants who may be interested in the question; so far I have never yet failed in attaining the degree of regularity required by the electricians in any engine I have undertaken to convert. Hermann Kuhne.

25-35, New Broad-street, London, E.C.,
October 24th.

### THE CONDITION OF THE THAMES BELOW KEW BRIDGE.

Sir,—In your article on the above subject in your paper of October 5th your concluding remark strikes the real keynote of the matter. You say that "it may be questioned whether shortness of memory does not account for most of the supposed changes." That is the real fact. The ebb tides have been becoming steadily lower year by year for many years past. Records are before me which show, for instance, that the ebb tides at Hammersmith were lower in 1894 than in 1893, but those in 1893 were much lower still than those of 1892. The Stoney Weir at Richmond was not brought into use until May 19th, 1894, and it has certainly had no material influence on the ebb tides.

Boating men are apt to compare the visit of one season to a particular spot, with the visit of another season, without taking notice that one was made at, say, half tide, and the other happened to be at the ebb of a spring tide. Like times of like tides have manifested a difference, but not much recently—not enough to be observable without the aid of instruments. The tidal records clearly demonstrate this.

The fact is, that from the time when the Richmond weir was first proposed, the attention of those interested in the river has been more directed to the subject than before, and it is human nature to regard—with some unconscious jealousy—the remedy which has been found for one part, as if it were the cause of mischief to another part. The trouble lower down is not a thing of yesterday, it has been growing these fifty years, and it has now attained a seriousness which calls for a remedy. Happily the remedy is ready to our hand, and as it is one which does no mischief either above or below, there is no reason why it should not be promptly applied.

It is always a work of time for the details of any new thing to be familiarised, and as there is much misconception as to the Richmond weir, perhaps you would allow me to remind your readers that its working is as follows:—(1) On all flood tides, both by day and by night, the great sluices are lifted entirely out of the water at the time of half flood, which then goes as freely up as it ever did; (2) on all ebb tides, except about ten in the month, they are put down at half ebb, so as to retain some water at Richmond; (3) the quantity so retained is about one twenty-eighth part of the whole water passing the site; (4) the sluices are never wholly shut down, the land water—which is the bulk of the whole—passes down as freely as it ever did; (5) there is no stagnant pond; (6) the weir has not caused any settlement of mud either above or below, but, on the contrary, the river at Richmond is rapidly becoming very clean indeed; (7) the traffic on the river has a new facility which it had not before, although the bulk of the traffic—being really tidal—arrives at a time when the 66ft. arches of the bridge are freely open.

Of course, the water taken by the water companies from the river is an element materially affecting it at low tide, but the weir cannot be blamed for that. On the contrary, the weir at Richmond is already the remedy for it at Richmond, and a similar weir would give similar relief further down. Now, as to the question of how much further down the next weir should be placed, this is governed by the amount of difference of level permissible in an engineering sense at the spot. If we go too far at once, we should have to make the difference of level too much to suit the many requirements which must be taken into account on sound engineering principles. Richard C. Rapier.

32, Victoria-street, London, S.W.,
October 24th.

### DETECTION OF ARSENIC IN COPPER.

Sir,—The detection of minute quantities of arsenic in copper, a process of great importance when the metal is to be used for electrical purposes, usually necessitates the expenditure of considerable time and labour on the part of the chemist. In the current issue of the "American Journal of Science" F. A. Gooch and H. P. Moseley describe a method by means of which a proportion of arsenic as small as five ten-thousandths of 1 per cent. may be not only detected but approximately estimated. The method employed is an adaptation of Sanger's successful process of estimating traces of arsenic in wall-papers, &c., in which the liquid suspected to contain arsenic is introduced into a hydrogen generator, and the gaseous arsenuretted hydrogen thus produced passed through a heated tube, when a mirror of elemental arsenic is deposited on the walls of the tube, as in the well-known marsh test. By comparing the mirror thus obtained with standard mirrors produced under like conditions with known quantities of arsenic, it is possible to approximately estimate the amount of arsenic in any given liquid. In order to determine the arsenic in copper, the authors dissolve about one gramme of the metal in nitric acid, remove the latter by means of sulphuric acid, and separate the arsenic from the copper by distilling the solution with hydrochloric acid and potassium bromide. The liquid distillate containing the arsenic is introduced into a hydrogen generator, and a mirror obtained as explained above. The method is most properly applied to electrolytic copper, in which the quantity of arsenic may vary ·01 per cent. to ·0005 per cent. G. E. B.

Putney, October 22nd.

### TRAINS AND LOCOMOTIVES.

Sir,—Mr. Percy Caldecott's letter in your issue of 12th October certainly hits the right nail on the head when it inveighs against the Midland Railway for fitting its coaches with archaic door handles, which are not only non-automatic, but give infinite trouble to the public and railway officials by requiring a great muscular effort applied in two directions at once to manipulate them. As for their thin 26in. by 24in. metal plates which do duty for footboards on many of their coaches, it is certain that some day someone will be killed by them, and that they could not be defended before a judge and jury.

While I am writing on the few Midland shortcomings, may I mention one huge mistake they have made lately—I refer to the new dining-cars, which they own jointly with the G.S.W.R., and which for some inexplicable reason are not vestibuled to the rest of the train, so that only those who can get seats in them right through from the start can use them, unless, indeed, by the very great inconvenience of changing out and in at stations, at the risk of one's belongings left behind. In 1894 such a blunder is inexcusable.

Mr. F. Bowles, in your issue of 19th October, is quite right in thinking that East Coast rolling stock is heavy to haul; for this is notorious, and is caused by the fact that they persist, in the face of common sense and universal practice, in building six-wheeled stock, which of course by its rigidity causes much friction on the rails and at the axle-boxes. Times without number this route suffers from hot boxes; the new dining-car trains at first averaged one a day for months. One has only to travel in a bogie carriage and then in a six-wheeler, and to feel the silence and gliding motion of the former and the jerking and grinding of the other, to realise the wear and tear of a rigid coach on the rails and itself, which all spells money in wheels, axle-boxes, haulage, and rails. In a bogie carriage one can talk with comfort, as the wheels are not fastened to the frame, which conveys the noise upwards. The ideal express train is the American and Australian of coaches on six-wheeled bogies, about 70ft. to 80ft. long, and vestibuled throughout. It is cheapest and safest in the long run.

Mr. Bowles is wrong when he says the new N.E.R. 94-ton locomotives are compound; only one is—1619—and she was not in the Northallerton smash. Norman D. Macdonald.

15, Abercromby-place, Edinburgh.
October 20th.

Sir,—Your correspondent, F. Bowles, is justified in calling attention to the comparative inefficiency of certain modern locomotives, a subject which deserves from railway shareholders more attention than it receives. He is wrong, however, in supposing that one of the North-Eastern compounds was in the Northallerton collision. The train on that occasion was drawn from Newcastle by No. 1622, one of the new engines, with cylinders 19in. by 26in. At Darlington it was found that a pilot was required, and No. 905

an engine built by the late Mr. Fletcher, was attached. Judging from the performances of the Fletcher engines for nearly a quarter of a century, there can be no doubt that No. 905 could have worked the train unaided.

The day after attending the Midland Railway meeting at Derby last August, I travelled from York to Newcastle by a portion of the ten a.m. express from King's Cross. With a moderate load, in beautiful weather, the North-Eastern Company sent on that train one of their largest compound singles, and one of their very large new engines of the 1622 class, weighing together without their tenders just under 100 tons. Remembering the offhand way in which one of the Fletcher engines, in the good old days, would have dealt with such a train, one cannot help wondering what the "progress" of recent years has really cost. It is a curious thing that the most successful engines which have ever run on the North-Eastern road were built at a time when the company was without a locomotive superintendent at all.

Had Mr. Bowles been at Carlisle this evening—October 20th—he might have seen a North-Western corridor train, composed of one six-wheeler, six eight-wheelers, and two dining cars, leave for the south, drawn by Mr. Webb's Greater Britain, and a rebuilt 6ft. coupled engine, of about as simple and cheap a type as could be constructed. In this case also the pilot by itself could have worked the train without difficulty, so that it is hard to see wherein the advantage of these enormously heavy and expensive engines lies.

W. B. Thompson.

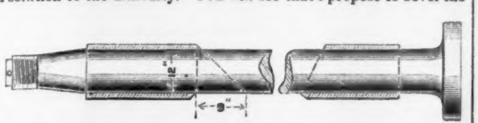
October 20th.

Sir,—I should be much interested if your correspondent in last issue, Mr. F. Bowles, would state on what railway "Mr. Macdonnel's" locomotives referred to may be found.

Cannon-street, London, E.C., Scrutator.
October 22nd.

### CORROSION OF PROPELLER SHAFTS.

Sir,—Referring to your issue of September 28th, and your remarks and illustrations on the above subject, and also the remedies proposed for the preservation of the shaft at the point where the liner ends on the shaft, I suggest that the enclosed sketch offers a solution to the difficulty. You will see that I propose to bevel the liner, in order that the circular current of water carried round by the liner may be broken up, and I venture to think that in removing one of the evident sources of corrosion, the evil will be readily and inexpensively overcome.



London, October 22nd. Consulting Engineer.

### BICYCLE MECHANICAL ENGINEERING.

Sir,—I am pleased to see your article under the above heading, pointing out the mechanical absurdity of the Boudard gear; but whilst I agree with you on this point, I think an explanation is needed of the fact that the gear in question does actually appear to drive a machine with greater ease to the rider than the ordinary direct chain gear. I believe this is due to the chain wheels of the ordinary gear being made too small to transmit the work of the rider, without excessive friction in the chain itself and in the axle bearings. With the ordinary proportions of crank and chain wheel, the rider's thrust upon the pedals is multiplied two and a-half times on the chain, and when the rider is doing his utmost, the pull thus brought on the chain and bearings is very great. In the Boudard gear a higher speed for the chain is obtained by the use of the intermediate wheel and pinion, allowing a larger driven chain wheel to be used on the hind wheel, and it would look as if the reduced friction of the chain gear under these improved conditions not only compensated for the friction of the extra wheel and pinion, which can hardly be less than 5 per cent., but left something to the good. If this should prove to be the case, we can secure the whole gain without the attendant loss by retaining the direct drive, but making the chain wheels larger, say double the present sizes, and this need not materially increase the weight, as lighter wheels and chain would suffice for the reduced strains. I am pleased to see a statement in a cycling paper, that larger chain wheels are to be the feature of next year's machines, as I have long held this to be a greatly needed change.

Whilst on the subject of bicycles, I should like to say a word as to the size of the wheels. It always seems wrong to me to have a 30in. front wheel to carry one-fifth of the rider's weight, and a 28in. wheel to carry the remaining four-fifths. I think that a larger hind wheel would justify its extra weight, particularly on heavy roads.

The diagrams illustrating your article, which I, of course, understand are only sketches, hardly serve to bring out the point I wish to make. As they stand the ordinary gear has a ratio of about 2 to 1, and the Boudard 4 to 1. Equalise the ratios by doubling the diameter of the driven wheel in the latter case, and you will see the advantage I point out.

J. G. H.

Bolton, October 22nd.

### LABOUR AND LUXURIES.

Sir,—Your correspondents "Hirn" and "W. A. S. B.," in replying to my letter, leave the facts untouched. Calmly considered their arguments simply amount to a statement that ethics and morals ought not to be ignored in political economy. On this point I have expressed no opinion whatever. Of course Mill, and indeed almost every writer on the subject, call attention to the operation of such things as natural affection, religious feeling, &c., but they do not assert that these affect the laws of the science in any way. They may affect the operation of those laws, just as mercy may free a criminal whose life is by law forfeited, but this is quite another matter. The utterances of standard authors on this point have nothing whatever to do with the facts to which I directed attention, and which none of your readers attempt to gainsay.

I may put the question in a yet stronger light than I have done yet. A is a working man who has just been paid his week's wages, two pounds. B is also a working man out of a job. B murders and robs A. He lives in A's district, and he spends the two pounds which he has stolen on food and drink at the shops at which A habitually dealt. Now, morally, B's action was the worst possible. But so far as the shopkeepers are concerned, the result is just the same as though A had spent the money; there is a change of distributor—that is all. The whole matter can be put in a nutshell by using the well-known small trader's phrase, "One man's money is as good as another's." In political economy it matters nothing how the gold has been got, or how it is expended, so long as it is expended. In the old days an Italian noble wrung gold by oppression from tortured vassals, and he expended this gold in hiring a bravo to assassinate an enemy. Ethically, nothing can be more reprehensible. Political economy takes no cognisance of a crime. The bravo's gold was just as good to those on whom he spent it as any other gold won in the most honest possible way.

Very many cases arise in which I think money is badly distributed. Thus, for example, a man may give a sovereign for a bouquet, which would be better expended on a starving widow. But that is so only because a time element is introduced. In the long run, so far as the whole community is concerned, the result would be the same whether the sovereign went to the gardener or the widow; and, if the widow died, the community would be on the whole better off, because there would be one less mouth to feed. If any of your readers can controvert the truth of my propositions let them do so; but to argue about them on sentimental, or charitable, or merciful grounds, is quite beside the case. So long as a sovereign is spent—that is to say, put in circulation—it matters not one straw on what it is spent, moral or immoral. The result to the community as a whole is the same.

If we leave political economy on one side for the moment, and consider expenditure in its ethical aspect, we may ask what is meant by the word "luxury." It is certain that what was luxury at the beginning of this century is regarded as necessary at the end of it. The facilities for production of necessaries are now so great that much more food, for example, of all kinds is available than seems to be needed. Wheat may be cited as an example. It will indeed be generally admitted that to employ more hands in this direction than are now employed would be a vain thing; but employment is still to be found in producing the superfluities of life, which are now enjoyed more or less by all but the very poorest.

If your correspondents will try to put sentiment on one side they will see that what I have stated is strictly true. Men are simply distributors of gold. They work to obtain their turn in the use of it, and then pass it on to someone else, who has it in his turn. It is open to anyone to say that A distributes money badly and that B distributes it well, but in the long run the result is the same whether the gold is in the hands for a time of such men as Mr. Peabody or the Emperor Caligula.

Well-meaning people, however, insist on mixing ethics with political economy. They spoil their political economy by the admixture of ethics, and then ruin their ethics by mixing them with political economy. This is one reason why promiscuous charity does so much harm. It is *the* reason why the administration of charity to advantage is the most difficult task conceivable.

It is perhaps a satisfaction that no one is responsible for the laws of political economy any more than we are for the laws of gravitation.

Y. X.

October 22nd.

### AN OLD TIME PUMPING ENGINE.

Sir,—The other evening, accompanied by a friend, I went over to the —— Colliery, near Bristol, to see a fine old specimen of the Newcomen atmospheric pumping engine at work. As the pit is fairly dry the engine is only worked during the night for about two nights a week. On arrival at the colliery we hunted up the engineer, who provided us with a couple of lamps and conducted us to the ancient driver. This individual, who looked fully as old as his engine, but who, in response to sympathetic inquiries, assured us that he was not so "owld as 'a looked," led the way to the engine-house door. This having been persuaded by gingerly treatment to open without falling in, we descended a flight of steps covered about 6in. deep with dust, and reached the basement. The cylinder of the engine is 6ft. internal diameter and about 10ft. stroke, the valves being worked partly by hand and partly by means of a heavy plug rod hung from the beam.

Naturally the construction is extremely primitive, and the ironwork never having experienced the luxury of a coat of paint is in a very advanced state of decomposition. Some of the smaller flanges past which the steam has been leaking for perhaps a hundred years are fully three-quarters rust. Amidst clouds of steam we stumbled up the dusty steps to the top of the cylinder and were shown a place where the cylinder side had been rusted completely through, but which had been successfully stopped up with cement! Water packing is used for the piston, a 2in. pipe delivering a constant stream of water on to the top side, which being helped by the atmosphere on the indoor stroke, leaks through as fast as it is delivered. This method of water packing is to be preferred to the other elegant method adopted in the old days, which consisted in shooting a load or two of dung on to the top of the piston. The beam is a wonderful structure, with a "horse's head" at each end, the inner end being connected to the three piston-rods by means of stout chains. Our guide related how the soundness of the cylinder bottom had been tested more than once by the snapping of these chains, the piston and rods coming down with a crash. The steam is taken from a large receiver, which is in connection with the main boilers of the colliery, the pressure, of course, being greatly reduced.

The engine, according to the driver, was put down upwards of 100 years ago. The old man had driven it himself since the days when he was a boy so small that he had to stand on a block to reach the valve handles, and his father and grandfather had driven it before him. At present there appears to be nobody but the old driver about the colliery who is sufficiently acquainted with the idiosyncrasies of the engine to be able to work it, and as there is a possibility that that patriarch will at some future date depart from this earthly life, it is supposed that from that date the engine will be allowed to rest in honourable retirement. It is even possible that it will one day grace the interior of the noble building at South Kensington which has become the last refuge of many engineering antiquities of a more recent date.

October 22nd. H. Verney.

### ROPE DRIVING.

Sir,—I do not know whether I may interest your readers by giving the following:—Messrs. Ashton Bros. and Co., of Hyde, have just started a pair of triple-expansion horizontal engines, by Goodfellow, of Hyde, 500-horse power, for driving their weaving department. The main driver is 97ft. centres, 24 1¼in. ropes. This is, so far as I know, the longest horizontal main drive in the world. The whole of the alterations and designs are and have been superintended by

J. Gillaird.

Edna-street, Hyde, October 24th.

## WATER SUPPLY.

By Professor Henry Robinson, M. Inst. C.E., F.G.S., F.S.I.*

It is proposed in this paper to refer to a few points bearing on the question of water supply that are the outcome of recent observations of chemists and bacteriologists, to whom engineers are indebted for clearing up difficulties which they have experienced in advising on this subject.

It has been contended by some that no stream should be utilised as a source of water supply if it had been subject to the slightest sewage contamination above the point of intake, and that unless the stream was absolutely free from even the suspicion of sewage pollution, it should be condemned as unfit to furnish a supply of water for dietetic purposes. It was formerly the custom to classify waters as "turbid," "slightly turbid," and "clear," and analyses of waters were made with a view to determining their purity entirely from a chemical standpoint. At the present time, however, a biological investigation is an essential part of the scrutiny that a water has to undergo. The "self-purifying" action of a stream is an important factor in effecting the destruction of pathogenic germs. If it were not for the natural purification which a river undergoes, the continuous discharge of even slight quantities of sewage or polluting matter into it would produce cumulative evils that would in time render every such stream an abomination. In writing on the subject of sewage disposal ten years ago the author stated:—"It has often been contended that organisms injurious to health derived from sewage decomposition continue to live after their discharge into a river, and are practically incapable of being destroyed. Alarmists have relied on this in support of the contention that no river water is fit for dietetic purposes. I think this view has been overstrained. Is it not a reasonable assumption that these organisms may be quite incapable of existing when favouring conditions cease? This must be the case when, after they are cast into a river with the filth they thrive on, the whole becomes largely diluted, its temperature altered, and a state of things produced very different from that which previously existed." The recent inquiry about London water led to the expression of opinion that "When pathogenic bacteria pass into the outer air or water they are in an unnatural medium in which they can only maintain their existence and power of multiplication for a limited period, during which they undergo more or less rapid attenuation or loss of virulence, and become generally weakened."

The author is the last to under-estimate the importance of preserving water supplies in the purest possible condition, but he wishes to combat the merely sentimental part of the case, which at times may lead to the imposition of grave burdens on communities in regard to water supply. In the application of the Rivers Pollution Prevention Act no efforts should be relaxed to prevent the streams from being employed as vehicles for carrying off sewage or manufacturing refuse. The standard of purity should be maintained high, and legislation should be made more compulsory to preserve the purity of the streams, both from a sanitary and æsthetic point of view.

Much information is now available in regard to the conditions under which the micro-organisms exist that are found in water, and the relation between the harmless and the harmful—or pathogenic—germs. Bacteriologists indicate that typhoid bacilli cease to have vitality in fœcal matter in fourteen days. However that may be, all agree that their capabilities of mischief and of multiplication are greatly lessened in a very few days.

Some of the chief causes of the destruction of these germs may be indicated briefly and generally. Low temperature is a factor adverse to their prolonged life, as they flourish in a higher temperature than that of river waters. Innumerable harmless bacteria which exist in rivers are found to be mortal enemies of the harmful bacteria. Light has an influence unfavourable to their existence, although the agency of light in destroying germs does not appear to be effectual at all depths. In shallow streams it is a more powerful factor in assisting their self-purifying action, than in deep sluggish rivers. Recorded experiments on cholera bacilli show that their virulence is greatly diminished by exposure to sunshine. Daylight without sun has also been proved to destroy them. The subsidence of suspended matter carries down germs which perish. Minute plants liberate oxygen under the influence of light, and assist this purifying action.

Bacteria appear to multiply more rapidly in pure water than in impure. In unboiled water they are found to multiply slightly, but in boiled water they multiply greatly. Miquel established this, and explained it as the action of a zymotic disease, by which the water that originally contained bacteria was inoculated against them, whereas a pure water was not. The same result was arrived at by the experiments of the State Board of Health of Massachusetts, and by Dr. Percy Frankland. He found that pure moorland waters—which are regarded as unobjectionable sources—were very favourable to the cultivation of these organisms.

The storage of river water in impounding reservoirs is not attended with the certainty—as some considered—of the pathogenic germs flourishing and increasing, thus constituting a menace to the community supplied by it. The doubt of the safety of such waters is after all a matter of degree, as it is improbable that any source of supply is theoretically free from the possibility of pollution. Take the Thames water which in past years has been supplied to London under far less favourable circumstances than now obtain as regards pollution. No outbreaks of disease have been traced to it.

Where there is a probability of contamination, and in order to reduce to a vanishing point the possibility of any pathogenic germs passing to the consumers, it is necessary to resort to filtration, and in judging whether filtration is requisite the engineer will be guided by the previous history of the water. A great amount of information on the effect of sand filtration is now available, notably the data published in the Massachusetts report, and also by Dr. Percy Frankland. It has been proved that efficient sand filtration will remove all but 2 or 3 per cent. of the micro-organisms, and this relates to the reduced number that have reached the filter after the destroying influences that have been referred to.

By constructing the filter so as to cultivate a nitrifying action there can be no question of the possibility of practically removing all germs. The best construction of a filter has to be considered in view of what it has to accomplish. If it has to remove finely-divided suspended matter which is not suspected of organic pollution, very fine sand under most circumstances would serve the purpose. In one case which the author is acquainted with, namely, the River Plate, this did not suffice, as the water contained a quantity of finely comminuted clay—giving the water a yellowish tint—which passed through the finest filter paper. A filter constructed of alternate layers of finely pulverised cinders and coarse sand was successful in arresting this matter. The efficiency of the filter was found to depend entirely on the fine cinders, even the absence of the dust caused a reduction of the efficiency. The experiments at Massachusetts established the fact that the chief bacteriological action takes place in the upper layer of filters. In the bottom inch there were but 3 per cent. of the number of bacteria that were present in the upper inch, and this has been found to be the case elsewhere. The conclusions drawn were, that with a 5ft. filter of coarse sand, ·06in. in diameter, about 30 per cent. of the bacteria could pass through. With sand of ·006in. diameter 14 per cent. passed. Very fine sand, 5 per cent. Garden soil, none. Experiments on the filters of the London companies indicate that the number of micro-organisms appear to be independent of the age of the filter-bed. If the cultivation of the germs has been once established it will continue, provided the supply of organic matter and of air is continued and the rate of filtration is regulated. If too fast, the purification is imperfect, as the nitrification of the organic matter would be arrested for want of oxygen. The cleansing of a sand filter interferes with its action, as the surface film has the most useful effect, and forms an essential part of the filter by arresting and cultivating the micro-organisms which pursue their functions of nitrifying the organic matters retained in the filter. Many filters have been constructed for dealing with the purification of sewage by utilising the action of micro-organisms, and they all point to a new departure in regard to the construction and the manipulation of filters in order to remove organic impurities. The subject is of so much interest and importance that it deserves the attention of all who are engaged in advising about water supply or sewage disposal.

## CATALOGUES.

S. A. Daniell, Birmingham. Illustrated Price List of Screwing Machines.

E. and E. Taylor, Limited, Finsbury Pavement, E.C. A neatly bound and well illustrated catalogue of hydraulic, steam, and hand power lifts, hydraulic pumping plants, wrought and cast iron ornamental work, iron buildings, &c.

Lancaster and Tonge. Handbook of their steam traps, and many other specialities.

O. Berend and Co., Fore-street, E.C. Price lists of Switches, Cut-outs, Resistances, and other accessories for Electric Light Installations, and their "A" list of "Daylight" Incandescent Lamps.

We have received from Mr. L. Casella a copy of a new catalogue of the very interesting and useful series of recording instruments for various purposes which have been devised by Messrs. Richard Frères, for whom Mr. L. P. Casella has been appointed agent in Great Britain, America, and the Colonies. These automatic recording instruments include various kinds for engineering, electrical, meteorological, and other purposes, speed recorders, speed indicators, recording pressure gauges, traction dynamometers, water level indicators, hydrographs, and others described in the carefully-compiled descriptive catalogue just issued.

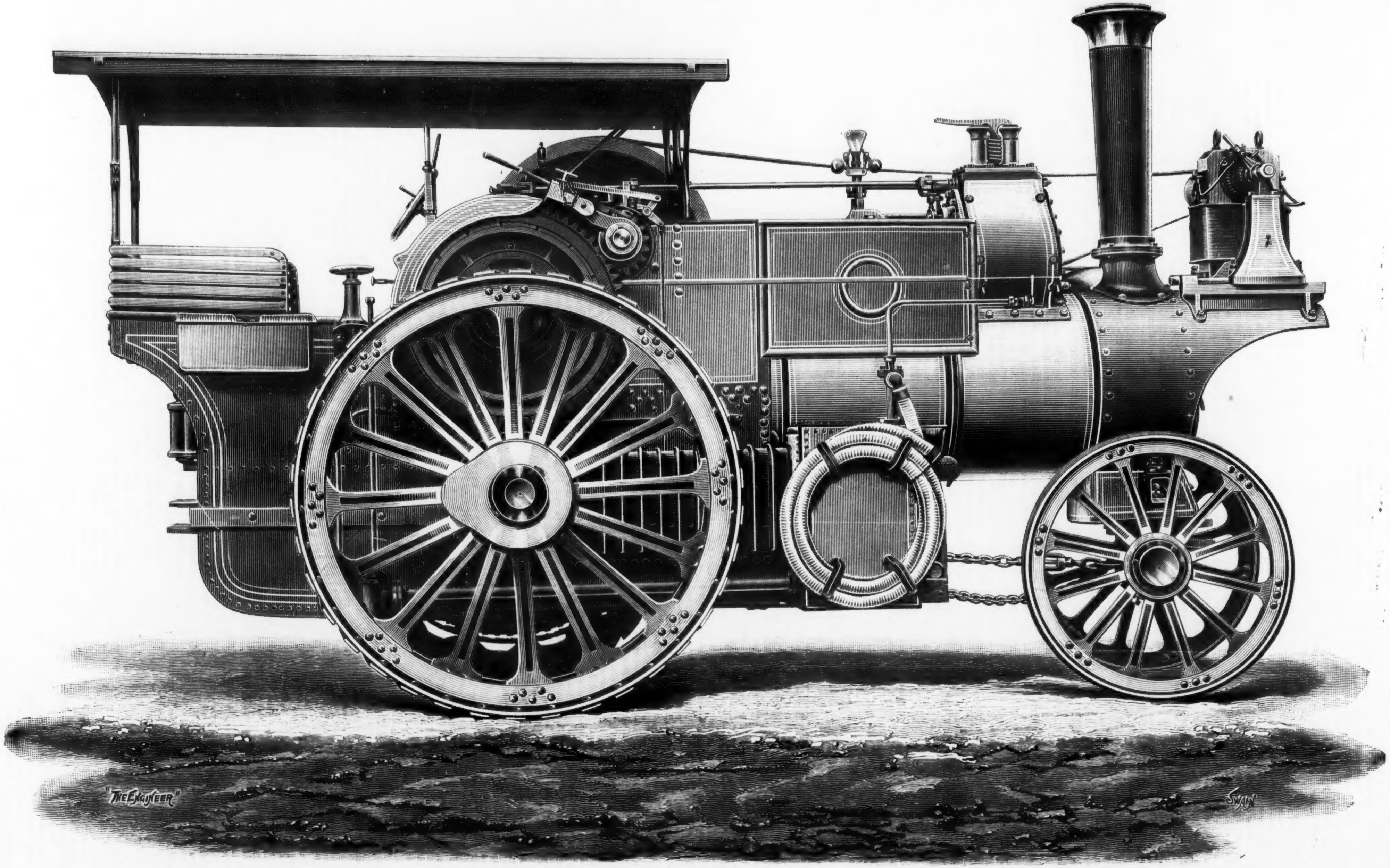
---

* Paper read at the Congress of the Sanitary Institute, at Liverpool, on the 27th ult.

TEN-HORSE POWER COMPOUND TRACTION ENGINE

MESSRS. CHARLES BURRELL AND SONS, THETFORD, ENGINEERS

(*For description see page* 367)


"THE ENGINEER"
SWAIN

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, October 26th, 1894.

Page
Pivoted Arched Bridges .. .. .. .. .. .. .. .. .. .. .. 355
A Modern Naval Battle .. .. .. .. .. .. .. .. .. .. .. 355
The New South African Steamer Norman. (Illustrated.) .. .. 357
The Brewers' Exhibition .. .. .. .. .. .. .. .. .. .. 357
Condensation in Cast Iron Radiators .. .. .. .. .. .. .. 357
Strains and Deflections in Solid Bridge Floors. (Illus ) .. .. 358
The Scientific Applications of Photography .. .. .. .. .. 358
The Sewerage at Portishead .. .. .. .. .. .. .. .. .. 358
Railway Matters—Notes and Memoranda—Miscellanea .. .. 359
Rolled Weldless Chains—Klatte's Process. (Illustrated.) .. .. 361
National Free Labour Congress, 1894 .. .. .. .. .. .. .. 361
Letters to the Editor—The Theory of the Steam Engine—Governing Electric Light Engines—The Condition of the Thames below Kew Bridge—Detection of Arsenic in Copper—Trains and Locomotives .. .. .. .. .. .. .. 362
Corrosion of Propeller Shafts—Bicycle Mechanical Engineering—Labour and Luxuries—An Old-time Pumping Engine—Rope Driving .. .. .. .. .. .. .. .. .. .. .. .. .. .. 363
Water Supply .. .. .. .. .. .. .. .. .. .. .. .. .. .. 363
Catalogues .. .. .. .. .. .. .. .. .. .. .. .. .. .. 363
Leading Articles—Locomotives and Trains—Sir Frederick Bramwell and Technical Education .. .. .. .. .. .. .. .. .. 365
Railway Extension in Asiatic Turkey—Cotton Machinery for China 366
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. 366
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 367
Edwin Clark .. .. .. .. .. .. .. .. .. .. .. .. .. .. 367
Ten-horse Power Compound Traction Engine. (Illustrated ) .. 367
Electricity in Wire Mills .. .. .. .. .. .. .. .. .. .. 367
Institution of Engineers and Shipbuilders in Scotland .. .. 368
Tenders .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 368
Kirkaldy's Evaporators and their Manufacture. (Illustrated.) 369
Manchester Association of Engineers .. .. .. .. .. .. .. 370
American Engineering News .. .. .. .. .. .. .. .. .. .. 370
Australian Engineering Notes .. .. .. .. .. .. .. .. .. 370
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire—The Sheffield District—The North of England .. 371
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 372
Money of the World—The Patent Journal .. .. .. .. .. .. 373
Selected American Patents .. .. .. .. .. .. .. .. .. .. 374

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

W. D. and S. (Cannon-street).—*W. Dickinson and Sons, Phœnix Ironworks, Blackburn; Hacking and Co., Bury, near Manchester; Thorpe and Priestley, Holmfield Mills, Bradford; J. Haigh and Sons, Priest Royd Ironworks, Huddersfield.*

W. F.—*The weight lost will be equal to that of the volume of water displaced. A cubic foot of iron might be disposed in various forms so as to displace different volumes of water, as, for example, in a solid block or in a very thin hollow cylinder.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*
*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)* .. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

Geologists' Association.—Friday, November 2nd, in the Botanical Theatre, University College, Gower-street, W.C., at 8 p m. Lantern slides of geological interest will be exhibited by Mr. G. F. Harris, F.G.S.

### DEATH.

On the 22nd inst., at his residence, Cromwell House, Great Marlow, Edwin Clark, J.P., M.I.C.E., in his eighty-first year.

# THE ENGINEER.

*OCTOBER* 26, 1894.

## LOCOMOTIVES AND TRAINS.

Several correspondents have addressed letters to us in which they criticise the action of the North-Eastern Railway Company in using pilot engines with the fast trains from the North. Another correspondent says that he saw the Greater Britain used as a pilot or second engine with a train of moderate weight running from Carlisle to the South. All these gentlemen assert that either one engine is competent to do the work, or ought to be competent, or else that the use of two locomotives instead of one is rendered necessary by the faulty construction of the coaches, which are carried on six wheels instead of two bogies. So far as we know none of the correspondents with whom we are dealing possesses any special acquaintance with the conduct of railway traffic. They do not speak therefore as those with authority; yet the questions raised must not be dismissed lightly because of the position of those whose letters will be found on another page. Indeed, we are repeatedly asked why two locomotives are used when ostensibly one would do. The subject has only been re-opened by the Northallerton accident. The train from the North was, it will be remembered, drawn by two very powerful engines.

Now, if we consider the relations existing between locomotives, trains, and speeds, bringing to the consideration a competent knowledge of all the circumstances, it will quickly become apparent, we think, that there is some method in the madness of the railway companies, and that neither the locomotives, nor the locomotive superintendents, nor the coaching stock are to blame. The general public who write letters to the newspapers do not seem to understand that in nearly all cases, when very high speeds have to be maintained over long runs, a locomotive is as a rule taxed to its utmost capacity. We use the words in a special sense, which will be understood at once by railway men; nevertheless it may not be easy—or indeed possible—to make our meaning clear to those who have had no experience on the footplate of a locomotive. It is nothing to the point to urge that an engine has great cylinder capacity, a big boiler, and so on. The moment speeds approaching sixty miles an hour are required, we find that certain peculiar conditions are essential to success; and if these are not present, the required speed cannot be maintained. After a certain point has been reached it does not appear that in the matter of speed alone much is gained by augmenting the dimensions of an engine, provided the road is good and level, and the loads just those suited to the engine. Thus, for example, during the famous "race to the North" of a few years ago, Mr. Webb used old engines of the Lady of the Lake class to haul his trains of four 20-ton coaches to Crewe, about a distance of 156 miles, and they did the work admirably. But the addition of a fifth coach would have been fatal, and they could not possibly have satisfied the conditions on the line between Crewe and Carlisle; much more powerful engines were required for that work. It has been proved over and over again in this and many other countries, notably the United States, that for high-speed express work, the train ought not to weigh more than one and a-half times the weight of the engine and tender on comparatively level roads. On lines abounding in steep inclines, the weight of the train ought not greatly to exceed that of the engine and tender. To make a long run over a hilly road at high speed it is essential that the engine should get up the hills rapidly. Let us suppose that on a certain stretch of line it is known that an average speed of sixty miles an hour must be maintained. Let that length be ten miles, with inclines rising both ways and meeting in the middle. The total time allowed is ten minutes. If the climbing is done at, say, forty miles an hour, it will occupy 7·5 minutes, leaving only 2·5 minutes for the descent. The train would consequently have to climb five miles at forty miles an hour, and run down five miles at 120 miles an hour, which is an impossible thing. Mr. Ivatt, of the Great Southern and Western Railway of Ireland, prepared some years ago a table showing the effects on average speed of temporary reductions below the normal. The influence of such reductions is not fully or even partially appreciated save by those who have given train speeds much attention. In the case we have assumed, it may be taken for granted that the maximum allowable speed down grade would require four minutes for the five-mile run, or seventy-five miles an hour. This would leave six minutes for the climb, or fifty miles an hour; but it is nearly as difficult to get seventy-five miles an hour out of a train on a down grade as it is to get fifty miles an hour on the corresponding up grade. Indeed, an incline five miles long, so steep that an average speed of seventy-five miles an hour could easily be reached going down, would also be so steep that very considerable trouble would be experienced in getting up it at fifty miles an hour.

If our readers have followed us so far they will have little difficulty in following us further. The road out of Edinburgh is very steep and hilly. The public demand that the expresses from and to the North shall keep excellent time and travel at a very high speed. Now given a fine day with little wind and dry rails, we have no doubt that the North-Eastern engine attached to the train could have hauled it at the required speed and kept time; but the weather was not particularly fine—there was mist hanging about. Up to Darlington only one engine was put on. There a pilot was taken. The train was already late, and to prevent further delay it was imperative that there should be no delay or hesitation at climbing banks. One locomotive would possibly have sufficed for the work, but there was a doubt, and so a second engine was attached to the train. The desire of the district locomotive superintendent was that assurance should be made doubly sure, so he used two engines instead of one. There is not a line in the kingdom on which really high-speed trains are run over hilly country, on which double banking the locomotives is not practised from time to time. It constantly happens that a driver arrives at a station, and, seeing threatening weather, asks for and gets a pilot engine. This is, so to speak, a sacrifice to the laudable desire of the public for speed and punctuality. The case of the London and North-Western train from Carlisle goes for nothing, because for miles out of Carlisle the line climbs through a desperately difficult country until Shap Summit has been reached, and, in fact, the whole road from Carlisle to Oxenholme Junction is very trying to a locomotive. The Midland trains running over the Settle and Carlisle route are in a still worse plight. It is useless to urge that the inclines to be surmounted represent but a small portion of the road. The second engines demanded by the difficulties of four miles out of a hundred will have to run the whole hundred. The Board of Trade regulations are opposed to "banking" a passenger train, and it would have in any case to stop at the foot of the incline to take a pushing engine on. It will generally be found that pilot engines are only used under strictly exceptional circumstances when the roads are level. It is the presence of inclines that renders their use necessary. The fact that the road between Darlington and York is one of extremely easy gradients throws doubt on the assumption that the pilot engine was taken on because it was wanted. It seems far more probable that it was a light engine returning to York, and that it was run as a pilot, as is very often done, to avoid having a second "train on line."

It may be urged that an engine with 19in. cylinders, 26in. stroke, and 7ft. wheels, ought to be competent to run up very steep inclines with heavy trains. So it is, and at a good speed too, provided the weather is favourable. But good as the speed may be, it may not be quite fast enough, and two engines are used. We remember a running-shed foreman being once asked why he had sent out two locomotives with a certain train, and he replied: "I put on two because I had not one and a-half." We have not the least doubt but that there is a great superfluity of power on many trains criticised by our correspondents, but the locomotive superintendents no doubt hold, and properly hold, that it is much better that such a train as the East Coast express should have a great deal too much than a very little too little power. Our correspondents' contention that the East Coast coaching stock runs heavily requires direct confirmation by experiment. On the London and North-Western Company's lines a great deal of six-wheeled stock is in use, provided with traversing arrangements, by which easy running round curves is ensured. Long bogie stock runs very easily on good roads as far as the passengers are concerned, but we have yet to meet with a driver who holds that it is exceptionally easy to haul. Finally it may be admitted that it seems strange that two very powerful locomotives should be employed to haul not very heavy trains. Yet there is no cause for wonder when we consider the conditions. The worst that can be proved is, we think, that the district superintendent or traffic manager, or both, are over cautious. The principal reason for using two engines lies in the hilly nature of the road traversed, and the necessity of running up hill at high speed in order that down hill the speed should be kept within safe limits.

## SIR FREDERICK BRAMWELL AND TECHNICAL EDUCATION.

The distribution of prizes and certificates to the successful students at the Westminster Technical Institute during the sessions of 1893 and 1894 took place in the Westminster Town Hall on Monday evening. Sir Frederick Bramwell was on the platform, and he made a very excellent little speech. Sir Frederick, indeed, seldom makes a speech that is not worth hearing. Years ago he took a somewhat prominent part in the development of scientific education among the masses. There is reason to believe that matters have progressed faster and gone much further than he intended or even contemplated as possible. His own training and the nature of his pursuits has easily differentiated him from the modern school of professors, and he has evidently little sympathy with much that he sees and is probably expected to praise. It was, of course, essential that he should say what he could in favour of the work done by the Westminster Technical Institute, but that seems to have been little enough. He said that the students before him "had sufficiently proved their knowledge of the value of the institution to which they belonged by the fact that in four or five years their numbers had increased from 20 to 1000." Of course, the facts in no way justify the deduction. The most that they could prove is that a number of young men and their parents and guardians *believed* in the value of the Institution. Belief is certainly not knowledge; and no attempt was made by the students—or anyone else—to show what advantage had been gained by those who attended the classes. Sir Frederick went on to say that when he was a boy his master taught him all he could teach, and that embodied a good deal of practical work, without much theory. The fact was that theory was not taught by his master, because he had no theory to teach. What they had secured in the institutions of the present day was not only a substitute for what was imparted in bygone days, but included a great deal of information which could not formerly be obtained. They now saw why they did certain things, and why certain results followed. "Formerly they only did what they were taught, because their forefathers had done the same things for generations." We wonder whether any of his hearers drew the deduction from Sir Frederick's certainly not unsuccessful career that there is a good deal to be urged for the old-fashioned method. Sir Frederick went too far when he said that engineers did formerly, or at any time, certain things because their fathers had done them. Sir Frederick has lived long enough to have been personally acquainted with the men who turned the world upside down; and generations yet further back which included such men as James Watt, George Stephenson, Rennie, Telford and Maudslay, certainly cannot be accused of plodding blindly in the rut worn by their forefathers. Where in modern times can be found, as the product of the technical college or the Universities, men to compare with the giants of the past.

But although for a moment, and as much out of courtesy as perhaps for any other reason, Sir Frederick Bramwell exalted the modern method of education, his own good sense and keen appreciation of truth quickly brought him back to facts. He refused to admit that the men of a past generation who lived in the pre-technical education days, were the ignoramuses some persons would have us believe. "He was one of those," he said, "who believed that if, from generation to generation, good iron was made from the iron ore of a particular district by a certain process, it was better to follow that process than to depart from it at the bidding of a scientific man. Indeed, if a philosopher told him that that which had answered for generations was entirely wrong, he should begin to doubt whether the philosopher had not lost sight of a bit of his philosophy." Pregnant words these, which ought not to be readily forgotten by those who heard them. After this warning, Sir Frederick went on to praise the labours of the physicist. Once more we find evidence that he spoke against the grain. He was unable to name, or even suggest, any great benefit which had been recently conferred on humanity by the followers of pure science. The utmost that he could say reminds us of a story told of Dr. Johnson, who was asked by Boswell what was the use of a balloon. "Sir," replied Johnson, "You might as well ask what is the use of a baby. It may become a man." Sir Frederick warned his hearers not to despise the beginnings of science, however small, because they might give rise to great things. They should remember that it was not so very long ago when "a man in an Italian city found that, by a certain arrangement of metal plates, he could cause a frog's legs to kick. People then said, 'It might be wonderful; but what was the good of it?' Well, the good of it had since been amply demonstrated, and one of the illustrations of what might be got from a new scientific fact was to be found in the lighting up of that large hall by the incandescent electric light." This kind of claptrap is not worthy of Sir Frederick. "It is a far cry to Loch Awe." The distance between the electric light and Spalanzini's experiments with frogs is so great that the ordinary human mind cannot grasp it, and Sir Frederick did not stop to point out that the incandescent lighting of the hall owed its existence not at all to men of pure science, but to hard-working practical individuals, who did things first and left it to the professors to explain subsequently how they were done. Sir Frederick concluded with a lengthy reference to Professor Dewar's experiments on gases and the phenomena displayed by liquid air, and it is worthy of notice that he refused to commit himself to an expression of belief in the existence of absolute zero.

Such speeches as those made by Sir Frederick Bramwell cannot fail, we think, to do good, and help to recall people to their senses. But we should much like to hear a speech made by Sir Frederick out of the fulness of his heart, untrammelled by the necessity for saying more or less pretty things of the modern craze for "scientific" education. Concerning this craze as it affects other professions and callings we care but little. The relation which it bears to engineering is, however, quite another matter. In season and out of season we have insisted that engineering, either civil or mechanical, is not to be learned from books or in colleges or technical schools. A laboratory and a big testing machine never made engineers yet. On the 1st of October Mr. Lockhart Stephens read a paper before Guy's Hospital Physical Society on "Medical Education in Relation to General Practice." There is probably no education given in any profession which is so thorough, both as regards theory and practice, as that to be had in the great London medical schools. We cannot resist the temptation to quote a passage or two from Mr. Stephens' paper, so pertinent are they to the matter in hand:—"It is most important that the fundamental truths of natural philosophy should be known to all, for without such knowledge it is impossible for any man to study and practice his profession intelligently. A student who has been grounded in elementary science, commences his more special work with a mind trained to a proper habit of thought and prepared to follow the inductive reasoning upon which scientific medicine is founded. He has learned how to study such subjects as anatomy, and he has a knowledge of the sciences which are indispensable in attempting to study physiology." We have here a very excellent definition of the use of education in physical science, and if we substitute in the preceding passage for "anatomy," say mechanics, or for "physiology" say railroad work, the application will perhaps be more fully appreciated by our readers. Again, dealing with practical work, can anything be more to the point than the following passage:—"Take notes of your dissections, for in that way you will become possessed of a knowledge of anatomy which in after years will take you back—not to a particular page of Ellis or Gray, but to a part where you will have a clear mental picture of the actual structures. In practice, gentlemen, it is 'dissecting-room' anatomy, not merely 'text-book' anatomy you want, and the only way in which to acquire it is by direct original observation, by solid hard work, and by taking notes of your work. Read the preface to your Ellis: 'Its purpose is to teach the anatomy of the human body by dissection.' I am told that men no longer dissect as they used to do." Paraphrased this may mean, "In practice, gentlemen, it is workshop engineering you want, not text-book engineering." We can readily fancy how fully Sir Frederick Bramwell would agree with all that Mr. Lockhart Stephens had to say about thoroughness and practice.

Those who watch the signs of the times can scarcely fail to see that a change, a happy change, has begun to manifest itself in more directions than one. The pure physicist is no longer regarded as the proper man to teach engineering. There is to be noted a leaning in favour of men who have really practised the profession and know something of what work is outside a laboratory and a class-room. At one period not long past, it was held that the engineering firms, civil and mechanical, in Great Britain would receive with open arms the highly-trained product of the college. They did nothing of the kind. They pursued the even tenor of their way as though the Superior Young Man did not exist; and now we find it tacitly admitted, and even sometimes plainly asserted, that the most a college or a technical school can do is to prepare a young man to learn engineering. With this we have reason to be satisfied. But it must not be forgotten that putting our own efforts to make the truth known on one side, the result has been largely due to the outspokenness of more than one man who, like Sir Frederick Bramwell, is not only always sure of an audience, but certain that his words are competent to influence his hearers.

### RAILWAYS EXTENSION IN ASIATIC TURKEY.

The British Consul-General at Smyrna in a recent report draws attention to the complicated and important question of railway extension in Asiatic Turkey. Railway communication between Smyrna and the interior is in the hands of two British companies, the "Aïdin" and the "Cassaba," which are free from competition; but these lines extend only 240 miles inland, and a German syndicate has recently obtained a railway concession from Ismid, practically from the Bosphorus to Kharahissar and Konia, and eventually on to Baghdad, thus cutting off the two British lines from any extension E. and S.E. The bulk of the produce of Konia and the far interior line on arrival at Kharahissar will be transmitted to Smyrna. This opportunity is taken for renewing a previous recommendation as to the advantages of amalgamating the two British lines, and of warning the companies as to the danger of allowing minor interests to prevent an alliance which alone can secure the future success of both. The Aïdin Railway was the natural line of communication, because the short extension necessary from its present inland terminus at Diner to Chaï on the German line would pass through a comparatively level country, but the company failed to obtain a concession for such extension. The Cassaba Railway would require to construct a longer branch from its inland terminus at Alashehir to Kharahissar on the German line, which would pass over a mountainous country, involving heavy gradients, and probably costing three times as much as the former route. A concession for this extension has been granted to a French syndicate, which has concluded a provisional agreement with the Cassaba Company to purchase their line at any time before the end of July, a date subsequently extended. If the two British companies could arrange for an amalgamation of their interests, the French syndicate would gladly join them, and means be found for adopting the cheaper, more convenient, and direct route to Chaï. This would get rid of the one drawback to the Aïdin line—the heavy gradients and narrow tunnel in its Ephesus section, which could be avoided by a short branch connecting the two railways. Though the German company will have no option as to the transport of a large proportion of its freight to Smyrna, it will be able to impose onerous terms on the new French company, burdened with the excessive cost of the mountain extension, by holding over it the threat of an extension of the Aïdin line to Chaï, and a transference of their traffic to the rival line. Another view of the question worth considering is—sooner or later, the Aïdin Company will obtain the concession for its natural extension to Chaï, but if the proposed Kharahissar extension of the Cassaba Railway be carried out, it is very doubtful how far two competing companies, supplemented to a certain extent by the competition of a third company running to Ismid, will find sufficient traffic to pay reasonable interest on three separate large capitals. The German company and the new French syndicate have obtained from the Porte guaranteed traffic of from £500 to £800 per mile, and in view of the competition that will ensue, the Ottoman Government will have to contribute annually large sums to each of these companies. The Aïdin Company, which will be the only British line connected with Smyrna, has no guarantee of this kind, and the Chaï extension will be too short to render one of any value. It therefore appears that the suggested amalgamation is more desirable than ever for the interests of all concerned. It is not too late for amalgamation, as difficulties are bound to arise in obtaining the large capital required, and the advantages of a coalition will duly become more obvious to the supporters of the French syndicate.

### COTTON MACHINERY FOR CHINA.

It is being asserted by commercial authorities supposed to be informed that one of the main effects of the present war in China, when the country gets rid of its invaders, will be a considerable change in the disposition of that Empire towards Western civilisation, and a determination to cast off the prejudice which has hitherto militated against her material prosperity. British machinists and engineering firms will greatly benefit, from a trade point of sense, if these expectations should be realised. Meantime it is instructive to notice the advance which, prior to the war, China was making as a purchaser of cotton machinery from the engineering workshops of this country. Four years ago the Chinese Government granted to one of the native firms a monopoly for ten years of the spinning and weaving industries. The monopoly is not without its points of discord. The original mill has recently been destroyed by fire, and the proprietors of the monopoly now insist that the close period should date from the time the reconstructed mill starts working. While the authorities have not yet come to a final decision, companies are being formed in various parts of North China to erect and work mills under royalty from the original possessors. Some difficulty is arising, however, in several instances from some hitch in getting the contracts for the machinery, entered into a few months back, executed. Payment was to extend over four years, and some of our engineers do not seem disposed to allow so long a credit. But the Chinese are hoping that the improvement lately observable in exchange will assist in getting the orders that are pending for machinery put through.

## LITERATURE.

*A Practical Handbook of Drawing for Modern Methods of Reproduction.* By Charles G. Harper. London: Chapman and Hall. 1894.

One of the most prominent developments of the last quarter of this century is the "illustrator." He need not be an artist, and generally he is not. Very often he is not even a trained draughtsman. But he must be "picturesque" in a curious popular sense, and "effective." It is not easy to account for his existence. Whether he is a result of the great increase in periodical literature, or of the simplification and extension of photographic processes, is not clear. Perhaps he owes something to both, and it is probably not too much to say that there would not now be so many illustrated papers and magazines if it were not for the existence of the "illustrator," and the ease and rapidity with which his work can be reproduced. Five-and-twenty years ago the relief printer was dependent upon the wood engraver for his pictures. For intaglio printing we had only engraving in its varieties, line and stipple produced by the burin, mezzotint by the scraper, and the bitten line of the etched plate. As an intermediate process there was lithography. In all we had the personal style and feeling of the engraver. Now nearly everything is superseded by photographic reproduction, by "process" as it is aptly called. On all sides men and women, young and old, are eager to become illustrators. As Mr. Harper says, "Never was illustration so marketable as now, and the correspondence editors of the Sunday papers have at length found a new outlet for the superfluous energies of their eager querists in advising them to 'go in' for black and white, as one might advise an applicant to adventure upon a commercial undertaking."

At first sight it is not quite easy to grasp the author's position, or why the book came to be written. Mr. Harper points out that drawing for reproduction should mean a good deal more than the staining of paper, and he is certainly not deficient in criticisms of contemporary draughtsmen, some of which, we think, is deserved; but with all this he explains in detail the mechanical side, and dwells on the mechanical resources and tricks open to the man who presumably is not an artist, the air brush and the manufacture of dots and "splatter work" with a tooth brush and a match stick. He seems to wish the illustrator to be an artist and to be trained as such, and yet by his book he has apparently sought to provide the impossible, a royal road to art. But it may be that he considers a knowledge of the various processes as useful to the artist as to the illustrator, and so it is.

The book contains a sufficiently detailed description of the gelatine, albumen and bitumen processes, and has useful notes on paper, pens and ink. We cannot congratulate the author upon all his illustrations; some are quite unworthy of the book. We are sorry to see that he supports the practice of *retroussage* in printing the etched plate. No doubt a good deal of bad etching can be disguised by skilful *retroussage*, but that is no reason for approval of the practice. The old masters did not rely on *retroussage* to adorn their drawings. Again, we think that he underrates the importance of line, and does not dwell enough upon form and value. No one can be said to be an artist who is not a master of the three. The illustrator of to-day indulges in his own conventions, because as a rule he is not able for more. We may accept them because, as a rule, we can discover what he means to express by them, but do not let him complain if we decline to accept them as of art.

*Electricity in the Service of Man.* By R. Wormell, D.Sc., M.A. Revised and enlarged by R. W. Walmsley, D.Sc. London: Cassell and Company. 1894.

This work is intended as a popular and practical treatise on the application of electricity in modern life. If the process of sifting is of advantage the present volume should only retain the valuable portion of earlier works. Its history is as follows:—A popular treatise was brought out some years ago in German by Dr. A. R. von Urbanitzky, and was considered so useful that a translation into English was made by Mr. Emil Beyer for the present publishers. This translation was placed in the hands of Dr. Wormell, who found that in order to adapt it to English readers somewhat extensive alterations were needed. All the autobiographical notices were excised, but the general plan of the work was retained, and the first edition was published in 1888. In 1890 further changes were rendered necessary owing to the improvements in the science, and Dr. Walmsley added appendices on dynamos and transformers. The present volume, which may be considered as the third edition, differs considerably from the earlier editions. Dr. Walmsley has excised 120 pages, and substituted about 200 pages of new matter, so that he is responsible for about 240 pages out of a total of 976 pages. The system upon which the book is written is first the historical treatment of the subject, and then the description of the applications of electricity to industrial life.

The volume has more than 950 illustrations, most of which are very good. In the original no formulæ or mathematical expressions of any kind were used, but the English editors have added simple expressions for many of their descriptions, and we think this increases the value of the work even from a popular point of view. Hydraulic analogies are skilfully used to explain the theory of resistance and potential, and it seems to us that when not pushed too far such analogies assist materially in the comprehension of electrical science. We expected in a book of this class to find descriptions of a good many antiquated apparatus and machines, but we have been agreeably surprised to find that Dr. Walmsley has been very careful to leave out a good deal of matter which appears time after time in most books intended to popularise the knowledge of electrical science. The matter relating to high tension currents, and the apparatus employed in producing such currents, is brought well up to date by clear descriptions of Tesla's experiments and Elihu Thomson's work. The dynamos described exhibit a very catholic taste on the part of the authors, German, French, and American machines being as well represented as British types. Three phase machines are illustrated and described, and the somewhat difficult problem of polyphase winding is described as simply as is possible.

The second part of the book consists of two divisions—(1) The Generation and Conduction of Electricity, and (2) Practical Applications of Electricity. The woodcuts of the commutators used upon the various types of machines are very well drawn, and the explanations are clear.

Diagrams of developed windings are also given, which are much more readily intelligible than the complicated wound diagrams found in some works. In his description of cells, the author alludes to the Fuller type, and states that about 20,000 of these are in use in the English telegraph department. We believe that primary cells are being done away with now as far as possible, and that their place is being taken by dynamos, as is usual in the United States.

Dealing with the question of photometry, the author describes Mr. Vernon Harcourt's "Pentane" standard, and expresses the wish that it may become a legal standard. We endorse this view as to a legal standard being eminently desirable, but the difficulty of comparing differently coloured lights will always be present. It is almost impossible to compare the light of the arc lamp with any of the ordinary standards at present in use. Descriptions are given of various electric railways, and also of the telpherage system. If Prof. Fleeming Jenkin had not died prematurely, this system would doubtless have received more applications than it has yet had. Considerable space is devoted to the description of telephones and microphones. The book closes with a chapter upon telegraphy. The work covers a very wide range, and is about the best popular account of the subject we have seen.

*Boiler Construction and Useful Information for Practical Men.* By W. D. Cruickshank, Chief Engineer Surveyor N. S. W. Government. 1894.

This book is produced by Messrs. Batson and Co., of Sydney. The type and paper are indifferent, and in our copy several corrections have been made with pen and ink; the plates are crude; and as the book contains only about 250 pages including the plates, and costs 6s. in Australia, it will be seen that in the matter of publishing there is room for considerable improvement in that colony. The work, however, is intended to meet generally the wants of those who cannot afford *editions de luxe*, the artisan, working mechanic, and foreman, and to put before him in language he will readily understand the leading principles and practice of boiler construction. We may say at once that these conditions are very ably fulfilled. Mr. Cruickshank has evidently been through the mill, and is therefore from experience in a position to give exactly the kind of information required by his intended readers. The book is divided into paragraphs to which an index gives reference, and not into chapters. It commences with a few leading notes on the nature and strength of iron and steel; the stresses in a plain cylindrical shell are then explained, and we must call the author's attention to the misleading use of the term "internal surface," when it is evident the "cross sectional area" is what is meant. The fault occurs several times, and renders passages otherwise clearly and correctly expressed almost unintelligible.

Into the matter of flues Mr. Cruickshank has gone very thoroughly; he discusses the relative strengths and suitability of all the modern flues, giving and explaining the formulæ, and making just and judicious remarks about the unfortunate difference of opinion between the Board of Trade and Lloyd's as to the diameter to be taken in these calculations. He says:—"There is no doubt that both Lloyd's and the Board of Trade are quite prepared, from their own point of view, to support and defend their action, but to practical minds of ordinary perception, it is questionable if the soundness of the logic used would be very apparent or of a convincing character."

In speaking of red-hot boiler flues the author expresses his opinion with characteristic colonial positiveness He considers an explosion from such a cause an impossibility, basing his arguments on the Lavington-Fletcher experiments. We would call his attention to Thurston's remarks and conclusions on the same matter, which will be found on pages 573-4 in his book on boiler construction. The staying of flat surfaces, and particularly furnace crowns, is then gone into by calculation and graphical construction in a satisfactory manner; and there follows a systematic, lucid, and exhaustive description of the various methods of riveting plates together. This section is conveniently epitomised in the end of the book by a number of plates illustrating the types of riveting, and each accompanied by its "personal equation."

The author's part of the work finishes with a short and not very able discussion on water-tube boilers. In this matter Mr. Cruickshank is not quite up to date—his forte evidently lies in marine boilers, Scotch type. Ordinary pattern land boilers are scarcely noticed, and locomotive boilers are passed by entirely. The letterpress concludes with a list of "the rules which govern the construction of machinery in this country," to which are added Lloyd's rules for reference. A table of areas and circumferences is also given. In conclusion, we can confidently recommend this book to the practical man; it is written on the whole clearly and well, and fills a place which no other work we know of exactly fits.

*The Electric Transformation of Power.* By Philip Atkinson, A.M., Ph.D. London: Crosby Lockwood and Son. 1894.

Mr. Atkinson's work is intended as a popular treatise on the electric transformation of power, and its application by the electric motor, including electric railway construction; and it is written in non-technical language. All historical matter has been excluded, as well as descriptions of experimental apparatus; only the latest and most approved methods are stated by the author to be referred to. The preface is dated from Chicago, and the work is published in New York as well as in London. All the matter appears to refer to American practice; the book is well printed, and the cuts are better than in most popular treatises.

The author describes a number of well-known types of American motors, giving, in some cases, details as to the winding; and then deals with the Tesla alternating current motor, and other recent types. He succeeds in giving a good general idea of the apparatus, and then passes on to the application of the stationary motor. These applications are very numerous in the United States, electric elevators, electric fans, and windlasses being much more commonly used than in Great Britain. The subject of electric railways and railway motors is then treated, and the working parts—such as poles, trolleys, insulators, and switches—well described. The motors themselves are well illustrated, and the author appears to consider that as the double reduction gear was given up in favour of single reduction, so the latter will be superseded by the gearless motors, of which he illustrates the Short type.

Central station work is described with special allusion to the power plants used in Chicago. The work has very few references to British work; in fact, two paragraphs, dealing respectively with the Liverpool overhead railway and the City and South London Railway, are the only cases we have noticed. To the ordinary non-technical reader in this country, this is a decided disadvantage; and the technical reader would desire fuller information on American practice than is here given.

*Applied Mechanics: An Elementary Manual on.* By Andrew Jamieson, M. Inst. C.E. London: Charles Griffin and Co. 8vo. 1894.

Although this manual has been written expressly for first-year students of applied mechanics under the Science and Art, the City and Guilds, and other bodies, it is one of those books that make us feel that there are many things which can be learned much more easily from some of the books of to-day than they could when we were at school. Mr. Jamieson has the faculty of selecting from amongst what may be called the old problems in such a way as to illustrate their solution and application by reference to familiar and useful modern practical examples, and he has made use of this faculty as he has previously done in his books on the steam engine which we had pleasure in noticing very favourably. The book is turned out in the satisfactory style usual with Messrs. Griffin.

## BOOKS RECEIVED.

*Geometrical Conics.* By Charles Smith, M.A. London: Macmillan and Company.

*The Construction of the Modern Locomotive.* By George Hughes. London: E. and F. N. Spon. 1894.

*The Slide Rule.* A practical manual. By Charles N. Packworth. Manchester and London: Emmott and Company.

*Elements of Metallurgy.* By W. Jerome Harrison, F.G.S., and William J. Harrison, jun. London: Blackie and Son. 1894.

*Specifications for the Use of Surveyors, Architects, Engineers, and Builders.* By J. Leaning, F.S.I. London: Sampson, Low, Marston, and Company. 1894.

*The British Fleet. The Growth, Achievements, and Duties of the Navy of the Empire.* By Commander Charles N. Robinson, R.N. London: George Bell and Sons. 1894.

*The Electric Current, how Produced and how Used.* By R. Mullineux Walmsley, D.Sc. (Lond.), F.R.S.E., &c. With 379 illustrations. London: Cassell and Company. 1894.

*The Durham College of Science, Newcastle-upon-Tyne, Calendar, Session* 1894-95. London and Newcastle-on-Tyne: Andrew Reid and Company. London: Whittaker and Co. 1894.

*The Decoration of Metals: Chasing, Repoussé, and Saw-piercing.* By John Harrison. With 180 illustrations of works by various artists and original designs. London: Chapman and Hall. 1894.

*The "Practical Engineer" Pocket-book and Diary*, 1895. Edited by W. H. Fowler, Wh. Sc., M. Inst. M.E., Assoc. M. Inst. C.E. Manchester: Technical Publishing Company; London: John Heywood.

*Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution to July*, 1892. Washington: Government Printing-office. 1893.

*The New Tariff of the United States, with the Necessary Consular Instructions and Regulations, Money Conversion, Tables, Names of United States Consular Offices, List of Ports, &c. &c.* London: *Shipping World* Office. 1894.

## EDWIN CLARK.

Mr. Edwin Clark, M.I.C.E., whose name is associated with the Britannia and Conway bridges, and will be ever associated with the rise and development of large girder bridge construction, died at Cromwell House, Marlow, on Monday night. He was born at Marlow in 1814, and after the usual school-days and apprenticeship, he became associated with several of the English engineers. He worked under Robert Stephenson, and as resident engineer had control of the construction of the Britannia Tubular Bridge, his brother, Mr. Latimer Clark, being appointed his assistant. After the completion of the Britannia and Conway bridges, he wrote the well-known book on these structures, to which the whole world looked as the greatest engineering feats to that date. He was assisted by his brother Latimer in this work, which was published in 1850. The Britannia bridge was begun in May, 1846, the first of the great tubes lifted on the 23rd June, 1849, and the first locomotive ran through in 1850. He was associated with Fairbairn, and carried out under him the celebrated experiments on the strength of materials, and of girders and girder tubes. He delivered a lecture on these bridges in Marlow in 1881. He was elected an Associate of the Institution in December, 1850, and was transferred to the class of member in April, 1855. He contributed papers to the "Proceedings," Institution of Civil Engineers, on "Hydraulic Lifting Graving Docks," in 1866, and on "Engineering Philosophy and the Durability of Materials," in vol. xxvi., in 1868, the latter containing some important references to telegraph work and insulating materials.

For many years he was chief engineer to the Electric Telegraph Company, and an interesting pamphlet exists describing his proposals for signalling by electricity on the London and North-Western Railway. He patented the hydraulic graving dock and the hydraulic canal lift, and was inventor of the block system of railway signalling. He constructed the famous harbour of Callao, in Peru, and carried out engineering works in various parts of the world, and in connection with the Anderton canal lift an important report by him exists on the causes of failure of some of the great lift cylinders in 1882. Retiring in 1876, he settled down at Marlow. Mr. Clark was a keen student of astronomy, and was a Fellow of the Royal Astronomical and Meteorological Societies.

## TEN-HORSE POWER COMPOUND TRACTION ENGINE.

Few of our readers are aware of the expense incurred by the proprietors of travelling merry-go-rounds in the purchase of their plants. The quantity of stuff to be frequently moved is very large. Thus, "Hancock's Great West of England Steam Switchback" requires five immense road wagons for its conveyance from place to place. The proprietors of these shows have found that it is very much cheaper to employ steam than horses to do the hauling, and they regard the traction engine as an important feature in their display. Messrs. Charles Burrell and Sons, of Thetford, have supplied several traction engines of this kind, the finish of which is as good as it possibly can be made. As these engines have to work through all kinds of hilly country they must be excellent. Thus, on one occasion a run was made from Poole to Weymouth, with a heavy load, and the thirty miles were covered in eight hours, or, excluding stoppage for dinners, seven hours and a-half. Starting from Poole at 8 a.m., the engine arrived at Weymouth Esplanade at 4 p.m.

Messrs. Hancock Brothers, of Bristol, purchased an 8-horse power engine at the Doncaster Show in 1891 from Messrs. Burrell, and that which we illustrate has recently been delivered to the same firm.

We have already fully illustrated and described in detail Messrs. Burrell's system of compounding, which consists in using one crosshead for the two piston-rods, and consequently we need not go over old ground. The new engine was specially built to order. The dimensions of the 10-H.P. engine are as follows:—Diameter of cylinders, 7in. and 11½in. by 12in. stroke; driving wheel, 6ft. 6in. diameter by 18in. wide; front wheels, 4ft. 1½in. diameter by 12in. wide; hind tank holds 178 gallons; front tank holds 125 gallons. The engine is exceedingly strong. The working pressure is 150 lb., and the finish is in all respects equal to that of a first-class railway locomotive.

## ELECTRICITY IN WIRE MILLS.

The President, Alderman Thomas Richardson, B.A., of the North-East Coast Institute of Engineers and Shipbuilders, delivered his address on the 16th inst. It was mainly devoted to the subject of "Electricity as a Power Transmitter." In the course of his address he said that an example of what may be termed ideal electrical driving is that of the Bedson Wire Company, of Middlesbrough, where the installation is the most perfect and complete that has as yet been attempted in this country. Every process connected with the manufacture of wire is carried out by means of electricity, the wire drawing, galvanising, spinning, and barb fencing machines, overhead and locomotive cranes, hydraulic pumps, induced draught fans, lathes, centrifugal pump, are all independently driven by electric motors. Owing to the entire absence of shafting and belting the construction of the building is very light, and the convenience of the whole plant is most noticeable. The current is generated by a 600-horse power dynamo, driven direct by a three-crank triple condensing engine with boiler of 160 lb pressure. A special tunnel, 350 yards in length, has been constructed for the conveyance of the conductors, and branches are taken from these to the 50 motors which vary from 5 to 40-horse power each. The lighting of the works is most complete, the greater part being carried out on the inverted arc principle, which is so perfect that there is an entire absence of shadows. The original plans for driving these works electrically were prepared by Mr. Selby Bigge, who appears to have given considerable attention to the question of electric driving. Before definitely deciding to put down such a novel plant several experiments were necessary, for which purpose special machines were designed by Mr. Bedson, the managing director of the Bedson Wire Company. These experiments were made at Liége by Mr. H. Pieper, and were so successful that after an exhaustive series of tests the directors of the company decided to adopt the electrical installation in its entirety.

A novel feature in connection with the boilers at Messrs. Benson's works is the application of Messrs. Ellis and Eaves' well-known system of induced draught. This is the second application of the system to land boilers, the first having been made at the Atlas Works, Sheffield, originally arranged with Lancashire boilers. These have gradually been replaced by ten single-ended boilers of the marine type, the advantages claimed being as follows:—(1) Considerable economy compared with the Lancashire boilers with Galloway tubes. (2) Considerable reduction in space occupied. (3) Absence of smoke. (4) Greater elasticity of power. In ordinary work, by maintaining a vacuum of 3in. at the fan, the combustion is at the rate of about 35 lb. per square foot of grate surface, and one single-ended boiler can readily evaporate as much steam as three Lancashire boilers 27ft. by 7ft., with ordinary chimney draught. Where the demand for steam varies in a works, the system is a great convenience, and this is especially the case for electric light installations. It is evident that with this system of draught, or with any other efficient system, the assumed consumption of 13 tons per day could be still further reduced.

The Iron Trade in Staffordshire.—In 1830 there were 123 blast furnaces in Staffordshire, producing 212,000 tons of pig iron; in 1872 there were 212 furnaces, producing 950,000 tons. In 1879 the furnaces had fallen in number to 181, and to 105 in 1893, of which only 39 were in operation, producing only a little over 500,000 tons. In the last fifteen years the puddling furnaces have gone down from 1577 to 900, and the production of certain forms of wrought iron from nearly 1,000,000 to 560,000 tons. But the furnaces at work are much larger than formerly, and the diminution of iron has more than made up by the growth of steel.

"Made in Germany."—A correspondent writes to the *Birmingham Daily Post* on the effect which the Merchandise Marks Act has had on the demand for goods "made in Germany." He maintains that the passage of the Act has simply had the effect of enabling British shippers to buy German goods and ship them direct to the Colonies instead of bringing them to the Thames and then re-shipping them—in other words, of transferring the carrying trade from England to Germany. "The idea of the sentimentalists who urged the passage of the Act," he says, "appears to have been that when goods were once marked 'German' or 'French' the English buyer would reject them. The English buyer is not such a fool. He may be surprised to find that articles he once accepted as English are of foreign make, but that he will pay any more for English than for foreign is simply a trade union fiction. It may serve for the platform. Unfortunately, it does; but there is no room for sentimentalism in business. The 'made in Germany' mark has proved a splendid advertisement for Deutschland. I first became aware that some kinds of lithography were done more cheaply in Germany than in England by seeing the mark upon the Christmas cards of a leading firm of stationers. The English printers have only had 'odd jobs' from me since. In the course of many years' trading I have often found myself beaten in price by my competitors. I had sought out, as I believed, the best markets, I had reduced everything to a minimum; but still I was beaten. A few months ago I was asked to quote for a certain article, of which I had for years lost the sale. A sample being sent me, I took it carefully to pieces for calculations. In doing so I found one of the parts—an important part—concealed in the finished article bore the ominous legend, 'Made in Germany.' The mystery was explained. I soon visited the Fatherland, and have now recovered my orders. Not only so, but I am procuring other similar articles from the Germans, much to my own benefit."

## INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.

### INTRODUCTORY ADDRESS.*

By Mr. John Inglis, President.

At this year's session of the British Association, the learned President of Section G recorded the opinion that Presidential addresses were in the nature of them almost immoral, and fit only to be abolished. It is always delightful to find one's own crude and unshapen thoughts expressed with vigour and precision by a master, and, in all my recent reading, nothing has more nearly attained to the ideal of the word in season, meeting my eye, as it did, just as I had awakened to the near approach of the thirty-eighth series of the meetings of this Institution. But though fortified in no small degree by the opinion quoted above, I have scarcely courage sufficient to introduce, all at once, so startling a change into our programme as the entire suppression of the remarks which, in accordance with usage, are expected from the chair at the opening of the session; and I propose to effect a sort of compromise by being somewhat brief on the present occasion, and in this also I follow the custom of most of my predecessors in their second year of office.

The Institution, I am glad to say, continues still in a flourishing condition, the numbers on the roll steadily increase, and there is no falling off in the interest of the members in its proceedings. Our short honorary list has been recently adorned by the name of the Director of Naval Construction, Dr. W. H. White, who worthily represents the profession of naval architecture. On the other hand, the name of the illustrious Helmholz disappears from among those of our honorary members, his death having taken place last month; and in December, 1893, Professor John Tyndall's decease was hastened by misadventure. Our obituary also contains the name of a Past President and most distinguished engineer, Mr. James Reid, whose busy life was suddenly closed during a short and well-earned holiday. Mr. Reid's addresses, while he held office, are among the most important of the contributions to our transactions, and display an exhaustive knowledge of the history of that branch of engineering wherein he made his reputation. The deceased members and associates are Mr. David Henderson, equally well known and esteemed as shipowner and shipbuilder; Sir Archibald Orr Ewing, Mr. John Morgan, and Mr. William M'Ivor Morrison.

The Institution work of last session may fairly be considered of much interest and value. A timely paper by Professor Biles, on "The Strength of Large Ships," is apparently, from its tenor, the first instalment of a lengthy contribution on this subject; and, doubtless, we may confidently expect, although it is not yet announced, that the learned Professor will follow his very complete statement of the strains to which large ships may be liable, by an equally complete exposition of the manner in which these strains are to be met, showing the most advantageous disposition of material in the structure. The elaborate paper by Mr. Arnot evoked one of the liveliest discussions ever heard within these walls, and one which has, for some time at least, delivered us from the reproach, often levelled at similar societies, of being conducted on the principle of mutual admiration. To the authors of some of the shorter papers, and to those who may have material by them for other short papers, I desire to offer a word of encouragement. The importance of a new invention or mechanical arrangement is hardly to be estimated by the number of words required to describe it. An epoch-making invention is indeed a rarity, and the birth of Minerva is in no way typical of the appearance of those contrivances which have wrought such mighty changes in the industrial world. There is probably no machine of any consequence which is not the sum of many successive increments of invention or discovery, and the product of the ability and efforts of many workers. It is on evidence that the ingenious spinning machinery, now in common use, is a compound of about eight hundred different inventions. How minute some of them must have been, and yet how indispensable.

Precisely because the progress of invention is, as a rule, made by short steps, and in obedience to necessity, which is the mother of it, the most notable inventors have, as a rule, not been "scientific men;" that is to say, men exclusively engaged in scientific research, as distinguished from those mainly occupied with commerce or manufactures. (A brilliant exception to this rule will at once occur to all Glasgow men, but there is only one Lord Kelvin.) The continual desire to strengthen the weak parts of an industrial process directs the minds of many eager searchers to contrivance, until to one a fortunate solution presents itself, and invention is carried forward another pace. Therefore, the diffidence that would make us hesitate to bring forward improvements because they do not appear sufficiently imposing, or because we may not be able to clothe our thoughts in words at once elegant and exact, is out of place among the members of this Institution. It must not be forgotten that one of our objects is discussion, and the salient points of a communication are more readily seized when they are few.

I have, though not without an effort, resisted the temptation to provide myself with a subject for this evening out of some of the remarks on ocean steamers made when I had the honour of addressing you twelve months ago. Adverse criticism is always stimulating, and I am far from complaining of it; but it was surprising to find what I introduced as a mere reference, or illustration, taken as the main subject of discourse, and an attempt to do justice to the past treated as a discouragement of progress in the future. We cannot but admire the enterprise and sagacity shown by the moving spirits of the great shipowning companies at home and abroad, and we must admit that it is not by a timid and shrinking policy that great industrial revolutions are carried out. It is an axiom, that he who never makes a failure never makes anything; and, in like manner, the cautious seeker after safe investments is not, as a rule, the pioneer of civilisation, or the organiser of new outlets for industry. But while we look with pride at our mercantile marine, its prodigious capacity for transport, the excellence of its construction, and the skill with which its movements are directed, there is no irreverence in watching carefully for the appearance of any policy which may endanger its prosperity. The profitableness of navigation is therefore a legitimate subject of inquiry to the scientific shipbuilder, whose methods may very possibly yield results not easily obtained by the unaided commercial expert. It is but a few weeks ago that one of the most able of administrators of shipowning enterprise publicly admitted that ships, of the type of the most recent addition to his fleet, could not be made commercially successful without the aid of a Post-office subsidy for mail carrying. It would be presumptuous to claim Sir Thomas Sutherland as a convert, or even to suppose that his mind on the subject had only been recently made up. I merely quote his dictum as an emphatic termination to the existence of any difference of opinion on this question which may have hitherto survived. The question of the profitableness, or, as many would prefer to say, the unprofitableness, of shipping in general, is but part of the larger question, the condition of the world's trade; and for that depression which is at present all but world-wide, there are many who consider that no small part of the responsibility lies on the makers of all kinds of machines for the saving of labour. According to one of the most prominent of continental steamship directors, "the engineer has gotten the better of the man of business;" and if this be true, and of general application, it is surely a very serious reflection for us who hope to earn a living by continuing to furnish labour-saving appliances. All the pessimists are, however, not of one mind, and various are the causes assigned for the present slackness of demand for our wares, and the abasement of ocean freights. Monometallism, labour disturbances, the private ownership of land and minerals, as well as over-production, are favourite suggestions of those disposed to take sombre views of the future. The optimist, on the other hand, points to recurrences of periods of good and bad trade, and talks of cycles and the swing of the pendulum; but, while it is pleasant to believe in him, we cannot altogether disregard the exceptional position among the ages of the century now nearing its close. It has seen the application, on a great scale, of steam to what are still called manufactures, and to locomotion, the peopling by civilised races of America, Australasia, and much of Africa, the spread and consolidation of our empire in India, the opening to commerce of China and Japan, and the shortening of trade routes to the East by means of the Suez Canal. That is to say, it has been a time of extraordinary increase of activity in production, of simultaneous increase of demand for commodities, and of the means of transporting these to great distances at small cost. Another so momentous a change in the aspect of the world, as the last three generations have witnessed, is hardly within the bounds of probability. Therefore, without being either alarmist or pessimist, one may feel some anxiety as to the future of those who depend on the continued absorption of the products of modern industrial appliances, and may decline to be quieted by the assurance that history repeats itself, and that what has been will be.

As concerns the use of this or that metal in coinage, it is difficult to see how the fixing by law of the relative values in exchange of any two or more substances could bring about a general increase of wealth and prosperity; and, having seen periods of good and bad trade, without any coincident alterations in the standards, I am of those who have no faith whatever in bi-metallism as a cure for the ills from which commerce now suffers.

The disastrous effects of labour troubles are too obvious to require demonstration, and the guilt of those who, from ignorance, prejudice, or self-interest, foment disputes in the labour market, is none the less manifest and heinous because it is not recognised by the law. But, as the abolition of all suspensions of industry by labour wars would result in still greater production, those who strive to promote industrial peace must still reckon with those who maintain that there is too much activity in production already.

I hasten to allay the uneasiness you may possibly feel as to any intention of mine to discuss the systems of land tenure in this country, or their effects upon the home or foreign trade. I shall say no more than that I believe the usages connected with the occupation of land have yet to be completely adapted to the new environment, of which modern mechanical appliances are mainly the cause, and that this adaptation, like all radical changes, will probably continue to be attended by much suffering to individuals.

The complaint of over-production is by no means easy to dispose of. It formed the subject of one of Carlyle's eloquent chapters half a century ago, when the sum total of production was a mere fraction of what it is to-day; and, indeed, it is not difficult to be both eloquent and impressive about over-stocked warehouses, and the destitution which surrounds them—about "the frightful overplus of shirts" and "the millions of bare backs." It is all very well to take refuge in epigram, and say that over-production is only a synonym for bad distribution, and when the blocks in the channels of distribution are removed all will be well; but the satisfaction to be thus derived is by no means substantial or enduring. Not that there is any lack of proposals for the amelioration of the world, in regard to the distribution of its goods. Dynamite, as an agent for the regeneration of society, has its advocates, and scarcely more reasonable are the leather-lunged preachers of the pillage of the rich, with or without legislative sanction—these we may leave to the police; but when one of the loudest of the orators from Hyde Park platforms speaks of Labour as crucified between two thieves—Capital and Machinery—our attention is arrested by this assailing of our craft. We can imagine the applause with which this sounding figure of speech would be received by even the respectable portion of the listeners, who doubtless, in a vague way, felt themselves flattered by being compared with the central figure in the great tragedy; but it was probably far from the speaker's intention to convey to his audience that when labour suffers, capital and machinery suffer with it. Such as he have usually no compassion to spare, except for those with whom they are bound *ex officio* to sympathise. What he wished to enforce was that the condition of labour, that is of the bulk of the people, was made not better, but worse, by the presence of capital and machinery. And this is the argument, not only of hysterical members for labour, but also of sober and studious economists, who, if they were to push their theories to a logical conclusion, would deprive us of all implements and devices, by the aid of which we have, as a race, emerged from the savage state of our remote ancestors. "Arms and the man," says Carlyle, "is no longer the epic of this world," tools and the man has taken its place;" and can we believe that the perfecting of tools, which is the engineer's business, is pernicious to the general interest? The truth about the matter I believe to be that the condition of things, which we agree to call over-production or depression of trade, is not primarily due to machinery, but in a great measure to the reckless borrowing by impecunious States, communities, and associations, encouraged by the imprudence of financiers, and the credulity of the public as to the powers of Governments and other debtors to fulfil their obligations. The abnormal and unwarranted demand for goods from those put in easy possession of borrowed funds is rapidly met by the setting in motion of modern machinery—itself partly brought into existence by the necessity temporarily created. High prices become the rule, until the inevitable glut takes place, when there follows the revulsion to prices which are unremunerative. The fall in values is perhaps increased in rapidity by machinery, but the unwholesome stimulus is not immediately traceable to mechanical appliances.

Apart from commercial crises, probably the most potent effect on price levels and the condition of trade is produced, not by the strife which is supposed to exist of necessity between labour and capital, but by the constant struggle of holders of capital with each other in the quest of remunerative employment for wealth, mainly created within recent times by machine production. This has caused the invasion of every department of industry by groups of persons without skill or experience, and possessed only of money or credit, or, it may be, of aristocratic lineage. The competition of these with each other frequently results in the redistribution of their wealth among the community, in the form of the increased wages and reduced prices, with which we are familiar, and against which we are sometimes disposed to rebel. The ever-extending use of labour-saving devices in workshops and factories, whose owners have command of large capital, gives some plausibility to the contention that machinery is much to blame for trade depression, especially if the displacement of labour is not at once, and obviously, made up for by the cheapening of products, and greater facilities for transport stimulating demand; but wider views would probably disclose that the balance is speedily restored. It is interesting, and indeed necessary, for us to inquire what becomes, after all, of the displaced labour, and if there is any visible limit to the substitution of machinery for handicraft. If we avail ourselves of the examinations of the census returns by Messrs. Booth, Hobson, and Marshall, we shall find, for example, that while the output of textile goods has enormously increased, the proportion of labour employed in their production has continuously diminished. Again, while rural population has declined but little, the number of persons engaged in agricultural labour has largely declined, and this falling-off began long before the comparatively recent fall in rents, and what is recognised as the decay of agriculture in this country. The additions to our working population have, therefore, not been absorbed in due proportion by these two great departments of industry, but are to be found, according to the authorities named above, engaged in shop-keeping, commercial pursuits, in the work of transport, and the industries subsidiary thereto. Among these, one of the most important is shipbuilding, which afforded employment to 40 per cent. more persons in 1891 than in 1881. Those engaged in the making of machines, tools, and instruments during the decade increased 28 per cent. These have been the most progressive of our industries, and indicate the extraordinary growth of transport and machine making as modern outlets for labour. The extension of railways has not prevented the increase of traffic by road, as the employment of labour in the making and repairing of roads, in the conducting of road traffic, in the building of carriages and wagons, and the making of harness, shows considerable increase. Coal miners have increased in numbers—35 per cent. in ten years—but the output of coal is only 20 per cent. greater, indicating the serious interruptions to which this industry seems peculiarly liable. Notable increase is also shown by the professions, clerical, legal, and medical—indeed, on the authority of the Chancellor of the Exchequer, the incomes of physicians and lawyers together exceed the whole of the profits of the cotton and coal industries. There is great increase of the teaching guild, and of the numbers of painters, actors, and musicians. These have been set free, by the action of machinery, from the necessity of manual labour. Machinery, therefore, indirectly encourages the study of theology and science, the cultivation of the fine arts, and the graceful acquirements of those who minister to our recreation. Even the army, navy, and police grow more quickly in numbers than the population as a whole. Our protection is thus made more adequate by the art of the mechanical engineer. And in spite of depression, the manufacture of luxuries rapidly increases. No one denies the function of machinery in the production of wealth, and it only remains to establish that the production and accumulation of wealth is not injurious, but, on the whole, beneficent, as by no possibility can its consumption be, in the long run, withheld from the many; and to realise that attacks on the capitalist, in so far as they discourage the amassing of riches, are more likely to lead to the distress than the benefit of the poor, and to the decrease of that purchasing power which is the spring of commerce.

In whatever way we may sum up our estimate of the net effect of labour-saving machinery, there can be no doubt whatever that its use is, in itself, a constant stimulus to invention, and that it will continually increase in efficiency, and in encroachment on the province of manual labour. Machinery, to use a slang expression, has come to stay, and machine tending is more and more taking the place of skilled handicraft in our staple industries. The collectivist, as he calls himself, jealous of the success of the successful, advocates, in the interests of the many, the national control of all means of production, distribution, and exchange, or the assumption by the State of the duties of the landlord, the factory owner, the railroad and steamship manager, and the banker. The old-fashioned virtues of industry, thrift, and self-reliance, are to be discarded, but it is not quite clear what is to take their place. The prayer of the collectivist, or socialist—as has been aptly said—contains but two petitions: "Give us our daily bread, and forgive us our debts." I venture to say that the granting of his prayer, and the adoption of his methods, would bring about a depression of trade such as has never been experienced, or even imagined; and it is hard to say in how great a measure the confused mutterings of this sort have been the cause of the diversion of our capital abroad, with the result of inducing a feverish and unhealthy state of trade for a time, a subsequent collapse, and irrecoverable loss. I deem it rational to hold that the lot of man has been made more tolerable by machinery, his toil lightened, and his opportunities for intellectual and artistic culture increased; but the best of results will not be reaped from its use unless wage-earners of all nationalities will make common cause with capitalists in procuring the withdrawal of all restrictions on the exchange of products and services for money or other considerations, in abolishing tariffs which hinder the production of goods in favourable localities, that they may be fabricated in places which are disadvantageous, and, having repressed their own tendencies to wasteful expenditure, in enforcing a like virtue on their governments, imperial and municipal. The escape from industrial depression lies in the removal of all obstacles to the steady increase of consuming power, in the setting of rational bounds to militarism, in the mobility of capital and labour—that co-relation between production and consumption may be more readily maintained, and by no means in the return to universal manual labour, or in attempts to realise formless dreams of a government assuming the functions of the universal provider. It is possible that the benefits, in the form of power to consume, which might reasonably be expected from the use of machinery, and the consequent creation of wealth, have not been so largely or so widely realised, or so wisely availed of as a generous sympathy with mankind might desire; but this is not admitting that machinery is injurious, or that destitution is the consequence of opulence, because they exist side by side. Impatience at the slowness with which the standard of living rises need not amount to denial that it rises at all. The conditions of labour in the early factories were sufficiently wretched, but they were an improvement on those of the home industries they superseded. Present conditions are immeasurably superior; but it is not generally held that finality in this respect has been reached, neither is it likely that the limit of consumption has been reached, or nearly approached, because, for the time, production appears to have overtaken, and, indeed, to have outstripped it, in the kind of goods hitherto in general demand. If Governments will refrain from what is known by the engaging name of "constructive legislation," and adhere to their primary duty of maintaining security for person and property, private enterprise, on which the State itself depends, may safely be trusted with the work of production and distribution, and the engineer, as heretofore, with the task of devising the means of making the necessaries and comforts of life ever more abundant and more generally accessible.

## TENDERS.

### REDRUTH WATERWORKS.

For the construction of a large storage reservoir, intake works at Lower Penstruthal and Gordon, cast iron mains and laying, &c. Engineer, Mr. H. Bertram Nichols, C.E., Birmingham. Quantities by the engineer.

| | £ | s. | d. |
|---|---|---|---|
| Godfrey and Co., Westminster | 14,215 | 15 | 0 |
| Garlick and Horton, 43, Sloane-street, London | 14,198 | 3 | 8 |
| James Dickson Townsend, St Albans | 11,785 | 0 | 0 |
| Wm. Trevena, Barley House Estate, Plymouth | 9,979 | 0 | 0 |
| Wm. Shaddock, 5, Hillsborough, Plymouth | 9,672 | 0 | 0 |
| E. Duke, 6, Gascoyne-place, Plymouth | 9,556 | 0 | 6 |
| Wm. B. Berry, Union-road, Crediton | 9,469 | 3 | 0 |
| Henry Roberts, The Bayes, West Bromwich | 9,377 | 0 | 0 |
| Geo. Shellabear, 23, Washington-terrace, Nutley, Plymouth | 8,990 | 0 | 0 |
| The Clay Cross Co., Clay Cross, Chesterfield | 8,569 | 15 | 8 |
| Herbert Weldon, Union Chambers, Temple-street, Birmingham | 8,413 | 1 | 3 |
| Wm. Jenkins and Son, Leamington | 7,977 | 0 | 0 |
| W. H. Thomas and Son, Old Vicarage, Crowan, Camborne | 7,765 | 15 | 0 |
| James Julian, Lemon Quay, Truro | 7,695 | 0 | 0 |
| John Shaddock, 15, Seaton-avenue, Mutley, Plymouth | 7,680 | 0 | 0 |
| John White Fereday, Wednesbury | 7,566 | 0 | 0 |
| *Abraham Delbridge, Camborne | 7,301 | 11 | 0 |

*Accepted.

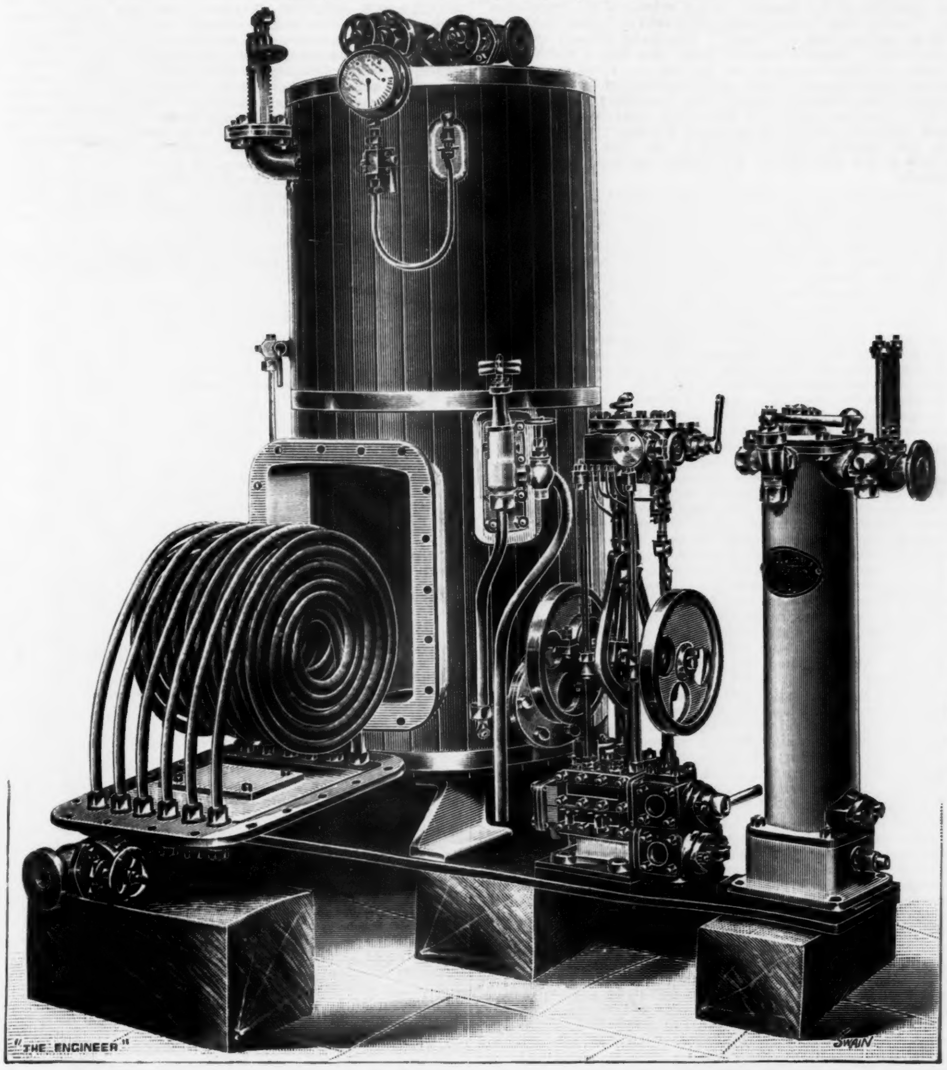
The Incorporated Association of Municipal and County Engineers.—The following gentlemen having satisfied the examiners, at the examination held in Birmingham on October 5th and 6th, have been granted the Association's certificate:—James G. D. Armstrong, Henry G. Bradshaw, Amos Burton, jun., William S. Green, Edward W. Hickes, Albert H. Hughes, Edward B. Newton, James Openshaw, William A. Palliser, Joseph Perkins, William Slater, Frederick Thackeray, and Frank Worrall. The next examination will be held in London on April 5th and 6th, 1895.

---

* Read 24th October, 1894.

# THE COMPACTUM EVAPORATOR AND DISTILLER

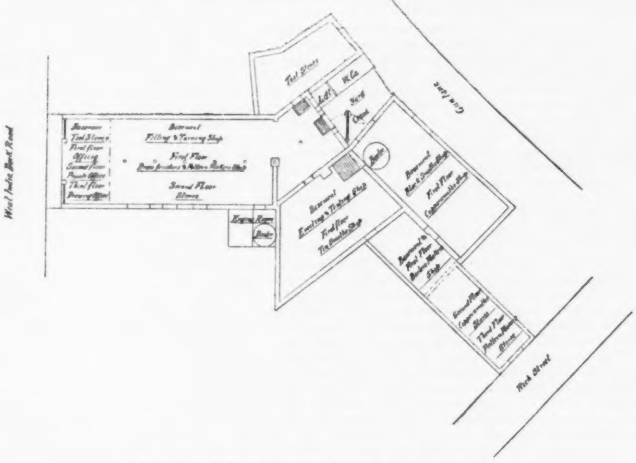
MESSRS. JOHN KIRKALDY, LONDON, ENGINEERS



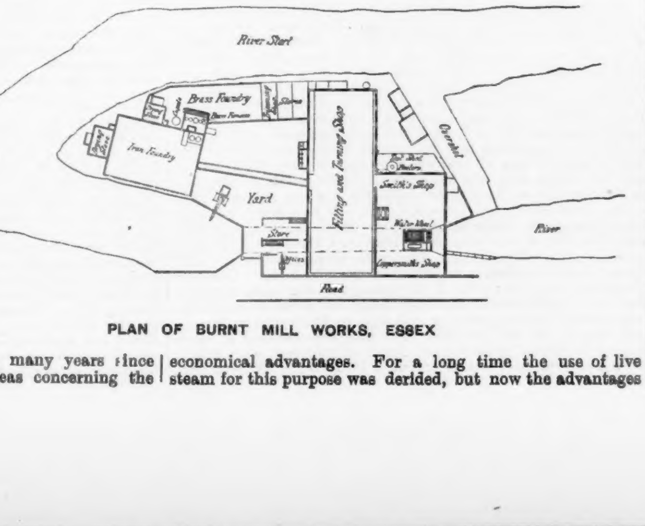
## KIRKALDY'S EVAPORATORS AND THEIR MANUFACTURE.

We have recently had an opportunity of inspecting a complete evaporating and distilling plant, such as is being fitted in vessels of the torpedo destroyer class, and which is entitled to some notice on the score of efficiency, light weight, and general compactness — a combination especially valuable in these small engine-rooms.

Our illustration, Fig. 1, shows the plant as designed and manufactured by Messrs. John Kirkaldy, Limited, West India Dock-road. About this plant the following figures are of interest:—The total weight of the plant, with water at requisite height, is only 1841 lb., disposed as follows:—Evaporator, 1180 lb.; pump, 206 lb.; distiller, 120 lb.; water, 330 lb.; the necessary spare gear would add 134 lb., bringing up the entire total to 1975 lb. The height is 5ft. 11in.; greatest width, 4ft. 4in.; and depth, 2ft. 9in. When it is borne in mind that the "feed-make-up" produced is 10 tons per diem, and that produced for drinking purposes another two tons, the weight of this machine for these outputs seems strikingly low, and shows how much Mr. Kirkaldy has achieved by constant and careful improvements. He has, it need hardly be said, met with the too frequent fate of those who strike out into new paths, and has been followed by a large number who, unable to initiate, are able to derive advantage from initiation by others, and in following, to attract much of the attention that would otherwise be accorded to the leader. Imitation is a form of flattery which may not be unaccompanied by pleasure experienced by the flattered, but Messrs. Kirkaldy complain that this pleasure is not worth what it costs. It is not many years since Mr. Kirkaldy put into practice his ideas concerning the importance of heating feed-water by methods which kept the water free from oil and other impurities, whether the heat for the purpose were obtained by exhaust or by live steam, and he proved that the latter might often be used with advantages which, under some circumstances, became economical advantages. For a long time the use of live steam for this purpose was derided, but now the advantages are generally acknowledged, and Mr. Kirkaldy's methods and apparatus widely employed.



PLAN OF WEST INDIA DOCK ROAD WORKS



PLAN OF BURNT MILL WORKS, ESSEX

The successful working of some feed-heaters and make-up feed evaporators has only been achieved by minute attention and special devices, which long experience and new inventions have made possible, and there are probably no manufacturers who have done so much in initiating and developing these now indispensable adjuncts to the high-pressure marine engine as the one to whose works we now refer. It is not only for the supply of water for potable purposes on board ship that evaporator or distiller plant is used, but for the much larger supply for boilers, which could not now be worked without this means of supply. Previous to the manufacture of the compact apparatus made by Mr. Kirkaldy, the space required for plant for so large a supply would have prohibited its use. The employment of these feed-heaters supplied with live steam, and placed between the feed pump and the boiler, has afforded most important aid to economical marine engine working. Live and exhaust steam feed-heaters and various forms of condensers are made on the Kirkaldy system for electric light stations, and for many places where the possible life of boilers is now, in consequence, much greater than would have been possible with high pressures without such aids.

The importance of the services frequently called for from the firm by the transport department of the Admiralty, in execution of large installations of distilling plant, may be gathered from the leading part it took in such work during the Zulu War and during the Soudan Expedition; the two Cape, Ashantee, and Italian Massowah Expeditions, when Messrs. Kirkaldy sent out distilling plants to produce upwards of 250,000 gallons per day. The plant carried by the Calabria, in fact, at Suakim, was the largest installation of condensing machinery ever put into one ship. Some of our readers may perhaps not remember that the Admiralty chartered the Calabria from the Telegraph Construction and Maintenance Company for trooping purposes during the Soudan Expedition, and gave Messrs. Kirkaldy the order for the distillers with filters, each being capable of producing 6000 gallons of cold water every twenty-four hours, or a total of 64,000 gallons a-day, two of the ship's main boilers supplying the necessary steam; or in other words, acting as evaporators. A donkey boiler drove the circulating pumps, two being in constant use, each throwing 16,000 gallons per hour. This plant was fully described and illustrated in our issue of October 30th, 1885. H.M.S. Wye, during the Ashantee Expedition, and the hired troopships Thames and Sprite, also carried similar plants in 1874.

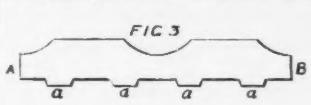
The present business of John Kirkaldy was founded by Mr. John Kirkaldy, grandfather of the present owner, in the year 1809, the firm being converted into a limited company in 1887. The establishment in the West India Dock-road—of which we give a plan, Fig. 2—comprises pattern shops, brass finishers', smiths', and boilermakers' shops, and a well-equipped machine shop which is capable of dealing with much heavier work than purely the firm's specialities. Marine repairs form an important branch of the work with which this plant has been designed to deal. There is a heavy lathe with a 7ft. face-plate, taking 40ft. between centres, by Whitworth, which has in its day turned a shaft weighing 7 tons. This is the largest lathe here, there being many others also by Whitworth, about which there is nothing especially noteworthy. Power for the machine shop is supplied by a 20-horse power engine, made by the firm, of compound tandem type, getting steam from one of John Fraser's vertical boilers. There is another smaller engine which drives the blowing fan for the smiths' fires when the larger engine is not running—during the night, for instance, when the smiths are working late.

All round us we see evidences of a considerable press of work—parts of feed-water filters, distillers, feed pumps, air pumps, circulating pumps, surface condenser combinations, &c., lying about in profusion—more or less disembodied—waiting for the erector. Galvanised shells are being banged and thumped, and if capability of giving a maximum amount of noise for a minimum weight of blow was considered a desirable feature, they should be of excellent material.

The testing department is well equipped with the necessary pumps, tanks, &c., the utmost care apparently being taken to secure accurate results not only in testing the finished article, but in the constant experimenting with new arrangements and devices.

Off the testing department is a boiler shop, where the most noticeable of the heavy tools is a combination of punching and shearing machine, and an engine to drive it, by Craig and Donald. Here the shells for the evaporators are being bent and riveted. In connection with this part of the work, the method of forging in the adjoining smiths' shop the square box which carries the tube plate is interesting, inasmuch as it is, flanges and all, in one piece. The plate which is worked up is first cut as shown in Fig. 3, the excrescences, *a a a a*, being left to supply material in turning the corners of the flange — namely, *a a a* in Fig. 4 — the two ends, A and B, being united at the dotted seam in Fig. 4. In the smithy there are sixteen forges, and a steam hammer by Thwaites and Carbutt. A Waygood lift is kept continually at work communicating with the three stories. One of Llewellyn's patent timekeepers does all the necessary checking of the men's attendance, the number employed being in all about 185, including those at Burnt Mill.

FIG 3



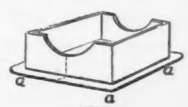


FIG 4

The West India Dock-road premises grew and grew till in 1886 there was no further room for growth, and the firm had to extend elsewhere. This they found at Burnt Mill, Essex, twenty-five miles from London, on the Great Eastern Railway Company's main line, and Fig. 5 is a plan of their premises at that place. Here are large brass and iron foundries, machine, erecting, smiths', and coppersmiths' shops, all fitted with plant and tools of improved types. There is besides great convenience in being alongside the river Stort, so that the establishment enjoys the advantage of both rail and water carriage. Power is derived for driving all the machinery from an undershot water-wheel. The fitting shop has a 40ft. span, traversed by an overhead travelling crane by Smith, of Rodley, near Leeds, to lift eight tons, the same firm having supplied another for the foundry to lift ten tons on a similar span. The majority of the lathes here are by Smith and Coventry, except the largest, which carries a 10ft. face-plate and takes 40ft. between centres, and was made by Smith, Beacock, and Tannett. It is a little amusing to see an old ship's bilge pump doing excellent service in driving the shafting when the river is too low, steam being supplied by a vertical boiler by Clarke, Chapman, and Co.

In conclusion, our thanks are due both to Mr. Kirkaldy and his manager, Mr. Seabury, who kindly gave us much of their valuable time.

## MANCHESTER ASSOCIATION OF ENGINEERS.

The present session of the Manchester Association of Engineers was opened on Saturday by an inspection of the Manchester Corporation Electric Works and the hydraulic power station, after which a social gathering of the members was held at the Grand Hotel, and during the evening there was an interesting display of various exhibits appertaining to electrical engineering. The inspection of the electric and hydraulic stations occupied the afternoon, but as both these important municipal undertakings were pretty fully described during the recent visit of the Institution of Mechanical Engineers, any further detailed notice of their general arrangement and plant is not now necessary. It may, however, be added that the demands upon the electric works have increased so rapidly that further extensions are now absolutely necessary. At present there are 39,268 incandescent lamps of 8-candle power, 256 arc lamps, and ten motors connected to the mains, which are being rapidly extended in every direction. To meet the increasing demand an additional boiler, similar in all respects to those previously put down, and two additional 400 indicated horse-power engines and dynamos, identical with the existing ones, have been ordered, and they are now in course of erection; whilst a third centrifugal pump for the condensing water, to be driven by an electric motor, is also to be put down. In connection with the hydraulic power station, about ten miles of hydraulic mains have so far been put down throughout the business area of the city, and although power has only been available since the 1st February last, agreements have been already signed for the supply of power to 270 machines, comprising passenger elevators, goods hoists, cranes, presses, intensifiers, &c. The power, it may be added, is maintained continuously day and night, including Sundays, and is charged for according to quantity consumed, as measured by meters.

After the inspection of the above works, over which the members, numbering about 150, were shown by Mr. F. M. Evanson, engineer of the hydraulic station, and Mr. C. H. Wordingham, engineer of the electric works, a visit was made to inspect the various interesting electrical appliances on exhibition. Amongst these was a portable electric drill sent by Wm. T. Taylor, of Manchester, which attracted a good deal of attention. This drill, which was in operation during the evening, has been designed to meet the requirements of work too heavy or inconvenient to be brought to a fixed drill, and the gearing has been designed to give great power in a small compass, combined with a very small loss through friction. The total weight of the drill is a little over 200 lb., but to facilitate its being placed in position it is so designed that by loosening two bolts it can be quickly divided into three pieces and readily put together again when placed in position. The pillar which carries the radial arm is screwed, and has nuts upon it by which it is easy to raise or lower the arm, and by means of which the arm can be swung round to any position without risk of dropping. The feed is either automatic or by hand, and the change can be made instantaneously. The electric power required to drill a 1in. hole at the rate of 1in. deep in three minutes is stated to be 9 ampères at 55 volts, and the machine can drill from ¼in. to 1½in. The whole machine is very simply arranged, and although the speed of work is perhaps not to be compared with what is accomplished by a heavy machine, it is satisfactory for a portable tool of such light weight, whilst an advantage of this drill is, that by putting full power on the motor it adjusts itself to the right speed for any size of drill from ¼in. to 1½in., so that time is not lost by the workmen running too slowly. The evening was brought to a close by votes of thanks to the Corporation officials and others who had contributed so much towards the interesting character of the opening proceedings.

## AUSTRALIAN ENGINEERING NOTES.

(*From our own Correspondent.*)

The Melbourne Tramway and Omnibus Company's report shows that a profit had been made for the year of £19,723, which together with the balance brought forward from last year, enabled a dividend of 5 per cent. to be paid, and a balance of £18,057 to be carried forward. The revenue has still declined, but the savings effected have nearly equalled the falling-off in the receipts. The employés have again suffered a reduction of 5 per cent. in their wages.

The profit and loss account for the year ending June 30th is not without interest to tramway engineers here. The expenditure is as follows:—Expenses of tramway trust, £476 2s.; feed, £4777 17s. 4d.; gas, municipal rates, licenses, insurance, &c., £7308 3s. 4d.; law charges and costs, £2013 16s. 5d.; salaries of staff and directors' and auditors' fees, £14,100 15s. 10d.; rating of tramway lines, £1094 1s.; repairs and maintenance of cars, buildings, and lines, £43,700 18s. 4d.; fuel, £13,268 18s. 5d.; wire ropes, £16,521 14s. 5d.; stationery and office expenses, £2313 2s.; wages, £109,871 9s.; depreciation of leaseholds, £1295 19s. 6d.; tramway debenture interest, £76,050; tramway debenture sinking fund, £25 950; tramway renewal reserves, £26,207 13s. 9d.; balance, £42,056 17s. 8d.; total, £387,007 9s. The income was:—Balance forward from last year, £22,333 18s. 5d.; advertisements, £617 10s.; interest, £3306 3s. 1d.; manure, £102 12s. 3d.; rent, £1054 8s. 10d.; transfer fees, £45 16s. 6d.; traffic receipts, £359,546 19s. 11d.; total, £387,007 9s.

A more settled prospect for the revival of trade in New South Wales is looked for since the return of the free-traders in the new Parliament, which, with the increased exports of wool to America, now that the wool is placed on the free list, is a sure indication of immediate prosperity. The phenomenal finds of gold in West Australia still continue throughout the various fields, and are causing increased activity in that colony. The Government is about to float a loan to provide for the construction of railways to three of the new gold fields.

The annual report of the Queensland railways is just published. The result of the working for the year ending 30th June last shows that the depression has affected those railways considerably. The gross revenue shows a decrease of £66,930 on the previous year; one of the principal causes of the decreased revenue is accounted for by the heavy losses in live stock consequent upon the protracted drought.

After an almost complete cessation of railway construction for the last few years in these colonies, a revival may now be looked forward to. In Victoria a committee was appointed by Parliament some time ago to investigate on the advisability of constructing narrow gauge light lines in agricultural districts, and from the evidence tendered, the committee appear to be strongly impressed with the practicability of the 2ft. 6in. gauge, and recommend the laying down of an experimental line. Conferences held between the Premier and the Chief Commissioner for Railways in New South Wales point to an early construction of light lines of standard gauge in the country districts.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*American locomotives for Brazil.*—The Brooks Locomotive Works are building for the Central Railway of Brazil thirty locomotives, of which fifteen are immense freight engines of the "mastodon" or "twelve-wheel" type, having eight driving wheels and a four-wheel leading truck or "bogie." They have Belpaire fire-boxes, eight-wheel American tenders, large cabs and a roof over the tender footplate for use in the wet season. These engines have already been shipped. They have cylinders 21in. by 26in.; driving wheels, 54in. diameter; boiler, 68in. diameter; boiler pressure, 180 lb.; fire-box, 114in. by 39in. The total weight of engine and tender is 251,100 lb., or about 112 tons; with 138,600 lb. on the driving wheels, 30,000 lb. on the "bogie," and 82,500 lb. for the tender. Air brakes are fitted to the driving wheels.

*Brush mattress work for shore protection.*—On the Upper Mississippi River considerable work is being done to protect the shores by means of dams or groins of brush work filled with stone, and by means of brush mattresses. The Government specifications provide that the dams shall consist of brush made into fascines and loaded with rock. The fascines may be laid one at a time or in mats, except in places where the water is over 2ft. deep, when they must be made into mats. Where only one layer of brush is laid, the covering of rock is 1ft. thick at the tips and butts, and 2ft. at the middle of the dams, if required. When more than one layer of brush is used, the bottom layer is covered with rock 6in. thick at the upper side, and 18in. at the lower side, if required. On this rock a second layer of brush is laid, 10ft. or 15ft. farther up stream than the lower layer, and this second layer is fastened and covered as the lower. Additional layers are similarly placed and covered, except that they each are placed and laid 2ft. farther up stream than the one immediately below it, and the top layer is covered with rock, as where a single layer of brush is used. In places the fascines and mats are fastened by stakes driven through them into the ground. When the mats or fascines are laid upon a dry bar, a trench 12in. to 18in. deep is excavated for them. The shore protections consist of a layer of fascines made into mats, sunk at the foot of the slope of the bank, extending out into the river and up the slope as far as may be necessary, with a covering of rock from 9in. to 2ft. thick, evenly and compactly laid. The upper portion of the slope is usually covered with rock alone. The bank to be protected is trimmed to a regular slope of one to two, and all trees, stumps, snags, &c., removed, before the protection is laid. The fascines are made of live brush, well trimmed and closely choked, 20ft. long, and from 12in. to 15in. diameter, and tied with bands of tarred rope or wire not more than 3ft. apart. When made into mats they are closely packed, and secured by at least three pairs of binding poles, joined by ties of tarred rope or wire not more than 2ft. apart. The mattresses or mats are from 12in. to 15in. thick, and not less than 12ft. long. The rock is of a kind that will not disintegrate on exposure to the action of the water and atmosphere; its minimum size for top covering and shore protections being 6in. cubed, or an equivalent thereto, and not larger than 10in. cubed, or its equivalent. A sufficient amount of small rock or gravel is used to fill all interstices and form a compact mass.

*Water power canal.*—Contracts are soon to be placed for the construction of a water power canal about 40,000ft. long, commencing on the upper Niagara river some miles above the falls, and discharging into the lower Niagara river near its Lake Ontario mouth. The canal will have a sudden drop at the end of the bluffs forming the high ground through which the river cuts its way, and on the low ground between the bluffs and the lake shore will be established a manufacturing city for utilising the water power. The canal will be 40ft. wide on the bottom, a water depth of 18ft. in earth, and 25ft. in rock, and side slopes of 1 to 1 in earth, and 1 to 10 in rock. The contracts will be let in eight sections, and the amount of excavation will comprise 4,304,000 cubic yards of rock, and 1,318,000 cubic yards of earth, or 5,622,000 cubic yards in all. Whenever the length of haul of the excavated material exceeds 1000ft., the contractor will be compensated for the overhaul. The contractor on each section is required to excavate and remove an average of not less than 2000 cubic yards per working day. The bottom and sides are to be brought carefully and uniformly to the required lines and grades, no depressions more than 1ft. deep being allowed, and all exceeding that to be filled up by the contractor. As to classification of material, the specifications say that solid rock shall include all rock in ledges, and also detached masses of more than two cubic feet, which in the opinion of the engineer cannot be removed without blasting. Earth comprises all material, of whatever nature, that does not clearly come under the classification of solid rock.

*Pumping engines.*—The Chicago water supply plant is to have five new pumping engines with an aggregate capacity of 88,000,000 gallons per twenty-four hours, partly to replace older engines and partly to afford increased supply. In the Chicago Avenue pumping station will be two vertical compound engines of 15,000,000 gallons daily capacity each; 1,150,000 foot-pounds duty per pound of anthracite coal; 120 lb. boiler pressure; 185ft. per minute maximum piston speed. The Fourteenth-street station will have a vertical triple-expansion engine of 30,000,000 gallons daily capacity; 1,300,000 foot-pounds duty; 120 lb. pressure; and 200ft. per minute piston speed. The Sixty-eighth-street station will have a horizontal four-cylinder engine of 14,000,000 gallons capacity; 1,100,000 foot-pounds duty; 80 lb. pressure, and 130ft. piston speed. A similar engine to this last will be placed in the Lake View station. The maximum stroke of piston for all the engines is 5ft. The boilers are to be of the return tubular type. All the engines are to be capable of running at a piston speed 10 per cent. above the specified maximum without injury. Cast iron is to be of such a quality that test bars 1in. square and 4ft. 6in. between supports will stand a central load of 500 lb., and show a tensile strain of 24,000 lb. per square inch. Cast steel is to have an ultimate strength of at least 57,000 lb.; elastic limit, 30,000 lb.; elongation, 25 per cent. in eight inches; reduction in area at point of fracture, 25 per cent. Wrought iron to have 50,000 lb. tensile strength; 30,000 lb. elastic limit; 20 per cent. elongation in eight inches, and to bend 180 deg. on a curve whose diameter is equal to the thickness of the test piece. Steel forging to have 0·22 to 0·32 per cent. carbon; 0·035 to 0·05 phosphorus, and 0·03 sulphur. Steel plates, 55,000 lb. to 62,000 lb. tensile strength, and not more than 0·03 sulphur or 0·04 phosphorus.

*Steel statistics.*—The following details are taken from the report for 1893 of the American Iron and Steel Association. Production of Bessemer steel ingots, 3,215,686 tons; Bessemer steel rails, 1,129,400 tons; open-hearth steel, 737,890 tons; total steel production, 4,019,995 tons. The production of all kinds of steel rails in this country, including Bessemer and open-hearth steel and iron rails, was 1,136,458 gross tons, a decline of 415,386 tons from the total product of 1892, and the smallest output since 1885. This is partly accounted for by the fact that only 2828 miles of new railways were constructed in 1893, against 4648 miles in 1892. The new railway mileage of 1893 was the smallest since 1878; but in the first half of 1894 only 525 miles have been built. At the close of 1893 there were forty-three completed standard Bessemer steel works, with ninety-five converters, and one new plant with two converters was in course of erection in Ohio. No Clapp-Griffiths steel plants have been built since 1889, and the total number of present works of this type is four, with seven converters. Only three were in operation in 1893. Of the four Roberts-Bessemer plants in the country, with six converters, only one was in operation last year. Bessemer steel, including the products of the above plants, was made in thirteen States in 1893, though Pennsylvania, Illinois, and Ohio lead in this industry. The production returns of open-hearth steel in the United States include steel made in the open-hearth by the basic process, and the output of 1893 was 737,890 gross tons, against 513,232 tons in 1890, the increase of output being continuous for the intervening years. In the year considered 63,613 tons of crucible steel were made, as compared with 84,709 tons in 1892. The report gives the figures for all kinds of iron and steel rails rolled in the United States for each year since 1848. It commences with 21,712 tons in 1849, rises to 183,070 tons in 1860, 553,571 tons in 1870, 1,305,212 tons in 1880, and 1,885,307 tons in 1890. The maximum output recorded is 2,139,640 tons in 1887. The exports of domestic iron and steel manufactures from the United States to all foreign manufacturers were valued at 30,159,150 dols. in 1893, against 27,900,862 dols. in 1892. In these exports cut nails and spikes form the chief item, the valuation being 10,512,576 dols. in 1893 and 10,348,675 in 1892. Agricultural implements come next, with 5,191,223 dols., and then come sewing machines with 2,456,487 dols., both of the latter for 1893. The wire nail industry has made wonderful strides in the United States since the output of 600,000 kegs, of 100 lb. each, in 1886. In 1889 the production had risen to 2,435,000 kegs, and in 1893 it was 5,041,945 kegs, the highest on record. The total of cut nails, which was 6,493,591 kegs in 1888, had fallen to 3,048,933 kegs in 1893.

*Railway statistics.*—I give this week some figures from the report of the New York Central Railroad for the year ending June 30th 1894:—

| | |
|---|---|
| Mileage | 5214 |
| Passenger earnings, dollars | 14,151,279 |
| Freight earnings, dollars | 24 104,509 |
| Gross earnings, dollars | 43,678.200 |
| Operating expenses, dollars | 29,508,406 |
| Net earnings, dollars | 14 169,794 |
| Percentage of operating expenses to gross earnings | 67·57 per cent. |
| Passenger train mileage | 14,374,625 |
| Freight train mileage | 14,118,939 |
| Total train mileage | 40,280 825 |
| Total passengers | 23,602,243 |
| Passengers carried one mile | 742,542,163 |
| Total freight tonnage | 18,728 592 |
| Tons hauled one mile | 3,275,998,571 |
| Earnings per passenger per mile, cents | 1·90 |
| Expenses per passenger per mile, cents | 1·46 |
| Profit per passenger per mile, cents | 0·44 |
| Average passengers per train mile | 52 |
| Average miles each passenger | 31 |
| Freight earnings per ton per mile, cents | 0·74 |
| Freight expenses per ton per mile cents | 0·57 |
| Freight profit per ton per mile, cents | 0·17 |
| Freight earnings per train mile, cents | 1·83 |
| Freight expenses per train mile, cents | 1·42 |
| Freight profit per train mile, cents | 0·41 |
| Average number of tons per train mile | 249 |
| Average miles each ton was hauled | 175 |
| Number of locomotives | 1211 |
| Number of cars in passenger service | 1488 |
| Number of cars in freight service | 39,302 |
| Capital stock, dollars | 94 273,400 |
| Cost of road and equipment, dollars | 157,468,008 |
| Number of employés | 27,088 |
| Amount of pay rolls, dollars | 16,439,064 |

*Government supervision of railway accounts.*—In view of the extensive fraudulent transactions in railway accounting and the enormous "steals" that have been perpetrated, resulting in great loss to the smaller investors, an agitation is being made in favour of having railway companies' accounts supervised and audited by Government officials in the same way that banking companies' accounts are inspected and supervised. This work would be a part of the duties of the Inter-State Commerce Commissioner. The proposition which seems to find special favour with those who advocate absolute Government control is the appointment of examiners similar to national bank examiners, with authority to visit railway offices at any time and overhaul every item of their accounts and securities. That the United States have full authority to impose such conditions as they choose upon railways engaged in Inter-State commerce is argued from the fact that the right to engage in such commerce is a specific grant by Congress. The friends of such legislation claim that it would do more to prevent violation of the Inter-State Commerce Act than all other provisions of the Act combined. It would put an end to the necessity of hunting evidence through aggrieved shippers, discharged employés, and detectives. The Inter-State Commerce Commission would be in absolute possession at any time it wished of the exact state of the accounts of every great railway corporation. Secret rebates, false bookkeeping, and the hypothecation of securities for private use, would be instantly disclosed by the discrepancy between the books and the cash. The method of accounting would be uniform for all roads, and the returns for one could be intelligently compared with those for another by the investing public. The Inter-State Commerce Commission already requires uniform annual reports from the railways, and issues a pamphlet giving instructions how these accounts shall be prepared, but they have no check upon false entries, and no power to prevent the keeping of private records of rebates, and the publication of reports essentially different from the ones submitted to them for influence upon the stock market. It is reported that a movement to regulate railway accounting is under way in New York, independent of the action of Congress or the Inter-State Commerce Commission. A body of eminent financiers with competent experts would be formed, under this plan, into a board of railway auditors, and it is believed that railways honestly conducted would gladly submit their accounts, and throw open their books to the examination of such a board. The certificate of proper bookkeeping and of an actual surplus, instead of a fictitious one, would be of great value to the roads submitting their accounts to such examination, and the refusal of a road to invite this form of guarantee would in itself be a cause of suspicion. Whether this method would be successful is doubted by some of the advocates of Federal regulation, but it is thought that it may be tried, if action by Congress cannot be obtained. Such action at the coming session is considered doubtful.

Maxim's Flying Machine.—An exhibition of the flying machine to the general public, the first of its kind, will be given by Mr. Maxim, in aid of the funds of the Bexley College Hospital at Bexley, on Saturday afternoon, November 3rd. The machine will be run along the track at a high velocity; but to suit all states of weather, only the main aëroplane will be in position. The large workshop will be open to visitors, and scientific instruments used by Mr. Maxim in his experiments will be on view. During the afternoon there will also be a practical display by Mr. Maxim of his automatic machine guns. The only entrance to the Park on this occasion will be at the Lodge, on Dartford Heath. Gates open at 2 p.m; proceedings commence at 2.45.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet engineer—Richard G. Callaway, to Philomel. Staff engineers—W. F. Abbott, to the St. George; George Aborn, to the Cambrian; W. A. Howlett, to the Grafton; John W. Henwood, to the Narcissus; and Charles Underhill, to the Emerald. Chief engineer—Charles A. Harding, to the Pembroke, reappointed on promotion. Engineers—Frank D. Thomsett, to the Charger; Walter K. Williams, to the Ardent; A. C. Darley, to the Grafton; Frank Main and George Attwool, to the St. George; Frederick H. Dart, to the Defiance; Henry Abbott, to the Cambrian; Arthur C. Darley, to the Grafton; George L. R. Perkins, to the Pembroke, supernumerary; Frederick G. Dawson, to the Philomel; Frederick C. Davis, to the Warspite; and Harry Basson, to the Thrush. Assistant-engineer—Thomas J. Dawson, to the Thunderer. Probationary assistant-engineers—Arthur Brown and Wellesley J. Steil, to the St. George; Herbert G. Ash and Henry T. Canning, to the Cambrian; and Thomas Pearce, temporary service, to the Philomel.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

BUSINESS in the district iron trade has a healthy tone, and the orders which have been distributed at and since the quaterly meetings have stimulated operations to a considerable extent. Producers of the best finished iron report themselves as having transacted a larger business of late than has been the case for some time. Among the new orders recently to hand is one mentioned for chain cables required by the Admiralty, which is estimated as worth over £20,000. Marked bars are on sale at £7 10s., with the usual 12s. 6d. extra for the L.W.R.O. brand; merchant bars £6 to £6 10s., and third class quality bars £5 10s. to £5 12s. 6d., though in some instances less is accepted. It is stated that the sum paid for the trade marks used in connection with manufactured iron produced by the late New British Iron Co. was £2000. Common iron hoops are this week quoted £6 5s. to £6 10s., and gas tube strip £5 10s. easy. A tolerably good request is forthcoming for galvanised sheets for Australia, South America, and the Cape, but local makers complain much of underselling by some firms. It is hoped, however, that this competition will be avoided by the operation of the National Galvanised Sheet Iron Association, which it is proposed to form. The association is, if established, to include all the makers in Staffordshire, and the Midlands, the West of England, Lancashire, Cleveland, and Scotland, and penalties are to be attached to any departure from the Association price. The general quotation of corrugated sheets, doubles, this week is £9 15s. per ton f.o.b., Liverpool in bundles. Plain doubles are £6 12s. 6d. to £6 15s.; trebles, £7 5s. to £7 7s. 6d. Pig iron sellers express themselves satisfied with the business lately done. Imported brands from Derbyshire, Lincolnshire, Northamptonshire and elsewhere, are in prominent request. Staffordshire part mines are 41s. 6d. to 42s., and cinder 38s. to 40s.

Prosperity, it is gratifying to note, is attending the operations of the St. George's Engineering Co. The directors, in submitting a statement of accounts for a period of eleven months, state that the business continues satisfactory. The amount available for distribution is £3285 3s. 9d. This they propose to appropriate as follows:—In payment of a dividend of 7½ per cent. per annum, £1749 19s. 9d.; in reduction of goodwill, &c., £1000; to carry forward, £535 4s.

Matters in the wrought nail trade of Warwickshire, Staffordshire, and Worcestershire, have of late been somewhat strained, but an arrangement was come to lately to pay on all classes of nails the 1892 list of prices less 10 per cent., wherefore amicable relations have now been re-established.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The position generally throughout the engineering and iron trades of this district continues without any really material change. It is still only in exceptional cases where engineering firms report any increasing activity, whilst in other cases the outlook is regarded as, if anything, even more unsatisfactory than it has been; and taking the condition of trade all through, it is only very indifferent, with any prospect of improvement apparently quite as remote as ever. In the iron and steel markets business still drags on in a hand-to-mouth sort of fashion, with a gradual weakening tendency in prices, which seem to be surely but slowly getting back to something like the old low figures. The position in the coal trade also is anything but satisfactory, as apart from housefire qualities, which are necessarily meeting with an increasing demand as the winter comes on, general requirements continue considerably below the supplies coming upon the market.

The Manchester Iron Exchange on Tuesday was fairly well attended, but complaints were general as to the absence of business of any weight coming forward. Here and there moderate inquiries for pig iron were reported, but in most cases the offers of buyers were below what makers seemed inclined to entertain, and where business is done prices as a rule have to give way to some extent upon recent quotations. For Lancashire pig iron makers still quote on the basis of about 39s. 6d. to 40s. for forge and 42s. for foundry, less 2½, at the works, but they are practically out of the market so far as open competition is concerned, the limited business doing at these figures being confined chiefly to small sales to regular customers. For district brands prices are rather easier, although some of the makers are altogether indifferent about booking further orders. In Lincolnshire forge sales have been made at about 38s. 6d. to 38s. 9d. net cash delivered Manchester, but for foundry qualities quotations remain firm at about 40s. 6d. net cash delivered. In Derbyshire foundry prices are rather irregular, ranging, according to brand, from 44s. 6d. to 45s. up to 46s. net cash delivered Manchester. With regard to outside brands offering here, Middlesbrough remains firm at about 44s. 4d., net cash, for good foundry qualities delivered equal to Manchester, with makers still asking 6d. above this figure for special-named brands. Scotch iron is necessarily easing down with the resumption of output in Scotland, and representatives of makers who are again offering in this market are finding that during the stoppage of production—through the strike—merchants here have been booking what business there was to be got, for delivery when the furnaces re-started, at considerably under the prices that were then being quoted in the market. For delivery at the Lancashire ports Eglinton is now being quoted at about 48s. net prompt cash, but in some cases might be bought a little under this figure.

In the finished iron trade there is still no move whatever towards any improvement, business coming forward only in very limited quantities, and forges not working on an average more than four to five days per week. Makers hold on to late quotations, but these are becoming difficult to maintain upon new business. Delivered equal to Manchester or Liverpool, Lancashire and Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.: and Lancashire hoops, £5 17s. 6d. for random, to £6 2s. 6d. for special cut lengths.

The steel trade all through continues extremely quiet, with hematites practically back at their old figure, ordinary foundry qualities not averaging more than 52s. 6d., less 2½, with ordinary billets remaining at about £4 net cash delivered Manchester. With regard to manufactured steel ordinary bars may be quoted at £6 to £6 2s. 6d., and boiler-plates about £6 5s. to £6 7s. 6d., although £6 2s. 6d. would seem to represent more nearly the figure which would have to be taken where buyers have business to put through.

In the métal market list rates for manufactured goods remain unchanged, with buyers still holding back from placing orders of any weight, in the expectation of some early giving way upon present rates.

Some time back I noticed the exceptionally successful results which have been obtained with a special system of pumping, introduced by Mr. Thomas Matthews, of Gorton, near Manchester, and this week I had an opportunity of inspecting one of his patent pumps that had been put down at the brewery of Messrs. Gartsides, Ashton-under-Lyne. In this case there had been for some years a bore-hole about 300ft. deep, and in it a pump driven by strong wheels, cranks, and levers, the full capacity of which, under any circumstances, was about 3000 gallons per hour. This supply having been found altogether inadequate for the requirements of the brewery, Mr. Matthews undertook to double the quantity without altering the bore in any way, and, after taking out the old pump, applied his patent system, putting down a very compact engine, working at thirty-six strokes per minute, and occupying scarcely one-fourth the space of the old engine, whilst with the new engine 7000 gallons per hour have been obtained, and lifted to a height of over 200ft. from the bucket. The manager of the brewery informed me that with the new engine and pumps they only required to pump six hours per day, instead of twenty-four hours with the old pumps, and that, with one-quarter of the time thus spent in pumping, they were obtaining a much more adequate supply of water. One of the special features of Mr. Matthews' system is the position in which the pump is put down in the bore-hole, whilst the engine, which is of the vertical type, is exceptionally compact in its arrangement, all the parts easily accessible, whilst, whatever the load, the pumps work without jar or noise.

I was present on Wednesday at a series of important tests carried out at an experimental station which has been put down at the Moss Colliery, near Wigan, for the purpose of testing explosives used in coal mining operations, with regard to their safety under the conditions of a blown-out shot coming in contact with coal dust or an explosive mixture of gas and air in a coal mine, and also as to their relative strength as explosives tested by the distance to which a projectile could be fired from a mortar. The experiments were witnessed by a number of Government mine inspectors, mining engineers, and by official representatives of the Miners' Federation of Great Britain. The various explosives which were put under test were dynamite, roburite, westphalite, bellite, tonite, ammonite, Ardeer powder, and carbonite, and the tests were carried out under the supervision of a committee consisting of Messrs. Joseph Dickinson, late Chief Inspector of Mines; D. H. F. Matthews, Inspector of Mines; J. Ishewood, J.P., miners' agent; and J. S. Burrows, of Messrs. Fletcher, Burrows, and Co., Manchester. After the experiments of firing cartridges of the various explosives into coal dust, the committee reported that the firing of the dynamite, roburite, bellite, tonite, and ammonite cartridges had resulted in complete ignition of the coal dust, large flame, and explosion; westphalite resulted in no ignition, no flame, and no explosion; and Ardeer powder and carbonite in no flame and no explosion. These were followed by experiments, with the object of testing the effect of the most successful explosives when fired in the form of a blown-out shot coming in contact with an explosive mixture of air and gas, and the following results were recorded by the committee:—Carbonite, Ardeer powder, and westphalite, no flame and no explosion; roburite, explosion and flame, apparently of gas only. The results of the tests as to the relative strengths of the various explosives were pretty nearly equal as regards dynamite, roburite, westphalite, ammonite, and bellite; tonite showing considerably less explosive power than the above, whilst Ardeer powder and carbonite, which in the first experiments caused no flame or explosion when fired into the coal dust, had only a very low explosive force, scarcely more than one-third that of dynamite, westphalite, and roburite, and to this low explosive power was due their immunity from flame or explosion in contact with coal dust, which no doubt would have been secured by the other explosives that "fired" if they had been brought down similarly low in power. The general opinion expressed after the conclusion of the experiments was that westphalite—which has already been largely adopted on the Continent, and in the mines of Saxony, which are very dangerous to work, is the only explosive the Government allow to be used—had under the conditions of the tests proved to be decidedly the safest explosive for mining purposes; but in view of the great importance attaching to the safety of explosives used for mining purposes, it was urged not only by the miners' representatives but also by one or two of the leading mining engineers present, that in future, experimental tests of explosives which are claimed to be flameless should be carried out by independent or officially-appointed committees of inspection, so that the relative "safety" properties of the now numerous explosives that are being put forward may be tested in a manner which may give to them some sort of official guarantee.

The better qualities of round coal are meeting with a steadily increasing demand, and pits are gradually getting on to five days per week, but other descriptions of fuel for iron-making, steam and general manufacturing purposes, continue bad to sell, and with plentiful supplies in the market prices show rather a weakening tendency than otherwise. For housefire qualities prices are steady at about 11s. to 11s. 6d. for best Wigan Arley, 10s. to 10s. 6d. for Pemberton four-foot, and seconds Arley 8s. to 8s. 6d. for common housefire coal at the pit mouth. Common round coals for steam and forge purposes, however, are only in exceptional cases fetching more than about 7s. per ton, whilst engine fuel is very irregular in price, surplus supplies coming in from outside districts at excessively low figures. Common Lancashire slack does not average more than 3s. 6d. to 4s., with best qualities averaging about 5s. to 5s. 6d.; but Derbyshire slack can be bought at the pit mouth at as low as 1s. 6d. to 1s. 9d. per ton.

Here and there moderate business is still reported for shipment; but generally this branch of trade is very quiet, and some extremely low prices have been quoted, common coal being obtainable from about 8s. up to 8s. 6d. and 8s. 9d. per ton, delivered at the Garston Docks or the High Level, Liverpool.

*Barrow.*—There is still a very quiet business in hematite pig iron. Orders are not increasing either on home or foreign account, and the inquiry for forward deliveries is very quiet indeed. The value of hematite is fairly steady at 43s. 6d. net cash, warrant sellers, and 43s. 5d. buyers, while makers ask 44s. to 45s. for parcels of mixed Bessemer numbers, net f.o.b. Only 33 furnaces are in blast, compared with 34 in the corresponding week of last year. Stocks are steady. There has been a slight decrease during the past week, amounting only to 10 tons. There are now in the hematite stores in the district 158,500 tons, being an increase of 63,877 tons since the beginning of the year.

Iron ore is very quiet in tone, and sales are limited. Prices remain steady, at 8s. 6d. for ordinary, and 13s. 6d. for best qualities, net f.o.b.

The steel trade does not show much more life, although prospects are fairly good so far as tin bars, ship plates, and steel castings are concerned. A quiet business is doing in rails, and the mills have this week been busy in the manufacture of steel props and girders for mining operations—a new branch of industry, and of some promise. There is not much doing in blooms, slabs, wire rods, or billets.

In the shipbuilding and engineering trades new business is quiet, and very few inquiries are in the market. Local yards, however, are well off for orders, although they are chiefly on Admiralty account. Repair work is not at present brisk.

The wood pulp and paper works at Barrow have lately been extended and are now in full operation.

Mr. D. Caird, at his new engineering and ironfoundry works at Barrow, has commenced business in the manufacture of steel ingots, &c., and is cultivating a general trade.

The coal and coke trades are very quiet and supplies are limited, but the consumption is very small all round. Prices are a shade easier.

Traffics on local railways remain very low, although a shade better than last year, but prospects of improvement are not good.

Shipping returns show an improvement. The exports of pig iron from West Coast ports during the past week have amounted to 9435 tons, compared with 5580 tons in the corresponding week of last year, an increase of 3855 tons. The exports of steel represent 10,153 tons, compared with 2607 tons in the corresponding week of last year, being an increase of 7546 tons. The aggregate shipments of pig iron this year so far have been 293,295 tons, and of steel 326,230 tons, compared with 222,463 tons of pig iron and 2607 tons of steel in the corresponding period of last year, an increase of 70,833 tons of pig iron and 65,432 tons of steel. Freights are still low.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE weather is so variable, cold and warmth alternating every day, that the reports from various colliery districts get perplexing. In one part it is stated that the cold has caused agents to hold out for higher prices, and in another that there is no actual change in the amount of business doing, while a general languor prevails. The truth is that a fair average trade is doing, and with a continuance of the fog of the last few days, with frost at nights, house coal is certain to be busy. At the same time prices are not so strong in this class of fuel as was expected. The advance of 1s. a ton imposed in several colliery districts was not generally obtained, and where it was enforced it lasted a very short time. The quotations remain pretty much as they were in September. In collieries favourably situated the advance cannot now be put down at more than 6d. a ton. Manufacturing fuel is not likely to be increased, manufacturers complaining that prices have been too high all the summer. The export trade will soon be at an end, and what with this, the reduction of miners' wages, and the absence of any indication of increased demand, colliery proprietors will no doubt be content if present quotations can be maintained. About four and a-half to five days a week are being worked at the pits, but the accumulation of stocks is a sure indication that the demand is still considerably short of the output. The dispute between the colliery enginemen — a far graver matter than has been generally admitted—has been postponed for the present. The men have shown an agreeably peaceful disposition by deferring their notices in order that the matter may have fuller consideration. The conference has been fixed for Tuesday next, and as the difficulty has been arranged between the West Yorkshire owners and their men it is not likely that an amicable settlement will be prevented in South Yorkshire. The leaders of the Men's Federation state that they have no easy task in persuading their members to agree to the delay, the hotter spirits being clamorous for a closure of the collieries wherever their demands were not immediately granted. A considerable tonnage of coal is being sent to London, but sales are slow and agents report the impossibility of obtaining advanced prices. Silkstones are quoted at 9s. 6d. to 11s. 3d. per ton, Barnsley hards from 8s. 6d. to 10s. per ton, other sorts from 8s. per ton. Goole as well as Hull is taking fair quantities of steam coal. The trade on the whole holds up well for the season of the year. The strike in Scotland has favoured Yorkshire collieries to some extent, and the advantage has been maintained during the present month. Barnsley hards—steam—make from 7s. 9d. to 8s. 6d. per ton, second qualities from 7s. to 7s. 6d. per ton. Gas coal is at 7s. to 8s. per ton, with large deliveries on contract account. For manufacturing fuel prices remain at 4s. 6d. to 5s. 6d. per ton, good pit slack being obtainable from 3s. 6d. per ton. A better business is being done in coke, quotations remaining at previous figures.

Steel and iron quotations have not materially changed since last week. The large establishments are anything but fully occupied, and were it not for the important orders on hand for armour-plates there would be no employment for many of their regular hands. East Coast hematites are at 50s. 6d. to 51s. 6d.; West Coast brands, 52s. to 52s. 6d.; forge iron, 38s. to 38s 6d.; Lincolnshire forge iron, 38s. 6d.; Bessemer billets, £5 10s.; bar iron, £5 10s. to £5 12s. 6d.; wire rods, £5 5s.; Roep rods and high carbon rods, £8 8s. In the Rotherham district some considerable orders have been received on Government account, but generally the ironworks are not running full time.

A little more is doing in the engineering establishments, although there is not so much reported as in the closing months of 1892. The demand from the Continent for crucible steel is maintained, the more valuable brands being most in request. Orders for railway material are provokingly scarce, but it would be unreasonable to expect railway directors to expend freely on new stock and plant until the traffic returns exhibit some hope of improvement. Very light business is doing in marine material, owing to the paralysis in the shipbuilding yards. A good line for steel ship-plates has come to one firm, but there is very little to report otherwise.

A steady improvement is reported in the cutlery trade. An increased demand for springs, scales, and blades, orders now being given by grosses instead of by dozens, in good evidence of improvement in that direction. Workmen, as a rule, are finding better employment, and in the absence of wages disputes the winter outlook is more hopeful than was the case last year. In the silver and electro-plate industry the workmen are busily employed, and for the most part have to put in overtime. Some very fine works for presentation purposes have recently been placed in our Sheffield establishments, and the tendency to prefer the sterling silver to plated goods, owing to the low price of the precious metal, is maintained. Saw manufacturers have experienced a light spurt in the country markets. India and the Cape have been fair customers, but very poor business has been done with Australia and South America. Affairs are looking up in Australia, but the Americans are cutting in that colony both in hand and circular saws, and thus attenuating the orders sent to Sheffield.

At the London ivory sales, which commenced on Tuesday, 107¾ tons were offered. Eighty tons are of new importation, having arrived since the termination of the last sales held in July, the remainder being old stocks. Considerably more than half of the East India, &c., kinds consists of large tucks, a fair proportion being of good to very fine quality soft grain, a small quantity of fine hard, and about one-third inferior or defective. Of the Egyptian, a large percentage is particularly free from serious defects, and much is exceptionally large in size, nearly two-thirds of the thirty tons being of the old-fashioned Alexandrian type. Fine qualities are chiefly absent from the West Coast African assortment. All the stock has been carefully inspected by a large number of buyers. On the opening day values varied considerably, and Liverpool advance was not sustained.

The Master Cutler, Mr. C. H. Bingham, gave his accustomed "banquet of the North" on Thursday night, with the Premier, the Earl of Rosebery, as his chief guest. The following day the Master Cutler's guests inspected the works of Messrs. Walker and Hall, silversmiths, electro-platers, and cutlers, Electro Works, Howard-street, Sheffield—of which the Master Cutler is a partner—Messrs. John Brown and Co., Atlas Steel and Iron Works, Sheffield, and Messrs. J. H. Andrew and Co., Toledo Steel and Iron Works, Sheffield. At the electro works, all the various delicate and beautiful processes associated with the production of silver plate, Britannia metal, and similar goods, were seen to great advantage in that large establishment, where upwards of 1000 men are employed. At the Toledo Steel Works, the production of steel for all the varied purposes used in the markets of the world was exhibited. Interest mainly centred in the visit to the Atlas Works. There the visitors saw the rolling of an armour plate for H.M.S. Magnificent, the finished dimensions of which were 15ft. by 6ft. 8in. by 14in., and the weight 25 tons. The process of chilling an armour-plate for the same ship was also shown, as well as the planing and slotting of armour-plates for H.M.S. Magnificent, Majestic, Powerful, and Terrible. In the armour press plates were forged for the Magnificent, one plate when forged weighing 27 tons. In the north machine shop the visitors inspected the turning and boring shaft for the Russian vessel Russia, and boring ammunition hoists for H.M.S. Powerful and Terrible. They were shown the boiler shop containing ten marine boilers, each 10ft. 6in. diameter by 10ft. 6in. long, fitted up with the "Ellis and Eaves" induced draught, capable of producing 8000 indicated horse-power without any smoke. The Master Cutler's guests also inspected the Bessemer process, the hammering, finishing and rolling of steel tires for railway engines and carriages, the Serve tube department, the bending and welding of Purves patent ribbed flues for boilers, &c.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUSINESS altogether lacks animation at present, and the improvement which has lately been experienced is disappearing, with little hope that there will be a return on this side the advent of spring, as after this month the quietest period of the year comes on. The chances are not in favour of prices going up again at any early date, and consumers therefore take their time about buying, for by purchasing as they require the material they get the advantage of any reductions that may be made. The outlook is not encouraging for those engaged in any branch of the iron and allied industries. With the close of this month the northern navigation season virtually ends, and very little iron will afterwards be sent to a good many of the ports on the Continent. Thus the consumption of pig iron will be reduced, and as in this month—which should be one of the briskest shipping periods of the year—stocks are increasing, it does not seem likely that the consumption for the rest of the year will be such as to prevent an ever-larger increase in stocks. Production has exceeded consumption in this district ever since last June, just during the very time when the latter should be the larger; and what is more significant still, just over the time when one leading district in the country practically ceased to produce. It would seem as if, to keep the stocks down, the only course open to ironmasters would be to reduce the output. Some of the quietness may be ascribed to political uncertainties abroad, in the face of which consumers do not feel inclined to buy ahead, and speculators are holding back, being rather sellers than buyers.

The market is not now held back by labour disputes, as it has been so much this year. The Scotch miners' strike is ended, and a better demand from that quarter for pig iron may be looked for, as there is abundance of fuel, and the mills and forges have recommenced operations. Locally the only strike of any importance in progress is that of the patternmakers, which has lasted since last April, and the men seem as determined as ever not to give in, a vote taken the other day showing a majority of five to one against any surrender, though it must be evident that they can have no hope of coming out of the struggle victorious. They will not follow the example of the moulders, who, after being five months on strike, agreed to have their difference with the employers settled by arbitration. The patternmakers have less chance of succeeding than the moulders had, for they are a smaller body, and their strike does not inconvenience the masters so greatly. Those who are managing the patternmakers' strike cannot be commended for their discrimination, for their own society's organ shows that trade is depressed and in many places bad. How, therefore, the men on strike in this district expect to succeed in getting an advance in wages cannot well be seen. The formation of a Conciliation Board has just been completed for the moulders of the North-East Coast. The board will consist of eleven employers and an equal number of moulders' representatives. The object of the board is to regulate general advances or reductions in the wages of moulders, but any other general question may, by common consent, be brought before the board. Sir Andrew Noble is elected chairman of the board, and Mr. T. R. Johnson, of Sunderland, vice-chairman, while Mr. James Robinson will be the employers' secretary, and Mr. Henderson will act on behalf of the men. It is arranged that a meeting shall be held next Monday to consider the request of the men for an advance of wages, and the counter-claim of the employers for a reduction. The Durham colliers have decided to claim a 15 per cent. advance of wages. They seem to pay little heed to the advice of their own Executive Council, which most strongly urged them, in face of the negotiations which are going on towards the establishment of a Conciliation Board, to vote for the postponement of any claim of the kind. The employers are not likely to grant any advance, much less an advance of the extent the men have claimed, especially when in the neighbouring county of Northumberland it has been arranged that wages are not to be altered this quarter, the realised prices not justifying any advance. The circumstances in Durham are very similar. Trade has certainly been brisk in the coal industry of the North of England during the continuance of the Scotch strike, and collieries have been kept fully employed, but the advances in price have been insignificant.

The quotation among makers generally for prompt f.o.b. deliveries of No. 3 Cleveland pig iron is 35s. 9d., but some firms can command 36s.—and even more—because they have so very little that is available for sale. Some of the middlemen have this week been selling No. 3 at 35s. 7½d.; but they could only offer small lots. Merchants are not very ready to sell at present prices, as much of the iron they have was bought when prices were higher than at present. When prices were rising there was a great rush to secure supplies, in the belief that there would be a still more substantial rise. Thus the competition of merchants is not now very keen. Cleveland warrants have not varied much in price this week, 35s. 7½d. cash being the highest, and the close on Wednesday evening was at that. The stock of Cleveland pig iron in Connal's warrant stores on Wednesday night was 88,620 tons, or 1125 tons decrease this month. The supply of No. 4 Cleveland foundry pig is very small, and 35s. 1½d. can be secured for it; but for grey forge, of which there is a plethora in the market, scarcely can 34s. be obtained. Mixed numbers of East Coast hematite pig have this week been generally sold at 42s. 9d., though 43s. is mostly quoted. The demand is slack and stocks accumulate, so that it is scarcely likely that any more furnaces will be put upon this class of iron, particularly when the shipping season is now almost at an end, and the local steel trade is so dull. It would be better to blow out than to blow in hematite furnaces. The shipments of pig iron from the Tees this month up to Wednesday night amounted to 62,260 tons against 62,480 tons last month, and 84,599 tons in October last year to 24th.

Finished iron and steel manufacturers as a rule give despondent reports about their business, and not many works are in full operation. Common iron bars are quoted at £4 17s. 6d.; best bars, £5 7s. 6d.; best best bars. £6 7s. 6d.; iron and steel ship plates, £4 17s. 6d.; iron angles, £4 12s. 6d.; and steel angles, £4 15s., all less 2½ per cent. and f.o.t. The rail makers find business very dull, and for heavy steel rails they ask £3 12s. 6d. net at works.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE is now some hope of an early improvement in the iron and coal trades, owing to the termination of the colliers' strike. Since last week the colliers in the East of Scotland—in the Lothians, Sterling, and Linlithgow and Fife—have abandoned the struggle as hopeless, and made a rush for admission to their old places in the collieries, so that the strike is now finally terminated all over the mining districts. It has been a most unfortunate one, not merely for those immediately concerned—the coalmasters and miners—but for the trade of the country generally. The stagnation of trade has been severe as well as general; but it has been succeeded by a feeling of hopefulness, which it is hoped is the prelude to a substantial improvement in business.

The Glasgow pig iron market has been quiet. There has been no occasion for any fresh speculative movement, and business has been on a moderate scale. For Scotch warrants the demand is slow, and prices are ½d. to 1d. per ton lower. A rather better inquiry has sprung up for Cleveland pig iron, the consumption of which in Scotland has, indeed, been comparatively good during the whole period of the strike. On some days there has been a slight tendency towards harder prices for Cleveland pig, but hematites have been comparatively neglected. For the latter, however, it is believed that the demand must now begin to improve, as much more of this class of iron will be required by the steel makers.

A large number of furnaces have been lighted in the course of the week, and there are now thirty-two in operation, compared with fourteen last week and forty-eight at this time last year. One or two brands of pigs that were out of the market can now again be had in moderate quantity. The stocks of makers' iron are low, but the prices have nevertheless been receding. G.M.B. f.o.b. at Glasgow, No. 1, is quoted 44s. per ton; No. 3, 42s. 6d.; Monkland, No. 1, 45s. 6d.; No. 3, 42s. 6d.; Carnbroe, No. 1, 47s.; No. 3, 45s. 6d.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie, No. 1, 53s.; No. 3, 49s.; Calder, No. 1, 53s. 6d.; No. 3, 48s. 6d.; Summerlee and Coltness, No. 1, 56s. 6d.; No. 3, 51s.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 49s. 6d.; Eglinton, No. 1, 48s. 6d.; No. 3, 46s. 6d.; Shotts at Leith, No. 1, 57s. 6d.; No. 3, 51s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 3019 tons, compared with 4333 in the corresponding period of last year. To Australia 370 were despatched, India 175, France 85, United States 30, South America 50, Italy 221, Germany 270, Holland 60, Belgium 90, Spain 45, other countries 210, the coastwise shipments being 1410, against 1595 tons in the same week of last year.

The market for malleable iron and steel now begins to exhibit a little more activity, the demand being better for home consumption as well as for export. Prices are still, however, in an uncertain state. In the course of the past week there was shipped from Glasgow locomotive engines and tenders to the value of £10,895, sewing machines £4913, other machinery £21,391, steel goods £5911, and miscellaneous iron goods £16,452.

There has been considerably more business during this week in the coal trade. Supplies are larger than they were last week, and still by reason of the extra demand, they are not much more than sufficient for the current wants. The blast furnaces and the malleable iron and steel works require large quantities, and shippers are now coming into the market. The downward course of prices has been arrested for the time, but so many miners are seeking employment that there is likely soon to be an ample supply of coals for all purposes.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE has been a slight lull in the coal trade during the last few days, followed by easier prices to the extent of 3d. per ton as compared with the figures of last week. On 'Change, Cardiff, there has been some discussion as to the cause of this and its probable duration. The likely cause, I think, is the boisterous weather of late, which has resulted in a good deal of damage to shipping and delayed the arrival of tonnage. Sidings at several of the large collieries are full, and managers are anxiously waiting to despatch some of the abundance—a question only of a few days.

One result of the "lull" is to retard the completion of contracts, as buyers will naturally think better terms can be obtained. I do not think that the figures quoted lately are likely to be altered. Any day an influx of shipping will send up prices or harden them. 11s. is the contract figure.

The P. and O. contract, to which I referred lately, and which should have been settled a fortnight ago, is still, I hear, hanging fire. From the present to the close of next month will be a period of anxiety to many coalowners. Once the usual large contracts are signed and sealed, a clear notion will be given of future trade.

I was in the old house coal district of Gellygaer this week, where a new company has been lately floated, and was impressed with the duration of this part of the coalfield. There are old workings there dating beyond the memory of man—one especially, in the district of Llanvabon. Thomas Powell, of the Gaer, the founder of Powell Duffryn, had his early successes at Gellygaer. Old and exhausted workings are to be seen, of course, but there is abundance of coal yet, and it is anticipated a big future awaits the district. The railway conveniences are very good.

I referred last week to the steady improvement going on in the import branch at the Bute Docks, Cardiff. In the matter of coal exports there is no cause for complaint, as the totals of the year will soon show. In imports there have not, up to late years, been a corresponding success; but careful nursing and persistent efforts have now begun to show good results—and it must be added, considerable expenditure has accompanied these efforts. Sir W. T. Lewis has directed this expenditure wisely, and given the fullest encouragement. As pointed out by a local contemporary, "the West Dock has been given up almost wholly to imports, and the East Dock largely taken up with this class of trade." The grain warehouses are large enough to store 26,000 tons; and the variety of commodities and manufactures is a striking one, from "excisable" articles to timber, joinery work, hardware goods, railway materials, moss litter, hay, straw, Dutch bulbs, and garden produce. The development of the import trade is in harmony with the great increase going on in the population of the large colliery districts of Wales.

There are several instances of dispute amongst the colliers, some of which have come before the authorities. An important case, tried this week at the Aberdare Police Court, was a charge against a number of hauliers by the Powell Duffryn Co. These had absented themselves from work without notice because the company would not pay for "shacklers" to fasten the horses to the trams. This was one of the simplest of duties and only taking a second or two of time, but the men would not yield, and the result was prosecution and conviction, each being fined £5 damages and costs. I give the particulars, as showing the character of this class of workman, and the difficulties coalowners have to contend with. As one of the audience in the court remarked, "they will strike some day because coalowners will not allow them boys to assist in driving."

The latest quotations, steam and house coal at Cardiff, are as follows:—Best steam, 11s. 6d. to 11s. 9d.; seconds, 11s.; dry coal, 9s. 9d. to 10s. 3d.; best Monmouthshire, 10s. 3d. to 10s. 6d. Small steam—now getting very plentiful—is being offered at 4s. 6d. to 5s. 3d., prompt shipment. House coal, which has dropped a little in sympathy with steam coal, is at 11s., best; No. 3, Rhondda, sells for 10s. 3d.; brush, 8s. 6d.; small, 6s. 9d.; No. 2, Rhondda, 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 9d. to 5s. Most of these figures are capable of a slight reduction, if quantity is brought into consideration. Local trade remains to a great extent unaffected, prices moderately firm. One notable feature of the trade is, that efforts are being made to get a special class of North of England coals into Welsh districts in competition with Welsh coals. Circulars have been sent widely, describing coal and price delivered in Wales.

The iron and steel trades do not show any unusual degree of quality. All that can said is that the works are in moderate activity, some a shade better than others. I hear that contracts held are running out, and fresh ones are slowly coming to hand. This causes a certain amount of depression. Only one export of 50 tons rails has been noted for the week. Tin bars in fair quantities have been despatched, and in merchant iron and miscellaneous make a little better tone is to be recorded.

Cardiff Exchange quotations this week were:—Bessemer steel bars, £4; Siemens, £4 2s. 6d. to £4 5s.; steel rails, heavy, £3 12s. 6d. to £3 15s.; light, £4 10s. to £4 12s. 6d.

Swansea Exchange quotations indicated a tolerable steadiness. Glasgow pig, 42s. 4½d. cash; Middlesbrough, 35s. 6½d.; hematite, 43s. 4½d.; Welsh bars, £5 2s. 6d.; sheet iron at works, £6 to £6 10s.; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s.; steel sheets, £6 5s. to £6 10s.; Bessemer bar, £4 to £4 2s. 6d.; Siemens the same. All delivered in district, cash less 2½ per cent. Tin-plate: Makers' quotations:—Bessemer cokes, 10s. to 10s. 3d.; Siemens, 10s. 3d. to 10s. 6d.; ternes, per double boxes, 28 by 20, 20s. to 24s. Best charcoal, 12s. to 12s. 3d. Wasters, 6d. to 1s. per box less than primes. Block tin is at £63 15s. to £63 17s. 6d. Copper, Chili bars, £40 7s. 6d. to £40 8s. 6d. Lead, English, £9 17s. 6d. to £10 2s. 6d.; Spanish, £9 16s. 3d. to £9 17s. 6d. Other Swansea quotations are:—Anthracite coal, 8s. 9d. to 12s. 6d.; cokes, 4s. 6d. to 4s. 9d. No. 3 Rhondda, 11s. to 12s. Cokes, furnace, from 12s.; foundry, from 17s. Patent fuel, 10s. 6d. to 11s. Pitwood, 17s. Iron ores, Tafna, 11s.; Rubio, 11s. 3d. to 12s.; ex ship, cash, 30 days.

At Cardiff, patent fuel was reported dull, price 11s. 6d. to 11s. 9d. Pitwood, falling demand; good wood selling at 15s. Coke inquiries, slack; prices unaltered, furnace at 15s. to 16s.; good foundry, 17s. to 17s. 6d. Special foundry, 21s.

It will be seen by the quotations that tin-plate has not made the expected spurt. The impression prevails that a change is at hand, and that it will be a marked one. The transition, however, will not be abrupt. Of late I have recorded the restart of mills which have been inactive. This has somewhat retarded the advance in price, as the increased demand has been met by an increased make. If the idle mills had remained idle, stocks would have fallen rapidly. Now the extra quantity sent from works has kept up stocks, and the result is a continuance of a fair trade without any "boom" about it. For instance, last week the exports were good, totalling 89.779 boxes from Swansea, and the make was equally good, 82,993 boxes, leaving stocks at 237,658 boxes. Tone of trade is hopeful, and a few weeks may see improvement.

The Government prosecution against officials of the Albion Colliery came to a conclusion at the close of last weeek at Pontypridd before the stipendiary, he holding that there was no case, and refusing to certify for a new hearing.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

A QUIET sort of business is still being transacted on the different iron markets over here, and the tendency of prices is more or less depressed. Both home and foreign requirements continue very small, makers, dealers, and consumers acting with caution.

There is as yet not the slightest symptom of an improvement to be noted in the various branches of the Silesian iron trade. Very few new consignments are in the market, and some of the blast furnace works complain of an entire absence of inquiry. The malleable iron business is in much the same condition, the majority of the mills being but indifferently engaged. List prices are only nominal as a rule, because there is scarcely any business to really test them, makers agreeing to the lowest quotations rather than lose a contract. The steel trade continues extremely dull, and there is also very little life stirring in the engineering department.

On the Austro-Hungarian iron market the general demand continues fair, but not brisk. A moderate degree of activity characterises the crude iron business on the whole, while the manufactured iron trade maintains a lively tone, although autumn business has developed more slowly and less favourably than was at first anticipated. The bar mills complain of an insufficient amount of new work coming in; while the plate and sheet trade continues quietly but altogether satisfactorily occupied. Girders and some special sorts of structural iron have been in very good call lately, but the quantities required are small generally, an order of some weight having not been booked for many weeks past. In Bohemia and Galicia the Upper Silesian works continue to offer iron at famine prices, which cannot fail to have a most depressing influence on the Austro-Hungarian iron business in general.

The production of brown coal in Austria is statistically stated to have been as under:—

| | 1893<br>100 kilogs. | 1892.<br>100 kilogs |
|---|---|---|
| Bohemia | 185,480 934 | 131,539,976 |
| Styria | 23,279,796 | 21,711,856 |
| Upper Austria | 3,719,179 | 3,631,346 |
| Carniola | 1,804,310 | 1,361,736 |
| Moravia | 1,188,562 | 1,110,215 |
| Istria | 900,085 | 868,883 |
| Carinthia | 753.326 | 810,753 |
| Dalmatia | 478,839 | 432,877 |
| Galicia | 366,900 | 192,609 |
| Tirol | 162,432 | 246,859 |
| Lower Austria | 19,704 | 16,147 |
| Silesia | 5,480 | 5,484 |
| Total output | 168,159,546 | 161,428,743 |

The accounts that are given of the general iron and steel trade in France continue of a cheering character. Current demand is reported to be good, that for plates and structural iron especially has been uncommonly lively, which led to a rising tendency in raw material. Prices are, for the present, without change, but there is a very firm tone noticeable all round, prospects for orders being good. Output of iron and steel in France was, for first two quarters of present year, as follows:—

| | 1894.<br>Tons. | 1893.<br>Tons |
|---|---|---|
| Forge pig | 818,988 | 762 859 |
| Foundry pig | 238,181 | 242,501 |
| Iron rails | 260 | 485 |
| Merchant bars | 360,870 | 357,618 |
| Iron plates | 53,202 | 56,304 |
| Steel rails | 97,060 | 117,804 |
| Steel rods, &c. | 152,493 | 141,641 |
| Steel plates | 78,678 | 58,265 |
| Hardware | 12,014 | 12,241 |

Rhenish-Westphalian iron business is still far from improving. All through last week there has been an exceedingly poor demand for both raw and manufactured iron; for the former article a continued weakness in prices must be noted, while in the manufactured iron branch a somewhat more steady tone is perceptible, although demand continues of the hand-to-mouth sort, and only small lots are generally required. Plates and sheets are in comparatively fair request, and so are girders. Export is languid and leaves no profit, at least so far as that to America is concerned.

The production of pig iron in the Saar and Mosel districts was, for September of the present year, in forge pig 26,642 t.; basic, 52,565 t.; foundry pig 10,483 t.; together, 89,689 t. Production was less by 2·7 per cent. during the preceding month of August, when it amounted to 92,219 t. In September, 1893, the total production was 81,526 t., which shows an increase of 10 per cent. for the same month of present year.

The collieries of the Saar district have yielded in September, within twenty-five working days, 560,060 t., and sold 571,890 t. In August 563,780 t. were produced within twenty-seven days, and consumption was 566,610 t. only, while in September of last year 529,563 t. were produced, and 552,735 t. were sold.

THE PANAMA CANAL.—The new Panama Canal Company was legally constituted at the meeting of shareholders held on Saturday afternoon. MM. Baillet, Brolemann, Carraby, Chanove, Jonquières, Lebegue, Ramet, St. Puentin, and Souchin were appointed administrators for six years, while MM. Barbier, Lemoine, and Fougen were named commissaries. Before closing the sitting, M. Lemarquis, the legal representative of the old bondholders, who presided, announced that a cablegram would be at once sent to M. Mancini, at Bogota, who would on its reception announce the constitution of the new company to the Colombian Foreign Minister, and that on Sunday 800 workmen would resume the so-long-abandoned work of the Culebra Cutting. Though the list of administrators proposed by M. Lemarquis was adopted unaltered by an overwhelming majority of the shareholders, the meeting was very tumultuous. M. Thiebaud protested against the constitution of the new company, and declared that the proposed new administrators were the representatives of the men who had ruined the old Panama Company. The proposed new administrators represented MM. Eiffel, who subscribed ten million francs; Hugo Oberndoerffer, who subscribed three million five hundred thousand francs; Buno Varilla, who subscribed two million two hundred thousand francs; the administrators of the old company, who subscribed eight million francs; and the credit establishment, which subscribed ten million francs. With such persons at the head of the enterprise, it would be useless to hope the public would subscribe the remaining five hundred million francs required to complete the canal. M. Thiebaud's remarks were received rather coldly, and did not prevent the list of administrators prepared by M. Lemarquis from being adopted almost unanimously.

## LAUNCHES AND TRIAL TRIPS.

Last week Messrs. Lobnitz and Co., Renfrew, launched the twin screw hopper dredger St. Martin, which they have built to the order of the British Admiralty. She will be capable of working to a depth of 46ft.

On October 22nd Messrs. Wm. Simons and Co. launched from their yard at Renfrew, complete, with its dredging and propelling machinery on board, the twin screw hopper dredger St. Enoch. This vessel is built to the order of the British Admiralty, and is a duplicate of the St. Alban, which has just been started to work at Portsmouth. It is designed to dredge and discharge clay of a very adhesive nature, and is capable of working to a depth of 46ft. under water. At the launch there were present Messrs. Painter, Parker, and Scroggins, her Majesty's Surveyors, under whose supervision the vessel has been built.

Messrs. Blackwood and Gordon, engineers and shipbuilders, Port Glasgow, have at present in hand a new screw steamer for the City of Dublin Steam Packet Company, of Dublin, for its Dublin and Liverpool trade, a duplicate of the steamer Louth, lately built by them, and which vessel has given the utmost satisfaction to her owners, as well as to the cattle dealers and the general travelling public. The new steamer will have a number of improvements made on the Louth's design with the view of obtaining increased speed and economy in working. The builders are pressing forward the work for the new vessel so as to ensure speedy delivery, and we have no doubt that the Dublin people will be well pleased to see a duplicate Louth in the cross channel trade at an early date.

On the 19th inst., at twelve o'clock, the Tyrone, the third canal lighter built for the Ulster Steam Lighter Company within the short period of about a year, was launched from the yard of Mr. Denis Crawford, Newry. The new boat will carry 72 tons of cargo. She will be fitted with patent adjustable twin propellers, the invention of Mr. Henry Barcroft, D.L. This propelling gear is now being manufactured by Messrs. Robey and Co., of Lincoln. The compound engines will in this instance be supplied by Messrs. Cochrane, of Birkenhead. She will be furnished with a patent heater, by Royle, of Manchester, which will heat the feed-water on its way to the boiler, which will have a pressure of 120 lb. This, it is expected, will effect a considerable economy in coal. The previous experience of the company furnishes data on the head of coal consumption which gives every evidence that the boat will run to Belfast and back—a distance by water of 130 miles—carrying cargo both ways, on a consumption of about 30 cwt. of Welsh coal. The entire weight of engine, boiler, &c., will be 55 cwt., and as the machinery is on deck, all space underneath is available for the cargo.

## MONEY OF THE WORLD.

Mr. Preston, Acting Director of the United States Mint, has prepared a table of the monetary systems of the world. The table shows that the aggregate stock of gold is 3,582,005,000 dols.; silver, 4,042,700,000 dols.; uncovered paper, 2,635,873,000 dols.

Stock of gold possessed by principal countries is as follows: United States, 604,000,000 dols.; Great Britain, 550,000,000 dols.; France, 900,000,000 dols.; Germany, 600,000,000 dols.; Russia, 250,000,000 dols. The stock of silver is as follows: United States, 615,000,000 dols.; Great Britain, 100,000,000 dols.; France, 700,000.000 dols.; Germany, 211,000,000 dols.; Russia, 60,000,000 dols.

The stock of silver is divided as follows: United States, 538,000,000 dols. full tender, 77,000,000 dols. limited tender; Great Britain, no silver full tender, 100,000,000 dols. limited tender; France, 650,000,000 dols. full tender, 50,000,000 dols. limited tender; Germany, 103,000,000 dols. full tender, 108,000,000 dols. limited tender; Russia, 25,000,000 dols. full tender, 38,000,000 limited tender.

The ratio prevailing in nearly all principal countries between gold and legal tender silver is 1 to 15½. The ratio between gold and limited silver is, as a rule, 1 to 14·38. The respective ratios in the United States are 1 to 15 98 and 1 to 14·95.

The various monetary systems as divided among countries: Gold and silver: United States, France, Belgium, Italy, Switzerland, Greece, Spain, Netherlands, Turkey, and Japan. Gold: United Kingdom, Germany, Portugal, Austria, Scandinavian union, Australia, Egypt, Canada, and Cuba. Silver: Russia, Mexico, Central and South America, and India. Of the uncovered money South America has 600,000,000 dols.; Russia, 500,000,000 dols.; United States, 412,000,000 dols.; Austria, 260,000,000 dols.; Italy, 153,000,000 dols.; Germany, 107,000,000 dols.; France, 81,000,000 dols.; and Great Britain, 60,000,000 dols.

The per capita circulation of gold is: United States, 9·01 dols.; United Kingdom, 14·47 dols.; France, 20·52 dols.: Germany, 12·12 dols.; Russia, 2·21 dols. Per capita of all classes of money is: France, 40·56 dols.; Cuba, 31 dols.; Netherlands, 28·88 dols.; Australia, 26·75 dols.; Belgium, 25·52 dols.; United States, 24·34 dols.; United Kingdom, 13·42 dols., and Russia, 7·16 dols.

The following figures indicate the relative powers, as they are estimated by some of our friends across the Channel, possessed by various kinds of fuel for converting water into steam:—One kilogramme of wood converts into steam 3·4 kilogrammes of water; one kilogramme of brown coal, 3·5 to 4·9 kilogrammes of water; one kilogramme of cut peat, 2·8 to 4 kilogrammes of water; one kilogramme of machine peat, 4·5 to 5 kilogrammes of water; one kilogramme of hard coal, 7 to 8 kilogrammes of water; one kilogramme of medium coal, 6 to 7 kilogrammes of water; one kilogramme of poor coal, 4 to 6 kilogrammes of water. It is estimated, on an average, that 100 pounds of peat are equal, in respect to the really available heating capacity, to 50 to 60 pounds of hard coal.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

10*th October*, 1894.

19,245. Watch Stands, F. H. Davidson, Manchester.
19,246. Straps for Raising Windows, J. C. Craine, Manchester.
19,247. Electrical Ceiling Roses, G. F. Kenyon and E. Moorhouse, London.
19,248. Bicycles, J. Hargreaves, London.
19,249. Manufacture of Blankets, W. Edwards, London.
19,250. Horseshoe, W. Chapman, London.
19,251. Separation of Mineral Slimes, G. H. Lloyd, London.
19,252. Concentrating, &c., Minerals, G. H. Lloyd, London.
19,253. Lifebuoy, J. M. Richards, London.
19,254. Pneumatic Tires for Cycles, A. Wadham, London.
19,255. Water Heaters, A. J. Boult.—(*C. H. Fuchs, Germany.*)
19,256. Pedal for Bicycles, W. P. Thompson.—(*The firm of Frankenburger and Ottenstein, Germany.*)
19,257. Washing Syphons, &c., G. A. Merchant, Liverpool.
19,258. India-rubber Balls, W. P. Thompson.—(*E. Meyer, Germany.*)
19,259. Machines for Cleaning Knives, M. W. Wright, London.
19,260. Fork Bearing for Bicycles, F. Rough, Hereford.
19,261. New Clip or Fastener, E. J. Wagner, London.
19,262. Jointing Staves of Casks, J. W. and T. G. Lahey, London
19,263. Recovering Used Solvents, G. Braun, London.
19,264. Air-ships, R. E. May, London.
19,265. Means of Signalling on Railways, L. G. Tate, London.
19,266. Window Ticket Hook and Clip, W. Potter, London.
19,267. Pumping Engines, &c., J. D. Wardale, London.
19,268. Governing Engines, W. Goodbrand and T. R. Wollaston, Manchester.
19,269. Steam and Water Separator, J. E. Sweet, London.
19,270. Shoe-fastener, I. D. Wright, London.
19,271. Construction of Billiard Tables, J. S. Burroughes, London.
19,272. Rotary Steam Engine, J. N. Hartzell, London.
19,273. Cleats for Ropes, C. A. McEvoy and T. Webster, London.
19,274. Expansion Gear for Engines, H. O. Beckh, London.
19,275. Braces, F. Cade, London.
19,276. Anchors, W. and J. Herbert, and E. Grahame, London.
19,277. Securing Stoppers in Jars, F. E. Hollyer, London.
19,278. Velocipedes, J. Bradbury, jun., London.
19,279. Heating Railway Carriages, R. T. Preston, London.
19,280. Producing Illusory Effects, G. D'Arc, London.
19,281. Printing or Gilding Machines, E. H. Schmidt, London.
19,282. Paint Brushes, A. T. Butchard, London.
19,283. Self-winding Clocks, A. G. Wiseman, London.
19,284. Furnaces of Marine Boilers, D. J. Morgan, London.
19,285. Electric Chandeliers, M. V. Luis and E. C. Elgood.—(*L. Priebe, Germany.*)
19,286. Electric Motor Appliances, L. B. Atkinson, London.

11*th October*, 1894.

19,287. Tilting Casks, C. Green, jun., and H. T. Wood, London.
19,288. Cycle Brake, A. Rainsford, Birmingham.
19,289. Hair Curler or Waver, T. P. Batkin, Birmingham.
19,290. Pulverisers, J. P. Griffiths, Dudley.
19,291. Electric Signal, D. F. Adamson and C. D. Hutchins, London.
19,292. Carding Engines, C. Whitworth and A. S. Mills, Heywood.
19,293. Retort Mouthpieces, J. L. and T. J. L. Mitton, Huddersfield.
19,294. Tip for Billiard Cues, E. H. Russell, Wallasey, Cheshire.
19,295. Toasting Appliance, A. E. Dinsmore, Liverpool.
19,296. Kitchen Ranges, J. W. Dobson, Keighley.
19,297. Egg Beating Apparatus, J. and A. T. Dewar, Liverpool.
19,298. Knitting Machines, J. H. Smith and F. W. Pare, Nottingham.
19,299. Smokeless Explosives, G. Hübner, Manchester.
19,300. Breech-loading Small Arms, S. Mills, Birmingham.
19,301. Preventing Accidents to Platelayers, A. Machin, Glasgow.
19,302. Apparatus for Fastening Envelopes, F. C. Lynde, Manchester.
19,303. Fire-bricks for Heating Steel, W. Hammond, Pott Shrigley.
19,304. Felloe for Wheels, H. Hollick, Coventry.
19,305. Brake Apparatus for Cycles, P. Weir, Bristol.
19,306. Pressure on Nip-rollers, J. H. Whitehead and W. E. Layland, Halifax.
19,307. Noble's Comb, J. H. Whitehead and J. Lister, Halifax.
19,308. Drafting Patterns, M. Knowles, Halifax.
19,309. Phosphate Food for Horses, T. T. Chard, Bristol.
19,310. Cycle Saddles, G. Salter, Birmingham.
19,311. Device for Heating Rooms, J. Cinnamon, Glasgow.
19,312. Case for Protecting Maps, W. Brierley.—(*The Firm of Bial, Freund, and Co., Germany.*)
19,313. Appliances for Recording Distances, J. B. Howard.—(*K. Keyssner and E. Hessdorfer, Germany.*)
19,314. Cycles, A. Jennings, Glasgow.
19,315. Stopping Leaks in Ships, W. Adams, Dartmouth.
19,316. Cycles, H. W. Ashby and R. Lindsay, Dublin.
19,317. Safety Trivet, T. L. Poidevin, Gurnsey.
19,318. Station Indicator, W. Ross and P. Tickle, St. Helen's.
19,319. Weather Bars for Doors, A. H. Williams, London.
19,320. Target, B. L. King, London.
19,321. Automatic Weighing-machines, J. H. Robinson, London.
19,322. Cabinets, A., A. jun., and J. S. Thomson, London.
19,323. Drawing-pins, B. Madoc, London.
19,324. Portable Hothouse, H. Courteen, London.
19,325. Fireproof Floors, T. R. W. Mossman, London.
19,326. Sash Fasteners, W. Fletcher and J. Tatham, London.
19,327. Construction of Navigable Vessels, H. F. Swan, London.
19,328. Automatic Mouse Trap, H. Coleman and F. Plaister, London.
19,329. Photographic Shutter, A. C. Jackson, London.
19,330. Apparatus for Delivering Coal, R. Cowie and Messrs. Dixon and Mann, Glasgow.
19,331. Opening Window-sashes, A. R. Austin, Glasgow.
19,332. Washing-machine, R. P. Gillon, Glasgow.
19,333. Tobacco Pipes, L. E. G. de Woolfson and E. Smith, Shrewsbury.
19,334. Driving-gear for Cycles, A. Jordan, London.
19,335. Hay-tedders, A. J. Boult.—(*C. H. Teicher, Germany.*)
19,336. Supporting Device for Pants, D. C. Fraser, London.
19,337. Ships' Rudders, P. A. Mensing, Liverpool.
19,338. Preparation of Yeast, W. G. Johnston and J. F. Warwick, London.
19,339. Couplings, K. Reyscher, London.
19,340. Preservation of Milk, R. G. Nash, London.
19,341. Oil Cans, B. H. Chameroy, London.
19,342. Production of Anilides, L. Lederer, London.
19,343. Oil Motor Engines, C. D. Abel.—(*The Gusmotoren Fabrik Deutz, Germany.*)
19,344. Vent Device for use with Beer Casks, J. Clemson, London.
19,345. Indicating Rotation Speed, M. S. Napier, London.
19,346. Pneumatic Tires, A. Wadham, Lonnon.
19,347. Packing Drinking Glasses, G. and E. Scott, London.
19,348. Shampooing Shield, A. F. Godefroy, London.
19,349. Combined Writing-desk and Type-writer, L. H. Dodge, London.
19,350. Extracting Heated Air from Cases, J. M. Sykes, London.
19,351. Turkish Bath, G. Hughes.—(*G. M. Sternkopf, Germany.*)
19,352. Leaden Pipes, C. and S. Constanduros, London.
19,353. Safety Stirrups, T. J. Dancer, London.
18,354. Paper Binding Machines, E. T. Greenfield, London.
19,355. Post-marking Machines, M. V. B. Ethridge and H. E. Waite, London.
19,356. Bags, H. Lewis, London.
19,357. Window Sash Fastener, P. R. J. Willis.—(*N. Johnson, United States.*)
19,358. Pneumatic Saddle Pad, J. Korbuly, London.
19,359. Making Plated Catgut Strings, P. Stark, London.
19,360. Nail, Pins, Screws, &c., G. C. Warden, jun., London.
19,361. Golf Clubs, W. T. Jennings, London.
19,362. Electrical Safety Devices, J. S. Raworth, London.
19,363. Anti-corrosive Composition, G. Rockliffe, London.
19,364. Electro-motors, C. Connors and W. L. Davies, London.
19,365. Window Catches or Sash Fasteners, W. Blair, London.
19,366. Safety Riding Skirts, E. J. Wagner, London.
19,367. Billiard Cue, I. Davis, London.

12*th October*, 1894.

19,368. Construction of Poison Bottles, W. Gibbin, jun., London.
19,369. Swimming Pads, F. W. Hoar, Southampton.
19,370. Safety Blouse Pin, A. Prym, London.
19,371. Pneumatic Tire Grip Pump, J. Slaughter, jun., Coventry.
19,372. Heald Machine, T. Blackhurst and T. Roberts, Darwen.
19,373. Detachable Pneumatic Tire, S. J. Rose, Witney.
19,374. Means for Sharpening Saws, W. E. Plested, Watford.
19,375. Valve for Water Ballast Tanks, J. Rowland, Sunderland.
19,376. Combination Collar Studs, T. Morton, Birmingham.
19,377. Cuff Links, T. Morton, Birmingham.
19,378. Doors of Railway Carriages, J. Bennison, Manchester.
19,379. Clothing Card Flats, G. P. Appleyard and L. P. Foster, Halifax.
19,380. Wheels for Vehicles, A. Hodgkinson, Manchester.
19,381. Cleansing Calico Printers' Blanketing, W. Hadfield, J. J. Sumner, and H. Hadfield, Manchester.
19,382. Flower-beds, F. Pesson, Manchester.
19,383. Feed-water Heaters, R. H. Turner and J. Whiteley, Manchester.
19,384. Weighing Machine for Grain, W. R. Baxter, London.
19,385. Suspension Lamp Hangers, T. Smith, London.
19,386. Cigarettes, G. C. Dixon, London.
19,387. Magnetic Shielding, G. F. FitzGerald, Dublin.
19,388. Printing Cotton Fabrics, W. E. Kay and the Thornliebank Company, Manchester.
19,389. Artificial Teeth, R. Marston and J. Parr, Leicester.
19,390. Drawing Instruments, A. A. Woodward, Birmingham.
19,391. Dust-pans, A. Paget, Loughborough.
19,392. Candlesticks, G. H. Rose, Bedford.
19,393. Telescope Tube for Exhibiting Chrysanthemums, J. Stiles, Teignmouth.
19,394. Utilisation of Purple Ore, T. Twynam, Surrey.
19,395. Fixing Rims or Felloes on Wheels, H. Hollick, Coventry.
19,396. Kilns for Burning Limestone, H. Parry, Liverpool.
19,397. Slipper Brake, &c., for Road Vehicles, C. H. Bennett, Sheffield.
19,398. Tap for Measuring Spirits, &c , L. F. Shove, Bristol.
19,399. Bead-threading Machinery, L. Myers and C. B. Ketley, Birmingham.
19,400. Connecting-link for Chain Cables, W. H. Simon, Birmingham.
19,401. "Square Motion" Combining Machines, T. W. Harding, Leeds.
19,402. Combination Framework Fire-light, J. F. Kempe and M. A. Eslick, Liverpool.
19,403. Production of Letters for Signs, A. Harris, Birmingham.
19,404. Potato Digger, D. Smith and T. H. Tilley, London.
19,405. Wrought Iron Pulleys, A. L. Schmidt, Germany.
19,406. Shovel with Rake Attachment, J. R. Parker, London.
19,407. Bird Cages, F. Baker, Birmingham.
19,408. Steam Brakes of Locomotives, W. H. Flitcroft, London.
19,409. Assisted Draught for Steam Boilers, J. W. Claridge, London.
19,410. Hook with Spring, B. F. Bryant, Ramsgate.
19,411. Fastening Tubing to a Nozzle, L. N. Fowler and W. C. Nangle, London.
19,412. Advertising by Post-cards, H. G. Maxwell and E. D. Richards, London.
19,413. Filter for Water Cisterns, A. W. Baylis, London.
19,414. Casket for Containing Photography, A. Murray, Dundee.
19,415. Rims for Wheels, F. Bowden.—(*A. C. Fairbanks, United States.*)
19,416. Cycles, E. J. Newell, J. Hodson, and J. P. Nicholson, London.
19,417. Changing Action for Cameras, A. E. Staley, London.
19,418. Velocipedes, B. Fort and C. Anderson, Liverpool.
19,419. Wheels, W. Fish, London.
19,420. Colouring Matter, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
19,421. Hauling by Electricity, &c., F. B. Behr, London.
19,422. Barrel Tilter, D. Bale and T. B. Evans, Cardiff.
19,423. Retorts for Production of Gas, J. H. Dunn, London.
19,424. Signal for Railway Guards, W. Vogeler and J. Seitz, Cologne.
19,425. Spurs, R. Ostermann, Cologne.
19,426. Trestles, J. Steinfeld and T. Becker, Cologne.
19,427. Apparatus for Dyeing Skins, R. Ergang, London.
19,428. Tubular Frames for Cycles, O. Schlick, London.
19,429. Rendering Goods Uninflammable, A. E. Webb, London.
19,430. Taps, F. Cobham, London.
19,431. Cork-grinding Machinery, J. B. Morrison, Glasgow.
19,432. Lamps, J. McAllister, Glasgow.
19,433. Engine Packing, H. S. Pringle and J. Jordan, London.
19,434. Preventing Breaking of Ropes, F. Shepherd, London.
19,435. Railway Carriage Lamps, F. Semmence, London.
19,436. Bicycles, &c., F. Sulley and W. E. Dowson, London.
19,437. Treatment of Terra-cotta, &c., E. Tortora, London.
19,438. Velocipedes, F. J. Endrès, London.
19,439. Cabinet Folding Bedstead, G. Willmot, London.
19,440. Skates, W. Harvey, London.
19,441. Paper Fastener and Ticket Holder, S. H. Crocker, London.
19,442. Collapsible Baskets and Boxes, J. Dobson, London.
19,443. Electrical Production of Music, P. T. Letchford, London.
19,444. Arc Lamps, G. G. Stout, London.
19,445. Turning Leaves of Music, B. F. Wallace, R. T. Proctor, and W. R. Hall, London.

13*th October*, 1894.

19,446. Boiler-cleaning Machine, T. Cudlipp, London.
19,447. Stair Protector, J. W. W. York and G. Whittle, Leicester.
19,448. Fire-escapes, G. M. Dudley, Dublin.
19,449. Gate-bottom, M. Lee and D. Davies, Llanelly.
19,450. A Catch for Fishing-rod Joints, M. J. Boyle, Cavan.
19,451. Bungs for Casks, R. D. Bailey, London.
19,452. Manufacture of Confections, R. J. Harrison, Belfast.
19.453. Lifts, F. Rawnsley, Halifax.
19,454. Theodolites, C. Merrick, Bristol.
19,455. Flushing Cisterns, T. S., W. and B. Stock, H. W. and T. L. Taylor and T. Shingleton, Birmingham.
19,456. Removable Terminals, J. H. Cartland, Birmingham.
19,457. Purification of Coal, T. Clapham and J. Laycock, Keighley.
19,458. Spindles, B. A. Dobson and E. Gillow, Manchester.
19,459. Sinking and Walling Scaffolds, H. Joyner, Barnsley.
19,460. Show Stands, G. A. Thomas, Bristol.
19,461. Sliding Rods of Chandeliers, R. H. Best, Birmingham.
19,462. Incandescent Gas Burners, F. E. Nichol, Portobello.
19,463. Separating Wool Washing Liquors, R. B. Gow, Glasgow.
19,464. Wheel with Elastic Tire, A. Metzger, Berlin.
19,465. Handkerchiefs, A. J. Pullman, Glasgow.
19,466. Screw Thread Dies, E. Beckitt, J. Rankin, and J. K. White, Glasgow.
19,467. Bottles or Vessels for Liquids, H. Rocholl, Dundee.
19,468. Delver or Digger, J. Morris, Kenyon, near Manchester
19,469. Blacking, J. Noad, London.
19,470. Valves for Steam Engines, C. W. Thompson, London.
19,471. Valves for Steam Engines, C. W. Thompson, London.
19,472. Cornice Ring Roller, R. J. Gibson, London.
19,473. Turning Leaves of Books, A. J. Boult.—(*O. Jäntsch, ——*)
19,474. Trunks and Boxes, &c., N. M. Bateson, Liverpool.
19,475. Stays, S. Herrmann, London.
19,476. Footballs, H. D. Hodgkinson and J. Cooper, London.
19,477. Boots, F. Schoelles, Manchester.
19,478. Treatment of Ores, H. F. Kirkpatrick-Picard, London.
19,479. Supplying Water to Hydraulic Lifts, J. C. Etchells, Manchester.
19,480. Buttons, C. F. Püschner and F. Püschner, London.
19,481. Heating Water by Electricity, J. W. Ewart, London.
19,482. Construction of Filter Beds, H. L. Hinnell, London.
19.483. Letters for Shop Fronts, &c., A. Standring, Manchester.
19,484. Clothing Clip for Bicyclists, J. M. Gillies, Dublin.
19,485. Treatment of Textile Fabrics, A. F. B. Gomess, London.
19,486. Device for Handling Cake, A. G. Stevens, London.
19,487. Lifts, F. T. Long, London.
19,488. Obtaining Salt, T. Scott and the Patent Salt Company, Glasgow.
19,489. Curling Hair, W. W. Twigg and F. R. Baker, Birmingham.
19,490. Guard Attachments for Doors, W. A. Thornton, London.
19,491. Sanitary Slop Receptacle, J. J. Feldman, London.
19,492. Wooden Blocks for Children, W. H. Drinkwater, London.
19,493. Safety Lamps for Mines, T. Coad, London.
19,494. Weighing Machines, D. Bacas-y-Montero, London.
19,495. Stoppers for Bottles, H. E. G. Earle, London.
19,496. Spectral Signals, J. Munro, Croydon.
19,497. Spray Nozzle, H. F. Neumeyer, London.
19,498. Puzzle, H. Hill, London.
19,499. Stand for Feed-bags, H. Bailey and W. Patterson, London.
19,500. Motors for Tramcars, &c., R. M. Macdonald, London.
19,501. Drawing Square, C. Hanke, London.
19,502. Marker for Cards, B. E. Edwards, London.
19,503. Folding Tables, J. W. Lyon, London.
19,504. Book-racks, J. W. Lyon, London.
19,505. Cycles, B. Endler, London.
19,506. Metallic Packing for Piston Rods, G. W. Manuel, London.
19,507. Cycle Spanner, G. W. and C. B. McIntyre, London.
19,508. Cut-outs for use in Electric Circuits, C. P. C. Cummins and J. L. Golding, London.
19,509. Photographic Objectives, P. Rudolph, London.
19,510. Alloy of Aluminium, H. G. Partin, London.
19,511. Conveying Paper through Printing-machines, W. Reader, London.
19,512. Curtain Rods and Brackets, J. R. Endean, London.
19,513. Dress Suspender, S. A. Cole, London.
19,514. Bicycle and Vehicle Wheels, G. E. Butcher, London.
19,515. Diffusing Light, C. Jousset and F. R. Boardman, London.
19,516. Mowing Machine, C. Stoldt and W. Spiess, London.
19,517. Indicating Electric Lamp Hours, R. Wende, London.

19,518. Rail Joints, R. H. Pierce, London.

19,519. Manufacture of Quill Tubes, R. Zeise, London.

19,520. Furnaces, A. F. A. Kinaux, London.

19 521. Indicating Quantities of Liquids, G. Price and G. J. J. Legrand, London.

19,522. District Telegraph Calls, W. H. Garven, London.

19,523. Tires and Rims of Cycles, J. H. Barry, London.

19,524. Cartridge-feed Apparatus, J. G. Accles, London.

19 525. Utilisation of Waste Materials, J. H. Barry, London.

*15th October*, 1894.

19,526 Manufacture of Tooth Brushes, W. Hawtin, London.

19 527. Producing Torpedo Rotation, T. Renville, London.

19,528. Bicycles, O. G. Gümpel, London.

19 529 Heat Non-conductor, G. C. Douglas.—(*W. Don and T. Watson, India.*)

19,530. Cranks for Cycles, G. Pirnie, Dundee.

19 531. Stair Treads, E. Nuttall and T. Oddy, Rochdale.

19 532. Combs, J., G., S., and J. Ambler, jun., and J. Shackleton, Bradford.

19 533. Accouchement Pulleys, C. and C Green, jun., London.

19,534. Sanitary Pipes and Joints, &c , J. Tuke Leeds

19 535. Varnish for Colours, T. Coppock, jun., Manchester.

19 536. Cycles, A. Maltby, London.

19 537. Automatic Coin-freed Machine, W. Edwards, London.

19 538. Sliding Sashes, C. Milne and R. Barton, Glasgow.

19 539. Hat Bands, F. W. and B. Franklin and P. E. Taylor, Birmingham.

19,540. Balling Wool, T. H. Wharton and H. Monies, Bradford.

19,541. Securing Clothing, J. and J. Vaughan and T. Houghton, Ashton-under-Lyne

19 542 Brooches and Bracelets, &c., E. Hulme, jun., Manchester

19,543. Stoppers, F. A Bird and J. B. Fenby, Castle Bromwich.

19 544 Walking-stick and Pipe Case, S. Kenyon, Doncaster.

19,545. Field Cooking Apparatus, R. Crudass, Aldershot.

19 546 Sounding Device, W. Aldred and W. Bradley, Sheffield.

19,547. Fixing Labels to Umbrellas, W. Corah, jun., Birmingham.

19,548. Automatic Egg Cooker, &c , C. Trewartha, Exeter.

19 549. Apparatus for Drying Bricks, A. Lilley, Newcastle-on-Tyne.

19 550. Shuttle Guards, H. Rhodes and G. Thornley, Manchester.

19 551. Weaving Inner Selvedges, E. T. Whitelow, Manchester.

19 552. Tire, W. Lowe, Manchester.

19,553. Sash Fasteners, H. R. Harvey and J. W. B. Unwin, Croydon.

19,554. Self-closing Doors, W. W. Burland, Stockton-on-Tees.

19 555. Concentrator, W. and B. Howard and C. A. Bleyl, London.

19,556. Envelope, Note, and Blotting Paper, R. Eaton, Leeds.

19 557. Valve for Pneumatic Tires, &c., T. G. Jelly, Birmingham.

19,558. Safety Apparatus for Cages, D. Brauckmann, Cologne.

19,559. Tobacco Pipes, J. W. Priestley, Bradford.

19,560. Transmitting Power from Engines, F. Royce, Manchester.

19,561. Mouthpiece, A. and A. Mokaiesh and J. S. Shepherd, Manchester.

19,562. Digging Machines, T. Haslam and P. Mawdsley, Liverpool.

19,563. Ruling Pens, F. H Batters, Liverpool.

19,564. Cycle Brake and Mudguard, S. Bramall London.

19,565. Turning Irregular Forms, W. A. Robertson, London.

19,566. Lamps for Burning Mineral Oils, R. Thompson, London.

19,567. Clips for Holding Letters, W. Higgs, H. P. Clemetson, and C. W. Higgs, London.

19,568. Driving Gear of Bicycles, R. Corsham, London.

19,569. Beam Attachment for Hatchways, E. Bond, London.

19,570. Form of Station Pointers, J. F. Stuart, London.

19,571. Anti-shoe-slip, G. S. W. Gillingwater, London.

19,572. Type-writing Machines, North's Type-writer Manufacturing Company, Limited, and M. Donne, London.

19,573. Scarf Retainer, W. Nicholls, London.

19,574. Sliding Sash Boxed Frames, W. Youlten, London.

19,575. Pockets for Ladies' Dresses, W. Hopekirk and E. Graham, London.

19,576. Machinery for Moulding Bricks, &c., J. W. Craven, London.

19,577. Alarms for Velocipedes, &c , E. W. Dickins, London.

19,578. Regulating the Supply of Lubricating Oil, W. R. Chester, London.

19,579. Manufacture of Wheel Rims, R. F. Hall, London.

19,580. Fire-proof and Weather-proof Materials, C. Williams, London.

19,581. Cream Separators, A. Krank, London.

19,582. Fastenings of Shirt Cuffs, C. E. Solomon, London.

19,583. Machines for Bottling Beer, T. Sutcliffe, London.

19,584. Pneumatic Quick-firing Guns, T. W. Just, London.

19,585. Arc Lamps, P. A. Mougin, London.

19,586. Keyboard Musical Instruments, F. Hanke, London.

19,587. Shelves, H. E. Davidson. —(*D. E. Hunter, United States* )

19,588. Oil-cups and Lubricators, E. Warwick, Birmingham.

19,589. Gas Engines, D. Davy, London.

19,590. Fuel Economiser for Ranges, J. P. Harding, London.

19 591. Paper Fasteners, R. M. Pancoast, London.

19,592. Heating Apparatus, H. E. Newton.—(*R. N. Oakman, jun., United States.*)

19,593. Pessaries, O. Ahlswede, London.

19,594. Filter, H. Crot, London.

19,595. Means for Trimming Lamp Wicks, P. Sharpe, London.

19,596. Marine Propeller Shafts, D. B. Morison, London.

19,597. Gauge, C. A. Dart, London.

19,598. Combination Turkish Bath, H. Nunnerley, London.

19,599. Cutting Apparatus, E. and R. Cornely, London.

19,600. Clip, O. C. Mootham, London.

19,601. Forks, T. Jones, London.

19,602. Stopping and Starting Road Vehicles, C. D. Vaughan, London.

*16th October*, 1894.

19,603. Electrical Fittings, C. L. Clarke and W. P. Theermann, Manchester.

19,604. Non-slipping Tire for Vehicles, J. R. Jackson, Manchester.

19 605. Electrical Conductors, &c , B. Andrews, London.

19,606. Submarine Torpedo Boat, S. and G. Rogers, Brighton.

19,607. Fire Tidy, S. J. Cockshaw, Huddersfield.

19,608. Drawing Rolls, A. G. Brookes.—(*W. Hinchliffe, United States.*)

19,609. Cushions for Furniture, A. G. Brookes.—(*W. Vogler, United States* )

19 610. Feed-water Heaters for Boilers, K. Lupton, Coventry.

19,611. Dissolvers for Optical Lanterns, W. H. Foulds, Glasgow.

19,612. Attaching Handles to Knitting Pins, G. Lewis, Redditch.

19,613. Bed-warmer, I. Stanton and W. Simmons, Wolverhampton.

19,614. Drawing Frames, C. Butterworth and J. Bowker, Hollinwood.

19 615. Ships' Berths, J. Duggan and W. Harley, Liverpool.

19 616 Umbrellas and Parasols, A. and W. Hill, Bristol.

19,617. Bedsteads, A. Rathbone and S. Taylor, Manchester.

19,618. Securing Terminals to Rods, W. H. Richards, Birmingham.

19,619. Cutting Machines, H. A. Oldershaw, Leicester.

19 620. Manufacture of Shirts, L Cox, Birmingham.

19,621. Hydraulic Pumping Apparatus, A. B. Brown, Glasgow.

19,622. Smoking Pipes, W. Warburton, Sheffield.

19,623. Adjustable Spanners, A. A. Allcard, Sheffield.

19,624. Chimney Cowls, E. Handslip, J. Grinton, and T. Christie, Newcastle-on-Tyne

19 625. Transparent Office Ruler, H. P. Ringwood, Dublin

19,626. Type Beds of Printing Machines, R. C. Annand, South Shields.

19,627. Washing Machine, T. Cudlipp, London.

19,628. Ascension Filter, F. Todd, Spalding.

19,629. Washing add Steaming Casks, P. Robinson, Birmingham.

19,630 Securing Purses, &c , D. I. Marcuson, Birmingham.

19,631. Rack for Photographic Negatives, J. B. Brooks, Birmingham.

19 632. Tongs for Lifting Hot Blooms, T. Williamson, Glasgow.

19,633. Cap Badges, C. F. Gaunt, Birmingham.

19 634. An Improved Ring, F. A. Ludlow, Birmingham.

19 635. Water Meters, L. H Nash, Liverpool

19,636. Covering Water Pipes, &c., J. A. Fisher, London.

19,637. Lighter for Pipes, Cigars, &c., A G. Lee, London.

19 638 Curling Hair, H. McClelland and F. G Baker, Birmingham.

19,639. A Drawer Cabinet, J. Young and F. J. Young, London.

19 640. Removing Foreign Matters from Roots, C. R Orr, London.

19 641. Wheel Tires, C. H. Gray, London

19,642. Feed-water Injectors, W. P. Thompson.—(*P. P. Hogue and H. G. Wiltshire, United States* )

19 643. Injectors for Steam Boilers W. P. Thompson —(*P. P. Hogue and H. G. Wiltshire, United States* )

19,644. Valve Gear, R. McC. Fryer, London.

19 645. Blast-feeding Apparatus for Furnaces, E. Cartwright, Liverpool.

19,646. Inducting Air into Furnaces, J. Mills, Liverpool.

19 647. Manufacture of Artificial Stone, W. Owen, London

19,648. Pneumatic Tires, L Stroud, London.

19,649. Pneumatic Tires, T. S. Paynter, London.

19,650. Windows, T. M. Houghton, Surrey

19,651. Boxes, Bewlay and Co , Ld., A. Needham, and W. Needham, London.

19,652. Steam Generators, H. E Franz, London.

19,653. Curtain Poles, Mouldings, &c., G. Smith, London.

19 654. Telephone Receivers, F. G. Bell and M. Binswanger, London.

19,655. Venetian Blinds, R. Christ London.

19,656. Railway Chair Manufacture, A. E. Muirhead, Glasgow.

19,657. Self-adjusting Ships' Furniture, F. Jörgensen, London.

19 658. Shuttles for Weaving Looms, A. Wood, London.

19 659. Water-closet Seats, C. Darrah and T. R. Kay, Manchester.

19,660. Carriages, F. W. Golby.—(— *Buffara and — Jarrit-Lacombe, France* )

19,661. Driving Gear for Cycles, J. H. Turvey, London.

19 662. Mechanism for Ageing Liquors, T. R. Timby, London.

19,663. Firelighters, N. Clarkson and T. Harrison, Bradford.

19,664. Bicycles and Tricycles, A. J. Battersby, London.

19,665. Changing Box for Cameras, H. G. M. Conybeare, Essex.

19,666. Bicycle Gear, F. W. D. Mitchell, Dublin.

19,667. Newspaper Wrapping Machinery, H. E. Newton.—(*R. Hoe, United States.*)

19,668. Carbons for Electric Lamps, A. F. B. Gomess, London.

19,669. Locks, B. Schlag, London.

19,670. Hair-curling Pins, A. J. Boult.—(*A. C. Jaeger, Austria.*)

19,671. Brakes for Perambulators, J. L. Durward, London.

19,672. Steam Boilers, J. Vanes, London.

19,673. Oil-distributing Apparatus, H. H. Lake.—(*H. See and G. L. Carden, United States.*)

19,674. Machines for Binding Box Corners, A. O. Wood, London.

19,675. Water Towers, E. F. Steck, London.

19,676. Expanding Mandrils, H. Berner, London.

19,677. Pneumatic Tires, R. Pritt, London.

19,678. Injectors, R. G. Brooke, London.

19,679. Steam Boilers, H. Tetlow and T. Harrison, London.

19,680. Appliance for Curling Hair, W. Doman, London.

19,681. Coin-freed Apparatus, W. Miller, London.

19,682. Stopping Railway Trains, O. Imray.—(*La Société Anonyme Pleterij voorhen L. I. Enthoven and Cie., Holland.*)

19,683. Manufacture of Thread Spools, W. H. Good, London.

19,684. Ammonium Chromates, V. I. Feeny.—(*The United States Smokeless Powder Company, United States.*)

19 685. Grain Separating Apparatus, J. Thornton, London.

19,686. Boiler and Superheater, E. Shydecker, London.

19,687. Condenser Carding Machines, E. Kay, London.

19,688. Stamping Cakes and the like, W. F. Curry, London.

19,689. Manufacture of Night-lights, W. G. Smith, London.

19,690. Elevating Apparatus, C. W. Hunt, London.

19,691. Retorts for Heating or Drying, J. Lyle, London.

19,692. Making Solid Petroleum Fuels, J. Lyle, London.

19,693. Making Asphaltic Compounds, J. Lyle, London.

19,694. Stopping and Releasing Liquids, G. Dussau, London.

19,695. Driving Gear of Bicycles, J. T. Gibson, London.

19,696. Regulating the Heating of Boilers, M. M. Brophy, London.

19,697. Apparatus for Heating the Air, M. M. Brophy, London.

19,698. Automatically Closing Doors, E. Wulff, London.

19,699. Appliance for Making Cigarettes, E. Brasier, London.

19,700. Vehicle Wheels, R. Haddan.—(*E. G. Schleicher, United States.*)

19,701. Carrier for a Lady's Purse, J. S. Rubenstein, London.

19,702. Accumulators, G. E. Heyl, London.

19,703. Drawing-off Foul Sewer Gases, C. Jones, London.

19,704. Rims of Wheels for Cycles, T. F. Drew, London.

19,705. Type-writers, J. G. Lorrain.—(*The Remington-Sholes Type-writer Company, United States* )

19,706. Key-boards for Type-writers, J. G. Lorrain. —(*The Remington-Sholes Type-writer Company, United States.*)

19,707. Type-writers, J. G. Lorrain.—(*The Remington-Sholes Type-writer Company, United States.*)

19,708 Type-writers, J. G. Lorrain.—(*The Remington-Sholes Type-writer Company, United States* )

19,709. Under-clothing, E. G. Deedes and G. A. Templar, London.

19,710. Dynamo-electric Machines, I. A. Timmis, Westminster.

19,711. Kilns for Burning Pottery, B. Dawson, London.

19,712 Obtaining Lactyl Compounds, G. W. Johnson.—(*The Chemische Fabrik, late Goldenberg, Geromont, and Co., Germany* )

19,713. Bottle Stoppers, C. de Witt, London.

*17th October*, 1894.

19,714. Raising of Sunken Vessels, A. Leech, London.

19,715. Ferrules for Umbrellas, &c., T. Pounds, London.

19,716. Fixed Surgery Splints, W. H. B. Moorhead, Newry.

19,717. Rail-joints of Railways, F. Willdey, Apperley Bridge.

19,718. Excluding Dust from Bearings, A. E. Schurr, Sidcup.

19,719. Speed-regulating Gear, A. A. Watkins and J. de L. Watson, London.

19,720 Curling-tongs, R Friedel, London.

19,721. Lid or Cover for Saucepans, A. Lowe, Bristol.

19,722 Treating Worsted Fabrics, T. Illingworth, Bradford.

19,723. Flanges for Warp Beams, J. Steel, jun., Bradford.

19,724. Withdrawing Railway Spikes, A. Cochrane Manchester.

19 725. Railway Signal Apparatus, A. H. Cochrane, Manchester.

19,726. Leather Belt and Strapping, F. G. Cockill, Huddersfield.

19,727. Chain Adjustment, B. S. and B S. Roberts and Co., Birmingham.

19 728. Bolt and Nut-lock Appliance, A. D. Kennedy, Glasgow.

19,729. Coin-freed Apparatus, J. W. Johnson, Isle of Man.

19 730. Railway Signals, R. Burn and H. W. Talley London.

19,731. Hose Pipes, W. Wild, Manchester.

19,732. Hanging or Supporting Mirrors, J. Whitehead, Birmingham.

19,733. Electric Clock, W. Hearn and C. R. Gatehouse, London.

19,734. Spanner, H. T. Daniels and J. H. Pick Stamford.

19,735. Inverted Bicycle, B. Doyle, London.

19,736. Adjustable Socket, H. T. Daniels and J. H Pick, Stamford.

19,737. Material for Roofing Purposes, J. Wheeler Ilfracombe.

19,738. Circular Aperture Mount Cutter, S. A. Smith, Salisbury.

19,739. Pleated Paper Bottle Wrapper, L. Wookey London.

19,740. Pulsometers, J. L. Berry and F. Hampson, Manchester.

19,741. Wheels for Cycles and Vehicles, J. Markus, Manchester.

19,742. Electrical Switches, W. P. Theermann, Manchester.

19,743. Valve Guard or Protector, M. T. H. Teagle London.

19,744. Driving Gear, R. O. Cowan and W. Radford, London.

19,745. Roller Mountings for Blinds, P. C. Walker, Dublin.

19,746. Suspender for Ladies' Hose, E. Fottrell Dublin.

19,747. Fittings for Waist-belts, &c , H. Brookes, Birmingham.

19,748. Valves, W. M. Walters, Liverpool.

19,749. Travelling Bags and Fittings, J. B. Brooks, Birmingham.

19,750. Syphon Flushing Cistern, A. Haddow, Edinburgh.

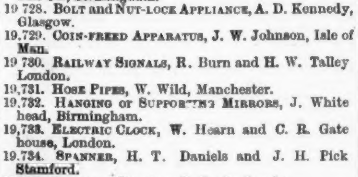
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**524,201.** Reversing Gear for Engines, *D. H. Grant and H. Miller, Raymore, Mo.—Filed March 31st* 1894.

*Claim.*—A reversing gear for engines, comprising a collar keyed on the main driving shaft, and formed with a lug, a sleeve adapted to be shifted axially and circumferentially, and arranged concentric on the said shaft, the said sleeve being formed with a spiral cam groove and a straight slot, of which the spiral cam groove is engaged by the lug on the said collar, and an excentric formed in the bore of its disc, with a lug engaging the said straight slot in the sleeve, substantially as shown and described.

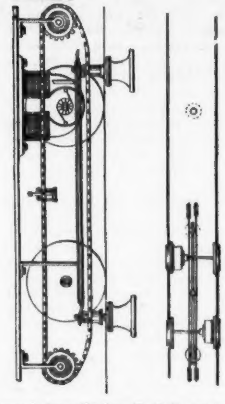
524,201



**524,368.** Electric Railway System, *T. B. Wilcox and H. Wilcox, Newark, N.J.—Filed August 16th,* 1892.

*Claim.*—(1) In an electric railway system, an insulated main conductor, in combination with a series of exposed insulated contact plates arranged along the track and normally disconnected from the said main conductor, a motor car, and electro-magnets carried by the car for connecting the said contact plates to the said main conductor, the said electro-magnets having a continuous movement with relation to the car while the said car is in motion, and the said electro-magnets being just as far apart as the said contact plates are distant from each other, as and for the purpose set forth. (2) In an electric railway system, an insulated main conductor, in combination with a series of exposed insulated contact plates normally disconnected from the said main conductor and arranged along the track, magnetic contact pieces within operative distances from the said plate, a motor car, and electro-magnets carried by the said car and having a continuous movement with relation thereto while the said car is in motion, the said electro-magnets being just as far apart as the said contact plates are distant from each other, as and for the purpose set forth. (3) In an electric railway system, a series of exposed magnetic surface plates arranged along the railway track, in combination with a motor car carrying an endless chain, a portion of which is in proximity to the said series of surface plates, and a series of magnetic devices supported upon the said chain, the said magnetic devices being just as far apart along the length of the said chain as the said surface plates are distant from each other, as and for the purpose set forth. (4) In an electric railway system, a motor car carrying a freely moving endless sprocket chain on which are mounted electro-magnetic devices contained in suitable boxes, a pair of trolley terminals on the said boxes arranged at the same level, and a bar making contact with the said terminals, and simultaneously pressing upon them to steady the boxes and their magnets, as and for the purpose set forth.

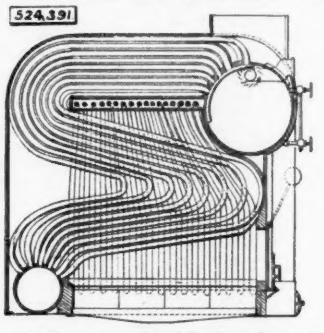
524,368.



**524.391.** Boiler or Steam Generator, *C. D. Mosher, New York, N.Y.—Filed January 7th,* 1893.

*Claim.*—(1) In a boiler or steam generator, the combination of a furnace or fire-box, a water drum located at the rear end of the fire-box, a steam drum located at the front end of the fire-box, said drums extending across the fire-box, a group of curved tubes connecting the upper portion of the water drum with the upper portion of the steam drum, said tubes being bent to form loops disposed in vertical planes extending lengthwise of the fire-box, return pipes extending vertically downward from the steam drum along the front of the fire-box and horizontally along the sides of the fire-box to the water drum, and side tubes springing from the horizontal portion of the return pipes and extending along the sides of the fire-box and constituting a lining therefor, as set forth.

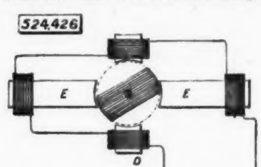
524,391



**524,426.** Electro-magnet Motor. *N. Tesla, New York, N.Y.—Filed October 20th,* 1888.

*Claim.*—(1) The combination in an electro-magnetic motor with a rotary armature of short magnetic cores as D D, and long magnet cores as E E, and energising coils around the same, those on the cores E E being placed at a distance from the inner ends of the said cores, as herein set forth (2) The combination in an electro-magnetic motor with energising coils adapted to be connected with a source of alternating currents, and cores of different magnetic susceptibility, of an armature wound with coils closed upon themselves, as herein set forth. (3) The combination in an electro-magnetic motor with a rotary armature of field cores of different magnetic susceptibility and energising coils thereon connected in series and adapted to be connected with a source of alternating currents, as set forth.

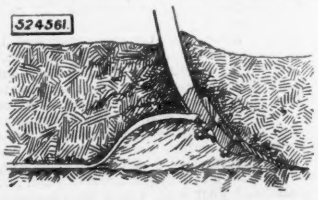
524,426



**524,561.** Cultivator, *J. Porteus, Fresno, Cal.—Filed January 10th,* 1894.

*Claim*—In combination with the shovel and shank of a cultivator, a means for guiding and steadying the cultivator, and preventing its vertical jumping movement, consisting of a bar having its forward end connected with the base of the shank, and its rear extending portion turned to present a broad, flat surface to the ground.

524561.



## EXPRESS PASSENGER LOCOMOTIVES, GREAT WESTERN RAILWAY.

THANKS to the courtesy of Mr. William Dean, the locomotive superintendent of the Great Western Railway, we are able this week to publish drawings of the latest additions to the locomotive power of that line. These engines are remarkable in several respects. They are the most powerful passenger engines at present running in Great Britain It will be seen that Mr. Dean has in the external configuration of the engine and tender adhered to Great Western practice as originated by the late Mr. Daniel Gooch. There is a general resemblance between the Achilles and the Great Britain for example, the bogie taking the place of the four leading wheels of the broad gauge engine. But here, of course, the resemblance ceases, the details being different. Mr. Dean adheres to the raised fire-box, but he adds a dome besides, holding that in this way he can secure maximum dryness of steam, a point of very great importance. Many of the principal dimensions can be obtained from the outline views on page 382, the remainder are set forth in the accompanying tables:—

*Achilles Class.*

| | |
|---|---|
| Cylinders: | |
| Diameter | 19in. |
| Stroke | 24in. |
| Steam ports | 1ft. 2in. × 2in. |
| Exhaust | 1ft. 2in. × 3¼in. |
| Boiler: | |
| Barrel | 11ft. 6in. |
| Diameter outs | 4ft. 2⅝in. and 4ft. 3in. |
| Fire-box: | |
| Outs | 6ft. 4in. × 4ft. |
| Ins | 5ft. 8in. × 3ft. 4in. |
| Height | 6ft. 2in. |
| Tubes: | |
| No. 266, diameter | 1⅝in. |
| Length | 11ft. 9¼in. |
| Heating surface: | |
| Tubes | 1434·27 square feet. |
| Fire-box | 127·06 square feet. |
| Total | 1561·33 square feet. |
| Area of fire-grate | 20·8 square feet. |
| Wheels: | |
| Bogie | 4ft. |
| Driving | 7ft. 8in. |
| Trailing | 4ft. 6in. |
| Water capacity of tender | 3000 gallons. |
| Working pressure | 160 lb. |
| Total weight of engine and tender | 81 tons 10 cwt. |

*Armstrong Class.*

| | |
|---|---|
| Cylinders: | |
| Diameter | 20in. |
| Stroke | 26in. |
| Steam ports | 1ft. 2in. × 2¼in. |
| Exhaust | 1ft. 2in. × 3¾in. |
| Boiler: | |
| Barrel | 11ft. 6in. |
| Diameter outs | 4ft. 2⅝in. and 4ft. 3in. |
| Fire-box: | |
| Outs | 6ft. 4in. × 4ft. |
| Ins | 5ft. 8in. × 3ft. 4in. |
| Height | 6ft. 2in. |
| Tubes: | |
| No. 266, diameter | 1⅝in. |
| Length | 11ft. 9¼in. |
| Heating surface: | |
| Tubes | 1434·27 square feet. |
| Fire-box | 127·06 square feet. |
| Total | 1561·33 square feet. |
| Area of fire-grate | 20·8 square feet. |
| Wheels: | |
| Bogie | 4ft. |
| Driving | 7ft. |
| Trailing | 7ft. |
| Water capacity of tender | 3000 gallons. |
| Working pressure | 160 lb. |
| Total weight of engine and tender | 83 tons 6 cwt. |

The Achilles class are employed in working the principal main line trains between London and Newton Abbot. We annex a memorandum showing the average loading of these trains for one week in the month of June last, before the heavy summer traffic commenced. In the two years ended June last there were twenty of these engines in steam daily, working as under:—Seven at Paddington, working between Paddington and Bristol; eight at Bristol, working between Bristol and Newton Abbot and Paddington and Bristol; five at Newton Abbot, working between Bristol and Newton Abbot. The average consumption per mile of the engines, taken over the whole of the two years, was as under:—Paddington, seven men, 31 lb. per mile; Bristol, eight men, 33 lb. per mile; Newton Abbot, five men, 31·8 lb. per mile. These figures include coal for lighting up.

It will be seen that the boilers for these two classes are identical in all respects, and so are the tenders. It is possible, therefore, to draw a fair comparison between the performance of a single and a coupled engine. Indeed, both types are employed in working the same traffic. But the coupled engines have not been sufficiently long a time at work to permit a trustworthy estimate of their performance to be made at present.

The coupled engines having 20in. cylinders, their tractive effort is approximately 124 lb. per pound of average effective cylinder pressure. Taking this at 100 lb., we have 12,400 lb. tractive effort. The load on the driving and trailing wheels is 31·5 tons, or rather less than six times the tractive effort. At starting, when a pressure 50 per cent. greater may exist in the cylinders, the wheels could be readily made to slip; but the proper use of sand disposes sufficiently of that difficulty. It is well known that 19in. and 19·5in. cylinders have been tried in this country before now, and they have not given satisfaction; but that was mainly, we think, because they were not built with boilers of adequate dimensions. Mr. Dean provides no less than 1560 square feet of surface, a very large fire-box, and nearly 21 square feet of grate surface. If the engine burns 70 lb. of Welsh coal per square foot per hour, the total consumption would be 1470 lb. per hour, and allowing that each pound of coal produces but 9 lb. of steam, we have still 13,230 lb. evaporated per hour, which, at 25 lb. to the horse-power per hour, gives about 530-horse power, which can of course be kept up for any time. The probability is, moreover, that the evaporation would be more nearly 10 lb. than 9 lb., and that the engine would use less than 25 lb. of steam per horse per hour, so that 600 indicated horse-power may perhaps be reckoned upon. Taking the actual consumption, without including lighting up, however, at about 31 lb. per mile, and reducing this to fifty miles an hour as a standard, we have 1550 lb. burned per hour, or 74 lb. per foot of grate, and the actual power developed is probably about 600 indicated horse-power.

Turning now to the single engine, we have a tractive effort of about 9400 lb. for an average pressure of 100 lb., or a little less than one fourth of the load on the drivers. Thus, even with sand, the engines cannot utilise the whole tractive effort of the steam in starting a train; but when running at high speeds the average pressure is less than 100 lb., and consequently the adhesion is sufficient. Taking again fifty miles an hour as a standard speed, which is, as we shall show in a moment, not far from the truth, we find that 7·5 lb. tractive effort represents one horse-power. Taking as before 600 as the total average horse-power, we have 4500 lb. as the tractive effort, which is of course a long way inside the limit at which slipping of the driving wheels would begin.

It is not easy to arrive at the precise weight of the trains. The coaches of the corridor train—that is the 10.15 a.m. down train from Paddington—weigh from 21·5 to 24 tons. The ordinary eight-wheeled coaches, which vary in length from 40ft. to 56ft., weigh from 16·5 tons to 23·5 tons. In taking the average load of the trains as given below, the total number of carriages is divided by the number of days; the result being worked out to the first place of decimals. We shall probably not be very far wrong if we assume that the average weight of a train such as the 5 p.m. is 200 tons, or including the engine and tender, 283 tons, and assuming that 4500 lb. of tractive effort suffices to haul it at fifty miles an hour, we have a resistance of a little less than 16 lb. per ton. As the road is nearly level, it is quite possible that this is very close to the truth, and the fact bears testimony to the ease with which the coaching stock runs. It will be seen, indeed, that if the resistance was much in excess of this figure it would be quite impossible that the engines could do the work on the stated consumption of fuel, unless, indeed, the evaporation efficiency of the boiler and the steam efficiency of the engines are very much in excess of anything we can believe to be possible. It is easy, moreover, to check the results so far by parallel calculations. Taking 600-horse power at 25 lb. of steam per horse per hour, we have 15,000 lb. of water, or 1500 gallons evaporated per hour. The total heating surface is 1561 square feet. Consequently steam is made at the rate of about 9·6 lb. per square foot per hour, which is a high, though not an excessive, rate.

By selecting any other standard speed, something like ideas of precision may be formed concerning the performance of these or indeed of any other locomotives. Thus, if we cut the speed down to twenty-five miles an hour, the average pressure and tractive effort must be doubled in order that the horse-power may remain constant. All such calculations, however, confirm the view that the astonishing statements sometimes put forward concerning the power developed by locomotives will not bear investigation. The ultimate appeal must be to the performance of the boiler. That, of course, does not know whether it is locomotive or stationary; a hint which it is needful to throw out, seeing that many persons appear to think that a square foot of grate or of heating surface in a locomotive must be much more efficient than it would be in a stationary boiler. The only advantage possessed by the locomotive boiler is that as compared with the land boiler of the same type and dimensions, it is much less given to priming, probably because the oscillation of the engine tends to shake the steam out of the water. As to the actual performances of the Great Western engines, we give the Table* A in the next column of trains running at and over fifty miles per hour.

Mr. Dean has produced two splendid types of passenger engines. The only feature in the design to which we think exception will be taken is the raised outer fire-box; but, after all, this can only be a matter of opinion. No doubt it gives more steam room and drier steam, and we are not aware of any countervailing disadvantage except that the boiler possibly costs a little more. The Achilles type ought to be competent to work any conceivable traffic at high speed on a level road, while the Armstrong type will not be less effective on roads with moderate gradients. Both are undoubtedly admirably adapted to the purpose for which they have been constructed, and reflect much credit on Mr. Dean.

*Great Western Railway.—Average Loads of Trains Worked by 7ft. 8in. Engines for One Week, June, 1894.*

| Train. | From Paddington. | | | From Bristol. | | | From Exeter. | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wheels. 8 | Wheels. 6 | Wheels. 4 | Wheels. 8 | Wheels. 6 | Wheels. 4 | Wheels. 8 | Wheels. 6 | Wheels. 4 | |
| Down Trains. | | | | | | | | | | |
| 5.35 a m. ex Paddington .. .. | 9·5 | ·8 | 3·1 | | | | | | | Not worked by 7ft. 8in. engine beyond Bristol. |
| 9.0 " " .. .. | 8·1 | ·1 | | 8·5 | ·5 | | 6 | | | |
| 10.15 " " .. .. | 6·1 | | | 6 | | | 6·1 | ·1 | | |
| 11.25 " " .. .. | 7 | | | | | | | | | Not worked by 7ft. 8in. engine beyond Swindon. |
| 11.45 " " .. .. | 7 | | | 7 | | | 6·1 | | | |
| 1.15 p.m. " .. .. | | | | 6·1 | | | 6·1 | | | Not worked by 7ft. 8in. engine Paddington to Swindon. |
| 3.0 " " .. .. | 7·3 | | ·1 | 7·1 | | | 6·1 | | | |
| 5.0 " " .. . | 10 | | | 7 | | 2·1 | 7 | | 1·3 | |
| 9.0 " " .. .. | 9 | ·1 | | 9 | ·3 | 2·1 | 8 | ·3 | 2 | |

| Trains. | From Exeter. | | | From Bristol. | | | Paddington. | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wheels. 8 | Wheels. 6 | Wheels. 4 | Wheels. 8 | Wheels. 6 | Wheels. 4 | Wheels. 8 | Wheels. 6 | Wheels. 4 | |
| Up Trains. | | | | | | | | | | |
| 4.50 p.m. ex Penzance .. .. | 9 | 1 | ·8 | 9 | 1·1 | ·5 | 9 | ·5 | ·8 | |
| 8.25 a m. ex Exeter .. .. .. | | | | 6 | ·5 | 1·3 | 6 | | 1·6 | |
| 8.45 " Plymouth .. .. | 6 | | | 7 | ·1 | | 8 | | | |
| 8.0 " Truro .. .. .. | 7·1 | | | 7·1 | | ·1 | 7·1 | | ·1 | |
| 8.15 " Penzance .. .. | | | | | | | 7·1 | ·1 | | Not worked by 7ft. 8in. engine Exeter to Swindon. |
| 11 5 " Penzance .. .. | | | | 6·3 | | | 6·3 | | | |
| 10.50 " Plymouth .. .. | 5·4 | | 1·4 | 7·1 | | 1 | 6 | ·1 | | |
| 3 58 p m. ex Plymouth .. .. | 7·1 | ·3 | ·5 | 6·1 | | | 6·1 | ·1 | ·1 | |

TABLE A.

| Train. | From. | To. | Dist. | Time | | Speed |
|---|---|---|---|---|---|---|
| | | | Miles | H. | M. | |
| 10.15, 10.45, .25, 11.45, 1.15, and 3.0 .. .. | Paddington | Swindon | 77¼ | 1 | 27 | 53¼ |
| 12.58, 1.26, 3.3, 6.18, 6.58, and 8.36 .. .. .. | Swindon | Paddington | 77¼ | 1 | 27 | 53¼ |
| 3.15 .. .. .. .. .. .. | Paddington | Swindon | 77¼ | 1 | 30 | 51½ |
| 1.5, 5.0, and 6.0 .. .. .. | Swindon | Paddington | 77¼ | 1 | 30 | 51½ |
| 4.43 .. .. .. .. .. | Swindon | Paddington | 77¼ | 1 | 32 | 50⅜ |
| 3.56 .. .. .. .. .. | Swindon | Reading | 41¼ | 0 | 49 | 50½ |
| 4.49 .. .. .. .. .. | Didcot | Westbourne Pk. | 51¾ | 1 | 2 | 50 |
| 12 52 .. .. .. .. .. | Bristol | Exeter | 75½ | 1 | 28 | 51½ |
| 3.40 .. .. .. .. .. | Exeter | Bristol | 75½ | 1 | 28 | 51½ |
| 2 9, 2 30, 3 45, 4 3, and 5.45 .. .. .. .. | Bristol | Taunton | 44¾ | 0 | 51 | 52¾ |
| 12.7 .. .. .. .. .. | Bristol | Taunton | 44¾ | 0 | 53 | 50⅝ |
| 11.18, 11.31, 12 55, 4.49, and 6 26 .. .. .. | Taunton | Bristol | 44¾ | 0 | 52 | 51⅝ |
| 2.40 .. .. .. .. .. | Taunton | Bristol | 44¾ | 0 | 53 | 50⅝ |
| 6.9 .. .. .. .. .. .. | Oxford | Birmingham | 65¾ | 1 | 19 | 50 |
| 9.33 .. .. .. .. .. | Oxford | Leamington | 42½ | 0 | 51 | 50 |

## THE MANCHESTER THIRLMERE WATERWORKS

### No. II.

IN our issue of October 19th we gave a map showing the line of aqueduct between Thirlmere and Manchester. We now publish a map showing the contour of the lake at the old level, 330 acres in extent, and also the area covered by water after it has been raised to the full height contemplated, viz., 50ft., when the area will be 800 acres. It is proposed from time to time to increase the supply of water by 10,000,000 gallons per diem. The following table gives the quantity of water impounded, according to the height added to the original level of the lake:—

| | |
|---|---|
| 20ft. | 2,534,000,000 gallons. |
| 30ft. | 4,192,000,000 " |
| 40ft. | 6,066,000,000 " |
| 50ft. | 8,135,000,000 " |

When raised to the full height, 50ft., water will be stored, sufficient to give a supply of 50,000,000 gallons daily for 160 days' continuous drought, after providing for 5,500,000 gallons per diem compensation water. This added to the 25,000,000 gallons procurable from Longden Dale, puts Manchester in possession of a supply of 75,000,000 gallons per diem.

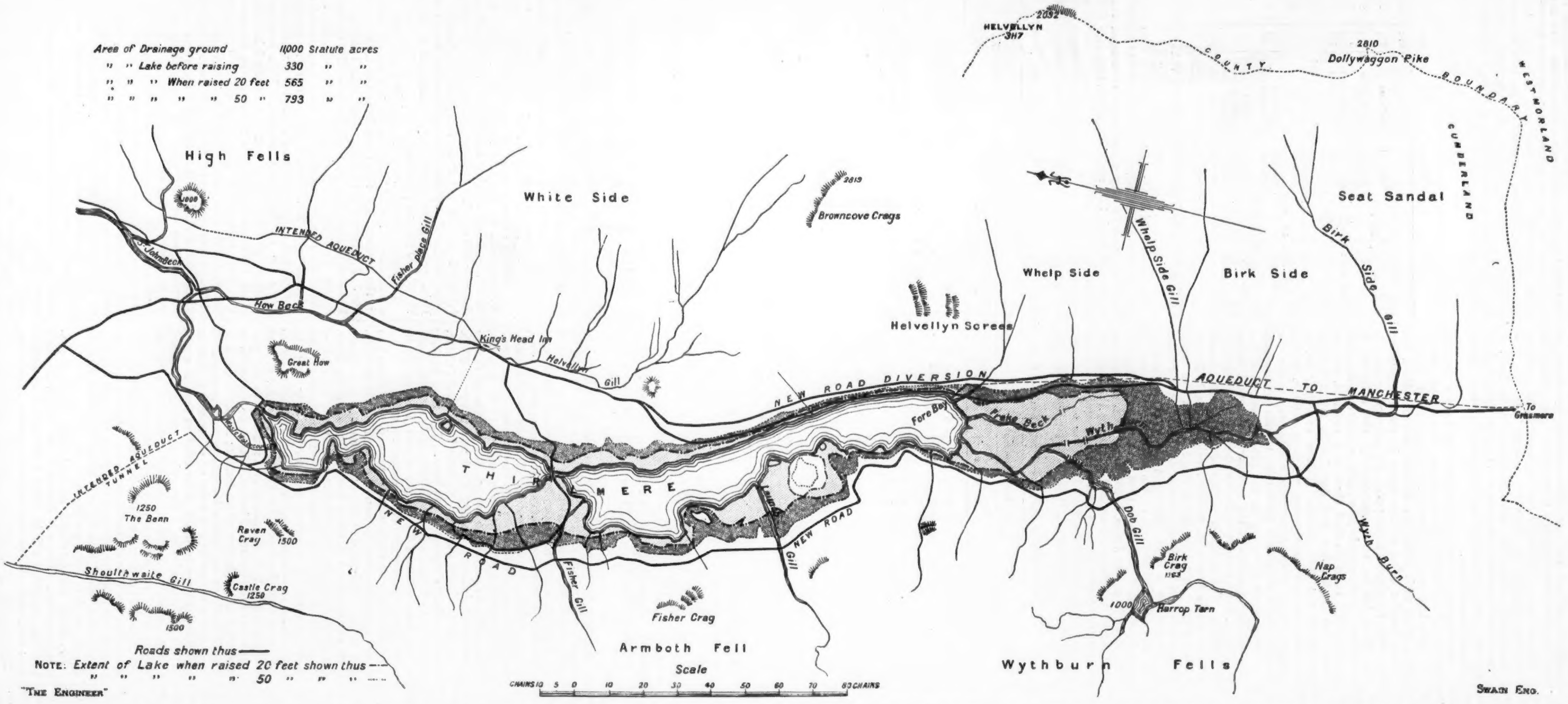
Thirlemere having been selected by the Corporation, a committee of five of their number was appointed to act in the matter. Of this committee the only survivor is Sir J. J. Harwood, who has since been twice Mayor of Manchester, and has been chairman of the Water Committee since 1886. They were given authority to purchase by private contract the land and water rights referred to in Mr. Bateman's report, so as to give the Corporation a good position whenever it was decided to apply for parliamentary powers. This involved the purchase of all rights connected with the lake itself, and of the 11,000 acres of land comprising the drainage area. The Corporation had learnt by costly experience in Longden Dale that unless the whole control was obtained at the commencement of the scheme the expense incurred when additional land was required for works and other purposes was much greater, to say nothing of claims arising from cattle and sheep straying and getting drowned. With the Corporation as owners of the land the tenants are more careful for the safety of their stock, as the loss falls upon the occupier. The wisdom of this policy has been acknowledged, and the example followed by Liverpool and Birmingham, in Wales.

Lake Thirlmere is situated in Cumberland, at the foot of Helvellyn, alongside the road from Keswick to Grasmere, and is about three miles long and a quarter of a mile across at its widest part; its natural depth is about 112ft. at its deepest part. At the southern end the land is flat, and appears to have been covered with water in olden times. At the north-east corner there is a narrow gorge forming the outlet through which St. John's Beck finds

---

* We may refer our readers who desire further information about express Great Western trains to a very interesting little book by Mr. P. J. Vintner, published by Messrs. Hoyten and Cole, Plymouth.

# THE THIRLMERE MANCHESTER WATER SUPPLY


Area of Drainage ground 11,000 Statute acres
" " Lake before raising 330 " "
" " " When raised 20 feet 565 " "
" " " " " 50 " 793 " "
Roads shown thus
NOTE: Extent of Lake when raised 20 feet shown thus
" " " " " 50 " " "
Scale
CHAINS 10 5 0 10 20 30 40 50 60 70 80 CHAINS
High Fells
White Side
Whelp Side
Birk Side
Seat Sandal
Helvellyn Screes
Browncove Crags
2819
HELVELLYN 3117
2032
2810
Dollywaggon Pike
COUNTY BOUNDARY
WESTMORLAND
CUMBERLAND
INTENDED AQUEDUCT
INTENDED AQUEDUCT TUNNEL
Fisher place Gill
St. John's Beck
How Beck
Great How
King's Head Inn
Helvellyn Gill
NEW ROAD DIVERSION
AQUEDUCT TO MANCHESTER
To Grasmere
Whelp Side Gill
Birk Side Gill
Fore Bay
Wyth Burn
Dob Gill
Birk Crag 1163
Harrop Tarn
1000
Nap Crags
THIRLMERE
NEW ROAD
Launchy Gill
Fisher Gill
Fisher Crag
Armboth Fell
Wythburn Fells
1250 The Benn
Raven Crag 1500
Castle Crag 1250
1500
Shoulthwaite Gill

"THE ENGINEER"

SWAIN ENG.

its way to the Greta, and ultimately through Derwentwater and by the river Derwent to the sea at Workington.

The surrounding hill sides are very steep and are covered with very little verdure. They consist of silurian rock, and rain falling from the clouds finds its way at once into the lake. The gorge enables an embankment or dam to be readily constructed, and the level of the water to be raised as required. Another advantage gained by taking Thirlmere instead of Ullswater is that the latter is to some extent surrounded by residential property, and lead is worked within the watershed.

The task imposed upon the committee was a difficult and delicate one to undertake. A portion of the property was in the hands of families who had owned it and resided on it for generations. Generally the land was held by "customary or copyhold tenure," which means that the sheep are let to the tenant with the farm and had to be purchased. By June, 1877, the committee felt able to recommend the Corporation to promote a Bill in Parliament to obtain power to carry out the scheme of raising the waters of Lake Thirlmere and conducting them to Manchester. It was stated that the cost of the Longden Dale Works, exclusive of distribution, had been about £90,000 per 1,000,000 gallons per diem, and that the cost of Thirlmere water would be about £100,000 per 1,000,000 gallons per diem for the first 20,000,000 gallons, and about £60,000 per 1,000,000 gallons per diem when 50,000,000 gallons of water per diem was taken from the lake. Up to this time the question of going to Ullswater for an additional supply was still under consideration; but before preparing the parliamentary plans, it was decided, on the advice of Mr. Bateman, to confine the scheme to Thirlmere. The pecuniary value of gravity is shown in his report, wherein he says, "That as Thirlmere lies at a height of 56ft. above Ullswater, if this additional fall was regularly distributed it would save about £200,000 in outlay, and deliver water at the temination of the aqueduct from 15ft. to 20ft. higher than if the conduit was placed at a level to bring water from Ullswater."

This saving he showed would entail a somewhat greater outlay of iron pipes when a further instalment of water was required; but the present saving of £200,000 appeared of sufficient importance to warrant the change. How much greater would the saving of capital have been if Liverpool had joined with Manchester in going to the lakes for a supply? As will be seen on reference to the map published on the 19th inst., the water taken from Rivington for the supply of Liverpool crosses the Thirlmere Aqueduct south of Chorley; and by means of additional pipes laid in the same track, if found desirable, a plentiful supply of water could have been sent to Liverpool.

The Bill was deposited in December, 1877, and a great parliamentary fight began. Not only was there opposition from interested landowners all along the route of nearly ninety-six miles, but also of Corporations of towns, railway and canal companies, and last, but not least, the Thirlmere Defence Association. This Association appealed to the public to preserve the Lake District from the "needless intrusion of works on a large scale." In all thirty-three petitions were presented against the Bill.

The House of Commons devoted two hours to its consideration, on the second reading, it having been urged that two new principles were contained in the Bill, viz., permission for a Corporation to enter into a speculation in water supply, and also the right of one district to resort to another 100 miles away for its water. It was therefore determined that the more formal submission to a Hybrid Committee should be made instead of the usual Select Committee appointed to sit on private Bills. A strong committee of nine members was appointed, on which Dr. Lyon Playfair, now Lord Playfair, was chosen as chairman, and Sir J. Lubbock, who subsequently sat on a similar committee to consider the Liverpool water supply, was an important member. The committee sat during nineteen days, and so strong was the local opposition, that a deputation from Manchester hurried to the neighbourhood, and explained to the inhabitants the advantages they would obtain in the way of employment, in the market for their produce, and the stimulus to trade generally, which the district would derive, if the works were proceeded with. These facts having been brought home to the population, and the local boards having passed resolutions in favour of the Bill, the local opposition was beaten. A careful and exhaustive report was made to the House by the committee approving of the scheme, but stating that towns and rural districts along the line of aqueduct had applied to be provided with water, and that in their opinion such supply should be reserved for them; giving, however, a prior right of 25 gallons a head to the population of Manchester, the cost of supply to be a matter of agreement, but if no agreement could be arrived at, then the cost to be at the rate of 4½ per cent. on the proportion of the capital expended to produce the supply demanded, and a like proportion of an annual sum of £20,000 for maintenance and management—practically a 5 per cent. charge.

Clauses to provide for the supply of local authorities were consequently inserted in the Bill, and were the cause of its failure to pass during the session; the examiner on Standing Orders for the House of Lords having reported that a new object had been brought within the scope of the Bill of which notice had not been given; and in those days, when Lord Redesdale was chairman, it was considered impracticable to obtain the sanction of the House to a departure from their Standing Orders. Since then we have seen both Houses of Parliament very amenable to arguments put forward by Manchester to enable Bills to be introduced which had not complied with Standing Orders.

It was felt that much time and much of the ratepayers' money had been expended in vain, but it was thought that so important a Bill, which was really a commencement of a new era in waterworks legislation, was bound ultimately to succeed, for the Bill had become not merely a Bill to supply Manchester and its immediate neighbourhood, but also to supply water to the large and populous towns in the neighbourhood of the intended works.

In the following session the Bill was reintroduced with the addition of the clauses required by the committee of the House of Commons, and passed with practically no opposition. Thus Manchester became entitled to draw a plentiful supply of water, the quality of which is shown by the following analysis, which also compares the water from Thirlmere with the Manchester supply from Longden Dale, and the Glasgow supply from Loch Katrine. The analysis was made by Sir Henry Roscoe, F.R.S., M.P.:—

| | | | Comparison with | | | |
|---|---|---|---|---|---|---|
| | | | Manchester. | | Glasgow. | |
| | Grains per gallon. | Parts per million | Grains per gallon | Parts per million | Grains per gallon. | Parts per million. |
| Total solids ... ... | 1·45 | 20·71 | 4·70 | 67·14 | 2·30 | 32·85 |
| Chlorine... ... ... | 0·40 | 5·71 | 0·70 | 10·00 | — | — |
| Free ammonia ... | 0·00 | 0·00 | 0·0021 | 0·03 | 0·00 | 0·00 |
| Albuminoid do. ... | 0·0049 | 0·07 | 0·0056 | 0·08 | 0·0056 | 0·08 |
| Nitrogen as nitrates and nitrites ... | 0·0247 | 0·35 | 0·017 | 0·24 | 0·0222 | 0·317 |
| Total hardness ... | 0 5 | — | 2·0 | — | — | — |
| Permanent do. ... | 0·5 | — | 2·0 | — | — | — |

Manchester water is supplied for use without filtration, and is found to be of excellent quality. The Act of Parliament contains clauses for the preservation of the scenery in the lake district, the operations of which extend to such parts of Cumberland and Westmoreland as are within 23 miles of Thirlmere, and requires that all reasonable care should be taken to preserve the beauty and distinctive features of the district for the public as well as for private owners. All mounds of surplus earth have been suitably planted so that the same may not disfigure the scenery. The surface of the lake may not be lowered below its ordinary level without the previous sanction of the Board of Trade. All valleys have been crossed by syphons, except in crossing the streams and rivers over which the aqueduct is shown on the deposited plans as carried above the surface of the ground. Portions of the aqueduct made in cut and cover have been re-soiled and planted, and no wall or fence has been erected on the land over the aqueduct without the consent of the owner of such land. The time for the construction of the works was limited to three years from the commencement of operations. The capital to be raised for the purpose of the Act was fixed at £3,425,000 to be redeemed by means of a sinking fund sufficient to repay the money raised within a period of 70 years from the date prescribed from the commencement of the sinking fund.

## THE ATLAS WORKS, SHEFFIELD.

On Friday, October 26th, Lord Rosebery and the guests of the Master Cutler visited the Atlas Steel and Ironworks of Messrs. Sir John Brown and Co., and were conducted round, and shown a number of the most striking and important operations, by Mr. J. D. Ellis, the chairman, and with other partners and the staff of the works.

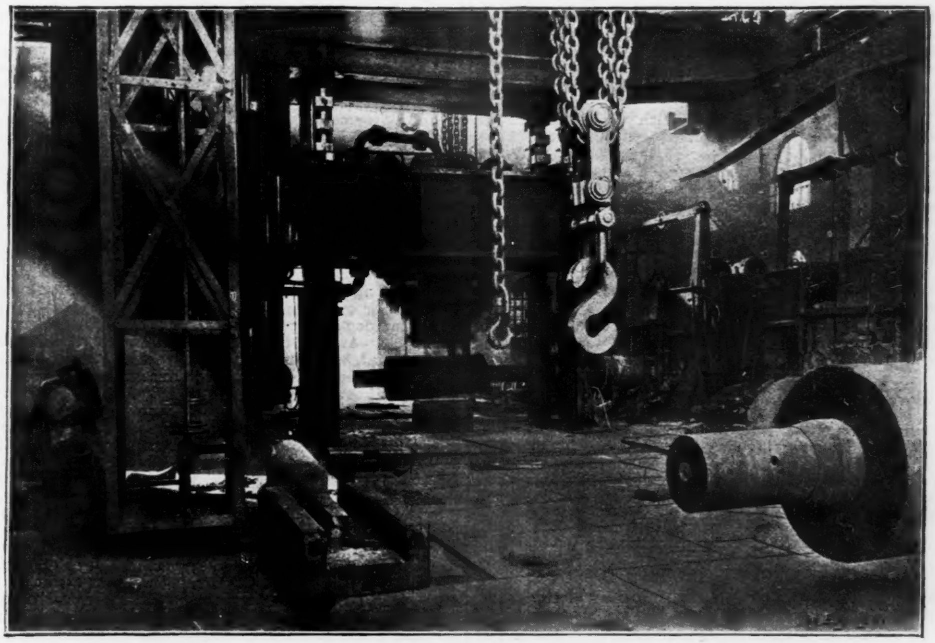
Such a visit naturally calls attention to the features of special interest that exist in such an establishment at the time. Messrs. Brown have obtained exhibition awards for many of the structures and designs seen on this occasion, such as Serve tubes, Purves' ribbed flues, and shafting. The subject of highest interest, however, is the armour now made on the method comprising the Harvey and Tresidder processes. As many of us are aware, some manufacturing difficulties have been caused by the extreme hardness of the face which has produced such remarkable results as a shot breaker; and some doubts have been expressed as to the power of bringing plates with chilled faces to the exact curves required for the different shields. As will be seen below, the former difficulty is met by drilling the holes required in the plate face and filling them with ganister and loose plugs before the hardening treatment, although it is possible with the use of the electric arc drill to make holes, if necessary, when no nickel is present in the armour. The latter difficulty has been overcome by leaving the necessary allowance for warping, and also slightly erring on the side of over rather than underdoing the required curves, as it has been found that a slight correction can be made with the hydraulic press if it takes the shape of compressing the hard steel face, not of stretching it. Probably the application of the jets of water against the upper and under faces of the plate in the horizontal position in the Tresidder chilling process was an operation that had been witnessed by few of the visitors, and the interest may be said to have focussed there, though the forging of a 27-ton plate for H.M.S. Magnificent was interesting to all, and the grand example of a heat burnt and run from the Bessemer converter had its special attractions for any who are not familiar with such operations. We give herewith a short account of the Atlas Works in general, and its armour manufacture in particular.

The Atlas Works are situated on the Midland Railway, were originally purchased by John Brown and Co. in the year 1854, the partners in the original firm being Sir John Brown, Mr. J. D. Ellis, and the late Mr. William Bragge. In 1864 the present limited company was formed, with Sir John Brown as chairman, and on his retirement, Mr. J. D. Ellis was appointed, and from that time has remained chairman of the company. It will be interesting to remember that these works took the first licence from Sir Henry Bessemer for his process, and fought the up-hill fight of the introduction of Bessemer steel rails, tires, and axles now almost universally in use. As has been the case in many subsequent inventions taken up, the first order for steel rails was obtained from abroad, and as an instance of the difficulty to obtain a trial, it was necessary to give a twenty years' guarantee.

At these works mild steel for shipbuilding was produced at the earliest period of its introduction in England, and thousands of tons made by the Bessemer process were supplied to the Admiralty and to private builders. Siemens steel becoming then specified for boiler plates, a Siemens plant was laid down for the same, but in consequence of the extra cost of production, necessitated by the heavy railway rates on raw materials and manufactured articles, the large business in steel rails, ship and boiler plates and bars, in which the works led the van, has been given up, and other industries equally or more important have been developed in their stead.

ARMOUR PLATE PLANING SHOP

The armour-plate manufacture commenced in 1859 with rolled wrought iron plates, which increased in thickness from 4in. to 24in. in course of time. In 1877 the company commenced the manufacture of compound armour on Mr. Ellis' patent system, and from that date this kind of armour has been employed in the construction of the most important battleships and other vessels, both for this country and abroad. Chrome and nickel steel plates are also made, and recently the plant has been laid down for supplying armour treated according to the Harvey and Tresidder patents. The rolling mill now in use was laid down in 1862, and has been in use ever since that date, while in the planing department large and powerful machinery has from time to time been erected, in order to meet the altered requirements of the trade.



THE FORGING PRESS

The blast furnaces were erected in 1873, and are capable of an output of about 1000 tons per week. The ore is principally brought from the company's own mines. The Purves patent flue shop, with its interesting special machinery, was commenced in 1887, and occupies the site of a large iron forge. Over 14,000 of these flues have now been made, and are in use in all parts of the world.

The large hydraulic forging press of 4000 tons power, and the powerful lathes and other finishing machinery, have been working since 1887, and are capable of dealing with the largest shafting and gun forgings. To meet the requirements of the latest type of armour, a new hydraulic press of 10,000 tons power is now being constructed. The large hydraulic press for the flanging of marine boiler plates can deal in one operation with a plate 20ft. by 10ft. It has flanged thus many thousands of boiler end plates, both in iron and steel.

The Serve tube is one of the latest specialities taken up by the company, and a large special shop is almost completed for its manufacture. About seventy ships and four hundred locomotives have been fitted with this special tube to date, and the success attending the same in turning into economy what would otherwise be waste heat has given a great impetus to the demand of late. This tube has also led to a very important improvement in boilers for use both on land and at sea. A much smaller number, or smaller sized boilers give, it is claimed, by the "Ellis and Eaves" suction draught combination the required steam more economically than in the old boilers, without risk to boilers, without smoke, and with much greater comfort to the firemen. Vessels for Australian and Atlantic voyages thus fitted are giving great satisfaction.

In 1873 the company purchased the Aldwarke and Car House Collieries, near Rotherham, which give now an output of about 3550 tons per day of superior gas, steam, and house coal. Recently the sinking of a further large pit, the Rotherham Main Colliery, has been completed, and gradually the output will be increased to about 2000 tons per day. Of this combined large quantity about 700 tons per day are used at the Atlas Works, exclusive of about 150 tons of coke per day, also made at the collieries.

The following are the objects and operations shown in connection with the manufacture of armour:—Historical group of armour plates, illustrating the types of plates in vogue at various periods and the nature of test to which they were submitted for acceptance. Period from 1859 to 1864, wrought iron plates tested with round cast iron projectiles. Period from 1864 to 1877, wrought iron plates tested with Palliser pointed projectiles of chilled cast iron. Period from 1877 to 1879, compound plates tested with Palliser projectiles. Period from 1879 to 1892, compound plates and steel plates tested with forged and hardened chrome steel projectiles.

*Plates of the present day.*—Nickel steel plates introduced about 1890. A 4in. sample was shown that has been tested—without backing—with Palliser shot. Harveyed plates introduced about 1892. These are of steel, with or without nickel. A 6in. nickel steel sample was shown that has been tested with forged and hardened chrome steel projectiles. Two experimental plates were also shown illustrating the wonderful results obtained against the best steel projectiles by submitting the ordinary compound plates to Tresidder's chilling process, which is also used in the last stage of manufacture of the Harveyed plates. These hardened compound plates did not go beyond the experimental stage—an admirable one obtained as award at Chicago.

*Armour-plate rolling mill and hardening apparatus.*—The rolling of a slab weighing thirty-three tons for the production of Harveyed $\frac{9}{14}$in. plate for H.M.S. Magnificent; the chilling of a 9in. Harveyed plate for H.M.S. Majestic. The chilling is practically the final stage in the manufacture of Harveyed plates. The plate is heated in a special regenerative gas furnace, by which a very easily regulated and uniform heat is obtained. The roof of this furnace, weighing twenty tons, is lifted in one piece by a crane, and travelled to one side, while a second crane comes over the furnace, picks out the plate with four dogs, and places it over the lower douche of the chilling apparatus. The upper douche, suspended from a carriage running on overhead rails, is then immediately advanced, and makes an automatic water-tight connection with the pump delivery. A patent indicating apparatus is then adjusted on each of the long edges of the plate, by which the change of form during the whole chilling operation is automatically and instantaneously recorded. This does not take many seconds, and immediately it is completed the then shape of the plate, which may have slightly changed during heating and handling, is known, and the best method of applying the water decided upon. The water is then immediately turned on, and issues from thousands of small orifices with great pressure upon both the upper and lower surfaces of the plate, cooling them almost instantaneously. The application of the water is continued in the case of 9in. plates for from thirty-five to forty minutes, and the plate is then usually from ⅛in. to ¼in. more convex on the face than required by the finished moulds. This convexity is purposely aimed at, because it can easily be remedied by pressure while the plate is cold, whereas an error in the concave direction could not be rectified without going through the whole chilling process again. Absolute accuracy of form from the chilling operation it is practically impossible to secure. After the chilling is finished, the plate is tested with large hardened cast steel punches, struck with a sledge hammer, which must be fractured against the hard surface without making an appreciable indent. All holes in the hard surface required for attachments will have been made previous to the chilling, but the final trimming of the edges to exact shape has to be carried out subsequently. This is accomplished on a planing machine as far as regards the soft portions of the edges, but as the planing tool comes up the edge to within about three-quarters of an inch of the hard surface, the material becomes too hard to be cut with a steel tool. The projecting rib thus left is removed by grinding, either on a large grindstone, or an emery wheel used as a planing tool. Finally, the bolt holes in the back of the plate by which it is attached to the ship are drilled and tapped, and the plates are erected in their proper relative position, and any slight deviation from exactness of fit is further corrected by subsequent grinding.

In the planing shops, one of which we illustrate, large numbers of plates in various stages of completion are to be seen, by far the larger number of them being Harveyed plates. It will be interesting from the taxpayer's point of view to state that the introduction of this class of armour has enabled the naval architect to provide for about £20 the same protection over the same area as previously cost £30, and at the same time to effect a saving of one-third in the weight of armour necessary.

*The forging presses.*—The hydraulic forging press, one of which we illustrate, is a very important tool. It exerts a total power of 4000 tons, and the water pressure, which is supplied by a pair of engines indicating 2000-horse power, is delivered into the press at a pressure of 2½ tons per square inch. The width of the press between columns is upwards of 15ft., and it can squeeze ingots and armour-plates of a total width of 9ft. Messrs. John Brown and Co., having in view the immense weights and sizes of the plates now being ordered by the various Governments, have in course of construction at Messrs. Whitworth's a 10,000 tons forging press which will handle ingots of 70 to 80 tons with much greater facility than the present arrangement of forging presses allows. This will be at work in seven or eight months, and will be the largest forging press in the world.

## THE IRON GATES OF THE DANUBE.

By Bela von Gonda, Chief of the Department of Navigation of the Interior.

In the article on these important works, published in The Engineer on the 8th of June last, reference was made to the interesting remains of the works carried out under Trajan for the improvement of the Danube navigation. Reference was also made to the Stenka cataract, which is the first obstacle on the Báziás-Turnseverin line of the Lower Danube—viz., a rock peak obtruding into the channel, where the fall of the water is not a large one (the gradient being only 0·000357 to 1 metre), and only the required navigable water-depth had to be established. For this purpose a straight waterway will be cut along the left shore at a distance of 300 metres, beginning at the channel of the river, and for a length of 850 metres, 2 metres deep below the lowest water, and of a bottom width of 60 metres, which will be accomplished by the blasting of the rocky bottom; 7400 cubic metres of rock have here to be moved. Fifteen kilometres from this is the double bank called Kozla Dojke, which forms a much more formidable navigation hindrance. It is in the wider channel, above the brooks of the Kozla and Sirinya and the Dojke barricades, the channel below this brook, at the beginning of the narrowing of the channel, so that the current of the river is obliged to leave the left shore and cross to the right to reach the deepest part, which is at the end of the rocky bank Dojke. The removal of the navigation hindrance formed by the rock banks of Kozla and Dojke, where the fall of the water is not so unfavourable, that it could be considered disadvantageous for the navigation—the proportional fall of the low water being 0 00093—only a navigation channel is projected by the blasting of the rocky bottom. This channel will lead from above the Kozla and from the natural current of the river. It takes a curve of large radius along the left shore, cutting through the bank of the Dojke, and will be constructed also with a bottom width of 60 metres, 2 metres deep below lowest water, and it will require the blasting and removal of 76,586 cubic metres of rock.

Eight kilometres from the cataract Kozla Dojke, a whole range of much more considerable navigation hindrances begin. These are the so-called Yzlás-Tachtália-Greben. Here not only the insufficient depth of water, but also the great fall of the water, which is a still greater impediment to the navigation. On the one side, above the rock banks Tzlas and Tachtalia, and below the rock peak of the Greben at low water, the necessary depth for the navigation does not exist in the channel, which widens out instantly; on the other side, the water coming from the channel is choked by the Greben rock peak, opposite the left shore by the rock bank called Vrany, flows into a channel, which is four times as wide, in consequence of which a considerable fall of the water is caused downward from the rock peak Greben. Thus the regulation has on this part a double difficulty. On the one hand, to create the necessary depth of water for the navigation, and on the other hand to stop the fast current impeding the navigation. In consequence of this, an open waterway will be made through the cataract Izlas Tachtalia in the channel along the right shore in a length of 3500 metres, with a bottom width of 60 metres, at a depth of 2 metres under the low water-mark — by the blowing up of 46,800 cubic metres of rocks. Further, the rock peak, which confines the water, causing below it a very large fall—will be cut down to a breadth of 150 metres, 2·8 metres high over the lowest water, and 2 metres above the swollen water surface. Beginning from this peak, at a distance of 500 metres from the left shore, a dyke will be constructed as far as the Servian village Milanovácz—see plan, page 473—whereby the water-surface will be raised in such a manner that on the one part the shallow depths will cease, and the necessary water depth for the navigation will exist; and on the other hand, the large fall of the water below the Greben will be equalised, that is caused to cease, whereby this last navigation hindrance will also be removed.

The whole length of the dyke is 6200 metres; its crown at the Greben above the low water before the regulation 2·80 metres, thence it flows a distance of 2674 metres to where the depth is 2 metres. The dyke will be constructed entirely of stone, with a top breadth of 3 metres, both sides having an inclination of 1 in 15, and the surface of the rubble stone dyke will be pitched as far up as low-water mark, in order that it may resist the action of ice and water.

At a distance of 120 metres, where the dyke fills two deep parts, and where it is exposed nearly perpendicularly to the impact of the current, operating as a cross-dyke or barricade, the dyke will be constructed with a crown of 5 metres with a batten or slope of 1 to 1·75, and towards the right shore, to give it stability to protect itself against the powerful current, with a slope of 1 to 3. In order to distribute the great difference of water surface in the blocked part of the channel, the narrowing dyke will be connected with the right shore by two cross-dykes, which will also be constructed entirely of stone of the same height, but with a crown width of 2 metres and with a slope upward to 1 : 1·5, downwards to 1 : 3. All the materials for the construction of these dykes will be furnished by the Greben rock destined to have a width of 150 metres cut off.

The proposed dyke at Greben-Milnovacz stores the present low-water surface to such an extent that while the necessary depth of navigation, viz., 2 metres below 0, will be obtained at shallow places, the great fall of the water at the Grebens will no longer occur, or will be moderated considerably, and this will be felt as far as the Tachtalia. The maximum damming back or restrictions of the passage of low water is, on the basis of previous calculations, 1·30 metre, whereby the great fall existing especially under the peak at Greben will be equalised at middle water during the season for navigation. By this regulation a very great hindrance of the navigation on the Lower Danube will be removed.

The cataract Tucz, 11 kilometres from Greben, constitutes a similar but smaller hindrance to the navigation, the whole channel being barricaded, like a bottom dyke, by a bank consisting of serpentine rocks, which at low water forms, through its shallow depth, a real cataract, and renders the navigation impossible. At high, and even at mean water level, this bank is submerged, because the stowage, or restriction of flow, of the water formed by the straits of Kazan, beginning at 14 kilometres from the Tucz, reaches to this point, and equalises the surface also above the Tucz. For removing the hindrances existing at the cataract of the Tucz, the regulation must solve a double problem, partly to create the necessary water depth for the navigation, and partly to moderate the great fall of the surface existing at low water. In order to attain this double object, on the one part an open navigation canal is to be formed in the channel itself, near to the left shore, in a length of 1000 metres, with its upper edge bending towards the current of the river, in a depth of 2 metres below 0, and in a bottom width of 60 metres, by the blasting of the rocky bottom. On the other part, a training dyke, at a minimum distance of 300 metres from the left shore, as far as the island, will be constructed from the right shore, beginning at the mouth of the brook Porecska, situated at the Servian village Golubinje, ending at the right shore. This dyke will be constructed entirely of stone for a length of 1600 metres. From a height of 0·5 metre above the flood low water mark, it rises to a height of 1·25 metres, with a crown width of 3 metres, and with slope bending 2 to 3; its top will be paved so as to resist the rushing current. The maximum rise of the water surface formed by the dyke is calculated to be 1·80 metres, and by this the fall over the cataract Tucz, unequally distributed during the low waters—0·00153, 0·0024, 0 005596, 0·00253—will be reduced to 0·00014, whereby—through the deepening of the navigation channel—the navigation will be assured also on this part. These works require the blasting and the removing of 30,000 cubic metres of rocks below the water, and the use of 70,000 cubic metres of stone material for the pressing dyke.

The last and largest navigation hindrance on the Lower Danube is the Iron Gate. There the bank Prigrada, traversing diagonally through the channel otherwise sufficiently wide, in conjunction with the rocky tongues at the foot of the mountain on the left shore, and with the prominent peaks, barricades the current of the river to such an extent that at low water the navigation ceases entirely. Even at middle water the navigation is bound to surmount great difficulties, and the communication of convoys is entirely impossible. The difficulties of navigation at the Iron Gate are so much more considerable than at the other cataracts, because the navigation meets with difficulties at every state of the water level, and is almost always limited, while on the other cataracts the navigation is impeded only at low water. For removing these hindrances at the Iron Gate radical means had to be adopted, whereby the unhindered navigation is rendered possible at every water level. In achieving this object it was decided not to stop or limit the small depth and the great fall of the water and the irregularity of the current—as this would be impossible—but to avoid them. In consequence of this, it was decided to construct a canal separated from the channel by dykes reaching above the highest water level, and this along the right shore, joining closely in an inward bending direction, following the survey proposed by the International Commission in 1873. The plan of the canal was determined in consideration of the existing water level above and below from the Iron Gate, so that these shall be equalised as far as advantageous, and so that the largest convoys shall have sufficient room to pass each other on the way.

For this purpose the Iron Gate Canal was originally projected, with a depth of 2 metres under the lowest water surface, with a bottom width of 80 metres, by removing the rocky bottom. The canal, which—as mentioned above—is dammed with dykes reaching above the highest water surface, begins with a funnel-shaped opening at 400 metres from the upper edge of the bank Prigrada, which in a corresponding length narrows itself gradually to the prescribed width of the canal. This funnel-shaped mouth is necessary, in order that even at the lowest water sufficient water can be obtained to feed the canal, with the required depth for the navigation, at the proportionally greater velocity which will naturally exist in the canal having a passably smooth bed. The canal is directed from the end of this funnel by a curve of a radius of 1770 metres, and a length of 1180 metres, and thence in straight direction it leads to the Servian village Sibb, for a length of 940 metres, so that the whole canal is 2480 metres long. The upper edge of the dyke on the right shore circumvents, by a curve having a radius of 435 metres, the peak of the Kasaina, and is connected at the upper edge of the remains of the Roman bulwarks with the shore. At its lower edge it is broken through by an iron bridge, so that the mountain streams can come down freely. Finally, along the whole length of the dyke, which will serve as a towage path, wooden railings or tramways will be laid.

(*To be continued.*)

## LIGHT RAILWAYS AND TRAMROADS.

The following letter has been addressed to the Associated Chambers of Commerce, the Central and Associated Chambers of Agriculture, the London Chamber of Commerce, the Railway Companies Association, the Institute of Civil Engineers, the London County Council, the Association of Municipal Corporations, and the Association of County Councils:—

Board of Trade (Railway Department),
7, Whitehall-gardens, London, S.W.
29th October, 1894.

Sir,—I am directed by the Board of Trade to communicate with you on the subject of a movement recently set on foot with the object of obtaining further powers and facilities for the construction of light railways and steam or electric tram roads. It has been alleged in some quarters that the requirements which are imposed by the Board of Trade upon new railways in the interest of the safety of the travelling public and of the railway servants, as well as for the public convenience, may stand in the way of those who are desirous of promoting railways through agricultural or sparsely-populated districts.

It has also been urged that light railways may have great utility and importance as a means of assisting those who suffer from the depression in agriculture, by affording them easy and inexpensive means of bringing their produce to the best markets.

The same observation has been made as regards an even more difficult branch of the subject—namely, the possibility of relieving populous urban districts by giving special opportunities to workpeople to travel in and out of towns at a minimum cost, or by making it easier for manufactories to be established in suburban or country districts.

Interest in the movement has no doubt been stimulated by the action of those foreign countries in which light railways have been developed.

The Board of Trade are sensible of the importance of the question in these various aspects, and have taken great interest in the representations which have from time to time been made to the Department, but they have not yet had before them practical proposals which would enable them to decide how far a demand for economy in construction would justify relaxation of any of their usual requirements now enforced in the interest of safe working, and whether a change in the law by which necessary powers might be more easily or cheaply obtained would be likely to be followed by any considerable development of the modes of transport contemplated.

It may, no doubt, be contended that the powers conferred by the Railways Construction Facilities Act, 1864, as amended by the Railways (Powers and Construction) Acts, 1864, Amendment Act, 1870, and the Regulation of Railways Act, 1868 (Part V.), on the one hand, and the Tramways Act, 1870, on the other, are sufficient to satisfy the requirements of ordinary trading companies desirous of constructing and working light railways or tramroads. The Board of Trade are, however, so much impressed by the desirability of obtaining all the information which can be afforded by persons interested in the movement, that they think it well to take prompt steps for the purpose of eliciting and focussing such views and information. And they conceive that both local authorities and traders, as well as the existing railway companies, will welcome an opportunity of joining in a discussion inaugurated with this object.

I am, therefore, directed by the Board of Trade to inquire whether the —— would be disposed to depute —— members of their body to attend such a conference at the Board of Trade on an early day, with the object of discussing:—

(1) How far the usual requirements of the Board of Trade as to constructing and working new railways may fairly be relaxed, especially in the case of lines built through sparsely populated and agricultural districts.

(2) Whether additional legal facilities for obtaining powers to construct tramroads and light railways are necessary or desirable.

I am, Sir, your obedient servant,
Courtenay Doyle.

To the Secretary the ——.

## RAILWAY MATTERS.

A disastrous collision occurred on Wednesday between two passenger trains at the station of Redfern, a suburb of Sydney. A Reuter telegram says six persons were killed and thirty injured.

The branch railway being made by the London and North-Western Railway Company to connect their system with the Ship Canal is progressing rapidly. The cutting on the north side of the main line east of Eccles station is finished, and has the bottom ballast laid on, and several bridges have been built. A very considerable area of land is fenced off close to the junction, which will be no doubt used for marshalling and shunting purposes.

Substantial financial support has been promised to the proposed new railway from Bristol to London, *viâ* Bath and Andover. A committee has been formed to further the scheme, which provides for a central station at Bristol, with access to the docks. At a meeting of the Bath citizens on Wednesday, it was stated that it was proposed to run over the Midland line from Bristol to Bath, where several streets would be crossed by viaducts, thence under and over the Great Western Railway, and, passing through a tunnel under the hills on the south-east side of Bath, emerge into Wiltshire at Limpley Stoke, and continue past Trowbridge on to Waterloo.

The regularly recurring hot season brings in its train a list of casualties among the Tramway Company's horses in Calcutta, as well as other places where this system of locomotion is in vogue, which *Indian Engineering* says is heart-rending. But apart from this, there is much to be advanced from the public point of view against relying upon horses for regularity and certainty of transit to their places of business. In such centres as Calcutta, Bombay, Madras, mechanical power should be insisted upon for the working of tramways, since it is unaffected by weather, and journeys may be timed with fair accuracy, which it is impossible when animal power is relied upon.

The bases of a preliminary convention between the French and Spanish Governments have been agreed upon for the construction of two international railways crossing the frontier near the ports of Salou and Somport. The first is to start from Saint Girons in Arriège, ascend the Satat Valley and penetrate into Spain by Esterri de Anen, to terminate at Lerida, while the second will leave Oloron in the Basses-Pyrénées and form a junction at Zuera with the Barcelona and Saragossa line. An international station is to be built on each of the two slopes, and the two tunnels to be driven for each line will be from 7 to 8 kiloms.—mean four and a-half miles—long. The works of the Oloron line, begun in Spain, must be completed in five years, and the duration of all the works is limited to ten years from the ratification of the convention.

Compressed gas for locomotive headlights has been used for some years in South America, and this light is being applied on twenty-five suburban engines now being built by the Brooks Locomotive Works for the Central Railway of Brazil. The Pintsch system is used, under the Safety Car Heating and Lighting Company, of New York city. The new engines have gas lamps in two 20in. headlights, four signal lights, and a gauge light in the cab. The gas tank is below the floor of the cab, and the lights at either end can be turned down according to which way the engine is running. In tests recently made on an engine in the Hoboken yards of the Delaware, Lackawanna, and Western R.R., an American contemporary says, it was found that while the light was much more powerful than the oil lamp commonly used, it did not interfere with reading the signals, as the electric headlight is said to do.

The Portsmouth Town Council had before them on Tuesday two schemes of railway extension to Portsmouth, which are being promoted by certain landowners of Hampshire, and were referred last week to a committee for consideration. One proposed new line would run from Portsmouth to Basingstoke, a distance of 25 miles, *viâ* Waterlooville, Meonstoke, and Alton, into a branch from a point near Meonstoke, to join the Didcot and Newbury Railway at Winchester. By this route an independent service of trains, it is said, would be secured, whereby Oxford, Worcester, Bedford, and the Midland counties would be brought within easy access to Portsmouth without change of carriages. The other line would connect Portsmouth with Basingstoke. The committee expressed a decided preference for the latter scheme, and the council unanimously agreed with the recommendation. The preliminary expenses, which are estimated at about £7000, have been practically guaranteed.

The special staff of clerks sent by the Railway Clearing House Association to assist the Board of Trade in their inquiries into the railway and canal rates, left Richmond-terrace on Wednesday, having completed their work, which has extended over five and a-half years. Lord Balfour of Burleigh and Sir Courtenay Boyle had several thousands of Railway Acts before them, which they cancelled and embodied in about forty Acts relating to England, Ireland, and Scotland; and a very large number of Canal Acts, some of them dating back to the time of Charles II., are now incorporated under fifteen Acts. The analysis of the Railway Acts has already been published by the Board of Trade, and the analysis of the Canal Acts will shortly be issued. Mr. Charles Smith and his staff return to the Railway Clearing House, the Board of Trade having conveyed their thanks to the railway authorities for the admirable services rendered during the inquiries into the Railway and Canal Rates.

In the course of 1893 the Russian Government took over the Moscow-Kursk, 341 miles; Orenberg, 372 miles; Donetsk, 444 miles; and Baltic, 378 miles lines of railway. During the present year of 1894 the Government have acquired the Nicholas Railway, with the Putiloff branch, 420 miles; the St. Petersburg-Warsaw line, 804 miles; the Moscow-Nijni, 284 miles; the Mitau line, 85 miles; and the Riga-Dunaburg line, 136 miles. Negotiations are now pending for the purchase by the Crown of the South-Western system of Russian railways. On the other hand, the Government ceded to the South-Eastern Company the Oriel-Griazi line, 193 miles; and the Livna Railway, 38 miles. On the 1st of January, 1894, the total length of the railway lines belonging to the Government, exclusive of the Trans-Caspian and Ussuri lines, amounted to 9761 miles, while the length of private railways, including the Moscow-Kazan line, extended over 8933 miles. The whole railway system was not much extended during the past year.

Electricity is to be used for lighting the cable cars on the Brooklyn Bridge, in place of the present oil lamps. At the last meeting of the Bridge Trustees, a report on this subject was handed in by Superintendent C. C. Martin, to whom the subject had been submitted. He reported that the Safety Car Heating and Lighting Company had submitted the following bid:—To equip sixty cars complete, with four 4-burner lamps each, or a total of 160-candle power for each car, for 14,708 dols. Including repairs, attendance, and interest on equipment, said Mr. Martin, the cost of using Pintsch gas would be 7½ cents per hour per car; if the bridge operated its own gas plant, it would cost 4·4 cents per hour per car. The General Electric Company proposed to equip sixty cars with ten 16-candle power lamps each, together with engines, dynamos, and complete plant, for 14,200 dols., and to guarantee that the operating expenses should not exceed 4905 dols. per annum. Taking the interest on the first cost of the plant at 5 per cent., or 710 dols.; depreciation and repairs at 6 per cent., or 862 dols., and adding these to the operating expenses, gives 6478 dols. for the total annual cost. This, says Mr. Martin, is equivalent to a cost of 5·3 cents per hour per car. Thus a heavy outlay is to be made for electric lighting, which will cost much more than the gas now so successfully used.

## NOTES AND MEMORANDA.

In London 2413 births and 1481 deaths were registered last week, or 310 and 101 respectively below the average numbers in the corresponding weeks of the last ten years. This decrease in the rate of increase is now very rarely departed from.

The deaths registered last week in 33 great towns of England and Wales corresponded to an annual rate of 18·5 per 1000 of their aggregate population. In spite of its struggle with its water supply, Leicester was lowest but one on the list, namely, 12·4; Croydon being lowest with 10·2.

The total number of supplies furnished by the London water companies during August was 809,202, representing an increase of 902 supplies on the previous month, and the total supply divided by the number of supplies shows a daily average of 241 galls. for each such supply.

The number of miles of streets containing water-pipes constantly charged in each London water company's district within the metropolis is as follows:—Chelsea, 85¼; East London, 185; Grand Junction, 135; Kent, 177⅛; Lambeth, 202; New River, 346; Southwark and Vauxhall, 160; West Middlesex, 133¼; total, 1423⅝ miles. Throughout this extent of streets hydrants for fire purposes can be fixed.

A recently tested form of roller bearing has for its rollers small closely wound spiral springs of rectangular section, the thickness of the wire being from about 15 to 30 per cent. of the diameter of the spring. This roller is intended to give just sufficient spring to make the difference between absolute incompressibility and that slight elastic compressibility which will prevent deformation of either roller or journal.

The average daily supply of water to London, delivered from the Thames during the month, was 108,586,290 galls.; from the Lee, 48,942,635 galls.; from springs and wells, 37,609,439 galls.; from ponds at Hampstead and Highgate, 3802 galls. The last is used for non-domestic purposes only. The daily total was therefore 194,142,166 galls. for a population estimated at 5,457,971, representing a daily consumption per head of 35·75 galls. for all purposes.

In a paper in the *Comptes Rendus*, "On the Degree of Incandescence of Lamps," by M. A. Crova, the conclusions given are:—(1) That the quantity of light emitted by a gas burner per litre of gas used increases with the quantity of the combustible burnt per hour, whereas the degree of incandescence slightly diminishes, up to a maximum yield which should not be exceeded; (2) that for lamps with incandescent substances, the maximum yield corresponds to the minimum amount of the combustible which must be burnt in order to obtain the maximum degree of incandescence.

The strength of a brick arch, having a span of 13ft. 1½in. and a rise of 1ft. 11⅝in., was recently ascertained at Beaue, France, with a view to determine the suitability of such a construction for a service reservoir now being built there. The *Australian Builder and Engineer* says:—"The bricks measured 11·8in. by 5·1in. by 1·2in., and were laid flat with a joint of cement mortar 4in. thick between them, and an ·8in. layer of mortar outside. A section 2ft. wide was built on rock abutments, and loaded with 820 lb. per square foot, which load was carried without any signs of failure for eighteen hours."

M. Raoul Pictet, who, with M. Cailletet, was the first to liquefy oxygen gas, has, according to the *Globe*, recently found that phosphorescence ceases at temperatures from 130 to 140 degrees below zero of the Centigrade thermometer. Phosphorescent substances, such as the sulphides of strontium, barium, calcium, lithium, when cooled to this temperature lose the property, but regain it when their temperature rises higher. M. Pictet hopes to introduce an apparatus capable of giving a temperature of 100 deg. below zero Centigrade, that is to say, a temperature as much below zero as that of boiling water is above it.

A French process of casting hard glass consists in first melting the material in a peculiar tank furnace, tapped into moulds, a special substance being used in place of sand, the mould and the glass inside of it being also heated and cooled together. The mixture to be used in the place of sand is selected so as to have as nearly as possible the same conductivity and capacity for heat as glass, in such a case the glass and mould forming, as it were, one homogeneous body. The glass thus treated cools, it is said, without cracking, even if the cooling process be comparatively quick, which is quite necessary when hard glass is to be produced.

A paper on observations of the pendulum in the Alps of Dauphiny was recently read before the Paris Academy of Sciences. The values obtained for the constant of gravitation are given below in column $g_0$, for comparison the values calculated for each place at latitude $\phi$ from the formula $g_1 = 9{\cdot}78124\,(1 + 0\,0005243 \sin^2\phi)$ are appended. The values of $g_0$ are corrected to sea level by means of the densities of subjacent formations taken from the most recent work:—Paris, $g_0$, 9·81013; $g_1$, 9·81030; Valence, 9·80640, 9 80682; Grenoble, 9 80603 9·80705; La Bérarde, 9·80530, 9·80682; Marseilles, 9·80539, 9·80536. *Nature* says the variation of the observed from the calculated value at La Bérarde becomes less when a correction is made for the influence of the mass of the surrounding mountains, $g_0$ is then 9·80575.

M. Raoul Pictet recently described some new experimental researches on the congelation of sulphuric acid of different degrees of concentration. Four extensive series of experiments carried out on large volumes of the acid, in different ways and with all the precautions indicated by the study of the laws of crystallisation at low temperatures, yield concurrent curves which include the cases between pure $H_2O$ and pure $H_2SO_4$. This curve crosses the line of zero temperature five times—including origin with pure $H_2O$. On descending parts of the curve the liquid contains a larger proportion of acid than the solid, on ascending parts the inverse is the case; at the summits of the curve the titre of the liquid is the same, *Nature* says, as that of the solid. The maxima and minima do not, in general, correspond to definite hydrates.

Writing on the use of liquid carbonic acid gas for chilling test pieces, especially stone, iron, and steel, at low temperatures, M. Ph. v. Haller, in the *Industrie Zeitung* of Riga, says that a cheap and simple form of apparatus in which the test specimens could be cooled would consist of a wooden box with double walls, top and bottom, the spaces between being filled with some non-conducting substance. The liquid gas could be led into such a box from the iron or steel flasks in which it is furnished, and would be deposited in great part in the form of frost at a temperature of about 78 deg. C. The test specimens could be readily put into and taken from such a box, and would quickly get a low temperature. One of the Russian railroad companies is on the point of having such an apparatus constructed for testing rails and wheel tires at low temperatures. The possibility of accomplishing the desired object with such an outfit, viz., the rapid freezing of specimens, was demonstrated by putting a number of iron test pieces into a bag of several thicknesses of coarse cloth and then introducing the liquid gas. This at once became solid and filled all the spaces between the specimens which thus lay packed in snow. Each specimen was provided with a depression into which mercury could be poured, and on doing this, after a short exposure in the freezing bag, it was found that the mercury immediately solidified, showing, in the absence of a suitable thermometer, that the temperature of the specimens was certainly below 39 deg. C., if not lower. At the St. Petersburg Laboratory of Experimental Medicine a cold room of quite large proportions has been fitted up in which also liquid carbonic acid is the cooling agent.

## MISCELLANEA.

It is stated that a third petroleum fountain has been discovered at Groonaia, in the Caucasus, yielding about 10,000 tons a day.

The success of the electric motors for moving the guns of H.M.S. Barfleur has been so complete, that it is proposed to employ them on H.M.S. Renown.

The Directors of the Eastern Counties Coal Boring Association have accepted the tender of the Vivian Boring and Exploration Company, of Whitehaven, for carrying out the search for coal, and operations are to be commenced within the next few weeks. The *Standard* says the first bore will be made upon the estate of Mr. W. J. Graham, at Sutton, on the banks of the river Stour.

Circumstances especially favourable to the electrician exist in Seville. Owing to the high price of gas it is estimated that the electric light, supplied by meter, will not cost the consumer more than he pays at present for gas. Accordingly an electric light company has commenced laying cables, and it is expected that it will be possible to give the electric light at the end of May, 1895.

A report on the southern approach to the Tower Bridge, agreed to by the Parliamentary and Improvements Committees, has just been submitted to the County Council. It recommended that the line of route proposed in the Bill of last session should be agreed to, and that the Bill should be re-introduced next session, but after discussion it was agreed to adjourn the consideration of the subject.

The Secretary of State for Foreign Affairs has received from her Majesty's Consul at Corunna a dispatch announcing that the Spanish Minister for Public Works invites tenders for the construction of a dock at San Estevan de Pravia, in Asturias. The cost is estimated at £70,000. The plans, &c., may be seen at the Ministry in Madrid, and at the Department of Public Works in Oviedo. Tenders will be received up to November 30th.

After being in existence for about a quarter of a century, the Beaver Line, between Liverpool and Canada, is to be stopped. The Line, which is owned by the Canada Shipping Company, has for many years performed weekly services of cargo and passenger steamers between the Mersey and Montreal and Quebec. The Line commenced with sailing ships, and some twenty years since there was inaugurated a steam service. The fleet comprises five steamers.

The following is another instance of the now too well-known undermanning of the engine-rooms of her Majesty's ships:—Application was recently made to the Admiralty for an extra engineer for the Dromedary, on the ground that she is a 1300-horse power vessel with nine auxiliary engines, and that while a ship in the Navy of this horse-power would carry an engineer and three artificers, there is only one engineer on the Dromedary. The application was refused.

Under Wilsons Loan Charity, loan are granted at £2 per cent. interest to young tradesmen under the age of 40 years carrying on business in the City of London, or within five miles of the City, who have been set up in business one year and not more than three years and succeeded in business. Three unquestionable sureties are required for £100, and four for £200 or £300. Personal application should be made to the Clerk of the Trust, Chamber of London, Guildhall.

The Art Gallery Committee of the City of Manchester has arranged to hold an exhibition of contemporary arts and crafts, in the rooms of the City Art Gallery, in April next. It is sought to bring together a display of fine examples of industrial art, with a view to educate the public taste, and to stimulate the desire for all that is excellent in design and workmanship. Especially is it desired to identify the actual designers and skilled workers in respect of the exhibits offered.

The Italian Naval Committee has examined and reported favourably upon a new type of ironclad of the first class. Signor Brin is responsible for the plans of this new war vessel, which is said to be entirely different from any existing type either in Italy or abroad. Its chief characteristics are very high speed, with the submersion of very nearly the whole of the body of the vessel, a method of construction which has already been suggested and advocated in our pages.

It is announced that the municipal authorities of Bordeaux have determined to organise an international exposition of arts and industries, to be formally inaugurated the 1st March next year. It is proposed that the exposition shall comprise ten sections, of which the sixth is to be devoted to mineralogy, chemistry, and mechanics, and the ninth to only one subject, electricity. Up to the present England, Italy, Spain, Switzerland, Belgium, and Portugal have been invited to co-operate in the undertaking.

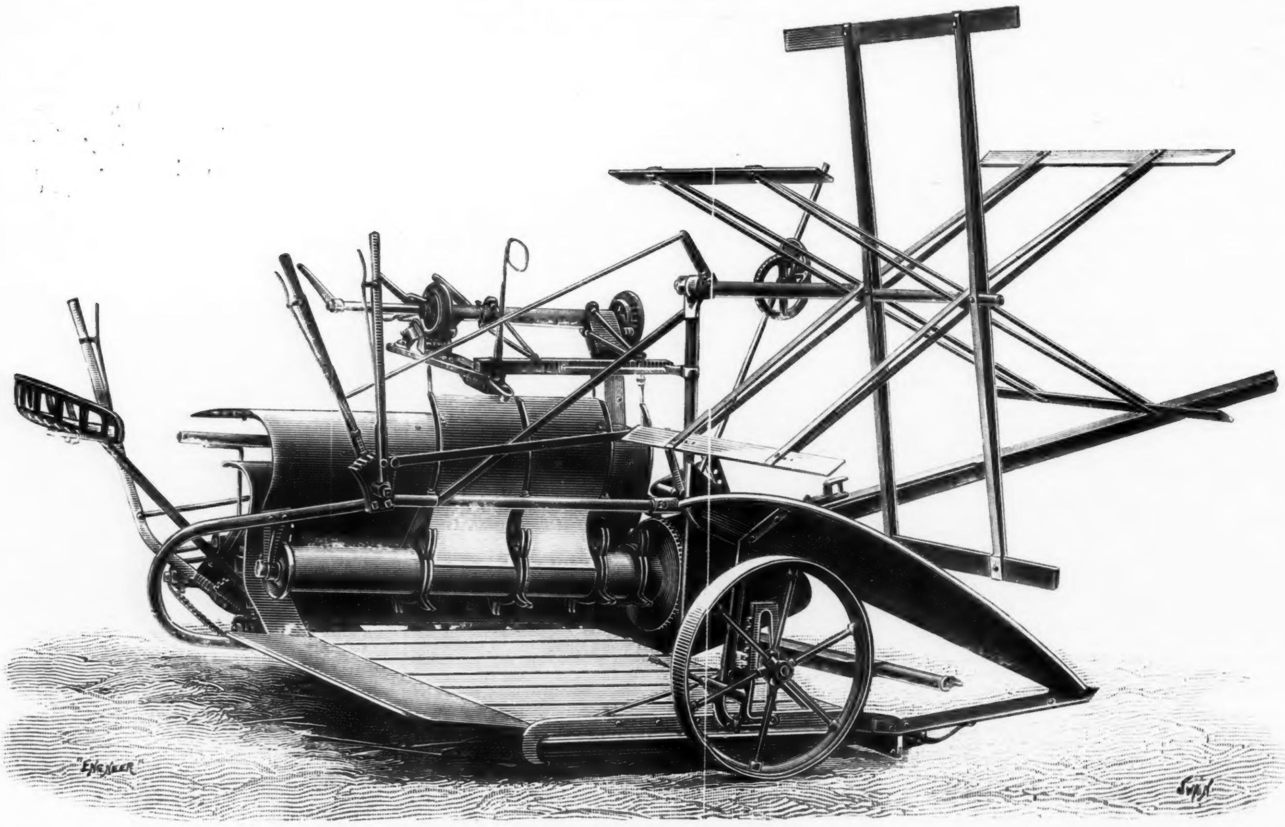
It is stated that the Government of Western Australia has just decided to construct a lighthouse on Cape Leewin, an important promontory on the south-west extremity of Australia and the first point of Australian land sighted by vessels bound to the Antipodes. The erection of the light was suggested some years ago by Mr. W. T. Douglas, M. Inst. C.E., consulting engineer to the Trinity Board. The Agent-General, Sir Malcolm Fraser, has issued an order for a quick-flashing revolving light.

The Board of Agriculture have received through the Foreign-office a despatch from her Majesty's Consul-General at Monte Video intimating that an agricultural exhibition will be held in that city by the Rural Association of Uruguay, with the co-operation of the Government of the Republic, from March 1st to March 31st, 1895. The exhibition will be divided into three sections, viz.:—(1) Live stock and poultry, and their products; (2) agricultural machinery and implements of all kinds; (3) agricultural products. Of these three sections, the second alone will be international, the remaining two being reserved exclusively for native exhibitors. Applications for space must be made by December 31st next, addressed to the managing committee. Forms for making such application may be obtained from the officers of the Rural Association of Uruguay, Monte Video.

The report on the working of the Indian mints in 1893-94 states that the imports of gold into India during the year were much larger than in 1892-93, having amounted to 472,635 oz., valued at Rs. 3,14.65,303, against 272,442 oz., valued at Rs. 1,78,17,891, in 1892-93. The imports in the latter year were, however, unusually small, and the exports greatly in excess of the imports. The value of the metal tendered for coinage in the Calcutta mint was Rs. 29,720; but no gold was coined during the year. In the Bombay Mint no gold was tendered for coinage or coined during the year. The net imports of silver during the year exceeded the imports in 1892-93 by 8,805,461 oz., and this although the imports of the latter year were exceptionally large, having been exceeded only three times during the last half century, and notwithstanding the fact that the mints were closed to the coinage of silver within a few days of the conclusion of the first quarter of the official year. Owing to this circumstance the coinage of silver in the two mints was only about 38 per cent. of that of the previous year, being smaller by Rs. 7,87,90,263. That there was even so much silver coined is accounted for by the fact that a considerable quantity of the metal imported by the exchange banks, and landed in India subsequent to the closure of the mints, was taken by the Government on special terms and used for coinage.

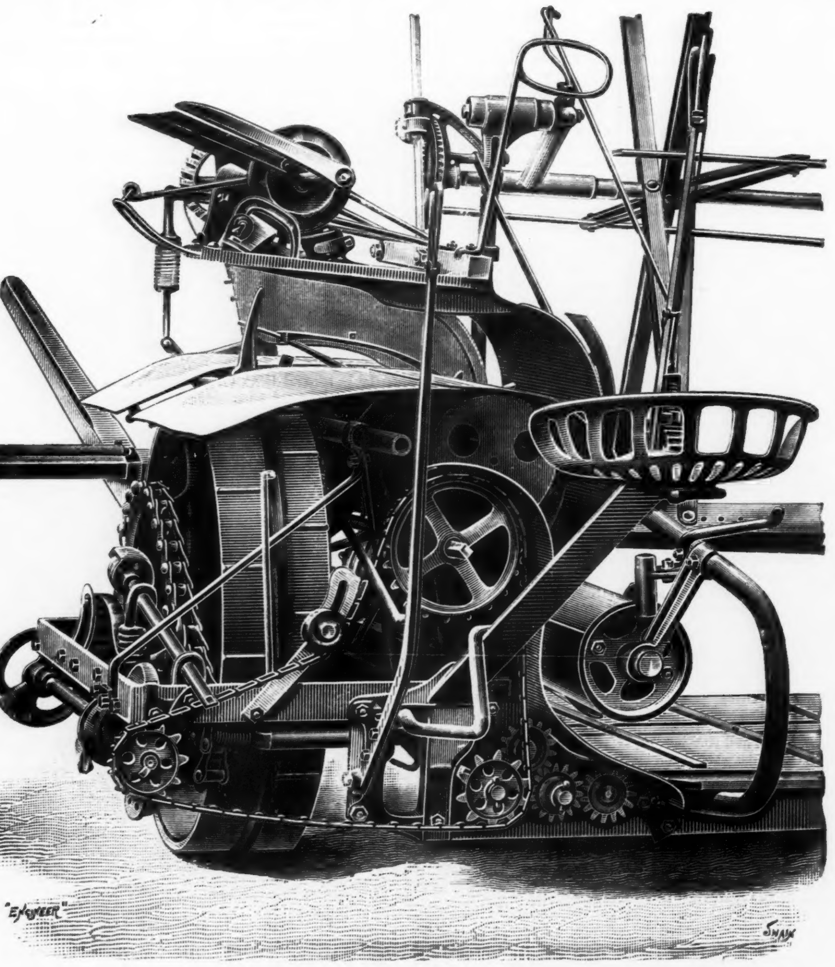
# SAMUELSON'S NEW LOW-DOWN HARVESTER

MESSRS. SAMUELSON AND CO., BANBURY, ENGINEERS



## SAMUELSON'S NEW LOW-DOWN HARVESTER.

THE new low-down harvester illustrated by the accompanying engravings has been made this year, and very fully tested during the past summer and autumn on crops of various kinds. It is the result of long-continued endeavours to make a machine in which the binding is effected at a lower level than is usual with the older forms of sheaf binders, and also to perform the work without the pair of vertical elevator webs generally used. The horizontal travelling web is used as usual to carry the cut crop towards the elevator, which in the new machine consists of a rotating cylinder with four sets of lifting prongs, as seen in Fig. 1 of our engravings. This roller carries a crown bevel wheel as shown, which is driven by a pinion on the front end of the spindle, which is itself driven by the chain and wheel shown in the lower part of the left-hand corner of the platform seen in Fig. 2. The four prongs on the elevator roller lift the crop high enough into the gathering chamber formed by the plate iron guards shown in Fig. 1 to place it within reach of the rotating picker arms, by which it is lifted and pressed up to the binding arm on the binding table situated immediately over the main travelling wheel.



LOW-DOWN HARVESTER—REAR VIEW—Fig. 2

Above this binding table is placed the knotting mechanism. After sufficient grain has been carried up by the packers on to the binding table to form a sheaf, the knotting mechanism is thrown into gear, and the needle rises from below the table, compresses the bundle, and the knot is formed, and the sheaf discharged by means of the ordinary discharge arms to the side of the travelling wheel, shown in Fig. 2. An efficient separation is obtained by the stoppage of the rotary packers at the throat or upper part of the gathering chamber, which prevents the loose grain from following the bundle which is being bound and discharged. As soon as the tied bundle is thrown off the machine, the needle again descends under the binding table, the packers again come into action, and bring forward the cut grain from another bundle, the actions of the parts being as usual automatic.

The driver is placed at the back of the machine, as shown by both engravings, so that he is in full view of the standing crop, and can see the whole of the operations, namely, the gathering and cutting of the crop, the formation of the bundle, the tying of the knot and discharge of the sheaf; at the same time the levers for raising and lowering the reel for tipping or tilting the finger beam, and for moving the binder head and knotting mechanism backwards and forwards so as to place the string in the proper position upon the bundle or sheaf, are all within his easy reach. The sizing of the sheaf is effected by the usual means. The whole machine is so compact that it passes without difficulty through a 9ft. gateway without taking the horses out or using any transport. This arrangement secures a reduction of over 2ft. in width, as compared with some of the ordinary type of elevator machine, with which it is necessary to use a separate transport arrangement, and to unhitch the horses, so as to allow the machine to be taken sideways through the gateways and along narrow roads. The position of the knotting mechanism above the binding table, as previously mentioned, is shown by both engravings, and is of Messrs. Samuelson's improved form of the Appleby knotter. It is within sight of the driver, and easy access for adjustment. The remainder of the packing gear and other parts of the mechanism are also very readily accessible.

The grain is raised less than a total height of 3ft., being a saving of 12in. to 15in., as compared with some elevator machines. The advantage attending the use of only one canvas, and dispensing with the two elevating canvasses and the necessary framing for carrying them, are considerable.

We recently saw one of these machines at work, hauled by a pair of horses, and cutting a late crop of wheat. It was a light crop, but was in parts very heavy with strong weed and thistle growth, and was badly laid, some of which could not be lifted by machine. This crop the machine dealt with in what, under the circumstances, was a very satisfactory manner, the separation being good, except now and then when the heavy weeds and cross-laid stuff, which no machine could deal with passed through. Already several of the machines have been sent abroad where harvest is about to commence, and there is no doubt the machine will create a large demand. The weight of the machine is from 11½ cwt. to 12 cwt. in working order.

## TEDDINGTON SEWAGE DISPOSAL WORKS.[*]

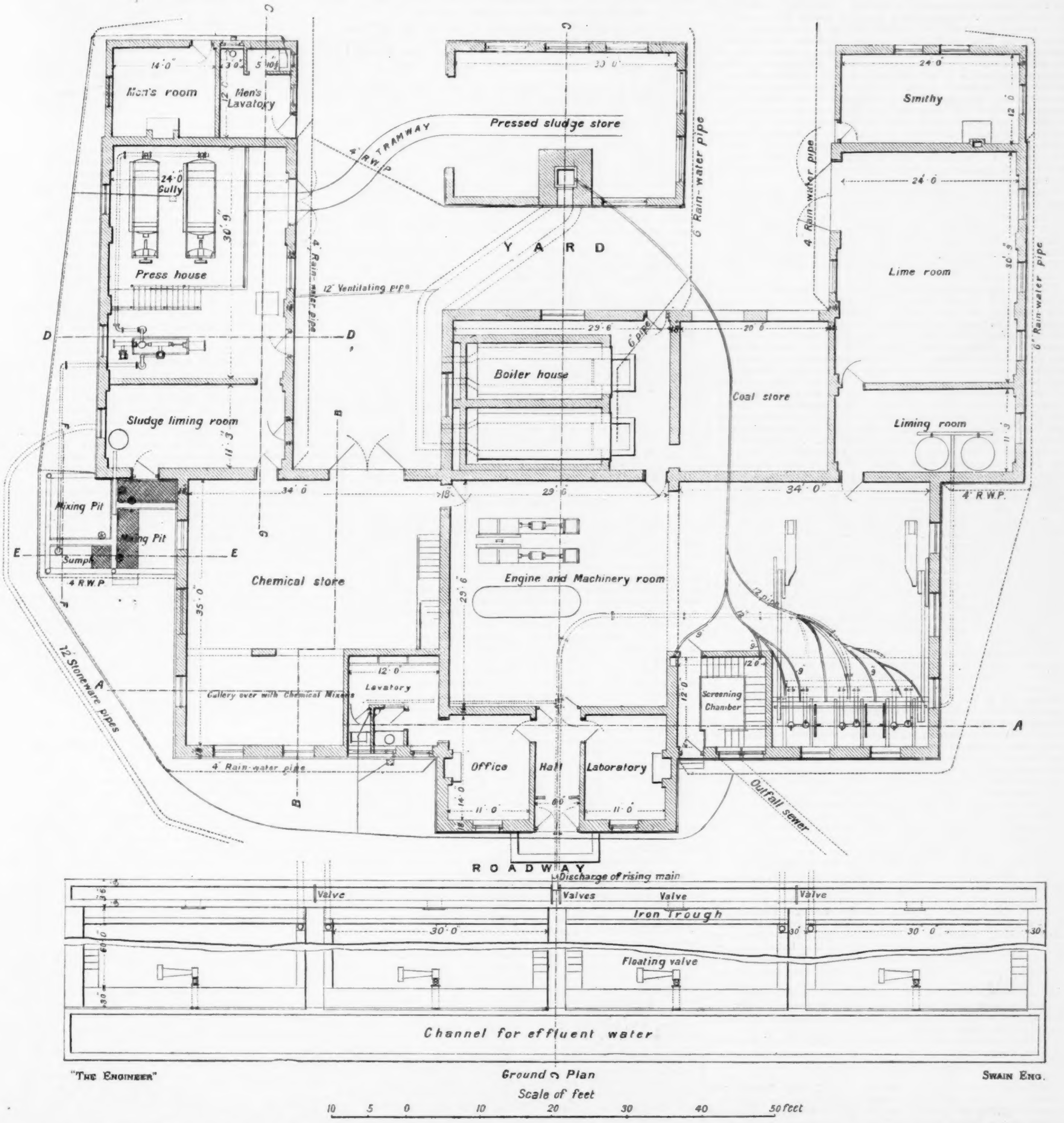
By HENRY YORK, F.S.I.

TEDDINGTON is situate on the Middlesex bank of the river Thames, and is distant about twelve miles from London. It has an area of 1214 acres, of which about 17 acres consist of water. The present population is estimated to be over 11,000, and is rapidly increasing. In 1871 the population was 4050, in 1881 the population was 6595, in 1891 the population was 10,020, the rateable value is £56,000. The parish is generally very level, the surface being about 25ft. above O.D., except towards the north-west, where the ground rises to about 65ft. above O.D. This rising ground is, however, chiefly farm land, the greater part of the populated portion of the parish having a variation of level of only 1ft. in 1½ miles. The soil consists principally of alluvial gravel which overlies the London clay. This

---

[*] Paper read before the Incorporated Association of Municipal and County Engineers, Saturday, June 23rd, 1894.

# TEDDINGTON SEWERAGE WORKS—GENERAL PLAN



"THE ENGINEER" SWAIN ENG.

Ground Plan

clay is generally found at a depth of from 18ft. to 20ft. below the surface, but in a few places it crops up nearly to the surface. The subsoil water at the present time is chiefly at a depth of from 6ft. to 8ft. below the surface, although in some places where the clay forms basins I have observed the subsoil water to be at a depth of only 18in. below the surface. In a few instances, on the other hand, water is not found nearer to the surface than 10ft. or 12ft. One result of the subsoil water being found in such shallow depths has been, that wells have been sunk in large numbers, and these wells being frequently in close proximity to percolating cesspools, the risk of the contamination of the water was very great.

In the very early days of the parish many of the houses were drained direct into the Thames by means of the ditches or small watercourses which intersect the parish. These naturally soon became a nuisance, and were built over in places, forming culverts. These culverts were the earliest form of sewerage in the parish, and from them arose the present system of storm water sewers. In 1865 the Thames Conservancy obtained an Act prohibiting sewage from being discharged into the Thames below Staines, and accordingly Teddington, with other places, was required to prevent all sewage from being discharged through the storm water drains. The Local Board, which was established in 1867, then set to work, and to a very large extent freed the storm water drains from sewage. They also, from time to time, extended the storm water drainage, until now the district has a system of storm water drainage almost equal in extent to the new system of soil sewers. One of the most beneficial results which followed upon the laying of the storm water drains was the lowering of the subsoil water. The drains in certain instances were laid with the avowed object of lowering the subsoil water, the pipes being jointed only half round.

So far it may be said the district was drained entirely by cesspools, and notwithstanding the liability of the wells to become contaminated the inhabitants were very fond of them, drank the water freely, and generally lived to a good age. In 1877, however, all the districts of the Thames from Molesey and Hampton to Barnes and Mortlake were combined to form what was known as the Lower Thames Valley Main Sewerage Board, the object of which was to obtain a scheme of outfall and disposal for the sewerage of the several districts. This Board had the reputation of being the most energetic and extravagant Board ever known. Innumerable schemes for the interception and disposal of the sewage were considered, and one—designed by the late Colonel Haywood—was approved by them, and a Local Government inquiry extending over forty-three days was held; this scheme was not sanctioned. Subsequently another scheme by Messrs. Mansergh and Melliss was put forward, and an inquiry held upon it. This scheme was approved by the Local Government Board but was not carried out, owing to some of the contributory districts forming the joint Board successfully petitioning Parliament to dissolve the Board. Thus ended the first efforts towards the sewerage of this district. The joint Board was afterwards dissolved.

The necessity for sewering the district, however, was increasing; and in 1887 I was instructed to prepare a scheme for the sewering of the district, Mr. Melliss being appointed by the Board consulting engineer in the matter. The first business of course was to obtain a site for the work of pumping and disposing of the sewage, and eventually the present site of the works was obtained privately through the then chairman of the Board—Mr. H. Page. The scheme was then put into shape, an inquiry held by Major General C. Phipps Carey, and the sanction of the Local Government Board obtained for raising a loan for the work. The sewerage scheme, as executed, does not vary in any appreciable degree from the original design. It consists of about fourteen miles of sewers ranging from 9in. to 21in. in diameter. Branch sewers have also been carried up from the main sewers to all existing houses. All are stoneware except where the railway is crossed, and there an iron pipe is used. They are laid without exception at self-cleansing gradients, and it is calculated that sewage will reach the outfall from the most distant part in one hour twenty-two minutes. Another contract is about to be entered into by the Board for an extension of the scheme through all the private roads, which will add another four and a-quarter miles to the length, making a total of over eighteen miles of sewers. Owing to the level character of so large a portion of the district, it became necessary to have an intermediate pumping station near the railway station. The sewers accordingly gravitate from the upper part of the district to that spot where the sewer—a 15in. pipe—is 21ft. below the surface, or 9ft. above Ordnance Datum. This sewer takes the sewage from all that part of the district lying west of the Kingston line of railway. The intermediate lift is effected by means of Shone's ejectors, of which there are three of 300 gallons capacity each, two being capable of doing the maximum required work, and the other being kept in reserve. The sewage is discharged by the ejectors into an 18in. gravitating sewer which conducts it to the outfall works. The remainder of the district has sewers which gravitate to the outfall works.

The main outfall sewer is 21in. in diameter and about 26ft. below the surface, or 1ft. below Ordnance Datum. At the upper end of each main sewer is an automatic flushing tank. These tanks contain from 750 to 1100 gallons of water, according to the length and size of the sewer into which they discharge. Many of the intermediate manholes are provided with flushing discs. The ventilation of the sewers is at present by means of openings in the manhole covers in the surface of the roads; but the question of sewer ventilation is now receiving the very careful attention of the Board, as I find that even with efficient flushing and carefulness in other matters smells occasionally arise from the gratings.

Although the present population is only about 11,000, the capacity of the sewers is sufficient to receive the sewage from a population of 30,000 persons, calculated at 45 gallons per head per day, half this quantity being allowed to pass away in six hours. The outfall sewer, which is at a gradient of 1 in 700, has a discharging capacity of 353 cubic feet per minute, with a velocity of 147ft. per minute when the pipe is running half full. The sewage is discharged into the purification works at the depth of 26ft. below the surface of the ground, and is there pumped to a total height of about 36ft. into the precipitation tanks. Previously to entering the pump well the sewage passes through a close screen in order that it may be freed from rags and substances likely to affect the pumps, and milk of lime is added to it, the mixing of the milk of lime with the sewage being performed by the operation of pumping. Chemical mixers are situate on the gallery in the room which on the present occasion is devoted to the purpose of the luncheon, and these are of sufficient height to inject the alumino-ferric into the rising main of the pumps before it leaves the building; by this means the sewage is deodorised entirely within the sewers and the pumps, thus providing against all risk of nuisance at the works from the smell of sewage.

The arrangement of the works is such that the Board may adopt any other chemical treatment if so desired. The sewage containing the chemicals is discharged direct from the pumps into a channel at the head of the tanks, from which channel it is conducted into either of the four precipitation tanks, which are of sufficient capacity to contain collectively 225,000 gallons, or nearly one-half the estimated daily flow from a population of 13,000 persons. The tanks are constructed so that they may be used either on the continuous or intermittent principle. The effluent water from the tanks after the sewage has been precipitated is conducted by the channels provided for the purpose to the filtration area which is $6\frac{3}{4}$ acres in extent, and which, with the exception of a small osier bed, is under drained at a depth of about 6ft. These under drains intercept the effluent water passing through the land and convey it by means of a stoneware pipe drain 15in. in diameter to the river Thames, discharging into the tidal portion of the river at a short distance below Teddington Weir.

To return to the purification works, the effluent water having been drawn from the tanks, the remaining sludge is swept up to the drain which conducts it to the sludge pit which is situated under the pressing house. The sludge has a small quantity of lime added to it, the mixing of the lime with the sludge being performed by means of compressed air, and then pressed, rendering it easily portable, the liquor from it being conveyed back to the sewer for re-treatment.

The air-compressing machinery by Messrs. Hughes and Lancaster or working the Shone's ejectors, which are about one mile away, s in duplicate, and is situated in the same room as the pumping engines. The pumps are arranged on the triple principle, and the engines for driving them are in duplicate, either engine being powerful enough and so arranged as to drive any two or three of the pumps if necessary. The sludge presses are in duplicate, we have also two 30-horse power boilers, one to work all the engines and machinery, the other as a standby. The machinery and tanks are designed so as to be readily capable of enlargement—if necessary—to deal with the sewage of a population of 30,000. The pumps are of the kind known as vertical plunger pumps, fitted with Okes' patent valves, which are specially adapted for sewage, and were supplied by Messrs. Owens and Co. An inspection of the diagram of the pumps, kindly lent to me by the patentee, Mr. Okes, will explain their action. They are each capable of lifting 450 gallons per minute, working at 38 revolutions. The engines driving the pumps are of the ordinary horizontally single cylinder kind, and were made by Messrs. Marshall, Sons, and Co. The sludge presses are those of Messrs. Johnson and Co., the sludge being pumped direct into the presses without the use of compressed air. The boilers are Messrs. Galloways' patent, 18ft. long and 6ft. diameter. The pump well and the sludge pits are ventilated by pipes into the chimney shaft. The lime and chemical mixers are those of Messrs. Johnson and Co., and the mixing is performed by means of compressed air; this I have found to be a very convenient arrangement, and the lime mixers perform their work very efficiently. The water required for chemical mixing and boilers is obtained from a well in front of the buildings and pumped into tanks in the roof by means of a donkey pump.

The buildings are lighted by electricity, which is generated by a dynamo worked by an arrangement of pulleys from the pumping engine; for ordinary purpose of work the speed of the engine is sufficient to obtain a very good light. Teddington was the first place in the United Kingdom whose sewage works were lighted by electricity. Seeing that we obtain water on the premises and generate our own artificial light, we are entirely independent of all water and gas companies. The character of the building is of good class, it being felt that it was due to the locality that a building of some appearance should be erected, and I moreover felt that where sewage has to be dealt with, against which there is considerable sentimental feeling, the better and more pleasant the surroundings are the more that sentiment is overcome. The entire cost of the sewers and disposal works has been £50,655.

The works have now been in operation and have successfully treated the sewage for the last twelve months. Until the end of last month pumping was carried on only during twelve hours of each day, but it was found that there were several objections to allowing the sewage to accumulate in the sewers during the night. An experiment of continuous pumping has, therefore, been tried, which so far has given most satisfactory results. I find that there is less smell from the manholes, and the sewage can be more easily treated at the works. Flushing is facilitated, and the flow being more regular the machinery can be used to better advantage. Continuous pumping is of course more expensive, but the advantages are so many that I shall urge my Board not to return to intermittent pumping. The quantity now pumped is equal to 379,000 gallons per twenty-four hours, the coal consumption being 22 cwt. per twenty-four hours. The chemicals used are lime, about five grains per gallon; alum, $3\frac{1}{2}$ ditto. The population at present draining into the sewers is nearly 5200; but this number is rapidly increasing, and fresh connections are being made with the sewers daily.

In a succeeding impression we shall publish additional drawings of these works.

ELECTRIC LIGHTING IN LONDON: A LARGE ORDER FOR ENGINES.—One of the largest orders yet given out for engines for electric lighting in London, or perhaps anywhere, has just been placed by the British Thomson-Houston Company in the hands of Messrs. Willans and Robinson, for the Bankside Station of the City of London Electric Lighting Company, as part of one of the largest orders for electric lighting plant ever determined at one time. There are eight engines in all, of 700 indicated horse-power each, coupled direct to Thomson-Houston alternators, and we believe they form part of a complete order which the British Thomson-Houston Company have received for engines, dynamos, boilers, pipes, exciters, &c. The Thomson-Houston Company have already put down at this station four engines of 300 indicated horse-power each, coupled direct to their alternators, and it is no doubt the successful working of these which has led to the present order.

THE CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—The Society visited on Saturday last the works of Messrs. Maudslay, Sons, and Field, of Lambeth, over which they were taken by Mr. G. M. Lemmi, on behalf of the firm. The party were first shown the historical portion of the works, which is the birthplace of modern machine tools, the self-acting lathe having been invented and constructed by Maudslay. Lathes constructed as long ago as 1800 are still at work, as also are three table engines constructed as long back as 1824. The members were then shown the engines in course of construction for H.M.S. Renown, together with a number of engines for torpedo boat catcher vessels. A pneumatic dynamite gun was then inspected. Various propellers in phosphor bronze, cast, and wrought steel, were shown. The visitors were then taken to the "Belleville" boiler, and were shown the simplicity of its arrangement, the ease and facility with which it is worked, the readiness with which steam can be raised, and the many other good qualities of this boiler. This type of boiler is not an experimental one, as it is now becoming largely used by both mercantile and naval vessels. The two warships Terrible and Powerful are to have boilers of this type; the French have adopted them, the Spaniards have adopted them, and they are in use in some of the largest mail steamships. Another type of water-tube boiler, the "White," is also constructed at these works, it having proved very efficient; it is used principally for the smaller class of vessels, such as torpedo boats. The party then visited the smithy and foundry, the latter being famed for the excellence of its productions. The model room, an important feature of this establishment, was not passed over.

## LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### THE LATE MR. EDWIN CLARK, M.I.C.E.

SIR,—It will probably be interesting to the readers of THE ENGINEER to hear that Mr. Edwin Clark, in 1844 and 1845, was an usher in a proprietary school owned by the late Rev. Edward Wickham, called Eagle House, and situate at Brook Green, Hammersmith.

That school was famous for preparing boys for public schools. At one period the headmasters of Eton (Dr. Warre), Winchester (Dr. Ridding, Bishop of Southwell), Harrow (Dr. Butler, Master of Trinity, Cambridge), and Wellington (Mr. Wickham, Dean of Lincoln) were quondam pupils at the school alluded to.

The position held by Mr. Clark was that of arithmetical and writing master. Many a rap over the knuckles he dealt me with a ruler for not following his instruction in respect of writing, which at the time I did not appreciate, and I am afraid that judicious punishment did not have the effect of making me an efficient caligraphist. He was much liked by the boys, was a first-class botanist, entomologist, and musician, and took much pains to impart his knowledge to those who had a liking for the subjects he knew so well.

Few men after the age of thirty could adopt a skilful profession such as that of a civil engineer, and become so eminent as he did. He must have felt sadly misplaced as a subordinate teacher in a private school; and instructing small boys in the rudiments of mathematics must have been a most uncongenial employment to so able a man. It was a lucky incident in his life which brought George Stephenson and himself together, and the undertakings carried through successfully by the former under the supervision of the latter are records of the great perseverance and skill displayed by those distinguished engineers. Smiles, in his life of George Stephenson, in alluding to the construction of the "Britannia" and "Conway" Bridges, describes Clark as the former's "able assistant," and states that the hydraulic power used in the erection of those bridges was after a method originally suggested by Clark.

Doubtless Stephenson in erecting the Victoria Bridge at Montreal was greatly assisted by the knowledge and experience he had gained in constructing the tubular bridges above alluded to, and which were completed under Clark's supervision.

Cambridge, October 29th. BROOK GREEN.

### LOCOMOTIVES AND TRAINS.

SIR,—I have read your leading article on "Locomotives and Trains," in your issue of the 26th October, with great interest. I was a passenger by the train that met with the accident, and being unhurt, I was able to make some observations on the state of the train, which very much surprised me, and have continued to furnish abundant matter for reflection. Like the other correspondents to whom you allude in your article, I possess no special acquaintance with the conduct of railway traffic. But I think the observations which I was able to make, and which in their general lines were published in a letter to the *Times* of the 5th October, are worth stating with a little more precision in a paper such as yours, where they will come under the notice of professional railway engineers, who may possibly be able to make some use of them.

I was travelling in one of the ordinary East Coast sleeping cars, which at the time of the collision was third carriage from the rear. I heard the danger signal blown by the goods driver, and noticed that the brakes were put down instantly. After probably not more than five or six seconds' violent jolting the train stopped. On looking out of the window nothing seemed to be amiss with the train, and I expected every moment that it would start on again. I only learned the truth when the guard came along with his head covered with blood, and reported that the whole of the front part of the train was demolished. I then got out to see what had happened, and to render any assistance that I could. Fortunately and miraculously all the passengers were—like myself—unhurt, and the wounded drivers and stokers were being attended to by several medical gentlemen. Bonfires were soon made out of the *débris* of the wagons, and it was possible to see the damage which had been done.

The condition of the train was roughly as follows:—The two engines were wrecked, the pilot one being thrown over on to the down line, and partially down the embankment. The guard's van next the engine and two third-class carriages behind it were demolished, the two third-class carriages being squeezed out to the left by the Pullman car, which came immediately behind. The body of the Pullman had been wrenched separate from the bogie truck frame which carried it, and slid along it, driving the third-class carriages out sideways, and penetrating into what remained of the guard's van. Behind the Pullman was an ordinary sleeping car which also had slipped forwards on its bearings, but was otherwise undamaged. The carriage behind this was very little hurt, and the remainder—some seven or eight carriages—were standing on the line, just as if they had been stopped in the ordinary way, and neither they nor their occupants had suffered any damage at all. Shortly, the engines and the great part of the train up to the Pullman car were destroyed. One or two carriages in the middle of the train suffered slightly, and the rear half of the train, consisting of at least seven carriages, was unhurt. The train was running at a high speed when the danger signal was given by the goods engine driver, and the brakes were put down instantly. Had there been no continuous brake, there would have been no sensible reduction of speed before the collision, and the carriages would have been piled one on top of another, and the loss of life would have been appalling. As it was, none of the passengers were hurt, but the guard in the front van got an ugly knock on the head, and the four men on the engines were seriously hurt. Could these men and their engines not have been saved? Looking at the train as it stood after the collision, it is evident that if, at the moment of putting down the brakes, the forward part of the train had been made to disappear, the rear part of the train would have stopped under the influence of its own brakes before reaching the mineral train which was on the line, and no collision would have taken place. If, on the other hand, at the moment of putting down the brakes the rear half of the train had been removed, the forward portion of the train would have run with greater violence into the mineral train, because it would not have had the drag of the after portion, which was efficiently braked. Hence the conclusion is forced, that if the forward half of the train had been as efficiently braked as the after portion no collision would have taken place.

An ideal distribution of brake power would be such that, on shutting off steam and applying the brakes, the train as a whole should come to a standstill in the shortest possible distance, and each individual vehicle making up the train should have its speed reduced at the same rate as every other one, so that there should be neither pull nor push between neighbouring vehicles. The brake distribution in the ordinary carriages of the Scotch express seems to approach this standard sufficiently for practical purposes. It is when we consider the engines that the great defect is apparent. The tender is always fitted with powerful brakes on all of its six wheels; but so have all the ordinary coaches, which do not weigh half as much as the loaded tender. Formerly the engine was entirely wanting in brakes, but gradually they have come to be fitted with them, but the friction surface supplied is quite insignificant when their great mass is considered. We may take the engine of such an express to weigh at least four times one of the ordinary coaches, yet the brake-blocks applied to its wheels are seldom of greater surface than those of the ordinary coaches. The leading wheels are never supplied with brakes at all.

As the velocity of every portion of the train is the same, the brake friction or retarding power ought to be proportional to the weight of each vehicle. If the pressure per unit of area of rubbing surface is the same in each vehicle, then the area of rubbing surface ought to be in proportion to the weight of the vehicle. This proportionality does not exist in any of our railways, when the ordinary carriages are compared with the locomotives. To the ordinary lay observer there would seem to be no insuperable difficulty in fitting an engine which has four 7ft. driving wheels and four bogie wheels in front, with four times the brake surface which can be applied to an ordinary six-wheeled carriage. It would be very interesting to know, from the professional side, how it comes that this great difference between the power which the driver has of stopping the train of carriages and that of stopping his engine has been allowed to continue. Had there been no such difference, the East Coast Railway would to-day be the richer by three or four carriages, two express engines, and the services of four experienced men. J. Y. BUCHANAN, F.R.S., F.C.S.

London, October 29th.

SIR,—I see that in your leader on this subject you have taken up the defence of the authorities, but you have not directly dealt with the point which I endeavoured to emphasise. It can be simply enough stated, and is this: If there are two engines, one of an old design, cheap to build, light in weight, and economical of fuel and repairs, and the other of a higher first cost, more expensive to work, and 50 per cent. heavier on the road; and if of these two engines the latter cannot work trains any heavier or faster than the former, then I think that you will agree with me that the older engine is the better of the two, and that, in default of some altogether fresh design being forthcoming, the most sensible thing to do would be to revert to the old practice.

I have no means of knowing whether or no your other correspondents are in "positions of authority," but am glad to see that THE ENGINEER is inclined to hold the official position theory at its true value. One constantly sees sententious paragraphs to the effect that no one can possibly tell as well as the engineer in charge what particular type of locomotive is most suited to the work to be performed on any particular railway, the inference being that whatever is is best, and that outside criticism is little short of impious. And yet, what is it that almost invariably happens when a locomotive superintendent dies or retires? A new engineer is appointed, and, having the same traffic to deal with under the same conditions, forthwith proceeds to build engines quite different to any hitherto in use on the line, and as often as not obtains better results than his predecessor. Surely this disposes of the argument that because those in authority approve of a particular type of rolling stock, that type must necessarily be the most suitable.

You refer to high speed and heavy loads as an excuse for the use of two engines; but the tendency of late has been to divide and lighten trains, and every one knows that under the pressure of bad times speed has been falling off all over England for some years; so that the work demanded of the locomotives of to-day is certainly no harder than that of the recent past, and it must be admitted that for some reason or other the newest locomotives on certain railways seem unable to accomplish it as successfully as those which they have been built to replace.

You make two charitable suggestions to account for the employment of a pilot engine on the night of the Northallerton accident, one "that there should be no delay or hesitation at climbing banks," the answer to which is that there were no banks to climb; and the other "that the pilot was only a light engine working home." But unfortunately for this view, the pilot was a Darlington engine, and was just starting away from home, and it has been specifically stated that it was taken on because the train engine was short of steam. W. B. THOMPSON.

Devonshire Club, St. James's, S.W.,
October 30th.

SIR,—I was very much interested in your leading article of last Saturday on railway speeds in connection with the correspondence arising out of the recent accident to the Scotch express. As you say, the subject is not a bit understood, and I am sure that having it so clearly explained as you have done will do good. The difficulty in making up time at high speed is very striking. Thus, to take the case you mention, 10 miles to be run at 60 miles an hour, average line, omitting the hill you introduce, suppose the driver is a couple of minutes to the bad when he comes to this length of 10 miles, which he generally runs in ten minutes. If he runs it, say, at 65 miles an hour, he is then only making up one minute in every 13 miles, and if he runs it at 70 miles an hour, he makes up one minute in every seven miles. He is probably so timed as to make it necessary to do the 10 miles about as fast as he can every day, so that trying to pull up even a couple of minutes in this length is out of the question. Again, if he relaxes the speed 10 miles, say, to 50, he is losing time at the rate of one minute in every five miles. Thus, from a speed of 60 an increase of 10 miles only gains one minute in every seven miles, but a decrease of 10 miles loses one minute in every five miles. You are quite right in saying that engines are worked up to their full capacity. I had twelve months' firing—six on goods and slow trains and six months on expresses—after I served my time, besides a good deal of riding on engines since, and therefore know something about it. There is another point which is often overlooked by people who make timetables and others who ought to know better, and that is the time lost in stopping at and getting away from big stations. You cannot run into stations like Rugby, or Crewe, or York, and stop as you would at a roadside station, nor can you get away from them in the same style.

If you look at the down Irish mail, 8.20 p.m. from Euston, in "Bradshaw," you will see that the time stands thus:—London to Rugby, $82\frac{1}{2}$ miles in 104 min., 47·6 miles per hour; Rugby to Stafford, 51 miles in 65 min., 47 miles per hour; Stafford to Crewe, 25 miles in 33 min., 45·4 miles per hour; Crewe to Chester, 21 miles in 28 min., 45 miles per hour; Chester to Holyhead, $84\frac{3}{4}$ miles in 109 min., 47 miles per hour. The timetable speed from Stafford to Crewe, and Crewe to Chester, is about two miles an hour slower than the rest of the run. But the actual speed required between those places is as fast—if not faster—than that on the rest of the journey; the reason being that the distances between are shorter, and they are large stations where time is lost approaching and leaving. As bearing on the present craving for high speed, it is a question whether the game is worth the candle; a very slight increase either in speed or load, will eat up any saving in coal that the locomotive superintendent can make. A. H.

London, October 30th.

SIR,—Instead of taking up your space with "dimensions"—already familiar to your readers—I will forward to "Scrutator" full particulars, if he will give me his full address. Having no theoretical knowledge of the subject, I cannot presume to discuss the virtues of any particular engines; but was simply asking for information as to whether the enormous increase in working expenses is fully accounted for by shorter hours and increased pay of employés; or whether it does not largely date from the employment of such heavy locomotives, and the running of such an unnecessary number of nearly empty express trains. A short speech made by Mr. Macdonald at the discussion on "Compound Locomotives," at the Institute a few years ago, seems to fit the—shareholders'—case exactly. F. BOWLES.

London, October 30th.

SIR,—That two engines were on the unfortunate train in the late accident at Northallerton, proves nothing as to the inefficiency of modern locomotives. Any man who understands railway working will tell you that a second engine is often attached, as you suggest in your excellent leader, in order that a man may get home. It is certainly better that he should assist a train than go light, or be "booked off" away from home. When standing on the footplate I have often been asked, by one of these amateur railway men, why two engines were attached to a certain train of moderate weight; but to jump to the conclusion that one of them—and as suggested, the modern one—is therefore inefficient, is too absurd to need further comment; and the imputations made by your correspondents against modern locomotives are, I consider, unjust and unfounded. H. A. C.

October 31st

### MORE DOUBTS AND SOME CONJECTURES.

Sir,—Colonel Basevi's letter expressing doubt of things accepted and "wanting to know, you know," has whetted my ever-existing thirst for information, and stirred the old doubts into expression. Perhaps some one of your correspondents will kindly dispel the doubts by satisfactorily proving that they only arise from my ignorance.

What is gravitation? What is "the ether?"

Gravitation? Oh, gravitation is, of course, the attraction that one body has for another. Newton, you know, discovered it. Very well, but why that attraction? Why should one body attract another? Let it be admitted that gravitation is a stopgap phrase halfway explaining; but is it not time—here we are at the end of the nineteenth century—that the essence, the remainder, of the explanation was forthcoming.

We know that heat, light, and electricity are practically interchangeable or convertible one to the other. Never mind the exceptions just now. Do they count much in accepted theories? Example, "Every particle of matter in the universe attracts every other particle." How about the pith ball experiment, and like poles of magnets?

Now we all know that electricity is potential energy. We receive light and heat from the sun. But how does the heat reach us? In producing a vacuum in any vessel is or is not the ether extracted with the air? Do the light and heat rays travel as light or as something else, and are converted to light on reaching our atmosphere, or does the ether convey them, as we must assume for the present there are no molecules to assist their passage? It is difficult for me to conceive of heat passing where neither molecule nor atom exists. We won't tackle the wave theory now, thank you.

Work is done by the sun upon the earth in holding us in our orbit. Work is done by the sun in holding all the planets in their orbits, and the same work is done by the planets upon the sun each tending to pull it in its own direction; the attraction is mutual and the work equal:—unorthodox.

Now if the sun were a gigantic arc lamp or an electrically incandescent mass, the centre of a great electric "field"—the best word, I think—as well as a gigantic mass retaining by its attraction many smaller bodies in their orbits in one plane, would the proportion of heat each planet obtains from the sun be in proportion to its mass, and therefore its attraction, or in proportion to its surface?

We know the earth is a magnet, but is it an electro-magnet or a permanent magnet? Let us assume it is a permanent one; then how did it become magnetised? We cannot conceive of its being magnetised in either of the ways we should magnetise a steel or iron rod to form a permanent or temporary magnet, except that of passing a current through it; also, except the magnetisation by induction in the manner of a steel poker standing vertically, but then the poles of the earth and of the sun, the only possible magnet of sufficient power to serve this purpose, are not "end on." And the earth being a magnet, and granting that light is convertible to electricity, then most light is received from the sun in the tropical regions. What becomes of this absorbed light? It must go somewhere, it cannot be completely dead, or the conservation of energy becomes a dead phrase. It cannot exist as light, it is not all reflected, it must therefore be changed. Let us assume that it is converted to electricity in some unexplained way, and we have a current passing in at the centre of the magnet and out at the poles, causing the rotation of the magnet, the earth, and producing the continuous auroræ, the light of the return current to the poles of the sun; and this energy is continually moving in this circuit back from the poles of the planets to the poles of the sun, and from the sun to the planets as light and heat.

There is a theory that a portion of the interior of the earth is molten, but always cooling—the sequence of the nebulous condition. True, the earth grows hotter the deeper we delve, and volcanoes and earthquakes occur; but are they proofs of a molten core? Then, why the dormant intervals when volcanoes rest and earthquakes sleep? Now, those currents continually passing through the earth to the poles, find here and there a greater resistance, and consequently the interior of the earth is maintained at a fairly-high temperature; but in a few places the resistance is exceedingly high, either continuous or set up at intervals by the perturbations of other planets, and you have local incandescence produced and the phenomena of volcanoes, earthquakes, and geysers.

Why should it be assumed that there are no gases filling the planetary space? It seems to me highly probable that air, in a highly rarefied condition, fills the plane of the ecliptic, if not all space.

It is very unorthodox, it is very unfashionable, to assume—except upon the accepted bases of assumption.

Let us now make a big assumption. The Milky-way is a series of planetary systems, each with a central sun, all arranged in one mighty ring. The suns are in the core or central line of that ring, and for ever passing round that ring from sun to sun is a current of electricity, assisting to maintain the incandescence of the suns. Hence the attraction of the sun for the planets, and the retention of the planets in their orbits; and also their rotation round the sun in what is practically one plane. In the moons, the currents making magnets of them are induced.

I know there are many profound and unexplainable gaps in this assumption, particularly the passage of the electricity from sun to sun round that ring, but then we have so long been in possession of the roof and the chimneys of the Castle Gravitation, without the castle and its foundations, and I want to suggest that we ought to set about possessing ourselves of the castle. I was struck with the similarity of the positions when a well-known scientist exhibited a planet—I mean an egg, spinning on a plate by the aid of a current beneath it—some time ago. All the planets revolve round the sun in one direction. It is really a question for the mathematicians whether the vast sum total of the work done by the planets upon the sun as the work is equal to the work done by the sun upon the planets, is not sufficient to generate heat upon the sun to largely assist in maintaining, if not alone producing a condition of incandescence, in its crust, seeing that it is only a small portion of the sum of the work done by the sun that is done upon the mass of the earth, and yet it is sufficient to maintain parts of the earth in a state of incandescence. It is true that the mass of the sun is greater than the total mass of the planets.

One feels inclined to kick at the idea that man should put a limit on the working of the planetary system, and calculate a time for its ceasing to work, like an old clock—for this is what cooling means—because he finds that a continuous or perpetual motion is impossible here. And it is chiefly because of the difficulty of conceiving a continuously balanced action without loss, a continuous working the whereof we see not the cause, the one part of the system reacting upon the other without waste of energy or heat, that we wish to bring the infinite down to the level of our finite views, and limit it by our own conceptions and experiences. We do not know, we do not understand; therefore we say that the sun and the earth must be cooling, because this accords best with our own puny experience, and because this fits with the very ingenious nebular theory.

Then, again, as to that continuous battery and bombardment of molecules. Is it not more consistent with well ascertained facts, a less strain upon our faith, and more in accord generally with what we know of the phenomena of heat, to assume, if something must be assumed, that the atoms or molecules of a heated body, solid, liquid, or gaseous, simply repel one another or attract less, reducing their cohesion in proportion to the increase of temperature of that body; and *vice versâ*, as a body cools, so the molecules of a body increase their attraction for other molecules of the same body, while gaseous and liquid molecules increase their attraction for all other molecules, or masses of molecules or atoms.

The earth is a powerful magnet, yet it is not iron. The earth induces magnetism in every particle and mass of matter upon it, every independent molecule or atom, or mass of molecules or atoms, is an independent magnet. I do not mean that magnetism is a universal property of matter, but that all matter possesses it by induction. A few metals are capable of an excess or abnormal "charge" of magnetism. The normal condition of all matter is attractive because of the earth current induction, but as this induced attraction occurs in everything, it passes unnoticed, and we have eyes only for the excess or abnormal condition, and the artificially created magnetism or attraction produced by an electric current. We appreciate these and also any excess in the shape of lightning because it is abnormal. So that assuming every molecule or particle of matter to possess induced magnetism by induced current or otherwise normally to the extent of 100 per cent., and we are able to increase the attraction electrically or magnetically of any matter by 2½ or 5 per cent.; we perceive and appreciate this, but are blind to its universal occurrence because it is universal and normal. Does anyone suppose that in a return through the earth the operator uses that same current that entered the earth at the other end of the line?

Is there a fourth condition or form of the triune mystery, light, heat and electricity?

Now, the passage of power from sun to sun in that stupendous—no adjective in the English language is strong enough—ring is no doubt a difficult thing to swallow. But power passes from the sun to the earth, and if from a sun to a planet, why not from a sun to a sun? If not, what is it keeps each sun in its respective position in space? We know that our planetary system roughly maintains its respective position, and Sirius does not career about in space in an aimless way. We know that order is maintained. It must, therefore, be order on an orderly basis, not an haphazard order.

Now let us assume that gravitation is all sufficient. How is each sun kept in its relative position? We must again assume that the Milky-way is a ring of planetary systems. Very well, but gravitation requires a vast central mass to retain by its attraction the suns and their satellites in position. We cannot see such a body. Is it to be supposed that a mass of such a size, assuming it to be a dark body, beside which our sun must be a pigmy, could remain unseen even with the naked eye at night, with a thousand suns throwing their light upon it? And is it at all consistent with our ideas of a great centre of power and motion, such as the suns are, or in accord with what one's idea of the centre of work and energy would be, that it should be cold and dark. The judgment rejects it.

True, dark bodies attract, but it is only by means of energy derived from some other body. For, however you may regard it, attraction is work, attraction implies energy. Conceive a steam engine giving power without fire in its boiler. Conceive any work without heat or an electric current.

I must apologise for the length of this letter, but as I have before said, it seemed to me to be time that we got below the roof of the Castle Gravitation, even if we never reach the foundations.

Manor-road, Teddington, October 30th. J. D. Roots.

### LABOUR AND LUXURIES.

Sir,—I am glad to see that your correspondent "Y. X." has sufficient sagacity to discover that I consider that "political economy" should take account of morals and ethics. But he evidently has not gone through the course of study which I advised, or he would not say that writers on the subject "do not assert that these affect the science in any way."

"Y. X." says that it is of no consequence to a shopkeeper whether he trades with a murderer or a honest man. Now, it seems to me that if the murderer has already killed his fellow-workman for his money, it is at least possible that when this supply is exhausted he will take the life and property of the shopkeeper, which will be of considerable consequence to him. Again, I must presume that "Y. X." thinks that this community would be "better off, on the whole," if we were to allow all our old and infirm people to die of starvation. I suppose he is ready and willing to take his turn when the time comes. As to the words "men are simply distributors of gold. They work to obtain their turn in the use of it, and then to pass it on to someone else who has it in his turn." Does "Y. X." include under this head Socrates, the Apostle Paul, Milton, Cromwell, Wesley, Livingstone, and countless others. Further, if this is true, why do men desire seats in Parliament, baronetcies, or Victoria crosses? Herein is the point where "Y. X.'s" political economy fails. Men cannot and will not live by gold alone, and any science (?) which takes for its hypothesis that they will is useless and delusive. Hirn.

Owens College, October 30th.

Sir,—If "Y. X." were a more careful student of the writers he recommends to others, he might not have blundered into the strange assertion that a science, which has for its subject the laws of the production and distribution of wealth, views with equal indifference the manner of its acquisition and the way it is spent—not to speak of the more commonplace fallacy of identifying wealth and money. Ethics and sentiment apart, political economy takes note of crime as a condition unfavourable to production. The neighbourhood of a robber chieftain is apt to lie waste; and when the murderous B., having devoured A.'s earnings, proceeds to supply the needs of another Saturday at the expense of a second industrious life, the local tradesman will begin to notice the difference. When a king levies ship money, is it all one in the day of battle whether he spend it in maintaining a navy or lavish it on prodigal favourites? Or take a case in which there is no question of gold or silver. A Pharaoh of old Egypt, rich in great store of corn and onions, is it all one whether the serfs who consume the food be set to build a pyramid or to labour on that system of irrigation which fertilised the land?

Or, to come home to ourselves, is it all one whether the toolsmith to whom I shall pay two sovereigns or so next Saturday is a craftsman who has rendered value for value or a botcher who has spoiled good steel? Neither in fact nor in theory is it true that economic man is a mere agent for distributing gold, except in the sense that a railway is a distributor of wagons. The wagons and the money are alike part of the machinery of distribution, and the ultimate interest of the community lies in the production and consumption of goods, not in the mere circulation of wagons or gold. Gold is not even co-extensive with the money of a country, which for the most part is now-a-days documentary, and representative of a claim to a certain part of the wealth of the country, expressed for convenience in terms of gold. Now, as things are, the holders of money possess the power of determining the direction of the productive powers of the country, and each in his degree can determine to the extent of his own holding whether that productive power shall be so exercised as to increase or diminish the total wealth of the community. It is therefore by no means a matter of indifference economically how money is spent. Everything that is expended by the Government is subtracted from the spending power of individuals. The more labour Government employs, the less can individuals employ.

On the other hand, apart from sentiment, fixity of employment is economically desirable; and in Government employ unnecessary fluctuations are just cause of complaint. To diminish fluctuations and facilitate the transfer of labour, at the same time eliminating the unfit, is perhaps the most urgent problem of the day. It does not help on the solution much to launch very dubious economics at the head of a labourer, who, suffering undoubted if unavoidable hardship, expresses his annoyance with somewhat more picturesqueness than scientific precision. As to what constitutes luxury, I incline to include flowers among necessaries; the line cannot be drawn narrowly. In any case, wasteful extravagance does not benefit the labourer. "Y. X." must clear up his monetary theory, and then he may realise, to quote a recent lecture of Professor Nicholson's, that "there is nothing more false than the opposition drawn between political economy and common-sense morality."

October 30th. W. A. S. B.

### TRACTION ENGINES.

Sir,—It would be very interesting to have all the charges against traction engines put into such a form that answers from owners and others interested in their use could be put so that a fair opinion could be formed. If the preponderance of evidence were against the engine, then let an Act be framed prohibiting their use entirely—either for agricultural purposes or road hauling. If, on the other hand, the traction engine—which has grown in large numbers even under the present prohibitive Act—was found to be a useful member, and one which was rendering good and economical service to society, then I say an Act to aid its further use should immediately be framed. The highways should be free at all hours for the passage of engines on any portion of the roads. Bad bridges, drains, &c., that were damaged by the passage of engines, should be made good at the expense of the Highway Authorities, and not by the engine owners; and further, if it were known that owners of shying horses—there are still some—which are very dangerous in streets, could not get such excessive damages, then fewer accidents would occur, as from my experience in nine cases out of ten the drivers of such horses could prevent them. That the traction engine, even in its present form, is performing very useful service every day cannot be denied by even its strongest opponents. All that is required for traction engines is fair play and no favour. Assuming the engine is allowed to travel at the same hours that horses do, it would very soon prove to be the most useful, economical, and humane system of cheap transport that can be adopted. Under the present county and borough bye-laws, engines are only allowed to travel during certain hours, in certain streets, and then only certain kinds of inefficient wheels are allowed by law, which wheels do such enormous damage, so surveyors say.

I will quote an instance. In a certain large town when a heavy piece of machinery has to be removed in an engineer's works, simply from the foundry down to the weighbridge, and then into the machine shop, this is done by, say, 10 a.m., and the engine dare not stir out of the works again until 5 p.m., how is it possible to avoid accidents when engines are only allowed to travel at times when the heaviest town traffic has to be faced, and men having had to waste their time for eight hours of good daylight? Many men would wait in public-houses, as they cannot remain in the street in all weathers. Further, how can traction engines be feeders of railways if restrictions such as I have quoted exist, so that they cannot get to the railway before closing time? My own experience after very many years' use of traction engines—as well as horses—is, that if only fair play is allowed to traction engines, for heavy work horses would never be seen moving the heaviest loads. The saving to the community would be very great, if only in reducing the amount of foreign food imported for horses, and the Society for the Prevention of Cruelty to Animals would do more if they would assist to get the Road Locomotive Act altered, than they do by hundreds of miserable prosecutions such as are undertaken at present. With a practicable Act of Parliament we should soon see a proper road locomotive appear, and the agricultural type disappear; it has done wonders, but that it is perfect for heavy haulage is more than any user can say. I. W. B.

Ashton-under-Lyne, October 27th.

### THE THEORY OF THE STEAM ENGINE.

Sir,—Professor Smith in your last issue appears to be hovering dangerously near the domain of metaphysics. I would, however, recall to his recollection that Clausius bases his exposition of Carnot's theory on the postulate that heat cannot be transferred from a hotter to a colder body without the expenditure of an equivalent in work. Surely, then, the reverse statement may be expected to hold, viz., that heat cannot pass from a hotter to a colder body without work being gained in some form or another. Professor Smith's statement that the "abstraction, not the supply, of heat" is that which "is really effective in producing" "mechanical power," is open freely to adverse criticism.

Personally, I have no sympathy with those who undervalue Carnot's work; but if Professor Smith can show how, by any means whatever—whether practically realisable or no—consistent with the employment of a working substance receiving and giving out heat cyclically, a greater amount of mechanical work can be performed in return for the passage of a given quantity of heat from hotter to colder bodies, he will have a better right to dispute the right of Carnot's reversible heat engine to the title of "Perfect" than he at present has. Henry Cherry.

21, Festing-road, Putney, S.W., October 27th.

Sir,—I confess that I have read the letters of Professor Alexander and Professor Smith with the utmost amazement. I have rubbed my eyes, and asked myself, "How can these things be?" I could understand Mr. Cross or "common or garden" engineers writing thus, but to be told by, not one, but two professors of engineering that the text-books are all wrong, and that we have for the most part to learn our thermodynamics of heat engines all over again, is indeed an eye-opener. But is this all true? Are Professors Smith and Alexander authorities on such matters on whom we can implicitly rely? I would ask Dr. Lodge for guidance, but that I see from one of your evening contemporaries that he is engaged just now in investigating table turning, as carried out by Miss Eusapia Palladino in one of the Hyères Islands. Truly this is a wonderful age.

The general effect produced on my mind by such letters as those of Profs. Smith and Alexander is that something very like a direct spirit of confusion has prompted certain men to write aforetime about heat. It cannot be possible that *all* the authors of text-books have been ignorant of the truths which your correspondents now put on paper. How long is it since Prof. Smith, for example, found out that Carnot's theorem represented nothing in heaven above or in earth beneath, save a species of mathematical phantasy? How long is it since he learned that it has no manner of application to any real heat engine? Did he know this a year ago, or two years ago, or not until last week? If the discovery was made long since, why has he held his peace about it so long? If he has only just found it out, how did he chance on the discovery? Precisely the same questions may be put to Professor Alexander; and as I have asked so many, may I put one more and beg either or both of the professors to refer me to some work where I shall find a theory of heat engines which really and truly does possess some practical utility, and is not marred by the astounding blunders which Professors Alexander and Smith have tardily set themselves to correct. And, Oh, *what* does Mr. Cherry think of it all? Why it actually seems that Mr. Cross may be right after all. Ttaw.

Soho, October 29th.

### PIVOTED ARCHED BRIDGES.

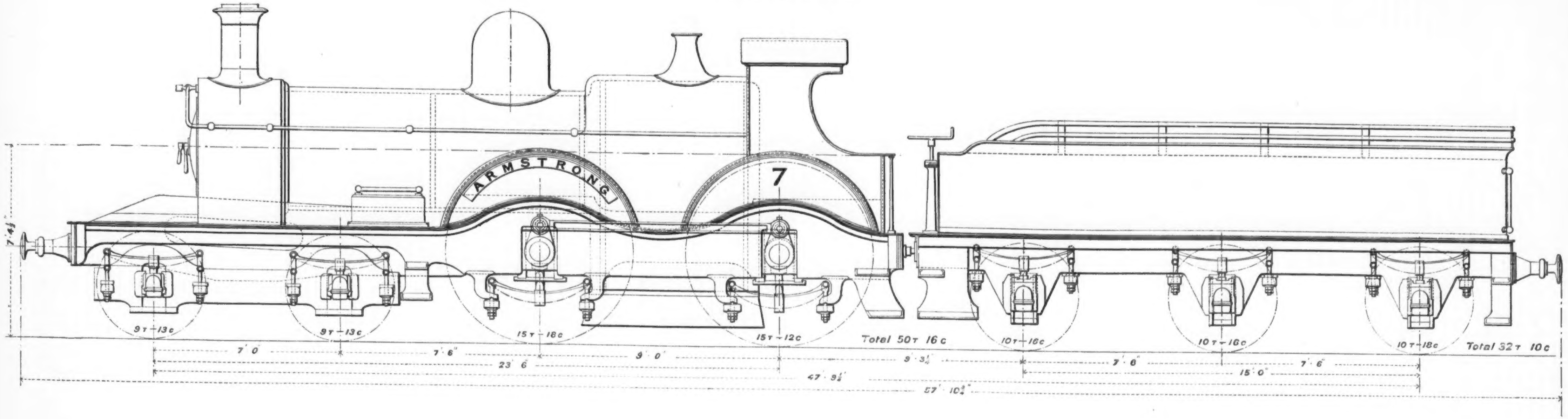
Sir,—In your article on the above in last Friday's Engineer it is stated that, "The practice among engineers of hinging the ends of solid arched ribs is comparatively very modern," and quote among others, Southwark Bridge as having fixed skewbacks. I think, however, on further inquiry it will be found that though these arches are not hinged as ordinarily understood, Rennie adopted a device of very much the same effect, forming the springers in such a way that whilst apparently furnishing a bearing for the whole depth of the rib, there is actual contact over a very narrow breadth only, thus ensuring delivery of the thrust within narrow limits as in a true hinge. W. H. T.

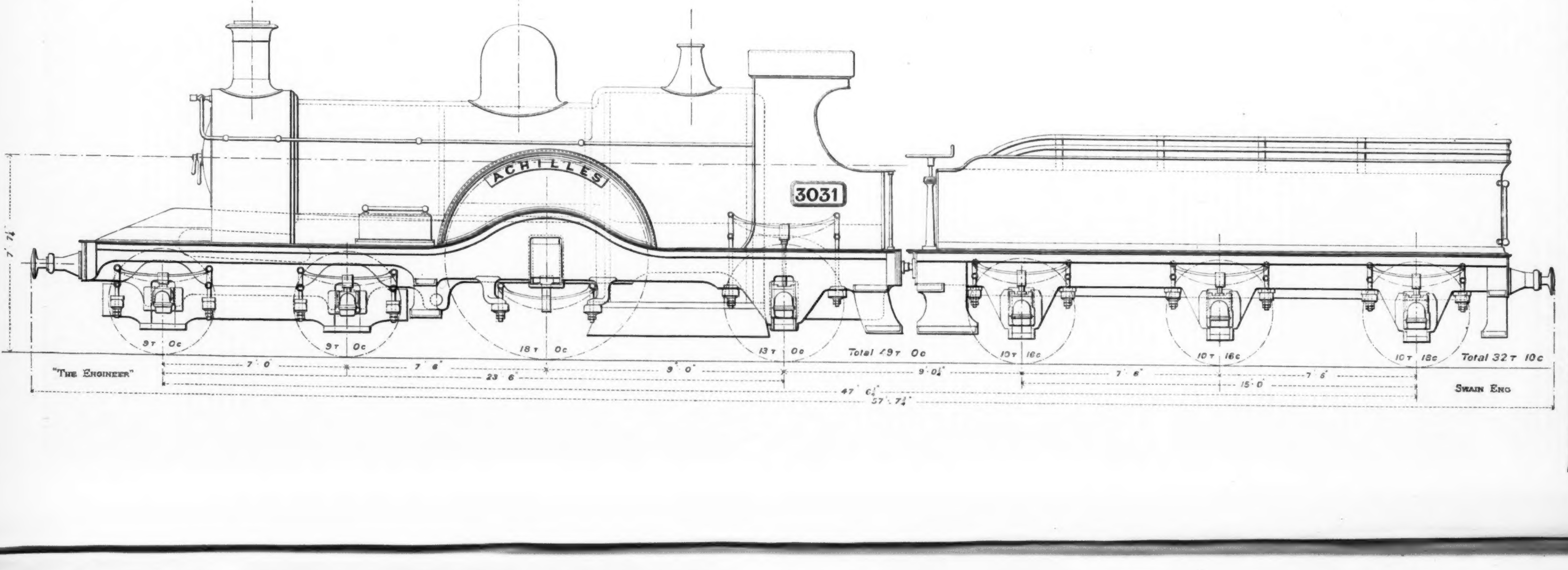
Derby, October 31st.

# EXPRESS PASSENGER ENGINES, GREAT WESTERN RAILWAY

MR. W. DEAN, M. INST. C.E., SWINDON, ENGINEER

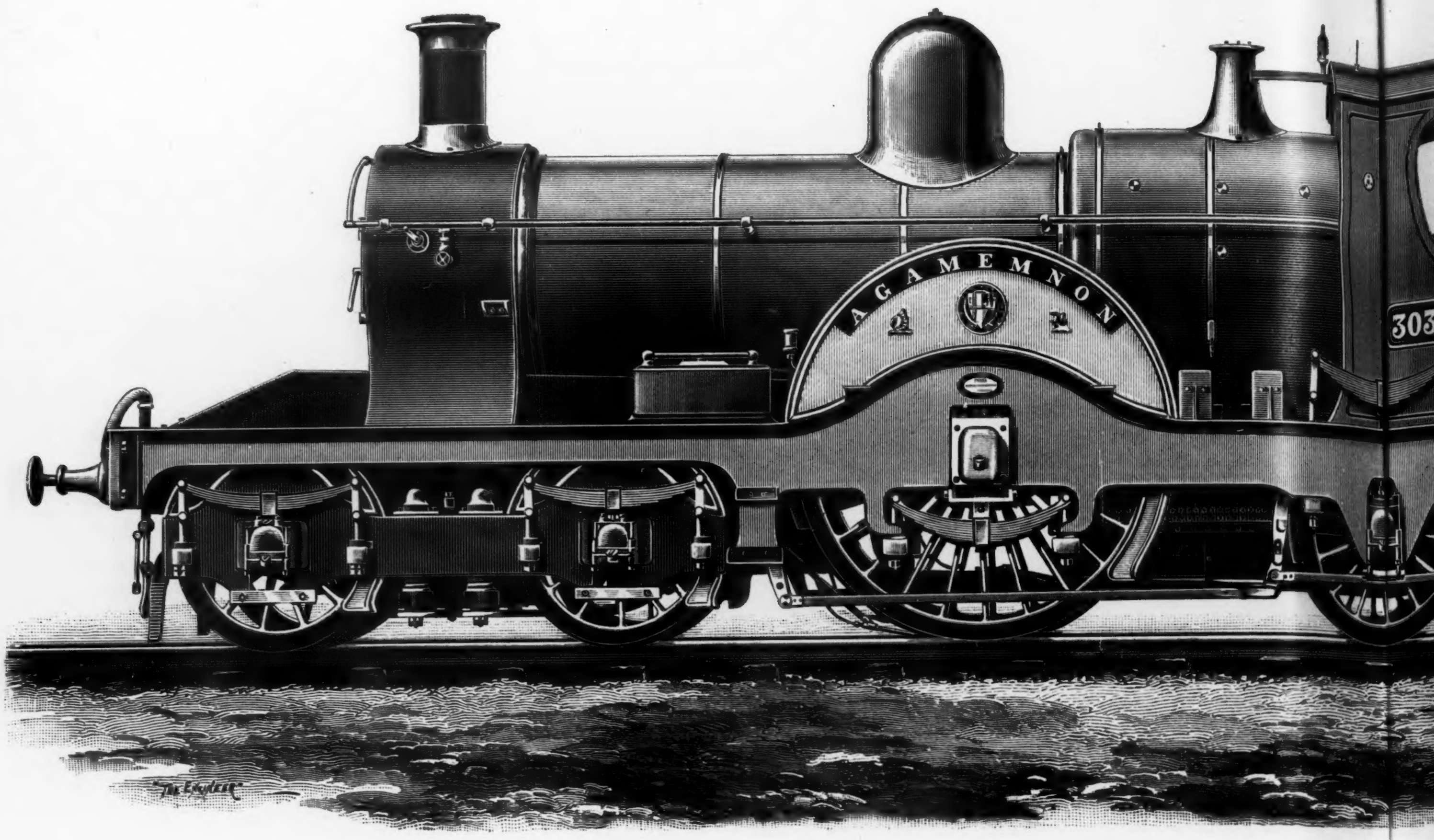
*(For description see page 375)*


ARMSTRONG
7
7' 4½"
9T – 13c
9T – 13c
15T – 18c
15T – 12c
Total 50T 16c
10T – 16c
10T – 16c
10T – 18c
Total 32T 10c
7' 0"
7' 6"
9' 0"
9' 3¼"
7' 6"
7' 6"
23' 6"
15' 0"
47' 9½"
57' 10¾"


ACHILLES
3031
7' 7¼"
9T 0c
9T 0c
18T 0c
13T 0c
Total 49T 0c
10T 16c
10T 16c
10T 18c
Total 32T 10c
7' 0"
7' 6"
9' 0"
9' 0¼"
7' 6"
7' 6"
23' 6"
15' 0"
47' 6¼"
57' 7¼"
"THE ENGINEER"
SWAIN ENG

# EXPRESS PASSENGER LOCOMOTVES

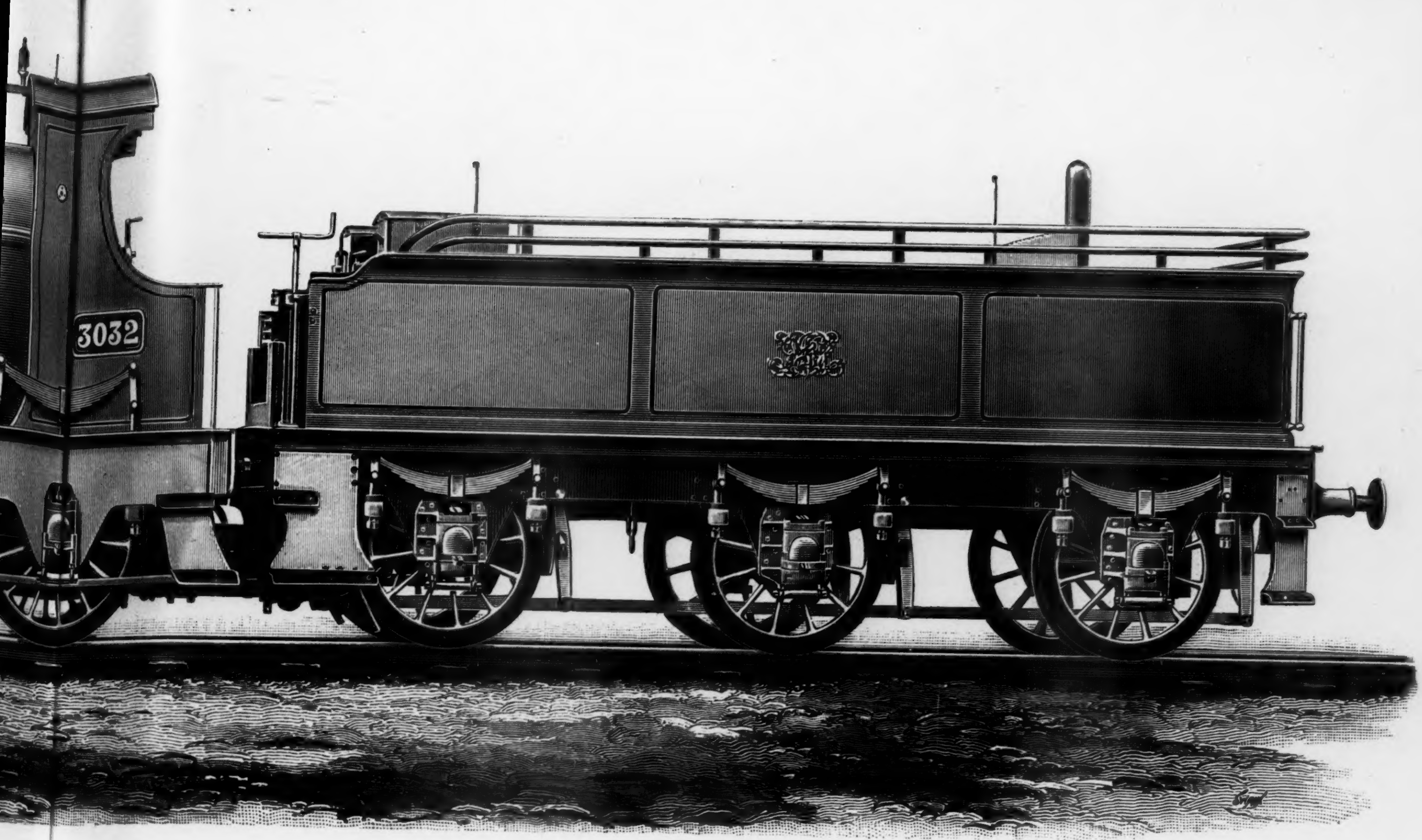
MR. WILLIAM DEAN, M. INS C.E., S

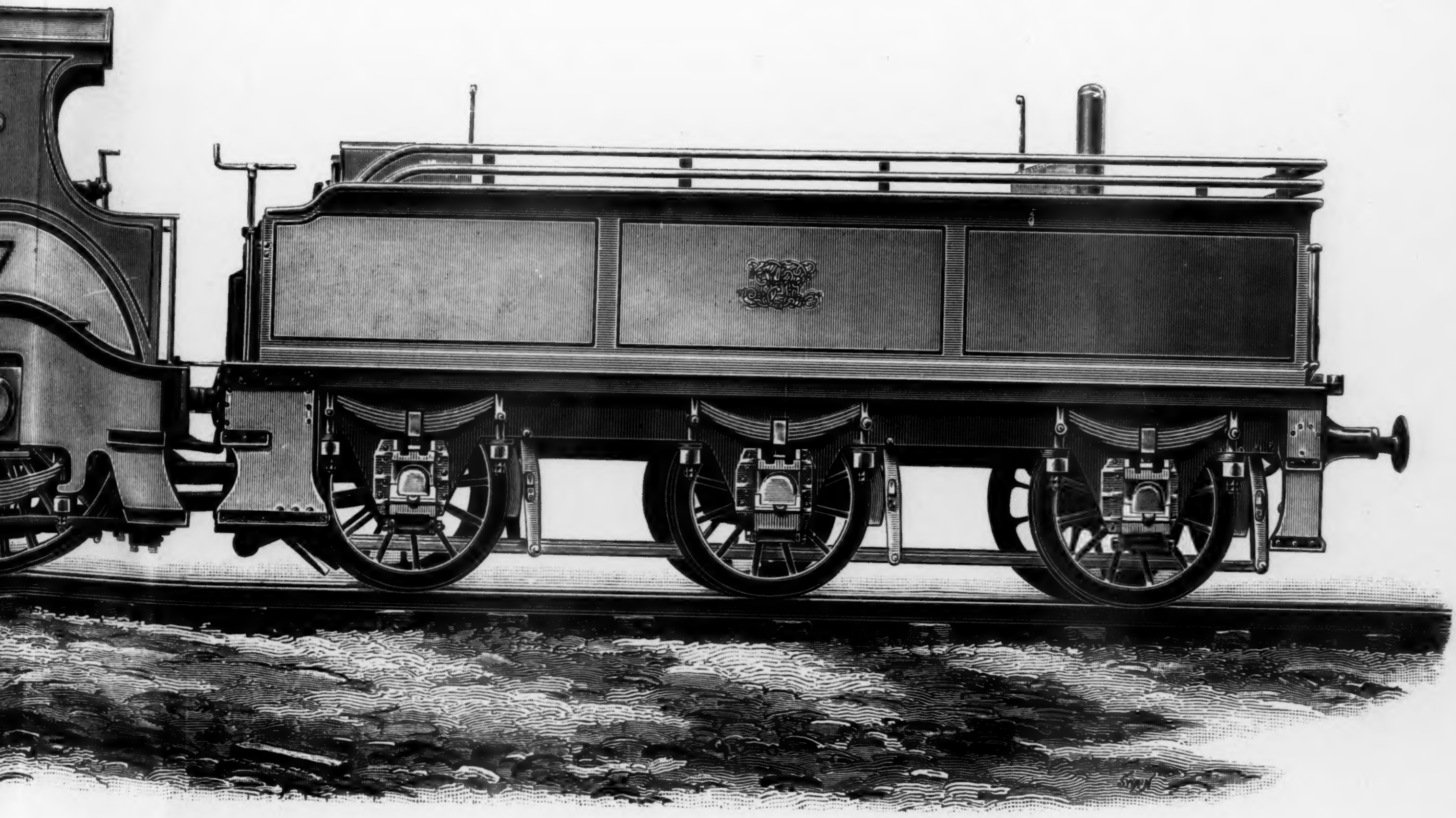

AGAMEMNON
303
THE ENGINEER

ARMSTRONG
7
THE ENGINEER

# MOT VES, GREAT WESTERN RAILWAY

AN, M. INS C.E., SWINDON, ENGINEER





FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

**** With this week's number is issued as a Supplement a two-page engraving of Express Passenger Locomotives, Great Western Railway. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it.*

## CONTENTS.

The Engineer, November 2nd, 1894. PAGE
Express Passenger Locomotives, Great Western Railway. (Ill.) 375
The Manchester Thirlmere Waterworks. No. II. (Illus.) .. .. 375
The Atlas Works, Sheffield. (Illustrated.) .. .. 377
The Iron Gates of the Danube .. .. 378
Light Railways and Tramroads .. .. 378
Railway Matters .. .. 379
Notes and Memoranda .. .. 379
Miscellanea .. .. 379
Samuelson's New Low-down Harvester. (Illustrated.) .. .. 380
Teddington Sewage Disposal Works. (Illustrated.) .. .. 380
Letters to the Editor—The Late Mr. Edwin Clark, M.I.C.E.—Locomotives and Trains .. .. 382
More Doubts and Some Conjectures—Labour and Luxuries—Traction Engines—The Theory of the Steam Engine—Pivoted Arched Bridges .. .. 383
Leading Articles—The Board of Trade and Light Railways—Steam on Common Roads .. .. 385
Telegraphy with Australia and the East—The Paris Metropolitan Railway—Colliery Engine Men .. .. 386
Literature .. .. 386
Manchester Ship Canal .. .. 387
The Antwerp Exhibition—British Awards .. .. 387
Brewers' Exhibition, Agricultural Hall. (Illustrated.) .. .. 388
Legal Intelligence .. .. 389
Society of Engineers. (Illustrated.) .. .. 390
A Shipyard Foreman on Trades Unions and Labour Troubles .. 392
Shells Capped with Wrought Iron .. .. 392
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. .. 392
The Sheffield District—The North of England—Notes from Scotland .. .. 393
Wales and Adjoining Counties—Notes from Germany .. .. 394
Launches and Trial Trips .. .. 394
The Patent Journal .. .. 395
Selected American Patents .. .. 396
Paragraphs—Electric Lighting in London: A Large Order for Engines, 382—The Civil and Mechanical Engineers' Society, 382—Engineering Society, King's College, London, 394—Economical Engines in Tin Mills, 394—British Machinery and Metals in Japan, 394.
Two-page Supplement—Express Passenger Locomotives, G.W.R.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

**** In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

**** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

**** All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

J. S. (Langton)—*The North of Ireland carriage is carried on two four-wheeled bogies.*

### GRANITE, STONE, AND MARBLE QUARRIES.

*(To the Editor of The Engineer.)*

Sir,—Does any reader know a work giving the locality of granite, stone, and marble quarries throughout the world? If so, I shall feel obliged if he will kindly furnish me with the name of the publisher of same.

P. T. J.

Burnley, October 25th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* | £0 14s. 6d. |
| *Yearly (including two double numbers)* | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* | £0 18s. 0d. |
| *Yearly* | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* | £1 0s. 3d. |
| *Yearly* | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

**** The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary," and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

Institution of Electrical Engineers.—Thursday, November 8th, at the Institution of Civil Engineers, at 8 p.m. Papers: "Notes on Electric Tramways in the United States and Canada," by H. D. Wilkinson, member; "Electric Traction, with Special Reference to the Installation of Elevated Conductors," by R. W. Blackwell, foreign member, and Philip Dawson, associate.

Royal Institution.—Monday, November 5th, at 5 p.m. General monthly meeting.

Society of Engineers.—Monday, November 5th, at the Town Hall, Westminster, at 7.30 p.m. Adjourned discussion on the paper on "The Utilisation of Town Refuse for Generating Steam," by Mr. T. W. Baker.

London Association of Foremen Engineers and Draughtsmen.—Saturday, November 3rd, at Cannon-street Hotel, at 7 p.m. Paper: "Drilling Square and Angular Holes," by Mr. Andrew King.

# THE ENGINEER.

*NOVEMBER* 2, 1894.

## THE BOARD OF TRADE AND LIGHT RAILWAYS.

A fortnight ago we directed attention to the action of the Board of Trade in the matter of light railways. Whether or not our words have stimulated the authorities, we cannot pretend to say; at all events, the publication of our article has been very closely followed by the issue of a circular—everything seems to be done by circular now-a-days—by the Railway Department of the Board of Trade. This circular acknowledges the existence of a movement recently set on foot with the object of obtaining further powers and facilities for the construction of light railways and steam or electric tram-roads, and suggests that a conference be held at the Board of Trade on an early day for the purpose of considering:—"(1) How far the usual requirements of the Board of Trade as to constructing and working new railways may fairly be relaxed, especially in the case of lines built through sparsely populated and agricultural districts; and (2) Whether additional legal facilities for obtaining powers to construct tram-roads and light railways are necessary or desirable." We shall not at present discuss the latter question, because it appears to us that there can be but one answer. Any modification of the law which will make the obtaining of an Act less costly than that process is now must be desirable. The only precaution needed is to see that the construction of a light railway shall not inflict an injury on any individual without providing that he shall receive suitable compensation. Care ought also to be taken that the promoters of "wild-cat" schemes shall not be afforded opportunities for robbing the public. The first question is one of far more general importance, and possesses a special interest and significance for many of our readers.

At the outset we may reasonably ask why the officers of the Railway Department of the Board of Trade find it necessary to consult with ordinary civil and mechanical engineers, traders, contractors, and others, as to how far the authorities can be justified in relaxing their rules? Surely the inspectors of the Board must already know all there is to be known about the working of every type and class of railway under the sun. All the gallant officers are past middle life, and have had years and years of special experience on such matters. How can they look for enlightenment to those who are outside their own ranks? Is there not a danger that if they appeal to others they may be misled, and induced to do that which they would subsequently have reason to regret? Thus, for example, if a line were not adequately fenced, a pig might be run over, or even two pigs. The theory that the Railway Department of the Board of Trade really does not know anything about light railways, and that the conference is to be held for purely educational purposes, is so ridiculous that it only needs to be stated to secure its rejection. But these reasonings, and conclusions, and deductions only leave us more puzzled than ever as to the object the Board has in suggesting the conference. The rules and regulations of the Department have, it is well known, been framed with great care—at least that is what we have always been told. But surely it is not too much to expect that those who prepare them and administer them understand precisely why, how, and where they apply, and how, why, and where they do not? Thus, for example, it is obvious that the complete block system should be established on our great main lines; but the inspectors must know that nothing of the kind is needed for the narrow gauge line between Slopperton-on-the-Marsh and a junction with a branch of the South-Northern road. The little line of ten or twelve miles is traversed by only three trains each way in the day, all mixed. Surely a conference is not needed to decide whether a 45 lb. rail can carry a 15-ton locomotive supported on six wheels and running at twenty miles an hour? These, and indeed nearly, if not quite, all the constructive or mechanical points that can be raised ought to be perfectly familiar to the officers of the Railway Department. The more the circular is thought over and pondered, the more puzzling does it become. The only solution of the difficulty is that about light railways the Department knows nothing and wants to learn. Some light was thrown on this point at the Conference of the Iron and Steel Trades Association held on Tuesday. We may say here that the proceedings of this conference were in general quite devoid of interest. Mr. Jeans, however, read the report of the special committee on light railways, and Mr. Hopgood, of the Board of Trade, who was present, said that in the event of any practical schemes being brought forward the Board of Trade would further as far as possible adequate inquiry into the subject of light railways; but practical schemes had not as yet been brought forward. The President of the Board of Trade had stated that the time had arrived when the Board might take steps to acquire by means of a formal conference to be held at the Board of Trade offices all information which could be afforded by those who were interested in the subject of light railways.

If this be the case the circular may be taken as a manifestation of a highly laudable frame of mind. The Department says:—"Here are a number of worthy folk who want light railways. We do not know much about these things ourselves, but we believe that they are very cheap and nasty, certain to kill people, and to prove general and particular nuisances. However, we must give way to the popular desire. We must obtain some information, and for that purpose we cannot do better than have a Conference." This is all very well so far. It remains, however, to be seen whether the speakers at the Conference can succeed in persuading the Department that excellent service may be done by little 2ft. 6in. roads laid with a charming disregard of much, if not all, that the Department deems essential. It may be useful to call attention to the circumstance that abroad 40-ton engines are carried not unsucessfully on 56 lb. rails, the sleepers being laid on the ordinary earth, no attempt whatever being made to ballast the road with gravel or broken stone, or other material of a proper and sufficient kind. It is possible, however, that after all, the words which we have quoted from the circular have a somewhat different meaning from that which they ostensibly convey. The Board of Trade may take a position which is best expressed by the word condescension. The Department may say, "We have drawn up certain rules which are altogether good. That is our affair. You assert that they interfere with the development of much needed means of transport. Perhaps so, but that is your affair. We are, however, willing to talk the matter over with you, in order to find how little relaxation of our rules you will be content to accept." This is quite intelligible, and it will be seen that it involves no assumption of ignorance on the part of the Department. It remains now to be seen whether the circular will elicit a sufficient response. We hope that such evidence will be adduced as will leave the officers of the Department no grounds for enforcing unnecessary restrictions. These restrictions may be of a double character. They may insist on such excellence of construction as would entail a prohibitive capital expenditure, or they may insist on the observance of traffic regulations which would very greatly reduce the utility of narrow gauge roads. We trust that those attending the Conference will be prepared to resist the Board of Trade on both points should the necessity arise.

Apart altogether from the action of the Board there is much that might be discussed with great benefit at such a conference as that suggested. For instance, it is by no means certain that any very great benefit is to be gained by laying rails 2ft. 6in. or 3ft. apart instead of 4ft. 8½in., and there are undoubtedly many objections to the narrow gauge for agricultural purposes. Farm produce, if we except grain, is generally bulky; and the rolling stock of a 2ft. 6in. road does not lend itself readily to the conveyance of fat bullocks. In mineral districts the case is different. There is a great deal to be learned yet about light railways, and certain popular prejudices concerning railway work in general must be abandoned if they are to be as useful as is desirable. But it is above all things desirable that exaggerated notions concerning what they can do should not be formed. Under no circumstances is it likely, for example, that goods or passengers can be transported over such roads at rates as low as that which obtain on great main lines. We can strongly recommend to our readers interested in these questions a paper on "Light Railways in New South Wales," by Mr. Charles Ormsby Burge, M. Inst. C.E., read last December before the Engineering Section of the Royal Society of New South Wales; and we cannot better conclude this article than with the following quotations from Mr. Burge's paper:—"The people of a district to be served must be content with slower speed, irregular running to time, less accommodation at stations and goods sheds, and, notwithstanding getting less, they must be prepared to pay more than those using the main lines, to cover the extra cost of working. . . The conclusion, therefore, which this paper maintains is that, generally, considerable cheapening of branch line construction can be made by lessening requirements and by improved locomotive design; but that there is a limit beyond which any considerable cheapening in capital expenditure will be more than overbalanced by excessive working expenses. An attempt has been also made to indicate what that limit is, as far as can be done, without having the ever-varying circumstances of each particular project in view." Mr. Burge's great experience and moderation of expression entitle his views to very careful consideration.

## STEAM ON COMMON ROADS.

From time to time efforts are made in a hesitating fashion to obtain such changes in the Highway Acts as will facilitate the use of steam on common roads. The law as it stands prohibits the use of steam-propelled pleasure carriages, and it grievously hinders the use of traction engines. Unfortunately, up to the present the owners and users of traction engines have proved themselves to be but weak and feeble folk, and nothing whatever has been accomplished. The history of the existing Act is a history of mistakes; and the builders of traction engines have to thank themselves principally for its harshness. As far back as 1862 traction engines were permitted to run about the country as they pleased. There was a grave doubt as to whether they could be made to pay turnpike tolls. It was understood that if any owner of a traction engine frightened horses or caused damage, he would have to pay a suitable sum in compensation. For different reasons, however, opposition was set on foot, and the traction engine builders and owners gave way, and instead of standing out for good terms took what they could get. The result was an Act of Parliament of the most oppressive character—one so full of pains and penalties, and restrictions and limitations, that it is remarkable that it did not kill the traction engine outright, as no doubt was intended by those who framed it. The fact that in spite of this traction engines are still built and used in this country supplies splendid testimony to their utility and capacity for doing good service. It is time that a change was introduced, and that steam on the common road was permitted to discharge the duties of which it is capable.

The objections to the use of steam on highways are in the main twofold. The first is that the traction engine frightens horses and is dangerous to human life; the other is that it injures the roads. As regards the first point, the argument is precisely that which has been urged not only against railways, but against steam, cable, and electrically worked tramways. We may put railways on one side and consider the facts. It is quite lawful to use a cable car drawing a tramcar up to a speed of eight miles an hour in a town. There is no red flag needed in front, nor, indeed, any other special precautions. Why should it be illegal to use a steam-driven vehicle on the same highway? Are we to seek in the rails the explanation of the puzzle? Would it be possible with the existing Traction Engine Act in force to obtain an Act of Parliament for a line of steam-driven omnibuses between, say, Westminster Bridge and Croydon? It is certain that the engines could be so made that they would give out neither smoke nor steam to alarm horses. The cable cars are passed by thousands of horses every day with perfect equanimity, and there is no reason that we can see why the steam car should not prove equally inoffensive. Any day and every day steam rollers may be seen at work in the streets of London. There is no trace of either steam or smoke, and horses take no notice of them. The greatest nuisance about them is the noise the rollers make, but that is in a sense part of their duty. The red flag business has been reduced to a farce. There is a boy, or even two boys, but the red flag might just as well be stuck on the engine chimney. One of the curiosities of the matter is that it is more than doubtful if the authorities have power to interfere with vehicles propelled otherwise than by steam. Some years ago an attempt was made to stop the use of tricycles, the "safety" was not yet born—but that came to nothing. Recently electrical omnibuses and parcel vans have run in the streets. No attempt has been made to bring the law to bear against them. Is it clear that a man running a phæton propelled by an oil engine could be stopped? It is certain that he could not run a steam engine until he had paid £10 for a licence, and then not without a boy a hundred yards in front with a red flag, and the speed must not exceed four miles an hour. All this seems childish, but it is true, and from first to last these regulations have been framed on the theory that horses must of necessity be frightened out of their wits by a steam engine on a common road or in a street.

The second argument, that traction engines ruin roads, is one worth discussing. The facts can be easily reached, but they must obviously vary with each special case. Traction engines are employed, for instance, in Kent in drawing manure to the hop gardens. Now the question presented for solution takes this form:—Is the damage done by an engine and a couple of wagons greater than the damage that would be done by horses and carts conveying the same weight of old woollen rags, &c., over the same ground? The answer will, we think, depend on the road. If that is well bottomed and properly kept up the engine will do much less harm than the horses. On a weaker road the contrary may be the case. The surface mischief will be greatest where horses are employed, but the engine has no doubt a capacity for finding out weaknesses in a road of which horses cannot boast. But even if it be conceded that the balance of evidence is against the engine, the difficulty admits of being readily overcome. The money paid for the annual licence could be devoted to the maintenance of the road. If the mechanical facts are sifted out it will be found that the law was based on the theory that the traction engine must be a noisy, clanking, puffing, smoking nuisance, to be discouraged as much as possible. No doubt time was when this theory was sound. At the present moment engines may be found which are in the most abominable sense of the word a nuisance. Yet there is no difficulty in building engines which are nothing of the kind. But there is nothing to be gained by doing this; the aid of Parliament was indeed specially invoked to prevent improvement. Whether an engine is noisy or ugly or not makes no manner of difference so long as it complies with the law, and consequently the better types of engine have been principally intended for use abroad.

It is better, having stated an evil, to suggest a remedy, although it is not indispensable that we should do so. The proper course seems to us to lie in modifying, not in repealing, the Highway Acts so far as they refer to the use of steam. Thus, for example, the use of any self-moving engine weighing more than ten tons, unless it be a steam roller, might be prohibited, on the ground that a greater weight ought not to be put on country bridges. Again, it might be settled that engines whose wheels did not each carry more than 1½ tons might run at a speed of nine miles an hour in the country and at six miles an hour in towns. For all engines or self-propelling vehicles licensed to run at the higher speeds, the use of the red flag to be unnecessary. As a matter of course, neither steam nor smoke must be emitted in a town. In every and any case the owner would be liable to an action for damages if his engine did mischief in any way—as by frightening horses, &c. Certain privileges might be conceded to engines specially contrived to avoid giving offence. In fact, the law as it stands is so one-sided and defective that nothing is much easier than to suggest improvements on it. One immediate result of a change would be, we think, that the use of steam for hauling purposes on common roads would be rapidly extended. It is argued all round us that *the* want of the age in this country is cheap transport; but transport by steam, it has been abundantly proved, is cheaper than transport by horses. No doubt the traction engine could be extensively used as a feeder to the railway if only suitable facilities were afforded for the purpose, and again improved engines capable of travelling at speeds of, say, six miles an hour, could be introduced. They have existed before in this country and did excellent service, and there is nothing but the Act of Parliament to prevent us from having them again. But besides the traction engine proper we should have self-propelled vehicles for the conveyance of passengers, and pleasure carriages. We have fully reported what has recently been done in France in this direction. If any of our readers can lay hands on Herbert's "Dictionary of Engineering," a work published nearly half a century ago, they will find in its pages ample evidence that the problem of successful passenger locomotion on common roads was worked out long since. Indeed, Sir F. Bramwell's paper read this year before the British Association, and published in full in our columns, can leave very little doubt on that point. French engineers have no doubt recently done very well. We venture to think that if English engineers were allowed a free hand they would do very much better.

◆

### TELEGRAPHY WITH AUSTRALIA AND THE EAST.

THE result of the working of the experimental lowering of the rate of cablegrams to Australasia is shown by the statement of the Eastern Extension—Australasia—and China Telegraph Company. It may be remembered that in the first year of the working of the guarantee under which the charges were lowered there was a loss of £55,040 to be shared amongst the guaranteeing Colonies and companies. In the second year there was an increase of traffic that brought down the loss to be so shared to £43,558; and now for the third year the loss is officially stated to be £12,384 only, to be shared in a similar method—one-half amongst the Colonies and one-half amongst the telegraph companies concerned. The bringing down to so small a sum is not entirely due to the increase of traffic, for it may be remembered that the Colonial Governments desired a slight addition to the tariffs to lessen the loss, and hence the increase in cost of 9d. per word has had much to do with the limitation of loss; and with the great depression in trade that has been known in the Colonies in the past year it may be fair to assume that it is to the increased cost more than to the continued growth of the use of the cables that the recent limitation of the loss is attributable. Still, there is an increase in telegraphy that must soon wipe away that loss, which is to the whole of the guarantors so small now, both from enlarged use of the cables, and from the tapping of additional feeders of the system. The value of the telegraphic communication with the Far East is known now, even with the censorship that seems to prevail, and it is probable that one result of the war that is raging will be to open out much more rapidly that great part of the East from which it has been shut out. To many parts of the East the system of cable communication has been so improved and strengthened by duplicate and triplicate cables, that whilst at the opening of communication the time occupied in transmission averaged ten hours to Australia, it is now effected in less than two hours; whilst to India thirty-five minutes is the average time, instead of five hours as at the opening of the line. There is now not only a rapid but also a sure basis of communication that is afforded by alternative routes and cables, and which must be expected to be increased. As the area for the collection of traffic is augmented by the opening out of new lines, so the receipts of the companies must be enlarged; and that enlargement could be aided materially by the guaranteeing by the Governments of the loss through reduction of the rates of charge—a guarantee which experience shows to be heavy at first, but to be reduced from year to year as the cheapness of telegraphy induces a larger use of its powers of quick communication.

### THE PARIS METROPOLITAN RAILWAY.

THE project of M. Barthou, Minister of Public Works, for constructing a metropolitan railway in Paris, is meeting with general favour by those interested in the carrying out of the undertaking. M. Alfred Picard, the Commissioner for the Exhibition of 1900, approves of the scheme, and says that the work ought to be put in hand next year, as it would be very undesirable to have any works in progress during the period of the Exhibition. The railway should be terminated at the earliest possible moment, so that the workmen should be free to be engaged upon the Exhibition buildings. He thinks it is absolutely essential that none but smokeless engines should be employed upon the Metropolitan, and in his capacity of inspector-general of the Ponts et Chaussées, he has already insisted upon the adoption of some such system upon the new extension from Molineaux to the Esplanade des Invalides. Since the project of M. Barthou was presented to the Municipal Council, it has been discussed by a committee appointed for that purpose, and criticisms have been passed upon the proposed two transverse lines, on the ground that they would not serve some of the districts in which several members of the committee were interested. The chairman also thought that the Council should have more authority over the Metropolitan than the Government seemed inclined to give them, especially in view of the fact that not only were the Council to make a grant of the land required for the construction of the lines, but they had to allow the free entry of the material used in the construction of the railway. It was feared that this latter condition would only be made the precedent for a claim by the Government to have the material to be used in the erection of the Exhibition buildings introduced into Paris free of octroi duty, in which event the Council would lose a revenue of several millions of francs. Another objection raised was the supposed danger incidental to such a vast system of tunnelling, as some members asserted that the disturbance of the subsoil might result in the spreading of an epidemic of contagious disease. Before pronouncing definitely upon the scheme of M. Barthou, the committee is considering the many other schemes that have been brought forward for the construction of a Metropolitan, but it is believed that it will finally pronounce in favour of the proposal of the Minister of Public Works with one or two slight modifications.

### COLLIERY ENGINE MEN.

THE dispute in the coal trade regarding engine men and boiler men's wages has now been settled. A conference between the coalowners and the men took place at Sheffield on Tuesday. The men's demand was that they should be allowed to stand, in regard to wages, as they did last July, before the Conciliation Board decreed a reduction of 10 per cent. They repudiated the right of the Conciliation Board to deal with their wages on the ground that engine men and boiler men were not consulted or represented on the Board. They, therefore, handed in their notices, and for a time it seemed as though a second grave strike was imminent in the coalfield. It was ultimately agreed to withdraw the notices on the understanding that a conference between the owners and men should take place. This was the conference held last Tuesday, which was of a very protracted character. It was found impossible to prepare any resolution which would fairly meet the views of both parties, or suit the circumstances of every colliery. The owners, however, intimated that each colliery proprietor would endeavour to arrange with his own engine men and boiler men, according to the circumstances prevailing at each pit, and added that in the event of any difficulty arising the owners' committee would willingly meet a committee from the other side and try to adjust any exceptional cases. After the conference the representatives of the engine men and boiler men held a meeting, at which they recommended that the whole of the men employed in the steam trade in the collieries in South and West Yorkshire to appoint delegates, who, with two of the officials of their Societies, should endeavour to bring about a settlement. It is believed on both sides that the dispute will be amicably arranged and give little further trouble.

## LITERATURE.

*Elementary Treatise on Natural Philosophy—Based on the Traité de Physique of A. Privat Deschanel.* By J. D. EVERETT, M.A., D.C.L., F.R.S., Professor of Natural Philosophy in the Queen's College, Belfast. Thirteenth Edition. London: Blackie and Son. 1894.

THE appearance, some thirty years ago, of Dr. Atkinson's translation of Ganot's "Physics," marks an important epoch in the scientific development of this country, as we were thereby first made generally acquainted with the accurate and artistic representation of scientific apparatus and phenomena. Professor Everett's translation of the *Traité de Physique* of Deschanel soon followed, and here in many instances the illustrations were complete works of art, some of which we are sorry to miss in the present edition; this is owing to the exigencies of space, and partly also to a change of scope and plan in the English version. For while the French text of Ganot's "Physics" is still closely followed in the translation, Professor Everett has struck out an original line, and now his "Treatise on Natural Philosophy" styles itself as based on Deschanel's *Traité de Physique.* In this thirteenth edition the work has been entirely recast, with the exception of the portions relating to the comparatively stationary subjects of Mechanics, Hydrostatics, and Acoustics, and thereby previous editions are now superseded; we hope, however, to find in the next edition a diagram and description of Mr. Fleuss's effective and workman-like air-pump. The engineer will find the diagrams taken from the French version more worthy of his approval than the usual absurdities made to do duty in our English text-books; at the same time he will recognise some old paradoxes which seem immortal; for instance, the figure 26, in which the equilibrium of the lower weight is impossible so long as the middle portion of the cord is on the slant. The first principles of statics are well explained in Chapter II., but the needless conception of a rigid body is introduced, as if the theorems were inapplicable to an elastic body, say the Forth Bridge or Tower Bridge; we only require the elastic body to have come to rest for the elementary principles of the composition and resolution of forces in statical equilibrium to be employed.

The explanation of the composition and resolution of forces in § 32 would be improved, in our opinion, if the second of the two components was always kept in view, as thereby a fruitful source of error in the minds of beginners would be avoided.

The C.G.S. system of units is carefully explained, as might be expected, considering the important part taken by Prof. Everett in their introduction; but the engineer will always despise these units, as too minute for any problem except of delicate physical measurement, and he will deplore the loss of Prof. Johnstone Stoney's amendment, that the metre and the kilogramme, instead of the centimetre and the gramme, should be adopted as units; as indeed they are in reality in the working electrical units, such as the joule, watt, volt, ampère, and ohm.

But what will astonish the engineer most is the extraordinary use of the word *weight*, interpolated in the English version, but not to be found in the original French of Deschanel. Article 81 runs, "The weight of a body, strictly speaking, is the force with which the body tends towards the earth." But, strictly speaking, this is no definition at all, but a mere description of one of the qualities of matter. A mathematical definition must be such as to afford a precise numerical estimate of the measure of a quantity, and this is lacking in the above attempt at a definition. If we amend it into "the weight of a body is the *number of units of force* with which the body is attracted by the earth," we shall find that the unit of force invariably employed in this definition is the gravitation unit. Thus, if a body weighs 10 lb., it is attracted by the earth with a force of 10 lb., and it is impossible that this force should be anything different, say 9 lb. or 9 99 lb. If the author will consult the Act of Parliament on weights and measures, he will find that he is liable to a fine if he employs his definition of §91, and attempts to sell grammes by weight in dynes, or pounds by weight in poundals. Does any engineer ever use the expression of a "pressure of 150 lb. *weight* on the square inch," so carefully insisted upon in this treatise? And if he meets it, does he not mentally look for an equivalent number of pound weights of matter, directly superposed on the safety valve? The two separate qualities of matter, as measured by *weight*, are very clearly distinguished in §89 as *mass* and *gravitation*; and no objection can be raised to the statement that the *gravitation* of one gramme is about 981 dynes, or of 1 lb. is about 32 poundals; but the attempt to degrade the good old word *weight* to the mere meaning of gravitation must result in confusion and failure. No wonder Professor Kennedy, in his inaugural address before Section G of the British Association at Oxford, dwelt upon the necessity for young engineers of a mathematical course quite distinct from that obtainable in the treatises prepared by the schoolmaster and the college professor.

Part II., on "Heat," contains two valuable chapters on thermodynamics worthy of study in conjunction with Professor Oliver Lodge's striking presentation of the subject in these columns. The mysterious quantity called "entropy" is dismissed rather curtly. A popular explanation is much wanted of the properties of this function, originally introduced into thermodynamics by Clausius and Rankine as an analytical help in the integration of the differential equations.

The rapid progress of electrical science in recent years has rendered sweeping changes necessary in Part III., on "Electricity," so that this part has been thoroughly recast in this edition. Extensive changes have also been made in Part IV., on "Sound and Light." The beauty of the diagrams makes this volume very suitable for a school prize, and serves to gild the pill of hard mathematical treatment occasionally—too frequently, to some minds—interpolated in the pages of description.

---

*Theoretical Mechanics: I. Solids; II. Fluids.* By J. Edward Taylor, M.A., B.Sc., London; Head Master of the Central Higher Grade and Science Schools, Sheffield. London: Longmans, Green, and Co. 1894.

Although published as separate works, the first nine or ten chapters of these two treatises are identical. They are intended to be used by young people preparing for the London University Matriculation and for the Science and Art Department examinations, and the corresponding syllabus has been closely followed. There is a wonderful similarity in the treatises on mechanics which swarm at the present time, each adapted to the requirements of some particular examination; and an engineer will be sure to find some amusement from the unpractical nature of the diagrams and illustrative examples, showing that the author has merely copied his ideas from some other similar treatise, and has never lifted his eye from the page to look at the real articles around him. In the present treatise the diagrams are, as a rule, fairly accurate; but the engineer will smile at the figure of the man pushing at a capstan-bar with a force of one hundredweight—Fig. 24—as this would imply that the man's weight is about one ton. No wonder the Georgia Magnet astonished the world a short time ago with her feats of strength, presuming on the ignorance of the spectators that the push or pull that can be exerted depends entirely on the overhang over the toes of the weight of the body through its centre of gravity. Fig. 116 of the second system of pulleys is statically impossible. Who is to be so bold an innovator as to correct it? But a statement on page 195 of Solids wipes out the science of dynamics of the last 250 years, and carries us back to the times anterior to Galileo.

"A stone will be found not to describe a straight line, but a curve. Why is this? Because the body is acted on during each second of motion by two forces, one producing a uniform motion, the other producing a uniformly accelerated motion. They are (1) the force of projection, producing a uniform motion; (2) the force of gravity, which produces a uniformly accelerated motion. The first acts in the direction of projection, *i.e.*, obliquely, whilst the second acts vertically downwards," &c.

After this we shall expect to find that the Science and Art Department accepts the mediæval theory of the Primum Mobile, or of a dæmon who turns the crank which keeps the celestial movement going.

The author attempts to clear up the confusion between $\frac{1}{2} M v^2$ and $\frac{w v^2}{2 g}$ as a measure of kinetic energy; this he does by saying that $M = \frac{w}{g}$, but in the numerical illustrations of page 208 he finds that he is obliged to put $M = w$ to make the results agree.

In an example on page 67, it is proved that 1 lb on the earth's surface would weigh 29·3 lb. on the sun's surface; but the reverse is the truth, if the weighing is carried in a balance, of the size demanded by Archimedes, reaching from the surface of the earth to the surface of the sun. These are some specimens of the ideas which are carefully driven into the schoolboy's mind, which he has to unlearn again as fast as possible when he comes as an engineer to deal with actualities.

---

*The Electric Transmission of Intelligence, Electrical Measurements, Electricity and Magnetism.* By Edwin J. Houston, A.M. The W. J. Johnston Co., Limited, New York; and Whittaker and Co., London. 1894.

We have before us a set of three advanced primers of electricity by Mr. Houston, who is perhaps best known on this side of the Atlantic from his "Dictionary of Electrical Words, Terms, and Phrases." He is careful to explain that these are not mere revisions of his "Primers of Electricity," which were published during the International Electrical Exhibition held in Philadelphia in 1884. The public are no longer so ignorant of the principles of electrical science, and more advanced works are required. The author's position as Professor of Natural Philosophy and Physical Geography to the Central High School of Philadelphia has shown him that the student is often in doubt as to the best books with which to begin his studies. In turning over the leaves of these primers, which are illustrated, we recognise the same old cuts we have seen so many times before. The "Electric Ray" still does service; what use its properties may be to the practical electrician we cannot say. The term "standard works," as used by the author, appears to include a considerable number which we had never seen classed under that heading before; and whether the young student will be assisted in forming a trustworthy opinion is open to doubt.

The primer on "Electricity and Magnetism" attempts to cover a great deal of ground; but, from our point of view, it is a misnomer to call it an advanced primer—in fact, all three appear adapted for boys of the upper forms in day schools. The author appears to favour cramming for examinations, as at the end of each volume he gives a "primer of primers," in which he attempts to give what we may designate "tips" useful for stimulating the jaded memory before an examination. The student is there, among other things, desired to remember that a particular shaped core is known as a Krizik core; and is informed that iron is preferable to copper for lightning rods.

The volume on electrical measurements appears to us better than the one just alluded to; and the chapters upon alternating currents contain useful information. Sufficient space is given to Tesla's experiments upon currents of high frequency to give the student some idea of what is being done. The portion treating of dynamo-electric machines appears the best illustrated; and here we can appreciate how much Professor S. P. Thompson has done to elucidate the construction of the machines, as the diagrams recall the illustrations in his works.

The telephone and telegraph are described in the third volume; but, throughout all the parts, many of the cuts are so very small and indistinct that they are quite useless to give the student the least idea of what they represent. In our opinion books of this kind are called into being by the rage for examinations. The class of questions set usually range over such a wide area that the student is required to pick up a surface knowledge of a mass of things, and doubtless considers he understands the subject he has read. Teachers are, of course, but little to blame; it is the system of education to which the result is due.

---

*An Elementary Treatise on Theoretical Mechanics.* By Alexander Ziwet, Assistant Professor of Mathematics in the University of Michigan. Part I., Kinematics. Part II., Statics. Macmillan and Co. 1893.

The present book owes its existence mainly to the difficulty of finding a good modern text-book suited to the requirements of the American student. So says the author at the outset in his preface; and certainly he is right as far as our text-books on mechanics are concerned; these are written to suit academical students, and the requirements of the engineering student are completely ignored. With the characteristic spirit of innovation of his countrymen, the author breaks through the old-fashioned entanglements employed in this country to retard the advance of the student. He starts off at once with the ideas and symbols of co-ordinate geometry and the calculus; but explains the details of the analysis as he proceeds, so that once the plunge is made into the new notation, the student is rapidly carried forward instead of being kept shivering on the bank, as his less fortunate fellow students in this country. The diagrams are elegant and correct, being taken from real objects, and thus they form a great contrast to the diagrams we are accustomed to expect.

While discussing crank and connecting-rod motion in Chapter III., the author might well introduce the important modifications due to the obliquity of the connecting-rod. An elegant geometrical demonstration, due to Professor Klein, has lately been brought before our notice by Mr. Archibald Sharp. The geometrical treatment of mechanical problems, well-known to engineers of all times, has now-a days been developed into a large independent subject under the name of Graphical Statics; the treatises of Culmann, Cremona, and Sir George Clarke may be mentioned. The author gives some well-chosen examples of the method, with sufficient indications for the engineering student to practice it further on his drawing-board, the only place where the subject becomes a reality. Mr. Boys' last determination of the mean density of the earth as 5·5270 should now be taken as practically final, and should replace the rough estimate of $5\frac{2}{3}$ given in §262. The American student is to be congratulated on the possession of so admirable a text book. It is a pity that it could not supplant the antiquated treatises in use over here.

---

*The Beam: or Technical Elements of Girder Construction.* By William Lewis Baker, A.M.I.C.E. London: Chapman and Hall. 1892.

This is a pleasant little treatise on the calculation required by the young engineer in the ordinary problems which occur in connection with beams and girders of moderate span. The methods are illustrated by a series of extremely simple examples, worked out to their numerical results. The author shows thereby that the complicated algebraical formulæ which bristle on the pages of more ambitious treatises, to the terror of the novice, are not found necessary for the determination of any ordinary question that may arise; and for this the student owes him best thanks.

The elementary stresses of a beam are well explained in Chapter I., including a model demonstration shown in Fig. 8; this is attributed to Professor John Perry, but must have been in use long previously at the Chatham Military School.

## MANCHESTER SHIP CANAL.

Some of those who are or may be credited with being well informed on this subject, maintain that there is no longer any doubt as to the prospects of the Manchester Ship Canal. Month by month they find the returns of the traffic department showing a better and more promising state of affairs. The approaching completion of some of the unfinished works confirms them in the belief that many of the commercial advantages are only now becoming available. This is perhaps more particularly to be noted in connection with what may be called the ports along the line of the canal.

The canal, as our readers will remember, does not touch Warrington proper, but passes to the south of the old river bend round the Arpley meadows. The original intention was to dredge and widen the Wilderspool bend of the Mersey, and to make it into a large dock, some twenty-three acres in extent, and 26ft. deep.

As yet the scheme has not been completed; the river diversion channel to the north, from Walton Arches to Arpley Bridge, has been cut, and now passes the tidal flow up to the town and beyond, as far as Latchford old weir, and the entrance to the proposed dock from the Ship Canal is made. Any future work can thus be carried out without difficulty or delay to traffic in any way.

From Warrington to the sea there are two distinct channels, viz., the old river course and the new Ship Canal. Both are tidal, or more correctly, the canal is semi-tidal, as the entrance gates at Eastham prevent the tidal waters from falling below a certain level, whereas the river falls to low tide level without let or hindrance. It is therefore to enable small coasting craft and other vessels to pass from the river to the canal at Warrington, or *vice versâ*, at all states of the tide, that the lock referred to has been constructed.

There is, however, a curious feature which somewhat complicates the situation. Although the tide rises in both canal and river, the time of high water at Walton is not the same in both channels. This is due to the more direct modern channel enabling the tidal flow to travel quicker than is the case in the tortuous old river bed. Thus the period of high tide is earlier in the canal, and the ebb, too, begins sooner than in the Mersey at the same point. From this it follows that the lock connecting these two channels must—if it is to be available at all times—be constructed to lift either way, and to work up-stream or downstream as the tidal conditions may require. Accordingly, we find at the Walton Lock duplicate gates mitreing in opposite directions at each end of the chamber, and working by chain gearing similar to that employed in the large locks, but actuated by hand instead of water power. The lock chamber, unlike those of the canal proper, which are of concrete and blue brick, is built of old sandstone, and is 229ft. long by 30ft. wide; the depth of water on the sill at low tide is 10ft. 6in. To the south of the lock is a sluice on the Storey patent principle, having an opening of 20ft., and intended for flushing purposes. It is scarcely more than ten months since this important work was begun, and already the permanent work is completed and the lock in use. All that remains to be done is the deepening and widening of the Warrington basin.

## THE ANTWERP EXHIBITION.

### BRITISH AWARDS.

#### Metallurgy (Iron and Steel).

*Diploma of Honour.*—Palmer's Shipbuilding and Iron Company, Jarrow.

*Gold Medals.*—Cradock, Geo., and Co.; The Patent Nut and Bolt Company; United Horseshoe and Nail Company.

*Silver Medals.*—Cardiff Tin Stamping Company; Chubb and Sons; Milward, Henry, and Sons.

*Bronze Medal.*—The Steel Forging and Ball Bearing Company.

#### Large Mechanical Construction: Motive Machines, Draining, Extraction Machines, Boilers, &c.

*Grand Prix Diploma.*—Babcock and Wilcox; Galloways, Knott Mill Ironworks.

*Diplomas of Honour.*—Green, Ed., and Son; Tangyes; Temperley, Joseph.

*Gold Medals.*—Bryan Donkin and Co.; Burt, Peter, and Co.; Dowson Economic Gas and Power Company; Fielding and Platt; Smith Bros. and Co.

*Silver Medals.*—Davis and Co.; Lockwood and Co., W.; Picksley, Sims, and Co.

*Bronze Medals.*—The Frictionless Engine Packing Company.

#### Machinery and Machine Tools.

*Grand Prix Diploma.*—Thomas Robinson and Sons.

*Diplomas of Honour.*—Barnett and Foster; Linotype Company; Smith and Coventry.

*Gold Medals.*—The Central Cyclone Company; Sowden, David, and Sons; Stevens, Thomas; the Hardy Patent Pick Company; the Steel Forging and Ball Bearing Company; Wilson Brothers.

*Silver Medals.*—Copley, Turner, and Co.; Leggott, W. and R.; Sagar, G., and Co.; United Horseshoe and Nail Company; Tilghman's Patent Sand Blast Company.

*Bronze Medals.*—Miller and Richard; Dermantine Company.

*Honourable Mention.*—Musto, J. J., and Co.

#### Railway Plant.

*Grand Prix Diploma.*—Westinghouse Brake Company.

*Diplomas of Honour.*—Lancashire and Yorkshire Railway; London, Chatham, and Dover Railway.

*Gold Medal.*—Patent Nut and Bolt Company.

*Bronze Medal.*—Skelsey, Geo. Henry.

#### Armoury.

*Gold Medals.*—Eley Brothers; Schultze Gunpowder Company.

#### Small Machinery. (General.)

*Diplomas of Honour.*—Chubb and Sons, Lock and Safe Company; North's Typewriting Manufacturing Company.

*Gold Medal.*—Thos. Robinson and Son.

*Silver Medal.*—The Cyclostyle Company.

*Honourable Mention.*—Leggot, W. and R.

#### Piles, Dynamos, Electrical Transmissions, Lighting, &c.

*Gold Medal.*—Crompton and Co.

#### Telegraphy, Telephone.

*Silver Medal.*—Ander's Telephone Company; Chubb and Sons.

#### Heating and Ventilation.

*Diploma of Honour.*—Wilson, Charles, and Sons.

*Silver Medal.*—Dowson Economic Gas and Power Co.

*Honourable Mention.*—Crawshay, F. G.

#### Lighting.

*Diploma of Honour.*—Cowan, W. and B.

*Gold Medal.*—Pain and Company.

*Silver Medal.*—Stott, Jas., and Co.

#### Bridges, Canals, Roads, Civil Architecture.

*Diploma of Honour.*—Chance Bros.

#### Shipbuilding, Armament, Equipment, and Life Saving Apparatus.

*Grand Prix Diploma.*—Armstrong, W. G., Mitchell and Co.; Cunard Steamship Company; J. and G. Thomson; Peninsular and Oriental Steam Navigation Company; Fairfield Shipbuilding and Engineering Company.

*Diplomas of Honour.*—Darlington Forge Company; Denny, Wm. and Brothers; Lloyd's Register of British and Foreign Shipping; Palmer's Shipbuilding and Iron Company.

*Gold Medals.*—African Steamship Company and British and African Steam and Navigation Company; Anchor Line; Blasberg, Eugène, and Co.; British India Associated Company; Canadian Pacific Railway Company; Castle Mall Packet Company; Chubb and Sons; Davis and Co.; Great Eastern Railway Company; Green, Joseph F.; Hawthorn, Leslie, R. and W., and Co.; London and India Docks Joint Committee; London and South-Western Railway; Orient Steam Navigation Company; Royal Mail Steam-packet Company; Silbe, Gorman and Co.; Sir Raylton Dixon and Co.; Swan, C. S., and Hunter; Thompson, J. L., and Sons; Union Steamship Company.

*Silver Medals.*—Allan and State Line; Barrow Steam Navigation Company; Brazilian Submarine Telegraph Company; Cook, Thos., and Sons; Edwards Bros.; Jeffrey, Alf., and Co.; Knott, James (Prince Line); London, Chatham, and Dover Railway Company; Pain, James, and Sons; Smith, G., and Sons (City Line).

*Bronze Medals.*—Chance Bros. and Co.; City of Cork Steam Packet Company; Clyde Shipping Company; Cochrane and Colper; Cork Steamship Company; Gibson, Geo., and Co.; Manchester, Sheffield, and Lincolnshire Railway Company; Palgrave, Murphy, and Co.; Tyne Steam Shipping Company.

*Honourable Mention.*—Blue Star Line, Carlisle and Co.; Farrar, Groves, and Co.; Henrard, Geo.; La Bandera Espagnola Hawkes, Somerville, and Co.; Pyman Bell and Co.; Trinder, Anderson, and Co.

---

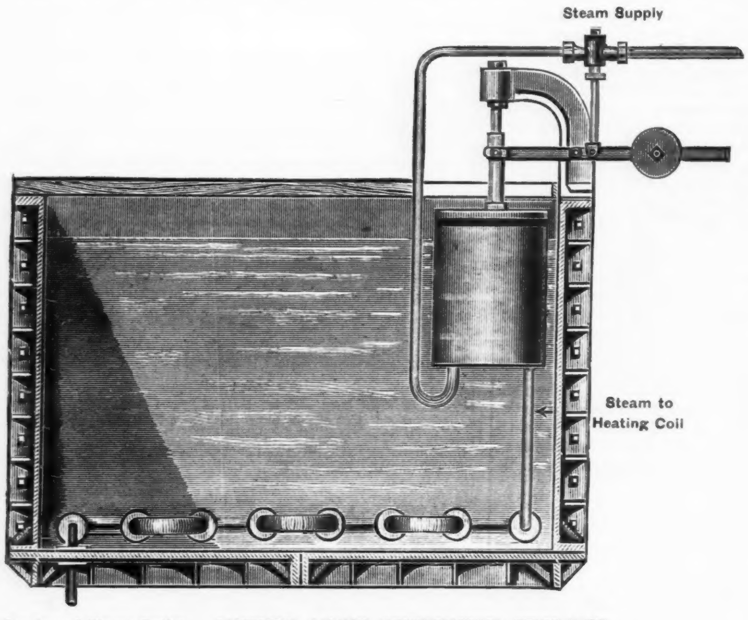
Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Fleet Engineer W. E. Beal, to the Katoomba. Chief Engineer Quinton W. King, to the Latonia. Assistant Engineer W. W. Bills, to the Victory. Engineers—H. L. Manning, to the Pembroke; and R. W. Donohue, to the Edinburgh.

## BREWERS EXHIBITION, AGRICULTURAL HALL.

### SECOND NOTICE.

THE Farringdon Works exhibited several new appliances, which will be useful to manufacturers other than those for whom this exhibition is more especially intended. One of these, called "Mackay's Patent Hot Liquor Tank Automatic Steam Regulator," is an apparatus designed to economise the steam employed for heating hot water tanks. By its use the supply of steam is so controlled as to ensure the maintenance of any required temperature.

The regulator is a hollow metal cylinder; and, like a diving bell, is open at the bottom, but closed at the top, except that the cover is provided with a small tap, to allow the air to escape. As will be seen by the illustration, this cylinder is connected with the steam cock by means of a hinged lever, which is so arranged that if the cylinder rises in the tanks the supply of steam will be cut off, whilst if it falls it will open the steam valve. The steam on passing through the supply valve is first conducted to a small coil inside the regulator, but not in contact with it. This coil is not shown in the illustration. The pipe then goes to the bottom of the tank, and the steam having traversed the large coil, goes out by the outlet at the opposite end. A ball-cock regulates the admission of fresh water, which is so arranged that the supply pipe will deliver it on to the lid of the regulator, which just projects above the surface of the hot water. The steam, on entering the small coil, heats the water enclosed in the regulator; this gives off a certain amount of vapour, though the temperature may not perhaps exceed 100 deg. Fah. As it gets warmer, the body of vapour increases, lifts the cylinder, and eventually closes the steam valve. Meanwhile the steam, in passing through the large coil, brings the rest of the water in the tank to the same temperature as that which is in the neighbourhood of the small coil, underneath the regulator. There is a sliding weight on the prolongation of the lever which connects the regulator with the steam valve, and this will partly balance the weight of the cylinder, when water at a comparatively low temperature, say 80 deg. or 90 deg. Fah., is required in the tank. If the apparatus has to be so constructed as to allow of a varying temperature, the rod on the top of the regulator cover is prolonged, and weights are placed on it. By means of these weights the temperature of the water in the tank can be raised to any degree below 212 deg. Fah. before the vapour under the lid of the regulator will lift it, and so shut off the steam supply. When the tank has been partially emptied the fresh water which has been turned on by the descending float of the ball-cock falls on the lid of the regulator and condenses the vapour underneath it. The vacuum thus created is of course filled by water from the tank, the regulator drops and opens the steam valve. It will thus be seen that when once set to a temperature this apparatus is automatic, so that not only is waste of steam prevented, but also those using it can be sure that the water will not be any warmer than they require it.



MACKAY'S LIQUOR TEMPERATURE REGULATOR

The same firm exhibit a new system of metallic packing for steam-tight joints, which they say will stand a pressure of 150 lb. It consists of from four to six sets of semicircular pieces of steel. These pieces, which are of the exact diameter of the rod, are placed so as to break joint with one another, and are held in place by small spiral springs behind each piece.

They also show two distinct sorts of refrigerators. In both ammonia is used; but whilst one is of the ordinary description, with pumps for compressing the ammonia, &c., the other is entirely without pumps or other moving parts. This machine, like the steam regulator, is the invention of Mr. F. Mackay, and the process is based on the fact that water at an ordinary temperature will absorb a large quantity of ammonia, and give the same off when heated. Refrigerators on this system are not entirely new. Mr. Mackay's machine is, to some extent, a modification of one patented some years ago by Mr. A. Glasson, of the same firm; and Messrs. Stewart and Co., of Glasgow, also made an absorption machine, using a steam coil to heat the solution of ammonia and water. The chief novelty in Mr. Mackay's machine is in the arrangement, the rectifier being placed on the generator, and the absorber on the top of that.

The generator is an iron vessel, which is heated by a ring of gas jets; or, if preferred, by petroleum. It is filled with a mixture of ordinary commercial ammonia and water, the ammonia being about one-third of the total, and the solution is at a pressure of 120 lb. to the square inch. On heat being applied, ammonia vapour mixed with steam ascends an upright pipe in the middle of the rectifier. In this the steam is condensed by means of the cooling water, and flows back into the generator, whilst the ammonia vapour, collecting at the top, also condenses, and flows down a spiral iron pipe that surrounds the other, as liquid anhydrous ammonia, the pressure remaining the same as in the generator, viz., 120 lb. At the bottom of the rectifier is a valve, through which the ammonia is allowed to pass very slowly into a pipe which leads to the brine tank. The pressure in this pipe being only about 10 lb., the liquid ammonia immediately expands and vaporises, its temperature at the same time dropping to from 30 deg. to 60 deg. below freezing. The ammonia vapour passes through coils round the cells, which have been filled with fresh water and placed in the brine tank; and its temperature on leaving the tank is only a little below freezing. From this it rises to the absorber, which is filled with weak liquor from the generator. The process of condensation and absorption is aided by a coil with cooling water which passes through this vessel. To return the recharged liquor to the generator, the process is stopped occasionally, and a valve in the absorber opened, when it is allowed to run back by gravity down a tube outside the machine, and then through another valve into the generator. The machine exhibited consumed 800 cubic feet of gas in twelve hours, and the cooling effect was equal to that obtained by melting half a hundredweight of ice per hour, or as heat efficiency, of from 17 to 18 per cent. Where a large quantity of ice, or great cooling power is needed, it is more economical to use a compression machine; but for small factories the simplicity of the absorption machine renders it very valuable.

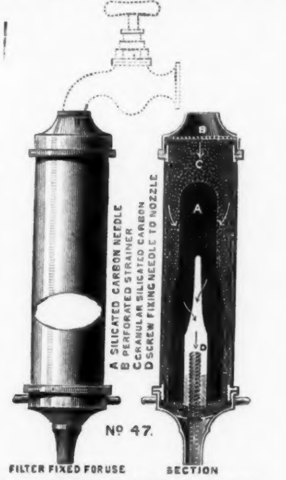
An ammonia compressor ice-making machine is also exhibited by the Linde British Refrigeration Company, and a carbonic anhydride machine by Messrs. J. and E. Hall.

From a mechanical engineer's point of view, the greatest change which has taken place in English breweries of late years has been in the method of cooling. The primitive plan of turning the wort out into immense "backs" or tanks, and allowing the air to cool it, has not quite disappeared, even in London, though it is gradually being superseded, or at least supplemented, by the use of cooling machines. These used formerly to be circular, the wort, passing through a spiral pipe, was met by cooling water which travelled in an opposite direction. No circular refrigerators are shown at this exhibition, and English brewers seem to be adopting the continental method, in which both air and water are used—partly by evaporation—to cool. Refrigerators of this type are exhibited by Messrs. H. J. West and Co., Messrs. S. Briggs and Co., Messrs. Lawrence and Co., and others. The apparatus usually consists in a series of copper pipes placed horizontally in an upright cast iron frame. These tubes, though circular inside, are made with a rib on the bottom and a groove on the top, running the full length of the tube, so that they fit close together, presenting a corrugated surface. The wort flows over the top, down either side, and is caught in a trough at the bottom; whilst water, either from a well or artificially cooled, is forced through the series of copper tubes from the bottom to the top. Several modifications of this system were exhibited at Antwerp, and described in THE ENGINEER a few months ago.

Besides vertical coolers, Messrs. Lawrence and Co. show a horizontal, or low-fall, refrigerator. It is the invention of Mr. C. F. Hughes-Hallett, and is intended for use where there is not sufficient height for one of the ordinary type. The one exhibited—see illustration—is 2ft. 6in. long, 4ft. 3½in. wide, and 15in. deep. It is placed on the slope, with a fall of 3in., so that the total height required is 18in. This machine is in five sections, and will, we are informed, cool fifteen barrels per hour. The cooling water is in copper pipes, flat, but corrugated longitudinally, and 12in. deep. The principal part of the invention consists in the use of a deflecting diaphragm between each of the sections containing water. These diaphragms have narrow feathers or ribs projecting opposite the corrugations in the water pipes, so that the wort may be forced into them, and have the full benefit of the cooling surface. It will be seen by the illustration that the water passes from left to right, and right to left, whilst the wort flows down one side of the coolers and up the other. The sections through which the cooling water pass are interchangeable, and if it should be necessary from any cause to remove one, the rest of the refrigerator can be used, so that the cooling would not be stopped.

Another instrument, exhibited by Messrs. Lawrence on the same principle, is the "sectional condenser" for condensing and cooling spirit. It consists of a set of corrugated sheets of tinned copper or other suitable material, each surrounded by a metal frame, faced on both sides. These sections are interchangeable, and a number of them are bolted together, the sides of the condenser being of cast iron. The vaporised spirit from the still enters one side at the top, and passes through alternate sections, whilst the cooling water, entering at the bottom, is forced through the intermediate sections in the opposite direction.

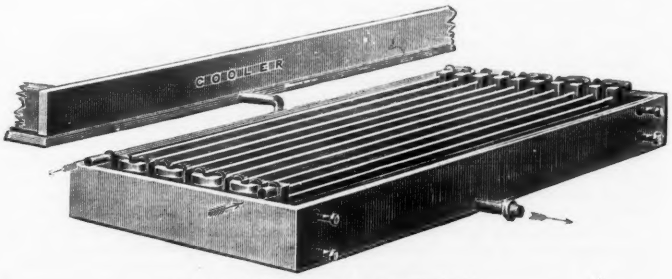
Another horizontal refrigerator is exhibited by Messrs. R. Morton and Co., of Burton. It is 20ft. long by 6ft. wide, and will cool sixty barrels per hour. The cooling arrangement is similar to that of Mr. Hughes-Hallett's refrigerator, but the diaphragms, of which there are fifty, are smooth, instead of being ribbed. This firm exhibit many other brewing appliances, including a Steel's mashing machine, a cask-washing machine, wort pumps, and a beautifully made mash tun. The washing machine consists of a cast iron receptacle communicating on one side with the steam and water supply, and on the other side with the cask. The whole process is done with one handle. In its first position it allows the receptacle to fill with cold water, the second admits steam to heat it, whilst the third injects the hot water into the cask, following it up by dry steam which drives it out again. While the cask is being removed, the handle is put back into the first position, to be ready for the next. The mash tun exhibited is of cast iron, with gun-metal rousers and false bottom. The chief novelty about it is that the sparger is self-acting, having holes on one side only of the arms, so that the falling water turns it. It is on ball bearings, and runs very easily.


B
C
A
D
A SILICATED CARBON NEEDLE
B PERFORATED STRAINER
C GRANULAR SILICATED CARBON
D SCREW FIXING NEEDLE TO NOZZLE
Nº 47.
FILTER FIXED FOR USE
SECTION

THE PRESSURE NEEDLE FILTER

The natures of different descriptions of wood, and the objects for which they may be employed, is always an interesting subject for engineers. Cedar, as a material for vat making, is comparatively unknown in England, but Messrs. Shuters and Chippendales, who exhibit some large vats and backs constructed with it, say that it is extensively used in the United States for that purpose. Railway sleepers made of cedar outlast oak, especially in positions where they are subjected to both heat and moisture; so that it is not surprising that for vat-making, it is found to be more desirable than fir or pine. The wood used by the exhibitors comes from North Carolina, and is known as "White Swamp Cedar." They say that besides being very durable, it is free from tannic acid, resin, or colouring matter, has hardly any expansion or contraction, and is not liable to crack; also that it is not affected by acids. The same firm exhibit various sized barrels, all made of oak. They do not recommend cedar for this purpose, but only for stationary receptacles, as it is too soft to withstand the treatment which a barrel receives.

Vats made of white cedar are also exhibited by Messrs. G. Adlam and Sons, of Bristol. The same firm show several other appliances used by brewers, such as an apparatus for washing and purifying a number of casks at once, but their chief novelty is "Hudson's Duplex Economiser." This machine is for the purpose of obtaining a supply of pure hot water for cask washing, boiler feed, or other purposes. It consists of two cylindrical tanks which, though separate, are for convenience placed one on the top of the other. The exhaust steam enters the lower tank at the side. Here any heavy matter in suspension, and nearly the whole of the oil is deposited. The steam—with a small oily residuum—passes by a pipe outside to the top of the second tank. On entering this, it is met by a spray of cold water, which must contain a small amount of carbonate of lime. There is no difficulty in finding hard water of this description, and if it is desired to use it for feeding boilers, the economiser has the additional advantage of being able to soften it. When the steam meets the spray, the former is condensed and the latter heated. The carbonate of lime is thrown out, mixes with the remainder of the oil, and falls to the bottom of the tank. By this means an ample supply of pure water is obtained at a temperature of 200 deg. to 208 deg. Fah.



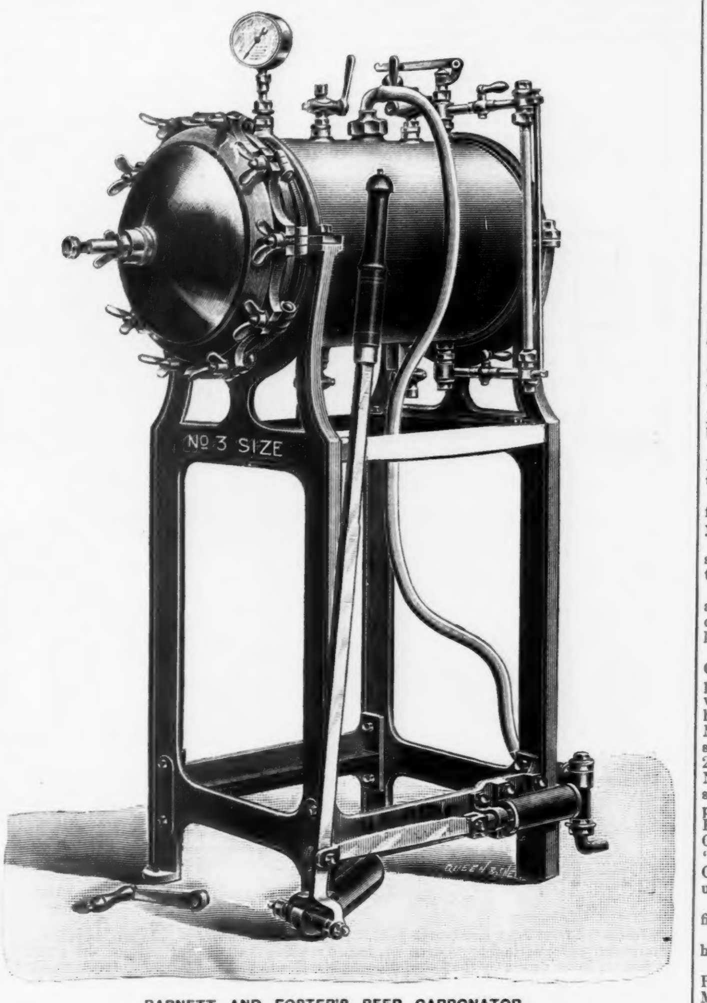
THE HUGHES-HALLET REFRIGERATOR

As pure water is an absolute necessity for mineral water manufacturers and brewers, it is natural that several descriptions of filters should be exhibited. Of these, only one appears to be new, the "Pressure Needle Filter," shown by the Silicated Carbon Company. As will be seen by the illustration, the water first passes through a strainer B, and is then partially filtered through granular silicated carbon C before impinging on the needle A. By this means the water is nearly pure before reaching the needle, and the makers claim that when it leaves the filter it is absolutely sterilised. Some of the tests to which this filter have been subjected are interesting; for instance, Professor Wanklyn writes that he has passed a poisonous solution of strychnine through it, and then drunk it. By unscrewing the nozzle, the needle can be removed, cleansed by boiling, and replaced, whilst at the same time the granular carbon may either be scalded, or replaced by new material.

The tubular fire bars made by Messrs. Caddy and Co., of Nottingham, have already been described in THE ENGINEER; but a novelty which they show at this exhibition consists in a rocking attachment. The bars are cast the whole length of the furnace, and by means of this arrangement the fire can be cleaned without using a pricker, or opening the furnace door. By raising a lever outside, every alternate bar will be lifted in front an inch and a-half, and at the same time will slide backwards about three inches; meanwhile the other bars will remain fixed. On lowering the lever, the bars move back into their original position. As this operation can be repeated without difficulty, the stoker has no trouble in keeping a clear fire, and preventing clinker from forming on the bars.

Of the subsidiary industries connected with the manufacture of aërated waters, the production of liquid carbonic acid is probably the most important. It is not so many years since the liquefaction of carbonic acid was considered to be a mere laboratory experiment; interesting, but leading to no practical result, whilst even distinguished scientists looked with wonder on a "snow ball" of solid carbonic acid. And now, thanks chiefly to the mechanical engineers who have made pumps to compress it, and bottles to hold it, liquid carbonic acid is sold by weight like any ordinary commodity, the present price being about 4½d. per lb. Each pound is equal to 52 gallons of expanded gas, capable of aërating eight or nine dozen 10-ounce bottles of mineral waters at an average pressure of 100 lb. per square inch, or of carbonating eighteen dozen bottles of beer at a pressure of 20 lb. per square inch. The Carbonic Acid Gas Company, of Lea Bride-road, show tubes containing the liquid acid, and appliances for using it. They have also lumps of solid carbonic acid at their stand, and these, notwithstanding the heat of the hall, diminished in size very slowly.

The use of liquid carbonic acid is gaining ground amongst the manufacturers of mineral waters, as it is cleaner and more convenient for them, as well as probably cheaper, to use it than to make their own carbonic acid, with whiting and sulphuric acid. It is especially useful for carbonating beer, which is then ready for use within twenty-four hours, instead of requiring to be kept till the gas had been produced and the beer matured by partial fermentation. Our illustration shows a machine for carbonating beer, which is one of a number of different sizes exhibited by Messrs. Barnett and Foster. The beer is pumped into the copper drum; in this machine the pumping is done by hand, but in some of the others by steam. The steel bottle containing the liquid carbonic acid is fixed to the machine, and connected to the drum by a regulating valve on which there is a pressure gauge. When the drum has been pumped full of beer and the gas has been admitted to the required pressure, the handle of the mixer is turned, and the beer is ready to be drawn off to the bottling machine. In some instances the gas is first charged into a gasometer, in order to have a large supply at a constant pressure. To do this without supervision, the exhibitors have just brought out an automatic valve. By the use of this valve the gas is admitted at the same rate as that at which it is drawn off, no matter how the speed may vary. On the tube becoming exhausted an electric bell is rung, so that the only attention which is required is to replace an exhausted tube by a full one.



BARNETT AND FOSTER'S BEER CARBONATOR

Another novelty is a filling machine, fitted with an automatic measuring attachment. This is intended for stone and other opaque or dark bottles, and ensures the bottle being filled with a definite and pre-arranged quantity of liquid, whatever the pressure may be, and without the operator needing to see the height to which it has been filled. This firm have also a large number of different descriptions of bottling machines for soda-water syphons, screw-stoppered bottles, &c. Two of these called the "Mammoth," and claimed to be the largest yet made, have been supplied to Kimberley and Johannisberg, South Africa.

Messrs. W. Meadowcroft and Son also claim to have made the largest soda-water machine in the world, and exhibit the "Giant," a very fine machine, which they say is capable of producing 10,000 to 12,000 dozen 10-ounce bottles of highly charged mineral waters per day of ten hours. They also show a large collection of smaller machines.

Another firm who have a very large show of aërated water machinery at work are Messrs. Bratby and Hinchliffe. Their latest production, the "Columbia" steam cork bottling machine, is a double machine, capable of filling 100 dozen per hour when both sides are being worked. A boy or girl can feed both sides, and does not require to touch the bottles after they have been once put in.

---

TWENTY-SEVEN boilers out of a battery of thirty-six, at the Henry Clay Colliery, Shamokin, Pa., exploded on the morning of October 11th. Five men were killed, two seriously injured, and four slightly. The nine remaining boilers were wrecked, although they did not explode.

---

## LEGAL INTELLIGENCE.

### HIGH COURTS OF JUSTICE—QUEEN'S BENCH DIVISION.

*October 25th*, 1894.

(*Before the* LORD CHIEF JUSTICE *and a Special Jury.*)

EARL OF SHAFTESBURY *v.* LONDON AND SOUTH-WESTERN RAILWAY.

THIS was an action by an owner of property in Dorsetshire to recover damages for the destruction of part of his property, which he alleged was set alight by the defendants through the negligent use of a locomotive on their line. The defendants denied their negligence or liability.

Sir EDWARD CLARKE, Q.C., Mr. E. U. BULLEN, and Mr. GORE BROWNE were for the plaintiff; Sir RICHARD WEBSTER, Q C., Mr. BUCKNILL, Q C., and Mr. ACLAND for the defendants.

Sir EDWARD CLARKE, in opening the case, said that the two questions the jury would have to consider were:—(1) Had the fire been caused by the defendants' engine, and (2) if "yea," had they been guilty of negligence in their use of it? The facts were simple, and were shortly these. On June 17th, 1893, a train left West Moors Junction on its way to Ringwood. The gradient was rather steep for about half a mile, and pressure had to be put upon the engine to get the train up. The train left at about 3.45 p.m., and at 4 p.m. a fire was observed to be burning three-quarters of a mile from the station just after the train had passed. Attempts were made to put out the fire, but without avail, and the result had been that 124 acres of valuable property had been burnt down. There was no footpath or house anywhere near the spot, and there could therefore be no doubt as to the originating cause of the mischief. As to the defendants' negligence, the engine in question had been in use since 1875, and although originally fitted with a "grid" to prevent sparks from coming out, this had been removed and the engine fitted with "Adams's Vortex blast pipe," which had the effect of, in fact, causing a much greater draught than before. It enabled, however, the defendants to use a much smaller engine than they would otherwise require, and that was probably the reason it was used.

Mr. A. H. Tyler, C.E., formerly in the locomotive department of the North London Railway, said he had examined the engine in question—the Milo. It had nothing to prevent an escape of sparks, and was fitted with the "Adams Vortex blast pipe," which would tend to throw up sparks on account of the increased draught. A "grid" would catch large sparks, and the use of "Adams's blast pipe" would cause sparks which would otherwise rest in the smoke-box to fly up through the funnel.

Cross-examined.—He was a pupil at the North London Railway Works at Bow from 1884 to 1887. He had never heard of a "grid" being used with Adams's blast pipe. The Adams patent claimed that it caused all the boiler tubes to act uniformly. He did not consider that the Adams patent should be used through a country liable to be set alight.

Re-examined.—The Great Eastern Railway used an adjustable blast pipe.

Mr. Fuller and Mr. Griffiths, civil engineers, gave evidence in the same direction. If a "grid" was used a stronger blast was required, and that would cause any sparks that got through the grid to travel further.

Mr. Richards, a land agent at Wimborne, estimated the damage at £1337, and Mr. Squarey, of Salisbury, at £1318.

Cross-examined.—The value of the land to sell might be from £1000 to £1200.

Mr. Wilbraham, Lord Shaftesbury's agent, fixed his estimate of the damage at £1463.

Sir RICHARD WEBSTER, Q.C., in opening the defendants' case, said that if plaintiff's view was correct, relief had at last been found for the "distressed landholder," who had only to have a good fire on his estate, and then sue an unfortunate neighbouring railway company. The law, he should submit, was now the same as in 1861, and recently Mr. Justice Mathew, in the case of "Groom *v.* Great Western Railway" (8 the *Times*, L.R., 253), referred to the direction of Mr. Justice Williams to the jury in "Freemantle *v.* London and North-Western Railway" (2 F. and F. 340). No engine had yet been invented that did not emit sparks, and the mere fact that sparks had come out did not make the defendants liable or guilty of negligence. The real question was, Had the defendants taken every reasonable precaution?

Mr. Watney, a surveyor, estimated the damage at £194.

Cross-examined: He valued the land at £4 an acre. That was an outside price, as it was situated at such out-of-the-way spot.

Mr. Harris, a Winchester surveyor, fixed his estimate of the damage at £218. In his opinion, if half the firs were replanted the plaintiff would be in a better position than he was before the fire.

At this stage the Court adjourned.

On the further hearing of this action,

Charles Oran, the engine-driver of the train which was alleged to have caused the mischief, examined, said he had been twenty-five years in the defendants' service, and during eighteen of the twenty-five years as engine-driver. On the day in question the fire was made up at Wimborne, and was not touched again until he reached Ringwood. This was after passing the scene of the fire. The engine was running at the least possible steam, and no ashes were raked or thrown off during the journey. At the end of the day the smoke-box was only half full of ashes. The Milo was not a particularly "wicked" engine with regard to giving off sparks.

Cross-examined.—This was the second occasion on which he had driven that particular engine in 1893, but he had driven it in previous years. He was four minutes late out of West Moors Junction, but he was not trying to make up time. He would start at full pressure, but after a hundred yards would bring his lever to the first notch. He passed up a gradient of 1 in 352, and was going at about 20 miles an hour when he passed the scene of the fire. There had been several fires near the line about that place and some a good way off the line. There was a rule of the company against throwing clinkers off the engine, and, indeed, during the journey they could not get at them if they wanted to.

Cornelius Spredbury, the fireman, gave similar evidence.

Cross-examined.—Removing clinkers from the fire would "clear" it, but it could not be done except when the fire was low.

William Goodwin, the guard, proved that no time was "made up" after leaving the junction.

Oran, recalled, said the "specimens" produced by the plaintiff were lumps of coke which had fallen off trucks, and were not Welsh coal such as was used on the engines. Coke would be found in the ballast on the line, as the cinders from the yards were collected and used for that purpose. The bits found within the "burnt area" were probably Welsh coal.

George Wilcocks, seventeen years a ganger on the defendants' line, said he saw the fire at about 4 p.m. He obtained help and put the fire out, as he thought, but the next day it broke out again.

Cross-examined.—He had not told Read—the plaintiff's first witness—that the train had caused the fire, or must have caused the fire.

Mr. Brewer, permanent way inspector at Ringwood, and Mr. Baines, permanent way superintendent, gave evidence as to there being footpaths near the spot where the fire commenced.

Cross-examined.—There were a good many fires near the line in 1893. Eight of these were between West Moors Junction and the scene of this fire, a distance of three-quarters of a mile.

Re-examined.—One of the fires was three-quarters of a mile from the line; another, a quarter of a mile off; and a third, 117 yards away.

Mr. Thomas Higgs, locomotive superintendent at Nine-elms, said he had tested the Milo, and after a run of 154 miles found that the smoke-box was only half full of ashes.

Cross-examined.—He did not see the plaintiff's engineers take any samples such as had been produced. The load the Milo was drawing on the day in question was only 75 tons, and with such a load a gradient of 1 in 352 was nothing.

Mr. Dugald Drummond, formerly chief engineer to the Caledonian Railway Company, whose experience extended over a period of thirty years, stated that the plaintiff's samples of coke which were picked up on the line were not Welsh coal at all, and had never been in the furnace of an engine. In his opinion the Milo was a perfect working engine, and was fitted with all that science or experience could suggest. In his opinion it could run 200 miles without requiring to have its smoke-box emptied. Nothing had yet been designed that would absolutely prevent sparks coming away from the engine. No engine with a blast pipe or modern fire-box should be fitted with a spark "arrester." He had been connected with the London, Brighton, and South Coast Railway and the North British Railway. The cost of "arresters" was nominal, and he had discarded them on the Caledonian Railway. He was not aware that they were generally used in America.

The LORD CHIEF JUSTICE.—They do not seem to prevent forest fires.

Sir EDWARD CLARKE.—I tremble to think what might have happened if they had not been in use.

Mr. Dean, chief locomotive superintendent of the Great Western Railway; Mr. Johnson, chief locomotive superintendent of the Midland Railway; and Mr. Whale, assistant locomotive superintendent of the London and North-Western Railway, all gave evidence in favour of the construction of the Milo, and against the use of a "grid" or "arrester" when the Adams Vortex blast was in use. They were of opinion that in any case they created rather than prevented sparks, on account of the stronger draught they required. Cage arrestors were used in the docks, where engines were continually starting and stopping with heavy loads. The Adams blast had been tried on the Midland, but was found unsuited to their engines. There were no objections to its use. It claimed to reduce the consumption of coal.

Mr. WILLIAM ADAMS, the inventor of the Vortex blast pipe, and locomotive superintendent of the London and South-Western Railway, having been called to explain his invention,

Sir RICHARD WEBSTER, Q.C., and Sir EDWARD CLARKE, Q.C., addressed the jury on behalf of their respective clients.

The LORD CHIEF JUSTICE, in summing up the case, said the chief question in the case was—had the defendants been guilty of negligence? Then and then only if that question was decided against them did the question of damages arise. As to that question, which he would deal with first, it ranged from £1463, the plaintiff's highest figure, to £194, the defendants' lowest estimate. At the same time they must remember that the plaintiff was not entitled to be put in a better position than he was in before the accident. The first question to consider was whether the fire was in fact caused by something which came from the engine. The fact that the other fires had occurred should not bias their minds, but they must draw their own conclusions from the evidence before them, and the fact remained that immediately after the train had passed the fire was discovered. Assuming that the fire was caused by the defendants' engine, then arose the principal question—Had the defendants been guilty of negligence or of want of reasonable care either in the construction or working of the engine? The law on this point was quite clear, that where a company had powers from the Legislature to do certain acts, they were not liable for the results of those acts so long as they acted with reasonable care. He hardly thought that they would come to the conclusion that the driver or stoker had thrown live coals off the engine, and therefore the question of negligence was narrowed down to the question of whether a "spark arrester" should have been used or not. The most recent case in the House of Lords was almost on all fours, and he would read them a portion of the judgment of the Lord Chancellor in that case:—"Port Glasgow and Newark Sailcloth Company *v.* Caledonian Railway Company"—Court of Session and House of Lords cases, volume xx., page 35, 9 the *Times* L.R., 300. In considering the question of negligence in construction it did seem to him that there was some force in the defendants' contention that a close mesh "arrester" would act as a damper and require a great extra draught. The question was shortly this—Was it negligence on the defendants' part to use the Vortex blast without an arrester? The learned judge, having carefully reviewed the evidence, left the following questions to the jury:—(1) What caused the fire? (2) Were the defendants guilty of negligence? (3) What damages was plaintiff entitled to?

The jury retired at 4.30 to consider their verdict, the parties having refused to accept the verdict of the majority. The jury returned into court at 5.15 and found:—(1) That the fire was caused by something from the engine; (2) that if an "arrester" had been used the danger would have been minimised; (3) damages, £400.

The Lord Chief Justice having left the building, the jury were ordered to attend on Saturday morning.

On the 31st ult., arguments were heard on a point of law, Sir E. CLARKE, Q.C., moving that judgment should be entered for the plaintiffs. It was distinctly laid down that a railway company were bound to avail themselves of every modern invention, unless —(1) the danger was very slight; (2) the cost of the invention very great; or (3) the use of the invention materially interfered with the working of the engine. In the present case the answer to every one of these questions was a negative. All the defendants could say was that they had saved a few pounds of coal per mile by not using an "arrester," and this they had no right to do at the expense of the public.

SIR R. WEBSTER, Q.C., for the defence said that the evidence showed that if arresters were used a stronger blast was required, which would cause more sparks. The defendants were called upon to provide "general" and not "particular" remedies, and he asked that judgment be entered for the defendants.

At the conclusion of the arguments the LORD CHIEF JUSTICE said he would take time to consider his judgment.—*Times.*

---

## SOCIETY OF ENGINEERS.

### THE UTILISATION OF TOWN REFUSE FOR GENERATING STEAM.*

By T. W. BAKER, B.A.

THE practice of the larger southern towns in England is that all fluid waste from dwellings is called sewage and its disposal is provided for in these towns by different systems of treatment; but there are even now some towns in the North where the pail system is still in use. The class of refuse treated under the latter system is not included in this paper, but what will be considered consists of the usual ashbin contents, street-sweepings, and sludge.

The disposal of the ashbin refuse and street-sweepings in large towns has been a source of considerable trouble and expense to the local authorities, and several vestries in London are now paying 3s. per ton for its disposal, exclusive of the expense of collecting it. Consequently if 70 per cent. can be utilised and barging saved, considerable economy must ensue. There appears at the present time no doubt whatever that ordinary ashbin and street refuse should be dealt with by fire at the earliest moment and at the nearest possible point, as it soon becomes a prolific source of zymotic diseases. Consequently prompt and localised destruction is particularly desirable as railway conveyance or barging causes delay and contamination to the surrounding atmosphere.

In order to better understand what ashbin contents consists of, the author appends the analysis of Mr. Joseph Russell, given in a paper read before the Sanitary Institute on February 10th, 1892, and which may be of interest, the same having been practically corroborated by several other authorities.

| Component parts. | Average per 1000 loads. Tons | cwt. | qr. | lb. | Percentages of weight. |
|---|---|---|---|---|---|
| Breeze, cinder, and ashes | 611 | 3 | 0 | 4 | 63·69 |
| Fine dust | 187 | 1 | 9 | 8 | 19·51 |
| Vegetable, animal, and various mineral matters | 44 | 3 | 3 | 20 | 4·61 |
| Waste paper | 41 | 1 | 1 | 20 | 4·28 |
| Straw and fibrous material | 30 | 18 | 1 | 6 | 3·22 |
| Bottles 5,000 | | | | | 0·96 |
| Coal and coke | 8 | 0 | 2 | 14 | 0·84 |
| Tins | 7 | 11 | 2 | 22 | 0·79 |
| Crockery | 5 | 5 | 0 | 0 | 0·55 |
| Bones | 4 | 12 | 1 | 1 | 0·48 |
| Broken glass | 4 | 11 | 2 | 2 | 0·47 |
| Rags | 3 | 15 | 3 | 16 | 0·39 |
| Iron | 2 | 0 | 0 | 20 | 0·21 |
| | | | | | 100·00 |

From the report of the London County Council on dust destructors, the average from several districts gives 260 tons per annum for one thousand of the population, although the actual quantities vary widely. Taking this into consideration, and the fact of the preponderant amount of combustible material which it will be noticed is present in this refuse, it is apparent that it should be disposed of by fire not merely with a view to its destruction for hygienic reasons, nor yet to reduce its bulk—which is done by the destructors in present use leaving only from 25 to 30 per cent. of ash and clinkers—but that the heat set free in the process of destruction should be utilised.

Professor Forbes and others have estimated the value of ashbin refuse at a much higher figure than results from practice, the various estimates ranging from 3 lb. to 5 lb. of water evaporated for 1 lb. of refuse. Hitherto in practice this result has not been obtained, and according to statistics collected by Mr. C. Jones, M.I.C.E., from the larger towns using destructors with steam generators by the waste heat, 6-horse power per cell burning from six to eight tons every twenty-four hours, appears to be the average result. This result, doubtless, can be increased by the use of forced draught, at the same time enabling the furnaces to do a far greater amount of work as destructors.

These statistics no doubt include the disposals of the street sweepings, which must be taken carefully into account, they being the vehicle for moisture impregnated with effluvia, which during destruction absorbs some of the active heat from the more combustible ashbin refuse. As the various local authorities, particularly around London, are now anxious to use their powers under the Electric Lighting Provisional Orders granted to them for laying down plant for lighting their districts by electricity, this appears to be the better and most direct method of using this source of gratuitous heat. At the same time there are waterworks and sewage pumping stations requiring steam, as well as baths and wash-houses which frequently belong to the local authorities, where the heat could be advantageously utilised.

There can be no doubt that the calorific value of the refuse is low, particularly when street sludge is used, and from results obtained by the author, only 1 lb. of water evaporated per pound of unsifted refuse is actually obtained. With screened refuse, however, that is, with the paper and loose rubbish, commonly called breeze, taken out, a fair average of 2½ lb. of water evaporated per pound of breeze is the result. For some months past the author has been using this fuel in an ordinary double-flued Galloway boiler, 22ft. long, 7ft. diameter, with twenty-two cross tubes and steam jet forced draught, the boiler being used for boiling purposes. These results could only be obtained by burning the breeze in direct contact with the boiler, and could not be so obtained if used in a destructor, and then passed through brick flues to the boilers; Mr. Jones' statistics before referred to are based upon the working of plants of the latter description.

The trouble in stoking, owing to the amount of ashes and clinkers, prohibits the general use of town refuse in boiler furnaces to any great extent. A very large boiler capacity and great area, proportionate to the quantity of steam required, are necessary, far beyond that usually required for ordinary coal burning, and further unless the refuse is mixed with coal, 60 lb. appears to be the maximum boiler pressure obtainable. Even with a strong forced draught in the ashpit 80 lb. only has been obtained. Consequently to make the use of the town refuse economical, in connection with the best modern steam engine practice, a greater heat must be available and a higher pressure attained. Moreover in thickly populated districts all escaping vapours must be rendered innocuous, so that there are three conditions for consideration, namely:—(1) Facilities for stoking and cleaning the fires. (2) Burning up the obnoxious fumes. (3) Temperature of combustion to be raised to produce higher pressures. First as regards facilities for stoking and cleaning the fires. The principle of the ordinary dust destructor in its general design is doubtless the best, viz.:—Having the feeding hopper at the upper end and the fire-bars at a lower level continuing towards the cleaning doors, and having mechanically moved fire-bars bringing the refuse forward, allowing the green fuel to be gradually brought towards the fire, thus evaporating and burning up the moisture in it. Of the several designs of different makers, that known as Healey's appears to be a good type, and most advantageous when used with a forced air draught, although there are several other designs which are equally applicable, viz:—Fryer's, Horsfall's Wiley's, and Warner's.

In Healey's furnace the hearth plate is at an upper level, on which the refuse is fed, and which in its descent, travels on to a movable gridiron and from thence to the fire-bars proper. In order to keep the furnace at its full work this continual feed is necessary; but Healey's movement of the furnace bars has the triple effect of feeding the furnace and clearing the clinkers off the bars and pushing them into a receptacle for removal. This is accomplished by resting the front of the fire-bars on the dead plate, the back bearer being a rotating cam-shaft with excentrics, on which is fitted each alternate bar, which has a slot fitting these excentric cams on their undersides. The other alternate bars are fixed to a bearer and in a recess on the front dead plate. On their upper edge another bar is fitted with a parallel ball-and-socket joint. The upper ends of these bars oscillate in a recess in the upper hearth plate. The fronts of the fire-bars also oscillate on the front dead plate, so that on the bearer shaft being rotated towards the front, the movable bars lift the clinkers and fuel forward off the fixed bars and a constantly clean fire is kept. At the same time new fuel is fed from the upper hearth plate. The shaft is rotated by a ratchet wheel worked by an excentric from a rotating shaft at the furnace front, driven by the forced draught blast engine. The air blast is brought from a conduit under the ashpits by pipes on either side and opposite each other, in the forepart of the ashpits. Special facilities are provided for clearing away the dust from the flues at all possible points, and a dust-settling flue or chamber is also provided between the furnaces and the chimney, which is preferably on the back of the furnaces.

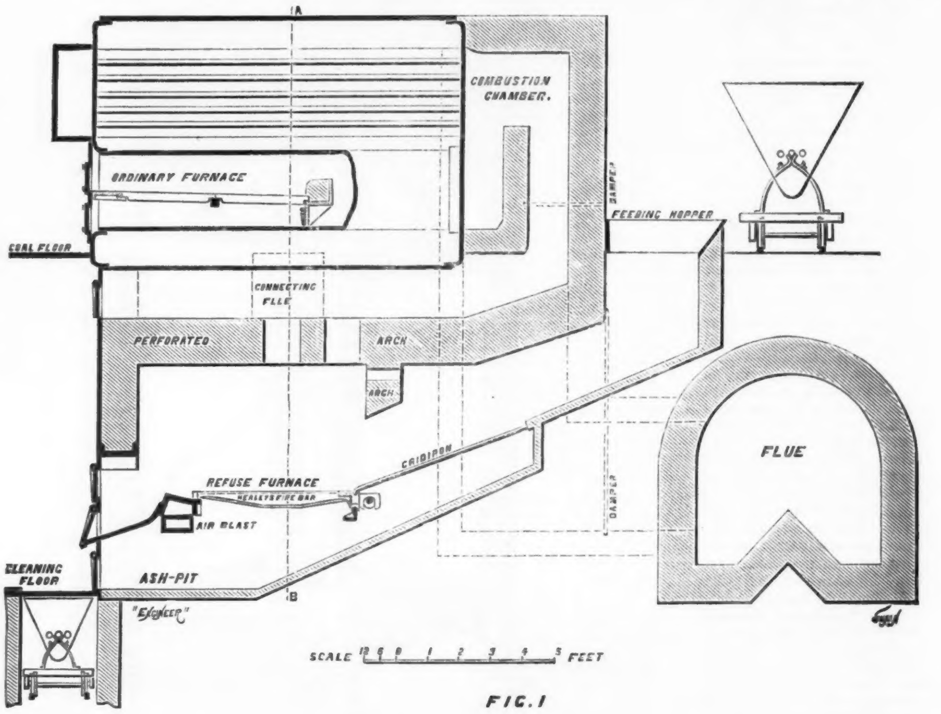


FIG. 1

Hitherto the practice as regards the generation of steam has been to place a tubulous steam boiler between the destructors and the chimney, leaving the walls of the flues to absorb a large quantity of the heat before reaching the boiler. Between the destructor and the boiler a Jones' fume cremator is frequently used, which consists of coke furnaces so constructed and arranged that the flues from the destructors conduct the gases over these fires by deflecting masonry, thus cremating them and rendering them innocuous by destroying the excess of moisture and effluvia which would otherwise escape as noxious vapour and condense in the atmosphere, and cause what has been recently described as an unmitigated nuisance.

At Cambridge, Messrs. Wood and Brodie's system of furnace is being adopted. It consists of a water-tube Babcock type steam generator placed in series between every two refuse furnaces. The waste gases are conducted through brick flues into a chamber under a V-shaped ash-tray or pit, and then over its upper edges through the fire-grate to the water-tubes and ordinary setting of the generators.

At Warrington a special refuse furnace has been erected in front of the furnace of a Babcock steam generator, the place of which it takes. It is fitted with forced draught, the refuse fuel being conducted by hoppers from the floor above to the furnace. The following are the results of working which Messrs. Babcock and Wilcox have kindly supplied.

*The Corporation of Warrington.*
*Test of Patent Destructor Furnace with Unscreened Refuse.*
*Warrington Installation.*

| | |
|---|---|
| Date noon to noon | Nov. 23 & 24, 1893. |
| Duration of trial | 24 hours. |
| Nature of fuel | Unscreened refuse. |
| Total quantity of fuel burned | 53,536 lb. |
| Quantity of fuel per hour | 2231 lb. |
| Total quantity of water evaporated | 61,314 lb. |
| Quantity of water per hour | 2556 lb. |
| Weight of clinker produced | 14,400 |
| Per cent. of clinker | 27 |
| Pressure of steam maintained | 66 lb. |
| Temperature of air in boiler-house | 45 deg. Fah. |
| Temperature of feed-water | 104 " |
| Temperature of gases leaving damper | 550 " |
| Quantity of water evaporated per lb. of house refuse | 1·14 lb. |
| Average temperature of copper wire test | 2000 deg. Fah. |
| Average air pressure (water) maintained | 8¼in. |
| Draught velocity in feet per minute | 82 ft. |

From the author's experience the system which recommends itself is that of placing a steam generator directly over the destructor furnace, so that the heat shall pass around or impinge directly on the heating surface of the generator. The ordinary generator furnaces are placed above the refuse furnace, and are used as supplementary furnaces to increase the temperature necessary for the higher pressure demanded, and also to cremate any obnoxious gases from the refuse furnace below. Where destructors are in use, and it is desired to utilise the heat from them to generate steam at high pressures, the generators may be arranged in a series adjoining the main flue to the chimney, and by connections the gases may be directed into their combustion chambers, and so utilised and cremated. Where it is practicable, however, to place the generators over the existing lower furnaces or destructors, it is greatly to be preferred, as being more effective.

There is no doubt that the gases from refuse are impregnated with a large percentage of moisture, and are of low temperature. This is shown by an analysis of the gases, where a preponderating amount of nitrogen is found, amounting to 22 per cent., and any contact with the side walls of brick flues has the effect of impairing the efficiency, the walls being always ready to absorb some of the moist heat, the surfaces necessarily having to be large. With these considerations it will be seen that to obtain the best effect the radiated heat must be absorbed directly by and transmitted to the generator. This is accomplished by placing a reverberatory perforated fire-brick arch over the refuse furnace, with the generator above it, so that when an excess of green fuel comes down from the hearth-plate, the regenerative heat from the arch assists to cremate the fumes before passing to the upper furnace.

There is no doubt that hand sorting of ashbin refuse will be largely discontinued on account of its degrading nature, and also from the decreasing prices of bones, rags, waste paper, &c., making it less profitable than formerly. There will therefore be a proportionately greater quantity of animal matter to be disposed of, and the consequent effluvia must be constantly dealt with, so that the need of an effectual fume cremator is absolutely necessary. These fumes it is proposed to cremate and destroy, with the assistance of the reverberatory arch, by the higher temperature of the combustion chambers of the ordinary and supplemental furnaces of the generators, this being their hottest part, the temperature of which will be never less than 1500 deg. Fah. It has been found that to effectually destroy refuse fumes, 1250 deg. Fah. is absolutely necessary, and it would appear almost impossible for any effluvia to escape after passing through these two heats. Means must also be provided for the admission of fresh oxygen into the combustion chambers if necessary to complete combustion, the gases or fumes from the destructors might also be burnt through the furnace bars of the supplementary furnaces if desired, when oil or producer gas is used as fuel.

The author has recently had some experience of the effect of escaping effluvia when saturated with moisture. It was proved in a recent law case that persons in close proximity to the 60ft. chimney shaft, from whence it was alleged the foul gases were escaping, scarcely complained, but numerous complaints arose from those from 300 to 1000 yards distant, showing that it took that distance to bring the saturated effluvia to earth. In some existing plants in which no utilisation is attempted, the cost of fuel for the crematory fires has been so great that they have been discontinued, but serious complaints from the neighbourhoods are now arising, thus showing the advantages of cremation.

The calorific value of refuse being low, it is necessary to provide ordinary generator furnaces to assist in raising the steam to the required pressure, for economical use as well as for cremating, as in several of the existing plants with the boilers in the flues, 40 lb. pressure per square inch is all that can be obtained, and at Warrington, as previously stated, 66 lb. only is obtained even with forced draught. In the ordinary furnaces of the generator, good fuel should be used, and if a supply of Russian oil can be obtained, that, or producer gas, appears to be especially applicable.

Having now described the general principles of the generation and absorption of the heat by the generator, and having specially in view the use of the steam generated by it for electric light stations, viz., to assimilate the supply to the demand, the author will deal with the question from the latter point of view. It is well known that the demand of electricity during the day is so light, even where a fairly high load factor is obtained, that the use of the steam generating plant at even half its capacity would be an excess, so that a system of heat storage is necessary for the economical use of the refuse, as the destructors must always be at work. Any ordinary form of steam generator may be adopted, but the cylindrical dry back marine boiler with two flues, or the inclined water-tube boiler of the Babcock and Wilcox type, are best suited. They are illustrated at Figs. 1, 2, and 3, and they are so well known as to need no further description. Fig. 2 is a section showing the method of connecting the refuse furnaces to either steam generator. Lancashire boilers on account of their length are not well suited to the present purpose, as the temperature of the gases in the combustion chambers frequently falls below 1250 Fah., and allows the moisture to pass away undecomposed. In all cases the refuse gases are conducted into the combustion chambers or their hottest part, while in the marine form they

---

[*] Paper read on the 1st October and open for discussion on the 5th inst.

are led to the space above the flues and opposite the tubes, the gases from the ordinary and crematory furnaces of higher temperature mixing with them. In the water-tube generators they enter the ordinary furnace from behind the furnace back, in both cases meeting with the partly incandescent fire-brick masonry, which assists in evaporating any moisture and destroying the effluvia. It is also necessary to keep the generators short, otherwise the feeding floors must be placed over the boilers with descending hoppers. This design also takes up more ground area for the inclined roadway, the other forms being conspicuous for the small space occupied by them.

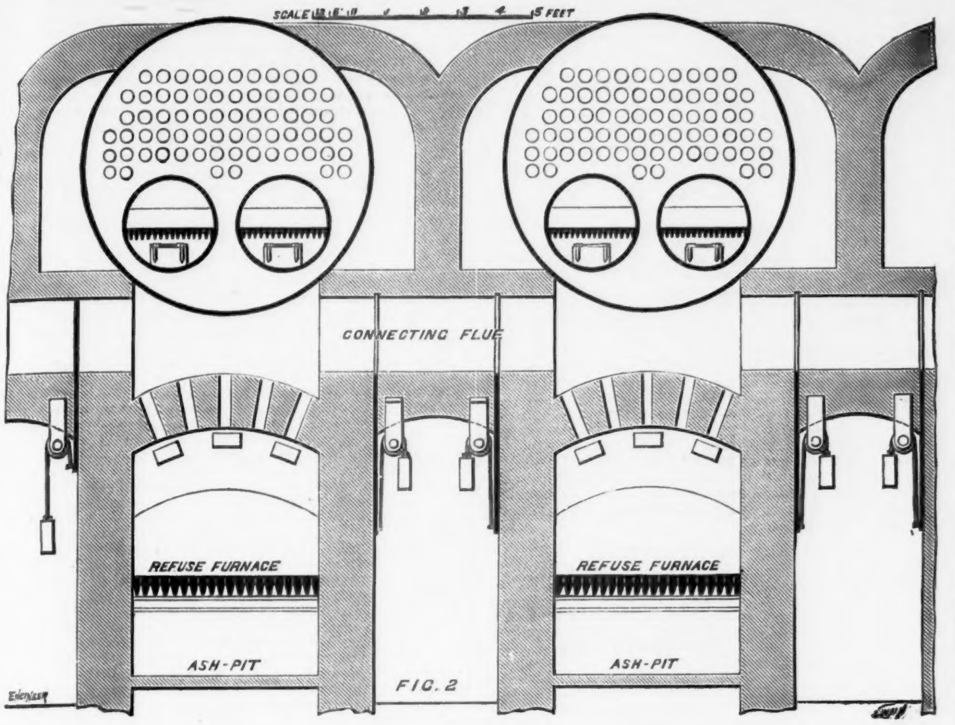


FIG. 2

Referring to the refuse destructor and steam generator combined, for dealing with 420 tons of refuse per week—which is an average quantity from several London vestries—some six or eight sets would be required for electric lighting purposes. These would be in one battery, adjoining each other, the flues between the arches over the refuse furnaces, and under the generators, would communicate with each other, so that any number of refuse furnaces might be coupled to one generator and its crematory furnace. For the day load, however, they should be worked in sets of three, so that the middle generator alone would have its ordinary furnace in use, the refuse furnaces below all communicating with the one generator by dampers being opened between them, and other dampers closing the two outer generators from the chimney flue. It will thus be seen that the two outer generators would be kept at the same working pressure as the middle one, and would always be available by their own furnaces being brought into use, so that the stand-by losses would be wholly taken up by the refuse. There would also be an excess of steam, during the extreme light loads, which should be stored in the following manner:—

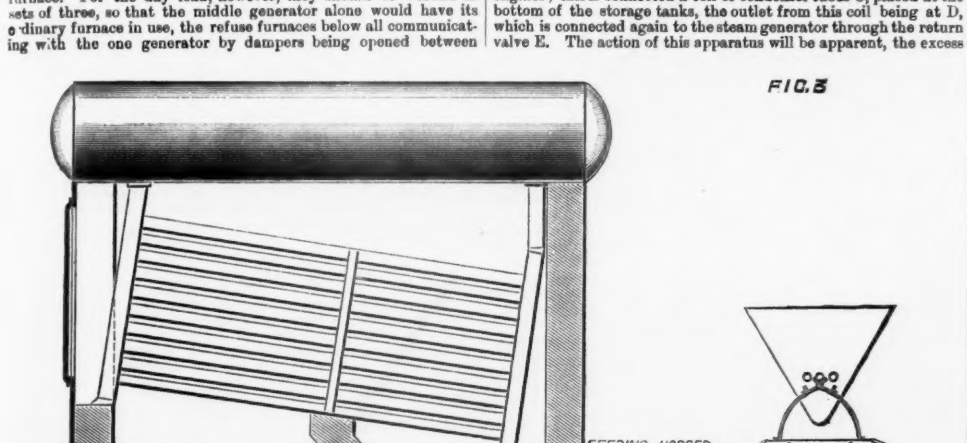


FIG. 3

A tank or reservoir properly clothed to prevent radiation is to be placed as a roof to the boiler house, and in this tank near the bottom is fitted a coil of pipes. The waste steam would be taken into this coil which is immersed in water, thus condensing the steam, and ejecting the condensed water into the tank itself, eventually filling it with practically distilled hot water every day, and this would be the case either with condensing or non-condensing engines; but when condensing engines are used it will be preferable to filter the condensed water from the air pumps, and use this as feed-water through the boilers, and thence into the storage tanks, as before described, but where non-condensing engines are used it would be better to allow the exhaust steam in the coil to heat up and boil the water in the storage tanks, in which would be deposited most of the impurities, the coil being connected by a system of steam flow and water return to the generators. Under these circumstances a live steam feed-water heater and separator would be necessary to feed the generators during the light load, bringing into use the boiled storage water during the heavy demand for steam.

This may be explained by reference to the diagram, Fig. 4, showing the steam generator and heat storage tank and their connections. A is the steam main supply pipe connecting the generators with the engines, &c., from the main by means of an automatic balanced steam valve B, allowing the escape of any excess steam over that required for the immediate requirements of the engines; this is connected a coil of condenser tubes C, placed at the bottom of the storage tanks, the outlet from this coil being at D, which is connected again to the steam generator through the return valve E. The action of this apparatus will be apparent, the excess of waste steam being conducted through the coil, which is immersed in the water in the tank—if used with a non-condensing plant—containing the original impurities inherent from its source; thus steam heat will then be transferred to the volume of water as previously stated of 20,000 gallons, preferably in four tanks or reservoirs, the condensed water returning by the pipes and valve E to the generator. Where carbonate and sulphate of lime is present in the feed-water, and with a non-condensing plant, it will be precipitated in the storage tanks, the live steam feed-water heating up the water to 300 deg. Fah., setting up the separation on its entering the tank and afterwards settling in it, means being provided for preventing its settling on the coil, so that practically pure hot-water will be provided for use without any pumping under pressure. In condensing plants, the feed-water having been filtered in coming from the air pump, it may be condensed and ejected into the storage tanks through the generators, having been previously purified, or directly into the tanks, and there reheated as in non-condensing plants. It must also be observed that any generators not actually in use for the day load will also be additional storage reservoirs.

When multitubular generators are used, care must be taken that increased internal tube area is afforded for the passing of the gases from the three refuse and crematory furnaces. This system can be applied to existing destructors, as water-tube generators may be made of a width to suit such circumstances, where probably cylindrical boilers could not be so placed. The net result of this system would probably be, that ¾ lb. of water would be evaporated by 1 lb. of refuse, allowing for the lesser value of street sweepings or sludge, and the absorption of a certain quantity of heat in the furnace masonry, as compared with the 1 lb. of water per 1 lb. of refuse, which has actually been accomplished—as before explained—a result which is corroborated by Mr. A. Collins, A.M.I.C.E., of Reading, and the Warrington tests in directly-fired generators. Reducing this to financial terms, the saving in barging which has been mentioned as the only credit must be first considered. This, according to the average cost per ton to several of the London vestries, amounts to 3s. per ton after collection, and 70 per cent. can be utilised, leaving only 30 per cent. of ash and clinkers as a residue to be disposed of, which in the spring is readily marketable for road-making, and where crushing machinery is in use it can be prepared for mortar, and with cement manufactured into street paving. This source of profit will, however, be absorbed by the cartage on the unsold residue, also by the fuel account for the generator furnaces, for working the forced draught and moving the furnace bars, the net saving being therefore the cost of barging or disposal of 70 per cent. at 3s. per ton; and, taking six furnaces burning ten tons each every twenty-four hours, equal to the consumption of 420 tons per week of seven days—294 tons at 3s., will represent the saving in barging, amounting to £44 per week, or £2288 per annum.

The gross credit will be the value of the steam generated from the refuse. As each furnace will be of a capacity to burn ten tons every twenty-four hours, and taking 20 lb. of steam per indicated horse-power per hour, and non-condensing engines without the cremating fires, the effective evaporation will be equal to 35 indidated horse-power per hour per generator set and available for electric lighting. From the returns of the various London electric lighting plants, published in *Lighting*, 1d. per unit appears to be a fair average for the cost of coal. Six destructors and generators would give an hourly output of 210 indicated horse-power from refuse only, or allowing 15 per cent. for frictional loss = 177 electrical horse-power, which at 1·34 horse-power per unit = 128 units at 1d., or 11s. 1d. per hour, say £93 1s. 6d. per week, against which the extra cost of maintenance, wear and tear have to be debited. If ashbin refuse alone were burnt the results would be 15 per cent. to 20 per cent. in excess of this, but this result could only be attained if the steam were used by the engine as generated, but against this, and as a general debit, the inherent losses of storing the heat and the reheating will have to be considered. As this process will be going on for two-thirds of each twenty-four hours, the author estimates this loss at 30 per cent., but being sixteen hours only out of the twenty-four = 20 per cent. on the total 35 indicated horse-power, leaving a net effective result—after deducting 15 per cent. for frictional losses—of 23·6 electrical horse-power per hour per set, which may be absolutely depended upon. The total value at 1·34-horse power per unit equals 1s. 5½d. per hour per set, or 8s. 9d. per hour for the six sets; that is £73 10s. per week, or, per annum, £3822; less £350 for steam for auxiliary blast and grate engines and pumps, £350; total, £3472.

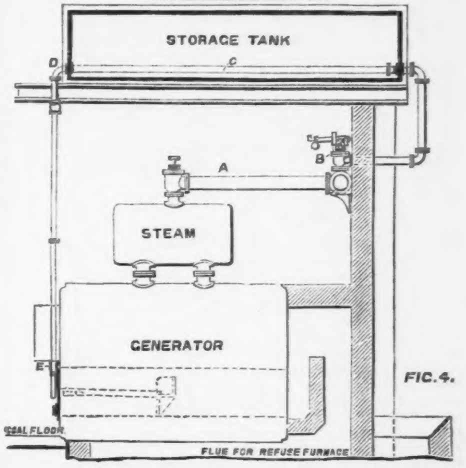


FIG. 4.

Mr. G. Watson, C.E., of Leeds, in his paper read before the British Association in 1892, gives the theoretical value of ashbin refuse as 1 lb. evaporating 2·13 lb. of water and the practical result at 1d. per indicated horse-power per hour with a steam generating plant of improved type, or 1s. 3d. per cell per hour, burning 5 cwt. of refuse at a total cost of 1s. 10d. per ton. At Oldham, some authorities give the cost at 1s. 6d. per ton, including all expenses and depreciation. Taking these figures and the evaporative tests of the author, of Mr. Collins, and those from Warrington, the foregoing figures may be considered fairly substantiated, together with the results deducible therefrom. The ordinary or supplementary furnace heat is not considered in these estimates, as that would be directly available for extra evaporation at proportionately increased returns. The author considers, as previously stated, that a plant capable of dealing with 420 tons of refuse per week would be of suitable working capacity for a London vestry. The plant would consist of eight refuse furnaces—two in reserve—with six steam generators for 140 lb. working pressure with feeding, coal and cleaning floors, forced draught, machinery, movable fire-bars, storage tanks and chimney, and capable of a total output of 900 brake or electrical horse-power when fully loaded. The author estimates the cost, including £3000 for the site, at £18,000.

The maximum indicated horse-power from the refuse only is computed at 48-H.P. per cell, the extra evaporation by the supplementary furnaces at high load utilising the remainder of the heated feed-water out of a total of 25,000 gallons. The following is a statement of the returns, which are inclusive of engineers' charges and royalties.

| | | | |
|---|---|---|---|
| To wages, renewals, repairs, oil, lighting, depreciation, water, &c., at the Oldham estimates of 1s. 10d. per ton .. | £2002 | By value of heat .. | £3472 |
| To yearly payment for redemption in twenty-five years of interest at 3½ per cent. and principal on a loan of £18,000 .. .. .. .. | 1092 | | |
| To credit balance .. .. .. .. | 378 | | |
| | £3472 | | £3472 |

From heat account .. .. .. .. £ 378
„ saving in barging .. .. .. 2288
Net saving .. .. .. £2666

The quality of ashbin refuse varies greatly. During the summer it is generally very poor, but from the better districts of London it may be advisable to sift it over a shoot during early spring, reserving the better fuel, which it will be found to contain, for use in the ordinary furnaces during the summer, and thus increasing the economy. From inquiries the author finds that the refuse from some localities would not repay this necessary outlay. The author's experience is that the Paddington siftings have been fully 25 per cent. less in value in July than in March, which has caused a lower evaporative average value to be given than the individual tests before referred to by others, as on individual weeks in January to March the breeze was particularly good, which is shown by the water and quantity tests.

The author has endeavoured to place the complex question of the disposal of town refuse in a practical light before the Society. The obtaining of the facts has been the outcome of the necessity of obtaining a cheap fuel for slow steaming, and of utilising refuse for producing electricity. The author's experience in connection with electric lighting since 1878, particularly when required for factories, is that would-be users first ask themselves—"Have I engine or boiler power to spare?" The idea of a separate plant using a waste product has been, until the past few years, quite foreign to the question. It now, however, may be said to solve an important problem. It will probably be admitted from what has been stated, that in addition to meeting sanitary and hygienic requirements, this system of refuse utilisation constitutes a valuable source of profit, to which public authorities are at length becoming alive.

## A SHIPYARD FOREMAN ON TRADES UNIONS AND LABOUR TROUBLES.

The Clyde Foreman Shipbuilders' Mutual Association met at Duncan's Hotel, Glasgow, on the evening of the 27th October, to discuss the paper read on the 28th April last upon "Trades Unionism," by Mr. Hugh Glen, of Clydesbank, which was reported at the time in The Engineer.

In the course of an interesting discussion, in which many of the members took a part, Mr. J. F. Paton, head foreman fitter at Messrs. W. Denny and Bros.' shipyard, Dumbarton, after complimenting Mr. Glen upon his able paper, said:—

The writer of the paper, in referring to Trades Unions in their in newest form, said:—"There is no subject in all the range of social or political economics that appeals so loudly to our consideration." I believe we may add "Amen" to that sentence, because industrial wars have been going on with increasing vigour before and since Mr. Glen's paper was written, and we can safely say, had it not been for the wretched blundering of our Legislature while tinkering with the conspiracy, combination, protection of property, and the picketting laws, for reasons best known to themselves, not 5 per cent. of the numerous strikes would have taken place, or continued for any length of time. Mr. Glen speaks of "colossal fortunes made in a brief space of time by successful masters, making many anxious for a share of the gains." There is nothing strange about that, but he must have heard of colossal losses too—what then. Not a word! Although we are "buffers" in a sense between capital and labour, we are not met to consider whether one or the other should dictate terms. Mr. Glen, while referring to the rights of both, steers clear of the point. But I hold, it is our duty, and also our right as a perfectly neutral body, to watch carefully the progress of every disturbing element introduced, and do what we can to preserve a good relationship between both; and yet it is sad for us to think that at this time of day we find members of trades councils, and workmen, or labour representatives openly bullying city and local authorities who are responsible for law and order. Mr. Glen says, "Workmen have united, and in all fairness we see no reason why they should not unite to guard their own interests and consider their value as well as our doctors or lawyers." "Why should not our workmen have as good a right to their union as our masters to their association, &c. &c.?" Mr. Glen is too late in the day in bringing up this point. It has been settled long ago; but the point which concerns us is just this: Should labour have the power to domineer over capital or capital over labour? Both are supposed to have equal rights. Doctors or lawyers have no Act of Parliament at their back to poison or plunder when they please or how they please, but we can almost believe from recent events that the men's leaders have the power to do both with impunity. We seldom read one of their orations but it is a case of poisoning the minds of all within reach of their voice; and when a midnight excursion has been arranged in the interest of labour, "urgent business" necessitates the departure of certain local justices to the coast. I cannot understand why men should be allowed to roam at large about a town or country like a lot of wild beasts, destroying property and frightening the life out of people, because employers will not knuckle down to their demands. I hold that all this nonsense must stop, and the fruits of both capital and labour be preserved and protected at the point of the bayonet, if need be. The administration of justice in our courts is simply a farce, justices and counsel alike being saturated with political bias and under the thumb of the mob. In following Mr. Glen through his interesting paper, we have evidence of great care in selecting reliable information for us. I have, like him, looked into the costs of trades unions, their benefits, and their errors; but their future seems to me to be something black and ugly, unless the reins of supervision and government are pulled in a little tighter. Mr. Glen, in the last page, says:—"Masters will associate and federate more and more, and men will unite and amalgamate more and more, and the sooner the better." Why? If the law of the land is not strong or good enough to keep both right, then the sooner our Legislature takes the question up the better for all concerned. Then Mr. Glen goes on to say, "My hope of fair and equitable adjustment of terms lies in the fact of each knowing the power and endurance of their opponent." No, no, Mr. Glen; this is an industrial question, and should not be allowed to approach the "beggar-my-neighbour policy." But to get over the bridge between us—Will this suit him, gentlemen? (1) Employers and workmen have a perfect right to unite, amalgamate, or federate; but neither should have power to put the ordinary laws of a civilised community at defiance to forward their own interests. (2) Employers and workmen have a perfect right to make or refuse a demand; but neither should have the right or the power to prevent a third party from accepting the conditions laid down; or, to put it another way, merchants or employers have the right to charge what they please for their goods or manufactures. Workmen have also the right to put on any value they please on their labour; but can you imagine any reason why the one should be favoured by the State and not the other? The words federation, or to federate, have been grossly abused in labour circles. We are told openly by trades and labour unionists that federated bodies aim at, and will have the power to stop the necessaries of life going into any district when capital and labour is at variance, in order to force capital to give way to the demands of labour. The public are told through the press what the 20th rule of the Miners' Federation of Great Britain is, and Mr. C. Robertson tells us through the same source, "That when the Englishmen saw the Scotch miners nine weeks' on strike, they should have applied the rule and stopped coal coming into this country." We know that strikers break away from their leaders and create mischief, but is there any reason why our Government cannot step in and stamp out such combinations before it is too late? I have no manner of faith in conciliation as a balancing power between capital and labour. Councillor Ben Dean—miner's agent—is reported to have said lately at a meeting of workmen:—"he was not in favour of strikes," he "believed in conciliation; but they would get nothing by it, unless prepared to hit hard, if hard hitting were required." Just so, employers, on the other hand, believe in conciliation too; but, at same time, don't hesitate about hitting hard when necessary. Workshops are shut up, capital is also shut up. Natural result, the general public have to bear the brunt of it, and who is to blame? You would have noticed lately during the industrial troubles the many frantic appeals for some third party to step in and end the disputes, but one and all sweetly declined. I see nothing for it but to allow capital and labour to fight if they wish to do so, but our Legislature should have the power to hedge both in, in such a way that no one outside of the ring would suffer. Workmen must not be allowed to prevent others from doing what they want to do. Employers must not be allowed to prevent other employers taking in hand contracts or work they have refused to do. I notice also that Mr. Glen, while covering little more than a page of his pamphlet with the benefits of Trades Unions, omits nearly altogether the fact that remedial measures are urgently wanted to cover the numerous errors and evils pointed out by him, and then he quietly begins the last part of his paper on the future of Trades Unions by saying: "I can give no forecast with certainty." I have, perhaps, said enough on Mr. Glen's paper; I may add, it seems to me the electors, rich and poor alike, do not seem to realise their power for good or evil when entering the ballot box. Modern faddism apparently has more concern for them than bread or butter, and I have no manner of sympathy with them when called upon to pay the enormous expense for extra police or troops when required in a district to preserve law and order through labour troubles. We have far too many political weeds in power to begin with, and the remedy for this evil also lies with our Legislature. Every individual ratepaper, in my opinion, should pay an equal share of the expense, without regard to either income or rent value; and I am certain the worries and troubles between capital and labour while at close quarters would be reduced to a minimum.

In the remainder of the discussion Mr. Lambie—Greenock—said he was in favour of paying workmen by results; and that the opinions of the older and more experienced men should prevail in the settlement of disputes.

Mr. Haughie—Govan—said he was opposed to the levelling of workmen, without regard to skill, which trades unionism effected. In his opinion workmen should be divided into three classes.

Mr. Cooper—Port-Glasgow—contended that all in charge of labour should combine, if for nothing else than the prevention, as far as possible, of friction between capital and labour.

Mr. Glen, in replying, said he still believed in trade regulation of wages, as employers had more than once broken faith with men; but he was against time wages pure and simple, and thought all workers, either time or piece, should be paid according to results. He belived in conciliation.

## SHELLS CAPPED WITH WROUGHT IRON.

It is extremely doubtful if the Ordnance Department of the Navy will conduct further experiments with shells capped with soft wrought iron. The first experiments, which were held on October 5th, at the Indian Head Proving Grounds, resulted so seriously to the gun that the Ordnance Department officials have come to the conclusion that further trials in this direction would be dangerous. The shells tested were four experimental Wheeler-Sterling 6in. A. P. shell, and the plate used was the 6in. Harveyised nickel-steel barbette plate, A-883, Carnegie Steel Company, which had already been attacked by four 6in. A. P. shells. Before the capped shell was fired, two projectiles were discharged against the plate, the first soft to file on surface all over, relative low carbon and high chrome, and the second hard to file as far as lower edge of bourrelet, ogive magnetised. The third round, in which the capped shell was used, resulted as follows, according to the official report of Ensign Tisdale, who superintended the test:—"Projectile, Wheeler-Sterling 6in. special A. P. shell, No. 6, of normal dimensions and weight, hard to file to ¾in. below the bourrelet, ogive magnetised, of relatively high carbon and low chrome. An annular ring ½in. wide and ⅜in. deep at its forward end was cut in the ogive about 3in. from the point. A soft wrought iron conical cap ½in. thick was placed over the point of the shell's ogive, fitting it neatly, and was held partially by the magnetism, but principally by three screws equidistant, about 1½in. from the bottom end of the cap, the inner ends taking in the groove, and setting up evenly against the shell. The cap then presented a length of about 3½in. When put on, it seemed to be perfectly tight and rigid. Weight of cap, 8 lb.; charge, 43·8 lb. O. P.-b.; striking velocity, 2000 foot-seconds; striking energy, 2776 foot-tons. It was my opinion that 2100 foot-seconds would be necessary to perforate the plate; but as this velocity was required to perforate 6in. Harvey plate without a cap, 2000 foot-seconds was used to demonstrate the value of the cap. The shell struck the plate 20in. from its top, and 48in. from its left edge; angle of impact inclined 6 deg. to the normal, striking the plate 12in. to the left of the point desired, which would have given a normal impact, smashed up the ogive welding in the plate, apex of cavity ·9in. in from the face of the plate, estimated penetration from 3in. to 4in. The remainder of the shell broke into numerous fragments, but the greater part was in two longitudinal fragments 7in. long, forming the lower body and base, weight 44 lb., its edges being fuzed, and showing a tough metal. A back bulge 2½in. high, about 18in. in diameter and cracked through, was raised. The plate about the impact scaled considerably, mostly in a vertical direction, the hardened surface separating from the softer metal of the plate, as before. A few surface cracks were started. No trace of the cap was found. At the time, the deviation of the shell from the line of fire was attributed to the peculiar form of the cap." After giving the results of another round, fired with a projectile, hard to file ¾in. below the bourrelet, which, with a velocity of 2100 foot-seconds, perforated the plate, the report concludes:—"None of the above shell did any more work on the plate than the ordinary service A. P. shell, and they broke up in very much the same manner. The plate itself acted remarkably well. (See photograph No. 320, showing the fragments of all the above four shells, partially built up) After the firing was over, the fragments of the different shells were more minutely examined, when it was found that there were marks of rifling on the lower body and rear of shell No. 6—third round—which had the soft wrought iron cap on it. The bore of the gun was then thoroughly cleaned out, wiped and examined. It was found that at a point about 8ft. 6in. from the muzzle, the gun was very seriously injured, the shell having jammed in the bore, possibly by reason of the cap being jarred off on discharge, the shell passing through it, or being jammed by it. This injury is the subject of a special report. The action of the shell in the gun, then, explains the great deviation from the mark on the plate in round No. 3."—*United States Army and Navy Journal.*

Another new submarine boat is announced. A Reuter's telegram from Melbourne says that Mr. Seymour Allan, a resident of Sydney, has invented a submarine torpedo boat capable of sinking to any depth and of travelling under water as quickly as on the surface without revealing its presence. A working model of the boat was tried the other day in the public baths at Melbourne in the presence of the Earl of Hopetoun, the Governor, the Naval Commandant, and a number of naval and military officers. The experiments were a complete success, the model rising or sinking, turning, reversing, or remaining stationary in obedience to the electric current by which it is worked. The inventor claims that a full-sized boat would be capable of remaining under water for three days and would carry torpedoes on the bow and stern decks. When fired the projectiles would be magnetically attracted to the bottom of an enemy's ship. The Admiral commanding on the station, who inspected the model at Sydney, declared that if the vessel would do what the model performed it would revolutionise naval warfare.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

Iron trade prices this week show little change from the quotationt given last week, but surprise has been occasioned by the statemen that in the ironmaking districts of the Western States of America bar iron at the present time is being rolled at £4 12s. per ton, and delivered to consumers 1000 miles or more inland from the Atlantic coast at £5 6s. per ton. This figure is compared to £6 5s., at which Staffordshire common or ordinary bars are being delivered to consumers in the West and other parts of England. Statements like this, showing the low prices now ruling in the American iron trade, are on a par with the report lately made to the Middlesbrough Chamber of Commerce by Mr. Jeremiah Head, that pig iron is being made in Alabama at 24s. 2d. per ton, and sold at from 26s. to 29s. per ton in trucks at works.

An important event of the past week has been the practical starting of the new steel works at Brierley Hill, erected at a cost of about £40,000 by the Earl Dudley Round Oak Iron and Steel Works Co. The works are not yet fully completed, and a meeting of the shareholders and others interested is called to consider the question of the raising of additional capital, but the company is now in a position to supply open-hearth steel in the form of bars, engineering sections, &c., for which there is an increasing demand. The restart is also announced this week of the Congreaves blast furnaces, late the property of the New British Iron Company, by the new proprietary.

Authoritative information this week of the extent of the orders for bridge and girder work lately placed in this district on account of the new Manchester, Sheffield, and London Railway extension puts the amount down at 8000 tons, and not at several exaggerated figures greatly in excess of this, which have appeared in different quarters. As previously announced, the work has gone to the Horseley Engineering Company, Tipton, and delivery is to extend over two years. The entire bridge work required for the line is understood to have been divided amongst seven British engineering firms located in various parts of the kingdom. As regards the Horseley Company's contract, all the material employed is to be of steel, and it is eminently satisfactory that the Staffordshire Steel and Ingot Iron Company has taken the order for the metal. The Horseley Company is at present employing some 600 workpeople.

In the matter of the brickwork necessary to the extension, this district has benefited to a greater extent than as concerning the iron and steel work. For the tunnelling required on three or four out of the seven sections the whole of the orders have come here. West Bromwich is the town which has secured the business, a number of firms having shared the contracts. One firm alone—Messrs. P. and S. Wood—will supply 10,000,000 blue and brindled bricks, and other firms have been equally fortunate. Large orders for bricks and invert blocks and copings have also just been booked by Messrs. Wood and Ivery for the Birmingham water scheme, through the Glasgow contractors for the work. These orders coming just in the face of winter, and after the prolonged depression in the iron trade, are all the more welcome. Delivery will be spread over a period of three and a-half years South Staffordshire stands pre-eminent in the production of blue bricks for constructive engineering purposes. For tunnel work, sea walls, quays, culverts, reservoirs, and all works where great strength is required, the bricks of this district is, it is stated, deemed by competent engineers to be even more substantial than granite. The Severn tunnel is, it is noteworthy, constructed of Staffordshire blue and brindled bricks.

The experience of gas engineers in the Midlands of late has been somewhat trying. The Gas Committee of the Birmingham Corporation are now paying for coal between £75,000 and £80,000 a year more than they paid a few years since, yet the price of gas remains the same. Then the introduction of the eight hours' shift for the men has also cost the Corporation a serious sum of money. Notwithstanding all this, the committee hope to reduce the price of gas in December, and they have also given immediate satisfaction to the manufacturers of Birmingham and district by lowering the price of gas-coke on Thursday, November 1st.

The new method for the treatment by electric chemistry of the materials used in the North Staffordshire pottery trades, to which I referred a few weeks ago, and which it is alleged is destined to supersede the ponderous machinery at present used in these trades for the grinding and preparing of the potting materials, is still engaging attention. It is stated that the results so far obtained have prompted several scientific gentlemen and capitalists to formulate an arrangement for the erection of an initial plant on a practical working scale. I hear that they do not expect to at once arrive at a complete solution of the problem, but they apparently believe in its possibility, and intend to go on with it. Meanwhile expectation in the pottery trade runs high as to what the exact particulars of the new process may be, and caution is countenanced in the expenditure of more money upon existing plants, as in case of the success of the new system such machinery expenditure would be lost. The present position of the potteries industries, owing to prolonged bad trade, growing foreign competition, and other causes, invests any suggestion for increased economy in processes with marked importance just now.

Well known in mining engineering circles the kingdom through as one of the least fiery and best equipped—even as it is one of the most prolific—coal raising concerns in England, the Sandwell Park Colliery, of West Bromwich, has hitherto been singularly free from accidents of a serious character. This enviable record, however, has been broken, for about seven o'clock last Saturday morning an explosion of fire-damp took place, which injured thirteen miners, of whom two have since died. The men were working in No. 2 stall of No. 1 pit, about a quarter of a mile from the bottom of the shaft. The usual first examination of the pit had been made, and "all safe" had been reported. The under-manager was making a second examination of this stall when a sudden rush of gas was heard, and this was followed by an explosion. The men were working with naked lights. It has been customary to use them, as that part of the pit was considered very safe. One theory of the explosion is that a hollow place had been struck, and that there had been also a change in the pressure of the atmosphere since the first examination. The inquest was opened on Wednesday, and adjourned until the 22nd instant for scientific evidence to be adduced.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The reports as to the condition of trade in connection with the iron and engineering industries of this district vary considerably. In some quarters one hears that there is apparently a "turn for the better," and that more business has been done in the iron market during the past week. Engineering establishments also are here and there reported to have experienced an improvement, and that they are better off for orders than was the case a short time back. There is, however, still no general improvement in the position, and business in the iron trade, taking it all through, continues extremely slow, with prices weakening, if anything; whilst as regards the engineering industries it is, as I have reported for some time past, only in exceptional cases where establishments are either better off for orders or more than very moderately engaged, and the outlook shows no reliable indication as yet of any revival as regards either the iron or engineering industries of Lancashire.

There was a more numerous attendance on the Manchester Iron Exchange on Tuesday than for several weeks past, and here and there an increased weight of business was reported. Generally, however, there seems to be an absence of inquiries of any moment, and where business was being put through sellers for the most part had to give way upon recent quotations. Lancashire makers of pig iron still quote on the basis of about 39s. 6d. for forge to 42s. for foundry, less 2½, at the works, but these are little more than nominal figures, so far as business doing in this immediate district is concerned, and transactions in local brands are chiefly confined to occasional special sales, or where makers have exceptionally favourable rates of carriage. District brands continue to ease down gradually, and in Lincolnshire forge moderate transactions have been put through at 38s. 6d. net cash, delivered equal to Manchester, with consumers who have further orders to place holding out for a still lower figure; but fair transactions would in all probability be put through if makers were prepared to accept about 38s. net cash, delivered here. Foundry Lincolnshire remains fairly steady, quotations averaging 40s. to 40s. 6d. net cash, but Derbyshire brands continue weak and irregular, ranging from 43s. 6d. and 44s. up to 45s. 6d. and 46s. net cash, delivered Manchester.

With regard to outside brands offering here, Middlesbrough remains without any really quotable change, 44s. 4d. net cash being still about the minimum for good foundry qualities, delivered equal to Manchester, with makers asking 6d. above this for special named brands. Scotch iron is, however, gradually giving way as the production increases, and 47s. 6d. net prompt cash is now the full quoted price for Eglinton delivered at the Lancashire ports, with sellers in the open market disposed to come something below this figure. and Glengarnock offered very low.

In the manufactured iron trade business continues of a hand-to-mouth character, with forges not kept running more than four to five days per week. Makers still quote late rates, but here and there give way to secure business. Delivered in the Manchester district, quotations for Lancashire and North Staffordshire bars remain at £5 7s. 6d. to £5 10s., but 1s. 3d. per ton under these figures has been taken. Lancashire and Staffordshire sheets are still quoted from £7 to £7 5s., and Lancashire hoops £5 17s. 6d. for random up to £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

The position in the steel trade remains without improvement, and only a very limited business is reported in either raw or manufactured material. For ordinary foundry hematites prices now average about 52s. to 52s. 6d., less 2½; ordinary basic billets remain at about £4 net cash; steel bars are quoted £6 to £6 2s. 6d.; and for steel boiler plates makers are asking £6 to £6 5s., delivered in the Manchester district, but business is scarcely practicable at this figure.

In the metal market buyers still give out only the smallest possible orders for manufactured goods, in the expectation that list rates, which are still maintained at the last advance, will have to give way.

The opening paper on Saturday last, for the discussion session of the Manchester Association of Engineers, was one by Mr. John Holliday, A.M.I.C.E., on the cost of steam raising, in which he dealt with his subject under four heads, viz.: Fuel, working expenses, maintenance, including insurance, and capital charges, and gave calculations showing the cost of evaporating 1000 gallons of water, which he adopted as a convenient number, at a brewery with which he was connected. In summarising the cost per week per 1000 gallons evaporated, of the steam made with forced draught and natural draught boilers respectively, Mr. Holliday said the average amount evaporated per week was 113,560 gallons by forced draught, and 195,440 by natural draught boilers, the larger amount evaporated by the latter giving it a slight advantage over the forced draught, but that in the latter system the fuel bill was 2s. less per 1000 gallons evaporated, and the total cost in the forced draught was only 7s. 8d., as compared with 8s. 6d. per thousand gallons in the natural draught. In considering the cost of steam raising it should, however, be remembered that the solid was not the only form in which fuel could be used. Gaseous firing with water-gas, affording as it did opportunities for recovering valuable waste products, such as sulphate of ammonia, had already been tried in several places, and it would be interesting to know what would be the minimum demand for steam that would justify a manufacturer in putting down a water-gas plant, complete with apparatus for the recovery of sulphate of ammonia, and firing his boilers with the water-gas made. In the course of discussion on the paper, Mr. James Hartley remarked, with regard to mechanical stokers, that he knew a case where a very considerable saving had been effected by discontinuing their use. Mr. J. Nasmith gave particulars of the cost of steam raising in several Oldham mills, which showed a range of from £3 2s. 5d. up to £5 14s. per thousand spindles. With regard to inferior fuel, he thought its use ought to spread, provided that the furnaces were specially adapted for it, and the boiler was fitted with appliances for dealing with it effectually. As to gaseous fuel, he had found that the gas produced almost invariably passed through the fewer burners when the many were not open, so that the system was not economical. The use of this fuel was only economical when adopted for steam raising in combination with other purposes. Mr. Marshall said he had adopted forced draught boilers, and not only got more power than previously, but saved a considerable sum in the cost of fuel. Mr. Craven pointed out that gaseous fuel possessed many advantages in its application for blast furnaces, and in many other cases, but not for burning under the flues of a steam boiler. Mr. Meldrum gave some interesting details as to the use of waste products for steam-raising purposes in connection with ironworks, collieries, &c., by which 75 per cent. was frequently saved. In one case the economy amounted to thousands of pounds a year, and he might add that the calorific value of inferior fuel was often as great as that of dearer fuel.

The outlook in the coal trade continues anything but satisfactory, and the winter season has so far brought forward no appreciable improvement in prices, such as is usually looked for, at any rate in the better qualities of round coals, suitable for housefire purposes. These still meet with only a moderate demand, and it is exceptional where the pits are able to work full time, four to five days per week remaining about the average. The most that can be said is that the better qualities of round coal are maintaining late rates, but it is still exceptional where more than 11s. is being got for best Wigan Arley, whilst Pemberton 4ft. and seconds Arley can be bought for 9s. 6d. to 10s., and common house coals 8s. to 8s. 6d. at the pit mouth. With regard to the lower descriptions of round coal, trades continue in an extremely depressed condition, with the probability of even still lower prices in some of the inferior qualities. Common round coals still move off very slowly for iron making, steam and general manufacturing purposes, and with plentiful supplies upon the market excessively low prices have to be taken, 7s. being about the average figure at the pit mouth, only specially good sorts fetching more than this; whilst engine fuel is a complete glut upon the market, with so many special parcels offering at excessively low figures, that prices generally are weakened, and common low slack is readily obtainable at 3s. to 3s. 6d., with better sorts averaging 5s. and 5s. 6d. per ton at the pit mouth. In the shipping trade only a quiet business is reported, with common round coals offering for steam purposes at as low as 8s. to 8s. 6d., and better descriptions, suitable for house fire consumption, fetching about 9s. to 9s. 3d. per ton, delivered at the Garston Docks or the High-level, Liverpool.

*Barrow.*—There is no change to note in the hematite trade this week. Orders are scarce, and only thirty-three furnaces are kept employed. Stocks have decreased only ten tons, and now represent in warrant stores 158,500 tons. Prices are easy at 43s. 6d. net cash sellers, 43s. 5d. buyers. Makers are quoting 44s. to 45s. 6d. for mixed Bessemer numbers, net f.o.b. Makers are holding considerable stock.

Iron ore is weak at 8s. 6d. to 13s. 6d. from ordinary to best samples, net at mines.

Steel makers are only indifferently employed in most of the heavy departments, except that of steel plates. Rails are quiet.

Shipbuilders are busily employed, and report the prospect of new orders.

Coal and coke quiet at late rates.

Shipping very depressed, although the returns show an improvement on the corresponding week of last year.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE South Yorkshire coal trade is not so active as it was last week. One or two reports confirm this statement, although others say the opposite. On the whole, however, I am inclined to believe that trade is rather more depressed than it was a week ago. The pits are at present working five days a week, but the output is still in excess of the demand, even in house coal. Although the London market is taking a large tonnage, the agents state that sales are not up to the mark, and that stocks are rapidly accumulating. In consequence of merchants having large supplies in hand, and buying being very limited, sacrifices are occasionally made to get rid of stocks on the rails. The advances which were reported to have been obtained at the beginning of this month are now altogether lost, and prices are about the same as they were in September. The quotations are as follow:—Silkstones are making from 9s. 6d. to 11s. per ton; Barnsley house coal is at 8s. 6d. to 9s. 6d. per ton; second qualities being obtainable at the low rate of 8s. per ton. Steam coal is in steady demand for the season of the year, and prices are fairly well maintained. The Humber ports are still receiving extensive supplies, and there is no doubt that the large amount sent to Hull and the other ports last month will be fairly approached when the October return is out. Hull and Goole, the two chief ports, are reported to be taking freely from the district pits. Barnsley hards made from 7s. 9d. to 8s. 6d. per ton; second qualities ranging from 7s. per ton. Gas coal is in fairly good demand, mainly on account of contracts; prices are well maintained, being at 7s. to 8s. per ton. Manufacturing fuel is in the same depressed condition as when last reported, and no improvement can be reported. Good slacks are at present making from 4s. 6d. to 5s. 6d. per ton; pit slack from 3s. 6d. per ton. Smudge and small coal exhibit no change, prices being low and the requirements far less than the supply. Coke is in good demand, and may be quoted at 9s. to 11s. per ton.

The iron trade, if anything, is somewhat weaker, the majority of the large works being but indifferently employed. Hematites range from 50s. to 52s. 6d. per ton, according to brand, and forge iron 38s., both delivered in Sheffield. Swedish brands still maintain the advance of half-a-crown which was imposed when English iron went up a few weeks ago, but unless a change for the better comes in trade the extra half-crown will no doubt be taken off. Bessemer billets are quoted at £5 10s., bar iron £5 10s. to £5 15s., wire rods £5 5s., rope rods and high carbon rods £8 8s. Very little is doing in railway and shipbuilding material. Railway companies are generally short of supplies of all kinds. It is impossible, therefore, that they can continue to hold their hands much longer, as the railway extensions in hand will compel them to increase their rolling stock. For the new Sheffield, Manchester, and Lincolnshire line to London, the company's works at Gorton are making adequate preparations. One of the orders to be executed at Gorton is no less than one million chairs for the permanent way.

A decided improvement is still maintained in the cutlery trade with the United States. The call is chiefly for the medium qualities of pen and pocket cutlery, which have received most benefit from the new tariff. Table cutlery and the higher classes of spring knives are in somewhat better request, but not to the extent anticipated. It is believed that the ultimate effect of the new tariff will be averse to Sheffield by fostering home production. But several years of good trade are looked for before that comes about. Manufacturers of silver and electro-plated goods are very busy at present, the season trade having set in most satisfactorily. There is a slight upward tendency in silver, which is quoted this week at 2s. 5½d. per oz.

Sir Ughtred Kaye Shuttleworth, M.P., Financial and Parliamentary Secretary to the Admiralty, visited the Cyclops Works of Messrs. Charles Cammell and Co. on Saturday. The Persian Minister, Mirza Mohamed Ali Khan Ala Es Saltane and family accompanied him. Sir Frederick Mappin, Bart., M.P., was also of the party. Mr. Alexander Wilson, J.P., managing director, conducted the visitors over the various establishments. They witnessed the rolling of a very large armour plate for the first-class battleship Mars, and the other processes of bending and finishing similar plates, together with several structures erected in the shops for H.M.S. Magnificent. At the Grimesthorpe Works the party witnessed the casting of a sixty-ton ingot, intended for the production of another armour plate for the Mars. The working of the 6000 tons hydraulic forging press was seen in operation for another armour plate, also intended for H.M.S. Mars. The production of steel shells for the War Department was afterwards witnessed. Sir Ughtred expressed his pleasure and surprise at the ease with which the huge masses of steel were dealt with, and the rapidity with which the company were completing the armour ordered for the Magnificent and other new vessels to be added to the Navy. The same day the Persian Minister visited the cutlery works of Messrs. Joseph Rodgers and Sons, and witnessed the processes of cutlery manufacture. The Persian Ambassador and suite had previously visited the works of Messrs. Mappin and Webb, Norfolk-street, where they witnessed the beautiful process of silver manufacture, electro-plating, &c.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

IT cannot be said that any change for the better has appeared in any branch of the iron and allied industries, and prospects are not encouraging, especially in the finished iron and steel trades. The recent improvement affected these trades, but very slightly, and prices have generally during the last few weeks lost much more than they gained; indeed, steel plates are now being sold at lower figures than were ever before known; in fact, they can be got at cheaper rates than iron plates, and thus the experience of the rail trade is being repeated in the plate trade —steel being cheaper than iron.

The steel plate mills are not kept fully employed, though it is to be borne in mind that the shipbuilding industry, which provides them with the bulk of their orders, is in an exceptionally dull condition, many of the builders having half their berths unoccupied, and a sorry winter for the workmen seems probable, for there is nothing in freights to induce owners to contract for more vessels, seeing that they cannot find profitable employment for those they have, and a large number of steamers are laid up on our rivers. At Whitby, however, the shipyard which has been for a long time idle has just been reopened. For steel ship-plates £4 15s., less 2½ per cent. f.o.t., has been generally quoted this week, and business has been reported at £4 12s. 6d., less 2½ per cent. f.o.t.—a price lower than has ever before been taken, and at least 10s. less than was being quoted a few weeks ago. Materials and labour have not come down in anything like the same proportions, so that the situation for steel plate makers has distinctly become worse, and shortness of orders has led to very keen competition, especially with the Scotch producers, whom North of England makers are underselling in their own markets. Iron ship-plates cannot well be had under £4 15s., less 2½ per cent. f.o.t., and leaves no profit at that. Iron ship angles are about £4 12s. 6d., less 2½ per cent. f.o.t., and steel angles are quoted half a crown higher, but both can be bought at less, though competition is not so keen as it is in the plate trade. Common iron bars have for several months been kept at £4 17s. 6d., less 2½ per cent., f.o.b., and though the mills producing them are not well off manufacturers adhere to the old quotations, and are undersold in some markets by the Belgians. Work at the steel rail mills is fairly active, but does not leave anything in the way of profit. The closing of the Darlington Steel and Iron Company's rail mills has thrown 800 men out of work, and to relieve the distress following on this the poor law authorities have decided to open a stoneyard for married men with families.

The final step in connection with the dispute between the moulders and their employers in the North of England has this week been reached. The men struck work in March last for an advance of 3s. per week, which claim they subsequently modified to 2s., and they were idle for nearly five months, when an arrangement was made that a Conciliation Board should be formed, which would deal with the men's claim, and also with the claim of the employers for a reduction of wages. The Board has decided that no advance is to be given. None could, however, be expected when the present state of trade is taken into account. Though it is nearly two months since the strike ended, many of the moulders are still idle, as the masters have lost so many orders that they cannot find employment for them. The pattern makers in the district continue on strike for 3s. per week advance in wages, and have been idle since the beginning of April, but in spite of the hopelessness of their case, they will not budge from their original demand, or allow the matter to be settled by conciliation or arbitration.

Pig iron makers in the North of England find business very quiet, but as competition is less keen they are able to keep up their prices. It was expected in the earlier part of this week that prices would have been easier, as is usual towards the end of a month, seeing that then speculators who find themselves unable to accept deliveries due to them in that month sell to those who can, and generally at less than the regular price. But there has been less of that than usual, and no further reduction in prices can be reported. The speculators seem to be in no hurry to sell, as, though the quietest period of the year is at hand, it is thought that prices will not fall materially below the present figures, and probably may show some improvement towards the middle of this month, when frequently there has been a spurt in demand and better prices, especially if the weather has been favourable enough to allow of large shipments. Holders of pig iron, either makers, merchants, or speculators, seem in no hurry to sell at present, but at the same time consumers hesitate to purchase for forward delivery.

The general quotation for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron is 35s. 9d., but rates have been made at 35s. 7½d. Cleveland warrants have fluctuated very little during the last three weeks, the difference between the highest and lowest prices being not more than about 2½d., and a little more is being paid this week than last. The closing figure on Wednesday was 35s. 8½d. cash. The stock of Cleveland pig iron in Connal's warrant stores on Wednesday evening was 88,631 tons, the decrease for October being 1114 tons. Of hematite pig iron Messrs. Connal and Co. also held 70,657 tons, an increase of 7891 tons for the month. No. 1 Cleveland pig iron is in smaller request, now that the northern navigation season is over, and it has been sold at 37s. 6d., while No. 4 foundry is at 35s., and grey forge at 34s., all for prompt f.o.b. delivery, but 33s. 9d. has been taken for the last named. East Coast hematite pig iron is in better supply than demand, and mixed numbers can readily be got at 42s. 9d. for prompt f.o.b. delivery. The prospects are not good for producers of hematite iron, because of the close of the navigation season, and local consumption will be reduced on account of the unsatisfactory condition of the steel plate industry. Foreign ore is somewhat cheaper, because freights have further declined, the rate Bilbao-Middlesbrough being now 5s.; Bilbao-Tyne, 4s. 10½d.; Bilbao-Stockton, 5s. 1½d.; Carthagena-Middlesbrough, 8s. 9d. Good Rubio ore can now be bought at 12s. per ton delivered Tees. The October pig iron shipments from the Tees amounted to 80,159 tons, as compared with 80,139 tons in September, 1894, and 95,673 tons in October, 1893, large deliveries having been made to Baltic ports.

The engineering industries are very quiet; in fact, some firms declare they have never known business so slack, and it is the exception to find full work being carried on at any establishment. Ironfounders give similar reports, as also do the bolt and nut manufacturers, but bridge builders are fairly well occupied, and a fair trade is done by wagon builders.

The coal trade is less active than it was, and some of the collieries do not work as regularly as they did in the summer, while for steam coal the price is lower, 10s. 6d., f.o.b., being asked for best Northumberland. Another improvement has this week been completed at Tyne Dock, which is the largest coal shipping dock in the world, covering over 55 acres, and shipping last year no less than 6,026,694 tons of coal. The improvement which the North-Eastern Railway Company on Wednesday inaugurated is the deepening of the sill of the chief entrance so as to admit the very largest vessels afloat. The entrance is now 70ft. wide, and has a depth of 32ft. at ordinary spring tides and 27ft. at neaps. The deepening of the sill, the dredging of the dock, and other allied works, advised by Mr. Wolfe Barry, have been carried out by Messrs. Lucas and Aird, and have been in progress over three years.

The traders, &c., of Sunderland appear to have a grievance against the North-Eastern Railway in respect to the way that large town is treated by the company, which has the monopoly of the carrying trade of the district. On Monday a public meeting was held in response to a petition presented to the Mayor and very numerously signed by commercial men. The Mayor presided, and the meeting passed a resolution declaring that the Central Station is altogether inadequate and unsuitable, while the facilities for travelling and for goods and mineral traffic need considerable revision and extension. Further negotiations are to be carried on with the railway authorities, and if satisfactory arrangements are not made the Board of Trade and the Railway Commissioners will probably be appealed to. As far back as April, 1888, a deputation waited upon the directors of the railway at York, but nothing has been done.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been comparatively quiet this week. Business has been done in Scotch warrants from 42s. 7d. to 42s. 6d. cash, in Cleveland from 35s. 7d. to 35s. 6d., and in Cumberland hematite at 43s. 6d., these figures in each case representing the slight decline of 1d. per ton, compared with the closing rates of last week.

The demand for makers' special brands is moderate. Nearly all those brands that disappeared from the market during the strike are again obtainable, although in no case is the quantity on offer believed to be large. Prices are steady as follows:—G.M.B. f.o.b. at Glasgow, No. 1, is quoted 44s. per ton; No. 3, 42s. 6d.; Monkland, No. 1, 45s. 6d.; No. 3, 42s. 6d.; Coltness, No. 1, 56s. 6d.; No. 3, 51s.; Summerlee, No. 1, 54s.; No. 3, 48s. 6d.; Calder and Gartsherrie, No. 1, 52s. 6d.; No. 3, 48s. 6d.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Carnbroe, No. 1, 47s.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 57s. 6d.; No. 3, 51s. 6d.; Glengarnock at Ardrossan, No. 1, 54s. 6d.; No. 3, 48s. 6d.; Eglinton, No. 1, 48s. 6d.; No. 3, 46s. 6d.; Dalmellington at Ayr, No. 1, 48s. 6d.; No. 3, 46s. 6d.

A large number of additional furnaces have been put in blast since last week, and there are now blowing at Gartsherrie twelve, Coltness eight, Eglinton, Govan, and Summerlee five each, Dalmellington, Calder, and Carnbroe, four each, Clyde and Wishaw three each, Shotts two, and Monkland one, the total in operation being 56, compared with 32 last week and 43 in the corresponding week of last year.

There is already a considerable improvement in the amount of the pig iron shipments, which are 5178 tons, against 6358 in the same week of 1893. Of the total there was shipped to the United States 175 tons, South America 500, India 103, Australia 1048, France 135, Italy 120, Germany 1260, Holland 245, Belgium 10, China and Japan 185, other countries 230, and coastwise 1167, against 2415 in the corresponding week.

The market for malleable iron is somewhat more active, but there is yet much room for improvement. Makers feel that coal is hardly yet cheap enough to enable them to enter upon the manufacture with confidence, and there is no great pressure of orders to force up prices. The steel trade is getting fairly well employed, but prices are very unsatisfactory, and only a few of the companies are understood to be able to make any considerable profit.

The circumstances of the Steel Company of Scotland have engrossed a good deal of attention on 'Change and in commercial circles this week. The statement was circulated a few days ago, and has since been confirmed, that Mr. James Riley, who has been the principal manager and backbone of the company almost since its commencement, had resigned his appointment and accepted that of general manager to the Glasgow Iron and Steel Company. The Glasgow Iron and Steel Co., of which Mr. Riley now takes the management, has amongst its proprietors one or two very enterprising men, who have lately been engaged in extending and renewing its plant. It is still a small affair compared with the Steel Company, but much may be expected from the influence and energy of Mr. Riley in the future.

The export trade in iron and steel manufactured goods, as measured by current shipments, would seem to be in a very unsatisfactory condition. It is to be hoped, and it may no doubt better the case, that the exports have now reached the lowest point from which we may reasonably look for recovery. They embraced locomotives worth £9200; sewing machines, £4945; other machinery, £2619; steel goods, £933; and miscellaneous iron goods, £7230.

A rapid improvement is taking place in the coal trade both in the inland and shipping departments. The shipments from Scotch ports in the past week reached 110,516 tons, showing an increase of 22,000 tons on the preceding week. The markets in Glasgow, Ayrshire, and in the Eastern colliery districts, keep wonderfully firm. The colliers are now all at work, all of them who can obtain places; but the production is limited by a variety of causes, chief among which is the state of disrepair into which the roads and workings fell during the strike, so that the output is fully absorbed and prices are maintained.

During the past month there were launched from the Clyde shipyards twenty-six vessels of 34,893 tons, compared with twenty-one vessels and 42,731 tons in October, 1893. The output for the ten months embraces 211 vessels aggregating 286,999 tons, against 212 vessels and 243,862 tons in the corresponding period of last year. It is worthy of notice that, of the twenty-six vessels put into the water during October, no fewer than nineteen are steamers.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE long-expected "boom" in tin-plates, to be followed by a rush for tin-bars, which would give a good momentum to business at the principal steel works, is still delayed, and in the meanwhile there is no marked activity at mills and furnaces.

On Tuesday there was a meeting of the Sliding Scale Committee of the iron and steel trades held at Abergavenny, when the report of the audit for the three months ended September was read, indicating no change in wages. It was tolerably certain that it would not justify an advance, and there is a small degree of comfort in the fact that it does not warrant a reduction. Probably the next audit may slightly alter matters, though this week a serious rumour is spreading in the tin-plate trade that some employers are contemplating a reduction of wages.

Welsh ironmasters have unquestionably to contend with severe competition. I note this week that Maesteg has imported 330 tons of tin-plate bars; and two cargoes of steel billets, one of 600 tons, have come into Port Talbot from Middlesbrough. Swansea imported large cargoes of pig iron from Harrington and 200 tons of steel scrap during the week, and 165 tons of iron slag. The only iron cargo of the week from Wales has been 100 tons of pig iron for Rio de Janeiro.

In the matter of pig iron Welsh ironmasters hold large stocks, and all are well provided with foreign ore for winter use. This week a considerable quantity have come in to Blaenavon, Cyfarthfa, and Dowlais, and moderate quantities for Neath, Swansea, and the West generally. Hence, with a tranquil labour market, and good supplies at hand, substantial business can be met if it will only come in.

The coal trade has not quite recovered tone, and prices are slightly weaker than last week. A good deal of this is due to the disturbed weather, which has delayed the arrival of tonnage at all ports, Cardiff and Swansea in particular.

The latest report from the Exchange, Cardiff, is to the effect that there is a good steady attendance, but that the business transacted is not in keeping. Midweek the demand was only moderate, and best steam was easily obtainable at 11s. 3d. to 11s. 6d.; seconds were selling at 10s. 9d. to 11s.; best Monmouthshire, 10s. 3d. to 10s. 6d.; seconds, 9s. 6d. to 10s.; small, 4s. 6d. to 5s. The price of small is a significant one.

House coal is fairly brisk; quite an average demand for this time of year is sustained, and prospects for this class of coal are regarded as good. Latest prices, Cardiff, for best house were 11s.; No. 3 Rhondda, 10s. 3d.; brush, 8s. 3d. to 8s. 6d.; small, 6s. 6d. to 6s. 9d.; No. 2 Rhondda, 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 9d.

Most of the large coal contracts remain unsettled, though I believe a few days will see a clearance. It was stated on 'Change, this week at Cardiff, that an important order had been received from the Egyptian Railways by Milburn and Co., of Newcastle and Cardiff. The total is about 100,000 tons, and the stated figure is 15s. c.i.f. A local authority discussing this remarks that the present freight to Alexandria is about 4s. 9d., but that the average for the year would certainly be more than this. Probably it might be taken at 5s. 6d. This would leave the contract price for the coal at 9s. 6d., and that double screened and f.o.b. Last year the contract was taken by Watts, Ward, and Co., Newport and Cardiff. I fancy there must be some misapprehension on the part of the local authority somewhere, possibly in estimating the freight too high. If the freight has been secured at 4s. 9d., the price would not be out of the way.

The colliers are moving in a very undemonstrative way, and chiefly by the action of their representatives, to bring about an organisation that shall include the great body of men in Monmouthshire and South Wales. This number is now estimated at 100,000, a formidable army of labour, if under uniform direction, and a power for good or evil, as it might be directed.

On Tuesday there was a meeting of the representatives at Cardiff. The muster was a full one, only Mabon being absent, from illness. This was to be regretted, as his temperate and peace policy is often effectual, especially when, as in the present instance, the General Federationists are at work. After a discussion the following resolution was carried: — "That the parties here assembled are of opinion that the time has arrived when one common cause is essential and necessary for the whole of the workmen of South Wales and Monmouthshire; and we, as representatives of the various districts, pledge ourselves to do all in our power to establish a general organisation for the whole of the Monmouthshire and South Wales coal field." Later on it was agreed to have a general conference of miners at Cardiff on the 26th November, when the following points will be submitted:—(1) To consider the best means of organisation; (2) to recommend that all workmen organise in each district, and become affiliated into one general association; (3) that a uniform subscription of 1s. per month be adopted; (4) that contributions be paid by the men, and not deducted through the colliery office.

There is a sting in the tail of this, which is evidently meant to show that colliers wish to act independently of their employers. I do not, however, believe that it is intended to "affiliate" on to the General Federationists, and, if not, some mode of working in unison with the sliding scale principles may be arrived at.

There is no improvement to report in the price of tin-plates, and though shipments continue large, they are fairly equalised by the quantity sent from works, thus leaving stocks little altered. Last week the shipments from Swansea were close upon 80,000 boxes; received from works, 73,092. Present stock, 231,472 boxes, as compared with 237,658 this day week, and 261,212 boxes this time last year.

Swansea harbour returns show by a decrease of 10,000 tons, compared with the previous week, the violence of the storms which have assailed the Welsh Coast. In all likelihood, with the lull, there will be a good spurt in of vessels. Last week the shipments of patent fuel were 4880 tons, Italy taking 3200, Algeria 1280, and France 400. Swansea quotations for this manufacture is down to 10s. to 11s.; Cardiff price, 10s. 9d. to 11s. 3d.

General quotations on 'Change Swansea this week are as follows:—Pig iron, Glasgow, 42s. 6d.; Middlesbrough, 35s. 6d.; Welsh bars, £5 2s. 6d.; steel rails—heavy from £3 15s., light from £4 10s.; sheet iron, £6 to £6 10s.; steel, £6 5s. to £6 10s.; Bessemer steel bars, £4 to £4 2s. 6d.; Siemens, £4 to £4 2s. 6d. Tin-plates: Bessemer cokes, 10s. to 10s. 3d.; Siemens, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 c., 20s. to 24s.; best charcoal, 12s. to 12s. 6d.; wasters, 6d. less. Block tin is advancing, and is now at £67 2s. 6d. to £67s. 7s. 6d. Iron ores: Tafna, 11s.; Rubio from 11s. 3d. Pitwood, 16s. 9d. to 17s. At Cardiff good wood is selling at 15s. Coke prices are unchanged, Cardiff and Swansea.

The Barry and Cadoxton Local Board have succeeded, I hear, in securing a loan for £170,000 at 3 per cent. for the purchase of the gas and water undertakings of the district.

In connection with the Rhondda and Swansea Bay Railway, the line from Aberavon to Neath and Swansea will be opened for mineral traffic at about the middle of November, and for passenger traffic at the end of November.

The extension of the Eagle Tin-plate Works, Neath, has been carried out, and on Saturday last a 500-horse power compound tandem engine and four mills were started under satisfactory auspices. The start was a most successful one, and all that remains for the increase of the producing power of the works is the completion of the gas furnaces.

The Briton Ferry Works have maintained a good average make of pig and tin bar during the week, and a larger make of tin-plate than usual.

There is a hitch in the negotiations between the Cardiff Corporation and the Bute Dock Company about the value of waste land, which, though of little use now, may become very valuable.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

GENERALLY, the position of the iron market remains very much what it has been for some time past. In a few instances makers are reported to be in a stronger position as regards their order books, but, on the whole, specifications come forward very indifferently.

In Silesia the pig iron business continues very dull and stocks are slowly accumulating, so that the damping down of blast furnaces has been taken into consideration. All descriptions of manufactured iron also meet with limited demand, and short time is being worked at some of the mills.

The condition of the Austro-Hungarian iron market is generally quite satisfactory, and a good deal of activity is to be noticed in some branches. The scarcity of pig iron is likely to increase during the coming quarter, as the blast-furnace works which are in course of erection will not be blown in before spring. With a steadily increasing quantity of Silesian iron offering in the market, anything like definite prices are scarcely quotable; in some instances, however, quotations have been tolerably well maintained. A fair employment is reported at the rolling mills; small orders are coming to hand rather freely, and list quotations are generally paid without much questioning. In Hungary, however, a slightly decreasing tendency has lately been perceived for some articles of manufactured iron.

In France the business in iron and steel continues slowly to improve, especially in the Department Nord an increasing liveliness is to be noticed, and both raw and finished iron makers report a fair amount of business doing, but no better prices are obtainable. In the Meurthe-et-Moselle Department foundry pig had to be sold below official quotations, on account of large stocks and of a very keen inland competition. Sheets, as well as all sorts of hardware, continue rather neglected. For the present there is but little life noticeable at the engineering and construction shops.

On the Belgian iron market makers of pig iron have been doing a fair business all through last week. In spite of the continued dulness in the malleable iron trade, the prices for crude iron have shown a decidedly stiffening tendency. During the first two weeks in October Athus has sold more than 22,000 t., and booked further 57,000 t., without going below 44f. p.t. Of the 42 existing blast furnaces, 29 were in blow on October 1st, 14 producing forge pig, 3 foundry pig, and 12 producing basic. Output of pig iron in September and for the first nine months of the present year was:—

| | September. | | January to October. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Forge pig .. | 36,600 | 32,400 | 300,240 | 291,600 |
| Foundry pig .. | 6,600 | 6,300 | 59,400 | 56,700 |
| Basic .. .. | 34,500 | 19,500 | 310,800 | 175,500 |
| Total.. .. | 77,700 | 58,200 | 670,440 | 523,800 |

The iron business in the Rhenish-Westphalian district is decidedly weak, and few contracts are being secured. The prices makers receive for their products are still ridiculously low, and there is little chance of obtaining higher rates. The different sorts of iron ore are in quiet but regular request, and the old prices of M. 7·40 to 7·70 p.t. for spathose iron ore, and M. 10 to 11 p.t. for roasted ditto, are still firmly maintained. Minette of Lorraine is in lively demand, and fetches M. 2·40 to 2·60 and 3·20 p.t. at mines.

There is really scarcely any alteration to be noticed in pig iron. Prices have been well maintained, thanks to the firmness in the coal trade. The Siegerland Pig Iron Convention has sold a fair quantity within the course of last week. Spiegeleisen, 10 to 12 p.c. grade, fetches M. 52 p.t.; Rhenish-Westphalian forge pig, No. 1, M. 46 to 47 p.t.; No. 3, M. 40 p.t.; Siegerland good forge quality, M. 44; hematite, M. 63 p.t.; foundry pig, No. 1, M. 63; No. 3, M. 54 p.t.; basic costs M. 45 p.t.; German Bessemer still stands at M. 49 to 50 p.t.; iron for making steel, M. 45 p.t. at works. Luxemburg forge pig is quoted 48f. p.t. free Luxemburg.

Manufactured ironmakers are short of orders in all branches, and there is for the present little prospect of better employment. Bars and girders are exceedingly quiet just now, and there is nothing doing in the hoop trade. Heavy plates are regularly called for, and give promise of a better market; while sheets, generally, are rather neglected.

The railway and engineering industries continue but very indifferently off for work. Here and there orders are reported to be coming in more freely; but this does not represent an improvement of a general character, and the outlook for the future can scarcely be said to show any really better prospect.

Latest list quotations, per ton at works, are as under:—Good merchant bars, M. 103 to 105; angles, M. 120; girders, M. 90 to 95; hoops, M. 108 to 113; billets in basic and Bessemer, M. 75 to 80; heavy plates, for boiler-making purposes, M. 150; tank do., M. 135; steel plates, M. 120 to 125; tank do., M. 120; sheets, M. 140; Siegen thin sheets, M. 125. Iron wire rods, common quality, M. 115 to M. 120; drawn wire in iron or steel, M. 105 to M. 115; wire nails, M. 125; rivets, M. 150; steel rails, M. 112 to M. 115; steel sleepers, M. 106; fish-plates, M. 110 to M. 120; complete sets of wheels and axles, M. 270 to M. 280; axles, M. 220; steel tires, M. 215 to M. 230.

The total production of pig iron in Germany, including Luxemburg, was for September, 1894, 473,070 t., of which 130,270 t. were forge pig and spiegeleisen, 37,841 t. Bessemer, 221,245 t. basic, and 83,714 t. foundry pig. Production in September, 1893, was 410,193 t.; in August, 1894, it amounted to 489,211 t. From January 1st to September 30th, 1894, no less than 4,088,246 t. were produced, against 3,646,873 t. for the same period the year before.

During the third quarter of present year output of coal in the mining district of Rheinland-Westphalia amounted to 10,337,835 t., against 9,846,114 t. during the third quarter in 1893, and against 9,619,787 t. in the second and 10,089,455 t. in the first quarter of 1894. Consumption was 10,323,709 t., against 9,845,658 t. during the third quarter of 1893, and against 9,579,326 t. in the second and 10,054,362 t. in the first quarter of 1894. The number of men employed was 150,948, against 145,578 in the third quarter of 1893, and against 150,119 for the second, and 153,349 for the first quarter of 1894. Total production for the first three-quarters of present year amounts to 30,047,077 t., or 1,750,739 t. more than during the same period last year; consumption was 29,957,398 t., or 1,693,289 t. higher than in 1893; average number of colliers employed was 157,472, or 6731 more than for the first three-quarters of 1893. Considering the heavy output in the present quarter, total production for 1894 is sure to not only reach but even exceed 40 million tons. In 1893 output was 38,613,146 t. only.

## LAUNCHES AND TRIAL TRIPS.

The turret deck steamer s.s. Progressist was launched from the yard of Messrs. William Doxford and Sons, of Sunderland, on the 27th ult., having been built to the order of Messrs. Angier Bros., of London. She will receive the highest class in both British Corporation and Bureau Veritas Registries.

On the 29th ult., Messrs. Ropner and Son launched a steel screw steamer of the following dimensions, viz.:—Length over all, 285ft. 6in.; breadth, 39ft. 6in.; depth moulded, 19ft. She will be classed 100 A1 at Lloyd's, and carry 3000 tons deadweight on 18ft. with Lloyd's freeboard; she has been built on the part awning decked rule, with break poop and raised quarter deck, cellular bottom for water ballast, and will have all the latest improvements for quick loading and discharging. Her triple expansion engines are by Messrs. Blair and Co., of 750 indicated horse-power, with two large steel boilers working at 160 lb. She has been built for Danish owners, and the name of Harald was given to her by Miss Nielsen of West Hartlepool.

On Saturday, the 27th ult., the s.s. Claverley left the Cleveland dockyard of Sir Raylton Dixon and Co., Middlesbrough, for the official trial trip. She is a fine spar-decked steel screw steamer, and has been built to the order of Messrs. Edmund Haslehurst and Co., of London, for their South African trade. The construction of the vessel has been carried out under the superintendence of Captain A. Bice, the consulting engineers being Messrs. Jacobs and Barringer, of London. The principal dimensions are:—Length, 322ft. 6in.; beam, 40ft. 6in.; depth moulded, 27ft. 11in., with a deadweight carrying capacity of 4650 tons. The main deck is of steel, the spar, poop, and topgallant forecastle decks of iron, and the bridge deck is of wood. She is rigged as a fore-and-aft schooner with steel masts, the pole topmasts being fitted with Sidgwick's patent hinge arrangement for quickly lowering when passing under low bridges, such as those on the Manchester Ship Canal, &c. The engines have been fitted by the North-Eastern Marine Engineering Company, of Sunderland, the diameter of cylinders being 23in., 36in., and 57in., by 42in. stroke, with two extra large steel boilers working at 160 lb. pressure per square inch. Notwithstanding the strong wind and high sea prevailing during the trip, everything worked in a most satisfactory manner, and the steamer afterwards went into West Hartlepool to complete her cargo.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—A general meeting was held on October 12th, when Mr. Kelsall read his presidential address on "Photography in Natural Colours." The author explained the processes of Ives and Lippman, and described, with diagrams, the photo chromoscope of the former, he also touched on three-colour printing. A discussion followed. A general meeting was held on October 19th, when Mr. Droop read a paper on "Forced Draught," giving detailed accounts of the development of the various systems, and treating of their applications both to marine and land boilers. A discussion followed.

ECONOMICAL ENGINES IN TIN MILLS.—At the Eagle Tin-Plate Works, Neath, on Saturday last, a new engine and four mills were added to the three already at work there. These were supplied by Messrs. Taylor, Struve, Eaton, and Price, of Neath and Briton-Ferry. The engine is a horizontal tandem compound, with cylinders 28in. and 50in. diameter, with a stroke of 4ft., driving two mills on each side of the cranked shaft; while running at forty revolutions per minute they will indicate nearly 600-horse power with the full load on. The valves of both cylinders are of the Cornish type: the high-pressure valves are controlled by a high-speed governor and a cut-off trip gear the firm has very successfully applied to their tin mill engines, as it ensures the steady running of the mill, however intermittent the work, and also a great saving in fuel over many other kinds of gears used in South Wales. The tin-plate trade of South Wales is now being so sorely pressed by America, and countries on the Continent, that the makers of the Principality are bound to adopt every means to save fuel, and it is only within the last few years that the use of high-class engines of this sort have been entertained.

BRITISH MACHINERY AND METALS IN JAPAN.—According to a recent Foreign-office report for railway locomotives, of which there has been an increased import, the Japanese private railway companies are beginning to have recourse to the United States, and in at least one recent instance a private railway company disposed of several of their English-built engines to the Government, supplying their place with newly-imported American engines at a cost greatly in excess of the proceeds realised by the sale of the old ones. The import of machinery increased last year by £225,290, or 150½ per cent. over that of the previous year. The imports of spinning machinery, £258,000, are nearly all English, and it is hoped that if the trade continues there will not be any falling off in the English share of it. The import of metal increased by £16,998, or 22·7 per cent., and was distributed over nearly all the several items included under the heading, except iron and nails, which substantially decreased. The continued construction of railways has caused a considerable demand for iron rails, which is likely to be maintained for some years to come. So far the attempts of the Japanese to compete with imported metal manufactures have not been marked with such success as will induce any general repetition of them. The requirements of the trade, viewed from the standpoint of the producers in Europe, seems full of promise. England's share in the trade of 1893 amounted to £598,000, or 65¼ per cent., her principal competitors having been Belgium and Germany. In other articles the figures were—Locomotives and railway carriages, £43,000, or 62⅓ per cent.; steam boilers, £19,000, or 90 per cent.; steamers, £91,000, or 76½ per cent.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

17th *October*, 1894.

19,751. Varnishing Machines, R. and A. W. Read, Reedle, and C. Masters, Liverpool.
19,752. Attaching Rims, J. and L. W. Shephead, Davenport.
19,753. Steaming Textile Fabrics, T. Illingworth, Bradford.
19,754. Boiler Furnaces, E. J. Booty, London.
19,755. Automatic Fire-lighting Device, J. Saxelby, London.
19,756. Oil Lamps and Stoves, H. V. Rippingille, London.
19,757. Detachable Gear Case, W. Mawby, Leicester.
19,758. Coin-freed Apparatus, S. D. S. Ross and J. C. Cox, London.
19,759. Cartridge Cases, G. F. Beutner, London.
19,760. Weighing Machinery, W. T. Langley-Smith, London.
19,761. Water Filtration, W. J. and C. J. Lomax, London.
19,762. Method of Railway Signalling, W. E. Hunter, London.
19,763. Culinary Utensils, W. Soutter, Birmingham.
19,764. Charging Accumulators, J. Hopkinson, London.
19,765. Portable Oven, W. Hill, London.
19,766. Couplings for Hose Pipes, &c., P. Schmahl, London.
19,767. Water-heating Apparatus, P. Jones, Liverpool.
19,768. Manufacturing Cyanogen Compounds, J. E. Riley, Manchester.
19,769. Manufacture of Sulphuric Acid, J. E. Riley, Manchester.
19,770. Manufacture of Ammonia, J. E. Riley, Manchester.
19,771. Furniture Castors, W. P. Thompson.—(*A. C. D. Seifert, Germany.*)
19,772. Hitching Devices, W. P. Thompson.—(*I. von Risch, Austria.*)
19,773. Ventilation of Sewers, &c., J. T. Biggs, London.
19,774. Dividing Bread, J. Gibson, London.
19,775. Packing Receptacle for Goods, F. Ulrich, London.
19,776. Breaking Rock and Stones, A. Brown, London.
19,777. A Screw-driver Brace-bit, H. Pecknold, London.
19,778. Cotter-pins, S. T. Norfolk, London.
19,779. Cased Windows, G. Wishart and A. Jeffrey, Glasgow.
19,780. Supply and Delivery of Fluids, W. Staples, London.
19,781. Automatic Extinguisher for Lamps, W. J. Heath and M. C. Greenhill, London.
19,782. Traction Dynamometers, J. Schiffer, London.
19,783. Permanent Way for Railways, T. F. Cashin, Hastings.
19,784. Screw-propellers, B. W. Maughan, London.
19,785. Combined Gas Burner, &c., H. Drueding, London.
19,786. Stuffing-boxes, D. B. Morison, London.
19,787. Flushing Apparatus, J. Breeden and Co. and F. Breeden, London.
19,788. Attachment of Paper Hangings, A. Markmann and J. H. Wetjen, London.
19,789. Chain-stitch Sewing Machines, F. R. Brauer, London.
19,790. Hydraulic Tires, O. Wartmann, London.
19,791. Picks and their Attachments to Shafts, T. Brown, London.
19,792. Bath Slippers, E. Edwards.—(*S. Kuttner, Germany.*)
19,793. Mercurial Vacuum Pumps, E. P. Clerc, London.
19,794. Propelling Mechanism for Velocipedes, T. C. Dennison, London.
19,795. So-called Forster Pipe-joint, C. Burnett, London.
19,796. Manufacturing Wheel Rims, C. M. Moore, London.
19,797. Zinc-coated Wire, The Cowper-Coles Galvanising Syndicate, Limited, and S. O. Cowper-Coles, London.
19,798. Hand Signal Lamps, A. V. Linley and W. H. Owensmith, London.
19,799. Edging Machines, E. and R. Cornely, London.
19,800. Bolting Mills, H. Ménager, London.
19,801. Brakes of Cycles, D. Marston, London.

18th *October*, 1894.

19,802. Foundations for Artificial Fringes, C. Richards and F. Horsnell, Westminster.
19,803. Collapsible Drinking Vessel, H. Lamplough, London.
19,804. Metallic Bedsteads, S. I. Whitfield, Birmingham.
19,805. Implement to Grip Stretched Wire, J. Messer, Germany.
19,806. Destination Indicators, W. T. Brown, London.
19,807. Electric Door Contact, H. Oppenheimer, London.
19,808. Hoof Pad, T. Cloke and W. J. Standbrook, London.
19,809. Fastener for Rubber Mats, S. Moss, London.
19,810. Railway Fog-signalling, J. G. Barras, Newcastle-on-Tyne.
19,811. Tiring, J. L. and W. C. Jones, Dublin.
19,812. Lighthouse Lights, J. R. Wigham, Dublin.
19,813. Attaching Sash Cords to Windows, S. Cooper, London.
19,814. Hydro-extractors, H. C. Longsdon, Keighley.
19,815. Manufacture of Fuel-blocks, H. Tempest, Keighley.
19,816. Attachment of Pneumatic Tires, W. H. Cresswell, Woodley.
19,817. Drum for Working Dredger Buckets, J. A. Saner, Liverpool.
19,818. Potato Cooker, C. Smart, Birmingham.
19,819. Box-irons, A. S. Jones, Birmingham.
19,820. Securing Pneumatic Tires, J. Clinch, Manchester.
19,821. Twin Crane, W. Purdy, Leeds.
19,822. Displaying of Goods, R. Sedgwick, Birmingham.
19,823. Bottle Metallic Mounts, T. Morton, Birmingham.
19,824. Pulverising Ores, P. B. Bradley, London.
19,825. Hair Curlers, A. H. Godfrey, Birmingham.
19,826. Action of Guns, H. Middleton, Birmingham.
19,827. Corkscrew, I. F. de L. Latoix.—(*Applicant's father, United States.*)
19,828. Chocolates, X. Marb and J. Bechtle, Glasgow.
19,829. Tubular Bricks, J. Tulloch, Glasgow.
19,830. Manufacture of Cardboard Boxes, J. M. Baines, Halifax.
19,831. Manufacture of Fustians, T. Holt and The New Victoria Spinning and Manufacturing Company, Manchester.
19,832. Hydro-extractor, T. Cudlipp, London.
19,833. Mixing Liquids, G. Field, Birmingham.
19,834. Coal Screen, W. E. Kochs, Chesterfield.
19,835. Machines for Corking Bottles, J. P. Jackson, Liverpool.
19,836. Counter Fountains, J. P. Jackson, Liverpool.
19,837. Bottling Carbonated Beer, J. P. Jackson, Liverpool.
19,838. Applying Colours to Tinned Plates, R. Read, A. Read, W. Eedle, and C. Masters, Liverpool.
19,839. Pneumatic Tires, J. McLaren and D. Shanks, Glasgow.
19,840. Comb Cylinders of Combing Machines, T. W. Harding, Leeds.
19,841. Fire-boxes, &c., of Boilers, W. Malam, Manchester.
19,842. Electric Storage Fuse Distribution-box, L. H. Cline, Wallsend-on-Tyne.
19,843. Valves for Regulating Flow of Liquids, C. H. C. Rudd, Walker-on-Tyne.
19,844. Discharging Products of Combustion, E. L. Burne, Guildford.
19,845. Gas Regulators, J. Paterson, London.
19,846. Steering Cycles, T. J. Biggs, Kildare.
19,847. Composition for use on Streets, N. Davies. —(*G. F. and S. P. Davies Australia*)
19,848. Retaining the Hair in Curl, M. Wedlake, London.
19,849. Pocket Metallic Match-boxes, R. P. Brown, London.
19,850. Toy Doll, A. M. Douglas, Birmingham.
19,851. Construction of Finger-plates, P. C. Bunn, London.
19,852. Cycles, R. Thompson, W. J. Freeman, and E. Freeman, London.
19,853. Pedalling Mechanism, W. J. and E. Freeman, London.
19,854. Seats, S. M. Birnie, Boscombe.
19,855. Adjustable Pulley, D. Speirs and J. Schmidlin, Manchester.
19,856. Wood-moulding Machinery, E. Youell, London.
19,857. Portable Structures for Polling Stations, C. R. Lapthorne, London.
19,858. Paint for Mirrors, A. J. Boult.—(*G. Philippe, Belgium*)
19,859. Boots, E. M. Scott, Liverpool.
19,860. Driving Gear for Velocipedes, J. S. Miller, London.
19,861. Brace Buckles, &c., F. and S. Taylor, Manchester.
19,862. Machines for Buffing Boots, W. R. Mudd, London.
19,863. Oars, H. Ferns, Liverpool.
19,864. Gas-glowlight Cylinder, M. Epstein, London.
19,865. Treatment of Frozen Carcases, J. Atherton, Liverpool.
19,866. Regulating the Pressure in Pumps, V. Montalto, London.
19,867. Curtain Rods, S. A. Stevens, London.
19,868. Electro-deposition Process, W. A. Thoms and W. H. Burgum, London.
19,869. Camphor Substitutes, J. E. T. Woods and W. J. Birnie, London.
19,870. Cash Registering Appliances, C. S. Snell, Saltash.
19,871. Attaching Labels to Bottles, T. S. Bunney, London.
19,872. Lemon-squeezing Apparatus, J. E. Harris, London.
19,873. Provision and other Knives, L. G. Rogers, London.
19,874. Hay Rakes and the like, J. H. Dugdale, London.
19,875. Metallic Teasels, G. Scrive and A. Scrive, London.
19,876. Concentrating Alkalies, &c., J. Armstrong, London.
19,877. Electrically-heated Grills, F. W. Schindler, London.
19,878. Cycle Cane Frames, T. Baylis and E. Perks, jun., Birmingham.
19,879. Construction of Coiled Wire Fabric, G. Watson, Birmingham.
19,880. Advertising on Vehicles, H. S. Dark, London.
19,881. Water-level Gauges for Boilers, V. Petherick, London.
19,882. Apparatus for Working Butter, R. Waide, London.
19,883. A New or Improved Fire-escape, J. E. Seary, London.
19,884. Band Saws, T. W. Bloxam, London.
19,885. Colouring Matters, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
19,886. Delivering Paper Sheets, G. and A. E. Watson, and A. McLaren, London.
19,887. Automatic Weighing Apparatus, M. E. Reisert, London.
19,888. Capillary Manometers, O. Steinle, London.
19,889. Electric Arc Lamps, C. T. Praed and P. R. Allen, London.
19,890. Iron-frame Pianofortes, M. J. Christie, London.
19,891. Door Spring, J. N. Maskelyne, London.
19,892. Fire-resisting Material, J. V. Boyd-Wilson, London.
19,893. Sewing Machines, A. S. Strutt, London.
19,894. High-speed Gas Engines, H. G. Harris, London.
19,895. Golf Scorer, C. M. Page, London.
19,896. Adjustable Skirt Fastener, C. G. Wright, London.
19,897. Railway Signalling Devices, J. J. Boyd, London.
19,898. Gearing for Bicycles, D. Lamont, London.
19,899. Treatment of the Hair, R. Haddan.—(*J. de Bouffard, Spain.*)
19,900. Steelyards, C. H. Bartlett, London.
19,901. Corkscrews, W. F. Williams, London.
19,902. Registering the Level of Water in Boilers, C. Strutt, London.

19th *October*, 1894.

19,903. Holders for Gas Globes, H. Edwards, Bristol.
19,904. Umbrella Protectors, S. B. Weaver, Melton Mowbray.
19,905. A Tubular Puddle Buller, A. F. Wilson, Stirlingshire.
19,906. Construction of Incubators, J. A. Hooper, London.
19,907. Reversing Gear for Washing Machines, W. E. Baker, Aldershot.
19,908. Cotton Machinery, J. Lobley, Ramsbottom.
19,909. Armour-plating, T. J. Tresidder, London.
19,910. Wood-block Sawing Machine, T. B. Marchant, London.
19,911. Hat-pegs for Railway Carriages, J. S. Pearce, Southampton.
19,912. Ships' Berths, W. P. Hoskins, Birmingham.
19,913. Boilers, C. S. Galloway, Glasgow.
19,914. Skates, D. H. Shuttleworth-Brown, London.
19,915. Cotton Preparing Machinery, T. Brooks, Manchester.
19,916. Wheels for Road Vehicles, T. and T. Wood, Manchester.
19,917. Stretching Frames for Garments, C. Goddard, Lytham.
19,918. Automatically Basting Meat, W. E. Bryan, Lyndhurst.
19,919. Counters, W. Chadburn, Liverpool.
19,920. Device for Holding Bed clothes, W. O'Mara, Liverpool.
19,921. Post card, J. Baldwin, King's Norton, near Birmingham.
19,922. Bread Tin or Plate, G. G. Mander, Birmingham.
19,923. Self-acting Mules, J. Clegg, Manchester.
19,924. Bedsteads, J. W. Hoyland and W. H. Sturge, Birmingham.
19,925. Stoking Steam Boiler Furnaces, F. Paget, Glasgow.
19,926. Making Boots and Shoes, F. W. Francks, Leicester.
19,927. Fog Signalling for Railways, W. B. Williamson, Bradford.
19,928. Fasteners for Placquets, B. Williams, Birmingham.
19,929. Bobbins for Spinning, B. W. Stevens and R. Whitaker, Birmingham.
19,930. Hand Shearing, &c., Machinery, A. Muir, Glasgow.
19,931. Fastening the Heads of Mops, R. Allen, Manchester.
19,932. Manufacture of Carpets, W. C. Gray, Glasgow.
19,933. Flushing Cisterns, M. J. McNamara, Birmingham.
19,934. Producing a Porous Mass for Electric Accumulators, G. Hubner, London.
19,935. Instruments for Stretching Carpets, A. Lunn, Edinburgh.
19,936. Duplex Vaporiser, A. H. Damkoehler, London.
19,937. Fabric Machines, J. M. and W. Starley, Coventry.
19,938. Preventing Fingers being Jammed in Doorways, F. C. Cawdell, Barnsley.
19,939. Engine Piston Valves, N. Browne.—(*H. J. Head, India*)
19,940. Railway Danger Indicator, P. Bergna, Sunderland.
19,941. Manufacture of Singe Plates, W. Sumner, London.
19,942. Flower-show Board, F. W. Littlewood, Sheffield.
19,943. Bicycles, G. J. Bowcock, London.
19,944. Water-tight Pipe Joints, R. Malabar, Liverpool.
19,945. Cycle Gear, J. R. Park, Norwich.
19,946. Safety Button, H. S. Knight, Teignmouth.
19,947. Cycle Driving Gear, A. Campbell, Glasgow.
19,948. Mechanical Stokers, A. Thomson, Glasgow.
19,949. Curer for Smoky Chimneys, H. H. Bridgman, London.
19,950. Dough-moulding Machines, G. Lewis, London.
19,951. Lamp Wick Trimmers, H. V. Rippingille, London.
19,952. Valves for Steam Engines, C. W. Thomson, London.
19,953. Combination Air Pillow and Rug, G. N. Cheetham.
19,954. Bottle Stoppers, W. J. Kelly and E. T. Whitelow, Manchester.
19,955. Locking Cycle Steering Bars, F. Brookes, Birmingham.
19,956. Sink Traps, W. Calvert, London.
19,957. Carving Forks, A. Heald, London.
19,958. Knicker for Married Ladies, M. Beadelle, London.
19,959. Recording, &c., Mechanical Motions, W. Nicolajczuk, London.
19,960. Torpedo Guard for Warships, F. L. Rovedino, London.
19,961. New Drain-testing Machine, J. Armstrong, London.
19,962. Paper for Cutting-out Patterns, A. Ferry, London.
19,963. Tires and Fastenings for Same, T. Thornton, London.
19,964. Hanging Lamps, R. H. Best and F. Hewitt, London.
19,965. Fire-arms, G. Luger, London.
19,966. Supplying Electrical Energy, H. Birnbaum, London.
19,967. Attachment to Crochet Hooks, H. Gründler, London.
19,968. Saponaceous Compound, H. Whitbread, London.
19,969. Transmitters for Sewing Machines, J. White, London.
19,970. Colouring Matter Manufacture, C. D. Abel. —(*The Actien Gesellschaft für Anilin Fabrikation, Germany*)
19,971. Colouring Matter Manufacture, C. D. Abel. —(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
19,972. Colouring Matter Manufacture, C. D. Abel. —(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
19,973. Hat Pins, W. B. Allison and R. P. Smith, London.
19,974. Type-writers, E. A. Jeffreys and W. Edwards, London.
19,975. Knitting Machinery, S. Lowe, London.
19,976. Utilising Waste Water, E. Larsen.—(*The Berliner Actiengesellschaft for Eisengiesserei and Maschinenfabrikation vormals J. C. Freund and Co., Germany.*)
19,977. Drilling Machines, W. W. Hulse, London.
19,978. Machinery for Filling Bottles, E. S. Chavasse, Birmingham.
19,979. Umbrella and Walking Stick, T. Ashford, London.
19,980. Pneumatic Tires, P. Davies, London.
19,981. Valve Mechanism, Tangyes Ld., and W. Johnson, jun., London.
19,982. An Adjustable Toast Frame, J. T. Hunt, London.
19,983. Xylonite Tablet, J. W. Marshall and H. E. Webster, London.
19,984. W.C. Flush Cisterns, &c., W. Edwards, London.
19,985. Polishing Paste for Metals, M. A. Capp and M. L. Bailey, London.
19,986. Vessels for Fluid Foods, J. Jörgensen, London.
19,987. Making Alimentary Product, J. Escuyer, Liverpool.
19,988. Water-proof Garments, I. Frankenburg, Manchester.
19,989. Steam Boiler Furnaces, J. W. Stock, Manchester.
19,990. Railroad Tie Anchors, The Daniels Steel Railroad Tie Company, Liverpool.
19,991. Couplings for Railways, A. Roth, London.
19,992. Heating Air, E. A. Jeffreys and W. Edwards, London.
19,993. Frying Pans, E. Colley, London.
19,994. Stamping Rivet Holes, R. Knights and H. Rigby, London.
19,995. Tobacco Pipes, L. L. Samuel, London.
19,996. Rain-water Shoots for Houses, T. B. Gibbs, London.
19,997. Front Cone Reflectors for Cycle Lamps, H. Salisbury, London.

20th *October*, 1894.

19,998. Teapots, E. H. Durnford, Hawley.
19,999. Steel Heck Frame, G. A. Binns and J. C. Hill, Sheffield.
20,000. Ventilating Contents of Saucepans, H. M. Fletcher, Ramsgate.
20,001. Driving Gear of Cycles, J. J. Atkinson, Northamptonshire.
20,002. Guide-posts, J. E. Brown, Hampshire.
20,003. Food for Cattle, B. R. Phillipson, Dublin.
20,004. Catapult Bagatelle, P. Diamond, Sheffield.
20,005. Knotting Mechanism, J. Hornsby, J. Innocent and I. Trolley, Grantham.
20,006. Radial Arm Operator, N. J. McAuslan, Derby.
20,007. Horse-shoe, I. C. Stuart, Cardiff.
20,008. Roundabouts, A. G. Bingley and J. L. Lister, Manchester.
20,009. Spring Resisting Power, E. C. Ibbotson, Sheffield.
20,010. Tooth Brush, P. J. Vetter, London.
20,011. Indicating Speed of Engines, W. Chadburn, Liverpool.
20,012. Self-oiling Bearings, F. M. Newton and T. Hawkins, London.
20,013. Laundry and Pressing Irons, H. S. Myers, Leeds.
20,014. Ironing Stoves, T. Cudlipp, London.
20,015. Round Game, F. Gill, Kingstown.
20,016. Parlour Game, J. M. Gillies, Dundrum.
20,017. Regulating Arc Lamps, A. G. New and A. J. Mayne, London.
20,018. Spanners, J. Bradbury and W. B. Lake, London.
20,019. Turning Cycle Hubs, &c., A. E. Herbert, Coventry.
20,020. Construction of Bottles, H. Edye, Newcastle on-Tyne.
20,021. Coal and Bread Weigher, J. Moreland, Nottingham.
20,022. Sparkling Wines, J. Y. Johnson.—(*E. L. Doyen, France*)
20,023. Adhesive Composition, &c., J. Round, Birmingham.
20,024. Chaff-cutters, J. G. Richmond, Manchester.
20,025. New Child's Mail-cart, F. Aldous, Manchester.
20,026. Case Hardening Wire, M. A. Mosley, Wakefield.
20,027. Means of Connecting Pipes, R. Wigan, Manchester.
20,028. Door Stop and Spring, W. M. Ralph, London.
20,029. Save-all for Necks of Bottles, C. G. Dolmage, Dublin.
20,030. Contrivance against Slipping, U. Prussf, Berlin.
20,031. Self-acting Lid for Closets, F. Müller, Berlin.
20,032. Self-feeding Hot-water Cylinder, A. Mackenzie, Liverpool.
20,033. Wool Yarns, &c., J. L. and B. F. Byrom, Manchester.
20,034. Spliced Joints for Golf Clubs, L. H. Smith, Glasgow.
20,035. Attachable Shovel Plates, J. Dawson, Sheffield.
20,036. Dress and Mantle Fasteners, L. Bryan, Cardiff.
20,037. Lock for Bicycles, &c., W. Sturmey, Birmingham.
20,038. Road Carriages and Vehicles, H. Höhmann, London.
20,039. Cigar, H. J., A. S., and G. A. Spratt, London.
20,040. Showing Clothing Stuffs, W. Lünser, London.
20,041. Gears for Cycles, J. Foxcroft, A. Blanchard, and H. Wood, London.
20,042. Heating Curling Irons, &c., G. Skinner, London.
20,043. Arc Lamps, W. Geipel, London.
20,044. Consulting-room Couch, J. R. Whait, London.
20,045. Sieves, A. J. Boult.—(*F. Brandstaedter, Belgium.*)
20,046. Meter Indicators, W. P. Thompson.—(*P. Marix, France*)
20,047. Shields for Soles of Boots, E. and S. W. de Horsey, Liverpool.
20,048. Diving Apparatus, T. Thomson, Liverpool.
20,049. Ladles, &c., C. Hildebrand, London.
20,050. Crucibles, J. W. S. Holt and S. Hargreaves, Liverpool.
20,051. Paper Tubes, W. P. Thompson.—(*M. C. Stone, United States.*)
20,052. Tires for Wheels, F. Sulley and W. E. Dowson, London.
20,053. Billiard Cues, W. P. Wethered, Great Marlow.
20,054. Folding Opera Glass, E. Bloch, London.
20,055. Street Gully, W. Calvert, London.
20,056. Burners for Gas Stoves, C. Gerlach, Birmingham.
20,057. Attaching Saddles to Cycles, H. Mills, Birmingham.
20,058. Removing Subaqueous Deposits, J. Corbett, London.
20,059. Casting by Electric Current, P. Scheidt and J. W. Tideman, Berlin.
20,060. Potatoe Rasp, R. Flemming, Berlin.
20,061. Door Fastener for Retorts, J. Mitchell, London.
20,062. Skirt Suspenders, C. Wood, London.
20,063. Pneumatic Tires, O. Wartmann, London.
20,064. Velocipedes, R. S. Lovelace, London.
20,065. Driving Chains, C. Powell, London.
20,066. Carburetting Coal Gas, W. E. Price, London.
20,067. Carburetting Armour-plates, F. Stubbs, London.
20,068. Ball Castors, T. Mawson and J. B. Blamires, London.
20,069. Cutting Indexes to Books, E. A. Goddin, London.
20,070. Blind Roller, R. Bolton and E. F. Lackerstein, London.
20,071. Coating Metals with Tin, L. Bangert, London.
20,072. Unsiltable Harbours, W. S. Randall and J. C. Gilmour, Kent.
20,073. Crank for Driving Cycles, A. Prunier, London.
20,074. Driving Gear for Cycles, E. Eite and A. Todd, London.
20,075. Manufacture of Metallic Brackets, G. Whitehouse, London.
20,076. Seat for Chairs, B. Clarke and H. C. Willmott, London.
20,077. Oil Lamps, C. F. R. A. H. Bagot, London.
20,078. Liquid Hydrocarbons, C. F. R. A. H. Bagot, London.
20,079. Securing Pneumatic Tires, F. H. Sprang, London.
20,080. Appliances for Obtaining Light, P. Stiens, London.
20,081. Telegraphic Transmission, C. Langdon-Davies, London.
20,082. Shoes for Horses, The Mail Horse Shoe Syndicate, C. J. Jutson and F. A. Poupard, London.
20,083. Coin-freed Apparatus for Liquids, W. Sherar, London.
20,084. Cigarette Making Machines, C. A. Marchal, London.
20,085. Ships' Side Lights, T. Utley, London.
20,086. Manufacture of Cellulose, A. Levinstein, London.
20,087. Apparatus for Cooling Wort, F. N. Mackay, London.
20,088. Bottle Filling Machinery, A. P. Blaxter, London.
20,089. Cycle Tires, D. Doig, London.
20,090. Ornamenting Metal Surfaces, G. Williams and F. H. P. Berlyn, London.
20,091. Pulpers, E. C. Blackstone, J. Kelly, sen., and J. J. Kelly, jun., London.
20,092. Cycle Tires, S. Chandler, jun., J. Chandler, and J. J. Chandler, London.
20,093. Incandescent Gas Burners, G. F. Redfern.—(*La Compagnie Parisienne du Bec Deselles-Gillet, France.*)
20,094. Indicating Dates, G. Hayes, London.
20,095. Magic Lanterns, W. H. Tomkinson, London.

22nd *October*, 1894.

20,096. Lug or Clip for Cycles, J. E. Meredith, Birmingham.
20,097. Handle-bars for Cycles, W. E. Hart, sen., Wolverhampton.
20,098. Cycle Chain Protector, W. E. Hart, sen., Wolverhampton.
20,099. Apparatus for Polishing Boots, C. Sadler, Manchester.
20,100. Tramcar Seats, C. Challenger and W. Strong, Bristol.
20,101. Hat Peg, E. Savill, London.
20,102. Junctional Parts for Cornice Rods, C. Snowell, Birmingham.
20,103. Machines for Pressing Bricks, T. C. Fawcett, Halifax.
20,104. Attachment for Cork Drawers, W. Manson, Birmingham.
20,105. Instruments for Measuring, B. Davies, Liverpool.
20,106. Wire Mattresses, I. Chorlton and W. Oldham, Manchester.
20,107. Washing Printers' Blanket, J. Hawthorn and J. P. Liddell, Manchester.

20,108. Method of Advertising, J. J. Gillespie, Newcastle-on-Tyne.
20,109. Concentrators of Minerals, W. H. Penning, Sussex.
20,110. Controlling the Twist Bands of Spinning Mules, E. Smethurst, Manchester.
20,111. Fire-screen and Table Combination, F. W. Reckitt, Harrow.
20,112. Seat for Velocipedes, W. C. Heighton and J. Meek, Leicester.
20,113. Potters' Kilns, H. Cartlidge, Longport.
20,114. Brakes for Spindles, A. Hitchon and J. Lucas, Accrington.
20 115. Covers for Gear of Cycles, W. Bramham, Keighley.
20,116. Clasp Fastenments for Apparel, W. Evans, Birmingham.
20,117. Postage-stamp Machine, W. W. G. Webb, Lichfield.
20,118. Labelling Bottles, G. A. Thornhill and F. Pardy, Stapleford.
20,119. Measuring-scales, O Schubert, Berlin.
20 120. Fixing Brush Handles, W. Butterworth, Manchester.
20,121. Cotton Thread, J. Y. Johnson.—(*L. F. Gros, France*)
20,122. Printed Woven Fabrics, J. Y. Johnson.—(*L. F. Gros, France.*)
20,123. Gas Motor, T. R. Shillito—(*The Leipziger Dampfmaschinen und Motoren Fabrik, Germany.*)
20 124. Metallic Bedsteads, C. Greenwood, Manchester.
20,125. Buttonhole for Collars, &c., J. H. Palmer, London.
20,126. Fixing Blocks to Electrodes, M. M. Bair, London.
20,127. Porous Pot for Batteries, M. M. Bair, London.
20,128. Watchmakers' Lathes, &c, C. F. Lorch, London.
20,129. Indoor Game, A. W. Thorneycroft, Ayr.
20,130. Imparting Elementary Instruction, &c, J. W. P. West, London.
20,131 Stereoscope, F. J. Jeans, London.
20 132. Draught Detainer for Doors, H. M. Lucas, Surrey.
20,133. Manufacture of Inlaid Floor-cloth, R. M. Harvey, London.
20,134. "Naval War" Game, E. H. W. von Niessen, London.
20,135. Knotters for Sewing Machines, A. W. Cochran, London.
20,136. Door-stop and Holdfast, F. Hughes, London.
20,137. Churns, E. A. Goodchild, London.
20,138. Manufacture of Pottery, &c., E. A. Shaw, London.
20,139. Glove, E. Watts and W. Godden, London.
20,140. Instrument for Measuring Hands, T. Nestler, London.
20,141. Signalling on Railways, F. Nowell, London.
20,142. Belts for Curved Pulleys, N. Browne.—(*P. Schivner, Germany.*)
20,143. India-rubber Pipe Mender, J. J. Deans, London.
20,144. Detachable Sleeve Shirt, T. A. Moody, London.
20,145. Manufacture of India-rubber, L. Wolff, London.
20,146. Cushion Horseshoe, A. Trewin, Watford.
20,147. Pendulum Frame for Advertisements, A. L. Summers, Surrey.
20,148. Steam Boilers, J. McLaren and H. McLaren, London.
20,149. Letter Files, J. C. Fell.—(*B. Lawrence, United States.*)
20,150. Knitted Fabrics, T. Hill, G. Matthews, and E. Goddard, London.
20,151. Pads for Trusses, &c, J. A. Calantarients, London.
20,152. Incandescent Electric Lamps, V. Fabris, London.
20,153. Coin-actuated Machines, A. J. Boult.—(*W. S. Burnett, United States*)
20,154. Tires for Cycle Wheels, L. B. McCulloch, Liverpool.
20,155. Composition for Pavements, J. O. McQuone, London.
20,156. Fireproof Lining for Furnaces, &c., E. W. Crebbin, Liverpool.
20,157. Mixing and Kneading Machines, P. Küpper, London.
20,158. Making Soft Soap, M. Perls, Liverpool.
20,159. Typewriters, A. C. Moll, London.
20,160. Showcard, A. Grice, Liverpool.
20,161. Gun-mountings, A. J. Boult.—(*The Bethlehem Iron Company, United States.*)
20,162 Weighing Apparatus, A. W. Gattie and L. Greene, London.
20 163. Furnace Grates, M. Fitz-Michael Mulready, London.
20,164. Pipe, C. V. McBean, London.
20,165. Metal Sleepers for Railways, G. Trasenter, London.
20,166. Metal Sleepers for Railways, G. Trasenter, London.
20,167. Refrigerating Apparatus, F. N. Mackay, London.
20,168. Producing Chromates, W. L. Wise.—(*Deutsche Solvay-Werke Actien-Gesellschaft, Germany.*)
20,169. Producing Manganates and Stannates, W. L. Wise.—(*Deutsche Solvay-Werke Actien-Gesellschaft, Germany*)
20,170. Electric Welding Apparatus, H. Zerener, London.
20 171. Footballs, W. Howard, J. F. Sadler, and W. H. Dallimore, London.
20,172. Metal Joists, W. H. Aston, London.
20,173. Ploughs, W. H. and R. H. Sleep, London.
20,174. Device for Facilitating Writing, W. F. Fair, London.
20,175. Process and Apparatus for Distillation, O. Perrier, London.
20,176 Type, G. W. Weaver, London.
20,177. Propelling and Steering Boats, &c., T. B. Heathorn, London.
20,178. Treatment of Petroleum, R. Schewe and F. Messedat, London.
20,179. Gilling or Combing Machines, C. Cholerton, London.
20,180. Envelopes, Wrappers, &c., W. E. Fisher, London.

*23rd October*, 1894.

20,181. Carriers for Magic Lanterns, G. Davenport, London.
20,182. Chess Timing-pieces, T. Grosse, Sale.
20,183. Screws used in Rigging Boats, G. E. Hughes, Wolverhampton.
20,184. Telescopic Luggage Carrier, A. McCormack, Portarlington.
20,185. Silk Trainer for Moustache, W. H. Wooler and F. H. Phillips, Weston-super-Mare.
20,186. Doll's Dresses, J. H. Maden, Manchester.
20 187. Driving Pulleys, J. G. A. Kitchen, Manchester.
20,188. Automatic Petrolier, J. Collins, Leamington
20,189. Fumigating Apparatus, M. Rymer-Jones and L. Swaby, London.
20,190 Boring Machine, A. Gray and G. Tarbit, Stockton-on-Tees.
20,191. Wet Spinning Frames, H. M. Girdwood, Manchester.
20,192. Hydrocarbon Engines, J. Grove, Paisley.
20 193. Mirror Spectacles for Ladies' Hair-dressing, C. E. Roberts, Liverpool.
20,194. Football Toy, W. Chaffer, Halifax.
20,195. Signalling on Railways, W. Kershaw, Leeds.
20,196. Cycle Wheels, W. Birks, F. Walker, and H. Rylands, Nottingham.
20 197. Gas Furnace, J. Heaton and G. H. Holden, Manchester.
20,198. Celluloid Cycles, J. B. Short, J. B. Short, jun, and T. J. Tomlinson, Sunderland.
20,199. Packing of Valve Spindles, J. Green, Liverpool.
20,200. Watch Keys, W. T. Smith, Birmingham.
20,201. Commercial Reels, H. P. Trueman, Birmingham.
20,202. Gas Purifiers, J. Entwisle.—(*W. L. Wallis, United States.*)
20,203. Coin-actuated Machine, J. P. Beretta, Manchester.
20.204. Detectors, T. Shevels and R. Simmon, Durham.
20,205. A New Game and Board, C. H. Abbot, London.
20,206. Spring Expansion for Cuffs, J. W. Baron, London.
20,207. Extracting Moisture from Air, J. Johnson—(*J. Galey, United States*)
20,208. Ball Bearings, I. M. W. Burke, London.
20,209. Food Warmer, C. Anderson, London.
20,210. Carriages, S. Cooper, London.
20,211. Loom Picking Bands, J. H. Morley, London.
20,212. Unicycle, F. H. Pickering, London.
20,213. Appliance for Washing Glasses, W. H. Greenwood, Southport.
20,214. Automatic Vent, R. H. Walker, Derbyshire.
20,215. Apparatus for Propelling Bodies, G. Wilson, London.
20,216. Horn Horseshoes, R. Aspinall, London.
20,217. Aluminium Tips for Boots, G. Mahaffy, London.
20,218. Manufacture of Articles T. Birnbaum, London.
20,219. Syphon-filling Machines, J. R. Lofthouse, Barnsley.
20,220. Bottle-corking Machines, J. R. Lofthouse, Barnsley.
20 221. Watermarking Paper, Henderson, Craig, and Co, and E. Rutley, London.
20 222. Spring Tires for Cycles, &c., A. Wadham, London.
20 223. Electrically-worked Pumps, R. L. Howard, London.
20 224. Devices for Cleaning Knives, E. A. Pike, London.
20,225. Machine Potato Diggers, R. Rosbotham, Liverpool.
20,226. Pen and Pencil Protectors, A. Harrison, London.
20,227. Anchors, W. Coltart and E. Shore Liverpool.
20,228. Menstrual Pad, N. B. Paul and E. Grahame, London.
20 229. Photographic Film Spool, J. B. B. Wellington, High Barnet.
20,230. Portable Advertisement Frames, H. Fabian, London.
20,231. Vices, J. L. Carpenter and W. M. Harris, London.
20,232. Loom Motions, H. Ainsworth, London.
20,233. Boot-jacks, H. Löwe, London.
20,234. Manufacture of Bricks and Tiles, H. Wood, St. Alban's.
20,235. Apparatus for Quieting Horses, A. Nowak, London.
20,236. Tobacco-stripping Machines, H. H. Lake.—(*S. Reid, United States.*)
20,237. Paper Board Scoring Machines, C. W. Gay, London.
20,238. Printing Machines, H. H. Lake.—(*C. B. Cottrell and Sons Company, United States.*)
20,239. Tack-driving Implements, H. H. Lake.—(*W. T. Hoofnagle, United States.*)
20,240. Positive Shuttle Motions, E. H. Graham, London.
20,241. Alternating Current Motors, H. H. Lake.—(*E. A. Clark, United States.*)
20,242. Making Wheel-hub Blanks, W. W. Tucker, London.
20,243. Automatically-acting Pump, N. Paissiadis, London.
20,244. Boot and Shoe Studs, W. Maddock, London.
20,245. Portiere Rods, R. Hodges and C. Johnson, London.
20,246. Bellows, T. Wallen, London.
20,247. Metallic Alloy, D. W. Sugg, London.
20,248. Tiles for Floors and other Surfaces, F. Furness, London.
20,249. Pneumatic Wheels and Tires, F. King. London.
20.250. Manufacture of Paint, &c, J. Armstrong, London.
20,251. Ventilators, J. Armstrong, London.
20,252. Garden Pump, F. B. Hill and R. D. Brett, London.
20,253. Enriching Gas, P. C. Tennant and J. E. Hall, London.
20,254. Harness for Horses, J. A. Thompson, London.
20,255. Paper-pulp Beating Engines, J. D. Pickles, London.
20,256. Pile Fabrics, J. Reixach and F. Bamford, London.
20,257. Apparatus for Cutting Buttonholes, L. Neville, London.
20,258. Bottle-stopper Extractors, E. W. Robinson and N. M. Marshall, London.
20,259. Electrolytic Apparatus, C. Kellner, London.
20.260. Smoke-consuming Fireplaces, G. W. Kraft, London.
20.261. Plushes, E. Edwards.—(*P. Kottlors, Germany*)
20,262. Busts for Measuring Garments, W. A. and A. L. Arfvidson, London.
20,263. Digestive Compounds, J. Carnick, London.
20,264. Cleaning Bottoms of Ships, G. S. Scorer, London.
20,265. Portieres, N. Vinall, London.
20,266. Construction of Pump, P. E. Jammes, London.
20,267. Bits for Horses, T. Pierpoint, London.
20,268. Banners, C. Matthews, London.
20,269. Protectors for Hay Ricks, R. Rottenbury, London.
20,270. Machines for Cleaning Grain, A Schnetzer, London.
20,271. Rubber Blanks, J. Spyer, London.
20,272. Iron Sewer Wagon, C. W. Smallbone, London.
20,273. Sash Locks, E. A. Abrams, London.
20,274. Screw Bolt, A. Mosley, London
20,275. Screw Propellers of Steamers, W. Ledden, London.
29,276. Nail Brushes, W. E. Deere, London.
20,277. Stockings, J. Park, London.
20,278. Stoppering Bottles, A. M. Gibson, London.
20,279. Valve Water-closets, E. H. Morton and H. E Baden, London.
20,280. Cartridge-filling Machines, P. Kämmerer, London.
20.281. Producing Nitropentaerythrite, B. Thieme, London.
20 282. Attachment for Sewing Machines, W. F. McGennis, C. Henwood, and F. S. Hammett, London.
20.283. Lock-nut, P. R. J. Willis.—(*J. A. Wells, United States*)
20 384. Delivering Parcels, J. T. Andrews and R. Knights, London.
20,285. Manufacturing Seamless Tubes, S. Briggs, London.
20,286. Upholstery, A. Balestre, London.

*24th October*, 1894.

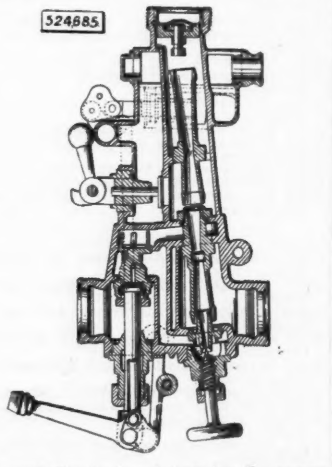
20,287. "Transfers," J. Slater and A. Doulton, Staffordshire.
20,288. Figure Bottle Holder, C. O. Brown, London.
20,289. Conversion of Rectilinear into Rotatory Motion, S. Butler, London.
20,290. Explosive Projectiles, H. V. Keeson, London.
20,291. Parlour Football Game, T. Thompson and W. E. Challis, London.
20,292. Stereotyping, R. H. Turner and J. Whiteley, Manchester.
20,293. Electric Lamp Shades, G. F. Sanders, Birmingham.
20,294. Machines for Excavating Soil, E. Latham, Liverpool.
20 295. Rabbit Coursing Machine, W. H. Best, Plymouth.
20,296. Winding Reels, C. C. Gossage and W. I. James, Birmingham.
20,297. Preventing Colliery Cages Falling, J. Stirland and W. Cottrill, Derby.
20,298. Racks for Tobacco Pipes, C. Laight, Crab's Cross.
20,299. Covers for Ships Hatchways, G. Brown, London.
20 300. Shield for Miners' Lamps, J. N. Guy, Newcastle-on-Tyne.
20 301. Attaching Stencil Sheets to Frames, T. C. Chandler and H. B. Saint, Newcastle-on-Tyne
20,302. Spoon Attachment for Knives, E. Proctor, Derby.
20,303 Photo-holding Calendar, R. G. Evans, Manchester.
20,304. Index-cutting Machine, A. Watkinson and F. W. Musgrave, Leeds.
20,305. Railway Fog Signals, T. Jenkins and S. Illidge, Birmingham.
20,306. Connections of Bands and Belts, P. A. Martin, Birmingham.
20,307. Ink-holding Pen, J. G. Smith and J. Couston, Edinburgh.
20,308. Printing of Cotton Fabrics, W. E. Kay and The Thornliebank Co., Manchester.
20,309. Filter, R. W. Hartley, Manchester.
20,310. Connecting Spindles to Levers, F. T. Jackson, Leicester.
20 311. Wheels of Vehicles, F. T. Jackson, J. and F. Hatton, Leicester.
20,312. Forming Adhesive Letters, H. S. Fearon, London.
20 313. Driving Belt, J. W. Knights and F. W. Bird, Cambridge.
20 314. Canister Shot for Small-arms, W. G. Hay, Liverpool.
20,315. Driving Whip, S. Williams, Oswestry.
20.316. Book-keepers' Hand-rest, C. Clarance, London.
20 317. Glow Lamps, J. R. Mally, London.
20,318. Cigarette, G. Lynn, Kingston-on-Thames.
20 319. Treating Meat and Foods, J. A. Wilson, Dundee.
20.320. Grates for Furnaces, R. H. Williamson and The Direct Automatic Stoker Syndicate, Ld., Manchester.
20,321. Leather Packings, T. Garner, Manchester.
20 322. Driving-gear for Cycles, H. Love and J. S. Braidwood, Glasgow.
20,323. Method of Trawl-net Fishing, W. Adam, Glasgow.
20,324. Wire-netting Machines, T. E. Bond, Birmingham.
20,325. Propulsion of Ships, W. Graham, jun., Manchester.
20,326. Buffer for Umbrella Ribs, G. T. Jones. Llwynypia.
20,327. Pumice Stones, Hubaleck and Co., Cologne.
20,328. Oscillating Fluid Motor, J. S. McAndrew, Glasgow.
20,329. Type-writing Machines, J. N. Williams, Glasgow.
20,330. Electro-magnetic Machines, I. Vago, Glasgow.
20,331. Smoke Consumer in Furnaces, W. Bracewell, Preston.
20,332. Ladders, J. H. Heathman, London.
20 333. Rollers for Sewing Machines, S. Wheeldon, Warwickshire.
20,334. Leaf-turners for Music, E. Richardson, Sheffield.
20,335. Railway Brakes, W. S. Laycock, Sheffield.
20,336. Bottle Openers, J. Hobson, Sheffield.
20,337. Cycle Tires, T. Staines, J. Leadbeater, and A. Preston, Leeds.
20,338. Curtains for Windows, W. J. Riley, Manchester.

## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

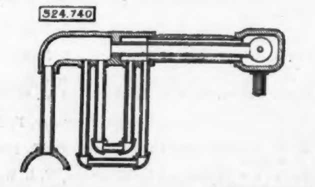
**524,685.** Injector, *W. R. Park, Taunton.—Filed September 25th*, 1891.

*Claim.*—In an injector the combination of a lifter composed of a steam nozzle and its tube, a forcer composed of an annular steam nozzle and its tube, a main valve controlling the flow of steam into the passages leading to the lifter and forcer, and a regulating valve between the main valve and the lifter and controlling the flow of steam through the passage leading to the lifter, substantially as described.


524,685

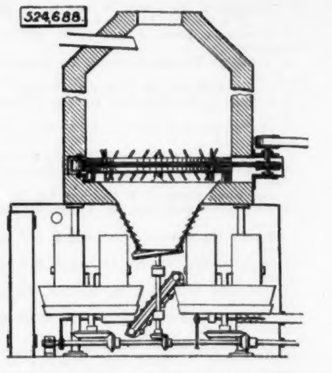
**524,740.** Steam Generator Section, *T. L Sturtevant and T. J. Sturtevant, Quincy, Mass.—Filed October 16th*, 1893.

*Claim.*—A steam generator section comprising an outer steam generating tube closed at its upper end, an inner return tube extended within said outer tube and open at both ends, and a series of steam generating tubes which extend laterally within the combustion chamber and connect the upper ends of the said outer and inner tubes, substantially as described.


524.740

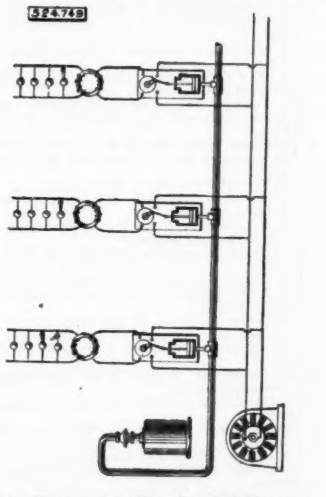
**524,688.** Means for Treating City Refuse, *E. L. Ransome, Oakland, Cal.—Filed January 2nd*, 1894.

*Claim.*—(1) The combination of a furnace, an air-locked chamber communicating therewith, means for forcing air into said chamber, and clinker-reducing devices located within the furnace and within the air-locked chamber. (2) The combination of a furnace, an air-locked chamber communicating therewith, means for forcing air into said chamber, clinker-reducing devices located within the furnace and within the air-locked chamber, and an air-locked outlet for the reduced material. (3) An apparatus for reducing clinker produced by burning, consisting of a furnace in which the material is burned, a breaker forming a grate for the furnace situated at the lower part upon which the clinker formed by said burning descends, devices upon which the breaker is supported and guided, adjustable breaking bars fixed in openings made through the breaker and projecting upward so as to form contact with the lower surface of the mass of clinker as it descends, and a driving chain and sprocket wheels through which power is transmitted to rotate the breaker.


524,688

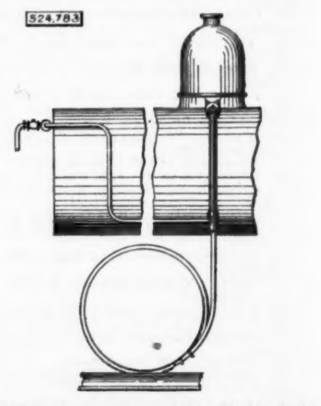
**524,749.** System of Electrical Distribution, *G. Westinghouse, jun., Pittsburg, Pa.—Filed June 16th*, 1890.

*Claim.*—The combination with a series of electric converters and a circuit for supplying the primary coils thereof, of circuit controlling devices applied to the respective primary coils for opening and closing the circuit connections thereof, and fluid pressure devices for operating said circuit controlling devices, substantially as described.


524,749

**524,783.** Railway-track Sander, *W. G. Middleton, Atlanta, Ga.—Filed April 20th*, 1894.

*Claim.*—(1) In a track sanding device, a casing having a cylindrical chamber therein, a sand-pipe leading from the sand-box to the top of said chamber, a discharge pipe running to a position near the track and led into said chamber so as to lie axially thereof therein, and provided on the end within said chamber with a sidewise extending nipple, and an air-induction pipe leading from an air reservoir into the side of said chamber, opposite the opening of said nipple therein; the end of said air-pipe being offset from the said nipple in such a manner that part of the air will be directed into the same and part caused to circulate in vertical currents within said chamber, substantially as and for the purposes set forth.


524,783

Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided for our breakfast and supper a delicately flavoured beverage which may save us many heavy doctors bills."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled, "James Epps and Co, Homœopathic Chemists, London.'

## MINERAL, METALLURGICAL, AND COAL INDUSTRIES OF SWEDEN IN 1893.

We have received a copy of the official report of the mineral, metallurgical, and coal industries of Sweden in 1893, from which we gain the following particulars. The total production of magnetic iron last year in Sweden amounted to 1,481,487 tons raised from 341 mines, whereas in 1892, when only 353 mines were being worked, the entire output was only 1,291,933 tons. The increase last year is therefore no less than 189,554 tons, or 14·7 per cent., *i.e.*, about one-seventh of the total output in 1892. As regards the yield of ore in ratio to the output of iron-bearing rock, we learn that the total quarrying of the latter amounted to 2,718,354 tons, making an average return of 54·5 per cent. for the eleven iron-producing provinces of the country. In 1892 the rock quarried amounted to 3,312,692 tons, the yield of ore to 1,291,933 tons, and the average return to 55·9 per cent. The ratio of yield varied from 100 (?) per cent. in the furnace of Linköping down to 58·7 in Kopparberg, 55·0 in Norrbotten, and 48·4—the lowest—in Orebro län. Of the total production last year 1,194,298 tons, or 80·6 per cent., were magnetic iron ore and 287,187 tons, or 19·4 per cent., hematite. The latter kind of ore is rare and occurs only in four provinces. The great increase in the output of iron ore in Sweden last year is principally due to the enormous advance in the production from the famous Gellivara iron deposits in the province of Norrbotten, where it rose to 306,594 tons in 1893, as against 178,181 tons in 1892, and only 200 tons in 1891. The output too is steadily increasing, being estimated this year at quite 400,000 tons. The ore is mostly shipped to Westphalia and Silesia, but a considerable quantity goes also now to Great Britain. In the south of central Sweden, too, where are situated the celebrated Grängesberg mines, the output rose from 110,237 tons in 1892 to 182,657 tons in 1893, nearly the entire quantity going to Germany. Only a few years ago these mines were idle through the lowness of prices of ore prevailing abroad. The Gellivara and the Grängesberg iron ores average from about 50 per cent. to 53 per cent. of pure metal. The following table shows the output of iron ore in Sweden since 1861, with increase and decrease, showing that the output last year was the heaviest on record.

| Annually. | No. of mines. | Output. Tons. | Increase or decrease. Per cent. |
|---|---|---|---|
| 1861—1865 | 500 | 453,486 | — |
| 1866—1870 | 422 | 542,323 | + 19·6 |
| 1871—1875 | 576 | 784,707 | + 44·7 |
| 1876—1880 | 382 | 721,232 | − 8·1 |
| 1881—1885 | 496 | 874,423 | + 21·2 |
| 1886—1890 | 530 | 930,037 | + 6·4 |
| 1889 | 393 | 983,609 | — |
| 1890 | 390 | 940,429 | − 4·4 |
| 1891 | 346 | 985,255 | + 4·8 |
| 1892 | 353 | 1,291 933 | + 31·1 |
| 1893 | 341 | 1,481,487 | + 14·7 |

The main output is furnished by five provinces as follows:—Kopparberg, 28 per cent.; Norrbotten, 20·7 per cent.; Orebro, 20·3 per cent.; Vestmanland, 15·8 per cent.; and 10·9 per cent. by Vermland and Upsala län, so that only 4·3 per cent. are returned by the remaining five iron-bearing provinces. During the year there were in operation nine iron ore separators, by which 13,575 tons were treated. There were employed in the iron mines 7510 persons, making an average return per head of 197 tons. And although the number of persons employed has fluctuated considerably during the period under review, the output per head has steadily increased, as the following table will show:—

| Annually. | Number of Mines. | Tons per head. |
|---|---|---|
| 1861—1865 | 5001 | 90 7 |
| 1866—1870 | 4581 | 118·4 |
| 1871—1875 | 6439 | 121 9 |
| 1876—1880 | 4883 | 147·7 |
| 1881—1885 | 6210 | 140 8 |
| 1886—1890 | 6257 | 148 7 |
| 1889 | 6238 | 157·7 |
| 1890 | 6335 | 148·4 |
| 1891 | 6223 | 158·3 |
| 1892 | 7564 | 170·8 |
| 1893 | 7510 | 197·3 |

In addition to magnetic ore there were raised 2275 tons of ore from lakes and bogs in Sweden, as against 1650 tons in 1892. The returns of such ores have varied considerably of late years, and they are steadily declining. These ores are particularly suitable for the production of soft malleable iron. The total ore production in Sweden has been as follows:—

| | Tons. |
|---|---|
| 1861—1865 | 464,363 |
| 1866—1870 | 553,759 |
| 1871—1875 | 795,263 |
| 1876—1880 | 726,712 |
| 1881—1885 | 877,408 |
| 1886—1890 | 932,470 |
| 1889 | 985,904 |
| 1890 | 941,241 |
| 1891 | 987,405 |
| 1892 | 1,293,583 |
| 1893 | 1,483,762 |

Turning to the pig iron industry in Sweden in 1893, we find that 152 furnaces were in blast at 134 works, returning 453,421 tons in 37,276 shifts of twenty-four hours, of which 6059 tons were produced "direct." There were also forty-seven furnaces not in blast. In 1892 the production amounted to 485,664 tons in 37,405 shifts, so that there is an increase of 32,243 tons, or nearly 7 per cent. The production in the period 1861-93 has been as follows:—

| Annually. | Pig iron. Tons. | Direct. Tons. | Totals. Tons. | Increase or decrease. Per cent. |
|---|---|---|---|---|
| 1861—1865 | 199,375 | 5451 | 204,826 | — |
| 1866—1870 | 261,810 | 6044 | 267,854 | + 30·8 |
| 1871—1875 | 326,510 | 5946 | 332,456 | + 24·1 |
| 1876—1880 | 350,414 | 6810 | 357,224 | + 7·5 |
| 1881—1885 | 423,176 | 6201 | 429,377 | + 20·2 |
| 1886—1890 | 441,876 | 4702 | 446,578 | + 4·0 |
| 1889 | 416,043 | 4622 | 420,665 | — |
| 1890 | 451,443 | 4660 | 456,103 | + 8·4 |
| 1891 | 486,680 | 4233 | 490,913 | + 7·6 |
| 1892 | 478,696 | 6968 | 485,664 | − 1·1 |
| 1893 | 447,362 | 6059 | 453,421 | − 6·6 |

The principal decrease in output falls upon the following provinces:—Kopparberg, 13,800 tons; Vermland, 6644 tons; Orebro, 3775 tons; Vesternorrland, 3359 tons; Gefleborg, 2106 tons; Ostergötland, 1638 tons, &c. The falling off varies from 3 to 71 per cent. It is worthy of note that two provinces, Orebro and Kopparberg, have from time immemorial returned more than half of the total pig production of the country. Pig iron is manufactured in thirteen provinces. The average output per furnace for the year was 2983 tons, and the average time of blasting 245 shifts of 24 hours, and the average diurnal return 12·18 tons. The following table shows the average annual output, the average time of blasting, and the average diurnal production during the last five years:—

| Year. | Annual average output. Tons. | Per furnace. Average Shifts. | Average diurnal Tons. |
|---|---|---|---|
| 1889 | 2804 | 239 | 11·73 |
| 1890 | 2962 | 246 | 12 04 |
| 1891 | 3167 | 259 | 12·23 |
| 1892 | 3174 | 257 | 12·35 |
| 1893 | 2983 | 245 | 12·18 |

The largest average annual output is shown by the province of Ostergötland, viz., 3778 tons at four furnaces in blast all the year, and the lowest by Jönkoping, viz., 294 tons. In some counties the average diurnal output was as much as 1430 tons.

The pig iron production of the year was made up as follows:—

| | Tons. | Per cent. |
|---|---|---|
| Forge and puddle iron | 285,718 | 63·86 |
| Bessemer and Martin iron | 145,479 | 32·52 |
| Spiegel iron | 1,294 | 0·29 |
| Pig iron for reduction | 6,922 | 1·55 |
| Pig iron for other purposes | 7,949 | 1·78 |
| Totals | 447,362 | 100·00 |

The first-mentioned kinds of iron are produced in thirteen provinces, varying from 215 tons up to 86,418 tons; Bessemer and Martin in several, but two return 57 per cent. between them.

Malleable iron and steel was produced at 153 works, as against 158 in 1892, situated in nineteen provinces, Orebro and Kopparberg possessing repectively 25 and 21. There were in operation 349 Lancashire hearths, 43 Franche-Comté hearths, and 25 Walloon hearths; whilst in the production of Bessemer metal were employed 30 furnaces, and in the production of Martin metal also 30, with six crucible furnaces. The total returns of raw materials are as follows:—

| | Tons. | Per cent. |
|---|---|---|
| Unwelded blooms and raw bars | 225,532 | 57·4 |
| Unwelded ingot metal | 166,845 | 42·4 |
| Blister steel, &c. | 664 | 0·2 |
| Totals | 393,041 | 100·0 |

Of the total production of blooms, &c., no less than 208,802 tons, or 92·6 per cent., were produced by the Lancashire method, and by the Franche-Comté process 14,942 tons, or 6·6 per cent., were turned out. The output of blooms and raw bars during the last quinquennial period has been as follows:—1889, 226,071 tons; 1890, 225,632 tons; 1891, 224,651 tons; 1892, 235,426 tons; 1893, 225,532 tons. There is therefore a decrease in 1893 of 9894 tons, or 4·2 per cent. The prices of this kind of iron have been low of late years, and the demand has been small. The production of Bessemer steel amounted to 84,398 tons, 50·6 per cent.; of Martin steel to 81,889 tons, 49·1 per cent.; and of crucible steel to 558 tons, 6·3 per cent. The manufacture during the last quinquennial period has been as follows:—

| Year. | Bessemer. Tons. | Martin. Tons. | Crucible. Tons. | Total Tons. |
|---|---|---|---|---|
| 1889 | 80,324 | 55,487 | 513 | 136,324 |
| 1890 | 94,247 | 72,985 | 646 | 167,878 |
| 1891 | 92,985 | 78,197 | 707 | 171,889 |
| 1892 | 82,422 | 76,556 | 617 | 159,595 |
| 1893 | 84,398 | 81,889 | 558 | 166,845 |

The total increase in the production of steel is therefore, in 1893, 7250 tons, or 4½ per cent.—viz., 1976 tons Bessemer, 5333 tons Martin, and 59 tons crucible steel. In these figures are included 23,467 tons of steel produced by the basic dephosphorisation method—viz., 8419 tons Bessemer and 15,010 tons Martin steel.

Coming next to the manufacture of finished iron and steel goods, we learn that the total production amounted to 288,317 tons, as against 293,036 tons in 1892—being a decrease of 4719 tons, or 1·6 per cent. The following table shows the detailed manufacture:—

| | Production. 1892. Tons. | 1893. Tons. | Increase or decrease. 1893. Tons. | Welded. Per cent. | Ingot |
|---|---|---|---|---|---|
| Blooms, billets, &c. | 11,222 | 8,726 | −2496 | 0·5 | 99·5 |
| Bar iron and steel | 145,173 | 146,042 | + 829 | 73·5 | 26·5 |
| Fashion iron and steel | 6,583 | 7,313 | + 730 | 0·7 | 99·3 |
| Hoops and nails | 72,056 | 70,828 | −1228 | 60·1 | 39·9 |
| Wire rods | 38,476 | 33,818 | −4658 | 62·4 | 37·6 |
| Heavy plates | 8,138 | 10,721 | +2583 | 1·2 | 98 8 |
| Rails | 6,627 | 5,677 | − 950 | — | 100·0 |
| Bottom boiler-plates | 1,579 | 1,004 | − 575 | 36·6 | 63·4 |
| Tires | 975 | 1,343 | + 368 | — | 100·0 |
| Axles | 1,223 | 1,640 | + 417 | 29·0 | 71·0 |
| Anchors and cables | 984 | 1,205 | + 221 | 18·7 | 81·3 |
| Total | 293,036 | 288,317 | −4719 | 59·8 | 40 2 |

In 1892 the manufacture of such goods from welded iron was 63·6 per cent., and from ingot metal 36·4 per cent.; so that there is an increase in the manufacture in 1893 by the former of 3·8 per cent. Bar iron and steel were produced in eighteen provinces, the largest returns being as follows:—Vestmanland, 32,888 tons: Gefleborg, 20,642 tons; Kopparberg, 19,718 tons; Ostergötland, 18,030 tons; Orebro, 17,046 tons; Vermland, 15,185 tons; and Upsala, 12,608 tons; the remaining eleven only producing 9925 tons together. Rails are only manufactured in Kopparberg län and tires only in Gefleborg. The production of actual bar iron of all denominations during the last quinquennial period was as follows:—1887, 274,734 tons; 1890, 281,833 tons; 1891, 280,430 tons; 1892, 273,510 tons; 1893, 266,727 tons. It appears that the quantity of bar iron produced by rolling is twice as great as that returned by forging. Of the total output 62,699 tons, or 67·8 per cent., were rolled from hard prepared iron; and 29,733 tons, or 32·1 per cent., from ingot metal; whilst again 39,495 tons, or 91·7 per cent., were rolled from blooms; and 3160 tons, or 7·3 per cent., from welded iron. Vestmanland län shows the greatest production of rolled bars, viz., 23,728 tons; and Orebro the greatest production by forging, viz., 9440 tons.

The production of other metal ores in Sweden in 1893 was as follows:—

| Ores. | No. of Mines. | Production. Tons. |
|---|---|---|
| Gold | 1 | 2,441 |
| Silver | 28 | 21,043 |
| Copper | 13 | 22,033 |
| Zinc | 1 | 101 |
| Manganese | 26 | 46,623 |
| Pyrites of sulphur | 12 | 7,061 |

The production of gold amounted to 93·3 kilos., as against 120 kilos. in 1892; the average annual production is 90 3 kilos. The production of other metals was as follows:—Silver, 4436 kilos. (1892, 5210 kilos.); lead, 462 tons, average 425 tons; copper, 544 tons, average 605 tons.

Finally, the coal industry of Sweden appears to be in a very flourishing condition, nearly 200,000 tons having been raised in 1893. The coals, which are lignite, are only found in the province of Scania, in the extreme south, seven fields being worked. The coals are of no use whatever in the iron industry, but they are largely used on the railways of South Sweden, special grates having been introduced for their burning. The detailed production was as follows:—

| | Tons. | Per cent. |
|---|---|---|
| No. 1 coal | 110,518 | 55·28 |
| No. 2 coal | 70,320 | 35·17 |
| No. 3 coal | 19,031 | 9·52 |
| Refuse | 64 | 0 03 |
| Totals | 199,933 | 100·00 |

The output in the period 1889-93 has been as follows:—1889, 186,719 tons; 1890, 187,512 tons; 1891, 198,033 tons; 1892, 199,380 tons; 1893, 199,933 tons. The number of colliers employed was 1217, as against 1260 in 1892. The motors engaged in these industries numbered 1881 of 61,169-horse power, of which about 50,000 were furnished by water, and 10,000 by steam. The total number of hands employed was 25,811, of whom 11,330 were employed in the mines, 14,481 at works; some 500 women were employed in the iron mines. There were in all forty-nine accidents, twenty-two being fatal.

## THE WATERLOO AND CITY RAILWAY.

One of the most important railway projects that have been carried out for many years within the area known as Greater London is that which is now being pushed forward in and below the bed of the river Thames on either side of Blackfriars Bridge—namely, the Waterloo and City Railway. Passengers by the South-Western Railway have now access to the northern side of the Thames in the City of London, but it is over part of the South-Eastern Railway, and, like some other modes of reaching the City which involve running powers on other lines, the convenience is not as great as it might be. Entrance to Cannon-street from Waterloo is only a makeshift for the better accommodation of the many who are occupied in the City who desire to make use of the South-Western Railway. The service is, for these and other reasons, not much employed as between the City and Waterloo, and the only other access for passengers by the South-Western Railway into the City or near it is *viâ* Wimbledon, Herne Hill, and Ludgate, and thus by a service where there is but one train an hour, and over lines actually or nominally the property of three different railway companies. This service of one train per hour is necessarily incapable of accommodating very large numbers, and the morning and evening trains are already excessively long and crowded, and have to be hauled by engines which are quite heavy enough for the much-repaired bridge over the Thames between Ludgate and Blackfriars. A frequent and rapid service of trains between Waterloo and the City is very much wanted, and has every probability of being well patronised, and in a few years will probably make a great difference in the relative numbers and in the distribution of City men who will reside respectively in the south-eastern and south-western districts.

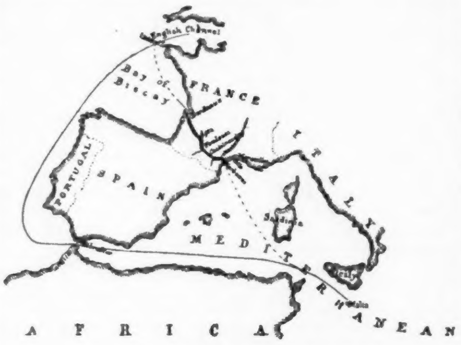
The new railway will be an electrical line, connecting Waterloo Station and the Mansion House. It will be entirely underground, mostly below the bed of the Thames, and the trains will be hauled by electric locomotives. It will be much larger, but much upon the same lines as the City and South London Electric Railway. The up and down lines will be in separate tunnels, connected at the stations and at some intermediate places, as, for instance, at the shafts by which descent is made to the tunnels from the staging now in the river near Blackfriars Bridge, and from which the spoil, nearly all clay, will be raised and deposited in barges for removal. The total length will be about two miles of double or four miles of single lines. The tunnels are 12ft. 1¾in. in diameter, and 12ft. 9in. on short curves where clearance is required.

The new railway is from the designs of Messrs. Galbraith and Greathead, MM. Inst. C.E., the engineers for the line. The contract for its construction has been let to Messrs. Mowlem and Co., who will carry it out under the engineers, and on Greathead's system of tunnel making, with his shields and method of tightly grouting the space between the cast iron tunnel lining and the hole excavated for its reception. Not only is the new railway to be worked by electricity when it is finished, but the contractors are carrying out the work largely by the aid of electricity, and in order that every precaution should be taken and the best means adopted for ensuring the rapid and successful operation of all the necessary plant, the whole of the arrangements have been separately devised. Messrs. Bramwell and Harris are acting as engineers for Messrs. Mowlem and Co. in this matter, and already a large part of the necessary plant for electric lighting and electric operation of the hydraulic pumps for operating the shields are in place, while the arrangements for the electric haulage of the spoil wagons are approaching completion; the locomotives for this work having been placed in the hands of Messrs. Siemens Bros. As many of our readers are aware, the tunnel works have been commenced some few months, a very large and strong staging has been erected a little west of Blackfriars Bridge and on the southern shore, being built on the mud flats usually occupied at low tide by stranded barges. This will be the chief centre of operations for some time, as it has been until now, the progress made already being almost marvellous. Already the two great cast iron lined shafts, each 16ft. diameter, are completed and sunk to the full depth of 78ft. from stage level, and rest in the massive brickwork of a large chamber below the Thames bed, which connects the two shafts, and is also a brickwork commencement of both tunnels in both directions. Two of the shields with their hydraulic presses are in place, and the cast iron shafts are lined with vertical timbers for guiding the tubs to the surface as soon as the excavation commences. Three fine steam cranes command the entrances to the shafts, which have to provide room for pipes to connect with air locks for providing the necessary air pressure for keeping out water when a wet gravelly part is reached. These cranes serve for taking the spoil from below and depositing it in barges alongside the staging, and also for lifting all the structural material, including the cast iron segments forming the tunnels, from barges, and lowering them down the shafts. For providing the compressed air which will be required for the air lock at the shield, a large plant of air compressing machinery will be fixed in the engine and machinery house on the stage. This is being made by Messrs. Markham and Co., of Chesterfield. Already two of Paterson and Cooper's dynamos with vertical engines are in place, each dynamo being capable of giving a current of 120 ampères at a pressure of 100 volts. As the work progresses, further dynamos and engines each of the same size as a unit, namely, 25-horse power, will be put down. For all the underground work, namely, for the hydraulic press motors, for the locomotives, and for the lighting, a pressure of 200 volts will be used—only 100 volts being used for the surface and office lighting on the stage. Three 100-horse locomotive boilers, by Messrs. Davey, Paxman, and Company, are at present ordered, one being already in place, to be supplied with Thames water after passing through a Torrent filter. The compressed air receivers will be placed in the river by the stage, and so cooled without expense. Everything is arranged with a view to carrying this important work through in the best way and at a high speed, and although the mechanical engineer has made all the changes in the modern methods of carrying out works of the kind, this is probably the first in which a firm of consulting engineers has been employed to design the whole of the mechanical arrangements from the first, so that the work shall start as a correlated system of operations and be carried through with mechanical precision and celerity as a piece of work effected by a special combination of machinery and apparatus. Messrs. Mowlem and Co. are to be congratulated on the rapidity with which they have completed a very important part of this undertaking, and also upon the methods of procedure which have been devised for them. These should undoubtedly lessen the cost of construction.

## THE FRENCH CANAL DES DEUX MERS.

The French Government has, after a great deal of pressure, at last consented to appoint a commission to examine the project for a ship canal from the Atlantic to the Mediterranean. This scheme has long had a fascination with many Frenchmen, especially with those in the south-west part of France, and the project has been brought forward again and again, only to be shown as thoroughly impracticable by those whose duty it has been to investigate the matter. The principal advantages held out by the advocates of the scheme are:—(1) The saving of the passage round Spain by all vessels passing to or from the Mediterranean and the northern part of the Atlantic; (2) the possibility of uniting the French naval squadron without passing under the guns of Gibraltar; (3) the commercial benefit to the neighbouring districts. The fact that the French fleet in case of a war would be able to proceed to the Mediterranean by this artificial waterway, and so escape the English guns at Gibraltar, would, in the eyes of many Frenchmen, deal a blow to our position as mistress of the sea, and lends a national enthusiasm on behalf of this scheme that serves to give it a vitality which could not otherwise exist. Some air of feasibility is given to the project by the existing Languedoc Canal, or Canal du Midi, by which barges drawing about 4½ft. can make their way from the Bay of Biscay to the Gulf of Lyons. Along this canal wine and other produce is at the present time conveyed, but the quantity thus transported is too small to hold out any hopes of any adequate proportion of income from local sources. An interesting account of this canal was given by Lord Clarence Paget, who passed through it in a steam launch drawing 4ft. 8in., in 1881. Its construction, considering the time when the works were carried out, constitutes one of the most remarkable engineering feats that have ever been accomplished. The scheme for constructing this canal was originated by Pierre Paul Riquet, who at the time he took up the project was a tax gatherer in the employ of the Government, and the possessor of a small property in the neighbourhood. Though by occupation only an exciseman, he taught himself sufficient mathematics, levelling, and surveying to enable him to lay out the line of the proposed canal, and of practical engineering to enable him afterwards to carry out the work. Having traversed the line of the canal several times on foot, examined all the sources of water supply, and had models made of the proposed locks and other works, in the year 1662, about a hundred years before Brindley began the Bridgewater Canal, he laid his plans before Colbert, the Controller-General of France, who was then actively engaged in endeavouring to open up new sources of wealth for his country. By order of King Louis XIV. a Commission was appointed to inquire into the scheme. After two months' investigation the Commissioners reported it as practicable, and a Concession was given to Riquet to carry out the works. For the purpose of raising the money Riquet was granted the sole farming of the taxes in the provinces through which the canal would pass. This source of money, however, proved utterly inadequate, and the scheme was hampered throughout the whole period of its construction by want of funds. However, Riquet, with indomitable perseverance, overcame this and the other difficulties with which he had to contend, and the canal, which was commenced in 1666, was, after fifteen years' labour, opened in 1681, six months after Riquet's death and after the loss of all his property. The total cost was £1,320,000. The length from the Garonne at Toulouse to Cette, on the shores of the Mediterranean, is 158 miles, including the passage through Lake Thau. The summit level is 600ft. above the sea, and this is overcome by 99 locks, 26 of which are on the side connecting the summit with the Garonne. These locks are 88½ft. long, 19ft. wide, with a depth of 5¼ft. on the sills. The canal is carried over rivers and under hills, by means of numerous aqueducts, bridges, and tunnels. A spur of the Montagnes Noir is passed through by a tunnel; and the aqueduct at Agen to carry the canal across the valley is 100ft. high. In some places the waterway is very tortuous, the line having to be carried in a roundabout way to avoid the land of owners who would not give their consent to its passing through their property.

The question of superseding this canal by one of sufficient size to take vessels of the largest class was first raised in 1880 by an association under the presidency of Senator Duclerc. By this scheme the ship canal was to start from the deep water basin at Bordeaux instead of from the end of the navigable part of the Garonne at Toulouse, and enter the Mediterranean near Narbonne, a distance of 254 miles, or about 100 miles longer than the existing canal, with a depth of 28ft. and a bottom width of 72ft. The summit level was to be 525ft. above the sea, to overcome which sixty-one locks were to be constructed. The estimated cost was £22,000,000. A commission of engineers which was appointed to examine this scheme reported that the cost was greatly under estimated, and that a sum of £60,000,000 would be required to carry out the work, including the necessary defence works at each end. The Board of Admiralty, which was also consulted in 1882, declared that the difficulties of navigation in the canal would be so great, and the risks of accident so numerous, that ships of the navy would never use it in times of peace; and that it was very problematical if it would be of any service during a war. The financial prospects of the scheme were also condemned by a separate Commission which examined this part of the subject.



Line of the French Canal des deux Mers

This project, thus condemned on all sides, was abandoned. In 1884, however, the idea was again brought forward by the Society for the Study of French Public Works, who applied to the Government for a concession for ninety-nine years of the right to levy tolls. The dimensions were reduced to 64½ft. width, with a depth of 25ft. The cost was put at £22,400,000, with £6,400,000 additional for the approaches. This scheme was also referred to a Commission, who reported that the cost, including interest during the ten years of construction, would not be less than £60,000,000, and that if the canal were made the advantage would not be sufficient to divert the course by Gibraltar; and that the canal would seriously interfere with the drainage of the country through which it passed.

In spite of this the Society, backed by the deputies for the region through which the canal would pass, continued to urge their claim for a concession, until at last the Government referred the matter to two Commissions consisting of engineers and nautical men. A modified scheme was submitted in which the depth was increased to 28ft. over half the width in the centre, and the number of locks reduced to thirty-eight, the estimate being altered to £29,600,000 including the approaches. The Commissions reported in 1887, declaring the project to be impracticable. The cost they put at £58,000,000 and the annual working expenses at £880,000, making an annual charge, including interest, of £3,520,000. The amount of shipping which passes Gibraltar was taken at nine million tons, and allowing the whole of this to pass through the canal, the receipts on the proposed rate of tolls would only amount to about half the annual charges. The Commission considered that the canal if constructed would only be serviceable for coasting vessels, the total tonnage of which would not justify such an enormous outlay. Notwithstanding this further adverse report, the scheme has been kept alive. Every possible means of publicity by newspaper paragraphs and pamphlets have been used; the local Councils in the department of the South-West have passed resolutions in favour of the construction of the canal. A fresh company of the Canal des Deux Mers has been formed; the public have been induced to subscribe Founders' shares, under the condition that if a concession be obtained the subscribers shall share in the profits. So much pressure has been brought to bear on the Government that M. Barthou, the Minister of Public Works, in order to enlighten the public on the matter, and out of deference to the Councils-General who have passed resolutions in its favour, advised the President of the Republic to issue another Commission. As a justification for this, he says in his report, "The promoters continued to work upon the population and on the elective bodies, and represented the Canal des Deux Mers as in the first instance an undertaking essential to the national defence, and also as a source of wealth for the country. They also appealed to the small capitalists, by making large issues of Founders' shares, promising to the subscribers a share in the profits in the event of a concession being obtained." The Commission is to consist of six of the engineers of the Ponts et Chaussées, six naval officers, three inspectors general of finance, three members of the Academy of Political Science, six shipowners and merchants, and two inspectors of agricultural hydraulics. The points on which they are to report are:—(1) Under what conditions a maritime canal between the Atlantic and Mediterranean could be constructed and worked. (2) What would be its practical utility as regards the navy, commerce, industry, and agriculture. (3) Cost of constructing such a canal. (4) To decide whether the concessions asked for should be taken into consideration."

After the reports which have been issued by previous Commissions, it seems to be a mere waste of time and money to make further investigations. Although the engineering features present no insuperable difficulties, yet, on the face of it, the scheme must be considered as financially impracticable. The advantage claimed by the promoters to the district through which the canal passes is already provided by the existing canal, which is sufficient for the conveyance of the produce of the country. As to the commercial advantages to steamers passing from the Mediterranean to the Atlantic, the tonnage of these would never be sufficient to furnish an income on such an enormous expenditure as this canal is estimated to cost, being about four times as much as that of the Manchester Ship Canal. The inducements for a large steamer to run the risk and delay of navigating a canal 254 miles long, in which it would have to pass through thirty-eight locks, and be raised and lowered over 500ft., and to pay the tolls, is very small. A steamer passing Malta and using the canal in place of going through the Straits of Gibraltar, if on her way to or from England, whence the greater part of the traffic comes, would save about 1000 miles. This saving in distance, however, is compensated by the slower rate at which a steamer would navigate the canal. On the Suez Canal, to prevent damage to the banks, the speed is restricted to 6¼ miles an hour. On the proposed canal the speed would be even less than this. It is practically impossible to drive a vessel through a waterway, the sectional area of which has so small a proportion to the midship section of a large steamer, as is proposed for this canal, except at a very low rate of speed, and as the speed diminishes the difficulties of navigation increase owing to the vessel refusing to obey her helm. The delay in getting in and out of the locks, especially with a beam wind, in addition to the time required to raise and lower the vessel, would be very great; time will also be consumed in repeatedly laying by to allow other vessels to pass. It may therefore be taken that an average speed of no more than four knots along the canal is all that can be counted on; along the Gironde double this may be allowed, but here again delay will arise waiting for the tide, as the river can only be navigated at high water, and even to ensure this very extensive dredging operations will have to be carried out. Taking the distance traversed by a vessel passing Malta and going through the canal and river to the same point in the Bay of Biscay as 1450 miles, of which 300 miles would be by river and canal and 1150 by sea, the time occupied, at four knots for the former and fifteen for the latter, would be 152 hours as against 163 hours by the present route. Taking two vessels starting from Marseilles, the saving in time by the canal would amount to about 38 hours. As regards the use of the canal for naval purposes, the smaller class of gunboats might be taken through, but the impossibility of navigating a large ironclad with a beam as great as the proposed width of the bottom of the canal, and drawing within a foot or so of the proposed depth, is apparent.

Royal Institution of Great Britain.—At the last general monthly meeting the special thanks of the members were returned for the following donations to the fund for the promotion of experimental research at low temperatures:—W. Morris Beaufort, £10; Mrs. Blomfield Moore, £200; Professor Dewar, £100; Sir Frederick Abel, Bart., £50; Edward Frankland, £21; the Right Hon. Sir John Lubbock, Bart., £20; John T. Brunner, M.P., £50; the late Thomas Hawksley (per Professor Dewar), £100; Charles Hawksley, £50; the Baroness Burdett-Coutts, £100; Sir Andrew Noble, K.C.B., £100.

Engineering Society, King's College, London.—A general meeting was held on October 26th, Professor Capper in the chair. Mr. Hayton read a paper of a very exhaustive nature on "The Use of Liquid Fuel in Boilers." He first described the nature of the fuel used, and then described the various furnaces as arranged for land and marine boilers; he also referred to the use of liquid fuel on locomotives. A discussion followed. A debate was held on November 2nd, when the relative merits of cable and electrical tramways were very freely discussed by several members. Mr. Brown led the discussion in favour of the cable system, and Mr. Welbourn advocated the electrical systems.

# NEW VICTORIA BRIDGE, BRISBANE—DETAILS

MR. A. R. BRADY, ASSOC. M. INST. C.E., ENGINEER

(For description see page 387 ante)

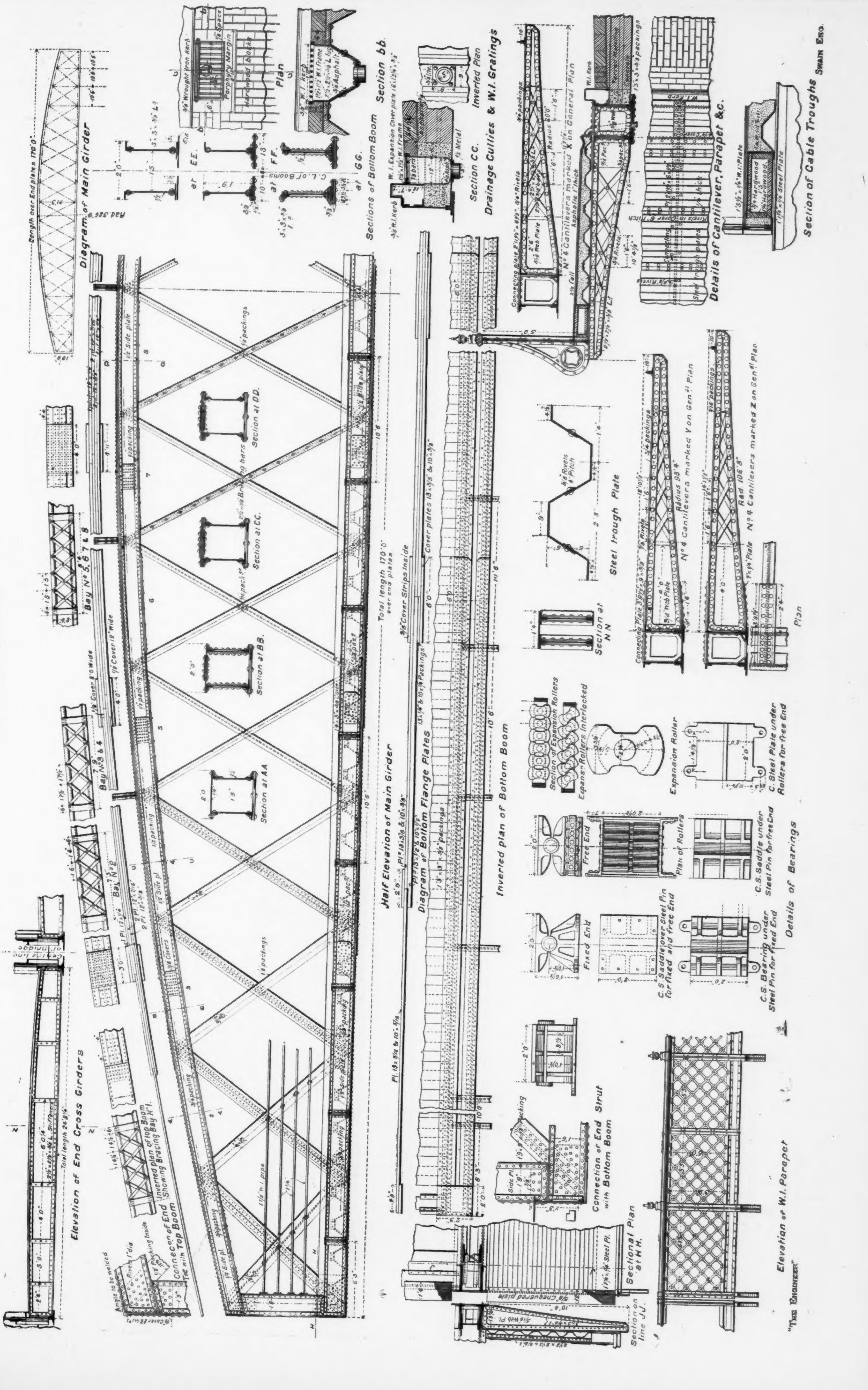


Diagram of Main Girder
Length over End plates 170'0"
Rad. 326'9"
Sections of Bottom Boom
at EE.
at FF.
at GG.
C. L. of Booms
Section bb.
Plan
Wrought Iron Kerb
Porphyry Margin
Hardwood Blocks
W. I. Kerb
W. I. Frame
Asphalt
Section CC.
Inverted Plan
Drainage Cullies & W. I. Gratings
No. 4 Cantilevers marked X on General Plan
Radius 80'0"
Details of Cantilever, Parapet &c.
Section of Cable Troughs
Elevation of End Cross Girders
Total length 28'3"
Connection of End Tie with Top Boom
Inverted plan of Top Boom Showing Bracing Bay No. 1.
Bay No. 2
Bay No. 3 & 4
Bay No. 5, 6, 7 & 8
Section at AA
Section at BB.
Section at CC.
Section at DD.
Bracing bars
Half Elevation of Main Girder
Total length 170'0" over end plates
Diagram of Bottom Flange Plates
Cover plates
Cover Strips inside
Inverted plan of Bottom Boom
Steel Trough Plate
Section at N N
No. 4 Cantilevers marked Y on Genl. Plan
Radius 93'4"
No. 4 Cantilevers marked Z on Genl. Plan
Rad. 106'8"
Plan
Section of Expansion Rollers
Expansion Rollers Interlocked
Expansion Roller
C. Steel Plate under Rollers for Free End
Fixed End
Free End
Plan of Rollers
C. S. Saddle over Steel Pin for Fixed and Free End
C. S. Bearing under Steel Pin for Fixed End
C. S. Saddle under Steel Pin for Free End
Details of Bearings
Connection of End Strut with Bottom Boom
Sectional Plan at HH.
Section on line JJ.
Chequered plate
Elevation of W. I. Parapet
W. I. pipe
packing
Side pl.
Swain Eng.

"The Engineer"

## THE UNION STEAMSHIP COMPANY'S MAIL STEAMSHIP NORMAN.

In our impression for Oct. 26th we illustrated the Norman, the latest addition to the fleet of the Union Steamship Company, whose vessels ply between Southampton and the Cape. On Thursday, and again on Saturday, a special train was run from Waterloo, conveying a large number of guests to see the ship. On Saturday she lay in Southampton water, and the visitors were conveyed on board by a tender. A little after noon the anchor was weighed, and the great ship proceeded under easy steam to a point nearly abreast of Cowes, when she turned and steamed back again, and took up her berth in the dock about three p.m., the visitors returning to town by the special. While the Norman was under steam an admirable luncheon was served, covers being laid for about 400. The usual patriotic and complimentary toasts were proposed and drunk with honours.

The Norman is believed to be an improvement on the Scot, than which ship the Norman is nearly 1500 tons larger, the extra displacement being obtained principally by augmenting the beam. She is 490ft. long between perpendiculars, 53ft. beam, and 37ft. 6in. deep. Her tonnage is 7392 tons. She has twin screws, and Sir Edward Harland's "drop," or hanging stern frame. The screw shafts are not carried outboard on brackets, but in-board in extensions of the tunnels worked in the hull, just as the shafts are carried in the Majestic, Teutonic, and several other vessels built by the Belfast firm. She was launched on the 19th of July.

It is not too much to say that nothing has been left undone to promote the comfort and well-being of passengers using the Norman. The state-rooms have been very carefully arranged, and the system of ventilation adopted is quite thorough and complete. The main saloon is a very beautiful apartment, and care has been taken not to overdo the ornament. The prevailing colour is that of light American or African oak—of which all the wainscotting is made—relieved with white and gold; the latter being very artistically used rather to define lines than for any other purpose. There is a great deal of wood carving in the shape of flat panel work, and this carving is uniformly excellent and artistic. The library, which also serves as a drawing-room, is fitted in much the same style, rosewood, however, being largely used for the furniture and writing desks. The smoking-room walls are surrounded by seats and couches upholstered in dark stamped Morocco leather. The walls above are hung with dark chocolate and gold embossed paper or lincrusta, and instead of the paintings which are now so often found in smoking-rooms, we find excellent engravings, most of them the best of their kind, hung on the walls. Every other part of the ship has been got up, as we have said, with the utmost regard for the comfort of the passengers. She berths 160 third-class passengers round their saloon on the main deck forward. The first and second-class are berthed amidships. The first-class saloon seats 150 passengers.

The ship is propelled by two sets of triple expansion engines, the cylinders of which are 31½in. + 52in. + 85in. × 57in. The boiler pressure is 175 lb., and there are thirty-six furnaces arranged in four stokeholds. The boilers are fired fore and aft, and there are two elliptical funnels. The speed is intended to be about seventeen knots. It has been found that on the Cape service high speeds are not asked for, and that they will not pay; but the Norman has a large reserve of power available to drive her against a head wind if needed.

We have never seen more admirable machinery. The finish of the engines is simply superlative. Their design is excellent, and the engine-room is so large that there is no cramping, and the ventilation is very good. At full speed the engines make a little over eighty revolutions per minute. On Saturday they ran at sixty, and they made no noise, nor was a drop of water to be seen on a bearing. The high-pressure rods are packed with "American" metallic packing, which seems to answer very well. The high and intermediate pressure cylinders have each one piston valve. The low-pressure cylinder has a slide valve, the weight of which is supported by a carrying piston and cylinder. The low-pressure pistons only have tail rods.

The steering gear consists of a very powerful segmental rack, the centre boss of which drops on to the rudder head. Under the rack is the tiller, which is connected with the rack by tremendous helical springs to take the jerk off the teeth. The rack gears with an endless screw, which is caused to revolve by a double vertical cylinder engine of considerable power, caused to revolve from the bridge in either direction in the usual way by a hunting screw. Hand steering gear is also provided for an emergency, the whole being shut up in a strong poop house.

Tested by any conceivable standard, the Norman is a splendid ship, and a valuable addition to the fleet of the company. In every possible way she is a credit to. her builders, Messrs. Harland and Woolf, of Belfast.

As an example of the progress of South Africa and the Union Steamship Company, it may be interesting to notice that in November, 1857, the original Norman sailed as the third ship despatched in the original mail service with Cape Town. The first Norman was a little vessel of 460 tons gross, and carried about twenty passengers and about 500 tons of cargo. She steamed at an average of seven knots, making her voyage to Cape Town in forty-two days. The new ship carries 420 passengers and 4000 tons of cargo, and will require about a fortnight to make the same voyage.

## MERSEY AND IRWELL JOINT COMMITTEE.

An important meeting of this authority was held on the 5th inst., when Sir H. Roscoe, M.P., reported on the streams in the district, and gave an approximate standard by which a comparison could be made between the existing effluent and its condition at any future time. In his statement to the committee they were informed that he had reviewed the results of 231 determinations. The oxygen consumed from permanganate of potash acting on the effluent water he considered was a most reliable method for estimating the presence and quality of the organic matter, especially as a large number of determinations might be made in a comparatively short space of time and comparisons drawn between the various effluents from sewage works. He had taken three standards, viz., one-tenth grain per gallon albumenoid ammonia; one-fourth grain oxygen per gallon three minutes' reaction; one grain oxygen per gallon four hours' reaction; twenty-three analyses were given of nineteen effluents of the sewage after treatment, and of four samples of water from the Manchester Ship Canal. Of the nineteen effluents eight came within the three standards; eleven complied with two of the standards; twelve complied with one of the standards and seven were outside all the standards. Of the four samples taken from the Ship Canal, none complied with all the three standards; one complied with two of the standards, and two complied with one of the standards.

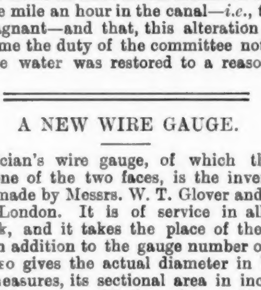
Within the area of the committee's jurisdiction it appears that there are seven county boroughs containing 1,148,700 inhabitants, and that from 43 per cent. of this population the sewage still flows untreated into the rivers. The treatment of the sewage of the remaining 57 per cent. was unsatisfactory, with the one exception of Rochdale, which has 71,400 inhabitants. Manchester was now treating the sewage from 269,800, or about one half the number of its inhabitants, by chemical precipitation alone. This was unsatisfactory. Bolton and Salford, with a combined population of over 300,000, were in a similar condition. Bury, Oldham, and Stockport, had as yet no sewage works in operation. Of the eleven non-county boroughs, with a population of nearly 300,000, Hyde having 30,000 inhabitants, was the only one in which sewage treatment was in work. The result in this case was satisfactory, With regard to the fifty-six urban sanitary authorities representing a population of 608,000, one half had no sewage works in operation; twenty-two had sewage works, generally speaking, affording satisfactory effluents. From the works of seven the effluents were unsatisfactory. The sewage from 43 per cent. of the population of six non-county boroughs flowed untreated into the rivers; 38 per cent. was satisfactorily treated, and 19 per cent. unsatisfactorily.

The Rural Sanitary Authorities have a better record. Eleven out of twelve sewage works afforded very satisfactory effluent. Notwithstanding this, it was considered that the proceedings of the committee were progressing favourably, and that those authorities whose works were unsatisfactory were being compelled by the committee to take measures to ensure satisfactory results. Extensions of time were granted to the authorities of Manchester, Farnworth, Glossop, and seven other towns. Orders were given for proceedings to be taken against Middleton for not complying with the demands of the Joint Committee, and the authorities of Knutsford and four other towns were warned of the unsatisfactory condition of the effluents in their respective districts. This shows how much time and patience is necessary to attain an end, however desirable it may be, when laxity of conduct has been tolerated for a long period.

The condition of the streams in the manufacturing districts has been a byword for a generation, and their state was disclosed by the Rivers Pollution Commissioners upwards of twenty years ago, but nothing was done to improve them. Now that the Ship Canal is made, the nuisance has become unbearable. Sir H. Roscoe states that whereas the rate of flow was previously ten miles an hour in the foulest of the rivers, it is reduced to one mile an hour in the canal—*i.e.*, the canal was practically stagnant—and that, this alteration being for the worse, it became the duty of the committee not to rest content until the water was restored to a reasonable state of purity.

## A NEW WIRE GAUGE.

The electrician's wire gauge, of which the engraving below gives one of the two faces, is the invention of Mr. Poole, and is made by Messrs. W. T. Glover and Co., of Manchester and London. It is of service in all branches of electrical work, and it takes the place of the old form of slot gauge. In addition to the gauge number of a wire, this instrument also gives the actual diameter in both English and French measures, its sectional area in inches and safe current, its resistance per 1000ft. and per mile, the number of yards of the wire to one ohm, and its weight per 1000ft.



It is thus very comprehensive, and will for all ordinary and practical purposes avoid those frequent references to electrical tables which are now unavoidable. The wire to be measured is passed through the opening in the outer ring into the space between the two circles, and moved along until it is stopped; the points of contact wire give the dimensions of the different scales. The instrument being flat is of a very convenient form for the pocket, is nickel-plated, and is issued in a neat leather case.

## SOME PECULIARITIES OF OXIDISED LINSEED OIL.

Last Monday night, at a meeting of the London section of the Society of Chemical Industry, Mr. B. E. R. Newlands in the chair, Mr. F. W. Reid set forth some treacherous characteristics of oxidised linseed oil when employed in various arts and industries.

The speaker said that nearly all the linseed oil utilised in this country is employed in the oxidised form; much of it is then used in the manufacture of linoleum and for mixing with india-rubber. There are two large and several small methods of oxidising it; the one large one is the application of heat, up sometimes to a maximum of 500 deg. Fah., and occasionally expediting the action by blowing air through it; the product is a dark-coloured viscid mass; by the other larger method the oil is boiled with litharge, then allowed to flow over a thin fabric, after which it is suspended in a shed at a temperature of 80 deg. Fah. to 100 deg. Fah.; the fabric is coated and dried thus several times in succession. These lengths of dried oil are passed between rollers; the substance then forms an amber-coloured mass of low tensile strength and considerable elasticity; it is heavier than water. When the doors of the drying sheds are first opened in the morning no mortal can enter them, the air being so full of acroleine; if any use can be made of this waste product, here is a plentiful supply. In the linoleum industry the dried oil is then ground and heated with cowrie gum and other resin until it forms what in the trade is known as "cement."

He had tried experiments with oxidised oil extending over many years, and had observed that the boiled oil goes on oxidising after it has been applied to its various uses. In two years it becomes sticky, in three years it begins to run, in five years it is partly liquefied, is easily soluble in alcohol and partly soluble in water, and finally it becomes a semi-fluid substance containing vegetable acids. These changes are more rapid when paints in which it is used as a vehicle are exposed to the weather, hence such coats of paint have to be renewed at short intervals. For the same reason it affects the permanency of oil paintings, and when it becomes acid attacks the basic pigments; moreover, the floating dirt in the air settles upon the sticky surface and is held there. The brown stains in old books on the pages opposite heavy engravings are due to this sticky product of decomposition, as he had found by analysis. The deteriorated oil causes old note books bound with American cloth and laid aside for a time, to stick together. When india-rubber is weighted with oxidised linseed oil it becomes useless in a very short time; this fault is sometimes found in the flexible tubing used in laboratories. It seems to be a peculiarity of nearly all flexible substances having somewhat the physical properties of india-rubber that they should oxidise rapidly. He knew but of one exception, and that was the scarce jelly-like mineral, elaterite, of which he exhibited a piece which had been exposed to the air for thirteen years and had not altered at all. Linoleum, with so much oxidised oil in it, lasted longer than might be expected, but then it must be remembered that therein the superoxidised substance was incorporated with 40 per cent. of powdered cork; out of any piece of linoleum several years old, the products of decomposition of which he had spoken could be extracted by alcohol. He regretted that eminent artists of to-day are using linseed oil in their work. Nut oil and poppy oil are as bad; they oxidise more slowly, but finally liquefy.

Professor T. E. Thorpe, the president of the Society, stated that once a blanket manufacturer near Huddersfield found his blankets going into holes soon after bleaching with fumes of sulphur; this was discovered by the speaker to be due to oil from the bearings of the centrifugal machine splashing on to the blankets, and sulphurous acid in contact with oil oxidised into sulphuric acid at a surprisingly rapid rate; the latter acid caused the holes.

Mr. Christie said that a peculiar oil and varnish made from petroleum is about to be brought into use, and he hoped soon to be able to lay the details before the Society. Painting a busy London restaurant is a serious thing for the proprietor, because meanwhile his customers disappear; one of these restaurants had been painted one night and varnished the next night with these substances derived from petroleum. There was no smell, and the customers knew nothing about it, except that they saw that the restaurant had been renovated.

Mr. Cresswell was of opinion that house paints without lead oxide in them to form a soap with the oil are usually of little durability. Shortly afterwards the proceedings closed.

## YORK SANITARY SCHEMES.

The city of York, which in point of rank, though not in commercial importance, is the second city in the kingdom, will soon have in operation an admirable scheme of sewerage and sewage disposal, designed by Mr. J. Mansergh, C.E., Westminster. The new scheme comprises about eight miles of sewers. The sewage pumping and precipitation works, plant, and machinery have ample present capacity, and can be readily enlarged to supply the needs of double the present population. There is a relay of steam boilers, with machine stokers, engines, machinery, and plant. The pumping station is situated at Fulford, about two miles southward from the Guildhall. The precipitation station is on the Naburn-road, about a mile further south. Both stations are on the easterly bank of the river Ouse. The buildings at both stations are of red brickwork, with Pateley Bridge, Yorkshire, sandstone dressings. Bramley Fall stone is used for plinths, as well as for engine beds, which are laid upon large blocks of cement concrete. The grading of the ground around the buildings is raised above the flood level of October, 1892. The buildings have slated roofs. Vertical triple expansion engines of 280-horse power are in course of operation at the pumping station where the lift of the sewage is 32ft. Dead animals and other large objects are here screened out of the sewage before it is passed onward to the precipitation station. Centrifugal pumping engines are in place to deal with sudden storm and flood waters.

The precipitation tanks, as well as the mixing, baffling and conveying channels, are constructed of cement concrete, and all are faced, coped, and paved with impervious brickwork. The bottoms have a gradient of one in eighty. Down along the centre of the bottom of the tanks a channel of steeper gradient is formed for the sludge. The engines, boilers, and machinery are not yet in place at this station, but the buildings are ready to receive them. The chemical treatment of the sewage is to consist of prepared lime and alum, which are passed into the sewage at proper points before it is passed into the precipitation tanks. The clarified effluent passes over an end weir of each tank, and is thence conducted to the river. Each tank is supplied with a swivelled sediment separator. The tanks can be used separately or in convenient combinations. The sludge is conducted to elevated iron tanks, from which it is passed to pressing machinery supplied by a Nottingham firm. The sediment is thus reduced to a convenient form to sell for manuring purposes. The engines, boilers, and machinery are not yet in place at the precipitation station, but the buildings are ready to receive them. This scheme is expected to be in operation early in January next. A six-cell refuse destructor is also contemplated.

Mr. I. McKie, C.E., is the resident engineer, Mr. Alfred Creer, A.M.I.C.E., is the city engineer and surveyor of York

Search for Coal in East Anglia: Commencement of Operations.—A meeting of the directors of the Eastern Counties Coal Boring Association was held at Ipswich on Tuesday, when there were present Mr. R. C. Rapier (chairman), Captain Pretyman, Colonel Barnardiston, Mr. G. Calver Mason, Mr. Reuben Hunt, and Mr. T. R. Elkington. The meeting was held for the purpose of going through the tenders for carrying out the boring, and after consideration it was decided to accept that of the Vivian's Boring and Exploration Company, of Whitehaven, and the contractors have to commence operations within the next few weeks. The Vivian's Company has an excellent reputation, and was recently successful in discovering coal at Haxey, in Lincolnshire, and just now has on hand some other heavy contracts for deep boring. The first bore will be made upon the estate of Mr. W. J. Graham, at Stutton, on the banks of the river Stour.

## RAILWAY MATTERS.

The railway from Tunis to Biserta was opened on the 2nd inst. with great rejoicings.

It is stated that the North-Eastern Railway Company has purchased land at Blyth for the purpose of erecting engine works.

We have received from Mr. F. Snary, of Castle-street, Bristol, an excellent photograph of the Great Western express engine Achilles. This is of the same class as the Agamemnon, illustrated in our last impression.

There are 15,812 miles of Prussian State railways, 62 miles of narrow gauge lines serving as common carriers and feeder lines. There are 124 miles not used for public traffic; 1118 miles of the Prussian State lines are outside Prussia.

The Cape railway officials visiting Pretoria have made amicable arrangements for a joint traffic. When the Natal line opens there will, the *Times* correspondent at Pretoria says, be a further conference between the heads of the Cape, Netherlands, and Natal Railways finally to settle the tariff.

The large falling off in North-Eastern Railway traffic receipts, while it shows that business is not as active as it was in the autumn of last year, does not unfavourably influence the market, because last year the traffic was abnormally increased by the miners' strike in the Midlands, which caused a much larger demand for the products of this district, especially the coal. Last week the mineral receipts were £12,062 short of those of the corresponding week last year.

It is proposed to "split" the ordinary stock of the Rhymney Railway, and thus follow the tactics of the Taff, which have answered very well. Circulars were issued in September to the shareholders for their opinion, and I hear that out of 150 replies only ten dissented from the project, so it may be expected to take place at an early date. It is thought that powers will be applied for in the next session, and, these granted, the Rhymney will be in as good a position as the Taff and the Barry, which obtained powers lately.

The commission, now sitting at St. Petersburg, to decide which of the many northern railway projects should be carried into execution, has apparently resolved on the continuation to Archangel of the existing Moscow-Vologda line. This proposal by no means meets with general approval among the merchants who would much prefer the project pressingly urged on the authorities by the new governor, viz., a railway from Kazan on the Volga to Kotlass at the junction of the Vychegda and Northern Dwina.

The Port Talbot Railway and Docks directorate will very probably, so thinks a local authority, be constituted as follows: Lord Dunraven chairman, Col. Wright, Messrs. S. H. Byass, E. Knox, Thomas Watson, and Mr. Llewellen Wood. This would imply vigour and ability of no ordinary character. Both Port Talbot and Llanelly have a promising future. The electric lighting of Newport is expected to be in full operation in January, and to some private consumers in December. The latter feature, so far, is not a promising one in the case of Cardiff.

Commenting on the recent granting of a franchise for a 78-mile narrow-gauge railway, to be built in the Government of Wilna, in Russia, the *Strassenbahn*, a German street railway journal, takes occasion to point out that the first narrow-gauge railway in Russia was opened on September 14th, 1892, and has been operated successfully ever since. It is the St. Petersburg-Ochta-Irinowka line, better known simply as the Irinowka road, and was built during the summer months of 1891 and 1892. The total length of the line is 33½ versts—about 22 miles—and the gauge is 750 mm., or about 30in. The locomotives in use are four-wheeled tender engines, rated at from 30 to 40-horse power. The entire road was built and equipped by the German firm of Arthur Koppel, of Berlin.

On Tuesday, the London County Council resolved, by 103 votes to 4, to serve a notice on the London Tramways Company, requiring it to sell to the Council the portion of its undertaking authorised by the Extension Order of 1873, consisting of about 2¼ miles from Kennington Park-road to Old Kent-road. The proposal is to purchase about 2¼ miles of tramway extending from Kennington Park-road, along Newington-causeway, Blackman-street, Borough, Great Dover-street to Old Kent-road. It is only a small section of the system belonging to the company, the whole measuring about 23⅝ miles, but it is a very important section, as two branches spread out from it, one going to Brixton and Streatham, and the other to Balham and Tooting. The remainder will fall in about four years hence.

In a report to the Board of Trade on the collision that occurred on the 31st August at Cambridge Station on the Great Eastern Railway, Major Yorke says:—"This collision, which presents all the features usual in cases of this kind, was clearly due to the fact that driver Downs entered the station at too high a rate of speed, and thereby broke the rule which enjoins that trains shall not enter dead-end bays at a greater than hand-brake speed. In conclusion, I would draw attention to the following extracts from my report of 22nd March, 1894, on the stop-block collision which occurred on the 26th February at the London and North-Western Railway's London-road Station at Manchester: 'It is satisfactory to note that the London and North-Western Railway Company do not permit the continuous brake to be used in stopping trains in terminal stations, except in cases of emergency. The instructions to guards in the Appendix to the Working Time-book as to the mode of entering terminal stations are as follows, viz.: "Guards must in all cases use their hand-brakes to assist in stopping trains on approaching terminal stations, bay sidings, or principal stations, and must not rely on the drivers pulling up trains by means of the vacuum brake."'"

Writing on the nationalisation of our railways, the *Railway News* says there is no use in blinking the fact; nationalisation by inches is an accurate and moderate phrase for describing the relations subsisting between the British State and the British railways. It is certain there has been no slackening in the collectivist policy from the date of the Royal Commission Report of 1867, which was dead against it, to the present; rather, the impetus gained from previous efforts has increased the speed. It is time, therefore, that railway shareholders should seriously consider the result to themselves of further developments along the same line in the future. It may be said that we are exaggerating; that no scheme for the State acquisition of railways is within the range of practical politics. The writer then refers to the gradually increasing interference by the State with the construction and working of our railways, and concludes:—Obviously, however, this form of "progress" has its limits. Public interference cannot extend indefinitely for the simple reason that it will exhaust its material. A certain amount more of "railway legislation," and there will be no railway of a privately owned and managed kind to legislate upon. The independent company will be metamorphosed into a department of the Board of Trade. No revolutionary change is necessary to effect this purpose, a steady continuance along the present lines is sufficient. Without our realising it our railway industry is slowly but surely being nationalised. And not a penny piece of compensation is being paid for property injured, and privileges curtailed. If we continue to drift along the path which we have hitherto folowed it will only be a question of time for the most magnificent heritage of modern industrial society to slip completely from the grasp of its owners into that of a democratic state. And its present holders will not be paid with even thanks.

## NOTES AND MEMORANDA.

The electrical conductivity of water in as high a state of purity as possible has been determined by Messrs. Kohlrausch and Heydweiller, and that of pure water calculated from the results. The water was distilled and examined in a vacuum, as contact with air rapidly raises the conductivity, which, in some experiments, rose from 0·11 to 0·14 in four minutes, reaching 0·58 in two hours. The results at various temperatures of the purest water obtainable were at 0 deg., 0·014; at 18 deg., 0·040; at 25 deg., 0·058; at 34 deg., 0·089; at 50 deg., 0·176.

In calling attention to the advantages of the inverted arc lamp, the *Ziet. fuer Elek.* says a 10 ampère 45·5 volt lamp gives a maximum of 2070, and a mean spherical intensity of 750-candle power, of which 640 are below the horizontal plane through the arc; by means of the inverted arc and a reflector almost the whole of this spherical intensity can be produced below the lamp, and it will be then equal to about 46 incandescent lamps of 16-candle power, which at 50 watts require 2300, while the arc lamp requires only 455, representing a saving of about 400 per cent.

In a correspondence on a new mode of decorating church walls, Mr. A. W. Keim draws attention to a process of his own called "Mineralmalerei," which consists essentially in the use of siliceous clay and sulphate of baryta, both on the painting-ground and in the colours. By the addition of carbonate of baryta the sulphuric acid gas found in the atmosphere of our large towns, and the sulphurous acid gas, which is very injurious to fresco paintings and to limestone, are neutralised and even become a means of hardening the paintings executed according to this process.

In a paper on the magnetic lag in iron cores due to periodic alternating magnetising forces, Mr. Dechant shows that two periodical alternating magnetising forces of a certain phase difference, when acting on different parts of an iron bar, develope magnetic waves of varying amplitude, which travel along the iron but with relatively small velocity; the latter is found when the distance between the places where the forces act are divided by the phase difference; he proves this experimentally. He also shows that the diminution in the intensity of magnetisation along the bar is an essential condition for the existence of this lag.

Cellulose in a dense form, having the appearance of ebonite, and capable of taking a high polish, can be prepared by treating cellulose with a 15 per cent. solution of sodium hydrate, and "mercerising" it. The "mercerised" cellulose is then exposed to the vapour of carbon bisulphide, which forms a soluble compound with it. On dissolving this in water, the carbon bisulphide and sodic hydrate are gradually given up, cellulose being precipitated. If some of the solution is spread on glass, a transparent film of cellulose can be obtained. Cellulose can also be deposited from the same solution on woven materials on paper, producing a permanent stiffening or sizing. The solution also forms a substitute for glue, of great strength, and insoluble in water when set. The material can also be obtained in continuous sheets or films.

The Welsbach incandescent gas burner mantles are made of fine cotton netting, carefully washed, to render it pure. The clean cotton mantle is soaked in a complex fluid containing amongst other things a chloride of zirconium. They are then dried, and after undergoing one or two intermediate operations, are strongly heated in a Bunsen flame, by which the cotton is burnt away. The skins or films which are left behind consist of the substances dissolved in the fluid just mentioned, and are so fragile as to crumble to dust at a touch. To make them sufficiently strong to bear handling they are dipped in collodion, and after being trimmed with scissors, wetted with methylated spirit, are packed in boxes for distribution. The light obtained as a result of this treatment is comparatively rich in actinic rays, so that it is quite possible to take photographs by means of it.

On Monday evening the Council of The Royal Agricultural Society entertained the Duke of Westminster, Sir Walter Gilbey, and others at dinner at Hanover-square, the new premises, into possession of which the Society has entered. There followed a conversazione, at which upwards of 600 guests were present. The mansion, now the property of the Society, was the residence of Lord Harewood, and was built by Richard Adams, one of the famous brothers after whom the Adelphi took its name. All the rooms are of handsome proportions; are decorated in the Adams style; the walls are hung with the paintings belonging to the Society—portraits of famous agriculturists, and pictures of famous animals. In the several rooms of the house were exhibits of special interest to agriculturists, specimens of diseased plants, insect pests, fertilisers and feeding stuffs, medals, the Royal Charter of the Society, and short lectures were given in the council chamber, with lantern demonstrations. The new occupants and guests greatly admired the fine old house.

At the date of the last decennial census in 1891 Canada had a population of 4,833,239 persons, of whom 2,466,573 were males, and 2,366,666 females. The populations of the several provinces were as follows:—Ontario, 2,114,321; Quebec, 1,488,535; Nova Scotia, 450,396; New Brunswick, 321,263; Manitoba, 152,500; British Columbia, 98,173; Prince Edward Island, 109,078; the Territories, 98,967. In 1893 there were in all 75,741 industrial establishments, having an invested capital of £70,905,252, employing 370,104 hands, distributing to wage-earners £20,131,300 a year, and producing articles the total value of which was £95,236,671. The railway mileage of the Dominion open for traffic was 15,020; the working expenses of these railways amounted to £7,323,207, and the earnings to £10,408,479. The public debt of the Dominion was at the close of last year £60,010,905, against which there were assets amounting to £11,674,697, leaving a net indebtedness of £48,336,208. The Government expenditure on railways amounted to £268,585, that on canals to £460,580, and on other public works to £276,674.

According to a paper on "The Prevention of Scale in Boilers," by J. Walter, if the water is fed into the boiler, together with small quantities of a solution of sodium carbonate, the deposit of scale is not prevented, but is localised more upon those parts which are nearest to the opening of the feed-water pipe in the boiler. The probable cause of this is the difference between the temperature of the water in the boiler and that of the feed-water. If, therefore, the temperature of the feed-water were raised to the temperature of the boiler before coming in contact with the latter, all incrusting matters would be precipitated beforehand and no scale could form upon the boiler plates. To effect this result a 6in. tube is placed on low supports along the centre of the boiler at a distance of about 6in. from the bottom. The front end of this tube is open, the back end closed with a blank flange. From the back end rises a vertical pipe reaching above the level of the water in the boiler and loosely encasing the feed-water pipe. The water fed into the boiler does not therefore mix immediately with the water in the boiler, but passes through the narrow vertical tube, and subsequently through the wider horizontal tube. During this passage its temperature rises to that of the boiler, and the incrusting matter is precipitated within the horizontal tube, no subsequent formation of scale upon the boiler plates taking place. Any of this precipitate washed out of the tube will be found to form a layer of fine sludge on the bottom of the boiler or a granular coating on the sides, which is easily removed by a brush. The greater part of the precipitated incrusting matter will be found in the horizontal pipe, which after being cleaned is reinserted. The *Journal* of the Society of Chemical Industry says this arrangement was found to form a reliable means of preventing the formation of hard scale.

## MISCELLANEA.

Mr. Alexander Siemens, M. Inst. C.E., of Woolwich, has accepted the Presidency of the Institution of Junior Engineers, formerly the Junior Engineering Society, for Session 1894-5, in succession to Mr. J. Wolfe Barry, C.B., V.P. Inst. C.E., and will deliver his Presidential Address on Friday evening, 16th inst., at the Westminster Palace Hotel.

Mons. George T. Rickard, director of the Société Cockerill's shipbuilding establishments at Hoboken, Antwerp, has been promoted to the grade of Officer of the Order of Leopold, in consideration of his services in promoting Belgian industry. Mons. Edmond Crets, the engineer at the shipbuilding works, is nominated Chevalier of the Order of Leopold.

The Board of Agriculture desire to acquaint intending exhibitors at the forthcoming Agricultural Exhibition at Montevideo, to which attention was directed by a notice issued on the 30th ult., that copies of the regulations and forms of entry can now be obtained on application, either personally or by letter, from the Secretary to the Board, 4, Whitehall-place, London, S.W.

The Staveley Coal and Iron Company made the iron pipes, &c., for the Thirlmere water supply of the Manchester Corporation. The work, which included 30,000 to 40,000 tons, was in progress for some seven years. The Staveley Company, which has recently concluded contracts for the waterworks of Liverpool and Leeds, is now engaged upon similar work for Alexandria and South Africa.

On Monday evening, November 5th, the members of the Hull and District Institution of Engineers and Naval Architects assembled at the Institute rooms, Bond-street, to hear Mr. Alfred H. Gibbings—Borough Electrical Engineer—read his promised paper on "Electricity on Board Ship, and its Application as Motive Power for Auxiliary Machinery," the president, Mr. J. H. Pearson, being in the chair.

It is proposed to establish an Association of English Cement Manufacturers for the purpose of dealing with and, if possible, of putting a stop to the adulteration of English Portland cement—a practice exceedingly detrimental to the best interests of the cement trade. Messrs. Renshaw, Kekewich, and Smith, solicitors, of 2, Suffolk-lane, E.C., are prepared to receive names of manufacturers willing to attend a meeting presently to be convened.

The Institution of Civil Engineers is building a new house, but it will not be ready until a year hence. In the meantime arrangements have been made by which the old meeting-room can be reached from a temporary entrance in Great George-street. The members will assemble next Tuesday, the 13th inst., to hear the inaugural address of the new president, Sir Robert Rawlinson, K.C.B., and to witness the ceremony of presenting the prizes and premiums awarded for papers read last session.

A well supported scheme for constructing a large embankment in the Bay of Fundy, for the purpose of reclaiming land, is under consideration, and a well-known English engineer has been in Nova Scotia to report upon it. Considering what a drug land is at the present time, it does not on the face of it seem a very opportune time to increase the quantity already in existence, but the people out there who have this matter in hand seem to see their way to make it a profitable undertaking if they can raise the capital.

On Tuesday, the 30th ult., the Sandwich Mayor and Corporation assembled at the pumping station, Woodnesborough, and took over the waterworks from the contractor. The party consisted of the Mayor, Major Mate, Mr. Courtney, M. Inst., C.E., representing the engineers, Mr. Brown, A.M. Inst., C.E., and others. The boilers, engines, and pumps are in duplicate, the pumps being capable of delivering 15,000 gallons of water per hour to the reservoir on Beacon Hill. They have been supplied by Messrs. Warner and Son, of Walton-on-the-Naze. Mr. H. Roberts, of West Bromwich, was contractor for the works, which have been designed and superintended by Messrs. Easton, Anderson, and Goolden, the engineers.

The Pittsburgh—Lake Erie Ship Canal project has now reached a stage when it will be possible for outsiders to gain some idea of how the proposed waterway is regarded by the business men of the Pittsburgh district. An examination of several routes has been made by an engineering committee of the Ship Canal Provisional Committee, the Pittsburgh organisation intrusted with promoting the project, and now the public is invited to subscribe to a guarantee fund of £20,000 to make the necessary detailed preliminary and final surveys, and to pay for other expenses in placing the project on a business footing. The subscribers are not to pay in the amount of their subscriptions at once, but calls will be made from time to time as funds are needed. The *Engineering Record* says the cost of the canal is estimated at about £5,200,000.

The annual meeting of the South Lancashire and Cheshire Coalowners' Association was held in Manchester on Tuesday, and Mr. W. Johnson, of the Abram Collieries, near Wigan, was unanimously re-elected president for the ensuing year. This association deals chiefly with Parliamentary and railway matters affecting the coal trade, and does not interfere with questions affecting either wages or prices; but the general secretary, Mr. Thomas Ratcliffe Ellis, who is also the secretary for the Coalowners' Defence Association, informed me that matters were going on very quietly and satisfactorily between the coalowners and the men, and that with reference to the proposal to form a Conciliation Board, which was not agreed to by the coalowners at a recent conference, there was no intention, at any rate at present, of making any further move in the matter.

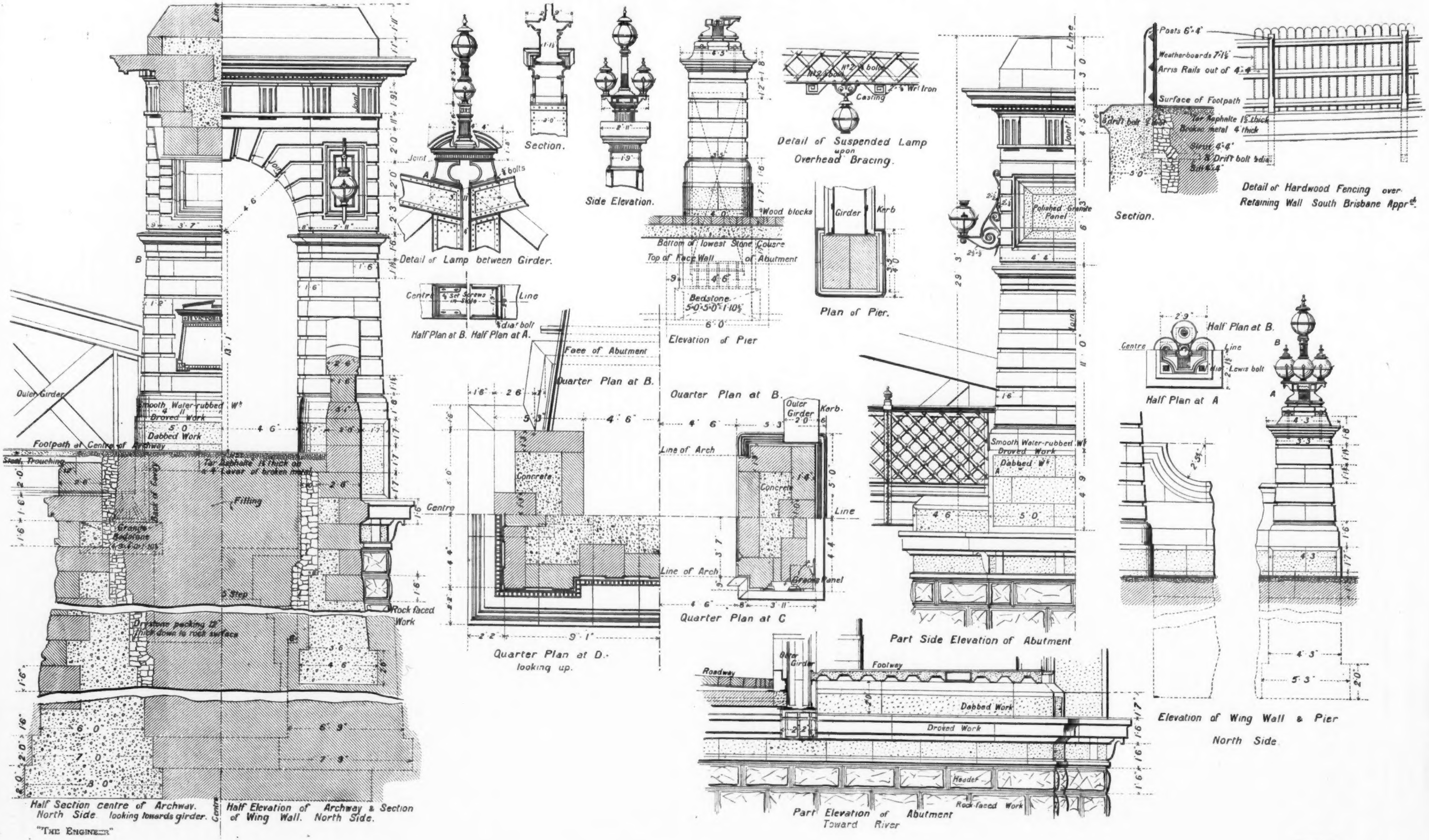
The 4000 tons forging press, with the power travelling cranes, each of 150 tons, and the plant generally at the Atlas Works of Messrs. Sir J. Brown and Co. were made by Messrs. Tannett, Walker, and Co. The pumping engines for working the press are, we believe, as large as any in existence; they have steam cylinders 60in. in diameter by 54in. stroke. The press is of great capacity, and this will be easily appreciated when we say that the distance from centre to centre of the columns is 18ft. This press and engines were at the time they were made a long way in advance of anything that had been done at that period, and we may mention that the firm have constructed similar presses for Herr Fried Krupp, Essen; the Baltic Iron, Shipbuilding, and Engineering Company, St. Petersburg; Schneider and Co., Le Creusot; Monk Bridge Iron and Steel Company, Leeds; the Terni Works, Italy; the Witkowitz Works, Austria; the Compagnie Anonyme des Forges de Chatillon and Commentry, Montlucon; the Spanish Government, and many others.

Sheffield will be largely represented at the cutting of the first sod of the Manchester, Sheffield, and Lincolnshire new line to London next Tuesday. The ceremony is to be performed by Lady Wharncliffe, the wife of the chairman of the line. The Countess will be presented on the occasion with a large and massive casket, which has just been completed by Messrs. Mappin and Webb, of Sheffield. It is in sterling silver, and weighs 160 ounces. The style is Palladian, or, as it is more generally called now-a-days, "Queen Anne." The casket, which displays some most elaborate and beautiful work, exhibits the arms of the Earl and Countess of Wharncliffe, with supporters and motto, and the four crests of the family. On the reverse is the ribbon with legends and shields of the five cities and towns, with intervening national embelms, which form the device of the Manchester, Sheffield, and Lincolnshire Railway Company. The centre circles on the obverse and reverse display raised monograms—that of the Earl and Countess on one side, and that of the Manchester, Sheffield, and Lincolnshire Company on the other.

# NEW VICTORIA BRIDGE, BRISBANE—DETAILS

MR. A. R. BRADY, ASSOC. M. INST., C.E., ENGINEER

(*For description see page 337 ante*)



Half Section centre of Archway. North Side. looking towards girder.

Half Elevation of Archway & Section of Wing Wall. North Side.

Detail of Lamp between Girder.

Half Plan at B. Half Plan at A.

Section.

Side Elevation.

Elevation of Pier

Detail of Suspended Lamp upon Overhead Bracing.

Plan of Pier.

Quarter Plan at B.

Quarter Plan at D. looking up.

Quarter Plan at C

Part Side Elevation of Abutment

Part Elevation of Abutment Toward River

Section.

Detail of Hardwood Fencing over Retaining Wall South Brisbane Appr^ch.

Half Plan at B.

Half Plan at A

Elevation of Wing Wall & Pier North Side

Line
Joint
B
Outer Girder
Smooth Water-rubbed W^k
Droved Work
Dabbed Work
Footpath at Centre of Archway
Steel Troughing
Tar Asphalte 1½ thick on a 4" Layer of broken metal
Filling
Granite Bedstone
Back of Facing
Step
Drystone packing 12" thick down to rock surface
Rock faced Work
Centre
bolts
Set Screws
diar bolt
Face of Abutment
Concrete
Wood blocks
Bottom of lowest Stone Course
Top of Face Wall of Abutment
Bedstone 5·0·5·0·1·10½
Casting
Wr^t Iron
Girder
Kerb
Polished Granite Panel
Line of Arch
Outer Girder
Granite Panel
Roadway
Footway
Header
Rock faced Work
Posts 6·4"
Weatherboards 7·1½
Arris Rails out of 4·4
Surface of Footpath
Tar Asphalte 1½ thick
Broken metal 4 thick
Strut 4·4
Drift bolt
Sill 4·4
Lewis bolt
"THE ENGINEER"
SWAIN ENG.

# LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

## THE THEORY OF THE STEAM ENGINE.

Sir,—Your correspondent, "Ttaw," asks if Professor Smith and I are authorities on such matters. Now, I thought that science discarded authority. For my part, I claim no authority. I always give a reason for what I say, and I think nothing I said in my last letter can be denied. Nay, I do not suppose that any writer on thermodynamics would try to deny it. All that I accuse writers on this subject—myself included—of is that they have not emphasised sufficiently the fact that Carnot did not intend his cycle to be aimed at in practice, but merely used it as a mathematical mode of investigation of thermodynamic principles.

I think that Professor Smith is quite right in what he says when he denies that this cycle has a superior claim to other cycles in the matter of reversibility, and—though, not being a practical engineer, I am not so sure of this—in the matter of efficiency. I see it stated with great emphasis in many books that the reversibility and consequent perfection of Carnot's cycle depends on the engine receiving all the heat it gets at one temperature, and giving out all that it does give out at another temperature—a lower temperature. Now, if those who are interested in this subject will study pages 107-9 of my treatise on thermodynamics, they will find it demonstrated that, if the cycle of Stirling's air engine could be executed without waste, it would be as perfect as Carnot's cycle gone through with equal perfection. Now, the cycle of Stirling's air engine is a ($t$, $v$) cycle with a regenerator, in which cycle the heat is not all taken in at one temperature, nor all given out at another temperature. This disproves the said teaching.

Again, in the complex cycle described by Clausius at §8 of his treatise, $Q_1$ units of heat are received by an engine at temperature $T_1$, $Q_2$ units are received at temperature $T_2$, and $q_3 + q^1_3$ units are given out at temperature $T_3$. The work which would be done by the engine would be

$$W = Q_1 \cdot \frac{T_1 - T_3}{T_1} + Q_2 \cdot \frac{T_2 - T_3}{T_2}$$

And its efficiency would be

$$\frac{W}{Q_1 + Q_2} = \frac{Q_1}{Q_1 + Q_2} \; \frac{T_1 - T_3}{T_1} + \frac{Q_2}{Q_1 + Q_2} \; \frac{T_2 - T_3}{T_2}$$
$$= 1 - \frac{T_3}{Q_1 + Q_2} \left(\frac{Q_1}{T_1} + \frac{Q_2}{T_2}\right)$$

Now if all the $Q_1 + Q_2$ units of heat received by the engine were to be received at one temperature it must be at temperature $T_2$—at the very highest—because while $Q_1$ could easily be let down from temperature $T_1$ to $T_2$, $Q_2$ could not be got up to $T_1$ without compulsion. If, then, the $Q_1 + Q_2$ units are all received at temperature $T_2$ the efficiency would be

$$\frac{W}{Q_1 + Q_2} = 1 - \frac{T_3}{T_2}$$

which is less than (1), which disproves the teaching spoken of.

26, Smith-street, Hullhead, Glasgow, November 5th.　　Peter Alexander.

---

Sir,—I have been much surprised to find that in the discussion on this subject no direct reference has been made to the results obtained by the discussion just concluded upon thermodynamic matters, and look with amused curiosity for the reply which may possibly be made to "Ttaw's" questions. It seems to me that fashionable *fin de siècle* thermodynamicians have altogether overlooked the fact that there are two classes of heat engines, viz., those in which the operative substance is itself the sole source of heat—for example, gas and oil engines—and those where we have to deal only with the heat added to the operative substance—for example, steam and hot air engines. In the case of the former, if the heat at first possessed by the operative substance is equal to the product of T, the absolute temperature produced by explosion multiplied by a constant number of foot-pounds, and the heat possessed by the operative substance at the end of the stroke on the eve of the opening of the exhaust is equal to $t$, its then absolute temperature multiplied by the same constant number of foot-pounds, the coefficient of efficiency must be less than $\frac{T-t}{T}$, because the whole of the heat corresponding to the fall in temperature, $T - t$, has not been expended in doing work upon the piston. The meaning of the ratio $\frac{T-t}{T}$ is, however, in this case *toto cœlo* distinct from the meaning of the ratio $\frac{T-t}{T}$ deduced from the Carnot cycle. In the case of the steam engine, we have to divide the whole operation into two stages, viz., the stage in which the heat is added to the operative substance and the stage in which it is utilised. If the value of J is independent of the temperature, and T $t_1$ represent the indicated temperatures of the steam and the feed-water, and N the number of thermal units of so-called latent heat, the heat added to each pound of the operative substance is equal to $(T - t_1 + N)$ J, and this, divided by the total heat expended per pound of water converted into steam, is the coefficient of efficiency of the boiler, which we may denote by the letter B. If $Sv$, the specific heat of steam, is independent of the temperature, and $t_2$ is the indicated temperature of the steam on the eve of the opening of the exhaust port, by which the steam is admitted into either the air or the condenser, and Q T represents the diminution of the so-called latent heat of steam from the instant of its generation to the instant of exhaust, the heat lost by each pound of steam is equal to $\left\{ Sv(T - t_2) + Q \right\}$ J. Since the whole of this has not been expended in doing work upon the piston, the coefficient of efficiency of the engine must be less than

$$\frac{Sv\,(T - t_2) + Q}{T - t_1 + N} = E,$$

the maximum theoretical coefficient. The actual coefficient of the efficiency of the whole installation must therefore be less than the product E B. In the case of the indicated diagram of a condensing engine, the work calculated from the area below the atmospheric line represents the saving effected by diminishing the back pressure, and has nothing to do with the value of E. The heat utilised by using the water from the condenser increases the efficiency of the whole installation, but this also has nothing to do with the value of E B.

Some authorities affirm that the value of Q J cannot exceed the value of $P\,(V - v)$, the work done by the instantaneous expansion, where V and $v$ represent respectively the volume of 1 lb. of steam and 1 lb. of water at the pressure P, and that the difference between the value of the whole of the so-called latent heat and of $P\,(V - v)$ can only be converted into sensible heat by condensing the steam. Now, in accordance with the theory of the convertibility of heat and work this difference can only be represented by molecular *vis viva*, which must be converted into heat by molecular friction. The greater the pressure, the more rapid the rate of conversion. This fact, and the greater length of time occupied in passing through the cylinders of the compound engine, constitute the chief causes of the greater efficiency obtained by the use of high-pressure steam and compound engines. The increase in the value of E caused by the increase in the value of T is utterly inadequate to account for the difference between the efficiency of a high-pressure compound condensing engine and a low-pressure single-cylinder condensing engine.

If we adopt the lowest admitted value of J, viz., 772 foot-pounds, the value of $P\,(V - v)$ per pound of steam is less than 80 J for steam at atmospheric pressure, and less than 86 J for steam at 150 lb. pressure. We may, therefore, for the purpose of this discussion assume that it is equal to 80 J for all pressures. If equal increments of volume correspond with equal increments of heat the value of N is about 965, and if the coefficient of expansion per increment of unit of heat is constant to about 1080 for the temperature of 212 deg. So far as this discussion is concerned, we may put $N = 1000$ for all temperatures. The coefficient of efficiency of the boilers may be taken to be equal to ·5. The heat possessed by 1 lb. of steam coal is said to be equal to about 16,000 thermal units, if $J = 772$ foot-pounds; this is equivalent to 6·2-horse power per pound of coal per hour. With the value $B = ·5$ therefore, the heat added to the water per pound of coal burnt per hour is equivalent to 3·1-horse power.

In the case of quick speed single-cylinder engines placed close to the boiler, we may assume that the value of Q J does not appreciably exceed the value $P\,(V - v)$. For the initial pressure of 60 lb. indicated the Boyle and Marriotte temperature of the steam is about 307 deg. Fah. In the case of non-condensing engines the final absolute pressure can hardly be less than 18 lb. absolute or $t_2$ not less than 220 deg. Fah. The value of $t_1$ may be taken to be equal to 60 deg. Fah. If, then, equal increments of volume correspond with equal increments of heat, and we put $S_v = ·3$, the maximum value of E is ·085 on the data stated above. If the coefficient of expansion per increment of unit of heat is constant, it will be somewhat less. The maximum effective work, therefore, which can be got out of the consumption of one pound of coal per hour is equal to 3·1 × ·085-horse power = ·26-horse power. In order to arrive at the maximum attainable indicated horse-power, we have to deduct from this the work done in overcoming the back pressure of the atmosphere. The volume of one pound of steam at 17 lb. pressure absolute may be taken to be equal to 23 cubic feet, and the number of pounds of water evaporated by one pound of coal is on the above data equal to $\frac{8000}{1247} = 6\ 4$ lb., so that the horse-power required to overcome the resistance of the back pressure is equal to

$$\frac{23 \times 14{\cdot}7 \times 144 \times 6{\cdot}4}{33{,}000 \times 60} \text{ H P.} = {\cdot}16 \text{ H.P.}$$

The maximum theoretical indicated horse-power therefore attainable per pound of fuel per hour is ·1 indicated horse-power, which corresponds with 10 lb. per hour per indicated horse-power. If we put $S_v = 1$, the maximum value of E is ·134 and the maximum attainable work which can be got per pound of coal per hour is equal to 3·1 × ·134-horse-power = ·42-horse power. The maximum indicated horse-power corresponding to this is ·26 indicated horse-power, which is equivalent to nearly 4 lb. per hour per indicated horse-power.

In actual practice with single cylinder non-condensing engines, the fuel consumption in the best installations does not exceed 6 lb. of coal per hour per indicated horse-power. In the case of condensing engines, when the condensed water is used for the feed-water without passing it through a regenerator, we may put $t_1 = 100$ deg. Fah. The final pressure cannot be put at less than 7 lb. absolute, for which $t_2 = 177$ deg. Fah. and, if $S_v = ·3$, we have $E = ·1$, and the maximum attainable work per pound of coal per hour is equal to ·31-horse power. The volume of 1 lb. of steam at 7 lb. pressure is equal to about 53 cubic feet; and if we assume the back pressure to be equal to 2 lb, the work done in overcoming back pressure is equal to

$$\frac{53 \times 2 \times 144 \times 6\ 6}{33{,}000 \times 60} \text{ H.P.} = {\cdot}05 \text{ H.P.},$$

since the water evaporated by 1 lb. of coal is equal to $\frac{8000}{1207} = 6\text{-}6$ lb. The maximum attainable indicated horse-power is therefore ·26 indicated horse-power, which corresponds with a fuel consumption of about 4 lb. per hour per indicated horse-power. If we put $S_v = 1$, we get $E = ·17$, and the maximum attainable work per pound of coal per hour ·53-horse power; so the maximum indicated horse-power attainable is ·46 indicated horse-power, which corresponds with 2·2 lb. of coal per hour per indicated horse-power. The actual consumption per hour per indicated horse-power in the best installations is about 3 lb. We cannot but regard these results as giving irrefragable proof that the specific heat of steam is equal to the specific heat of water.

In the case of compound engines, we may take the initial pressure to be 150 lb. to the square inch, which corresponds with the Boyle and Marriotte temperature of about 366 deg. Fah. As in the case of the single-cylinder condensing engine, we may put $t_2 = 177$ deg. Fah., and with the help of a very efficient regenerator we may put $t_1 = 200$ deg. Fah. The water evaporated would be nearly 7 lb. per pound of coal, but the work done in overcoming back pressure would be practically the same as in the single-cylinder engine, viz., ·05-horse power. If we put $S_v = 1$, we get $E = ·23$, and the maximum attainable work per pound of coal per hour equal to ·71-horse power, so that the maximum attainable indicated horse-power is ·66-horse power, which corresponds with a consumption of 1·5 lb. of coal per hour per indicated horse-power. In the case of the best quick-speed marine engines, the fuel consumption does not exceed this, and in the case of slow stroke compound beam engines it is much less. We have, therefore, in this case, not only a proof that the specific heat of steam is equal to the specific heat of water, but also that the value of Q J is equal to many times that of $P\,(V - v)$.

November 6th.　　William Donaldson.

---

Sir,—Mr. Henry Cherry writes to you that my statement "that the abstraction, not the supply, of heat is that which is really effective in producing mechanical power," is open to adverse criticism. I did not state this. I stated that "in the case of pieces in tension it is the abstraction, not the supply, of heat that is really effective in producing extra mechanical power." Criticism that proceeds by the method of asserting that one has said something totally different from what one has actually said is not valuable. I myself do not think it worth printing. Those who have studied Clausius, or any other of the great teachers of thermodynamics, both carefully and cautiously, will readily recognise my statement to be true, even although it may possibly be new to them. If Mr. Henry Cherry be unable to recognise that the omission of the reference to "tension," and also of the word "extra," or of either of them, from my statement totally changes its meaning, that would prove him incompetent to discuss this subject.

Perhaps one should feel no surprise at such gross misquotation by one who is careless enough in stating the second thermodynamic law in the form preferred by Clausius, to turn it upside down so as to assert the exact and precise contrary of the truth, as Mr. Cherry does in his letter. But Mr. Cherry imputes to me that I "undervalue Carnot's, work" and that is more serious. On the contrary, I value his work highly, and protest "against the unfairness of fathering those mistaken notions upon Carnot." I also incidentally pointed to his having given a "mathematical demonstration of an all-important law in thermodynamics." If the law is all-important, surely its demonstration gives Carnot a claim to high appreciation; I do not for a moment suggest that this is his only claim.

In reply to the pleasant letter from the gentleman who, in his signature, hiccups over the Greek symbol for temperature, it is perhaps right for me to say that I did write to defend the statements of Mr. Maurice Cross. It seems also necessary to say that I have at no time "found out that Carnot's theorem represented nothing, &c." It represents the "mathematical demonstration of an all-important law in thermodynamics." It is twenty years since I have recurrently taught that his "cycle" is quite different from the indicator diagram of any actual heat engine. Those who have learnt these notions from me do not seem to have been much upset by them. I trust they understand the true teachings of Carnot better in consequence.　　Robert H. Smith.

Mason College, Birmingham, November 3rd.

---

Sir,—Every steamship owner and shipbuilder should read the following figures. When the Great Western crossed the Atlantic in 1838 she worked with 5 lb. on the safety valve, or what is now called 20 lb. steam cut-off at ¾ stroke, and then discharged into a vacuum condenser having a back pressure of 2½ lb. from imperfect vacuum. A cubic foot of water boiled off into 20 lb. steam, and worked through such an engine, would produce "theoretically" 3,976,934 foot-pounds, and the Great Western crossed the Atlantic with that steam at the rate of ten miles an hour.

The Lucania now crosses the Atlantic at twenty-five miles an hour, but she uses 180 lb. steam expanded to 10 lb. before it is let into a vacuum condenser, which, like the other, has a back pressure of 2½ lb. from imperfect vacuum. A cubic foot of water boiled off into 180 lb. steam, and worked through such an engine, would produce "theoretically" 33,382,427 foot-pounds, or 8⅓ times as much power as the Great Western was able to develope from the same quantity of water and of coal. Every engineer knows that the very same coal as boils off a foot of water into 20 lb. steam would boil it off at 180 lb. pressure or at any higher pressure. The Lucania then has gained all that extra power and extra speed by simply using stronger boilers and suitable engines to work the high-pressed steam.

If, now, steamship owners instead of using 180 lb. steam would use still stronger boilers, and boil off their water into 500 steam, and expand it down to 10 lb. as at present—the same quantity of coals will do it—each cubic foot of water would produce "theoretically" 83,643,100 foot-pounds, or two and a-half times as much power as the Lucania at present developes with her 180 lb. steam. It is said the Lucania burns 6000 tons of coal on the double voyage out and home, and if her boilers could bear the pressure of 500 lb. steam—they could not—and her engines could work it, then 2400 tons of coal would do the work of 6000 tons, and she might dispense with three boilers out of each five boilers she uses now. That is to say, she could cross the Atlantic at the very same speed as now, and yet she would only burn two tons of coal for each five tons she burns at present, and she might dismiss three stokers out of each five and three coal trimmers out of each five, and carry 3600 tons more cargo than she has room for at present.

These are startling figures, Sir, but they are true, and they are worth the consideration of Messrs. Cunard and of every other steamship owner, because there is no doubt whatever that 500 lb. steam, raised in boilers properly constructed for it, is quite as safe as the 180 lb. steam which all our fast steamers now use.

Penithon, Radnorshire.　　G. A. Haig.

---

## LABOUR AND LUXURIES.

Sir,—Your correspondent "Hirn" commits the common controversial error; he attributes words and statements to me which I have neither used nor entertained. I never said, "It was of no consequence to a shop-keeper whether he trades with a murderer or an honest man." I did say that a sovereign had just the same purchasing power, and was just as capable of paying for labour or for luxuries, whether it passed through the hands of a murderer or an honest man. Can "Hirn" prove the contrary? I have not the smallest idea what he means by his reference to Socrates, Milton, and a host of others.

"W. A. S. B." has written a sufficiently interesting letter, which has, however, little or nothing to do with what I have said. Indeed, I do not know that there is much difference of opinion between us on several points. On others, "W. A. S. B." draws deductions from my words that they will not bear, and then blames me. I have contented myself with the assertion that so long as a sovereign changes hands often enough and quickly enough, the reason for the change matters nothing, the result to the community at large is the same. Your correspondent appears to think that a sovereign can be spent to more advantage in one way than in another. Within narrow limits this statement is true, and I have not so far disputed it; but in the long run it makes no difference on what it is spent. I have given examples to prove my proposition, and these he does not attempt to prove unsound. He asserts that "it is by no means a matter of indifference how money is spent." My reply is that if we deal with the immediate it may be of consequence; if we deal with the future it is not, and in no case does it make the smallest difference to the worker. A sovereign is a sovereign to a tailor, just as much as it is to a boot maker, or a fisherman, or a firework manufacturer. Your correspondent is setting a value on money which it does not possess, on the one hand; and on the other, he is confounding the action of men and their works and sentiments with the power of gold. This is very commonly done, but it is none the less wrongly done.

"W. A. S. B." holds that labour may be wasted. In that I fully agree with him. A man may waste all his energies in producing that which is entirely useless, or even deleterious or criminal, and is not paid for. This is an aspect of political economy which I have not attempted to discuss. Gold cannot possibly be wasted in a community; but labour certainly can. "W. A. S. B.," like many others, will say that unless the man got gold for his labour he would have to do something else. That may be true, but it does not affect my proposition. The man's labour cannot be considered to be wasted, so far as he himself and the family whom he supports are concerned, so long as he gets gold for it; and the gold is certainly not wasted so long as it does its duty in supplying a man and his family with food and raiment. But gold buried or lost in a shipwreck would certainly be wasted. I have often heard it asked, "How can the production of more gold encourage trade?" The answer is very instructive, and is worth giving here.

A certain individual—whom I may call A—has lived for years with more or less unsatisfied desires. Above all things, he has wished for a handsome carriage and horses; but he had not the wherewithal to buy them. Already in his country there are more coachbuilders than employment for them; more horses than can find purchasers. But A goes in search of gold, and finds it—say, in a watercourse. Thereupon he orders a carriage and horses. The possession of the gold enables him to give employment to the coachbuilders who are idle; but they in turn purchase boots and coats, and such like things which they needed, and so on. Thus it is clear that although A was the first in one sense to benefit by the gold which he found, the whole community shares the advantage with him. It matters, as I have already said a dozen times, nothing on what he spent the money in the first instance. In the long run every one in the community would be the better of it. If immediately after A had found it, B had murdered him and robbed him, the result would have been the same, the community would have been the better of the gold. If, however, B, having killed A, hid the gold, then the community would be distinctly the worse of the hiding. All this about the part which gold—not necessarily money—plays in political economy ought by this time to be fully understood; almost every primer of political economy contains it.

There can be but one answer to "W. A. S. B.'s" questions about his tool smith, but it is equally certain that "W. A. S. B." does not know and does not care whether the two sovereigns with which he pays him were at one time stolen or not. They answer his purpose and discharge their duties equally well in either case. They may for all he cares have been at one time paid for the perpetration of a diabolical crime. They may be blood-stained in the fullest sense of the word. "W. A. S. B." cares not for such things, and if he did he could not help himself.

Your correspondents, in so far as I understand them, seem to say that if gold is spent on certain works instead of others, the community will in the long run be better off. My reply is, that the improvement will not be due to the gold, but to the labour; and furthermore, it remains to be proved that in any case it is possible to spend gold in such a way that it must do more good than it would if spent in another way. I repeat, that so far as the functions of the gold itself are concerned, that is not true. To simplify matters, however, I will state a case for "W. A. S. B.," and ask him for an answer. If £50,000,000 of gold came into this country to-morrow as a free gift, just as a much larger quantity came by discovery into California, how could it be spent to do more good in any one way than another? Let us suppose that there were two great claimants for it, agriculture on the one hand, manufacturers on the other. Is it to be supposed for a moment that the manufacturers could get this gold without benefiting the farmers, fruit growers, meat and wool growers. Is it, on the other hand, conceivable that the farmers getting hold of the money would not do good to the manufacturers? It is the old story of the belly and the members. No matter what the gold is spent on, all the benefits that the gold can confer will be conferred, and "W. A. S. B." has not even attempted to advance a single argument to the contrary. His error is that he attributes to gold powers that it does not possess. Y. X.

London, November 4th.

SIR,—Owing to absence from home I have been unable to reply earlier to your correspondent "Y. X.," but I notice in the meantime that he has been fairly well handled by "Hirn" and "W. A. S. B." in a manner that effectively disposes of many of his contentions. The most striking feature of "Y. X.'s" letters are the glowing inconsistencies between his theories and the examples he advances to prove them. It is difficult to see what the application of political economy, as a science, would be as "Y. X." presents it, for, on the one hand, he tells us that it takes no cognisance of how or why money is obtained, and on the other, that it is of no consequence how it is spent so long as it is distributed. In other words, it matters nothing to the political economist whether the individual makes any return or not for the commodities with which the community provides him. "In any or either case the result is the same; the money has been distributed, and has, to use words in a well-understood sense, given employment." And, again, "So long as a sovereign is spent it is a matter of no importance on what it is spent;" and "so far as the worker is concerned it matters nothing what he produces." All considerations of this sort are, according to "Y. X.," ethics and morals. Well, if this is the case, I think many will agree with me that political economy is a very negative and useless science, and one which is distinctly in want of some ethics in its composition.

If all that is required of money is that it should be "distributed," and that it is of no consequence on what it is spent, will "Y. X." tell us why it is that a country with the soil, climate, and natural advantages of Italy, is in a state of bankruptcy, and its working classes in one of abject poverty? This is a country in which money is distributed and circulated enough in all conscience. What could be a better and more regular distributing agency for the national money than its vast army and navy, and its still more vast army of police, Custom House officers, and officials generally? The amount of stores, clothing, equipment, food, &c., that these men consume, causes the circulation of vast sums of money, and gives employment to thousands of workpeople in every branch of industry.

Why is it then that with an employment—finding and money-spending apparatus greater in proportion to its size and population than any country in Europe, it is at the same time the most poverty stricken? Would "Y.X." suggest that to double the army, navy, officials, &c., of Italy, and so double the amount of money spent among the population, would tend to improve matters? Hardly, I think, but I should not be surprised if he calls such considerations "sentimentalism," and declines to deal with the question accordingly.

As regards the way in which your correspondent disposes of my case of the "pork" millionaire, I readily admit that I know nothing of the details of a pork corner, but yet I fail to see that this affects the case, or even if it does, that, as "Y. X." says, "he distributes more gold among the farmers—*i.e.*, in buying up the pigs—than they would otherwise have got." For suppose the farmer had the day before sold his pig, not to the millionaire, but direct to the butcher for, say, £8, is he not as well off as if he had sold it to the "corner" man for £8, and is not the butcher better off than if he had to pay the latter £9 for it instead of £8 to the farmer? But in case this is not sufficiently convincing for "Y. X.," may I be allowed to quote an actual case recently stated in the daily papers? It is the announcement of the death of M. Wattine, of Roubaix, "whose colossal syndicate 'rig' will long be remembered on the wool markets of Europe. By simultaneous action all over the world the Wattine ring was enabled to buy up all available wool to the amount of 200,000,000f., on which the eventual profit was about 25,000,000f." Instead of a problematical corner in pork, here we have an actual corner in wool, and I fail to find anything in the arguments of "Y. X." which would serve to convince such as myself that the world was better for having to pay 200,000,000f. for 175,000,000f. worth of wool, simply because the persons composing this ring were afterwards gracious enough to "redistribute" in the shape of "employment" the 25,000,000f. which they had previously netted from the public; though if distribution of money is all that is required no doubt "Y. X." regrets that the sum netted was not 50,000,000f.

It will be noticed that in his letter of September 25th "Y. X." says, "It would, perhaps, not be easy to select a worse example of mis-spent money." But, if money can be "mis-spent," how can it be at the same time a matter of no importance on what it is spent? For, if money can be mis-spent, it can surely also be well-spent, and this is the very point which "Y. X." has all along denied, and on which the whole controversy has hung. How can "Y. X." maintain that it is of no importance how money is spent when he says in his letter of October 22nd that the community would be better off if the widow died than if the gardener died? The simple and evident reason is that the gardener does something in return for his sovereign, and the widow does not. It is the same with the army and navy of Italy. They are all "widows," if you will, and very expensive widows too—it is only a question of degree; and if they were "gardeners," or in other words producers, the community of Italy would be equally as better off as the community in the example cited by "Y. X."

There are many other striking inconsistencies in "Y. X.'s" various letters which are evidently apparent to others besides myself, and I think it still remains for him to show a little more convincingly than he has done so far how it can be a matter of indifference to the community how money is either got or spent.

Macclesfield, November 7th. R. G. B.

## GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—If one may judge from the tone of his letter in your issue of the 26th inst., Mr. Kuhne apparently mistakes hard language for righteous indignation. Nevertheless I give the apology he suggests, so far as the apparatus he illustrates is concerned, as it was not until kindly furnished with details by Messrs. J. Storey and Sons, the makers, that I was aware of the improvement necessary to obviate the defect I mentioned, having already been made; and I would have it understood that my remarks referred wholly to the earlier form of the apparatus. At the same time I have reasons for believing that the number of apparatus of the later form represent only a moderate proportion of the Proell apparatus in use; but whether or not the earlier apparatus are still in use, the manufacture was only discontinued at a comparatively recent date, and from Mr. Kuhne's remarks it is admittedly defective. The extent to which it is defective is apparently the only point of difference left; and as Mr. Kuhne says he is unable to show this graphically, except by some cumbersome method, I suppose that is the reason its manufacture was continued so long without those interested finding it out. This may account for the hard language. At any rate the accompanying Figs. 3 and 4 will show that no great stretch of imagination is required to understand that when the apparatus reaches its mid position the bell-crank $R_2$ will pass into gear with its lifter $h_2$, and if the trip takes place immediately afterwards, will prevent the valve falling on its seat until the bell-crank is moved up to its engaging position, when the valve will close. Why this should be cumbersome to show graphically I cannot make out, but I have invented a system of trip gear diagram that will show it very simply, and if it helps Mr. Kuhne to sooner understand the gears he may represent, I shall be perfectly satisfied; if not, then it may interest others. The case taken is that of my previous letter, viz., C O E = 38 deg. negative advance angle and A O F = 6 deg. lead angle. The apparatus is in its extreme position in one direction at the position O M of the crank, and the descending bell-crank will come in contact with its lifter at the position O E, and as both lifters are closely confined by the bridle on the valve stem, whatever movement one makes the other must make also. Bearing this in mind, it will be understood that at any position of the crank the position of both lifters is at once indicated by a line crossing the centre. At the position O H the apparatus is in its mid position, and at O E is in its other extreme. If the trip does not take place before this position is reached, the valve will remain open until the position O V is reached, and consequently the angle between the mid position O H of the apparatus and the position O V produced, that is O G, is the angle during which there is the possibility of the valve being arrested, and for some part of it, determined by the condition of the trip edges, actually is arrested and prevented from closing until O G is reached. If Mr. Kuhne is able to point out where this differs from my calculations and is misleading I shall be glad to stand corrected. It will be understood that in the statement, "If the trip does not take place before this position O E is reached, the valve will remain open until the position O V is reached," only one side of the apparatus has been taken into account; for if by any means the governor could drop far enough to admit of no trip taking place, the valve, instead of closing at O V, would at the position O H produced be lifted by the other side of the apparatus, and so prevented from closing at all. This, however, does not affect the interval of no "control" when the governor is correct—or not—in its adjustment.

Fig. 1

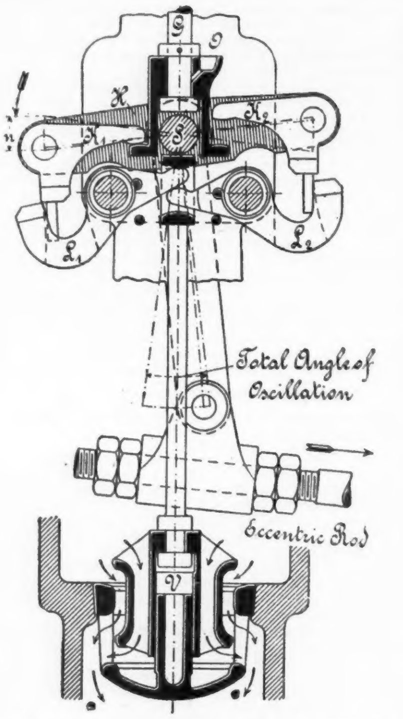


Fig. 2

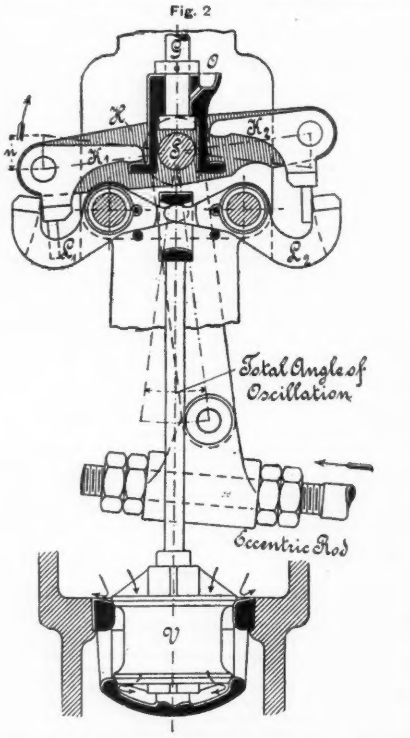


Fig. 3

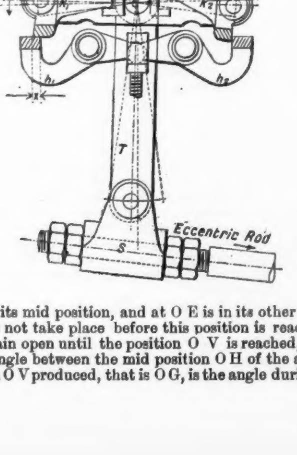
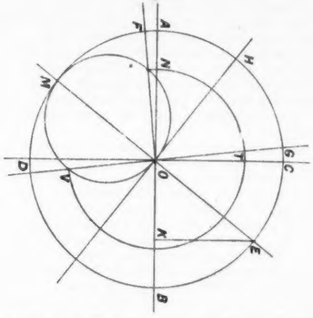
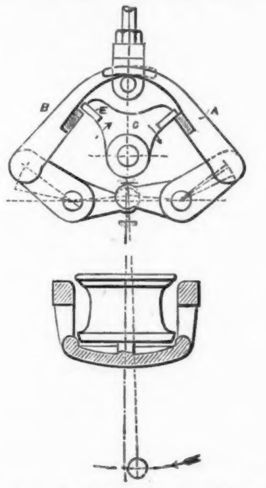


Fig. 4



240, Wallgate, Wigan. JAS. DUNLOP.
October 27th.

SIR,—Will you kindly insert the following in reply to the letter of M. Jas. Dunlop contained in your issue of the 19th instant, which I had only brought under my notice this morning. Regarding the peculiar feature in single-valve automatic trip gear referred to, Mr. Dunlop may rest assured that the peculiarity does not exist in my gear, the enclosed sketch of which will doubtless make this clear. The gear is shown lying in a position a little beyond zero cut-off. The active edge is bearing on the right-hand latch A. It will be evident that should the governor cause the latch A to be released at this point, the idle latch B cannot prevent the valve from closing, as the lever on which it is hung is prevented from rising by means of a spring. At any point of the stroke earlier than this the face E on rising simply pushes the latch B aside, so that should release of the active latch occur during this interval, the valve still seats itself automatically.



Maryport, October 29th. W. CAMERON.

## LOCOMOTIVES AND TRAINS.

SIR,—In last week's issue your correspondent Mr. Buchanan appears to recommend increased rubbing surface on locomotives, but does not say from whence he would obtain the necessary increase of pressure on the brake-blocks, without which it would be useless to increase their surface, which would simply mean that the pressure per unit of area would be proportionately less, the total pressure on the brake-blocks remaining the same. For we have by the second law of friction, that the amount of friction between two surfaces is independent of the extent of surfaces in contact. It is the usual practice to take the whole weight of carriages as brake force or pressure, and 50 per cent. of the weight in the case of engines and tender. If we assume that the forces producing a stop, including brake power, friction, gravity, &c., are constant and acting uniformly throughout the stop, then if

$f$ = the brake force or pressure in percentage of the weight of the train.
$d$ = the distance moved by the train after application of brake.
W = the weight of the train.
$v$ = the velocity in miles per hour.
$x$ = the retardation in percentage of the weight of train.

Then $f = \frac{x}{100}$ W

whence

$$\frac{x}{100}\,\mathrm{W}\,d = \frac{\left(\frac{5280}{3600}\,v\right)^2 \mathrm{W}}{2 \times 32{\cdot}19}$$
$$= \frac{2{\cdot}15\,v^2\,\mathrm{W}}{64{\cdot}38}$$
$$\therefore x = \frac{215}{64{\cdot}38} \cdot \frac{v^2}{a}$$
$$= 3\;34\;\frac{v^2}{d}$$

The wheels of a train should never be allowed to skid, that is to say, become locked to the brake-blocks, for in that case the retarding friction is considerably decreased, owing to there being only the sliding friction between the wheels and rails, instead of the sliding friction between the wheels and brake-blocks, and the rolling friction between the wheels and rails when the wheels do not skid. It is very evident that this will limit the amount of brake force which can be applied to a train without skidding the wheels, which is also dependent upon the velocity of the train when the brake is applied. The coefficient of friction at high speeds is less than at low speeds, consequently the brake force or pressure which may be applied without skidding the wheels is greater in the former than in the latter case. Now a brake is most efficient when it is acting at a maximum pressure without skidding the wheels. It should be applied immediately at this maximum pressure corresponding with the speed of the train at the instant of application, and should graduate down in accordance with the consequent reduction in speed, otherwise the brake pressure which would not be sufficient to skid the wheels at the higher speed would easily do so at the lower speeds. Any deviation one way or the other from this maximum efficient pressure will detract from the efficiency of a brake, in the one case owing to insufficient pressure, and in the other through skidding the wheels as pointed out above. When the train is moving at its highest speed attention to this may be sufficient to avert a collision.

The lesser the difference between the retarding force of the carriages and that of the engine and tender, the less will be the stress on the connecting draw bar. It has, however, been found to be advantageous to give less retarding force to the engine and tender in proportion to its weight, than in the case of the carriages, inasmuch as the consequent drag by the engine and tender on the following vehicles decreases the unpleasant jar which would otherwise occur on the application of the brake.

If we take the weight of the train as given by Mr. F. Bowles in his letter of the 19th ultimo, viz :—

Weight of the two engines and tenders = 162 tons.
Thirteen 6-wheelers 169 tons, and one Pullman 25 tons ... ... ... ... } = 194 tons.
Total ... ... ... ... = 356 tons.

Taking the brake force on the above assumption we have

$$\left(\frac{162}{2} + 194\right) = (81 + 194) = 275 \text{ tons.}$$

The percentage of retarding pressure will be

$$\frac{275}{356}\,100 = 77{\cdot}24 \text{ per cent.}$$

Assuming the average coefficient of friction to be about 0·15, and the speed sixty miles per hour, and applying the preceding formula, we have

$$77{\cdot}24 \times 0{\cdot}15 = 11{\cdot}586 \text{ tons, or say, } 11\ 6 \text{ tons, and}$$

$$11{\cdot}6 = 3{\cdot}34\,\frac{(60)^2}{d}$$

$$\text{whence } d = \frac{3600 \times 3{\cdot}34}{11\ 6} = 1036{\cdot}55\text{ft., or say, } 1037\text{ft.}$$

Now if we take the engines and tenders as fully braked in the same manner as the carriages, we get 100 × 0·15 = 15 tons.

$$\therefore\ 15 = 3{\cdot}34\,\frac{(60)^2}{d}$$

$$\therefore\ d = \frac{3{\cdot}34 \times 3600}{15} = 801{\cdot}6\text{ft., or say, } 802\text{ft.}$$

This gives a saving in stopping distance = (1037 − 802) = 235ft., that is to say, the train would be stopped in a distance of 235ft. less in the latter than in the former case, but the disadvantages might be greater than the advantage gained.

EDWARD J. M. DAVIES.

24, Harrington-square, London, N.W.,
November 5th.

Sir,—I did not in my former letter—which you printed on the 26th—touch upon the question of using two engines for one train, because I do not agreee with Mr. Thompson and Mr. Bowles on this point, and think your article is quite correct. Mr. Thompson's statement that a re-built 6ft. coupled L. N. W. R. engine could—punctually—take a corridor train over Shap with fourteen on is going too far; and when he speaks of an old N. E. R. engine and the work it could do now, he forgets the great increase in the weight of the coaches and the greater booked speed.

I think you will find that locomotive superintendents, drivers, &c., on lines where both six-wheeled and bogie stock is used—like the Caledonian, L. N. W., Midland, G. S. and W. R., &c.—are quite convinced that weight for weight when you have a shorter wheel base and less rigidity the trains are easier to haul, and also cause less wear to the wheels and rails; and that it is chiefly for this reason that the West Coast, G. W. R, G. S. and W. R., Midland, Highland, Caledonian, &c., stock—for fast trains—is all being built on bogies.

As for Mr. J. Y. Buchanan, who was in the Northallerton smash, and his letter to you in your last issue, his general theory that you cannot brake your train too well is most excellent, and he will be surprised to hear that on the East Coast stock only four wheels out of six can be braked, whereas had they been bogie carriages every wheel would have been braked. Things are not so bad as he would make out, however, on the engines, as the driving wheels of all engines fitted with the Westinghouse brake can be instantly so powerfully braked as to skid the wheels—a point just short of this is best—as I have often seen done. I fear Mr. Buchanan lays too much stress on his "area of rubbing surface," whereas the point is the amount of force employed to press the brake blocks on. He is quite right when he says that all the wheels of the locomotive bogie should be braked also; in short, every wheel in the train should be, as is now being done on all the good lines in America. I give above two points in favour of bogie stock, and a third is, that in a smash it does not so easily telescope or collapse; in short, we should have trains of carriages like the Americans, who are nearly half a century ahead of us in passenger stock.

15, Abercromby-place, NORMAN D. MACDONALD.
Edinburgh, November 5th.

Sir,—Mr. Bowles does not answer my question, which was simply, on what railway Mr. McDonald's locomotive with pick-up which he specified might be found. I judged this a matter of interest to other readers besides myself, and do not think I am entitled to the exclusive information he suggests. Of course if the engine is only theoretical, I cannot expect a plain answer to my query. SCRUTATOR.

London, November 2nd.

### TRACTION ENGINES ON ROADS.

Sir,—I have charge of 1029 miles of main road, and find in many cases traction engines have helped to make the roads as they find the weak places, and these once cut out, the bottom carefully pitched, and the top metal consolidated, they do little harm. Given a good road with a hard subsoil, a traction engine is not an excessive weight for an ordinary road, but with wet soft clay or peat the road lifts or puffs, the metal eats through, and the road is ruined.

In this county, hitherto, a very liberal policy has been adopted; it has been thought the roads should be made to carry the traffic, and engines are allowed to run between sunrise and sunset. Your suggestion that the traction licence should pay for the repairs is impracticable—the sum received is so small. The exemption of engines used for agricultural purposes is a mistake, every engine should be licensed, and the county surveyor should have power to stop their use on roads to be specified on the licence, or for any failure to comply with the statutes—two men, a driver and flag man, and occasionally a brakesman, are all that are required.

The present state of agriculture requires every obstacle to progress and transit in rural districts to be removed, and I look to improved traction engines rather than light railways as the solution of the problem, with horse or steam omnibuses carrying parcels, milk, and passengers on definite lines of road, with proper hours of stopping and starting. The difficulties are old and worn-out engines purchased by impecunious men and placed on the roads. The system of purchase hire adopted by the manufacturers stops all improvement. Excessive competition reduces prices, so that a poor class of workmen are employed. Carrying too heavy loads, causing damage to the roads every time the engines stop and start. The greatest of all, defective driving wheels, the use of spikes, and the badly designed diagonal bars. Frightening horses; horses that pass a steam roller quietly are frightened at a traction engine. The horse is an animal very sensitive to smell. Steam rollers are under competent engineers, are kept clean, and good oil is used. Traction engines belonging to private owners are generally as dirty as an old cow, and the cheap oil can be smelt a long way off. The horse dilates his nostrils, and will not face it. They can be seen to do the same thing over a sewer manhole. They do not like the look of the roof lately added to traction engines, and this has caused one or two accidents in this county. Personally, I would not let them run when fox-hunters are about; they hate traction engines.

The existing statistics and legal decisions would enable any authority to ruin a traction engine owner if they wished, but the remedy is a mechanical one. Improve your engines, and opposition will die a natural death. ROBERT PHILLIPS,
County Surveyor for Gloucestershire.

November 6th.

### THE INVENTOR OF THE BLOCK SYSTEM.

Sir,—In your issue of the 25th ult. you state that the late Mr. Edwin Clark was the inventor of the "block system of railway signalling." Mr. Clark's system is not the system of railway signalling compelled to be adopted throughout the United Kingdom. With Mr. Clark's system employed on the London and North-Western Railway between London and Rugby in 1855, one train was allowed in each section, and where tunnels did not intervene a second, third, and fourth train was allowed to follow on the same length if necessary, with a verbal caution from the signalman, after the driver had sufficiently slackened speed to receive such a caution. This is in accordance with the Government Inspector's report before 1865, the date of my publication, and is also mentioned in the late Sir G. Findlay's work upon "Railway Working," &c. In the present system of railway signalling, known as the "absolute block system," commonly termed the "block system," one section is kept empty behind the trains, and with permissive block working a train is allowed in the empty section with a verbal caution to the driver, "station blocked," "section clear."

CHRISTOPHER J. LITTLE, Mem. Soc. Arts.

17, Groombridge-road, South Hackney, N.E.,
November 7th.

### MORE DOUBTS AND SOME CONJECTURES.

Sir,—If I understand Mr. Roots' aright he has advanced a very startling proposition, namely, that the action of gravitation is not universal. If it be, why do the fixed stars retain their relative distances?

The answer is, first, that they do not retain them, but that their distances are so vast that we are unable to measure the rate of change of place; and, secondly, that all the "fixed" stars are rotating in vast circles, so that centrifugal force supplies stability.

Since reading Mr. Roots' letter I have consulted two or three works on astronomy, but I can get no information concerning the opinions of authorities on this point. In fact, the question is as though it had never before been raised. M. A.

Woodstock, November 5th.

### CORROSION OF PROPELLER SHAFTS.

Sir,—You were good enough to publish a letter of mine on a suggested remedy for the corrosion of propeller shafts, together with a sketch. I am sorry to say that there is an obvious mistake in the illustration as given by you. The bevel of the liner on the after end of the shaft should be the same as shown on the forward end, the full lines running out to where the dimension lines terminate. The liner is shown correctly at the forward or coupling end.

London, Oct. 26th. CONSULTING ENGINEER.

### POUNDS WEIGHT.

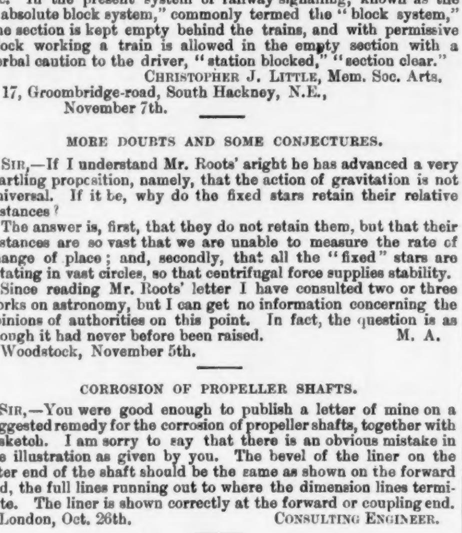
Sir,—In the notice of the new edition of my "Deschanel" in your last issue, the phrase "lbs. weight per square inch" is given, in quotation marks, as one which I carefully insist on. Permit me to say that I have neither insisted upon it nor used it. I employ the ordinary phrase, "lbs. per square inch."

Derryvolgie-avenue, Belfast, J. D. EVERETT.
November 7th.

### A BICYCLE PROBLEM.

Sir,—Will any of your readers be good enough to solve the following problem?

The sketch represents a common form of rear-driving safety bicycle standing on the ground with its cranks vertical. The bottom pedal is pulled by means of a piece of string in the direction indicated by the arrow. In which direction will the bicycle run? J. HARBOTTLE.



18, Crossley-terrace, Newcastle-on-Tyne.

## STEAM ENGINE MAKERS' SOCIETY.

The seventieth anniversary of the above Society, which was established in November, 1824, has during the past week been celebrated in various ways by the different branches throughout the country. The most important of these celebrations was, however, held at Manchester, the headquarters of the Society, on Saturday, when there was a very numerous gathering at the Belle Vue Gardens of members from the surrounding towns, and special interest was given to the occasion by the presence of Sir Wm. H. Bailey, the Mayor of Salford, accompanied by Lady Bailey, and, attended by his Marshal, his worship, wearing his chain of office, receiving quite an ovation, which in large measure was no doubt due to the leading part he has taken in the promotion and successful completion of the Manchester Ship Canal, together with the high reputation he enjoys as an employer of labour in the district. Sir William Bailey, in the course of an interesting address, spoke of his own and Lady Bailey's long connection with the making of steam engines, and pointed to the invention of the printing press and the steam engine as having been foremost in the promotion of peace and prosperity, whilst the marine engine in particular had done much to keep famine away from our shores. Personally he had a great respect for trade combinations. There was just now a great talk of old-age pensions, but so long as they had mutual aid societies similar to their own, the Oddfellows', Foresters', and Druids' societies, he could not see any occasion for the old-age pensions of politicians. The objects of societies like that were to assist their own poor, and so long as they carried out that principle, there was no necessity for the Government to step in, because the moment the Government came on the scene the people were shorn of some of their liberty. As a general rule employers and employed, in their trade at least in Lancashire and Yorkshire, had worked well together in equalising the rate of wages, and the more trades unionists pushed on with their efforts to equalise the rate of wages of their fellow workers in other countries, the better it would be for them in this country. Mr. James Swift, the general secretary, gave some interesting particulars respecting the early history of the Society and its operations since its establishment seventy years ago. He said that as the Combination Laws were repealed in the autumn of 1824, the Steam Engine Makers founded their Society in the November following, and from that time it had retained its position as a bonâ fide trades union. At first it appeared to have been more of a social club, as its rules provided more for entertainment at their meetings than paying its members benefit. This was continued until 1833, when sick and funeral benefit was instituted, and at a later period superannuation and out-of-work benefit. As evidence of what had been done in the past twenty years he gave the following figures, showing the financial operations of the Society. They had paid for unemployed donation and railway fares £74,286; sick benefits, £52,130; funeral benefits, £15,602; superannuation to aged members, £28,130; disabled compensation, £4470; benevolent grants to members, £1558; and contingent benefit, £5100; making a total of £181,384, in addition to which there had been working expenses amounting to £32,254, bringing the full total up to £213,638. The above figures showed that in the twenty years, whilst they had distributed this large sum, only 6 per cent. had gone in strike or lockout pay, and if they deducted the years 1879, 1887, and 1892, this was only 3 per cent. of the total expenditure. Another point was the limited sum spent in management, as in 1893 the working expenses were only equal to 2s. 2d. in the pound. As a Society of seventy years' standing, it might be assumed that they had many old men amongst them, but this was discounted by a table in the annual report, showing that one-half its present membership had been admitted within the last ten years. Another proof was that, whilst they paid superannuation benefit to members, ranging from 6s. to 10s. per week, the average cost in 1893 only averaged 8s. 3d. on the members of the Society. They, however, had seen for some time past that this benefit would be a difficulty in time to come, and six years ago the members decided by vote to create a special fund by voluntary levies, with the result that they had now over £11,000 invested on that account with corporate bodies. As to their general finances, their capital value in June last was over £29,000, with a membership of 6500, and their present value per member was not surpassed by any other trade organisation. Addresses were also delivered by members of the council, branch officers, &c., the intervals being filled up by an excellent vocal programme, which included the "Steam Engine Makers' Trade Song," composed by a member of the Society, and at the close an enthusiastic resolution was passed to Sir Wm. and Lady Bailey for their attendance, and the hope was expressed that they might be long spared to maintain the honour recently conferred upon them.

**Naval Engineer Appointments.**—The following appointments have been made at the Admiralty:—Fleet engineer: J. A. Court, to the Iron Duke. Staff engineer: J. Fielder, to the Minerva. Chief engineers: A. V. Blake, to the Pallas; W. G. Mogg, to the Curlew; and W. T. Wiggins, to the Harrier. Engineers: F. G. George, to the Wizard; G. Pascoe, to the Conflict; W. H. Hardwick, to the Swordfish; G. F. Thompson, to the Mersey; A. Hills, to the Janus; J. T. Willoughby, to the Salmon; and T. W. Christian and W. Edwards, to the Victory. Assistant engineers: G. C. Nicholson, to the Alexandra; and R. W. Martell, to the Conqueror.

**Forthcoming Books.**—Messrs. Whitaker and Co. are about to publish a book on "Steel Works Analysis," by Professor J. O. Arnold. We understand that this work is in many respects a new departure. The book has been written specially as a practical guide to assistants in steel works laboratories and students taking up the analytical chemistry of iron and steel with a view to becoming steel works chemists. A new feature will be found in the fact that in articles separate from the practical instructions, the author has dealt with the theoretical principles involved, and has, as far as possible, formulated every reaction taking place. The same firm are about to publish a book by Mr. J. Alexander upon "Model Engine-making." The work embraces locomotive, marine, and stationary engines, and is accompanied by working drawings to scale and dimensioned. There will be twenty-one of these, each sheet containing a separate form of steam engine.

**Death of Sir D. A. Lange.**—The death is announced of Sir D. A. Lange, of Somers-place, Hyde Park, and Hurstpierpoint. He died suddenly on Friday last, in the shop of a hairdresser in Belgrave-mansions. Sir Daniel Lange was the second son of the late Mr. J. W. Lange, of London, who was descended from an old Amsterdam family. The deceased distinguished himself by his work in connection with the Suez Canal; especially in its earlier days, when he was acting as the agent of the Canal Company in London. He received an appointment in 1858 from Said Pacha, Viceroy of Egypt, in connection with the construction of the canal, and was for some years director in England of some of that work, on the completion of which he received the honour of knighthood from the Queen. He was a fellow of the Royal Geographical Society and of the Society of Antiquaries. He had several foreign orders conferred upon him. He published, among other works, "Reflections on the Desert," "The Suez Canal Viewed in its Political Bearings," and "A Narrative of the Suez Canal Works."

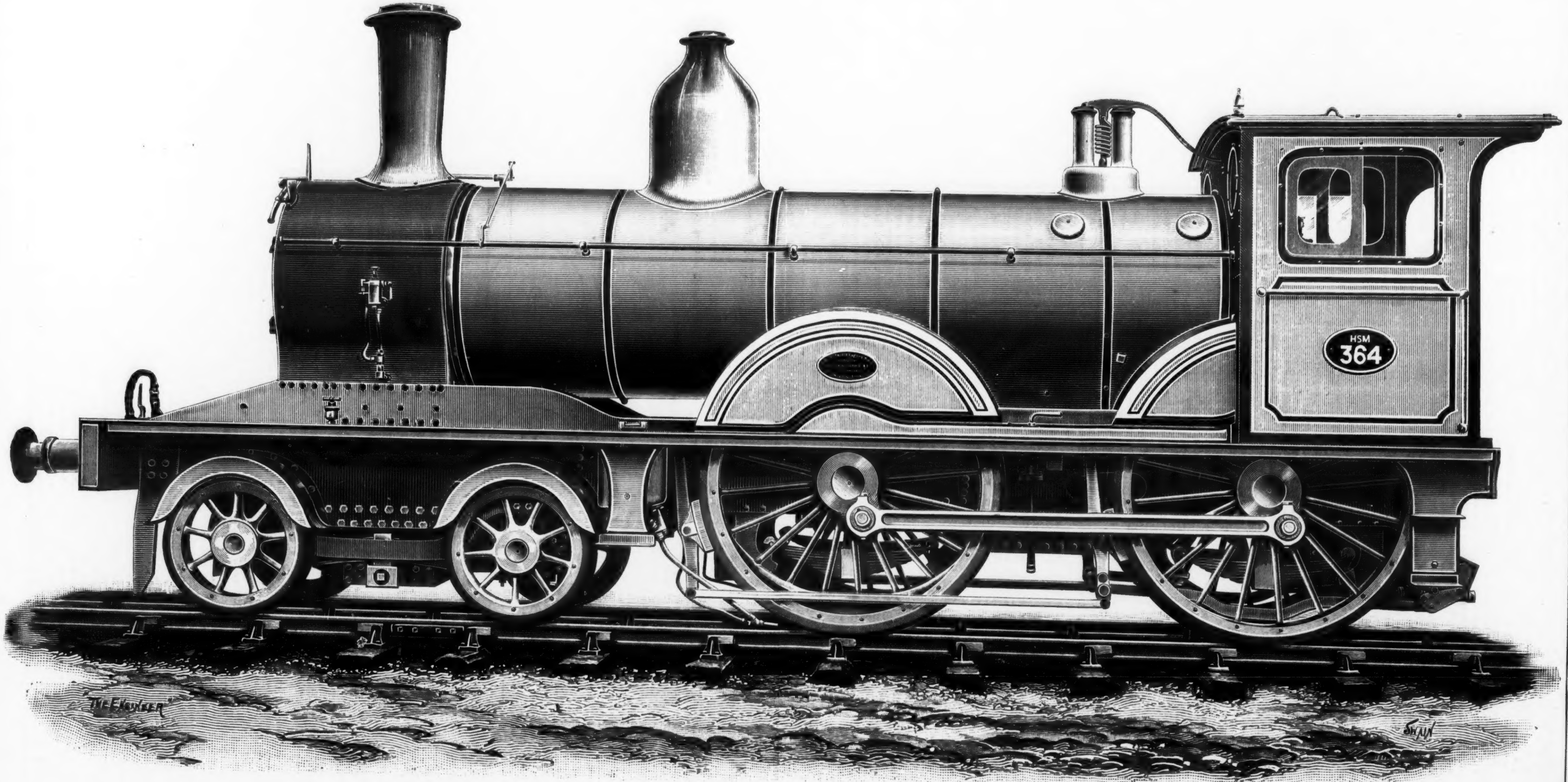
**Society of Arts.**—The arrangements for the 141st session of the Society of Arts are now announced. It commences on the 21st of November with an address from the chairman of the council, Major-General Sir John Donnelly. The first regular paper of the new session will be by Mr. Hiram Maxim on his "Experiments in Aeronautics," and this will be followed the succeeding week by one by Mons. Hermite on "The Electrical Treatment of Sewage." Two other papers—one by Mr. Thomas Ward on "Salt," and one by General Michael on "Forestry"—will be read before Christmas. A number of papers for meetings after Christmas are also announced. Six courses of Cantor Lectures are promised, of which the first is by Professor Vivian Lewes on "Explosives." There will be, as usual, a course of juvenile lectures after Christmas; the lecture this year is by Professor Vernon Boys, the subject being "Waves and Ripples." The meetings of the special sections for the discussion of matters connected with India, foreign countries and the colonies, and applied art, do not commence until after Christmas.

**Utilisation of Electricity in the Construction of Bridges.**—A bridge on the arch principle, with a span of 540ft., is in process of construction over the canal near Kiel, at an elevation of 145ft. above the level of the water, to carry the railway from Eckemforde to that town. Four cranes, two of the locomotive and two of the pivoting type, are employed, instead of the usual hoisting appliances, and are all worked by electricity. According to the *Electrotechnische Leitschrift*, loads of ten tons are raised in twenty minutes, and smaller loads at a much quicker rate. With 850 revolutions per minute, the cranes develope 7-horse power, and the electro-motive force of the current does not exceed 220 volts, with a yield of 84 per cent. Two compound dynamos, disposed in parallel, act as generators, driven by a steam engine of 25-horse power. Both dynamos and electro-motors are of the four-pole type, with two indicator coils of Siemens-Martin steel. As the consumption of the motive-power in the cranes was of a very variable character, variable resistances, composed of spirals of nickeline attached to slabs of slate are interposed, as required, by an automatic appliance. The electric circuit comprises three parallel wires ¼in. in diameter, with a total length in both directions of three-quarters of a mile. In order to work the cranes, which have a dead weight of their own of 33 tons, at a speed of 6in. per second, the electro-motor requires 40 ampères and 210 volts.

# EXPRESS PASSENGER LOCOMOTIVE, DUTCH RAILWAYS—COLOGNE-AMSTERDAM SERVICE

MR J. A. ROESINGH VAN ITERSON, ENGINEER

(*For description see page* 409)


HSM
364
"THE ENGINEER"
SWAIN

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, November 9th, 1894. PAGE
Mineral, Metallurgical, and Coal Industries of Sweden, 1893 397
The Waterloo and City Railway .. .. .. .. .. .. .. .. .. 397
The French Canal des Deux Mers .. .. .. .. .. .. .. .. .. 398
The Union Steamship Company's Mail Steamship Norman .. .. 400
Mersey and Irwell Joint Committee .. .. .. .. .. .. .. .. 400
A New Wire Gauge. (Illustrated.) .. .. .. .. .. .. .. .. 400
Some Peculiarities of Oxidised Linseed Oil .. .. .. .. .. 400
York Sanitary Schemes .. .. .. .. .. .. .. .. .. .. .. .. 400
Railway Matters .. .. .. .. .. .. .. .. .. .. .. .. .. .. 401
Notes and Memoranda .. .. .. .. .. .. .. .. .. .. .. .. .. 401
Miscellanea .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 401
Letters to the Editor—The Theory of the Steam Engine—Labour and Luxuries .. .. .. .. .. .. .. .. .. .. .. 403
Governing Electric Light Engines—Locomotives and Trains .. .. 404
Traction Engines on Roads—The Inventor of the Block System—More Doubts and Some Conjectures—Corrosion of Propeller Shafts—Pounds Weight—A Bicycle Problem.. .. .. .. .. .. 405
Steam Engine Makers' Society .. .. .. .. .. .. .. .. .. .. 405
Leading Articles—English and American Locomotives in the Argentine Republic .. .. .. .. .. .. .. .. .. .. .. .. 407
The Utilisation and Purification of Sewage—Coal Carriage by Land and Sea—Miners' Wives and Miners' Wages—Mine Ventilation in America .. .. .. .. .. .. .. .. .. .. .. .. .. 408
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 409
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. .. 409
Herbert John Allison .. .. .. .. .. .. .. .. .. .. .. .. 409
Allan Duncan Stewart .. .. .. .. .. .. .. .. .. .. .. .. 409
Express Passenger Engine, Dutch Railways. (Illustrated.).. .. 409
Teddington Sewage Works. (Illustrated.) .. .. .. .. .. .. 410
American Engineering News.. .. .. .. .. .. .. .. .. .. .. 412
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire—The North of England.. .. .. .. .. .. .. 413
The Sheffield District—Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. 414
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. .. 415
Selected American Patents .. .. .. .. .. .. .. .. .. .. .. 416
Paragraphs—Royal Institution of Great Britain, 398—Engineering Society, King's College, London, 398—Search for Coal in East Anglia: Commencement of Operations, 400—Society of Arts, 405—Forthcoming Books, 405—Utilisation of Electricity in the Construction of Bridges, 405—Naval Engineer Appointments, 405.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

### PISTON-ROD PACKING.

(*To the Editor of The Engineer.*)

Sir,—Will any reader tell me whether the metallic packing now so much in favour has a tendency to corrode the rods as asbestos, indiarubber, hemp, and, indeed, all other packing has in a greater or lesser degree?

Gland.

Limehouse, November 8th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, November 13th, at 8 p.m. Address by Sir Robert Rawlinson, K.C.B., the President, and presentation of medals, premiums, scholarships, and prizes awarded at the close of last session. Friday, November 16th, at 8 p.m. Students' meeting. Paper: "The Economics of Direct Current Central Stations," by Mr. John F. C. Snell, Student Inst. C.E., Dr. Alex. B. W. Kennedy, F.R.S., Member of Council, in the chair.

Institute of Marine Engineers.—Monday, November 12th, at 7.30 p.m. Paper: "Some Considerations on the Causes Affecting the Commercial Speed of Steamships," by Mr. J. D. Young, member.

Cleveland Institution of Engineers.—Monday, November 12th, at 7.30 p.m. Paper: "On Different Types of Basic Open Hearth Steel Furnaces," by Mr. Bernard Dawson, Malvern Link.

Northern Society of Electrical Engineers.—Monday, November 12th, at Palatine Hotel, Hunt's Bank, Manchester. at 8 p.m. Paper: "Lighting Installations," by H. A. Henderson, member.

## DEATHS.

On October 31st, at Innerhadden, Allan Duncan Stewart, M. Inst. C.E., of Bunrannoch and Strathgarry, aged sixty-three.

On the 6th inst. at Borstal House, Norwood-road, Herne Hill, Herbert John Allison, Librarian of her Majesty's Patent-office, aged sixty-five.

# THE ENGINEER.

*NOVEMBER* 9, 1894.

## ENGLISH AND AMERICAN LOCOMOTIVES IN THE ARGENTINE REPUBLIC.

In Argentina are two considerable railways. One is the Buenos Ayres Western, and the other is the Buenos Ayres Great Southern. For our present purpose it is unnecessary to go into any details of the construction of these lines. It suffices to say that they exist, and are important financial undertakings. The half-yearly reports of both lines have recently been made public, and are, perhaps, to be regarded as in the main satisfactory. The interest in the lines for our readers lies in the fact that the locomotives of one line are American, and of the other English. The Great Southern Railway is worked exclusively by engines designed and built in Manchester. The locomotives of the Western line have, we believe, all been constructed by Messrs. Baldwin. For some reason which we are unable to give, it was said that the Great Southern Railway could be worked much better by Baldwin, or, at all events, by American, than by English engines. Just twelve months ago a report on the question thus raised was prepared by Messrs. Elordi and Esteves, two Argentine engineers, and this report has been very extensively circulated. It is altogether damaging to the English engines; altogether in favour of the American locomotive, and in every way curious reading, exemplifying as it does the methods by which engines built in the United States are pushed into favour without any special regard for the facts. It will not be unprofitable to consider the report in a little detail.

Messrs. Elordi and Esteves begin by saying that they have found it necessary to make a comparative study of the rolling stock of the two roads. They admit that as regards quality of material and strength the English engines are all that could be desired, but "the builders did not take into account the character of the road bed and track on which the engines had to run, and therefore made them too heavy and the wheel-base too rigid." This is, of course, the old, old story. The English engine is too good for the roads, or the country, or the climate. If only it was worse it would give more satisfaction. "It may be concluded," say Messrs. Elordi and Esteves, "from all the data furnished in this report that the Southern Railway locomotives are but iron masses, entirely injurious to the roads and interests of the company." Now it forms no part of our purpose to defend English locomotive builders against any and every assault. On the contrary, we have very frequently urged that they ought to take more care than they do to supply engines suitable to the imperfect track of new countries. In Great Britain is the best permanent way in the world, and its excellence has no doubt in a measure disqualified English engineers for the work of constructing colonial locomotives. But it has by no means wholly unfitted them for the task. They have not been slow to acquire information and experience; and if they were given a free hand any one of all the great British locomotive building firms could supply suitable engines for any quality of road. It is matter of common knowledge, however, that locomotives for use abroad are usually designed, as far as regards their principal characteristics, by civil engineers who possess no specialised knowledge of the locomotive. It so happens that information is available outside Mr. Elordi's report which enables us to test its accuracy and form an estimate of its value. At the outset there is of course strong presumptive evidence that the American engine, whatever its defects may be, will be a better vehicle for a bad road than the English engine. In the present case, however, this presumption is not supported by the facts save to a very limited extent. One way in which the suitability or the reverse of locomotives for a given road may be tested is by an examination of the working expenses. It is not of course conclusive, but it is good as far as it goes. Now in 1893 for the first half year the working expenses of the Great Southern road were 40·72 per cent. of the total receipts, while those of the Western road, worked with American engines, were 41·95 per cent. There is no great difference here to the credit of American rolling stock. But in the first half of the present year there is a very great difference to the credit of the English engine. The working expenses of the Southern line dropped to 37·15 per cent. of the gross receipts, while on the Western line they rose to 46·95 per cent. Of course, it is to be understood that many conditions affect the working expenses; but it is fair to conclude that if the English engines are "mere masses of iron," it is unlikely that the working expenses should show so considerable a reduction as that we have just stated.

It would occupy much more space than we can spare to follow Messrs. Elordi and Esteves through their report. We find on almost every page of it statements which show that its authors have not mastered all the facts, or having mastered them, have not made them public. We shall confine ourselves at present to one point—the relative merits of the two classes of engine regarded as vehicles, for that is indeed the principal question. The English engines have all been supplied by Messrs. Beyer and Peacock, of Manchester; the American engines by Messrs. Baldwin. As regards weight only, there is little to choose, many of the American engines being heavier than the English. It is a noteworthy circumstance that the English engines very closely resemble in general outline the American engines. For example, Class 5, on the Southern road, a fast passenger engine, is carried on a four-wheeled bogie, one pair of driving wheels, and a pair of trailing wheels. It has outside 16in. cylinders, 24in. stroke, and 6ft. 6in. single drivers. The Baldwin engine on the Western road, which is nearest in characteristics, has also, *mirabile dictu*, single drivers, 6ft. 6in. in diameter. It has a four-wheeled bogie and a pair of trailing wheels, but the cylinders are 18in. by 24in. The load on the drivers is about 16 tons, unless we are mistaken. In the English engine the load does not much exceed 13 tons. In this case it is easy to see that, so far as mere weight is concerned, the English engine has the advantage. In goods engines, again, an interesting comparison may be drawn between the Southern class 7 and the Western class 15. Both have six-coupled wheels, and a pony or two-wheeled truck in front; both have outside cylinders, 18in. by 24in. in the English, and 18in. by 24in. in the Baldwin engine; the latter has, however, 4ft. 6in. drivers, and the former 5ft. 1½in. drivers, but the English engine carries 150 lb., and the American 135 lb. pressure. In both engines the loads are very evenly distributed. Messrs. Elordi and Esteves particularly insist on the want of flexibility in the English engines because of the absence of balance beams. In the single driver English engine there are no beams, in the American engine there are beams between the 6ft. 6in. drivers and the 3ft. trailers. But the goods engines have both got balancing beams; between the leading and driving wheels in the English engine, and between the driving and trailing wheels in the American engine. The wheel base of the latter is much greater than that of the former engine. We might extend this comparison to other engines if it were necessary. Broadly, the fact is that Messrs. Beyer and Peacock have in these engines modified English practice and given their locomotives flexibility, outside cylinders, &c., until it is very difficult to see in what respect the American engine can be superior to the English, regarded as a vehicle. We turn, however, to Messrs. Elordi and Esteves for information on this point, and we get very little. The distribution of weight given for American engines appears to us in many cases to be of doubtful accuracy. We are not told that Messrs. Elordi and Esteves weighed the American engines; and nothing short of an assurance that they had done this would convince us that the figures given are correct. But above and beyond all this, we may ask ourselves what there is about the American engine to make it more flexible than the English? In the latter we find plate frames, in the American engine bar frames. The plate frame should be at least as flexible transversely as the bar frame. Furthermore, in English practice the boiler is only secured to the frames at the smoke box end. The fire box is carried on two angle iron sliding pieces, so that it can expand or contract as it pleases; and possesses, as every railway man knows, considerable latitude of movement; but the American engineer ties his frames to the boiler, in the middle and at each end. Nothing can be more rigid than this combination; nothing more likely to throw injurious stress on the boiler seams. So far, the English engine is more flexible than the American. Again, as regards power of radiating, there is nothing to choose; each has a bogie. In the extended use of compensating levers or balance beams lies the difference. There is more vertical flexibility in the American than in the English engine; but this is not so much, we think, due to the absence of compensating levers—because they are not absent—as to the comparative stiffness of the English springs. Curiously enough, moreover, Messrs. Elordi and Esteves grumble because in one class of English engine they find a transverse compensating lever from one side of the engine to the other, while they are unstinted in their appreciation of a similar device used in American engines.

To sum up this question, the locomotive as a vehicle—would be to write much that has already appeared in our pages. On bad roads, and for moderate speeds, long, easy springs and compensating levers are necessary. On first-class roads, such as those of England, compensating levers and flexible springs are of very doubtful advantage, and at high speeds are a positive source of danger, especially when a train is travelling fast down hill. Under such circumstances the engine is very likely to begin to roll, and finally, if left to itself, to roll off the road. Long springs without compensating levers are better, and they have been found indispensable in France, where the roads are weak. Generally it may be said that on all foreign roads the springs have nearly double the range found best for this country. We believe that English locomotive builders are prone to make their springs too short and too stiff for colonial work; but this seems to be the head and front of their offending; and so far as we are aware Messrs. Beyer and Peacock appear to have avoided this fault in their Argentine engines. Perhaps the springs are not quite so flexible as they might be; but it does not appear that they in any way justify Mr. Esteve's strictures.

Concerning other portions of Messrs. Elordi and Esteves' report we may have more to write at another time, and we should very much like to know what Mr. Gould, the locomotive superintendent of the Southern road, has to say on the subject. Various statements are open to question. The assertion that the American engines can be kept in perfect repair for an outlay of £50 per annum is too much for any exercise of faith. But what can we say to such a statement as the following: "The high-pressure, 160 lb. per square inch, at which the boiler is worked, becomes necessary to overcome somewhat the lack of adhesion." Surely there is here a most ingenious "derangement of epitaphs." The connection between boiler pressure and adhesion existing in the minds of the men who wrote the passage is, to say the least, mysterious. The figures put down for the consumption of coal by the American engines agree with nothing that we have read of in United States railway practice. For passenger trains of 120 tons we can believe that the consumption was as low as 31 lb. per mile; but when we are told that the goods engines only burn 43 lb., we are driven to conclude that the freight trains cannot be much heavier, and we ask why 19in. cylinders are used. Concerning compound engines, too, Messrs. Elordi and Esteves make certain statements which are well worth examination. The report as a whole bears, however, such inherent evidence of bias and prejudice that it loses much of the scientific value which it ought to possess.

### THE UTILISATION AND PURIFICATION OF SEWAGE.

It is by no means an uncommon error to confound the purification of sewage with the utilisation of it, although in many instances the one process is totally distinct from the other. While it is true that the utilisation of sewage frequently does include the purification of it, in both an incipient, and subsequently more thoroughly effectual stage, the latter operation can be and is carried out in districts and localities where there is not the slightest reference to, or intention of, effecting any utilisation whatever, in the proper signification of the term. The word, in the present article, will be understood to mean such an employment of sewage in the service of agriculture, as will extract and utilise all, or nearly all, of the fertilising properties it contains, and will result in the production and growth of plants and crops of various descriptions. Regarded in this sense it is — without reverting for corroboration to the present seat of Oriental warfare—the oldest method adopted for dealing with a national and social problem, which in point of magnitude, gravity, and urgency, has now assumed proportions which have rarely been equalled and probably never surpassed. Bunzlau, in Prussia, can boast of having utilised sewage for over three hundred years. The far-famed and continually-quoted meadows of Craigentenny, near Edinburgh, can date back to nearly a couple of centuries, and the city of Milan is also well to the front on the score of antiquity. It will not, we think, be denied that without dispraising or underrating the value or efficiency of other methods of dealing with sewage separately or combined, such as sedimentation, precipitation, filtration, or by the use of chemicals, yet the generally received opinion is that under certain conditions the fulfilment of which is not optional but imperative, the most effective means of treating it is by causing it to pass over and through land. Whether the agricultural utilisation of sewage should include a preliminary process of purification or clarification before it is passed on to the land, not necessarily by chemicals, is a subject concerning which engineers and scientists are not altogether agreed. In other words, should sewage in its crude or raw state be applied to land? When so applied does it cause the land to become sewage sick, or so saturated with noxious and septic elements as to become dangerous to the health and lives of the neighbouring population? Something depends upon the nature of the soil constituting the sewage farm, but a great deal more upon the character and quality of the sewage itself, as we shall point out.

It is asserted, very naturally, in support of the direct application of raw sewage to land, that at Edinburgh no ill effects, either with respect to the land or the people, have resulted from the irrigation of it for ages, in the foulest and coarsest form, and applied in the rudest and most primitive manner. It should not, however, be forgotten that this statement should be qualified by another, which is to the effect that the Craigentenny meadows are never allowed to be saturated persistently with sewage. When a sufficient quantity has been run on to them, the surplus is carried away to the sea. At Berlin, which with its acquired land of 19,000 acres for sewage farms, is supposed to set an example to the rest of the world, both the broad irrigation and filtration principles are put into practice. A difference worth notice is made in the treatment of the plots upon which crops are grown and those used for the cultivation of grass. In irrigating the former, the sludge is allowed to pass on to the land with the sewage, and consequently remains there after irrigation, when it is ploughed deeply into the ground. In the case of the sewaging of the grass plots there are catch pits provided which intercept the sludge, as it was found that it clogged the surface and seriously interfered with the growth of the grass. When raw sewage is turned on to land, the latter acts, no doubt, in the first place as a simple mechanical filter, leaving the heavier and coarser particles on the surface. The liquid portion which contains the dissolved ingredients, and the lighter and smaller particles in suspension, penetrates into the soil, and thus accomplishes the double purification already referred to. If it is simply a question of removing the larger particles only, the result can be obtained by upward filtration through successive layers of a coarse medium. It must be kept in view that purification, so as to procure a pure effluent, which generally finds its way into a running stream, is the first point to be aimed at; the question of a remunerative return or revenue from the land, sludge, artificial manure, or other manufactured residue, being altogether a secondary consideration. In truth, there is very little necessity to trouble about these made articles, as they rarely sell for anything, although they have been quoted at the fabulous prices of £3 and £4 per ton. The sewage farms at Gennevilliers, near Paris, have been held up here as a pattern for our imitation, and as a kind of reproach to us for the manner in which we deal with the sewage of our own metropolis. We add a few chemicals to a minimum daily discharge of 150,000,000 gallons, and then pump the whole into a river that any capital in the world might be well proud of, to the contamination and pollution of its foreshore, and to the annoyance and danger of those having the misfortune to reside in the neighbourhood of the outfalls. In France, the utilisation of Parisian sewage at Gennevilliers is not regarded with quite the same admiration which appears to be accorded to it here. Some of the French engineers do not consider it by any means in the light of a scientific, economical, or practical utilisation of the alimentary and fertilising properties of the raw material. No doubt the farmers are strongly in favour of the present system, and unquestionably raise very fine crops, considering that they pay nothing for the sewage, which is over abundant in quantity, and exceedingly rich and productive in quality. The whole process has been described as a reckless agricultural waste.

That the composition of the sewage itself is an important factor in the method to be adopted for its utilisation is rendered indisputably manifest by the experience gained at Wolverhampton. The sewage farm there was purchased some twenty-five years ago, and occupied a site possessing the advantages of receiving nearly all the sewage of the borough by simple gravitation. For some years the local authorities made most laudable attempts to effect agricultural utilisation by means of the broad irrigation principle, and that of intermittent downward filtration. Their efforts were unfortunately all in vain, and they were ultimately driven to the conclusion that precipitation, or a preliminary treatment of the raw material in some form or another, must be undertaken before it could, with any beneficial results, be turned on to the land. The fact was that the sewage was rendered so foul by the quantity of refuse, waste water, and bye-products of the numerous trades and manufactures in the town and district, that it was utterly unfit to be applied directly in its crude state to the soil. It was found that when the sewage of only fifty persons to one acre was the proportion employed, the purification effected was of a most perfunctory character, notwithstanding that the percolation extended to a maximum depth of 6ft. By excluding as much as possible the storm waters from the sewers, by the construction of precipitation works, by the erection of plant for pressing and consolidating the sludge, and by the proper preparation of the quantity of land for the final treatment of the effluent, the Sewerage Committee has successfully overcome the difficulties formerly besetting it. Bad as the raw material was at Wolverhampton, that which the Local Board of Nuneaton had to contend with was many degrees coarser and fouler. It was useless to think of irrigating land with a fluid containing ingredients absolutely destructive to all plants, crops, and indeed to all vegetable life. For many years the lime process was employed, then the lime and alumina process, and at present chemical precipitation has been supplemented by filtration through sand and polarite. This treatment is an example of purification only, since the effluent water, after passing from the settling tanks to the artificial filters, is discharged into the nearest stream. It sometimes occurs, in spite of all care and attention in mixing the chemicals, that the clarification is of so imperfect and unsatisfactory a character, that it becomes necessary to pump it up again for fresh treatment, before allowing it to pass into the filters, which are not intended for the filtration of the grosser particles of matter held in suspension.

The purification of sewage simple and pure differs from the utilisation of it, inasmuch as its object is to produce an effluent of a certain standard quality, without much concerning itself about the fertilising qualities possessed by the raw material, although it cannot at the same time afford wholly to neglect them. A simple and very natural process of purification is effected in principle on a certain scale by the agency of rivers. They appear to accomplish this result partly by chemical, partly by mechanical, and partly by biological action. Experiments were recently made in the river Spree, with the object of more fully investigating this question, but, from the unfavourable nature of the stream and other physical features, it was impossible to arrive at any satisfactory conclusion. Although the principle of chemical precipitation is the same for all the different mixtures, the variety in them is almost infinite, and the result in all cases "sludge," which is usually given away to any one who will take it off the premises.

It is alleged that chemical precipitation does not purify but only clarifies raw sewage; and in a very great number of instances the statement is perfectly accurate. It is also asserted, while granting that the purification is effected, that it is only of a temporary character, and that if the effluent be discharged into a river, it will, after a brief period, revert to the same condition of impurity and pollution which it possessed previously to precipitation. It must, however, in fairness be admitted on the other side that experiments conducted at Salford with polarite, and also with an electrolytic process, tend to rebut the temporary theory. The last-named and most recent method of treating sewage seems to promise well, but it has not yet reached a sufficiently advanced stage to enable its merits to be definitely pronounced upon, and its cost is said to be rather high.

Owing to the ever-recurring difficulty of obtaining land for sewage farms, partly due to its high price and partly to the actual scarcity of suitable sites, the cultivation of them has never really had fair play, at any rate in England. It is scarcely possible to avoid at certain times drenching the land with an over dose, and in this respect the farms here are more heavily drawn upon than in Germany. In 1875 a Commission was appointed to investigate and report upon the whole question of the purification of the Seine, with the object of acquiring a part of the forest of St. Germain for purposes of utilisation. The Commission arrived at the conclusion that while the land required was capable of purifying 710,000 cubic feet per acre per year, it would utilise agriculturally only one-fifth of this quantity. Upon this basis it was estimated that 150,000 acres would be needed to accomplish the utilisation of the total sewage of Paris, while 10,000 would suffice for the simple purification of it, provided a suitable outlet was secured for the percolating fluid. Since the population of London may be taken at twice that of the capital of France, the corresponding figures for our metropolis would be 300,000 and 20,000 acres respectively. Calculating from the results obtained at Berlin, 60,000 acres would be sufficient to utilise the sewage of London, an area which accords far better with the usual proportion between population and acreage than the extravagant estimate proposed for the city of Paris.

◆◆◆

### COAL CARRIAGE BY LAND AND SEA.

It is now definitely stated that the question as to the "increase" of rates for the carriage of coal by railways will be brought before some of the authorities for decision. It may be remembered that at the beginning of last year there was a change in the method of charging for carriage of coal—that is to say, that the "ton" was brought down from 21 cwt. to 20 cwt., and the contention of the coal merchants is that there should be a corresponding reduction in the cost of conveyance. For months the question has been agitated; and last month a deputation from the Society of Coal Merchants waited on the managers of the railways and explained their views. The coal merchants agree that there is no likelihood of going back to the carriage of 21 cwt. to the "ton," but that the change for carriage for the ton should be lowered in proportion. On the average it is claimed that the alteration in the method of assessing the charge means an alteration of about 2¾d. per ton, and with such a reduction the coal merchants would be content. But whilst the sum is small in the actual variation for the ton, it is very large in the aggregate, whether regarded by the coalowners or the railways; and it is not likely that it will be readily disposed of. There are, however, other questions that interfere with the ultimate decision—the relation of the railway rates to the freight on coal carried by sea. It is sometimes pointed out that the sea freight on coal is "only 3s. 4½d. per ton," but this is an inadequate statement. It is that rate on the summer average; but in winter the rate rises to 4s., and even higher; and it must not be forgotten that there is to be added to that the cost of the railway carriage from the colliery to the coal-port, which may vary from 1s. 6d. to 2s. 10d. per ton, so that the cost in the Thames is very different for carriage from the 3s. 4½d. that is put forward. The percentage of small produced is very much larger in sea borne than in land borne coal. On the other hand, the railway charge is that from colliery to depôt, so that the charge is known, but that of the sea-borne coal is from port to port only. It would be well if the question could be so treated that the public could grasp the relative cost of the coal, of its carriage by the two methods, and of the way in which the total tion is adopted now "employ about 90 per cent. of the charge for coal in the metropolis is arrived at, for on all these subjects there is only a very limited knowledge amongst the general public. The legal investigation of the question that seems likely now to ensue in consequence of the change in the nature of the "ton" will probably do much to enlighten the consumers as to the actual sums paid for coal, for carriage, and for cartage; and it will also throw light on the relative cheapness of the two methods of carriage by which the supply of the metropolis and other centres of consumption is effected.

### MINERS' WIVES AND MINERS' WAGES.

At Parkgate, near Rotherham, on Monday night, Mr. Benjamin Pickard, M.P., was presented with a handsome marble clock, on solid bronze pillars, this being a gift subscribed for by the miners' wives of Rawmarsh and Parkgate, as "a tribute of esteem for the services rendered to the miners during the late coal war." The occasion was chiefly interesting through some remarks made by Mr. Pickard on the coal trade, with special reference to the work which had been done by the miners' wives. He mentioned that in 1880 there were only about 6000 members on the roll of the Yorkshire Miners' Association. The figures, we believe, are now at least ten times that amount. The men were directly appealed to, but the chief influence, it appears, in increasing the numbers and extending the influence of that admittedly powerful Union, was, as Mr. Pickard puts it, "tea parties all over the county to get the sympathy and assistance of the miners' wives." "When the stoppage of last year took place," he added, "no woman who compelled her husband to pay the contribution of sixpence per week regretted the action she had taken. All the money saved, and a great deal more, was returned to the branches, so that the women and children had a fair share so long as there was anything left." It is certainly the case that during the late stoppage the miners' wives of England differed very much from those in Scotland. The Scotch wives, in many cases, were against their husbands remaining idle, while in England the women were amongst the most active supporters of the strike, and have always been the first to make unpopular any collier who was disposed to resume work without obtaining the consent of his Union. Mr. Pickard holds still that the coalowners had no right to require a reduction. "The owners," he says, "knew they were making vast profits, and he is convinced that the money made in collieries was lost through being invested in other works and in large establishments." Mr. Pickard said that they had paid £30,000 to Scotland to help the miners there, and the total amount sent by the Miners' Federation was £74,000 to £75,000. Of the £30,000 sent from Yorkshire, the Yorkshire miners had contributed £24,000 directly out of their own pockets. Mr. Pickard gave it as his opinion that the drift of colliery extension clearly showed that in fifty or a hundred years Doncaster would be the centre of mining, just as Barnsley was the present headquarters. He was sarcastic enough in pointing out that some colliery owners, who had been complaining that they were not making money, had invested £300,000 and sometimes £400,000 in a new colliery, "the money having been previously made out of the old-going concern."

### MINE VENTILATION IN AMERICA.

In no recent official statement is the determination of the methods of colliery ventilation more clearly shown than in the coal reports for the State of Illinois, to which we have already made some reference in The Engineer. A series of reports as to the methods of ventilation are given, and a comparison is drawn between the methods in use in the years 1887 and 1893, which we may summarise as under:—1887, fans, 176; furnace, 286; steam, 27; natural, 304; 1893, fans, 286; furnace, 189; steam, 20; natural, 251. There were slightly fewer mines at work in the latter than in the earlier year, the tendency being in the American coalfield, as in many others, towards a production from fewer and larger mines. It will be seen from the above abstract that the use of the fan is growing with some rapidity, and at the cost of the furnace and other methods of ventilation, and this is even more apparent when the class of mine is remembered. In the official volume to which we have referred it is distinctly stated that the mines in which the fan method of ventilation is adopted now "employ about 90 per cent. of the miners in that State." Seven years ago each of these collieries had, on the average, only 81 mines employed, but now they have about 106, which is a higher average than that of those mines ventilating by other methods; and there is a further fact that is of value in this connection—the mines that are ventilated by fan are the deepest of those that are working, so that measured by numbers or by extent of work, the fan is now doing much the most of the work in the mines of Illinois. These ventilating fans are not large in comparison with those in some of our own mining districts. Two of those added in the past year are "Murphy fans, 6ft. in diameter;" another of the new fans is 10ft. in diameter, and a third 15ft., whilst a Guibal fan 18ft., and another of 20ft. are amongst the largest that are named in the reports for the past year, though there are evidently some others previously in use of a larger size. The facts we have named, however, are conclusive as to the increased dependence that is being placed in the coalfield we have named on the ventilating fan, and it is probable that its efficiency and its economy will, with the growth of the mining industry, cause it to be more and more preferred in the future.

## LITERATURE.

*Electric Light Installations.* By Sir David Salomons. 3 vols. Seventh edition. London: Whittaker and Co. 1894.

*Portative Electricity.* By J. L. Niblett. London: Biggs and Co. 1894.

Sir David Salomons is so well known as the author of a very useful book upon the management of electric light installations, that a revised work from his pen needs little notice on our part to make it widely known. The seventh edition, which is in three volumes instead of one, is stated to be mostly re-written. Vol. I. deals with the management of accumulators, and a comparison of it with the portion of the sixth edition, which dealt with the same subject, shows how much additional matter has been added. The introduction remains as before, but the author now takes a wider view of his subject, and describes types of cells which are used in other parts of the world besides England; and whereas in the earlier editions the descriptive matter related almost solely to the electrical power storage cells, we now have references to such cells as the Tudor, Epstein, Lithanode, and Crompton-Howell. The author describes in his usual lucid manner the method of setting up the cells, and gives very practical hints for the avoidance of difficulties. He draws particular attention to the changes in appearance of the surface of the plates during the processes of charging and discharging. The chapter on "Failures and their Causes and Remedies" is perhaps the most valuable to owners of installations who are not electricians.

Vol. II. deals with apparatus, and an explanatory note is prefixed informing the reader that in this volume a certain amount of information is given regarding the mode of use of the apparatus, but as a rule the general description of the apparatus is given in the second volume, while any special application of it is reserved for Vol. III. The author points out that it may appear at first sight as though the author were prejudiced in favour of certain manufacturers, but he has simply selected the foremost types, which admits of the fact that other makers construct similar apparatus probably as good as the instruments illustrated in this work. Had the products of all known manufacturers been described, a mere illustrated catalogue would have been obtained. In his chapter upon dynamos and motors the author alludes to the number of persons now experimenting with alternating currents having very high frequency and high electromotive force, and describes an alternator built to the designs of himself and Mr. Pyke for experiments in this line. The experiments alluded to are in the same direction as those of Mr. Tesla. A considerable amount of space is given to the description of various types of governors, and several patterns made by the author are illustrated. At the end of the volume are a number of illustrations intended to show some of the many practical uses to which electricity has been put. The book in its present form is more useful than any of the earlier editions, and contains much more information.

Mr. Niblett has had very great practical experience in the subject upon which he writes, so that his work should be of value. He believes that no book has hitherto been written which affords concrete information with reference to the uses and management of portable apparatus for storing electrical energy. The treatise is not intended so much for the use of electrical engineers as for the guidance of those in possession of small secondary batteries; the author has therefore endeavoured to avoid technicalities as far as possible. Comparative tests of the Lithanode and other miners' lamps were made at the Rochebelle mines in Belgium, and the Lithanode lamp was found to be very satisfactory. A translation is given of the report of the mining engineers, from which it appears that these lamps were tested for considerable periods, and found to be superior to the oil lamps in ordinary use. It is somewhat astonishing that so little progress has been made in the practical application of these lamps. Some little time ago many of the London omnibuses were fitted with batteries of this type, and the inspectors were provided with small neat lamps, which appeared to be very convenient; but we have heard nothing of the work lately. Whether the fact that one company was fined for allowing travelling without lights—after the charge in the batteries was expended—led to disuse of the system we cannot say, but the fact remains that it does not appear to make much progress.

It is stated that Custom-House officers are in future to be supplied with the portable electric lamps when looking for contraband goods on board petroleum boats. The application of electric lamps to surgical purposes is described, and also for the exploration of earth borings upon the plan invented by M. Trouvé, who uses an instrument called the erygmatoscope. Details are given of the application of the light to gun sights, and to electric launches, divers' helmets, cycles, and sundry other uses. The author then passes on to a description of the application of the light to decorative purposes, and gives an interesting account of the methods of applying batteries and lamps for use on the stage. The author deals with detectors for explosive gases, and describes his own apparatus, the action of which depends upon the effect of the explosive gas upon oxygen occluded by platinum black surrounding the bulb of a mercurial thermometer.

We believe an extension of the use of small secondary batteries will gradually take place as the use of electricity in private houses becomes more common. When persons can charge their own batteries off the public supply circuits with ease, a greater demand for carriage and other lamps must take place. The book is a useful little work, and gives in convenient form data which previously were scattered in various technical journals.

*Newfoundland as it is in* 1894. *A Handbook and Tourist's Guide to Newfoundland.* By the Rev. M. Harvey, LL.D., F.R.S.C. Published by Kegan, Paul, Trench, Trübner and Co. 1894.

This is a valuable addition to the already long list of handbooks. The question of fishing rights has been so long and so frequently before the public, that the full information here given of this important fishery, and the oldest of our Colonies, will be of peculiar interest. The advantages of the island, however, from an agricultural point of view, the richness of its forests and its mineral wealth, were entirely concealed until some seventy years ago. It has an almost equal length and breadth of 316 miles; its area is 42,000 square miles. Its climate is more temperate than that of North America, though colder than lands of the same latitude in the Old World. Its fishery trade was for generations monopolised by merchant adventurers from the West of England, whose interest it was to retain for their own use all the coves and harbours, and who in order to discourage all immigration, represented the country as a barren wilderness unfit for habitation. The Government, misled by these misrepresentations, enacted repressive laws, forbidding, under heavy penalties, the cultivation of the soil or the building of houses, restrictions which were not finally removed until 1820. From that time substantial progress began to be made, and in 1825 the first road was made; there are now about 1000 miles of postal roads and 2000 miles of district roads. Steam communication was etablished in 1873, and in 1880 the first steps towards the construction of a railway were taken.

In 1864 a geological survey of the island was made, which completely revealed the resources of the country. Large deposits of copper ore were discovered, iron, lead, asbestos, and considerable quantities of coal found, also gypsum, stone and marbles of all colours. To attract settlers to this fertile land it remains only further to develope the railway system, which has been vigorously entered upon. In 1881 a line was commenced from St. John's to Hall's Bay, with branches to Brigus and Harbour Grace, a distance of 340 miles, but owing to financial difficulties, only 33 miles of this were in working order in 1886, when the Placentia line was undertaken from Whitbourne Junction to Placentia. In 1889 a railway was commenced towards Hall's Bay to Brigus, or Clarke's Beach, to be completed in five years, and in 1893 a line was undertaken from Placentia Junction to Port-aux-Basques, about 500 miles in length, running through the richest and most fertile part of the island. The tables of produce, exports, and population, given by Mr. Harvey, are carefully drawn up, and the details of everything relative to Newfoundland are so complete that the reader of his little book could not fail to find himself well informed on the subject.

*Theorie du Navire.* Tome IV. Par J. Pollard et A. Dudebont. Paris: Gauthier Villars. 1894.

This is the concluding volume of the treatise which has already been noticed in these columns. The subjects treated are Dynamics of the Ship; its Movement; Horizontal, Oblique, and Curvilinear Propulsion; Vibration of the Hull of Screw Steamers. The authors are professors in the Ecole d'Application du Génie Maritime, the equivalent of our old School of Naval Architecture, now carried on at Greenwich; and the book is thus presumably the text-book of their students. No analytical difficulties are avoided; and we think that a little more geometrical treatment would have reduced the length of the treatment. The subject of the Rolling of Ships and of the Vibration of the Hull are of pressing importance at the present day; a study of this volume will serve to show how to encounter these difficulties.

## *BOOKS RECEIVED.*

*Mason College, Birmingham, with Queen's Faculty of Medicine. Calendar for the Session* 1894-5. Birmingham: Cornish Bros. 1894.

*Papers and Addresses.* By Lord Brassey, K.C.B, D.C.L. *Work and Wages.* Edited by J. Potter, with an introduction by George Howell, M.P. London: Longmans, Green, and Company. 1894.

*A Text-book of Mechanical Engineering.* By Wilfrid J. Lineham. Part 1—*Workshop Practice.* Part 2—*Theory and Examples.* London: Chapman and Hall. 1894.

*Papers and Addresses.* By Lord Brassey, K.C.B., D.C.L. *Naval and Maritime from* 1872 *to* 1893. Arranged and edited by Captain S. Eardley-Wilmot, R.N. Vol. 1. London: Longmans, Green, and Company. 1894.

*Papers and Addresses.* By Lord Brassey, K C.B., D.C.L. *Naval and Maritime from* 1872 *to* 1893. Arranged and edited by Captain S. Eardley-Wilmot, R.N. Vol. 2. London: Longmans, Green, and Company. 1894.

*Thermo-dynamics Treated with Elementary Mathematics, also containing Applications to Animal and Vegetable Life, Tidal Friction, and Electricity.* By J. Parker, M.A. London: Sampson, Low, Marston, and Company. 1894.

*The Repair and Maintenance of Machinery.* A handbook of practical notes and memoranda for engineers and machinery users. By Thomas Walter Barber, C.E, M.E. With about 400 illustrations. London: E. and F. N. Spon. 1895.

*Ways and Works in India.* Being an account of the public works in that country from the earliest times up to the present day. By G. W. MacGeorge, M.I.C.E. With numerous illustrations and maps. London: Archibald Constable and Company. 1894.

*The "Mechanical World" Pocket Diary and Yearbook for* 1895. Containing a collection of useful notes and formulæ arranged for the use of engineers, draughtsmen, mechanics, manufacturers, and others. Manchester: Emmott and Company. London: 56 and 57, Fleet-street, E.C. 1895.

## HERBERT JOHN ALLISON.

A host of visitors to the library of the Patent-office, Southampton-buildings, will hear with sincere regret of the death, on Tuesday, of Mr. Herbert John Allison, the principal librarian. Who, indeed, of all those who have used the library will fail to remember the courtesy with which he supplied information, or aided them in the search for facts? In no sense or way was Mr. Allison a typical "official." He was a kindly and courteous gentleman who never spared himself in the service of others. He entered her Majesty's Patent-office about forty-two years ago, just about the time when the old Patent Law of 1852 came into force. He was then employed in assisting in classifying and arranging the patents for inventions which had been granted prior to the passing of that Act, and also in the examination of documents filed on applications for patents made under such Act.

About thirty years ago he entered the Scientific Library of the Patent-office as assistant librarian. On the decease of the head librarian—Mr. Atkinson—about twelve years ago, he was appointed to succeed him, and this post he occupied up to the time of his death. To his duties as librarian were —until a few years since—added those of editor of the *Patent Office Journal.* The numerous readers who frequented the Patent-office library, amounting as they do at the present time in the aggregate to 1,403,869, and now numbering over 2000 per week, and including as they did most of the principal inventors, patent agents, and patent experts, as well as the whole of the Patent Counsel of the past and present generation, and also a large number of the general scientific public, will have all had occasion to profit by the knowledge acquired by him during his lengthened service, both in regard to the general organisation of the Patent-office in matters relating to patents, as well as to the splendid collection of scientific works comprised in the library. Mr. Allison early foresaw the increase that the new Act of 1883 would bring in the number of patentees, and strenuously urged the provision of increased facilities for the assistance of inventors. The Scientific and Patent Library with this view rapidly developed under his care, and his one desire was to live to see the complete realisation of his idea, and all the books transferred to and properly arranged in the new library to form part of the building now in course of construction.

For over twenty years he had fulfilled his duties in spite of much personal suffering, due to rheumatic gout, such as would have compelled most people to have sought repose and a pension, and there can be no doubt that his continued efforts in the public service have much to do with his decease at the comparatively early age of sixty-five.

## ALLAN DUNCAN STEWART.

The death is announced of Mr. Allan Duncan Stewart, an engineer of mathematical attainments, well known in Westminster. He was in his 63rd year. He was born in March, 1831, and, after taking mathematical honours at Cambridge, he was 9th wrangler of his year, 1853. He was articled to Mr. Benjamin Hall Blyth, M. Inst. C.E., with whom he was from 1855 to 1858 as pupil, and as resident engineer under him on the Banff and the Portpatrick Railway. Subsequently he practised as a consulting engineer during twenty years, during which time he planned out the Windsor, Ascot, and Aldershot Railway, the Sheffield, Buxton, and Chapel-le-Frith line, the Esk Sewerage, and other works. During this time he assisted numerous engineers in the mathematical work connected with bridges and other structures, including the Redheugh Bridge, the proposed bridge across the Forth, the roofs of Waverley and Dundee Stations, and afterwards, under Sir John Fowler and Sir Benjamin Baker, on the mathematical work of the construction of the accomplished Forth Bridge. He subsequently made the accepted competitive design for Wembley Tower, which, with various modifications, is now in course of construction. Mr. Stewart was elected a Member of the Institution of Civil Engineers in 1883.

## EXPRESS PASSENGER ENGINE, DUTCH RAILWAYS.

The Dutch railways are worked for the most part by locomotives built in England, Messrs. Beyer, Peacock, and Co. having supplied many, and Messrs. Sharp, Stewart, and Co. others.

We illustrate this week one of several fine engines employed in working the heavy express passenger traffic between Cologne and Amsterdam. These engines handle trains of twenty seventeen-ton coaches very comfortably at a high speed. The grate area enables a somewhat inferior coal to be burned satisfactorily. The engines have been built by Messrs. Sharp, Stewart and Co. to comply with the specification of Mr. J. A. Roesingh Van Iterson, the locomotive superintendent of the line.

These engines are used for the through express continental traffic on the Dutch Railway in connection with the Great Eastern Railway Company's route *viâ* Harwich.

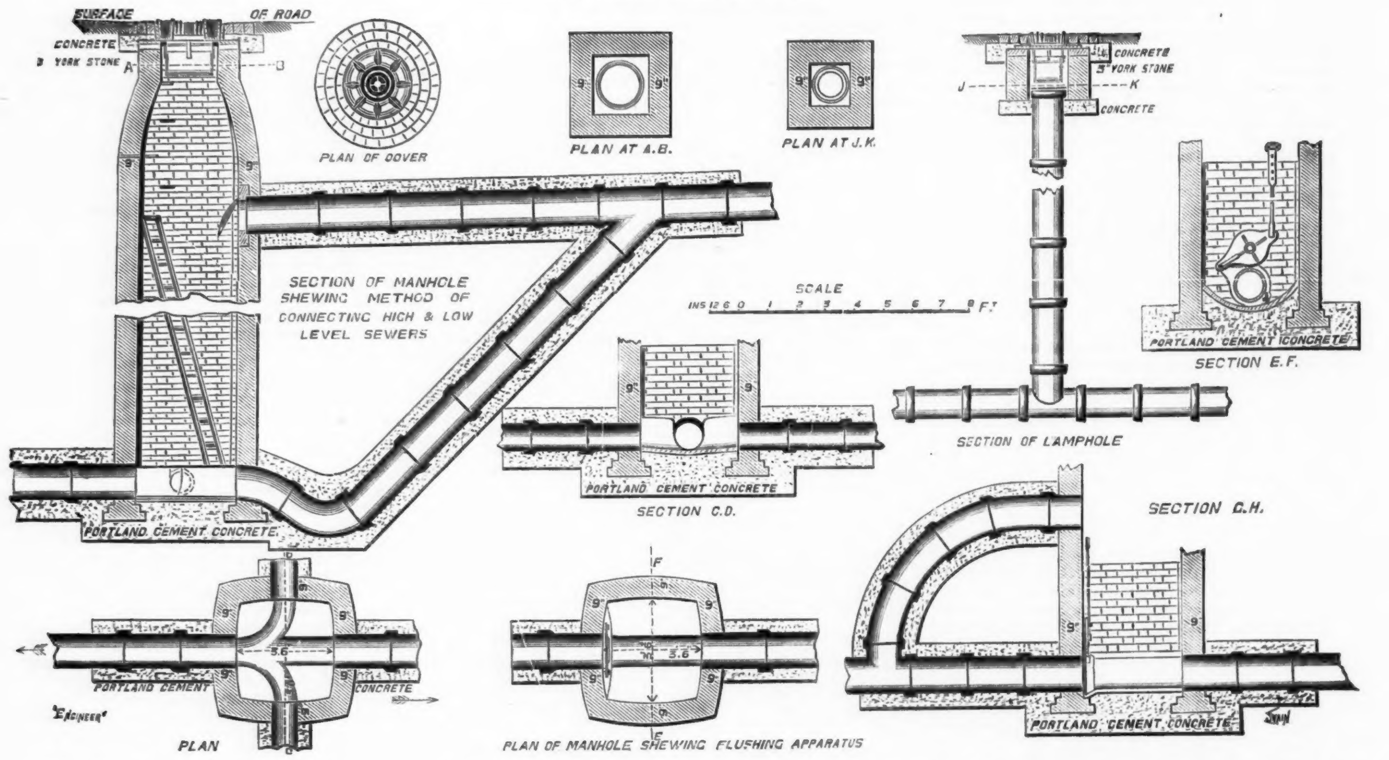
*Leading dimensions:—*

| | |
|---|---|
| Cylinders (inside) diameter | 18in. |
| „ stroke | 26in. |
| Wheels, four-coupled, diam. on tread | 6ft. 7⅝in. |
| Centres of coupled axles | 9ft. |
| Bogie wheels, diameter | 3ft. 3in. |
| Centres of bogie axles | 6ft 5in. |
| Total wheel base | 22ft. 9¼in. |
| Boiler (best Yorkshire iron)— | |
| Length of barrel (telescopic) | 11ft. |
| Diameter inside of smallest ring | 4ft. 2⅜in. |
| Length of fire-box, outside | 7ft 8in. |
| Tubes (iron) number | 217 |
| „ external diameter | 1¾in. |
| Inside fire-box (copper) length | 6ft. 11⅝in. |
| „ „ width at bottom | 3ft. 1¼in. |
| Heating surface of fire box | 106 sq ft. |
| „ „ tubes | 1129 sq. ft. |
| „ „ total | 1235 sq ft. |
| Grate area | 22 sq. ft. |
| Height of centre of boiler above rails | 7ft. 6in. |
| Height to top of chimney | 14ft. |
| Weight of engine in working order | 45¾ tons |
| Tender— | |
| Capacity of tank | 2800 galls. |
| Six wheels, diameter | 3ft. 7½in. |
| Weight in working order | 29½ tons. |

The engine is fitted with the Westinghouse brake and Holt and Gresham's steam sand gear. It has an extended smokebox, and is in addition provided with Mr. Adams' patent vortex blast pipe. The engine has the ordinary Stephenson link motion and screw reversing gear.

## TEDDINGTON SEWAGE WORKS—DETAILS

MR. HENRY YORK, ENGINEER

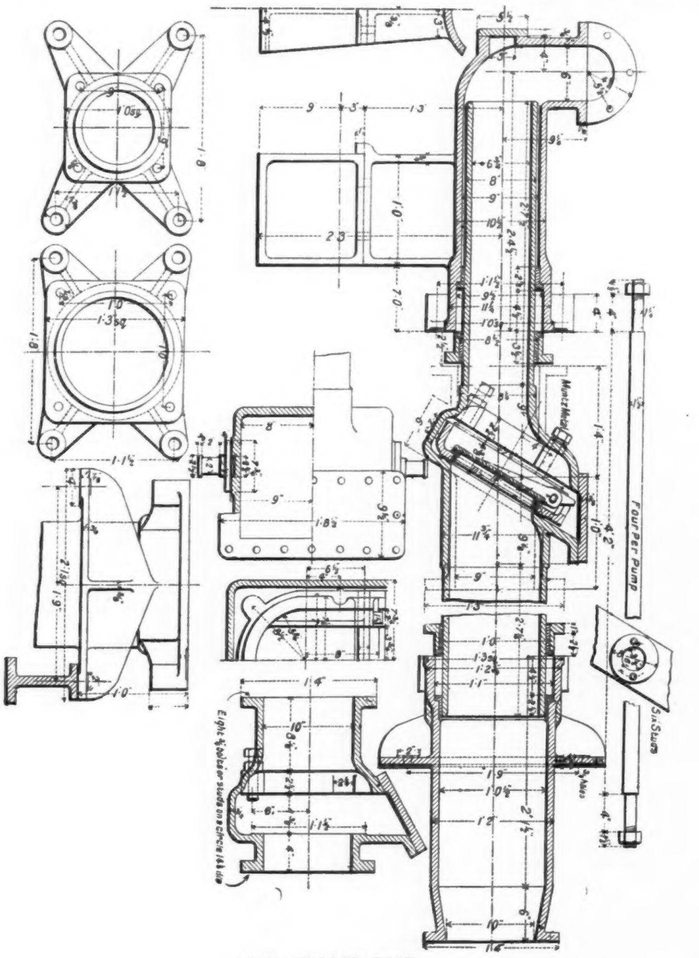

SURFACE OF ROAD
CONCRETE
3" YORK STONE
A
B
PLAN OF COVER
PLAN AT A.B.
PLAN AT J.K.
CONCRETE
3" YORK STONE
J
K
CONCRETE
SECTION OF MANHOLE SHEWING METHOD OF CONNECTING HIGH & LOW LEVEL SEWERS
SCALE
SECTION E.F.
PORTLAND CEMENT CONCRETE
SECTION C.D.
SECTION OF LAMPHOLE
SECTION C.H.
PLAN
PORTLAND CEMENT
CONCRETE
PLAN OF MANHOLE SHEWING FLUSHING APPARATUS
"ENGINEER"

### TEDDINGTON SEWAGE WORKS.

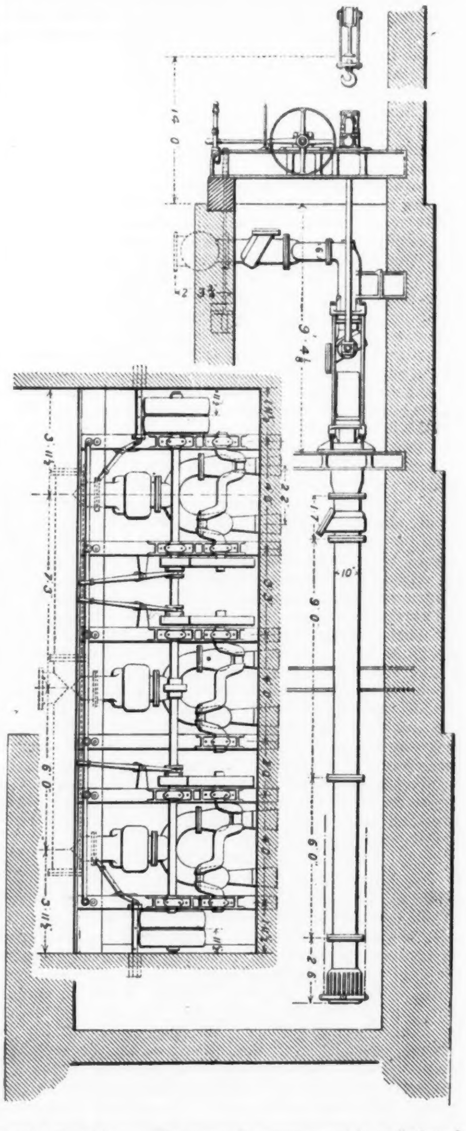
In our number of 2nd inst. we gave a general plan of these works, in connection with a paper read by Mr. Henry York, F.S.I., surveyor to the Local Board, before the Incorporated Association of Municipal and County Engineers, held at these works on June 23rd, 1894. The present scheme was originated in 1887, and has been carried out entirely under the superintendence of Mr. H. York, Mr. J. C. Mellias acting as consulting engineer. We now have pleasure in illustrating the works more fully by drawings, which will, with a few remarks, explain themselves.

On page 411 is a front elevation and various sections of the sewage pumping and disposal works. The buildings are faced externally with stock brickwork, with dressings of red bricks and red Corsehill stone. The roofs are covered with Westmoreland green slates. The engine-room is faced internally with pressed gault bricks, relieved with red, and has a dado all round of chocolate-coloured glazed bricks, the floor being tiled. The press house is faced internally with red-faced bricks, relieved with buff, and, the bricks being of an impervious nature, all soiling of the walls from the operation of pressing is easily removed. The precipitation tanks are constructed of concrete, faced and coped with blue bricks.

On this page are various details of the sewers and manholes. The sewers are all constructed of glazed stoneware pipes, a large proportion having Hassall's patent joints. The manholes are of pink wire-cut gault bricks, and the tops are circular, of cast iron with wood blocks, and act as ventilators; but this system of ventilation is now being abandoned in favour of shafts. Where a high-level sewer discharges into a low-level sewer a dip or syphon arrangement is provided, which effectually checks all undue splashing of the manhole from the sewage. In manholes provided with disc flushing valves, overflows have been constructed to be of service in preventing the undue rising of the sewage in the event of the valve becoming jammed when closed. The manholes have been constructed with square bricks, laid all headers, thus avoiding the use of purpose-made bricks. We give an elevation and plan of the pumping machinery, consisting of three pairs of hollow plunger pumps fitted with Okes' patent removable valves and seats. The pumps are in pairs, and are placed vertically—the two plungers balancing each other—the cranks being placed in opposite directions. The general arrangement is so designed that any pair of pumps can be driven by either engine; thus one, two, or three pairs can be used at a time to suit the varying requirements of the station. This is effected by the engines driving a lay shaft, common to all the pumps, and as


Four Per Pump

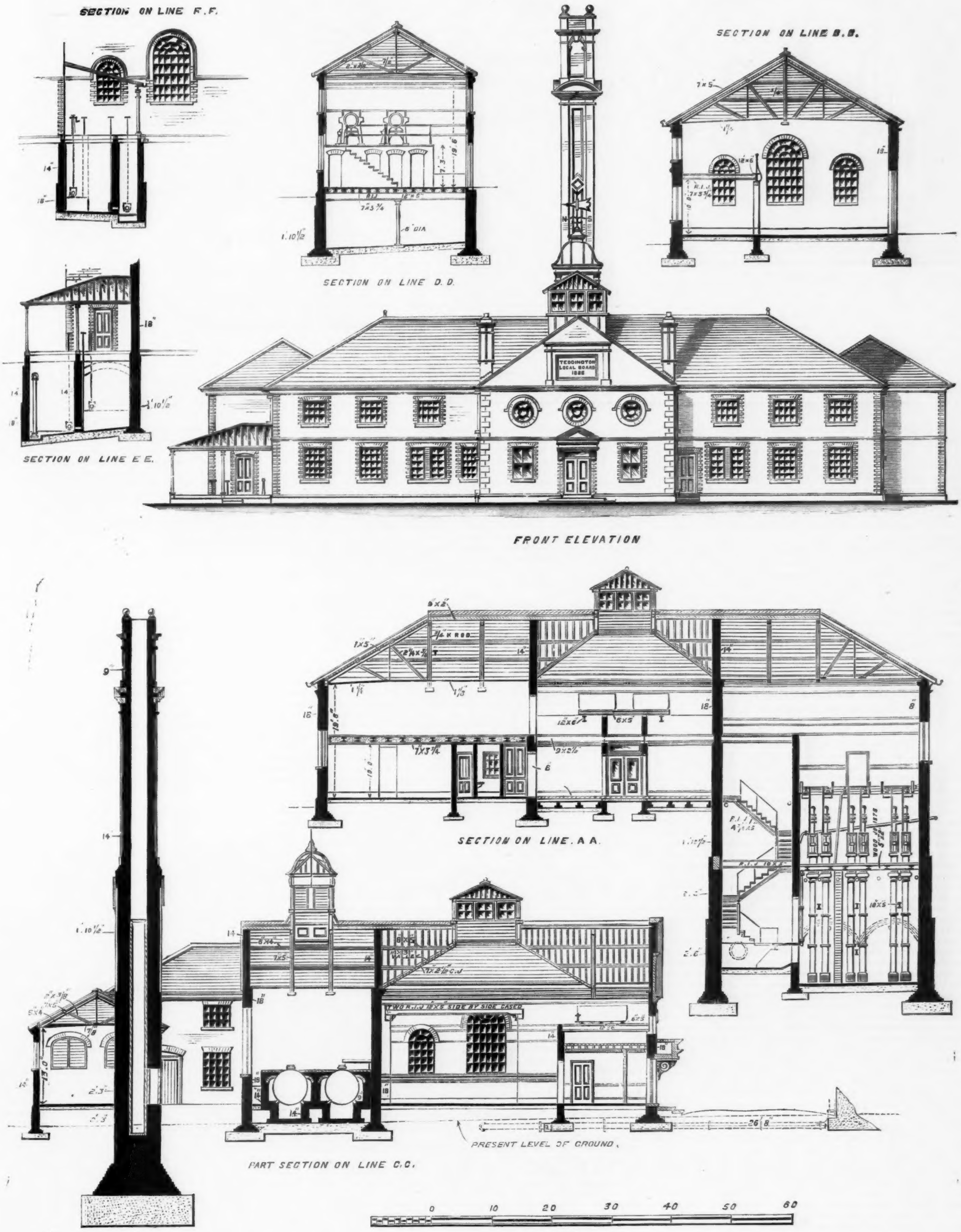
OKES' SEWAGE PUMP



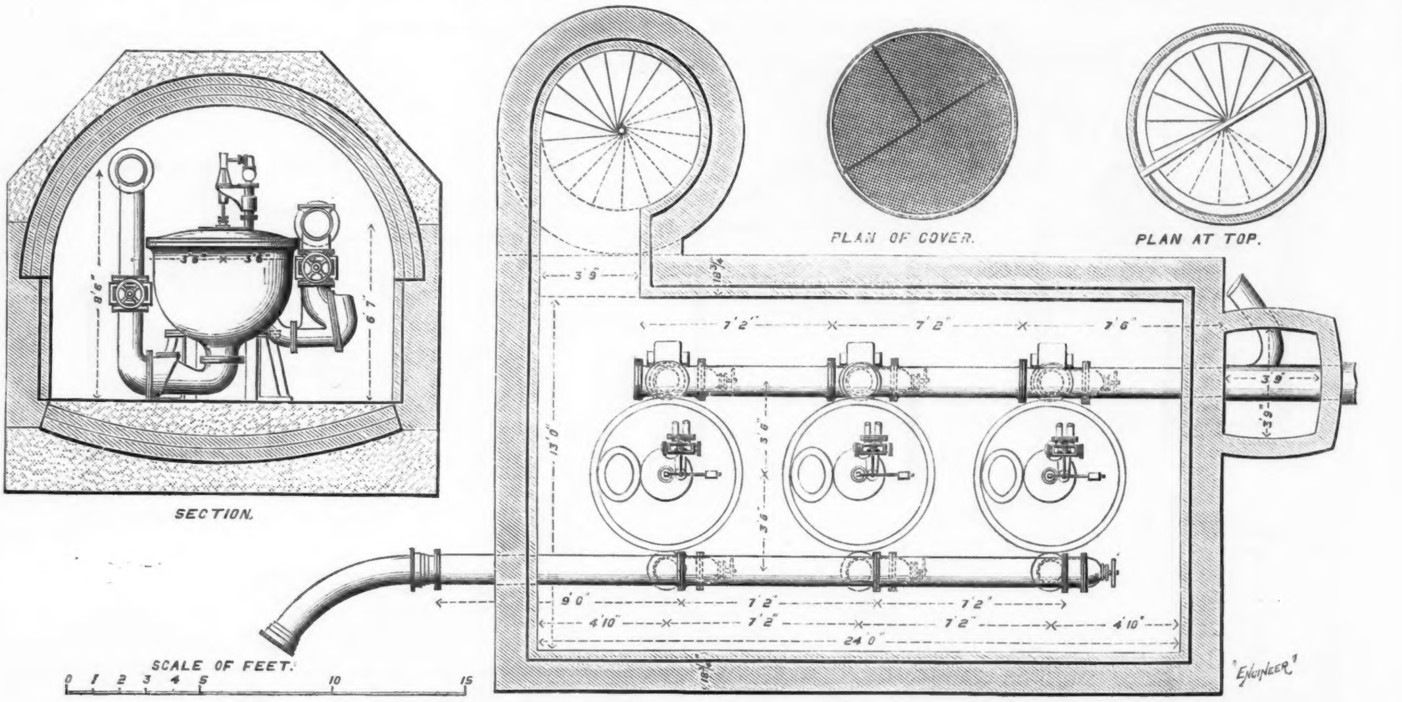
# TEDDINGTON SEWAGE WORKS—DETAILS OF PUMPING STATION

MR. HENRY YORK, ENGINEER; MR. J. C. MELLISS, CONSULTING ENGINEER

(*For description see page* 410)


SECTION ON LINE F.F.
SECTION ON LINE D.D.
SECTION ON LINE B.B.
SECTION ON LINE E.E.
TEDDINGTON LOCAL BOARD 1886
FRONT ELEVATION
SECTION ON LINE. A A.
PART SECTION ON LINE C.C.
PRESENT LEVEL OF GROUND
TWO W.I. J 9X5 SIDE BY SIDE CASED
0 10 20 30 40 50 60
SCALE OF FEET
PART SECTION ON LINE C.C.
PRESENT LEVEL OF GROUND
SECTION OF TANK
ENGINEER
Swain

# TEDDINGTON SEWAGE WORKS—SHONE'S EJECTORS



each pair of pumps is driven by a pinion and spur-wheel, any pair can be set in motion by simply throwing a clutch into gear with the pinion. The hollow type of pump is admirably adapted to sewage work. The plunger in this case forms, as it were, a part of the straight run of pipe. There are no pockets or corners in which the thick matter can lodge, and a great feature is that of the patent removable valves or seats, as in a few minutes both valves and seats can be renewed by spare ones, and the damaged valves, or seats replaced at leisure.

The air compressors for working the "Shone" ejectors are by Messrs. Hughes and Lancaster. They are of the horizontal type, working up to an air pressure of 14 lb., the ejectors being distant about one mile. These are in duplicate and are coupled, the cut-off being so arranged that they work automatically. The sludge pressing machinery is by Messrs. S. H. Johnson and Co., and consists of two presses, the sludge being forced into them by direct-acting sludge pumps. We understand that the plant is working very satisfactorily.

## AMERICAN ENGINEERING NEWS.

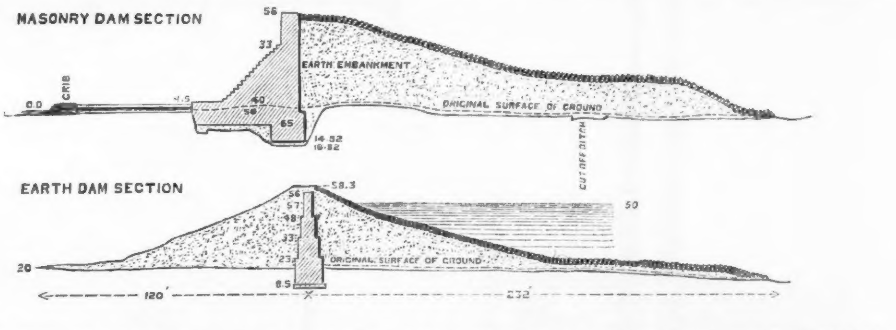
(*From our own Correspondent.*)

*Large pumping engines.*—The Philadelphia waterworks have now what are said to be the two largest waterworks pumping engines in the world, each having a capacity of 30,000,000 gallons in twenty-four hours. They are vertical inverted triple-expansion engines of the marine type, with steam cylinders 36in., 62½in., and 92in. diameter, pump plungers 30in. diameter, and all of 5ft. stroke. The pumps have double-acting, outside-packed plungers, and the pump chambers are directly under the engine. When running at their rated capacity the engines will make twenty revolutions per minute, equivalent to a piston speed of 200ft., and they are guaranteed to show a duty of 125,000,000 foot-pounds for 1,000,000 heat units in the steam received. They work against 145ft. head, and carry a pressure of 140 lb. at the throttle valve. The suction and force mains are 4ft. diameter. Each engine has two shafts, the inward crank arms being connected by a crank pin for the intermediate cylinder. The shafts are 19in. diameter, with bearings 17½in. and 27in. Each engine has two fly-wheels, 19ft. diameter and 30 tons weight. The steam valves are of the Corliss type, and the valve gear admits of the cut-off being set as desired, and also being adjusted independently for the cut-off in each cylinder. The pump valves are circular rubber flap valves. The volume of the low-pressure cylinder is about six and a-half times that of the high-pressure, and the steam is expanded from eighteen to twenty-five times its initial volume in its passage through the cylinders. All the steam cylinders have steam jackets, and are clothed with non-conducting material and polished wood lagging.

*Road improvements.*—Road conventions are now the order of the day, and several States have already held them, the object being the discussion of ways and means for the efficient and economical improvement of country roads. Some harm has been done by a too enthusiastic advocacy of macadamised roads, the cost of which is entirely out of reach of many small communities, but engineers who take the economics of engineering into consideration—and these are not as numerous as could be wished—are bringing out the improvements which may be made at smaller expense on the present roads, especially in matters of maintenance and repair. Some Southern States are trying the experiment of working their convicts on the roads, with good results. One county in Virginia began this in 1892, the first work being on specially hard sections of road, and later more systematic work has been undertaken. The number of men is small—taken from the State penitentiary and the county and town jails—and about three miles per month are covered, the total cost being from 100 dols. to 125 dols. per mile, or 4000 dols. a year in all. The farmers approve it, as it saves the time of their men, and the convicts cost only 35 cents a day to keep—less than half the price for free labour. It has stopped the practice of tramps getting themselves arrested to live comfortably for a few weeks as vagrants, as these tramps do not like the idea of being made to work on the roads. In a few years this county will have an excellent system of highways, the cost of maintenance of which is estimated at 1000 dols. a year. A jail wagon for sleeping purposes is provided, so that the men can do a full day's work.

*Cableway for sewer trenches.*—The Carson and Lidgerwood cableway is designed for use in the excavation of sewer trenches, and reduces the width of street obstructed to a minimum. It is a combined hoisting and conveying device, with buckets suspended from carriers running on a fixed cable, the ends of which pass over two trestle frames and are firmly anchored. The travellers are controlled by an endless travelling wire cable, and a separate cable is used for hoisting and lowering. The engine and boiler are placed on a car at the head of the excavation. The trestles are from 200ft. to 300ft. apart, and 200ft. of sewer can be finished at each setting. The capacity varies according to the size of the buckets and the material excavated, being in several from 200 to 500 cubic yards in ten hours. The cableway can hoist 5000 lb. at a speed of 225ft. per minute, and convey the same at a speed of 450ft. per minute. The material excavated can be run back and dumped as backfilling on the completed work, or can be dumped into carts. Scrapers can be operated as well as buckets. In working a trench 18ft. wide and 15ft. deep, for a sewer 11½ft. diameter, the cost for picking, shovelling into buckets, hoisting, conveying 150ft., and dumping into wagons was 16 cents per cubic yard, the cost for hoisting, conveying and dumping being 5·3 cents per cubic yard. The machines have been used on about twenty contracts, and some cities have purchased them for doing their own sewer work. The carrying and fall-rope devices are on the Locke and Miller patents' as used on other cableways.

*The Dunning Dam.*—At the meeting of the American Society of Civil Engineers, on October 17th, Mr. E. S. Gould described the construction of the Dunning Dam, for a water supply reservoir for Scranton, Pa., built in 1888. At the site selected sandrock crops out on the southerly side, and continues to about the middle of the stream, where it breaks abruptly off. The remainder of the bed on the opposite side being mostly a stiff clay, the dam had to be built half on rock and half on earth, the transition point occurring near the centre of the spillway. The spillway, or wasteway, is 152½ft. long, and its top is 5ft. below the crest of the dam. On the rock is a masonry dam, faced with an earth bank on the inside. Beyond there is a masonry wall with earth banks on both inside and outside. The masonry was backed up to its full height by a heavy bank of earth; in other words, the inside embankment is continuous over the entire length of the dam, so in one sense it is an earth dam with masonry spillway, &c. The engineer strongly favours earth backing for all masonry dams. The sloping front of the spillway was stepped, rather than curved or battered, as this is cheaper and prevents the water from obtaining a high velocity by sweeping over an unobstructed surface. The spillway, during construction, was repeatedly swept by floods. The effect was to excavate the bottom of the stream more or less in front of the dam. In constructing it, a timber crib filled with stone was placed at its lower limit. The bottom of the stream was levelled up with dry stone, the largest obtainable ones placed regularly on top. The joints were packed with spalls, and then a continuous bed of concrete about 1ft. in thickness spread over the dry stone. On top of the concrete a stone masonry pavement was placed. A 48in. cast iron pipe was built in the masonry of the dam as low down as possible, provided with two horizontal gates. This pipe is supported in solid masonry blocks throughout its entire length, reaching from side to side of the pipe gallery, with holes to drain off any water which may accumulate. Over this is a 36in. pipe. This also has two gates, and is supported by the same blocks of masonry. Of the two gates on each pipe, the inner one is to be kept open, or partially open always, and the water turned on or off by means of the lower or down-stream one. No trouble arose in the 1200ft. wall, except at one point, where a crack was open about ⅛in. wide at the top, apparently running out to nothing further down. The leakage was partially stopped by the use of sand, cement, sawdust, &c. The engineer believes that this crack was due to contraction. There was very considerable leakage through the wall of the upper gate chamber, due to the fact that the tower had not been raked and pointed. Hay seed, sand, sawdust, &c., was thrown into the tower, and the leakage was finally overcome. The engineer believes that it is not wise to immediately rake and point the joints of hydraulic masonry, or cover it with plaster, but thinks that it is better to turn the water on first, and see how tight the wall is, and to point and plaster afterwards. In clearing the reservoir site, all trees and stumps were cut as closely to the ground as possible, and the site of the embankment thoroughly grubbed and all sods removed, and the material ploughed up before placing the embankment upon it. The embankment was placed in layers as far as possible. The material was taken out with a shovel or excavator, carried to the foot of the bank in cars, and scraped into place by a scraper drawn by horses, also by wagons in the ordinary way. It was sprinkled while being put in, and the travel of the teams, men, and scrapers was sufficient to compact it. The material was mostly clay and gravel loam. The stone used was mostly conglomerate. Perfect bedding and jointing of all stone with compact mortar was insisted upon, and at the beginning of the work stones were frequently raised, after being bedded, to see that all portions of their beds were in close contact with the mortar. In thick walls all beds were kept swimming. Concrete was mixed ordinarily 1, 2, and 5, but where there was running water to contend with a richer mixture was used.



*American Institute of Mining Engineers.*—The autumn meeting was held at Blackrock, near Bridgeport, Conn., in October. The first papers presented were one on "A Uniform Method for the Assay of Copper Materials for Gold and Silver," by Albert R. Ledoux, and another on "The Inaccuracy of the Commercial Assay for Silver and of Metallurgical Statistics in Silver Mills, with special reference to the Treatment of Roasted Ores by Amalgamation and by the Russell Process," by C. A. Stetefeldt. The purpose of the latter was to show that the reports of managers of silver mills in regard to the percentage of silver saved are far from being the truth. There was also some discussion on the effect of coal dust in mine explosions, which led to some remarks as to dust explosions in flour, sugar, and saw mills. Dr. R. W. Raymond, secretary of the Institute, read a paper on "The New Mining Law of New York," showing the injustice to landowners which the new law effects, amounting almost to confiscation of property. The discussion on the question, "Does the Vibration of Stamp Stems change their Molecular Structure?" turned on the general question of molecular change of metal due to vibration or continual shock. One member said that he was still unsatisfied, but inclined to believe that the stems do crystallise, and that molecular disintegration is going on all the time, even though the change in structure may not be visible. Other members recorded the fact that broken stems show a crystalline fracture, and in one case bars which lasted only about six months were made to last over two years by reversing them occasionally. Another member said that in connection with a legal case involving the failure of a screw shaft, he took a good car axle and broke it slowly under a steam hammer, developing a fibrous fracture. He then broke it in another part by one heavy blow, and the result was a crystalline fracture. Dr. Raymond said that it cannot be that the molecules move around and change from a fibrous to a crystalline arrangement, but that they are either pulled out or broken short off according to the way in which the bar is broken. Mr. Kirchoff said that the ends of broken staybolts from an exploded boiler showed a crystalline fracture, but tests of the bolts showed them to be of good, tough metal. Mr. J. F. Kemp read a paper on "The Nickel Mine at Lancaster Gap, Pa.," which is practically the only productive nickel mine in the United States which has been developed, although discoveries have been made in New York, Oregon, &c. The Pennsylvania ore is pyrrhotite and chalcopyrite, like that of Norway and of Sudbury in Canada. The rock is marked through and through with mundic, and is very hornblendic in structure. It contains about 1 per cent. nickel, some copper, and a little gold. The deepest workings are 250ft. deep. The mine was worked until February last, but it is said to be now full of water. The nickel deposits at Riddles, Ore., resemble those of New Caledonia. Besides the reading and discussion of papers there was an excursion by special train to Ansonia and Waterbury to visit several of the machine works, and the numerous brass and copper mills. At the Benedict and Burnham works, a plant for making copper and brass tubes up to 12in. diameter by the Mannesmann rolling process is being put in.

Another day was spent in visiting the works at Bridgport, and taking a steamer trip on the Sound. On the closing day the party went to New Haven, and visited the numerous buildings of Yale College.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE feature of most importance during the week relates to the progress of the proposed new Galvanised Iron Trade Association to which I have previously referred. The project is assuming proportions which show it to be one of the most complete and far-reaching ever proposed in this department of the iron trade. It will be all-England in its scope, but at the same time the Midlands will have the chief interest in it, since out of an aggregate of some thirty firms engaged in the industry the kingdom over, some twenty-two or more are situated in Warwickshire and Staffordshire. Of the remaining firms, about three are in the West of England, two in Scotland, and two or three in Lancashire. The committee of the combination are being advised by Mr. E. J. Smith, of Messrs. Hoyland, Smith, and Co., bedstead manufacturers, Birmingham, and chairman of the Birmingham bedstead trade. He was the founder of a similar combination which has worked successfully in the English metallic bedstead trade. An important point about the undertaking is that the combination will embrace not only the makers and sellers of the finished sheets but also the makers of the black sheets and spelter, and also the workmen employed at the galvanising establishments.

Finished iron prices remain much the same as last week, with a fairly steady demand, but pigs are weaker. Northamptons are down to 40s.; Derbyshires 40s. to 41s., less 2½ per cent; and Lincolns, 41s. net.

Some difficulty continues to be experienced with reference to the change in proprietorship of the Round Oak Works, which, it will be remembered, passed some time ago out of Lord Dudley's hands into the possession of a company known as "The Earl of Dudley's Iron and Steel Works, Limited." But as the new steel works have been started and are in operation, it is understood that the difficulties are to some extent formal and temporary, and that matters will right themselves in a short time. A private meeting of the company's creditors was held this week. It was announced as far back as July that, under the new scheme for the resuscitated company, £20,000 would be found by Lord Dudley, and £20,000 would be paid under certain conditions by the shareholders. It was hoped that this combined amount would enable the creditors to be paid the sum they had previously agreed to accept, namely, 10s. in the pound, and 10s. in debentures. It seems, however, that a hitch has now occurred. It is stated that out of about £12,000 liabilities, £3000 is due to the Earl. His debentures and first mortgages also swamp the whole of the assets, and the creditors appear to be entirely dependant upon his generosity. A further meeting is to be held. Meanwhile, operations are proceeding quite as usual, and seem likely to continue to do so.

A new departure in cycle engineering, involving the use of machinery different in some respects from that hitherto in use in this industry, has been made by the Jointless Rim Company, at its new works at Long Acre, Aston. The process is patented by Mr. C. H. Pugh, of Birmingham, who is also one of the directors. The rim is a steel tubular structure, and can be made of any section to suit any kind of tire. It is produced from a flat sheet of steel. The sheet is first cut to a circular form, and is next placed under a powerful stamping press, which converts it into a dish-like shape with an upturned and also outwardly turned margin. The centre of the dish is next cut away, and the upturned margin is left to be converted into the cycle rim. The bottom edge is next turned by a metal-spinning process into the same form as the one produced by stamping. Further stages of spinning against blocks of different patterns give the form necessary for the inner side of various sections. A moulded band is next sprung into this groove to form the tread, after which the two outward edges are folded over it, spinning machines being again used for this purpose. The entire process is carried out in cold metal.

Experiments with steel sheets have led so far to the adoption of Siemens-Martin metal—rolled, however, unfortunately, not in this district but in Wales. The treatment to which it is subjected developes the original undefined grain into a continuous interlocked grain of firm spring temper. It is claimed that rims produced by this process are sufficiently strong to bear the weight of a man standing upon them. The absolute truth in circularity obviates unequal screwing up of spokes, such as is necessary with some rims of the customary jointed type. Moreover, there is alleged to be no weak point, as is sometimes the case through the brazing of joints.

Works extensions are in progress at the well-known Beeston premises of the Humber Cycle Co. The concern has been able to extend its connections both on the Continent and in the Colonies during the past season, and in France they have done exceptionally well. The financial year just closed has been the most successful one in the concern's history, enabling the declaration of dividends which are equal to 12½ per cent. for the whole year. The total reserve fund stands at £45,000.

Birmingham manufacturers are hoping that subscriptions to the new Chinese war loan will continue to come in well. The last Chinese loan issued some years ago was subscribed eleven times over. China is spending money freely in the Midlands.

The war in the East is indeed making the Birmingham gun and ammunition trade just now more busy than for many years past. Since the outbreak as many as 150,000 guns are believed to have been exported to the East by a roundabout route, being consigned first to South Africa, and then trans-shipped, according to arrangement, in mid-ocean. Some of these were, however, antiquated weapons which were used in the Franco-German war by the two countries then engaged. They were bought up at that time at a low price from the German Government by a Birmingham firm, who have spent a good deal of money in effectual attempts to modernise them, and are now glad to get them off their hands. It would be amusing to know whether the Chinamen or Japs imagine they are using the latest English inventions in this line.

Negotiations are also reported for another consignment of 20,000 rifles and bayonets, and the number of military cartridges turned out in Birmingham during the past two months is estimated at the enormous aggregate of over ten millions.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester*.—The position as regards the engineering and iron trades of this district remains about stationary. The usual monthly returns of the engineering trades union societies with reference to out-of-work members are not yet completed, but so far as they have come to hand they show no material change either one way or another, and much the same applies to reports which I obtain from representatives of engineering firms as to the position of the leading establishments throughout the district. Taking the bulk of the engineering works, they may be said to be moderately off for orders which just keep them going, with here and there establishments under special conditions fairly busy. It is, however, for the most part only a hand-to-mouth sort of trade that is doing, and the more encouraging reports that I came across a week or two back do not seem to have been followed up by increased activity to any appreciably general extent; a great many works in the district continue extremely slack, and the outlook for the future is still anything but satisfactory. In the iron market there is still only a slow dragging business, whilst in the coal trade complaints from not a few quarters are made that it has not been worse for a number of years past.

The Manchester Iron Exchange on Tuesday was fairly well attended, but only a very limited inquiry was reported generally. The reports from Glasgow and Middlesbrough showing a decided hardening in warrants, necessarily tended in some measure to give rather more confidence, and sellers of outside brands were stiffer in their prices compared with those they would have taken last week; but as regards local and district brands there is no improvement whatever, the tendency in some instances being rather downward than otherwise. Lancashire pig iron makers still report practically no business of any weight coming forward; their quotations of about 39s. 6d. for forge to 42s. for foundry, less 2½ at the works, are little more than nominal in face of the much lower prices at which district brands can be bought, and it is only where local makers have specially favourable rates of carriage that they are booking occasional orders. In district brands also there is little or no business of any moment being put through. Lincolnshire remains fairly steady at the quotations of last week, forge averaging 38s. 6d., and foundry about 40s., net cash, delivered Manchester; but Derbyshire foundry brands have had to ease down so far as the maximum quotations are concerned, and delivered in the Manchester district prices now range from about 43s. 6d. and 44s. to about 45s. and 45s. 3d. net cash. Moderate inquiries have been coming upon the market for outside brands, and sellers of Middlesbrough have been able to get slightly better prices, good foundry qualities being scarcely obtainable under 44s. 6d. to 44s. 9d. net cash, delivered Manchester. In Scotch iron also sellers have stiffened up in their prices, Eglinton not being quoted under 47s. 6d., and Gartsherrie about 50s. 6d. net prompt cash, delivered at the Lancashire ports.

The finished iron trade remains without any improvement, new business still coming forward only in very small quantities, which scarcely keeps forges going more than about four days per week, and although makers quote late rates concessions here and there are made to secure orders. Delivered in this district, Lancashire and North Staffordshire bars range from £5 6s. 3d. and £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random and £6 2s. 6d. for special cut lengths.

Only a very quiet business continues to be reported in the steel trade as regards either raw or manufactured material. For good ordinary foundry hematites quotations remain at about 52s. 6d., less 2½, for ordinary basic billets £4 net cash; ordinary steel bars are readily obtainable at £6, and steel boiler plates at about £6 2s. 6d. to £6 5s., delivered in this district.

In the metal market list quotations for manufactured goods remain unchanged, and buyers who have been holding back in the expectation of some reduction are giving out orders, perhaps, rather more freely, but there is still only a very small business doing generally.

An excellent and novel arrangement of pillar heat radiators for public buildings, where economy of floor space is a matter of importance, has been designed for the Manchester Corn Exchange by Mr. A. H. Roylance, mechanical engineer. The pillar heat radiators of the ordinary type are not only frequently somewhat unsightly objects, but occupy a very considerable amount of floor space surrounding the pillars. The heat radiators designed by Mr. Roylance are, however, so constructed that the circulating heating pipes are practically worked into the design of the pillar, and made to correspond with the ornamental features in such a way that they form no obstruction whatever, and, in fact, are rather an embellishment than otherwise to the base of the column. Twenty-five heat radiators of this type are being constructed round the base of the supporting pillars in the large hall of the Corn Exchange, each radiator having fourteen double-circulating tubes, with a total heating surface of upwards of 50ft. The diameter of the pillars themselves is 11in., and the outside diameter of the radiators—which is scarcely 18in.—does not project beyond the ornamental cap surmounting the base of the pillar, the heating tubes being so arranged that they correspond with the flutings in the upper portion of the pillar, and in this way are no disfigurement of the base, but have really the appearance of forming a portion of the original design of the column. To economise further the floor space, these radiators are so constructed that the foot of the column for a distance of 12in. from the floor is left perfectly clear, thus providing ample toe space—the radiators, in fact, not occupying any portion whatever of the floor.

Depression prevails all through the coal trade, and even the better qualities still meet with but slow inquiry for house-fire purposes, which, only in exceptional cases, is keeping pits running more than about four days per week, and with plentiful supplies in the market prices are barely maintained at late rates. It is difficult to get more than 11s. for the best Wigan Arley; second qualities of Arley and Pemberton four-feet are offered at 9s. 6d. to 10s., and commoner qualities of house coals can be bought freely at 7s. 6d. to 8s. per ton at the pit mouth. With regard to common round coal for ironmaking, steam, and general manufacturing purposes, the demand is still of a very limited character, and prices, as I have previously anticipated, extend downwards, common steam and forge coal being obtainable at as low as 6s. 6d. to 7s. per ton at the pit mouth. Engine classes of fuel continue a complete drug upon the market, with all sorts of prices taken to effect clearance sales of surplus supplies. Common Lancashire slack can be bought readily at 3s. to 3s. 6d., with best qualities quoted at 5s. to 5s. 6d. per ton at the pit mouth — with slack from other districts offered from as low as 1s. 6d. per ton at the pit — and in the Manchester district the leading colliery firms who have been selling at under their list rates to meet outside competition, have this month formally brought their list rates down to what have previously been their selling price in most cases.

In the shipping trade the position is also quite as unsatisfactory and common round coals can be bought at from 8s. to 8s. 6d. per ton, with better qualities quoted at 9s. per ton, delivered at the Garston Docks, or at the High Level, Liverpool.

In view of the extremely discouraging outlook of the coal trade some very gloomy predictions are here and there made as to the possibilities in the future, especially under the conditions to which the coalowners have agreed with regard to the rate of wages for the next couple of years. The result of this agreement, it is predicted, will be that a number of collieries may in all probability have to be stopped altogether, unless there is some substantial improvement in the condition of trade, especially as the Scotch coalowners, having beaten the men on the wages question, will be in the position of being able to drive Lancashire coal out of some of the important markets, whilst Lancashire coalowners being unable to touch wages will have either to sell at a loss or stop their pits altogether.

*Barrow*.—There is still a very weak market in hematite pig iron. Makers are quoting 44s. 6d. to 45s. 6d. for mixed Bessemer numbers, f.o.b., usual West Coast ports, but they report that business is very quiet all round, and that the disposition to buy forward is exceedingly small. Most of the few contracts entered into are on prompt account. Only thirty-three furnaces are in blast, compared with thirty-four in the corresponding week of last year. Stocks still represent 158,450 tons in warrant stores, being an increase of 63,827 tons since the beginning of the year. A few transactions are noted this week in warrant iron at 43s. 9½d. cash sellers, and 43s. 8½d. buyers.

Iron ore is a very quiet industry. Sales are few on local account, and only a small tonnage is being sent away either by rail or by shipping. Prices remain unchanged at 8s. 6d. for ordinary to 13s. 6d. for best, net at mines.

Steel makers are not so busy as they have been. Last week Cammell's works in Cumberland were stopped, and this week the Barrow works are at a standstill except the steel-casting department. Orders for rails are very quiet. There is a fairly good inquiry in the market for Indian State Railways. The plate trade is not so brisk as it has been, but some new orders are expected as well as on local as on general account. Tin-plate bars are in rather better inquiry. Billets and hoops are quiet. Slabs, wire rods, and blooms are quiet.

Shipbuilders are hopeful of new work, although very few inquiries for new tonnage are in the market. Considerable activity is maintained in makers' yards, and in the engineering and boiler shops things are very busy indeed.

Much progress has lately been made in the steel barrel-making industry at Barrow, and it is expected a good trade will be built up in this department.

The Kellner Partington Paper Pulp Company, which has just declared a dividend of 7 per cent. for the year, is now producing 120 tons of finished high - class paper per week at its Barrow Works, and in addition to this it produces about 50 tons of pulp, which is sold to paper makers in other districts. The directors speak very hopefully of the success of this concern in the future.

Shipping is still quiet. During the week 5255 tons of pig iron and 5990 tons of steel were shipped from West Coast ports, compared with 5275 tons of pig iron and 7375 tons of steel in the corresponding week of last year, a decrease of 20 tons of the former and 1385 tons of the latter. The aggregate shipments to date this year represent 301,515 tons of pig iron, and 342,084 tons of steel, compared with 234,208 tons of pig iron, and 404,570 tons of steel in the corresponding period of last year, an increase of 67,307 tons of pig iron, and a decrease of 62,426 tons of steel on the year.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE market has been somewhat more lively this week than it has been for some time past, but the improvement has been confined entirely to the demand for Cleveland foundry pig and warrants, and has been very short-lived, for a considerable part of the recent advance has already been lost. Still, a fair amount of business has been done at better prices, and less pressure to sell is reported, and holders of warrants are more disposed to keep them, so that they compete less with makers' iron than usual. The market has been influenced partly by the more encouraging commercial news from abroad, more particularly from the United States, where there are more encouraging signs, demand being larger, and failures fewer. Then foreign political reports are much less disquieting. Another favourable influence has been the October statistics of the Cleveland Ironmasters' Association; these were certainly not good for the time of the year, but are less unsatisfactory than had been predicted. In October, which should be one of the briskest shipping months of the year, seeing that it is the last in which cargoes can be sent to some important markets, a considerable decrease in stocks should be reported, whereas this year an increase of 4689 tons was reported in Cleveland iron, and there has been an increase in every month since June, which are just the months when there should be decreases. Still, last month's increase of stock was not nearly as large as had been looked for, and this helped the market up a little.

A considerable quantity of Cleveland foundry pig iron has been sold this week, and not only did the demand for prompt iron increase, but endeavours were made to purchase for delivery over the first quarter of next year, the buyers offering 36s. for No. 3. This was accepted in an odd case or two. It has been paid regularly this week for prompt deliveries, this quality being extremely scarce, and both makers and merchants have not been accepting less. Cleveland warrants have been up to 36s. 0½d. cash, that being 6½d. above the recent lowest, and the best price that has been ruling since the latter part of July, but the advance has not been maintained, and at Wednesday's close the figure was 35s. 9d. cash. The stock of Cleveland pig iron in Connal's warrant stores on 7th was 88,859 tons, or 228 tons increase for the month. Last month there was a decrease of 1114 tons, but the stock of hematite pig iron stocked with them increased 7890 tons, raising the total quantity of hematite with them to 70,657 tons, there having been an increase reported each month for a considerable time past. Grey forge pig iron has been a drug upon the market for the last two months, the furnaces producing more than usual, while the demand has fallen off, owing to the poor condition of the finished iron trade. On this account it is relatively much cheaper than No. 3. Under normal conditions it is only 1s. per ton cheaper, now it is 2s. 6d., and cannot be produced at a profit. In the early part of the year it was quite as dear as No. 3, but then the supply was short. Now any quantity can be bought at 33s. 9d. per ton, and there has been some business at threepence less than this. The make of hematite pig iron continues in excess of the requirements, and the stocks are increasing, though to what extent cannot be said, as the ironmasters do not issue any record of their stock of hematite pig, similar to that given with respect to Cleveland iron. There must now be a large stock, but no move is made towards reducing the production, and the prospects of improvement are not very encouraging. The hematite makers have recently had to reduce their quotations 3s. 3d. per ton, whereas the cost of materials has been but very slightly reduced. The producers of Cleveland pigs have the advantage of those making hematite, as their price of No. 3 has only declined 6d., and where hematite pig used to be 10s. dearer than Cleveland No. 3, it is now only 7s. Foreign ore is dearer.

The Cleveland Ironmasters' October statistics show that out of 141 furnaces erected in the North of England, 95 were in operation at the end of the month, of which 51 were producing Cleveland iron, and 44 hematite, basic, and spiegel iron, no change having been made during the month. A year ago only 85 furnaces were working. The total production of pig iron was 262,309 tons, or 10,038 tons increase on September. Of this 126,628 tons was ordinary Cleveland iron —increase, 4270 tons—and 135,681 tons hematite, spiegel and basic pig—increase, 5768 tons; the increases being due in great part to October being the longer month. Makers' unsold stock of Cleveland pig amounted at 31st to 100,967 tons—increase, 4762 tons; in makers' stores, 2626 tons were held—94 tons decrease; in the North-Eastern Railway Company's warrant stores, 4650 tons—increase, 1135 tons; and in Connal's, 88,631 tons—decrease, 1114 tons; the total stock being thus 196,874 tons, and the increase 4689 tons. The pig iron shipments from the Tees amounted to 80,253 tons; increase on September, 1894, 114 tons, and decrease on October last year 15,420 tons, there being a large decrease in the oversea business, which only reached 44,471 tons, against 56,419 tons last year. About five-sixths of the exports of pig iron were ordinary Cleveland.

The Corporation of Middlesbrough have resolved to honour Sir Lowthian Bell, Bart., F.R.S., by conferring upon him the freedom of the borough in recognition of the eminent services he has rendered to the town. At the meeting at which this resolution was carried it was reported that Sir Lowthian was conducting experiments with a view to eliminating at a cheaper cost than at present the phosphorus in Cleveland iron, so that the best steel can be made from it, and at a cost which will enable it to compete successfully with hematite steel for all purposes. His firm have spent nearly £50,000 in this work. It has also been decided to confer the freedom of the borough on his son, Mr. Hugh Bell.

Steel and iron manufacturers find trade very quite, and profit is out of the question at present prices, but competition is extremely keen, and nothing better can be secured. Bar iron producers maintain their position better than any others, and have for a long time kept the price of common bars at £4 17s. 6d., less 2½ per cent., f.o.t., but even they cannot run their mills regularly. Steel ship plates are quoted at £4 15s., less 2½ per cent., f.o.t., but can be bought at less, but iron ship plates are not below that figure; iron angles are about £4 12s. 6d., less 2½ per cent, f.o.t.; heavy steel rails are offered at £3 12s. 6d. net at works.

Shipbuilders find trade a little better, and a few more orders are secured, chiefly from those who run regular lines of steamers, and are taking advantage of the low prices to get vessels which they will need. Freights are improving a little, and that will influence people to give out more orders. The Tyne Steam Shipping Company has ordered a steamer of 800 tons deadweight to replace the Grenadier, which was lost recently. The vessel will be built by Messrs. Wigham, Richardson, and Co., Walker. Some orders for vessels for the Russian volunteer fleet are also expected. Engineers are also ordering more. The North-Eastern Marine Engineering Company, Wallsend-on-Tyne, has received an order for the machinery for a large steamer for a Liverpool firm, and also one to alter the machinery of a large Spanish mail steamer, converting the existing machinery into the tri-compound system.

Among the mayors for the ensuing year is Mr. Charles Arthur Head, one of the managing directors of Messrs. Head, Wrightson, and Co., Teesdale Iron and Engineering Works, Thornaby-on-Tees. He will be the second mayor of that borough, succeeding Mr. William Anderson, who is the other managing director of the same firm. Mr. William Whitwell, of the Thornaby Ironworks, Thornaby, has been appointed a deputy-lieutenant for the North Riding of Yorkshire.

Prices of coal are fairly well maintained, and the demand is good, though it is tapering off for steam coal, as is usual at this time of the year. At the Ashington Colliery, Northumberland, Messrs. Ernest Scott and Mountain, of Gateshead, are to lay down a dynamo to run 1000 incandescent lamps of 16-candle power, and the Horton Coal Company has ordered from them a similar dynamo for lighting its Whitburn Colliery. At West Hartlepool Dock the North-Eastern Railway Company has completed the erection of a hydraulic coal drop for bunkering large steamers. The new lift is capable of raising a wagon 34ft. above the level of the staith, which is 12ft. from the ground.

### THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE general outlook in the coalfield is somewhat unpromising. Buyers are disposed to show unwillingness to enter into fresh contracts. On account of the mild weather which is at present prevailing, and the conclusion of the Scotch strike, trade on the whole is in an unsatisfactory condition. The dispute with the enginemen has been settled in such a way that each owner has now to privately deal with his own men, and in very difficult cases deputations from the masters and the men will be formed to arbitrate. The men are quite expecting that the owners will at once give them the terms they require. The outcome of this agreement is being looked for with interest by the large body of surfacemen, on whose behalf a new association has recently been formed. There is not much doing in household fuel, owing, as previously stated, to the mild weather. Merchants have laid in large stocks in anticipation of the advance in prices for the winter, but very little buying is at present going on. Although the tonnage forwarded to the metropolis is not up to the usual standard, even the present consignments are blocking the rails, and have to be sold at a reduction to clear off the stocks. The attempt to levy an advance has entirely failed, and some of the agents report that in many cases it is even difficult to keep up summer prices. Quotations, however, remain practically the same, and are as follows: Silkstone house coal, 9s. 6d. to 11s. per ton.; Barnsley house, 8s. 6d. to 9s. 6d. per ton; other qualities from 8s. per ton. Not so much is doing in steam coal, owing both to the advancing season and the fact that more North-country coal has been put on the market since the termination of the Scotch strike. The tonnage sent to the Humber ports is not so large, and stocks are reported to be waiting for shipment at Hull, Goole, and Beadby. Railway companies are taking a fair average on contract account. Barnsley hards are from 7s. 9d. to 8s. 3d. per ton, inferior sorts from 7s. Gas coal is in good demand at 7s. to 8s. per ton. Manufacturing fuel continues to be in the same depressed state, and it is likely to stop there, according to the reports from the textile districts. Pit slack, 3s. 6d. per ton; screened slack, 4s. 5d. to 5s. 6d. per ton. Smudge and small coal in abundance at low rates. Coke the same as last reported.

The prices of iron and steel continue so low that in many cases the machinery is simply being turned round without leaving any appreciable profit. It is believed that prices have now fairly got to the lowest ebb, and the present rate of colliers' wages will certainly preclude any further decline. Hematites remain at 50s. to 52s. per ton, according to brand, delivered in Sheffield. Common forge iron stands at 38s. per ton. Bessemer billets at £5 7s. 6d., and bar iron, for which there is a very feeble demand, at from £5 5s. upwards. In the latter department manufacturers are still suffering severely from the coal stoppage of last year. It occurred at the time when the colonial market was opening out for bars, and our firms were unable to take the work then offered. There is no expectation of any considerable improvement this side of Christmas.

In the general branches of the heavy steel trade business is decidedly slack, and manufacturers have not much hope now of any animation before next year. Railway material, for which there must be a heavy demand very soon, remains at present, however, in very light request. Extensive railway developments are in progress and projected at home, and there are still further movements in that direction in the great Indian market. In both cases a large amount of work is certain to come to this city. These will mainly be in the production of tires, axles, springs, buffers, and the parts which go to make up the completed locomotive. There is some prospect of a change for the better in shipbuilding material, but at present it is not very pronounced. Although the closing quarter of the year is always looked forward to in the steel trade as the busiest, manufacturers so far have not found it so. The colonial trade is just now setting in, but the Birmingham houses appear to be feeling its benefit more appreciably than in the Sheffield district. A good deal of work which would have naturally come here last season went there while the work was standing, and it will be interesting to know how far it will return. Experience in Sheffield proves that once trade has been displaced there is nothing so difficult to win it back to the old channel.

The armour-plate departments are exceedingly busy. The three firms producing that important class of work are now engaged upon armour for five first-class battleships simultaneously. This is altogether a new experience in the armour-plate establishments. The plates are being turned out with exceptional celerity, and, as the Secretary to the Admiralty admitted last week, to the complete satisfaction of the naval authorities. Another class of military material is in quite a different condition, viz., the manufacture of armour-piercing projectiles. No orders have come to Sheffield for a considerable period, and if it turns out to be true, as reported, that the Government intend to commence making steel shells at Woolwich Arsenal, a large amount of costly machinery and plant will be thrown idle. Sheffield manufacturers feel strongly about this competition of the Government establishments, and hold that it is very unfair, after they have lavishly spent capital upon the best procurable plant, and made many expensive experiments, that they should be refused the orders. It is stated that the Government contemplate a new class of shell, and that they have obtained specimens from Sheffield and elsewhere, which they are testing at Woolwich.

In the larger silver plate and electro establishments overtime is at present being worked, on account of the season orders for Christmas and New Year. The smaller houses, however, are not so well off as they expected to be, the tendency being more and more to concentrate the bulk of the work in the more extensive establishments. A feature of this business is the extraordinary variety of new patterns and styles, their number being the clearest possible proof of the necessity which exists for tempting buyers with novelties, which combine artistic beauty with practical utility.

### NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has exhibited a good deal of animation this week. Scotch warrants have changed hands in comparatively large quantities. Prices advanced 3d. per ton early in the week, and although subsequently there was a reaction, the market continued fairly active. Cleveland iron has followed a similar course as to prices, but business has been restricted. Cumberland hematite has been a little firmer.

The lighting of blast furnaces has continued, and there are now 60 in operation in Scotland, compared with 56 last week and 53 in the corresponding week of last year. There are 12 blowing at Gartsherrie, all on ordinary iron; Coltness has 3 making ordinary and 6 hematite, Dalmellington 3 ordinary and 1 hematite, Shotts 2 ordinary, Eglinton 8 ordinary, Clyde 1 ordinary and 2 hematite, Wishaw 2 ordinary and 1 hematite, Carnbroe 4 ordinary, Calder 1 ordinary and 3 hematite, Govan 3 ordinary and 2 hematite, Summerlee 5 ordinary, and Monkland 1 ordinary. There are thus 45 furnaces producing ordinary, and 15 hematite pig iron, the production of basic pig being as yet neglected.

The balance of makers' special brands remain comparatively steady as follows:—G.M.B. f.o.b. at Glasgow, No. 1, 44s.; No. 3, 42s. 6d.; Monkland, No. 1, 45s. 6d.; No. 3, 42s. 6d.; Carnbroe, No. 1, 46s. 6d.; No. 3, 45s.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Calder and Gartsherrie, Nos. 1, 52s. 6d.; Nos. 3, 48s.; Summerlee, No. 1, 53s 6d.; No. 3, 48s.; Coltness, No. 1, 55s. 6d.; No. 3, 50s.; Glengarnock at Ardrossan No. 1, 52s. 6d.; No. 3, 47s. 6d.; Eglinton, No. 1, 48s.; No. 3, 46s. Dalmellington, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 58s.; No. 3, 50s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 4313 tons, compared with 3820 in the corresponding week of last year. The 4313 tons were disposed of as follows:—China and Jtpan 650 tons, India 433, Canada 400, Holland 360, South America 150, United States 50, Australia 90, France 43, Germany 270, Belgium 30, Spain 105, other countries 70, the coastwise shipments being 1662 tons, against 1171 in the corresponding week.

The manufactured iron trade recovers but slowly. The capacity of the works in the West of Scotland is such that orders just now available are easily absorbed and executed. Prices are fairly steady, but, as is also the case with those obtained for steel, they are not in the main very remunerative. The mainstay of the steel trade is the shipbuilding industry, which is at present well employed with a number of very good additional orders coming to hand.

The exports of manufactured iron and steel in the past week embraced general machinery worth about £10,000; sewing machines, £14,660; steel goods, £4108; and general iron manufactures, £14,476.

The coal trade continues to expand in volume, the demand for home use is much greater, owing to the large quantities now required for the iron and steel works, and the shipments are likewise increasing, the improvement in the past over the preceding week being 31,444 tons. The increase has arisen chiefly on the East Coast, where the miners are now all at work. Prices continue steady, and for manufacturing purposes they are generally regarded as rather stiff.

### WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

IN a run over a section of the colliery district this week I have been much impressed with the change brought about by the last few weeks of stormy weather. Steamers having been driven back from the ports, or failing absolutely to come in, have led to very partial work at collieries and a thorough congestion of coal traffic. At one colliery I noticed that every siding was blocked with laden coal wagons, and a modified condition of the same state of things was visible in every direction, at collieries and at ports, while in the colliery towns fully half the week has been spent in holiday making.

There was a partial break on Tuesday, but a return of the stormy hindrances on Wednesday, and the week's total coal exports will, I fear, be a small one, comparatively. This has naturally told on prices, especially on steam coal, which remains weak. So far the lowest prices keep at 11s., but there are fears that a drop is likely into the "tens." The last quotations, Cardiff Exchange, were: Best steam, 11s. to 11s. 3d.; seconds, 10s. 3d. to 10s. 6d.; best Monmouthshire, 10s. 3d. to 10s. 6d.; and seconds, 9s. to 9s. 3d.

Small steam has seen a good deal of the up and down character of late. The market has been so glutted that prices dropped below 4s. Midweek there was a slight recovery, and the last quotations were: Ordinary, 4s. to 4s. 3d.; best, 4s. 6d. to 5s.

House coal figures remain much about the same, instead of advancing, as is generally the case at this time of the year. Cardiff quotations this week were:—Best qualities, 10s. 9d. to 11s.; No. 3 Rhondda, 10s. to 10s. 3d.; brush, 8s. 6d.; small, 6s. 3d. to 6s. 6d.; No. 2 Rhondda, 8s. 6d.; through, 6s. 3d. to 6s. 6d.; small, 4s. to 4s. 6d. It is not likely that these figures will remain, and as inland trade is getting stronger, an advance is certain.

Patent fuel is dull, both at Cardiff and Swansea. Cardiff prices, 10s. 9d. to 11s.; Swansea, 10s. to 11s. For coke the demand continues moderate. Latest Cardiff quotations:—Furnace, 14s. to 14s. 6d.; foundry, 15s. to 15s. 6d.; special foundry, 19s. to 20s. At Swansea furnace coke is quoted at 12s. to 12s. 6d., and best foundry 17s. 6d. to 18s., thirty days cash, less 2½.

The iron and steel trades show little change. The large works at Dowlais continue fairly active, though there is little special business in hand, and the sidings on Monday exhibited but a small quantity of steel bar. The busiest department at most of the works from Blaenavon to Ebbw Vale, and thence to Cyfarthfa and Dowlais, was that connected with foreign ore receipts. The aggregate quantity to hand during the week was very large, and, coupled with a little brightening of pig iron prospects, gave some encouraging signs. Prices continue very weak. Cyfarthfa holds its own well, especially in bar.

From an old document, dated 1807, it will be seen what a remarkable decline has taken place in values. Then pig iron was sold at £5 10s., bar was at £16, and a bag of coal at the pit, 8½d.

Swansea quotations this week are as follows:—Pig iron, Glasgow warrants, 42s. 10½d.; hematite warrants, 43s. 9½d.; Middlesbrough, 42s. 7½d.; Welsh bars, £5 2s. 6d.; steel rails, heavy, £3 15s. to £3 17s. 6d.; light, £4 10s. to £4 15s.; sheet iron, £6 to £6 10s.; steel sheets, £6 5s. to £6 10s. Bessemer steel, bars for tin-plate, £4 to £4 2s. 6d. Siemens, best, £4 to £4 2s. 6d.

Tin-plates: Bessemer, 10s. to 10s. 3d.; Siemens, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 c., 20s. to 22s.; best charcoal, 12s. to 12s. 3d., according to finish of brand. Wasters, 6d. to 1s. less than primes. All delivered Prince of Wales' Dock, Swansea; cash, less 3 and 1 per cent. Block tin is at £66 10s. to £66 12s. 6d. Iron ores, Tafna, 11s.; Rubio, 11s. 3d. to 12s.; 1s. 6d. per ton extra for selected large. Other Swansea quotations this week were lead, English, £10 to £10 2s. 6d.; Spanish, £9 17s. 6d. to £10.

It will be noticed that now that English quotations approach so near to those of foreign, there may be a little more hopefulness for the Welsh mines, many of which have been in a depressed condition for years, owing to foreign rivalry. Aforetime the difference was fully £1 per ton against that of Wales.

The Birmingham influences brought into the Rhayder district may lead to a better development of the lead mines of that neighbourhood.

The outlook of the tin-plate trade has not the roseate appearance one would wish to see, yet I think too gloomy a view is being taken from the fact that wage reductions are imminent, and some works contemplate closing if they are not accepted. There is no denying that stocks are decreasing, and so too is the production. When stocks have fallen to a certain point the crisis will come, and a turn, I confidently think, for the better. The weeding out of a few struggling works would improve the situation, though it is always regrettable to see capital and wasted energies scattered for nought.

One would have thought that a more buoyant tone would have been exhibited on 'Change, Swansea, mid-week, for the stocks were reported as 30,000 boxes less than the corresponding week last year. The shipments last week totalled 97,448 boxes, and the receipts from works 68,240 boxes. Stocks at Swansea now only amount to 202,264 boxes. One of the best tin-plate shipments of the year was that of 3300 tons last week sent by the Minnesota to the United States. Large clearances are expected to take place with arrival of tonnage.

The present time is evidently regarded as a favourable one for bringing house coal collieries to the hammer. In addition to those I have noticed of late as changing hands, I see that the Adare Colliery, Dinas, Rhondda Valley, will be sold early in December. The colliery is situated near the "Naval" Steam Colliery, and the seam worked is No. 2 Rhondda. On the 27th, at the Pyle and Brynda Railway and Cefn Collieries, near Bridgend, the whole of the surplus plant, machinery, and materials will be put up for auction. I note that the surplus includes a number of vertical and horizontal winding engines, two Cornish pumping engines, and a number of coal wagons.

Another illustration of the thoughtlessness of some colliers is being given in the opposition shown in various places to the public benefactors of the country towards the Albion calamity being vested in the Provident Miners' Society. This excellent organisation has done good service for many years, and requires more general support than it gets; and with its matured appliances could distribute well and with extreme economy; but no, the collier wishes to get relief from this fund and the public as well. I am glad this is only a partial opinion of the inconsiderate. The mass of intelligent and thoughtful colliers support the fund.

### NOTES FROM GERMANY.

(*From our own Correspondent.*)

MATERIAL changes have not taken place on the general iron market since last report. Activity in the different departments continues moderate; buying, especially that on foreign account, is still being carried on very cautiously, and there is a general belief that there is not much probability of any improvement taking place until the beginning of next year.

A lifeless tone characterises the Silesian iron industry. There has even been less doing this week than last, and prices are, if possible, a little more depressed than usual. Steel manufacturers are hardly able to keep their mills in regular operation; they meet with the greatest difficulties in securing further orders, even though they willingly agree to prices which scarcely cover the costs of production.

The situation of the Austro-Hungarian iron trade is satisfactory on the whole. Concerning the different branches there has been quite a regular demand experienced for pig iron, and prices show considerable firmness. Common forge pig is sold at 46 fl. p.t.: mixed lots, 47 to 48 fl.; while grey forge stands at 48 to 51 fl. p.t. Bessemer continues to be quoted 49 to 51 fl. p.t. at works. The malleable iron trade is well employed in almost all departments. The requirements of the railway companies, though of small weight generally, will help to keep the mills in fairly good activity for the remainder of the year. Bars are in quiet call at 107·50 to 115 fl. p.t., while girders fetch 106 to 110 fl. p.t. Heavy plates quote 180 fl.; tank do., 135 fl.; galvanised sheets, 215 to 270 fl. p.t. at works. The majority of the wagon and locomotive factories are in a poor condition, and some of them had to dismiss a number of their men.

Output of pit coal in Austria is statistically stated to have been as under:—

| | 1892.<br>100 kgs. | 1893.<br>100 kgs. |
|---|---|---|
| Austrian Silesia | 39,900,531 | 36,935,416 |
| Bohemia | 37,479,977 | 36,887,145 |
| Moravia | 12,672,376 | 11,797,896 |
| Galicia | 6,790,299 | 6,324,794 |
| Lower Austria | 480,220 | 463,869 |
| Styria | 3,106 | 2,141 |
| | 97,326,509 | 92,411,261 |

On the French iron market the tendency of prices is rather less firm than during previous weeks. Orders are coming in but slowly, and there is generally much reserve practised on both sides. Some of the large establishments are very busy at present executing orders of former date, and until these are finished makers do not care so much for new work. A real improvement cannot reasonably be expected before New Year, and even then it is doubtful whether the hopes that are being entertained in some quarters will be realised. Up-to-date production has been about equal to consumption; only for some special sorts of structural iron demand has slackened off lately, and manufacturers accept prices that are a little below list rates.

In Belgium the iron and steel trade has, if anything, gathered further strength in the course of the past week. Pig iron is still to be had at very cheap rates, but in the malleable iron department a fair activity is reported, and there is an undeniably improving tone in the export trade, though the prices offered are, as a rule, too low to allow any profit.

The unfavourable situation of the Rhenish-Westphalian iron industry, which was reported in last week's letter, continues.

On the pig iron market a tolerably firm tendency has hitherto been noticeable as regards quotations, although demand is limited and makers are rather badly off for new work. High prices of coal and high wages in many instances prevent a further going down in quotations, and the fact that prices of pig iron are well maintained may be accounted for by the utter impossibility of further reductions rather than by an improving tendency in trade. The blast furnace works of the Siegerland have been booking a lot of fair orders upon the week, and are for the greater part much better situated than the works of the Westphalian district.

For malleable iron a weak demand is experienced generally; both bars and girders are exceedingly dull, and the depression in prices continues, and in some cases even increases. Hoops have been a trifle more lively, consumers and dealers being, it appears, rather anxious to cover their demand at the ruling low quotations. Plates and sheets are in moderate call, and the business in drawn wire and wire nails moves from bad to worse. Rivets are likewise suffering from the unfavourable condition of the market. The moderate employment in the railway and engineering line continues, and the foundries are also but very indifferently engaged. At the wagon factories, on the other hand, a fairly regular activity is going on.

Figures of French foreign trade published by the Board of Customs were, for September and for the first nine months of present year, as under:—

| Import. | 1894.<br>f. | 1893.<br>f. | Difference.<br>f. |
|---|---|---|---|
| Victuals | 90,840,000 | 86,651,000 | +4,189,000 |
| Raw materials | 159,396 000 | 154,538,000 | +4,858,000 |
| Manufactured goods | 42,164,000 | 43,847,000 | −1,683,000 |
| Totals | 292,400,000 | 285,036,000 | +7,364,000 |

| Export. | 1894.<br>f. | 1893.<br>f. | Difference.<br>f. |
|---|---|---|---|
| Victuals | 54,318,000 | 58,897,000 | −4,579,000 |
| Raw materials | 78,161,000 | 60,619,000 | +12,245,000 |
| Manufactured goods | 110,898,000 | 138,369,000 | −27,471,000 |
| Parcels sent by post | 3,894,000 | 2,915,000 | +979,000 |
| Totals | 242,271,000 | 260,800,000 | 18,826,000 |

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*24th October*, 1894.

20,339. Memorandum Books and Postcards, J. Jensen Essex.
20,340. Machines for Washing Potatoes, J. Burrell, London.
20,341. Broad Silk Pieces, G. C. Franklin, Birmingham.
20,342. Lace Fastening Block, S. Genese, London.
20,343. Photographic Apparatus, A. J. Boult.—(*L. Joux, France.*)
20,344. Map Carrier for Cyclists, W. P. Thompson.—(*M. Tixier and L. Maisounabe, France.*)
20,345. Bottle Stoppers, W. P. Thompson.—(*M. Tixier and L. Maisounabe, France.*)
20,346. Boring Implements, A. Lane and C. E. Lane, London.
20,347. Cleansing Carding Machines, F. X. Zettler, Germany.
20,348. Securing Coats and the like, J. H. Leber, London.
20,349. Stoves, R. Poore, London.
20,350. Supplying Food to Horses, W. D. Farn and T. U. Clarke, London.
20,351. Feed-water Heating Apparatus, J. E. Carroll, London.
20,352. Graduated Measure-stopper for Bottles, L. Wookey, London.
20,353. Inkstands, A. Barker, London.
20,354. Electro-deposition of Aluminium, P. Marino, London.
20,355. Blinds, H. Kent, London.
20,356. Flushing Apparatus, H. Kent, London.
20,357. Clothes Drying Machine, T. Cudlipp, London.
20,358. Photographic Paper, H. H. Lake.—(*Arndt and Trost, Germany.*)
20,359. Waterproof Fabrics, W. Boeddinghaus, jun., London.
20,360. Coin-freed Locks for Doors, J. N. Maskelyne, London.
20,361. Paper Fastener, C. Schwegler, Wiesbaden, Germany.
20,362. Frost Pegs or Cogs for Horseshoes, T. Parish, London.
20,363. Telephone Supports, H. and A. B. Gilbert, London.
20,364. Bicycles, &c., J. S. Taylor and J. V. Pugh, London.
20,365. Recovery of Zinc from Alloys, W. S. Rawson and R. Heathfield, London.
20,366. Controlling or Regulating Machinery, L. Epstein, London.
20,367. Steam Cultivators, A. J. P. de Souza, London.
20,368. Apparatus for Pumping Liquids, L. Gunn, London.
20,369. Keying Railway Rails in their Chairs, A. Mosley, London.
20,370. Hot-water Boilers, &c., E. W. Herendeen, London.
20,371. Window Sashes, The Simplex Window Fittings Company and P. Daw, London.
20,372. Bolts for Windows, F. R. M. Phelps and The Simplex Window Fittings Company, London.
20,373. Production of Zinc Compounds, J. P. Lacy and A. J. Ash, London.
20,374. Stone-grinding Machines, P. R. J. Willis.—(*J. Lavers, United States.*)
20,375. Manufacture of Asphalt, F. X. Byerley, London.
20,376. Manufacturing Rugs, &c., J. Fels.—(*R. Grubb, United States.*)
20,377. Photographic Cameras, J. Wilson, London.
20,378. Bedsteads, F. J. Chubb, London.
20,379. Trucks for Conveyance of Guns, E. R. Hicks, London.
20,380. Sponge Bags, E. Hanisch and C. Adamy, London.
20,381. Pulleys and Brackets for Same, J. Hewitt, London.
20,382. Electric Telephones, A. C. Brown and G. R. Neilson, London.
20,383. Pneumatic Tires, R. R. Gubbins, London.
20,384. Faucet, W. D. King, London.

*25th October*, 1894.

20,385. Cycle Saddles, T. Middlemore and J. Beesley, London.
20,386. Tobacco Pipes of Aluminium, C. G. Jacobsen, London.
20,387. Rope and Chain Wheels, T. Meacock, Stafford.
20,388. Wood-splitting Machines, E. Cory, F. W. Reynolds, and W. C. Catford, London.
20,389. Roundabouts, &c., L. Hibbs and T. Collier, Nottingham.
20,390. Wearing Apparel, J. A. Gregory, Nottingham.
20,391. Keeping Fencing Wires Strained, W. H. Lindsay, Bristol.
20,392. Mud-guard for Cycles, H. Wells, Stockton-on-Tees.
20,393. Dress-guard for Cycles, E. Hall and H. Hall, Leicester.
20,394. Pneumatic Tires, A. Shiels, Glasgow.
20,395. Windows, H. Wilson, Lanarkshire.
20,396. Clothes-horses, H. Ashby, Newcastle-on-Tyne.
20,397. Cutting-out Electric Arc Lamps, H. J. Crefield, Kent.
20,398. Steering Engines, W. E. Moss, Liverpool.
20,399. Gas Burners, A. Bennett, Glasgow.
20,400. Belt Fasteners, J. Oswald, Manchester.
20,401. Pneumatic Tires of Wheels, C. G. Virgo, Manchester.
20,402. Barrel Ratchet for Watches, R. Thorneloe, Birmingham.
20,403. Cigarette and Cigar Cases, M. Blanckensee, Birmingham.
20,404. Barbed Chain or Barbed Fencing, P. A. Martin, Birmingham.
20,405. Nailing Machines, J. Hawley, C. Cooper, and J. Lee, Liverpool.
20,406. Means for Insulating Chambers, M. C. Bannister, Manchester.
20,407. Gully, R. M. Gloyne, Eastbourne.
20,408. Wall Lamps and Brackets, C. Meason, Birmingham.
20,409. Lamps, C. Meason, Birmingham.
20,410. Drawing-boards, J. Crabtree, London.
20,411. Chair-locking Devices, J. Walker, Glasgow.
20,412. Heels for Boots and Shoes, W. Brewster, Manchester.
20,413. Clearing Hook for Anglers, H. Warry, Totnes.
20,414. Making Briquettes for Fuel, R. Fegan, London.
20,415. Gripping Appliances, H. P. Hoghton, Manchester.
20,416. Ruling Apparatus, F. Bardelli, K. Danielovsky, and A. Orszagh, Manchester.
20,417. Golf Clubs, J. Smith, Glasgow.
20,418. Fittings for Window-blinds, T. Sumner, St. Helens.
20,419. Baits, Flies, &c., for Fishing, W. M. James, Redditch.
20,420. Folding Music Stands, J. Berg, Glasgow.
20,421. Buffing-machines, A. and F. H. Pochin and H. Addison, London.
20,422. Manufacture of Steel, W. P. Thompson.—(*E. Bertrand and O. Thiel, Austria.*)
20,423. Printing Colours by One Impression, F. Barnwell, Liverpool.
20,424. Fonts of Lamps, R. O. Jones, Manchester.
20,425. Preparation of Foods, C. H. Biss, Liverpool.
20,426. Double-action Beer Drip Saver, C. J. Herbert, London.
20,427. Bottling-machines, E. Stahl, London.
20,428. Sterilising Milk, F. Guilleaume and E. Goltstein, London.
20,429. Candlestick, A. M. Coleman, Hants.
20,430. Bicycle Lamp, J. Benn, Birmingham.
20,431. Flying Machine, W. Frost, Saundersfoot.
20,432. Electric Bell, F. C. Allsop, London.
20,433. Manufacture of Window Tickets, H. E. Ash, London.
20,434. Protector for Scarf-pins, V. Drew and J. C. Saunders, London.
20,435. Buffers of Railway Wagons, B. Ramsden, London.
20,436. Type-writing Machines, J. T. Armstrong and G. F. Wetherman, London.
20,437. Combined Funnel and Measure, A. G. Luck and H. Mitchell, Sussex.
20,438. Cycle Tires, and Rims, G. T. Frankland, London.
20,439. Electrical Energy, H. Tipping, H. A. Tobias, W. H. Cadman, and R. J. Crowley, London.
20,440. Harrows for Agricultural Purposes, E. Slade, London.
20,441. Staple-making Machinery, B. J. B. Mills.—(*P. C. Oscanyan, United States.*)
20,442. Arc Lamps, J. E. A. Gwynne and R. Kennedy, London.
20,443. Holding Glass Balls for Advertising, J. B. Adams, London.
20,444. Automatic Mechanical Stoker, M. Sonnenschein, London.
20,445. Stopper for Bottles and the like, T. Chanson, London.
20,446. Sinks and other Sanitary Appliances, S. H. Rowley, London.
20,447. Process for Soot Combustion, W. Michalk, London.
20,448. Portable Steps, A. F. Whislay, Brightlingsea, Essex.
20,449. Rotary Hair-brushing Machine, H. Leslie, London.
20,450. Chimney and Ventilating Cowl, L. W. Shedden, London.
20,451. Drills, M. C. Johnson, London.
20,452. Protecting Ladies' Dress Skirts, A. Smith, London.
20,453. Pneumatic Tires, A. James and D. Steffano, London.
20,454. Sunshades, Parasols, and Umbrellas, J. Allcock, London.
20,455. Locomotives, H. Degener and R. Deissler, London.
20,456. Speed Indicators, J. Prokofieff, London.
20,457. Apparatus for Diffusing Scents, R. V. Wagner, London.
20,458. Bandoliers, W. G. Leckie, London.
20,459. Butter Workers, F. T. Gade, London.
20,460. Cycle Gear Cases, W. Bransom, London.
20,461. Propelling Ships, S. Burton, London.
20,462. Induced Current Telegraphy, F. E. W. Bowen, London.
20,463. Pneumatic Tires, S. Lee, London.
20,464. Sliding Sashes, W. A. Bramley, London.
20,465. Armour Plate Manufacture, J. A. Hunter, London.
20,466. Steam Generators, L. E. Solignac, London.
20,467. Egg Supports for Plates, P. W. V. Brooks, London.

*26th October*, 1894.

20,468. Ploughs, J. Hornsby, J. Innocent, and I. Trolley, Grantham.
20,469. Sheaf Binders, J. Hornsby and J. H. Smith, Grantham.
20,470. Word-builder for Teaching Spelling, J. R. Sharpe, Lincoln.
20,471. Fish and Fruit Packing Tins, W. Hodkinson, London.
20,472. Graduating Clawker Apparatus, S. A. Hill, Nottingham.
20,473. Pneumatic Tires, C. Inglefield, Manchester.
20,474. Venetian Window Blind, A. Chenhalls, jun., Cornwall.
20,475. Coin-freed Apparatus, W. Alexander and W. E. Thompson, Birkenhead.
20,476. Hair-curling Pins, J. Hewitt and F. R. Baker, London.
20,477. Springless Latch Lock, J. B. M. Stewart and A. W. King, Sussex.
20,478. System of Announcements, T. H. Rochford, Dublin.
20,479. Carding-engines, E. and S. Tweedale and J. Smalley, Manchester.
20,480. Treatment of Liquids, J. J., T. F. and J. W. Meldrum, Liverpool.
20,481. Rims of Wheels, R. Green, Birmingham.
20,482. Junction Couplings, H. A. Cutmore, London.
20,483. Jointing Stoneware, F. H. Brook, London.
20,484. Carpets, W. C. Gray, Glasgow.
20,485. Condensed Milk Products, W. F. Maclaren, Glasgow.
20,486. Friction Clutches, W. Shore and G. E. Coupe, Manchester.
20,487. Spinning Textile Fibres, R. Todd, Manchester.
20,488. Tyres, J. Watt, Glasgow.
20,489. Infants' Chairs, T. C. Dickie, Glasgow.
20,490. Cycles, P. H. Newill, Salop.
20,491. Cleaning Railway Carriages, J. R. Hazel, Glasgow.
20,492. Pneumatic Harness Pad, W. T. Day, Wolverhampton.
20,493. An Improved Horseshoe, A. Felstead, London.
20,494. Label and Postage Stamp Server, J. R. Kilroe, Dublin.
20,495. Hand Air Pumps, W. Brown, Birmingham.
20,496. Spinning and Doubling Cotton, T. Ashworth, Manchester.
20,497. Jacquard Apparatus, W. and H. A. Fielding, Manchester.
20,498. Wagons, F. Warburton and W. Warburton, Manchester.
20,499. Hoops for Laminated Springs, T. Turton and Sons, Ld., and J. Roberts, Sheffield.
20,500. Drying Clothes, &c., H. C. Longsdon, Keighley.
20,501. The Sanitary Protector, I. Kaufmann, London.
20,502. Firelighter, W. Sander.—(*C. W. Winkelmann, Germany.*)
20,503. Protectors for Watches, G. Stegmann, London.
20,504. Pianoforte Actions, G. D. Rose, London.
20,505. Fire-proof Dwellings, H. W. Butler, London.
20,506. Casing for Hot-water Pipes, J. W. Kitson, London.
20,507. Driving Gear for Cycles, J. S. Miller, London.
20,508. Rims for the Wheels of Cycles, W. H. Taylor, Manchester.
20,509. Increasing the Power of Marine Boilers, J. Hodgkinson, London.
20,510. Cup and Hat Hooks, J. J. James, Birmingham.
20,511. Fittings for Carriage Windows, J. Ingram, London.
20,512. Steam Generators, R. H. Radford, Sheffield.
20,513. Stoppers for Bottles and Jars, R. Hornby, London.
20,514. Water Jacket Tube Boilers, W. T. Allen, London.
20,515. Brackets for Velocipedes, A. J. Edmonds, London.
20,516. Hitching Straps, J. H. Valleau, London.
20,517. Ventilators, F. O. Prince.—(*J. Featon and J. P. G. Martin, New Zealand.*)
20,518. Tires for Road Carriages, H. T. Stephens, London.
20,519. Bearings, F. W. Kitto and W. Haworth, London.
20,520. Combined Umbrella and Stick, I. Keyzor, London.
20,521. Artificial Musk, C. D. Abel.—(*Fabriques de Produits Chimiques de Thann et Mulhouse, Germany.*)
20,522. Friction Clutches, F. W. Golby.—(*M. Kastler, France.*)
20,523. Extracting Pickles from Bottles, W. O. Joseph, London.
20,524. Safety Valve Apparatus, A. Sempell, London.
20,525. Spinning Machines, J. Good, London.
20,526. Closing Openings in Dresses, S. Miller, London.
20,527. Straw-trussing Machines, J. H. and G. Howard and G. Gibbs, London.
20,528. Mitre Cramp, &c., J. and J. Hampton, Ld., London.
20,529. Manufacture of Cigars, J. Reuse, London.
20,530. Lifting-jacks, E. R. Stilwell, London.
20,531. Fastening for Wearing-apparel, C. Smith.—(*S. A. M. Sevin, France.*)
20,532. Addressing Envelopes, &c., F. D. Belknap, London.
20,533. Shuttle-race for Looms, H. H. Lake.—(*L. Scondetti, Italy.*)
20,534. Means of Dissolving Saccharum, A. Young, London.
20,535. Material for Building Purposes, F. Wittmann, London.
20,536. Trivets, W. Coates, London.
20,537. Wheel Tires, H. Carmont, London.
20,538. Hot-air Engines, E. H. Norris and C. G. Henty, London.
20,539. Velocipedes, W. E. Evans.—(*L. Marchand, France.*)
20,540. Covering Walls with Glass, The Ceralite Syndicate, Ld., E. T. Hall, and J. Breeze, London.
20,541. Cradles, J. Abraham, London.
20,542. Packings, J. P. Gauthier, N. Henriot, and A. Tourdanet, London.
20,543. Garment Holders, A. Provost, London.

*27th October*, 1894.

20,544. Holders for Pens, J. Strick, London.
20,545. The Poison Bottle, H. H. Moore, County Cavan.
20,546. Electric Telegraph Systems, S. Butcher, London.
20,547. Moles, J. Grey and W. Taylor, Norden, near Rochdale.
20,548. Electrical Motor Fittings, H. Lea, London.
20,549. Cup for Pie Dishes, M. A. Thomas, London.
20,550. Steam Heating Apparatus, H. M. Wilson.—(*J. Langridge, Japan.*)
20,551. Preparing Cotton, &c., J. W. Bullcck, Wigan.
20,552. Throwers for Book-sewing Machines, A. Logan, London.
20,553. Mackintosh Overcoats and the like, W. Tuley, Halifax.
20,554. Chimney Cowls, G. N. Millward and B. Nicklin, Birmingham.
20,555. Door and other Similar Bolts, B. Nicklin, Birmingham.
20,556. Disinfecting Compounds, C. Gates, Glasgow.
20,557. Furnaces for Heating Steel, W. G. Moore, Banbury.
20,558. Preventing Horses form Kicking, M. E. Medhurst, Cardiff.
20,559. Babies' Pacifier, Toys, &c., A. S. Cartwright, Birmingham.
20,560. Raising Nap on Textile Fabrics, A. D. McLaren, S. Irwin, and L. H. Marsden, Manchester.
20,561. Electric Arc Lamps, G. W. Lowcock, Manchester.
20,562. Rims for Cycles, B. and W. H. Barton, and W. S. London, Leicester.
20,563. Pneumatic Tires, T. Sloper, Devizes.
20,564. Clip for Securing Umbrellas, M. Egginton, Reading.
20,565. Automatic Two-speed Cycle Gear, J. Beesley, Coventry.
20,566. Nursery Chair, J. Davies, London.
20,567. Holders for Photographic Films, H. R. Cox, Cork.
20,568. Train Tablet Lock, J. E. Griffith and S. T. Dutton, Worcester.
20,569. Peeling and Washing Machines, E. Birch, Manchester.
20,570. Self-acting Coal Box, C. Quin, Ascot.
20,571. Dark Slide for Cameras, B. Wilkinson, Manchester.
20,572. Perfume Bottles, B. Hennig and M. Jahn, Manchester.
20,573. Pencil Cases, Perry and Co. and J. Clement, Birmingham.
20,574. Vulcanisation of Timber, W. E. Heys.—(*F. E. Grumbacher, Germany.*)
20,575. Fixing Shields for Gauge Glasses, H. Field, London.
20,576. Raising a Sunken Ship, G. W. Patterson, Reading.
20,577. Storing Postcards, The Stamp Distribution (Parent) Company and J. Frazer, London.
20,578. Fog Signal Machine, M. M. Buckley and W. Cash, Elland, Yorks.
20,579. Dress Support, W. H. and T. H. Finney, London.
20,580. Spinner for Fishing Tackle, P. D. Malloch, Glasgow.
20,581. Lids of Saucepans, &c., H. B. Banbury, London.
20,582. Lamps, E. Bosanko, London.
20,583. Construction of Ships' Rudders, J. Spear, London.
20,584. Roller Blinds, F. G. Gardiner, London.
20,585. Fastening Buttons to Boots, S. L. Pearce, London.
20,586. Pins of Brooches, J. B. Stewart, London.
20,587. Paraffin Lamps, D. G. Lewis and J. Davis, London.
20,588. School Desks and similar Furniture, G. A. Spink, London.
20,589. Doubling Spindles, R. Crabtree and J. Hargreaves, London.
20,590. Brackets for Mantelboards, H. and B. Bracewell and T. Whalley, London.
20,591. Buffers for Water-closets, J. Duckett and Son, Ld., and S. Middleton, London.
20,592. Preventing Halation in Photography, R. Roberts, London.
20,593. Matches, &c., G. Schinko.—(*A. Thimann, Austria.*)
20,594. Fixing Buffing Springs, T. D. and H. W. Swift, Liverpool.
20,595. Railway Signalling Device, W. Grimes, London.
20,596. Electric Accumulators, S. Hammacher, Liverpool.
20,597. Middlings Purifiers, W. N. Whitmore and G. Binyon, London.
20,598. Stamping or Marking Bale Bands, W. Hall, Liverpool.
20,599. Advertising, A. R. Upward, London.
20,600. Printing Photographs, J. W. Shaw and H. W. Chinnery, Walthamstow.
20,601. Scissors Sharpeners, J. T. Pedersén and A. B. Young, London.
20,602. Separating Postage Stamps, C. E. Smith, London.
20,603. Applying Brake Power to Cycles, J. Morton, London.
20,604. Knitting Machines, E. Mills, A. S. Rogers, and W. S. Thomson and Co., London.
20,605. Steam Generators, C. D. Jermyn, London.
20,606. Coupling-bar for Railway Cars, J. Spence, London.
20,607. Key, W. Prosser, London.
20,608. Bicycle Wheels, C. V. Craster, J. C. and G. L. Imeson, London.
20,609. Candles, W. B. Fitch, London.
20,610. Manufacture of Glass Bottles, W. B. Fitch, London.
20,611. Doll's Apparel, C. G. Mason, F. A. Foster, J. C. Elms, jun., and S. Sprague, London.
20,612. Window Catch for Carriages, A. E. Mallandain, London.
20,613. Electric Relays, &c., C. Langdon-Davies, London.
20,614. Electric Heating Wires, F. W. Schindler, London.
20,615. Reducing Aluminium, J. C. Fell.—(*F. A. Gooch and L. Waldo, United States.*)
20,616. Reducing Aluminium, J. C. Fell.—(*F. A. Gooch and L. Waldo, United States.*)
20,617. Cycle Saddles, J. Harrington and T. Middlemore, London.
20,618. Door and Window Check, L. Bonvoisin, London.
20,619. Grain, &c., Drying Apparatus, J. Sleeman, London.
20,620. Post, Letter, and Money Boxes, L. A. Parrock, Birmingham.
20,621. Railway Couplings, R. B. Eggar and D. Petrie, London.
20,622. Carbonate of Soda, P. Bateson and E. K. Muspratt, London.
20,623. Cycle Frames, C. F. Pichard, London.
20,624. Stretchers for Trousers and the like, J. A. Cheape, London.
20,625. Jointing Sewerage Pipes, F. H. Brook, London.
20,626. Label Fastener, J. B. Fisher and H. J. Hayes, Norwich.
20,627. Automatic or "Maxim" Guns, H. S. Maxim, London.
20,628. Studs for Cuffs and Shirts, A. Lehmann, London.
20,629. Trolley Carriers for Step Ladders, W. J. Sumner, London.
20,630. Devices for Copying Books, L. M. Bärwinkel, London.
20,631. Fire Escapes, E. I. Blount, London.
20,632. Crimped Paper Articles, H. J. Drane, C. Moritz, and P. Chant, London.

*29th October*, 1894.

20,633. Window Blinds, J. F. Waters, London.
20,634. Runners for Umbrellas, C. Wood and A. E. Busby, Birmingham.
20,635. Manufacture of Horseshoes, G. Welch, Sheffield.
20,636. Preservation of Steel, &c., A. Ryrie, Co. Durham.
20,637. Wind Motors, G. Moseley and W. Tapling, Kingston-on-Thames.
20,638. Lacing Boots and Shoes, T. Laycock, Wellingborough.
20,639. Handles for Trunks, F. W. Whitlock, Wolverhampton.
20,640. Tipplers for Wagons, S. Tate, Newcastle-on-Tyne.
20,641. Wrenches, A. A. Tattersall, Glasgow.
20,642. Pickers for Looms, T. F. Percival, Glasgow.
20,643. Cycle Frames and Forks, W. Andrews, Birmingham.
20,644. Two-reel Sawing Machines, D. Flanagan, Halifax.
20,645. Portable Barometer, J. Joly, Dublin.
20,646. Iron-band Cutter, C. A. Devenish, Birkenhead.
20,647. Life-saving Apparatus, A. Woodward, Cardiff.
20,648. Umbrella, W. H. O'Brien, Dublin.
20,649. Paper Winding Machinery, J. W. Hacking, Darwen.
20,650. Gypseous Walls, L. Küpper, Germany.
20,651. Measuring Areas, &c., H. S. Hele-Shaw, Liverpool.
20,652. Eye-glass Suspender, D. Roberts, Llanfairfechen.
20,653. Gas Engines, H. and A. E. Robinson, Manchester.
20,654. Bellows, E. Decesari, London.
20,655. Joints for Cornice Poles, W. Allman, Birmingham.
20,656. Separating Dust from Air, W. C. Morison, Birmingham.
20,657. Football Inflator Valve, P. J. Morris, Erdington.
20,658. Harness Buckles, W. Albery, London.
20,659. Two-wheel Cycle, J. P. Howe, London.
20,660. Lids for Pans, J. Turner and H. Seddon, Manchester.
20,661. Watering Carts, J. Stenfield and T. Becker, Cologne.
20,662. Ceilings, J. Schmitz and C. Bürker, Cologne.
20,663. Protectors for Water-gauges, J. Büllerbach, Cologne.
20,664. Protector for Cycle Tires, W. Rebentisch, Cologne.
20,665. Testing Tubes or Fittings, J. Davies, Wednesbury.
20,666. Umbrellas, E. Lewis and T. S. Nicholls, London.
20,667. Tents, H. Heaton, jun., and H. D. Hope, London.
20,668. Hanging Lamps, R. H. Best, London.
20,669. Pneumatic Horse-collar, J. H. Barnett, Leeds.
20,670. Mat-cleaner, H. Hughes and W. L. Pearson, Dublin.
20,671. Fastening Folding Shafts, &c., G. Lacy, London.
20,672. Game of Skill, J. B. Young, London.
20,673. Safety Purse, W. H. A. Sleigh, London.
20,674. Fastening Boots to Feet, J. Dunbar-Brunton, London.
20,675. Cycle Pedals, E. P. Gilman, London.
20,676. Gas Meters, F. Moore, London.
20,677. Water-closet Trap, R. F. Moore.—(*E. C. S. Moore, Bermuda.*)
20,678. Barometers, H. Wilson and F. G. Phillips, London.
20,679. An Improved Plough, G. W. Tiffen, London.
20,680. Cycle Saddles, C. Thomann, London.
20,681. Chimney Pots, J. W. Brown, London.
20,682. Boots and Shoes, H. Fogerty, Cheltenham.
20,683. Dusting Piano Keyboards, A. Seebold, London.
20,684. Cleansing Sand, F. A. Cowell and F. P. Candy, London.
20,685. Taps for Measuring Liquids, H. W. Turner, London.
20,686. Combustion Chambers of Furnaces, R. Marshall, London.
20,687. Pneumatic Tires, J. Iddon and J. E. Baxter, London.
20,688. Lubrication of Pulleys, W. H. Cranstone, London.
20,689. Stoves, E. E. F. Golterman, London.
20,690. Manufacturing Seamless Tubes, P. Hesse, London.
20,691. Machinery for Rolling Metal, P. Hesse, London.
20,692. Preservation of Liquid Food, P. Reichard, London.
20,693. Acoustic Device for Telephones, A. Maceland, London.
20,694. Urinals, F. A. Wells, London.
20,695. Water-closets, F. A. Wells, London.
20,696. Weaving Cotton Dusters, &c., D. Scott, London.
20,697. Duster, D. Scott, London.
20,698. Multiple Boring Machine, V. and G. Jetley, London.
20,699. Spray Bath, E. Tabor, G. Hinchcliffe, and W. A. Finch, Cambridge.
20,700. Knitting Machines, F. W. Golby.—(*L. Bosi, Italy.*)
20,701. Sanitary Towel Napkin, D. Scott, London.
20,702. Producing Letters, Words, &c., C. Chester, London.

20,703. Telephonic Switch and Indicator, G. L. Anders, London.
20,704. Cigar Lighters, G. W. La Baw, London.
20,705. Ancestral Record Book, F. W. Bailey, London.
20,706 Steel Stiffeners for Dresses, G. Rosenwald, London.
20,707. Hydraulic Accumulators, &c., G. Fletcher, London.
20,708. Expansion Joints and Couplings for Pipes, W. S. Dawson, London.
20,709. Grooving Cardboard, T. Sowersby and W. Allen, London.
20,710. Dog Kennels, W. T. C. Bruce and A. Still, Liverpool.
20,711. Safety Pins, H. A. Dale, London.
20,712. Press Copying Books, W. P. Thompson.—(*W. A Cooke, jun, United States.*)
20,713. Cycle Brakes, J. S. Foley, London.
20,714. Apparatus for Cleaning Grain, J. Higginbottom, Liverpool.
20,715. Making Cardboard Boxes, T. Sowersby and W. Allen, London.
20,716. Portable Electric Light Circuits, P. T. Letchford, London.
20,717. Brakes for Road Vehicles, G. S. Thompson, London.
20 718. Valves for Pneumatic Tires, G. H. Tansley, London.

*30th October*, 1894.

20,719. Treatment of Town Refuse, S. Willoughby, London.
20 720. Apparatus for Supporting Curtains, F. W. Perry, London.
20,721. Handle-bars for Bicycles, &c, E. Telling, London.
20,722. Anti-slipping Goloshes for Horses, T. Johnson, Dudley.
20,723. Miniature Hand Hearse, C. Oldfield, Macclesfield.
20,724. Caulking for Sewer Pipe Joints, T. Thorp, Whitefield.
20,725. Gun Carriages, J. G. Hartell, J. Watson, and E. A. Brandon, Bristol.
20,726. Link Belts, W. T. Rowden, Glasgow.
20.727. Miners' Safety Lamps, S. H., M, and W. Ellis, Wakefield.
20,728. Pedals and Cranks of Bicycles, T. Knowles, Manchester.
20,729. Wheels for Light Vehicles, F. Walker, London.
20,730. Cleaning Glass, T. Bevington, Bristol.
20 731. Carrying Liquid Substances, J. C. Wilson, Lancashire.
20,732. Bath, G. Chisholm, jun., Glasgow.
20,733. Making Woven Belting, J. Oswald, Manchester.
20,734. Excavators, S. Porter, Liverpool.
20,735. Bodies for Incandescence, O. Tiegs, Manchester.
20,736. Kilns for Firing Bricks, &c., J. S. Stein, Glasgow.
20,737. Carrier for Packages, E. C. Gripe, Manchester.
20,738. Dry Closets, R. C. Sayer, Bristol.
20,739. Stopping Currents of Air, W. C. Morison, Birmingham.
20,740. Door Locks and Latches, H. Wylde, Birmingham.
20,741. Hammer, T. W. Newey and J. H. Newey, Birmingham.
20,742. Manufacture of Staples, &c., C. March, Glasgow.
20,743. Locking Seats of Polo Carts, C. Glasgow, Glasgow.
20,744. Apparatus for Purifying Sewage, E. W. Ives, Derby.
20,745. A Book Cover, W. M. Sladdin, London.
20,746. Prepayment Gas Meter, F. Villiers-Stead, London.
20,747. Tents, J. J. Rinn, Liverpool.
20,748. Delivering Powdered Substances, F. Huldchinsky, Manchester.
20,749. "Flossa" Apparatus, O. E. Wollert, Manchester.
20 750. Pneumatic Arrangement for Beds, O. Y. Rhodes, Leeds.
20,751. Low-water Alarm for Boilers, R. Tonge, Pendleton.
20,752. Supplying Coal to Mechanical Stokers, J. Proctor, Manchester.
20,753. Mechanical Stokers, S., H., and L. Hall, Manchester.
20 754. Jacquard Machines, A. and H. I. Lawton, Manchester.
20,755. Tubes and Pipes, S. J. and H. E. Norton, Upton Manor, Essex.
20,756. Chucks, E. Sonnenthal and G. Sonnenthal, London.
20,757. Pneumatic Dome Tents, J. B. Small, Glasgow.
20,758. Pneumatic Collar and Saddle Pads, W. Gillman, Dublin.
20,759. Pipe Plug and Nicotine Absorber, A. G. Thomas, Leeds.
20,760. Elastic Wheels for Cycles, &c., G. Ross, London.
20,761. Vessels for Honey, J. S. Green, F. R. Syms, and W. Adams, London.
20,762. Fastening Castors to Furniture, N. Harker, London.
20,763. Combing Vegetable Fibres, T. Burrows and D. E. Radclyffe, London.
20,764. Stringed Instruments, D. Mayer and W. Robinson, London.
20,765. Shirts, F. C. Parker, London.
20,766. Braces, &c., R. E. Daish and M. M. Dessau, London.
20 767. Contrivance for Steering Ships, R. M. Phillips, London.
20,768. Hand Camera, A. J. Jones and S. J. Levi, London.
20,769. Automatic Valve for Starting Compound Engines, W. E. Worrall, London,
20,770. Screw Propellers, W. H. Jay, London.
20,771. Naval Handkerchief, C. Fulton, London.
20,772. Regulating Speed of Engines, J. H. Greenwood, London.
20,773. Packing Hydraulic Rams, &c., D. Walton, London.
20,774. Hinges, E. Harnett, London.
20,775. Mechanical Toys, W. Britain, jun., London.
20,776. Microscopes and other Instruments, H. G. Sedgwick, London.
20,777. Water-closets, F. F. W. L. Müller, London.
20.778. Pneumatic Tire Horseshoe, G. T. Price and E. D. Brewer, London.
20,779. Projectiles, W. Whitley and J. Parker, Keighley.
20,780. Towel Racks, R. Haddan.—(*C. E. Cochrane, United States.*)
20.781. Preparing a Homogeneous Mixing Product, O. Fahnehjelm, London.
20,782. Roofing Tiles, G. Schulze, London.
20,783. Telephone Transformer, J. W. Ray, North Shields.
20,784 Electric Incandescent Lamps, H. J. Thiroux, London.
20,785. Wire Chains, F. W. Smith, jun., London.
20,786. Machines for Making Matches, E. B. Beeches and J. P. Wright, London.
20,787. Shirts and Cuffs, R. G. Knowles and N. P. Cook, London.
20,788. Making Type-printing Bars, J. C. Fowler, London.
20,789. Scouring and Cleaning Machine, G. Carlson, London.
20,790 Compounds for Filtering Liquids, C. D. Abel. —(*A. Schlumberger, France.*)
20,791. Pumps, H. E. Newton.—(*C. C. Worthington, United States.*)
20,792. Magazine Fire-arms, H. F. Woodgate, London.
20,793. Check Punches, C. A. Allison.—(*W. J. Jenner, United States.*)
20,794. Safety Slop-pail with Removable Strainer, K. B. Sharman, London.
20,795. Rotary Swathing Machine, T. M. Jarmain, London.
20,796. Manufacturing Beer, P. Kropf and A. Gruell, London.
20,797. Seamless Shoe, H. H. Lake.—(*St. Petersburg Boot and Shoe Manufacturing Company, Russia.*)
20,798. Railway Signalling Systems, W. P. Hall, London.
20,799. Tobacco Pipes, E. Ropp, London.
20,800. Cigar-bunching Machines, H. H. Lake.—(*H. A. Streeter and J. P. Bacon, United States.*)
20,801 Generation of Steam, J. E. T. Woods and J. B. Hamond, London.
20,802. Elevator Safety Attachments, C. B. Labatt, London.
20.803. Construction of Lime Kilns, J. H. Janssen, London.
20,804. Saucepans and Boilers, W. A. L. Bailey, London.
20,805. Preventing Kettles from Boiling Over, A. Shulver, J. Self, and G. Constance, London.
20,806. Beer and other Traps, H. G. Chamberlain, London.
20,807. Telegraph Transmitters, H. A. Taylor, London.
20,808. Steam Engines, M. N. Forney, London.
20,809. Forming Screw Threads on Rods, S. P. Lehmann, London.
20,810. Locket Cases for Portraits, &c., H. Penn, London.
20,811. Centering, J. J. Nobbs, London.
20 812. Preventing Boats Capsizing, C. A. J. Bien, London.
20,813. Sewing Machines, J. Chappell and T. R. Rossiter, London.
20 814. Ores, C. F. Claus, C. Goepner, and C. Wichmann, London.
20 815. Metallic Alloy, E. A. L. Langlois and P. F. de Susini, London.
20,816. Portable Sheds, D. Young.—(*La Compagnie des Constructions Démontables and Hygiéniques, France.*)
20,817. Chalking Billiard Cues, R. Naumann and C. Kunze, London.

*31st October*, 1894.

20,818. Cycle Saddles, T. Staines, J. Leadbeater, and A. Preston, Leeds.
20,819. Clock Timing Stand, G. E. Cornioley and A. Haiman, London.
20,820. Stands for Bottles or Jars, G. Burnett, Workington.
20 821. Douche, R. H. Rains, London.
20,822. Postal Cards, A. H. Hallen, London.
20,823. Pants, A. H. Hallen, London.
20,824. Opening and Closing Gates, R. E. D. Rudman and H. E. Williams, Chippenham.
20 825. Roller Brake for Cycles, H. Le Jeune, jun., London.
20,826. Bath Valves, G. Gregory, London.
20,827. Telephone Switchboard Jack, J. Taylor, Warrington.
20,828. Securing Mattresses, &c., to Bedsteads, F. Hoskins, Birmingham.
20,829. Buttons, A. Appleby, Birmingham.
20,830. Toy, W. J. Hawke, St. Austell.
20,831. Teaching Apparatus for Schools, G. Wood, Leeds.
20,832. Fibre Spinning Machinery, A. Hitchon, Accrington.
20,833. Brakes for Railway Wagons, H. T. Purdon, Dublin.
20,834. Testing Cycles, J. J. H. Sturmey and G. D. Leechman, Coventry.
20,835. Knitting Machine Needles, G. F. Sturgess, Leicester.
20,836. Replacing Derailed Wagons, J. Brook, Sheffield.
20,837. Smoking Pipes, H. J. Marsden and J. W. Bagshaw, Sheffield.
20,838. Inflating Elastic Tubes, W. and J. Ellis and T. Spurr. Hull.
20,839. A Mechanical Toy, W. S. Adams, Gateshead.
20,840. Elastic Tires, W. H. Bird and C. Erade, Leicester.
20,841. Steam Engine Pistons, W. Owen and T. Fryer, Staffordshire.
20,842. Electric Railway Vehicles, T. Machin, Birmingham.
20 843. Electric Railway Vehicles, T. Machin, Birmingham.
20,844. Attaching Labels to Railway Wagons, R. Mustard, Birmingham.
20,845. Combination of Locks, H. K. Morley, Manchester.
20,846. Securing the Covers of Pneumatic Tires, H. Weatherill, Manchester.
20,847. Memorandum Forms, W. G. Leatherbarrow, Lancashire.
20,848. Portland Cement, E. Wilder and H. Holt, Kent.
20,849. Making Portmanteaus, R. M. T. Murdoch, London.
20,850. Appliances for Drawing, A. C. Snell, Cornwall.
20,851 Preventing the Loss of Parasols, &c., J. S. Martin, London.
20,852. Disinfectant Compound, E. Burton, London.
20,853. Advertising Station, F. Villiers - Stead, London.
20,854. Reducing Cycle Vibration, D. B. Brazier and W. F. Eaton, London.
20,855. Lavatory Basins, M. J. Adams, York.
20,856. Speed Gear for Cycles, J. C. Webster, London.
20,857. Locking Nuts, A. W. Daw and Z. W. Daw, London.
20,858. Cycle Locks, S. C. Hone, London.
20,859. Candlesticks or Holders, F. W. Field, London.
20,860. Vehicles, W. G. MacIvy and the Princess Company, Ld., London.
20,861. Railway Signalling Apparatus, W. B. Quelch, London.
20,862. Closing Bottles, Jars, and the like, T. Pink, London.
20,863. Sifting Apparatus, A. Rohrbach, M. Meyer and W. Bindewald, London.
20,864. Printing from Photographs, A. P. Negley, London.
20 865. Wire Chain, F. W. Smith, London.
20,866. Chimneys of Gas Stoves and Fires, J. Atkins, London.
20,867. Wheel Tires, S. C. Peuchen and P. Clarke, London.
20,868. Postal Envelopes, W. Orchard and J. Wright, Liverpool.
20,869. Fire-proof Doors, &c., G. F. Bowman, London.
20,870. Footballs, S. Kramrisch, Liverpool.
20,871. Car Starters, H. M. Crisp and H. F. Wilson, London.
20,872. Method for Extraction of Gold, P. De Wilde, London.
20,873. Driving Gear for Cycles, J. and J. Saxby, London.
20,874. Mixing Liquids, A. Bloch, London.
20,875. Table for Parlour Games, A. C. D. Seifert, London.
20,876. Clasp for Belts, F. L. Brunet and J. Lévy, London.
20,877. Softening Leather, C. A. Hardy and R. Dodgson, London.
20,878. Babies' Feeding Bottles, L. F. Beesley, London.
20,879. Fastenings for Boots, &c., W. A. Saunders, London.
20,880. Boiler Tube Joints, C. McKenna, Newcastle-on-Tyne.
20,881. Sewer Ventilating Apparatus, S. Holman, London.
20,882. Tobacco Pipes, F. Laycock, London.
20,883. Apparatus for Labelling Bottles, E. Perry, London.
20,884. Device for the Use of Smokers, J. Hume, jun, London.
20,885. Trouser Suspenders, W. Bennett, jun., London.
20,886. Telegraphic Relays, A. D. Macdonald, London.
20,887. Blackboards, E. Edwards.—(*W. Antony, Germany.*)
20,888. Tubular Boilers, A. van Overbeeke, London.
20 889 Pneumatic Tires, G. H. E. and T. Cooke, London.
20,890. Delivering Goods, F. Origgi and G. Caimi, London.
20,891. Side Arm Fittings, H. Garner and T. Perry and Son, London.

*1st November*, 1894.

20,892. Governors for Steam Motors, H. F. C. Whitehead. Stockport.
20,893. Oval Hinged Door, R. Sheard, Wakefield.
20,894. Apparatus for Ringing Cycle Bells, F. Clelland and J. Jessop, Manchester.
20,895. Self-registering Frame, T. J. Jenkins, London.
20,896. Locking Angle Iron Fencing, I. Price, Wolverhampton.
20,897. Construction of Tip Wagons, J. and C. Smith, Barnard Castle.
20,898. Cycle Brakes, O. S. Wraith and J. W. Dean, London.
20,899. Corset Busks, J. J, W. and J. E. Clarke, and F. R. Baker, Birmingham.
20,300. Teaching Apparatus, G. Wood, Leeds.
20,901. Steam Motors, W. M. Walters, Liverpool.
20,902. Spring Tires for Cycles, J. Barlow, Nottingham.
20,903. Horseshoes, H. Pickles, Bradford.
20,904. Metallic Mounts, T. Morton, Birmingham.
20,905. Cycle Hubs, J. G. F. Temple, Birmingham.
20,906. Portiere Rods, J. F. Hall-Edwards, London.
20,907. Tents, H. Heaton, jun., London.

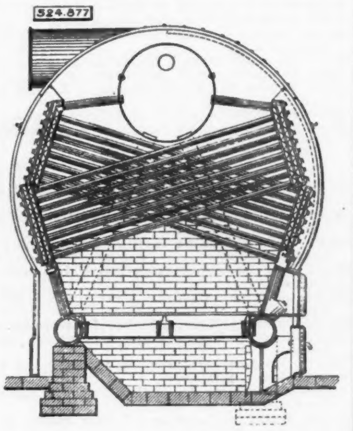
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**524,877.** Sectional Steam Boiler, *A. Worthington, Brooklyn, N.Y.—Filed June 2nd*, 1893.

*Claim*—In a sectional steam boiler, the combination, with a plurality of series of oppositely inclined water tubes, a steam and water drum, a plurality of water drums extended longitudinally of the boiler, and tubes for independently connecting the steam and water drum with the water drums and for connecting such water drums, of a water arch for connecting one of the series of water tubes to one of the water drums, whereby to form a door or stokehole with the water arch extended above and the water drum extended below the same, tubes and headers for connecting the other series of water tubes with the other series of water drums and for connecting both series of water tubes with the steam and water drum, and a fire-box or furnace located below the water tubes, substantially as described.

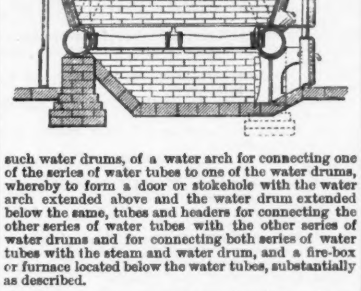
524.877



**524,902.** Fire-box for Steam Boilers of Locomotive Type, *W. Malam, Fairfield, England.—Filed October 30th*, 1893.

*Claim*—(1) A corrugated fire-box of a locomotive type of boiler having vertical corrugations formed in the body of the side sheets, the said corrugations being wedge shaped, that is to say, of the full depth at or near the top and gradually diminishing toward the line of grate bars, so as to obtain the increased heating surface without diminishing the area of the fire-bars, substantially as hereinbefore described. (2) The combination of a corrugated fire-box having vertical wedge-shaped corrugations formed in the body of the side sheets, with a water space extending beneath the bottom of the said fire-box, substantially as hereinbefore described.

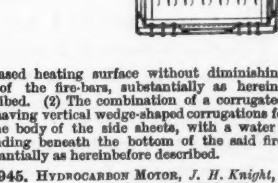
524.902



**524,945.** Hydrocarbon Motor, *J. H. Knight, Farnham, England.—Filed November 16th*, 1893.

*Claim.*—(1) In a hydrocarbon motor, a vaporiser having two chambers, one of which constitutes a vaporising chamber that is normally disconnected from, but is adapted to be placed at intervals in communication with the combustion end of said cylinder, and the other of which is in free and constant communication with the combustion end of said cylinder, substantially as herein described for the purpose specified. (2) In a hydrocarbon motor, the combination with the motor cylinder, of a vaporiser comprising the casing 1 provided with an inlet 4 and outlet 5, controlled by a valve 6, metal plates arranged within the vaporising chamber between the lower and front sides of said casing and adapted to transmit heat from one to the other, and a metal tube or chamber 10 closed at its rear end and in open connection at its other end with the motor cylinder and extending into said vaporising chamber substantially as herein described.

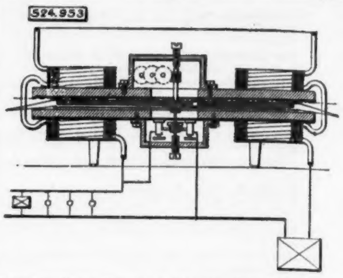
524.945



**524,953.** Electric Meter, *C. D. Raab, Kaiserslautern, Germany.—Filed January, 18th*, 1894.

*Claim.*—An electric motor meter comprising. the revolving armature having the coils in a shunt, the damping discs adjacent to the armature, the stationary coils and conductors and the mica discs interposed between the armature and the damping discs, whereby the air damping will be reduced, substantially as described.

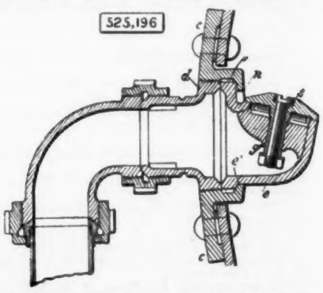
524.953



**525,196.** Safety Check Valve, *J. M. Foster, Elizabeth, N. J.—Filed September 30th*, 1893.

*Claim*—(1) A removable inside boiler check valve, and in combination therewith a suitable flanged supporting piece and a retaining ring adapted to be screwed therein as described and set forth. (2) The flange piece *c*, provided with the auxiliary seat *c'*, and clip *n*, in combination with a valve, the removable valve body, as *e*, provided with the flange portion *v*, and corresponding clips *n'*, *n'*, and suitable retaining ring as *d*, as and for the purpose specified. (3) A check valve provided with a sleeve as *g*, in combination with the bolt *s*, and slotted nut *h*, and projections *g'* for engaging the slots in the nut arranged and constructed substantially as herein specified. (4) The combination of the auxiliary seated flange piece *c*, valve body as *e*, sleeve valve piece "B," provided with the wings *i*, *i*, a valve seat in which the said valve reciprocates, bolt *s*, and nut *h*, all constructed and arranged and held in position by the retaining ring piece *d*, as illustrated and described.

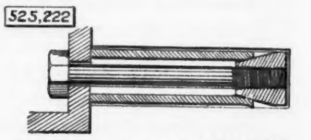
525,196



**525,222.** Expansible Bolt, *W. M. Levering, Philadelphia, Pa.—Filed April 16th*, 1894.

*Claim.*—(1) In an expansible bolt. a sleeve having a longitudinal slot extending a portion of the length thereof, and a neck at the end of said slot forming an integral portion of the wall of said sleeve, a bolt entering said sleeve, and a conical nut on the threaded end of said bolt having a spline on its side interlocking with the end of the sleeve, the body of the nut contacting with the inner wall of the sleeve adjacent to said spline, the parts being combined substantially as described. (2) An expansible bolt consisting of a sleeve having a division extending the entire length thereof, and a slot extending a portion of the length thereof, a connecting neck at the end of the latter division forming an integral part of the wall of the sleeve, a bolt with a threaded end, and a conical nut with a spline on its side, guided in said division and slot, said parts being combined substantially as described.

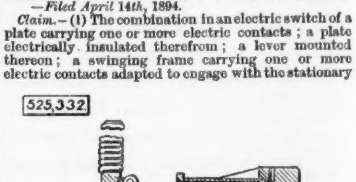
525,222



**525,332.** Electric Switch, *G. F. Card, Covington, Ky.—Filed April 14th*, 1894.

*Claim.*—(1) The combination in an electric switch of a plate carrying one or more electric contacts; a plate electrically insulated therefrom; a lever mounted thereon; a swinging frame carrying one or more electric contacts adapted to engage with the stationary contacts; an air cylinder upon the swinging frame having an aperture adjacent to the contact point; a piston adapted to reciprocate in the cylinder; a spring adapted to press the piston in the direction of the aperture, and a connection between the piston-rod and the lever whereby the piston-rod may be actuated, substantially as and for the purpose set forth.

525,332



Throat Irritation and Cough.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d.; tins, 1s. 1½d, labelled, "James Epps and Co., Homœopathic Chemists, London."

## THE PROPOSED CARDIFF HARBOUR TRUST AND SOUTH WALES DOCK EXTENSION.

In the annual story of progressive action among the ports on the Welsh Coast of the Bristol Channel, a first place needs to be given to the movement for the constitution of a Harbour Trust for Cardiff, which until this week had seemed to have reached success. Thirty years ago far-sighted observers of the signs of the times and the possibilities of the district, urged it as a question of expediency and a provision for the future. During the past ten years the project has forced itself more and more upon the attention of a shrewder public as a matter of necessity. The competition between neighbouring ports on the Welsh littoral, the increasing rivalry of aggressive ports elsewhere, and the evidence accumulating on every hand that if Cardiff is to continue to advance it must add an import trade to the coal export of its docks, have within the last two or three years brought the issue to a critical point. There is no reproach to the present dockowners that they have not kept pace with the ever-growing demands of the coal-shippers for larger accommodation and quicker dispatch. The claim and the lament is rather that the dock companies have devoted their enterprise and energies exclusively to exports of coal and rails, which practically monopolise the dock accommodation, and have not offered due encouragement to the import trade which the geographical position of the port and the great population of its "hinterland" might be expected to invite. The "dockising" of the capacious harbour is the demand of to-day, and for two reasons. It should be the means of reclaiming large tracts of the foreshore which would be available as the sites of warehouses, oil and seed crushing works, manufactories, and—as the more sanguine anticipate—even cotton mills. It would also afford space for discharging and warehousing inward cargo at spots remote from the inevitable dust, dirt, and other inconveniences attaching to the constant tipping of coal. All the interests in the port—the dock proprietaries, the shippers and merchants, and the local railway companies—are agreed in the abstract that such a scheme is desirable and not impossible. But in and between those interests there are keen competitions and jealousies, and in the absence of an incentive to common action nothing is done. The harmonising element, it was believed, would be found in the creation of a representative body, on the initiative of the Cardiff Corporation, which should incorporate all the docks, and railway adjuncts to the docks, together with the necessary and adjoining lands, under the style and with the powers of a statutory Harbour Trust. It looks a vast scheme; it involves the acquisition of properties estimated to be worth seven odd millions sterling. It is a greater scheme than the Tyne or Glasgow undertook in the infancy of their Harbour Trusts, inasmuch as they began in the beginnings of their prosperity, while Cardiff has to take over some of the largest and best-equipped dock properties in the kingdom. The idea, however, was exhaustively examined from all points of view by a committee of the municipality for twelve months past, and the final report was a strong recommendation to the Corporation to carry out the plan by (1) taking steps to acquire the various estates on a 4 per cent. basis and twenty-five years' purchase, and (2) pledging the Borough rates as security, and borrowing at 3 per cent.; the difference between the 4 per cent. ensured to the vendors and the 3 per cent. to be paid for the loan representing a distinct gain to the Corporate Trust on the financial side of the transaction alone.

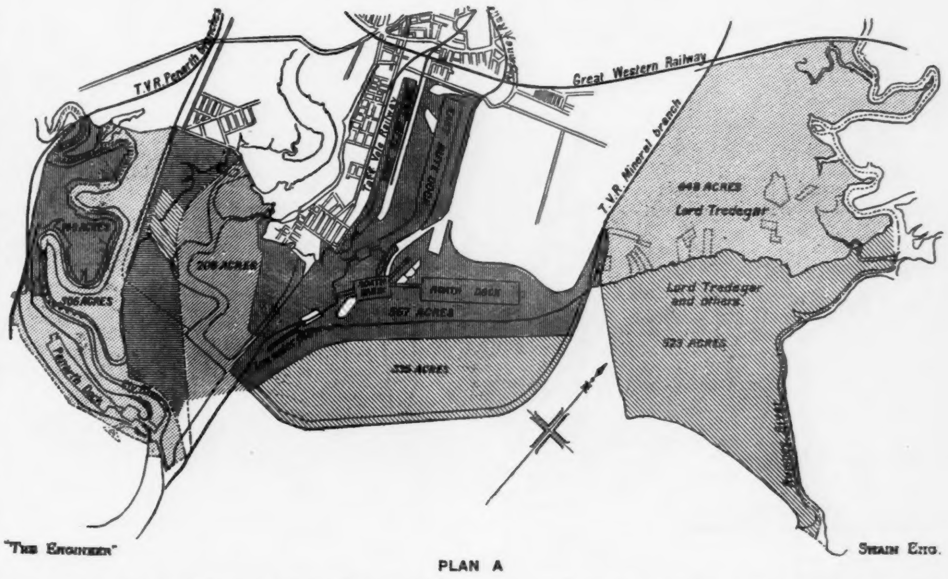
The Cardiff County Council has had before it the plans, and an elaborate report which has been framed by the Corporation Trust Committee, after careful inquiry into the constitution of other Harbour Trusts, and a series of interviews with Sir W. T. Lewis, of the Bute Docks, the representatives of Penarth and Barry Docks, Lord Tredegar's solicitors in reference to portions of the foreshore, and the directors of the Taff Vale and Rhymney Railways. The plan A we reproduce excludes the Barry Dock estate, and deals solely with the properties comprised in Cardiff Harbour between Penarth Head on the west and the Rumney river on the east.

Lord Tredegar's land, which it was proposed to acquire for building purposes, lies between the Taff Vale mineral branch and the river Rumney, its northern boundary being the Great Western Railway. It contains 1171 acres, including foreshore, and a large portion has already been surveyed in connection with a dormant scheme for constructing docks at the mouth of the Rumney. The Bute Docks property is sufficiently described on the plan, and covers an area of 892 acres. To the westward extends the land of Lord Windsor, and the estate of the Penarth Dock and Harbour Company, held on a 999 years' lease by the Taff Vale Railway. The whole of the dock works, lands, and foreshore, to be taken over by the Harbour Trust, is 2900 acres, and it is pointed out in the report that the amalgamation of all the interests therein comprised would probably make it necessary to incorporate the township of Penarth in the Borough of Cardiff. The report continues:—

> Your Committee would point out that a portion of the land proposed to be acquired would to a certain extent remain unproductive in the immediate future; still they consider it most advisable to secure it, for in the natural course of things, with the extension of the docks and trade, this land will increase immensely in value, and they could not recommend the Council to secure the dock property alone without acquiring even a surplus of land for the building of works, warehouses, and manufactories, so as to be in a position to provide cheap land to traders and others willing to take advantage of the development of the trade of the port, and the facilities afforded by its geographical position. Most ports are suffering from the want of land in the vicinity of their docks. Bristol and Swansea are much handicapped in this direction at the present time. The Mersey Docks and Harbour Board, of Liverpool, are now buying land for enlarging their docks at sums very much in excess of those at which such land could have been secured not very long ago. Your Committee could mention many similar cases, and are particularly anxious to avoid the oversights of those other Trusts who have been good enough to draw the attention of your Committtee to the lesson taught by experience as to the unwisdom of not securing sufficient land at the outset. Cheap land your Committee consider as essential as any other part of the undertaking, for Cardiff is sadly behind many other ports in works and manufactories, and for the development of an import trade these businesses are necessary. Once you induce merchants and manufacturers to build works and warehouses you have practically linked them to the port, for even with fluctuations of trade they cannot move their buildings from one port to another.

The Committee concluded by expressing its firm conviction that its inquiries and its negotiations with the dockowners and others had so far progressed as to call for a further and more practical step in advance. On its recommendation the Council resolved by large majorities to pledge the Borough rates as security for a £3 per cent. loan, if the project showed a £4 per cent. net profit on the average of the last three years. To test this question, it was further decided that Mr. R. W. Hedley, who has special knowledge of the dock accounts involved, should be appointed valuer for the Corporation, and Mr. R. W. Perks, M.P., whose financial connection with the Barry undertaking is historical, was named financial adviser, on honorary terms, at Mr. Perks' own request, that gentleman intimating that his remuneration would come from the capitalists who found the seven millions, more or less, required.

The next step was to obtain the consent of the dockowners and others to the proposed examination of their books for the three preceding years. Lord Tredegar had from the first expressed his willingness to assist the Trust Committee in every way. The Marquis of Bute, and the Bute Dock Company, through Sir William Thomas Lewis, raised no difficulty; and for some time past Mr. Hedley has been pursuing his investigations into the accounts of the various Bute estates. It is not improbable that the Chancellor of the Exchequer may have indirectly facilitated the progress of the Harbour Trust movement in regard to these particular properties. The Marquis of Bute and Lord Tredegar are possibly of opinion that it is more advantageous to transfer their lands and works on the terms proposed, than to leave them subject to the enhanced death duties which would fall upon their successors.



"The Engineer" Swain Eng.

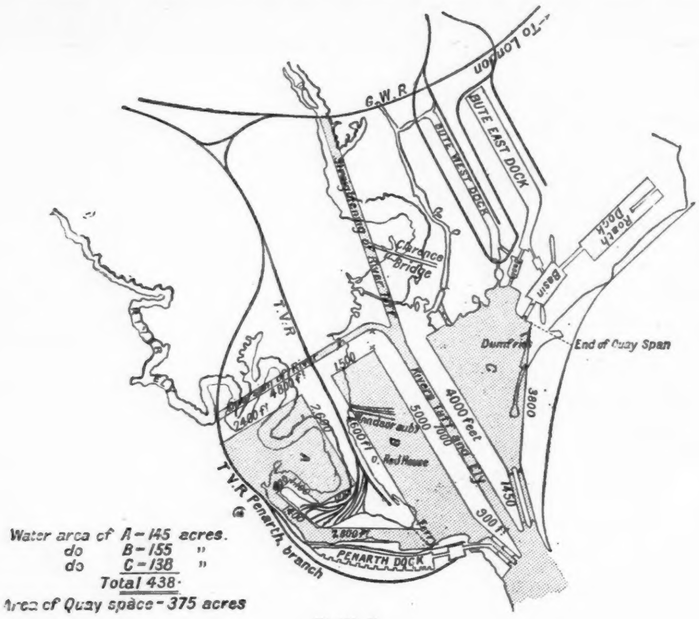
PLAN A

So far matters had progressed up to November 10th, when a meeting of the Harbour Trust Committee was held, to receive an important report from Mr. Hedley and a financial statement from Mr. Perks, M.P. It appeared at once from these documents that the seven odd millions set down as the capital required for the acquisition of the Barry, Penarth, and Bute Dock properties was far too modest an estimate. The cost of buying out the Bute Docks Company, together with Lord Bute's freeholds and reversions, is alone stated in Mr. Hedley's valuation at £4,701,653. But that is not all. Mr. Hedley goes on to say, "In addition to the capital required for the purchase of the proposed undertaking, the Corporation will have to provide sufficient capital for the current working expenses of the docks, the purchase of stores, capital for the construction of the new dock and equipment, and also the cost of the Bute Docks Act, 1894." This further sum is estimated to be upwards of £1,000,000, the new dock works involving an expenditure of £650,000, irrespective of equipment. The total charge, therefore, solely on the Bute Docks account, would reach at least six millions sterling. The Corporation Committee resisted stoutly the proposal that the Harbour Trust should carry out the new dock plan. It argued that its own plan was to construct a floating harbour, which would supersede the new dock, and offer greater advantages to the trade of the port. Sir W. T. Lewis, however, was inexorable on this point. The completion of the dock, he maintained, was an indispensable condition, as the demands of the trade required it, and it would be impossible to permit the delay which would be involved in the execution of the larger scheme of dockisation. To quote the text of Sir William Lewis's remarks on this head, "It is of the utmost importance, in order to prevent the diversion of traffic to rival docks, that the increasing demand for special accommodation for the larger class of vessels, and additional means of entrance and exit, with a larger lock and deeper sills, should be provided in connection with the Roath Dock and Roath Basin, with the least possible delay," and he further pointed out that in his opinion, based upon his forty years' experience at the Bute Docks, "the accommodation required to maintain the position of the port could not be otherwise provided so economically, while, either as regards direct communication with the various railway or the convenience of freighters sending traffic to the Bute Docks, no better site could be selected." But even upon terms so much higher than had been anticipated, Mr. R. W. Perks, M.P., advised the Corporation to proceed with the Harbour Trust. Taking the initial sum of £4,701,653 for the purchase of the Bute Docks properties, and excluding the new dock, he remarked that the figures show an actual and estimated annual revenue of 3½ per cent., and he believed that the necessary capital could be borrowed as Corporation Harbour Stock at 3 per cent., which would leave a margin of upwards of £35,000 a year between the revenues estimated and the interest on the debt. "Should Parliament," he added, "impose an annual sinking fund, even for sixty years, it will not involve, should Mr. Hedley's estimate of revenue be realised, any charge upon the rates of the town. The proposed purchase is one which, in my judgment, the Corporation may, as prudent business men, adopt, and which cannot fail under efficient control to conduce to the commercial and industrial progress of the port and town of Cardiff."

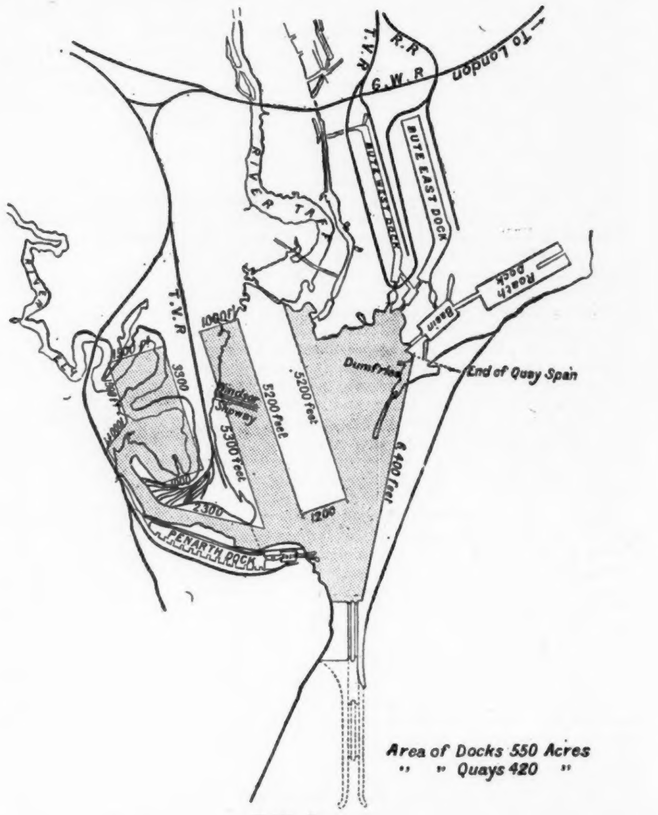
The Trust Committee had no plenary power, and in face of the unexpectedly large dimensions the purchase price had assumed, it was resolved to call an early meeting of the whole council to consider Mr. Hedley's report. Most unfortunately the "minute" sent to Sir W. T. Lewis, contrary to the view subsequently explained, stated that the committee "would proceed to negotiate with the other interests, with a view of obtaining from them the terms on which they are prepared to transfer their various properties." The special meeting of the Corporation was held on Tuesday last. In the meantime Sir W. T. Lewis had written and published a letter which fell on the borough like a "bolt from the blue." He wrote that "as the negotiations have proceeded on the distinct condition that the matter should be disposed of one way or another by the middle of this month," the transaction must be considered at an end, and neither of the parties he represented would be thenceforth bound by the terms he had discussed with Messrs. Perks and Hedley and the Trust Committee. There seems to have been some inexplicable and egregious blundering over the date Sir William Lewis appointed for a definite agreement, several members asserting that they were not told of it until Saturday, and others saying it had been an understanding all along. As to the Corporation in its collective capacity, it found itself in an *impasse*. In view of Sir William's letter, the question arose, What is to be done? Mr. Morel, a member of the Trust Committee, aware that there was a serious misunderstanding, and possibly a concealment of facts, moved that Sir William Lewis should be desired to withdraw his letter, and permit negotiations to continue. Mr. W. J. Trounce, ex-mayor, seconded the motion in the belief that it had been shown that the revenues of the dock properties—if purchased—would comply with the conditions laid down. A member, who suggested that the Corporation "should sing the doxology and go home," vehemently opposed this overture for renewed negotiations. After a wrangling and incriminatory discussion, the meeting resolved by 23 votes to 13 to abide by the terms of Sir William Lewis's letter. That ends the Harbour Trust scheme so far as this Corporation is concerned; for it is not to be expected that the Marquis of Bute or Sir William Lewis would reopen negotiations with a body of such instability of mind as the Cardiff Council seems to be.

Something more may possibly be heard at an early day of a trust or dock and railway combination scheme relating to the properties we have described, but in that event it would have its origin in a wealthy syndicate working for financial results, and not in a public corporation which is unable to hold the same views two months together.

According to the Harbour Trust plan there would have remained to be considered the negotiations with the Barry Railway and the Taff Vale Railway for the transfer of Barry and Penarth Docks. There can be no doubt that the inclusion of Barry presents more difficulties than any other part of the project. The Barry directors say that they would "be prepared to give due consideration to a scheme embracing every interest, and calculated to put an end to unnecessary rivalry and expensive Parliamentary contests, and to secure to the public the best facilities on the most economical terms. But until they are supplied with full details of the plans of the Corporation, they cannot see their way to definitively discuss the subject, or accede to the application for an inspection of their books." Some facts and considerations, however, stand out in relief, and they point to the conclusion that Barry must have been left out of the scheme. It is improbable that a company which earns 10 per cent.—a considerable proportion being derived from its dock receipts—and which is even now building a new dock of large capacity—would part with a portion of its property on a 4 per cent. basis. It would be a task of infinite complexity to sever the dock, dock railways, and adjacent lands and foreshores from the still expanding railway part of the Barry undertaking. It is held also in another quarter that it would be manifestly unfair to Cardiff that its municipal credit should be pledged for the purchase of property in a new town twelve miles away—a property which was dependent upon an independent railway company, and in a town over whose good or bad government, sanitary or insanitary condition, its indebtedness and its high or low rates, the Cardiff municipality would have no control whatever. The difficulty in the case of Penarth was more distinctly one of terms. The Taff Vale directors informed the Council that they are only lessees, though practically perpetual lessees, of the Penarth Dock and Harbour, and have no power to dispose of the property without the consent of the original shareholders. They are, moreover, under a specific obligation to pay these original shareholders 5¼ per cent. upon the capital expended in the construction of the dock and railway. They have spent themselves over £200,000 in additions to the dock property, on which they are paying dividends out of their general revenues at an equal, if not a higher rate than the Corporation proposes. They cannot therefore entertain the present offer; but they add, "They are perfectly willing, so far as their interests are concerned, to favourably consider any scheme for the formation of a Harbour Trust that would be for the advantage of the port and all concerned."



PLAN B



PLAN C

The Trust Committee declined to consider this reply as a *non possumus*. In the course of discussion it was pointed out that the Penarth Dock was old-fashioned, with an obsolete equipment, and so placed in a corner between the cliff and the Ely river that expansion was impossible, while there was no spare land to meet the demand for warehouse accommodation, &c. Doubt was expressed whether, since the opening of the Barry Dock, the Taff Vale had earned so much as 4 per cent. per annum on the Penarth Dock account. The Mayor further remarked that the area of the Penarth Dock holding was only 306 acres, while in Cardiff there were 2411 acres in the combined Bute and Tredegar Estates; while, with reference to the dockising of the harbour—the ultimate object of the Trust—"engineering experts would tell them that it was as easy to float the harbour from the north side of the river Ely to the pier of the new Bute Dock, as to carry the sea wall—as originally proposed—across the harbour to Penarth Head."

That may be; but the importance from an engineering point of view of including Penarth in the Trust estate is shown in the plans here annexed. With Penarth Dock and harbour excluded from the Trust, not only must a free outlet be left for the channel of the Ely, and the Dock traffic, but the proposed diversion of the Ely, by which a large tract of mud flats would be reclaimed, must be abandoned. Plan B illustrates the diversion of the Ely into the straightened Taff, and the greater water area and quay spaces, together with sites for warehouses and manufactories, that would thereby be afforded. The alternative plan, C, exhibits a larger area of quay space, and the piers or breakwaters which would form and guard the entrance channel. On both maps the point marked "End of quay space" indicates the site of the Sea-lock leading to the new dock to be constructed on the foreshore, south-west of the existing Roath Dock. A good deal would have depended upon the action Lord Windsor took up as the owner of part of the mud-flats west of the river Taff. He responded to the overtures of the Trust Committee in terms as cordial and encouraging as they could have desired. He had not been approached for a final settlement, and he would have an important voice in determining, irrespective of the Penarth Dock, how much of the harbour space may be enclosed and dockised.

The Bute Docks Company meanwhile, as will have been seen, is insisting on the need of proceeding with its new dock scheme, for which Parliamentary powers were obtained in the past session. Whatever becomes of the Harbour Trust project, the owners of the Bute Docks are under statutory obligations to complete their works within a term of years. They will go on with their undertaking irrespective of the Harbour Trust, for the reasons that (1) they are supplying a demand for increased shipping facilities, which increased demand should redound to their own profit; and (2) that all the works they lay down on their private account will become a more and more important asset, now or at some future time, among the properties the Trust Commissioners of the harbour seek to secure.

By the new Bill it was proposed to reclaim the mud flats —indicated as 335 acres—by building two sea walls, one 3050ft. in an easterly direction from the south-east corner of the Low-water Pier, now converted into an embankment; 3025ft. southerly from the south-west corner of the Roath Dock, and extending thence southerly and south-westerly to a point on the foreshore 2400ft. south-easterly from the same corner of the Low-water Pier, whence it will turn north-westerly, and terminate on the mud banks about 910ft from the piers. The other sea wall runs south-easterly for 800ft. from a point 120ft. to the eastward of the same pier, and thence 800ft. north-easterly and easterly to the fore-shore. Within the area thus enclosed—all practically land which will have been reclaimed—the new dock and entrance lock will be constructed. The dock itself is to be 2600ft. long by 650ft. wide, with an average depth of 30ft., or more than sufficient for the largest ship afloat. It will have a larger water area than the Roath Dock—*i e.*, thirty-five acres—and 6ft. 6in. more water on the sills, owing to the entrance lock being carried out to low-water spring tides; while another lock will give it communication with the Roath Dock, so that the two will combine a larger water space than any other dock in existence approached by a deep-water channel. The Sea Lock, or entrance, will be 700ft. long and 120ft. wide. There will be about 7000ft. of quayage space, and while the north-west side of the dock is intended for the import trade, the south-east is to be devoted to coal shipments exclusively, the Lewis-Hunter loading tips being provided.

The Parliamentary Committee made havoc of some of the collateral lines of the Bute Dock Bill. It refused permission to straighten and divert the river Taff, and it declined to grant an extension of the Dockmaster's sphere of control. It left, however, a great work to be executed, free of further legislative interference, at a cost which was originally estimated at about £650,000, and which engineers who know the land say will take at least £1,000,000 to complete. Until now the actual excavation of the dock and lock areas has not been commenced. The preliminary works, which are in themselves extensive and laborious, were at the beginning of the month well under way. Since Springtime great headway has been made with the embankment which is to inclose the foreshore, and give a dry area, as far as may be, for the delving to the future dock bottom. Railways have been placed on this new ground, and also on the old ground ranging from what was aforetime known as the Low-water Pier. There are about three miles of railways, and the ordinary contractors' wagons are casting out from these lines on to the foreshore which is being reclaimed 1000 tons of slag and ballast per day. It may not seem much to say that 150,000 tons have been deposited since the engineers went to work; but it means an entire transformation of the aspect of the shore line from the channel within a short twelvemonths of time.

There are great works going on, in the same neighbourhood, at Barry. The Barry Railway Company was again to the front early in the year with a proposed extension of its own line, and as the supporters of another scheme for a new railway, right across Glamorganshire, into a part of the Monmouthshire coalfield which had hitherto been a "preserve" of the Rhymney and Brecon and Merthyr companies, with the Great Western and London and North-Western as co-operative participators in the trade. The East Glamorgan Railway, as the new line was called, started from Barry and came back to Barry. It would not only bring Barry Dock into touch with a number of important collieries at present served solely by the Taff Vale or Rhymney, and enable it to "tap" the traffic at present sent to Newport for shipment; it would also benefit the passenger business of the Barry Railway by giving it direct communication, *viâ* the London and North-Western, with the Midlands, Lancashire, and the North. That bold measure suffered discomfiture at Westminster; but, according to all reports, and to use the Doric remark of Mr. Archibald Hood, the vice-chairman of the Barry Company, the scheme is "scotched, not killed." It is to come up again, all being well, and in the view of the Barry Railway directors, "all being well" would indicate an assurance that they have with them in their new endeavour not only the support of the London and North-Western Railway Company, but the interested sympathy of one important local railway corporation, which opposed the East Glamorgan Railway at its outset. There is one thing about the Barry people which is ever commendable. Instead of resting upon their new-found prosperity they strike out new lines of enterprise. Disappointed of one auxiliary railway, the Barry directors are undertaking the financial responsibility for a line from Barry into the Vale of Glamorgan, and the coal measures on its north-western borders. They are also making a new dock, and this dock will nearly double the shipping accommodation of the port.

Among other dock and railway works deserving notice are those for the development of Port Talbot. Many earlier projects of a similar kind have centred in Port Talbot, which holds an exceptional geographical position, and since the opening of the Rhondda and Swansea Bay Railway has had a prospect placed before it which did not exist before. Here, in somewhat the same manner as with the new Bute Dock, it is intended to build two breakwaters, 270 yards apart, running about 350 and 530 yards respectively seaward from the end of the existing pier. Within these sea walls a dock is to be excavated 350 yards long by 198 yards wide, with an entrance lock 217 yards long, terminating in the river Avon. From the dock a railway is eventually to be made through a new mineral region, touching the Llynvi and Ogmore line near the Llynvi Ironworks, and not far from North's Navigation Collieries, and thence proceeding to the recently developed and reputedly rich Garw Valley, and there making a junction with the Garw branch of the Great Western Railway.

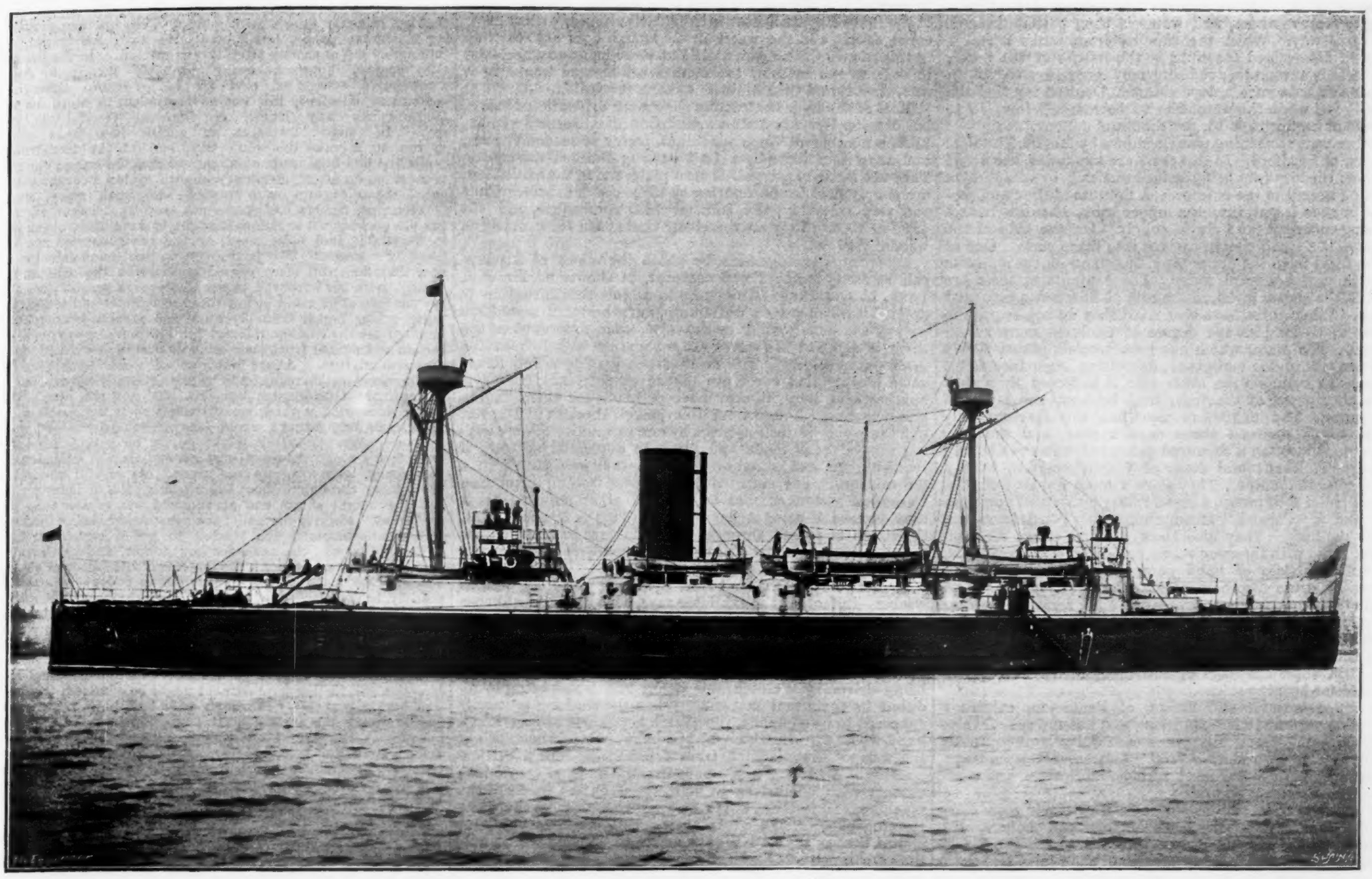
---

A PITTSBURG company proposes to build a rolling mill for the manufacture of structural steel, in which, the *American Manufacturer* says, electricity will be the power employed. This will be the first iron mill to be operated by electricity alone. The advantages offered in the way of cheap power by the company, which has fastened its dynamos to the floods of Niagara, will bring great industrial changes.

# JAPANESE CRUISERS NANIWA AND JAKACHIBO

SIR W. G. ARMSTRONG, MITCHELL AND CO., NEWCASTLE-ON-TYNE, BUILDERS

*(For description see page 422)*



## A CURIOSITY IN BOILER REPAIRING.

The accompanying engraving shows an original and, we hope, unique example of misplaced ingenuity. The boiler was at work on a Scotch farm until a week or two since, when it was removed and replaced by a new one. It was employed in making steam for an engine constructed by Messrs. Carmichael, of Dundee, not less than 43 years ago. We are indebted to a correspondent for the photograph which we reproduce. The owner did not apprehend any danger. What would the verdict have been if the boiler exploded and caused loss of life? It is possible that some of our readers may be able to name worse cases, but we doubt it. We have seen the bottom of an old-fashioned box marine boiler held up with screw jacks bearing on the ribs of the ship, but the pressure was only about 8 lb. on the square inch, and the expedient was adopted as a last resource to get the ship into port. How long the boiler we illustrate had been at work with the front end supported by two wooden struts we are unable to say—apparently for some time, at all events.

## PROPOSED RAILWAY EXTENSION IN BARBADOES.

It is proposed to construct a light railway in Barbadoes, and we have received a copy of a report furnished by the consulting engineer, Mr. Walter Merivale, M. Inst. C.E., to the chairman and board of directors of the Barbadoes Railway. The author reports that he has completed the survey of the proposed circular light railway round the island. He estimates the cost of the extension from Belleplaine to Bridgetown, *viâ* Speightstown, at £65,000. These figures are based upon a preliminary instrumental examination of the ground, and represent the worst which the author expects to encounter.

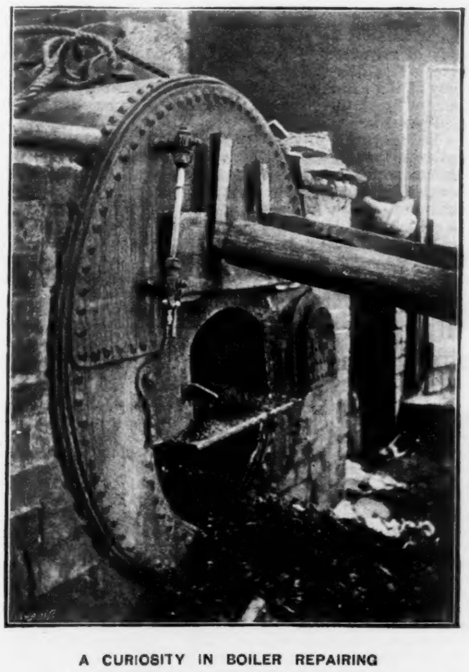
In the final scheme he suggests 2 per cent. as the ruling gradient, and 300ft. as the radius of the sharpest curve. Steel sleepers and 40 lb. rails are proposed as best suited to the requirements, and 14-ton six-wheel locomotive steam engines, with pony trucks in front and behind. All the rolling stock to be built with double bogies and trussed frames, otherwise more like tramcars than railway carriages.

Details are given as to the direction to be taken by the proposed line. Leaving Belleplaine Station the line would be along the public road for the first 1000ft., and in various other places it again follows the road. The author, however, points out that although a saving in first cost would be made by using the public roads, there are serious objections to it, which might entail much higher cost for maintenance. It appears that plantation land is valued at from £35 to £40 an acre, and land in small allotments at from £50 to £60 an acre, to which 25 per cent. must be added for compulsory sale.

The rolling stock would consist of four six-wheel 14-ton pony truck tank engines at £850 each, making £3400, and the rest of the rolling stock, consisting of eighteen open third-class bogie cars to seat forty-eight persons, two covered first-class cars to seat thirty persons, and various trucks, would cost £8940, being a total of £12,340. It appears that wooden sleepers are not considered suitable. Four stations are suggested, namely, St. Lucy, Speightstown, Holetown, and Bridgetown. The first three stations would each cost £200, and the last £300, very plain structures only being needed.

For land purchase the author considers £5500 would be sufficient. The bridges are to be of timber, although later on masonry might be substituted. The author, however, does not feel certain as to the desirability of using coral for railway work, as he has not had experience with this kind of rock.

Mr. Merivale insists upon the desirability of completing the circular railway, if possible, owing to the economy which would be obtained in construction and facility for dealing with the traffic. It would, however, entail the subscription of about £30,000 more capital. The total population of the island appears to be 182,306, of whom 43,000 are labourers, 22,229 domestic servants, and 27,693 artisans. The present line passes through the parish of St. Michael, with a density of 3753 persons per square mile, and various other parishes having a mean density of 835 persons per square mile. The proposed line passes through the same parish of St. Michael, and through other parishes, the latter having a mean density of 760 persons per square mile.



A CURIOSITY IN BOILER REPAIRING

About 58 per cent. of the people earn on an average less than £30 a year, about 36·8 per cent. are children and scholars earning nothing, and of the remaining 5·2 per cent. possibly 1000 earn over £500 a year, and 8000 earn less than £500 a year. It is probable that these facts account for the result, that although the average payment per passenger has been reduced from 21 cents to 6·2 cents, the revenue has been raised 15 per cent.

The total length of proposed extension is twenty-four miles from St. Andrew station to Bridgetown *viâ* St. Lucy and Speightstown. The cost is put down as follows:—Earthwork, £6750; bridges, £5400; ballasting, £4860; permanent way, £23,814; stations, £1500; level crossings, £300; rolling stock, £12,660; land and property, £5320; telephone, £192; engineering superintendence, £1524; and for contingencies, £3000; total, £65,000. It will be seen that the cost of the extension works out to about 7s. 9d. per head of the population. By the old system of tickets the line took about £12 a day from passengers. This by a new system was increased 15 per cent. The author puts down the gross revenue per annum as follows:—

| | |
|---|---|
| Passengers | £11,000 |
| Parcels | 1,000 |
| Goods | 8,200 |
| | 20,200 |
| Subsidy | 6,000 |
| | 26,200 |
| Working expenses 65 per cent. | 17,030 |
| | 9,170 |
| Interest on £65,000 at 6 per cent. | 3,900 |
| | £5,270 available for dividends. |

## THE LAUNDRY EXHIBITION, AGRICULTURAL HALL.

The Agricultural Hall at Islington is again opened for the exhibition of machinery and appliances connected with a special industry. Directly the brewing, distilling, and mineral water plant was removed, it was replaced by washing machines, hydro-extractors, ironing machines, and the other fittings of a modern laundry. This Exhibition, which opened on the 7th inst., and is to close on the 17th, is only the second under the present management; but it is proposed to continue it annually, and the date for 1895 has already been fixed. The Brewers' Exhibition only lasted for six days, whilst this is to remain open for ten, excluding Sunday. Possibly for this reason some of the exhibitors seemed to consider the first four days as preparatory, and were not even in full working order on Saturday afternoon. This is not fair to the majority, who had responded to the appeal of the promoters, Messrs. Cordingley, and were ready for the public on the first day.

Most of the appliances shown are especially designed for laundry work, though some of these, such as, for instance, the hydro-extractors, are used in other industries. Amongst the exhibits of more general interest, there are two sets of water-softening apparatus. One of them forms the principal feature of Messrs. Doulton's exhibit. There are many businesses in which a good supply of soft water is essential, but nowhere is it more needed than in a laundry. Messrs. Doulton's exhibit consists of a series of galvanised iron tanks. Lime is thrown into the first of these tanks, and the hard water which runs into it turns a small galvanised overshot wheel, causing stirrers in the first and third tanks to revolve. A concentrated solution of lime flows from the first tank into the second, where the excess of lime is allowed to settle. The third tank contains a solution of ordinary soda ash. The hard water flows into a cistern at a lower level than these three tanks, and is there mixed with the requisite proportion of lime water, and afterwards into another tank, where the soda solution is added. It is finally filtered through sponges held between perforated plates. The arrangement for cleaning these sponge filters is novel. The upper plate can be pressed down by a hand-wheel, so as to squeeze the sponges dry without having to remove them, and water is then passed through the reverse way. When the supplies from tanks 2 and 3 have been determined according to the nature of the water, the process is automatic; it being only necessary to put in the lime and soda once a day. Messrs. Doulton say that the cost of these, when the water has to be reduced from 18 to 3 degrees of hardness, is 1d. per thousand gallons.

Another water softening plant is shown by Messrs. Thwaites Brothers, of Bradford. In this there are two tanks, one above the other; the lower one being divided vertically by a diaphragm extending nearly to the bottom. A mixture of lime and carbonate of soda is put into the upper tank, about a bucket full being sufficient for a day's supply. On the side of the apparatus is a small cistern divided into three parts. One of these is filled from the upper tank, and that on the opposite side with ordinary hard water. The contents of these are mixed in the centre division, the rate of flow being regulated by taps. When these have been fixed they do not require to be altered, as long as the degree of hardness remains unchanged. The water which has been treated, passes slowly down one side of the main tank, depositing impurities at the bottom. In rising on the other side, it is forced through a strainer composed of shavings, held between two layers of wire gauze. The exhibitors say that the shavings only require to be renewed about once a year, and that the apparatus will soften a thousand gallons of water per hour.

Messrs. J. Evans and Sons, of Wolverhampton, have a good display of pumps. They show a small duplex pump, a vertical boiler feed pump, a small rotary gun-metal pump for milk, and a "Cornish" steam pump with Tonkin's valves, (tappit motion). They also show a small steam air compressor, fitted with the same valves, some Pickering governors, and different sizes of hand pumps. At the same stand, Messrs. Meldrum Brothers, of Manchester, have a full-sized model of a furnace, to burn breeze and dust, arranged to show the action of their steam jet blowers, in which the steam is forced at a great pressure through a nozzle $\frac{1}{16}$in. in diameter, into a tube under the fire-bars, and draws air with it. The same firm show drawings of furnaces of this description, arranged for burning refuse.

Messrs. Lancaster and Tonge, of Pendleton, exhibit a novel slide valve. It is cylindrical, and has the cut-off valve inside it, being practically one steam valve working inside another. They also show several "Lancaster" steam traps, piston rings, with spiral steel springs, lubricators, and other accessories for steam engines.

No exhibition at the Agricultural Hall would seem complete without Messrs. Hindley's engines and boilers, the "Eagle" ranges and the Blackman ventilators. The Blackman Company are increasing the size of their fans, and show one of 6ft. diameter, capable of moving 60,000 cubic feet of air per minute. They also show a good arrangement of drying room; in this the space is divided by a partition, and hot or cold air can be blown into either side as may be required. Thus one compartment may be cooled, emptied, and refilled, while the drying process is continued in the other.

In washing machinery, one of the largest exhibits is that of Messrs. Summerscales and Co., of Keighley. Their largest washing machine is called the "Practical;" it is made entirely of metal, the outer cylinder being of steel, and the inner revolving drum of perforated brass. An automatic reversing motion causes the drum to revolve in the opposite direction every three or four revolutions. Liquid soap, soda, blue, &c., can be introduced without stopping the machine; and the temperature of the water can be varied from cold to boiling, or high-pressure steam can be introduced when required for disinfecting. Another exhibit at this stand is an ironing and finishing machine, 96in. wide. The object to be ironed passes over an iron roller covered with felt, and a concave segmental casting with smooth inner surface and steam-heated, travels in a direction parallel to the axis of the roller. The pressure of the roller against this can be increased or diminished at will, and the length of the reciprocating stroke is 4in. Similar washing and ironing machines are shown by other makers, differing only in minor points of detail. An interesting method of applying heat is shown in Messrs. Summerscale's shirt-ironer. The roller is hollow, and a mixture of gas and air is burnt in it. This necessitates three supply tubes, as besides the air which is mixed with the gas, there is a third tube to admit sufficient air to allow combustion to take place. Besides washing machinery, they show a fifty-gallon steam-jacketed cooking pan just made for the Chelsea Guardians.

The Keighley Laundry Engineering Company exhibit an ironing machine, in which the drum is made in a different manner from those of most other makers. It is 3ft. diameter, and 9ft. long, and like others is made of cast iron. But instead of being turned perfectly smooth, it is fluted, and it has also 17,000 holes $\frac{5}{8}$in. by $\frac{1}{4}$in. cast in it. It is covered with wire gauze, and the felt is then put on as usual. The makers consider that this serves to keep the felt dry, as the moisture can pass through it into the interior of the roll, instead of having to evaporate from the surface, and that better work is the result. They also show some gas-heated box-irons, in which the bottoms are of gun-metal. They say that various mixtures have been tried for this gun-metal, and that they are using a material which effects a great economy in gas.

An exhibit which is attracting a good deal of attention is that of Messrs. T. W. Barber and Co., of Queen Victoria-street, who show irons, &c., heated by electricity.

Messrs. R. G. Whitaker and Co. have a very varied selection of machinery, chiefly made in the United States. The principal feature of their exhibit is a self-balancing hydro-extractor. This machine, which runs at 1000 revolutions a minute, works very smoothly, being carried on an india-rubber washer 9in. diameter and 2in. thick. They also show several washing machines for steam and hand power. In all of these, the inner drum is made of pitch pine. The question whether wood or brass is preferable for these seems quite undecided. Wood is certainly cheaper, and Messrs. Whitaker say that hospitals prefer it, as many chemicals which corrode brass have no effect on wood.

Another firm who prefer wood to metal for the drums of washing machines, is the Blair Engineering Company, of Peckham, who exhibit a composite rotary washing machine, 4ft. 6in. long, by 3ft. 8in. diameter. They consider that the lightness of wood, as compared to brass or steel, causes the machine to run more easily, and that a wood-lined machine washes better, whilst as iron is used for the vertical parts and stays, strength is not sacrificed.

In the machines described above, and in several others, the drums are made of pitch pine; but in the "Eyelet Drop" washing machine, exhibited by Mr. J. A. Mawson, of Bolton, the drum is of oak. It is divided into four compartments, and perforated with 4000 holes, which are eyeleted with tin, to prevent the edges of the holes from fraying. The partitions of the four compartments are irregularly shaped, with angular corrugations, and the water in the trough does not reach up to the axle; by this means, without there being any necessity to reverse the motion, the clothes are thrown from side to side, rinsed, and then drained, at each revolution.

Most of the hydro-extractors shown are driven from below, but Messrs. Watson, Laidlaw, and Co., of Glasgow, who exhibit a number of these machines, prefer to suspend them, and drive from above by a shaft passing through the centre. They are made of galvanised steel plate, and in the exhibition, are simply held to the flooring by three coach screws. They run very smoothly, the 30in. at 1500 revolutions, and the 48in. at 1000. They are massively made, the 48in. machine weighing 48 cwt.

A very neat arrangement, by which the valves of a pump can be easily removed and replaced, is shown by Mr. J. J. Lane, of Old Ford. The pump to which this invention is applied is a belt-driven wall pump, and the valve seats form part of the same casting as the valve cover, so that when the cover is removed the valves are withdrawn with it from the main pump casting. The faces of the casting which forms valve seating and cover are planed at right angles to one another, and they fit into a recess made for them in the pump casting. A stud from this passes through the cover, and the whole is held in place by one nut. The cover carrying the valves is made and fitted in duplicate, so that, if requisite, one can be removed and another substituted in a few minutes. The same exhibitor shows ironing machines, Decoudun system, similar to those of other makers, except that, instead of using a flexible steam pipe or knuckle joint, the steam is passed through a spiral brass pipe, which has spring enough to allow of the four inches travel of the ironer, thereby preventing all risk of leakage.

A machine which serves as hydro-extractor as well as washer—in fact, as the exhibitor says, a complete washhouse in one machine—is shown by Mr. E. D. Reeve, of Wandsworth. The revolving drum is divided into three compartments, and is made of perforated gun-metal plates. When the clothes are first inserted, it is run as an ordinary washing machine, being driven by a clutch, the steam and water being introduced in the usual manner. When the washing process is supposed to be complete, the clutch is put out of gear and a hand-wheel turned, which, by means of a worm wheel, brings the axis of the machine from a horizontal into a vertical position. A friction cone above the clutch then comes into contact with one driven at high speed on the frame of the machine, and it then works as a hydro-extractor, the water running out through a tap at the bottom. The exhibitor claims that as the clothes have not to be handled whilst wet, they are much less likely to be damaged, and the saving of time is evident.

The heaviest washing machinery in the Hall is that shown by Messrs. Clements, Jeakes, and Co., of Great Russell-street. They have a Decoudun ironer 110in. wide, with steam-heated bed and roller, and resembling a huge lathe rather than a laundry appliance. They also show several very strong washing machines. One, which they say is the largest ever made, is of $\frac{3}{8}$in. steel boiler plate, and is 6ft. diameter; the drum being constructed of galvanised steel bars $\frac{5}{8}$in. diameter. This machine has been tested up to 150 lb. pressure on the square inch, and is especially intended for disinfecting large quantities of clothes. An over-hung hydro-extractor is stepped at the bottom in a phosphor-bronze bearing, and is intended to run at from 2000 to 3000 revolutions per minute.

Messrs. Harper Twelvetrees show a washing machine very similar to that described above, except that the drum is made of galvanised steel tubes $\frac{3}{4}$in. external diameter, and set close together. In another of their machines the periphery of the drum, and a central partition in it, are both made of brass tubes. They have also a large selection of hand-power machines.

A large number of machines are shown by other makers similar in type to those described, and there are also many exhibits which are of no special interest for engineers, though they help to fill the Hall, and conduce to a successful Exhibition. Amongst these may be mentioned a red marking ink exhibited by Messrs. G. G. Wolff and Co., of Haggerston, said to be identical with that used by the Egyptians over 3000 years ago. Certainly the exhibitors submit objects marked with it to very severe tests, such as boiling in caustic potash, without the colour losing its brilliancy.

## THE MODERN DEVELOPMENT OF THE GAS ENGINE.

An interesting paper on the above subject was read on Saturday last before the members of the Manchester Association of Engineers, by Mr. James Atkinson, M.I. Mech. E. The paper, which was illustrated by numerous diagrams, first dealt with three epochs of the "Otto" gas engines, of which three diagrams were given, showing the great reduction in the gas consumption which had been effected during the last fourteen years. The "differential" and "cycle" gas engine, invented by the author, were next described, after which the reasons for the recent greatly improved consumption in the Crossley "Otto" engine were explained and shown to be mainly due to the scavenging arrangement for getting rid of the burnt gases entirely, which was a recent invention of Mr. Crossley and the author. The means for getting rid of the burnt gases left in the cylinder at the end of the exhaust stroke were described in detail. By an alteration in the position at which the exhaust valve in an ordinary "Otto" engine would be closed and the admission valve would be opened, the improved engine was so arranged that for a quarter of a revolution the air valve and the exhaust valve were both open at the same time. The improved engine was fitted with a long exhaust pipe, an average length of about 65ft. being found the most suitable. When the exhaust valve was opened, there was some 30 lb. to 40 lb. pressure in the cylinder. The energy stored up in this cylinder full of hot gases was utilised in putting in motion a long column of exhaust gases in the exhaust pipe. When, therefore, the piston commenced to slow down, after the middle of the exhaust stroke, the column of gases being in motion caused a reduction of pressure in the cylinder, the reduction being accentuated whilst the crank was passing from one position to another, during which time there was a partial vacuum in the cylinder. Both the admission valve and the exhaust valve being open at the same time, a strong current of air was drawn through the end of the cylinder, sweeping out the burnt products and replacing them with pure air. It was, however, necessary to so shape the end of the cylinder that the burnt gases were completely swept out. As soon as the burnt gases were replaced with pure air, the gas valve was also opened, and an explosive mixture was drawn in during the suction stroke, the cylinder being thus filled entirely with pure air and combustible gases. The effect of this was shown by means of a diagram, which represented a mean pressure of 98·75 lb., and bringing the consumption of gas per brake horse-power per hour down to 16·487 cubic feet. This was an enormous reduction, being the greatest ever made by any single improvement in the gas engine, and the consumption was not more than half the amount required formerly. Incidentally there were other advantages in the improved engine. It was known that an ordinary type Otto engine, working for long periods at its maximum power, would not give as much power when thoroughly hot as shortly after it was started. In the improved Otto engine, however, owing probably mainly to such a considerable volume of cold air being drawn through the combustion chamber, this engine continued to work as satisfactorily for any length of time as it did on starting. In some instances an engine had been allowed to run on a brake the whole day, and at the termination a brake test had been made which proved that the engine was giving as much power as at starting, and with as low a consumption of gas. When engines were worked with weak gases, such as Dowson gas, trouble had sometimes been experienced when the gas was perhaps not so rich as it ought to have been, owing either to unsuitable fuel being used, or the gas generator not being properly managed. The mixture being too uninflammable gave poor diagrams, and often caused ignitions in the exhaust or air pipes. With the improved engine, however, a greater quantity of gas per revolution could be got into the cylinder and satisfactorily burnt, giving higher mean pressures, and practically complete immunity from the troubles referred to. Ignition also was made more certain and regular from their being no waste gases mixed with the explosive mixture. At the first glance it would be supposed that the improved engine required to be more strongly constructed than an ordinary Otto engine, but this was not the case. When gas engines were working unsatisfactorily—as, for instance, with the ignition tube rather too cold—they occasionally missed igniting a charge. Sometimes this might go on for several revolutions, until finally a cold charge of pure gas and air was ignited, and an abnormally large diagram was given. As several charges had been drawn through without being ignited, the cylinder was cold, and the weight of gas and air enclosed was greater than if the engine were working normally, the consequence being that under such circumstances it was possible to get a certain maximum strain which was the same for any engine, and this maximum strain was not affected by the improvements. It was therefore necessary to make all gas engines strong enough to stand this possibly heavy strain, so that, though a higher initial pressure was obtained in the improved engine, it was not necessary to strengthen any of the parts beyond what would in any case be required, the maximum possible strain being proportional to the compression pressure. The improved engine did not expand the charge beyond the original volume before compression, and in this direction still further improvement might be obtained, though this was hardly probable. A rough trial had been made with an engine closing the admission valve earlier, so as not to fill up the cylinder at the end of the suction stroke. From experiments made, there did not, however, appear to be any economy in reducing this charge, though it must be admitted that the trial was not made as completely as it might have been. They must bear in mind that, by increasing the expansion in this or any other way, a larger cylinder and engine per unit of power was required. Consequently, the mechanical efficiency could not be as good, and from a commercial standpoint cost of engine per unit of power was an important element. All things considered, and bearing in mind the excellent results obtained, it was very doubtful whether any material all-round gain could be made in this way.

In the discussion following the reading of the paper, Mr. Jenkins, after remarking that the costliness of gas retarded the introduction of gas engines, which might be very usefully adopted for a great many purposes, said he would like to know whether the increase of compression pressure from 40 to 79 had any detrimental effect upon the mechanical efficiency of the gas engines when working at reduced pressures. Mr. Guthrie thought the modifications and alterations recently introduced in the gas engine were sound in every direction. Mr. Fulton, commenting upon the introduction of the long exhaust pipe, said that if this had necessarily to be made straight, it would be impracticable in some situations where this could not be done. He thought that with this pipe the increased friction in the pumped-out air when getting away would tend to throw still more load upon the piston in expelling the air, and as to the method of getting rid of residual products, it might possibly happen that some of those products would, on the incharging stroke be drawn back from the exhaust pipe into the cylinder. Mr. Saxon observed that, in his opinion, the brake efficiency of a gas engine would not equal that of the steam engine. It was a very peculiar feature in Messrs. Atkinson and Crossley's gas engine that the exhaust opened so early and closed so late, and the getting rid of burnt gases was certainly effected in a praiseworthy manner. Mr. Craven, in giving some interesting particulars of the working of a 20-horse gas engine, made by Crossley, and developing 30-horse power, which he had put down in his works, said this engine drove a 15-ton overhead rope-driven travelling crane, and about forty machine tools of various kinds. The gas consumed in the engine was 500ft. per hour, and at 2s. 6d. per 1000 cubic feet, the cost equalled ½d. per horse-power per hour. Mr. E. Constantine observed that though testing by the brake was no doubt the right way, they must also consider the indicated horse-power. An Otto engine, consuming 14½ cubic feet of gas per indicated horse-power, cost about ·4d. per indicated horse-power per hour, taking the charge for gas at 2s. 6d. per 1000 cubic feet; whilst a steam engine, using 40 lb. of steam per horse-power, evaporating 8 lb. of water per 1 lb. of coal, would cost ·4d., at 15s. per ton of coal. A large cotton mill engine averaged ·138d., whilst a triple expansion engine, consuming 14 lb. of steam per indicated horse-power, and evaporating 9 lb. of water per 1 lb. of coal, cost ·125d. per indicated horse-power per hour. The President—Mr. Thomas Daniels—recommended the adoption of gas engines for separate bays in a locomotive or machine works. Mr. Atkinson, replying upon the discussion, said that with regard to the increase in compression from 40 lb. to 79 lb., he might observe that in the former case it was difficult to keep the slides of the engine right, and this necessitated a limit being placed to the compression pressures. When the slide was done away with, and the ignition tubes introduced, no difficulty was experienced in getting the higher pressures. The exhaust pipes in the present engine could be made with any reasonable number of bends, but no elbows must be introduced.

MEAT IMPORTATION.—The first successful cargo of chilled beef brought into London by a new line of meat-carrying steamers from Boston has just arrived at the Victoria Docks, in the s.s. Virginian. This vessel, one of the Leyland Line, has recently been fitted with a new refrigerating plant on the Linde system. The machinery is in duplicate, and the insulated holds, which will carry about 1600 quarters of beef, are cooled by means of a system of brine pipes. The machine very easily maintained the requisite temperature, even when only one half of the machine was working. The average of six thermometers showed a mean temperature of about 28¾ deg. At no part did the temperature fall below 28 nor rise above 29¼. The remarkable regularity of the temperature is of course a very great advantage in the transport of meat which must not be frozen, and which at the same time must be kept at as near freezing point as possible. The success of this cargo will no doubt lead to the importation of a considerable quantity of meat direct from the United States to London instead of coming through Liverpool.

## RAILWAY MATTERS.

The much needed harbour railway at Helsingfors has been completed at a cost of £81,500.

Mr. Wm. Purcell O'Neil, C.E., has been appointed by the directors to the position of chief engineer of the Midland Great Western Railway of Ireland entire system.

The necessary plans have been prepared for an ordinary narrow gauge railway between Civita Vecchia and Tolfa, possibly with the view of extending the line to Bracciano, but for the present the matter is left in abeyance.

Messrs. Allan, Whyte and Co., wire rope manufacturers, Rutherglen, have just shipped a cable for the Melbourne Tramway and Omnibus Company, Limited, the length of which is 18,000ft. It weighs over 18 tons, and it is the first rope for this purpose which has ever been made in Scotland.

A scheme is under consideration for the construction of a light railway from Menai Bridge or Llanfairpwyllgwyngyl to Beaumaris, Anglesea, and surveys of both routes have been completed. At present communication between Beaumaris and neighbouring towns is restricted to ferries and roads.

A landslip occurred on the 12th inst. on the Swindon and South Wales section of the Great Western Railway, 200 yards above Stroud, where the lines run on an embankment above the Thames and Severn Canal. The slip has been threatening for some weeks past, and during Monday night it was found that the down line of rails could not be used any longer. The traffic is therefore being worked entirely on the up rails. The down rails will soon be again ready for use.

The new railway from Rome to Viterbo, a distance of fifty-four miles, opens up communication with Bracciano, Vetralla, and Ronergtrone, the latter place being reached by a branch line from Caprancia, a distance of five miles. Some other interesting places from an artistic point of view, *i.e.*, Caprarola and Toccaretta, are rendered more accessible by the new line, and the ruins of Ancient Veii are reached from the station of La Storta, twelve and a-half miles from Rome.

A general classification of the accidents on American Railways in September last shows that the derailments continue to be a large proportion of the whole. The derailments from all causes were 62 per cent. of the whole, and the unexplained derailments were nearly 40 per cent. of these. The unexplained accidents of all kinds amounted to 33 per cent.

| | Collisions. | Derailments. | Other ac'd'ts. | Total. | p.c. |
|---|---|---|---|---|---|
| Defects of road .. .. .. | 0 | 15 | 0 | 15 | 11 |
| Defects of equipment .. .. | 8 | 14 | 4 | 26 | 19 |
| Negligence in operating .. | 25 | 11 | 0 | 36 | 25 |
| Unforeseen obstructions .. | 0 | 15 | 4 | 19 | 12 |
| Unexplained .. .. .. .. | 14 | 36 | 0 | 50 | 33 |
| Total .. .. | 47 | 91 | 8 | 146 | 100 |

The record of train accidents on American railways in September includes 47 collisions, 91 derailments, and 8 other accidents, a total of 146 accidents, in which 50 persons were killed and 126 injured. These accidents are, by the *Railroad Gazette* classified as follows:—Collisions: Trains breaking in two, 7; misplaced switch, 2; failure to give or observe signal, 6; mistake in giving or understanding orders, 3; miscellaneous, 15; unexplained, 14. Total rear collisions, 22; butting, 13; crossing, 12. Total, 47. Derailments: Broken rail, 3; loose or spread rail, 7; defective bridge, 1; defective switch, 3; bad track, 1; broken wheel, 4; broken axle, 6; broken car, 1; fallen breakbeam, 1; fallen deadwood, 1; failure of coupling, 1; misplaced switch, 4; careless running, 2; track repairers, 1; open draw, 1; bad switching, 3; animals on track, 5; landslide, 1; tornado, 1; maliciously misplaced switch, 2; malicious obstruction, 2; accidental obstruction, 3; unexplained, 36. Total, 91. Other accidents: Boiler explosion, 2; broken side rod, 2; cars burned while running, 1; other causes, 3; total, 8. Total number of accidents, 146.

The question of the linking-up of the narrow-gauge railway systems of northern India is one which is of the highest importance to the country, says the *Pioneer*, for through communication between trade centres without break of gauge is indispensable to the rapid development of trade. As was announced some time ago, Cawnpore is to be put in direct touch with the Bengal and North-Western system, the Gogra River being bridged. The work will be done presumably during the ensuing cold weather, as its progress should be as rapid as possible. The Government of India have agreed to the Secretary of State's proposals, and only details have now to be settled. This linking-up through Lucknow will not shorten the actual distance to be traversed, but it will obviate breaking of bulk in the goods traffic between Rajputana and the trans-Gogra districts. Salt from the Sambhu Lake will pass in one direction, rice, sugar, tobacco, and other commodities in the other. Once loaded in the wagons, these articles of trade will reach their destinations without having to be handled, as at present, at junctions between the broad and narrow gauge systems. The Government, however, have looked further afield than Bahramghat. They see that great advantages would follow upon direct connection between the metre gauge system administered by the Rohilkhund and Kumaon Railway Company and the Cawnpore-Achnera line. A line from Bareilly to Soron would open out a fertile tract of new country, and, in addition to avoiding break of bulk, would shorten the distance and materially cheapen the interchange of produce between Rohilkhund and Rajputana, at the same time facilitating transport of goods by providing an alternative route between Rohilkhund and the country north of Bareilly and the sea coast. The Bareilly-Soron line, therefore, will probably be undertaken simultaneously with that linking Cawnpore with the trans-Gogra districts, and thus the various metre gauge systems will be dovetailed together.

According to a recent report of the United States Consul at Chemnitz, the trolley system of electrical propulsion was substituted for that of horses on the city tramways a year ago. The wires are hung from the house walls instead of poles. The method of laying or stringing the wires is by rosettes fastened into the walls or woodwork of the houses, from which hooks, to which the wires are attached, project. In the case of wooden walls, large screws are turned into the wall; in the case of stone walls, a long jagged iron is driven in and cemented. These are then tested with at least seven times the weight that they are intended to bear; owners of property preferred to allow the use of their houses free for a year, to having a post on the sidewalk. The system is simple, cheap, convenient, easily adjustable, and free from much of the ugliness inseparable from the network of wires used for the trolley. The lines—as the law requires—are level with the pavements. This costs the company more money, but is infinitely better for the public. Accidents to wagons, carriages, and vehicles of all kinds are consequently rare. The gauge is narrow. The cars run at the rate of 220 yards per minute in the heart of the city, and 350 yards per minute in the suburbs, seldom if ever leaving the rails. The cars have no conductors, the motor man being the only person representing the company. The saving to the company thus effected amounts to £2200 a year. The fare is but 1½d. on all routes, including transfers. Fare boxes are attached to the front and rear parts of the car. The increase in traffic since the change from horse to electrical propulsion is said to be 60 per cent., notwithstanding a strenuous opposition for a long time to the change, and a year of exceedingly hard times. Public opinion was divided between the trolley-overhead and the underground system now working in Buda-Pesth. It was claimed, and pretty satisfactory proved, that in northern cities, where snow falls heavily and lies on the ground a long time, not only is the trolley best, but the underground system is not satisfactory.

## NOTES AND MEMORANDA.

The rainfall during September over some parts at least of the Thames valley was deficient to the extent of nearly 1in. The actual amount falling at Oxford was 1·74in., the average for twenty-five years being 2·66in.

The death rate of London declined last week to 15·0 per thousand annually, against an average of 16 9 for the thirty-three great towns. Preston's record was the worst, 28·8, and Birkenhead was the lowest with 11·8.

A recent number of the *Comptes Rendus* contains a paper on "Experimental Verifications of the Theory of Weirs, with either Adherent or Partly-submerged Watersheet, with regard to the pressures," by M. J Boussinesq.

The total number of supplies furnished by the London water companies during September was 810,471, representing an increase of 1269 supplies on the previous month. The total supply divided by the number of supplies shows a daily average of 231 gallons for each such supply.

The following statement of figures give, in the case of each London company, the number of gallons per head per day supplied during September:—Chelsea, 40·35; East London, 32·06; Grand Junction, 48·32; Kent, 29·36; Lambeth, 32·14; New River, 32·25; Southwark and Vauxhall, 37·96; West Middlesex, 32 67.

The Peninsular and Oriental Company's new steamer Caledonia has on her first voyage beaten the record. She arrived at Brindisi on Tuesday evening at 8.30 with the homeward Indian mails, which left Bombay on the 3rd inst. Her passage, therefore, from Bombay, including stoppages, occupied only ten days six hours, which is the fastest time hitherto made. Her mails will be delivered in London this morning, 12½ days after leaving Bombay.

At a recent meeting of the Paris Academy of Sciences, a paper was read "On the Superposition of Optical Effects of Several Asymmetric Carbon Atoms in the same Active Molecule," by MM. Ph. A Guye and M. Gautier. In a molecule containing several asymmetric carbon atoms, each of them acts as if all the remainder of the molecule were inactive. The optical effects of several asymmetric carbon atoms in the same molecule are algebraically added to give the optical activity of the molecule.

Dr. Froelich has published another paper, in which he endeavours to establish the law of the magnetisation of iron; he deduces the constants occurring in his law from a number of different observed results with different irons, and shows how the calculated and the observed values agree; he shows that good magnetic experimental data can always be represented by a formula with close agreement; the various coefficients determined for a number of different irons differ very considerably from each other, and those obtained from one set can therefore not be applied to another. He discusses the various methods for making measurements, and concludes that there is no doubt that the best method for obtaining the magnetisation curve is by means of a closed ring of iron.

The total number of the mines registered in Spain is over 15,000, of which only about 2000 are worked. The province of Biscay, however, still gains very considerable profits from its rich iron ore mines, as may be deduced from the fact that in 1893 out of a total production in Spain of 5,497,540 tons, the consular district of Bilbao was responsible for 4,918,650 tons; whilst in 1892 out of a total for Spain of 5,405,170 tons, the consular district of Bilbao furnished 4,573,560 tons. The exportation of iron ore from Bilbao to the United Kingdom in 1893 was over 3,000,000 tons, and as the total foreign import of iron ores into the United Kingdom was 4,065,863 tons—3,624,083 tons from Spain and 441,780 tons from other countries—it appears that shipments of Bilbao ores made up 84 per cent. of the importation from Spain and 75 per cent. of the total foreign importation of iron ores in the United Kingdom in 1893; and, calculating the yearly production of iron ores in the United Kingdom to be 14,000,000 tons, it would appear that Bilbao supplies about the fifth part of the iron ores yearly consumed in the United Kingdom.

The milling industry is the largest in the United States in point of capital and help employed. The *American Miller* says: "Our mills have ample capacity to convert into flour every bushel of wheat grown in this country, and, like the railroads and farming interests, the milling industry is spread over the entire country, being confined to no particular section. In 1835, flour represented 97 per cent. of the wheat exports from the United States. That per cent. has steadily declined until flour represents now about 30 per cent. of the wheat exports—a decline of 67 per cent. in the face of a constantly increasing capacity to manufacture flour in this country. In 1892, the wheat exports amounted to 225,665,812 bushels, of which 157,280,351 bushels went as raw material, and 68,385,461 bushels as the manufactured product. In 1893, the exports amounted to 191,912,634 bushels, of which 117,121,109 bushels was in the shape of raw material. Were it possible to export this as flour, the saving to our country would be from 8,000,000 dols. to 10,000,000 dols., the cost of manufacture. Of this amount the greater part would be paid out in labour."

A redetermination of the temperature of greatest density of water has recently been carried out by M. de Coppet, who gives an account of his results in the *Annales de Chimie et de Physique*. On account of the very slow change of density about that temperature, it is difficult to determine it within a hundredth of a degree Centigrade. The method adopted was a modification of that of Despretz. A number of thermometers were mounted in the lid of a cylindrical water vessel with their bulbs at various distances from the bottom, and symmetrically disposed about the axis. On immersing the vessel in a cold water bath, a current was set up, passing down along the sides and ascending in the centre. After a while the current stopped, and then was reversed. The course of the current could be followed by the readings of the thermometers. The water having the greatest density would sink to the bottom, and the temperature of the lowest bulb would be approximately that of greatest density. But the temperature at which the lowest thermometer stopped for a time was higher on cooling than on heating. *Nature* says, "The curves exhibiting the two series of changes are, however, symmetrical, and give the temperature of maximum density as 3·982 deg. by the hydrogen thermometer under a pressure of one atmosphere."

The structure of gold nuggets is the subject of a paper recently contributed to the New South Wales Royal Society by Professor Liversidge, F.R.S. Gold nuggets on being cut through, or sliced and polished, and then etched by chlorine water, were found to exhibit well-marked crystalline structure closely resembling the Widmanstatt figures shown by most metallic meteorites, except that in the nuggets the crystals are more or less square in section, and show faces which evidently belong to the octahedron and cube. On heating the nuggets in a Bunsen burner, blebs or blisters form, on both the polished and unpolished surfaces, and on still more strongly heating, these, in some cases, burst with sharp reports, and pieces of gold are projected with considerable violence. As no explosions have been observed on dissolving or eating away the crusts of these blisters by chlorine water, it would appear that the blebs are probably due to the vaporisation of some liquid or solid substance. As soon as a fresh supply of nuggets is obtained, experiments will be proceeded with to ascertain definitely whether gold nuggets contain occluded gases, or liquids, or solids which are vaporisable. In slicing some nuggets, scattered granules of quartz were met with inside, although quite invisible outside, and at first it was thought that the explosions might be due to the quartz; but the gas, in some cases, continued to issue from the burst bleb—where the aperture formed was small—and forced the Bunsen flame out into lateral jets, just as if urged by a blowpipe

## MISCELLANEA.

Mr. H. Johnson Phillips, F.I.C., F.C.S., late of the Great Western and Great Eastern Railways, announces that he has begun practice as an analytical and consulting railway chemist at Palace Chambers, Westminster Bridge, London.

We understand that Mr. Robert Zimmerman, who for the past ten years has been connected with the Germanic Company of Kiel, is about to leave that concern to take up the position of manager of the Vulcan Works at Stettin, the largest works of that class in continental Europe.

Mr. Alderman Robert Readhead has been elected for a second year to fill the position of chief magistrate of the borough of South Shields. Alderman Readhead is head of the engineering department in the well-known firm of shipbuilders, Messrs. John Readhead and Sons.

In his quarterly report of the health of Tunbridge Wells, Dr. Stamford, the medical officer of health, states that the deaths registered in the three months numbered only 81, being 16 less than in the corresponding quarter of last year, and equal to a death-rate of only 11·11 per 1000 of the estimated population.

The *Liberté* points out with satisfaction that the French cruiser Alger, which entered the Suez Canal on October 14th, several hours after the English cruisers Edgar and Spartan, has outstripped them, though it went *viâ* Obock, thus lengthening the voyage by 65 miles. It reached Saigon on the 6th inst., whereas the English cruisers only reached Singapore on that date, thus being 36 hours behind.

A Council of Ministers was held at Cairo on the 8th inst., the Khedive presiding. Mr. W. E. Garstin, C.M.G , Under Secretary of State to the Ministry of Public Works, presented a note in regard to the Nile reservoirs, which the council approved. In this note Mr. Garstin proposed to construct the dam at Assouan at a lower level than was formerly decided upon, in order to prevent the Philæ and other temples from being submerged. He also suggested that Mr. Willcocks should be sent to England to consult Sir Benjamin Baker regarding the final details of the plans. Mr. Garstin asked that money should be provided in next year's Budget to enable the Department of Public Works to commence supplementary works connected with the reservoirs next year. Mazloum Pasha, the Minister of Finance, undertook that this should be carried out.

Professor Mendelaieff calls attention in the *Novoe Vremya* to the great development of Russian industry during the reign of the deceased Emperor, who adopted the protective system exemplified by the Tariff of 1891. The articles specially protected were cotton, iron, precious metals, coal, salt, and timber. The production of these articles increased and gave an impetus to business in all directions. In 1880 the total of Russian industries amounted to 1,220,000,000, roubles, in 1890 to 1,660,000,000 roubles, and at present this total cannot be less than 2,000,000,000 roubles. The *Times* St. Petersburg correspondent says the whole production of grain in Russia does not exceed 2,000,000,000 poods, which in money is hardly a third of these figures, so that Russia's industries are now worth more than her agriculture. On agriculture alone Russia could not exist.

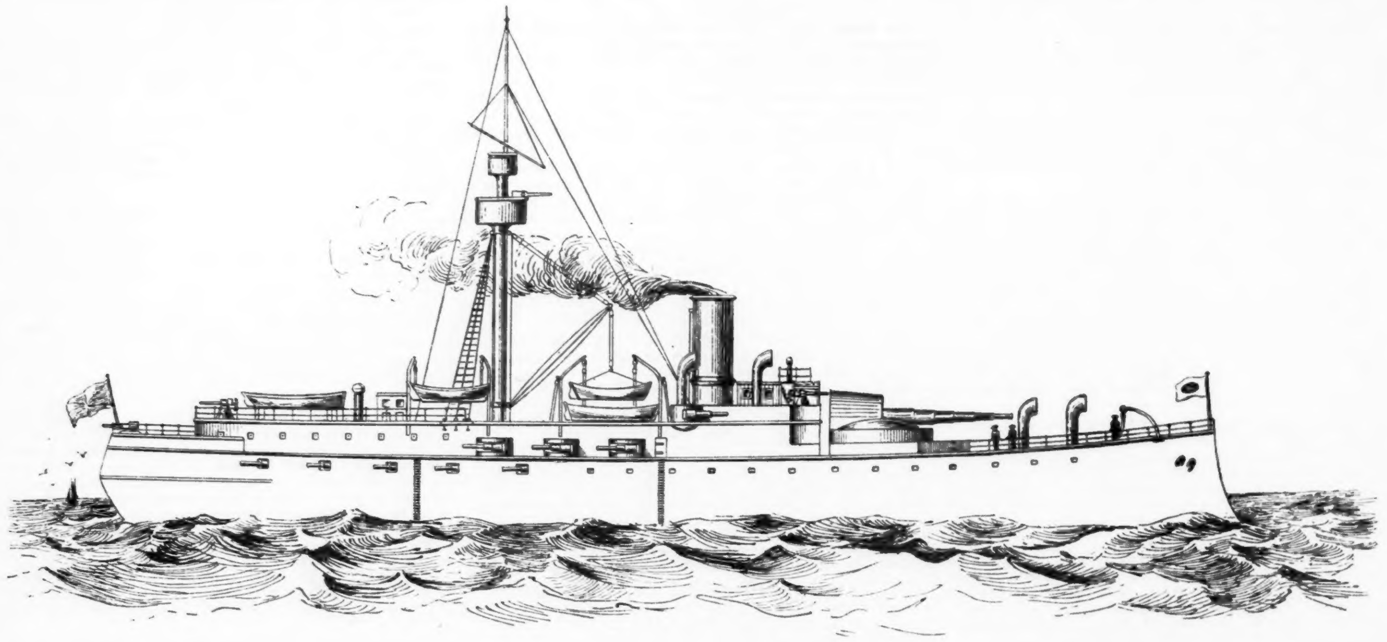
If the American farmer acts on the following there will be a little chance for the English wheat grower. The present crop year in the United States has shown that the farmers in the country, tributary to Duluth, have made up their minds that there is no money in raising wheat at prevailing prices. The *American Miller* says, they have also discovered that there are other cereals which can be raised with profit on the prairies of Minnesota and the Dakotas. This accounts for the large receipts of flax seed and barley during the past month. Last year during September the receipts of barley were 27,927 bushels. This season the receipts for the same period are nearly one-half million bushels. Last year in September there were received here about 38,000 bushels of flax seed, while during September of this year there was about 450,000 bushels received. Secretary Wyman, of the Board of Trade, estimates that the receipts from the 1894 crop, in both these grains, will be from two to four times as heavy as that of 1893. Prices for both flax seed and barley have been higher, considering the cost of raising, than of wheat.

During a preliminary trial of the torpedo-boat destroyer Ardent, built and engined by Messrs. J. I. Thornycroft and Co., and on two runs, one with the tide and the other against, a mean speed of 29 182 knots was obtained. The following are the principal dimensions of the Ardent and two other new vessels:—Length over all, 200ft.; breadth, 19ft.; depth, 14ft. The engines are similar to those fitted in the Daring and Decoy, being of the three-stage compound type, with two low-pressure cylinders. The diameters of the cylinders are—high-pressure, 19in.; intermediate, 27in.; and the two low-pressure, each 27in. The vessel is twin-screw. The boilers are of the Thornycroft water-tube type, and somewhat larger than those of the Daring and Decoy. An automatic boiler-feed control is used, and talc is used in place of glass for the boiler water gauges, the increased pressures now used necessitating a departure from the old gauge-glass. The power developed was about 5000-horse power, the boiler pressure being 210 lb. to the square inch, and the mean revolutions 407 per minute. The Admiralty was represented by Mr. W. J. Harding and Mr. Adams of the Controller's Department.

The Receivers of the Philadelphia and Reading Railroad have presented a petition for permission to negotiate a loan of £32,000, for the purpose of erecting an extensive coal-storage plant at Port Richmond. The plant will be located on property to the north of the present track at Port Richmond, which covers an area of 600ft. by 1800ft. The coal-storage plant will consist of six coal-trimming or piling machines; two of 20,000 tons capacity, two of 30.000, and two of 40,000 tons, making a total capacity of 180,000 tons, which may be increased by chuting to about 200,000 tons. The plant will be adapted to receive and store coal at the rate of between 5000 and 6000 tons in ten hours, and by the use of reloaders coal can be taken from stock, screened, and loaded into cars at the same rate. The plant to be erected is guaranteed to store and reload the coal at a cost not exceeding 2·5d. cents per ton for both operations. The difference between this cost and the present cost of handling coal at Port Richmond will, it is estimated, effect a saving of about £8000 a-year. The new plant will be erected by the Dodge Coal Storage Company, of Philadelphia.

A singular accident is reported to have occurred shortly after one o'clock on Saturday last. A horse attached to a brougham was being driven along Cannon-street, and on turning into Budge-row the animal began to tremble violently and immediately afterwards fell down. When the coachman, George Clark, got off his seat, he at once received an electric shock, but sustained no injury. The horse, however, died in a few moments. Directly afterwards two explosions occurred simultaneously in the Electric Lighting Company's junction boxes opposite No. 22, Budge-row, and in Cannon-street, facing No. 22, Walbrook. The latter premises are occupied by a hosier, whose shop window-blind was damaged, the basement window being also broken. The explosion forced off the covers of both boxes; and part of the brickwork and iron frame of the box in front of the shop was considerably damaged. A portion of the footway and kerbstones was blown into the carriage-way, striking and injuring two men. Others were taken to hospitals and found to be suffering from shock. A few seconds after the explosion dense smoke was seen issuing from the junction box opposite No. 22, Budge-row. The officials of the Electric Lighting Company will report the circumstances to the Board of Trade.

# JAPANESE CRUISERS MATSUCHIMA AND ITSUKUSIMA



## JAPANESE WAR VESSELS.

We engrave this week illustrations of two classes of Japanese cruisers, the one representing the Naniwa and Jakachibo, the other the Itsukusima and Matsuchima, all four of which were present at the recent naval engagement off the Yalu River, and with the exception of the Matsuchima, which was disabled during the action, are now employed in the investment of Port Arthur. The Hasidate, which was also at Yalu, is at the same time practically represented by the engraving of the two larger vessels, as she is a sister ship of the same dimensions, build, and tonnage, only her barbette is aft instead of forward, she having been built at Yokasuka in Japan, and completed only at La Seyne, near Toulon. The others were built and completed at La Seyne.

The principal dimensions, &c., of the Naniwa and Jakachibo, built by Sir W. G. Armstrong, Mitchell, and Co., are as follows:—Length, 300ft.; beam, 46ft.; draught, 18ft. 6in.; displacement, 3650 tons. The vessels are constructed of steel throughout. Over the entire length, and covering the machinery, boilers, magazines, and steering gear, there is a strong protective deck about 3in. thick, extending amidships from 1ft. above the water-line to 4ft. below. The hull is divided throughout into numerous water-tight compartments. The ships are fitted with two military masts, mounting two machine guns behind shields in each top, but no sails are carried.

The armament is placed on the upper deck, and is powerful. At the bow and stern two 35-calibre 10in. 28-ton breech-loading guns are mounted on revolving centre-pivot carriages, giving an uninterrupted arc of fire of 240 deg. The mountings, which were designed at Elswick, presented many novel points when completed. The training is effected by means of hydraulic engines placed directly under each gun beneath the protective deck, so as to be secure from injury. A shaft is led up to the deck and engages by means of a pinion in a rack fixed to the base of the revolving carriage. There are two engines to a gun, each capable by itself of performing the rotation—a duplication of parts which greatly diminishes the risk of accident. The working platform, which is in rear of the gun, provides space for the crew and contains the mechanism connected with the elevation and training; it revolves with the carriage, the crew being sheltered by a steel shield. The carriage is fitted with Vavasseur compressors, and the gun, after discharge, returns automatically into position of firing. The elevation is easily performed by simple gearing, whilst the loading is carried out at a fixed station placed amidships and protected by stout steel armour, within which are situated the hydraulic rammer and hoists for the charges and projectiles. Spaced along each broadside, on sponsons, are six 6in. 5-ton breech-loading guns, also of 35 calibres in length, with a horizontal range of 130 deg., mounted on Vavasseur centre-pivot automatic carriages, covered by steel shields, and along the upper works, at every available space, are placed ten Nordenfeldt machine guns. On the ends of the bridge are situated two 6-pounder quick-firing guns. There are four torpedo tubes.

A conning tower of steel armour stands on the forward bridge, and within it are placed the engine-room telegraphs and various voice tubes, the hydraulic steering-wheel, the directors for simultaneous electric firing of the guns, &c.

Four powerful arc lights are placed on elevated stations at either end of the forward and after bridges, capable of covering with their rays the entire space surrounding the ship. The engine-rooms, stokeholds, magazine and shell-rooms, and other compartments below the protective deck, are illuminated by incandescent electric lamps, as are also the coal bunkers on that deck and the captain's state-rooms. The total coal stowage is 800 tons, capable of driving the ship about 9000 miles at a speed of 13 knots. The number of officers and crew is about 325.

At the official trials of the Naniwa and Jakachibo, respective mean speeds of 18·72 knots with 7235 indicated horse-power, and 18·77 knots with 7120 indicated horse-power, were obtained.

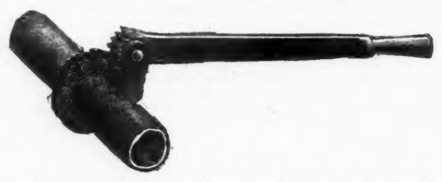
The Itsukusima, which may be described as representative of her class, has the following principal dimensions:—Length, 295ft.; beam, 50ft. 10in.; mean draught, 21ft. 2in.: two propellers; displacement, 4277 tons. Neither of these three cruisers carry any side armour, but there is a steel protective deck 2in. thick, which rises amidships and in the centre-line of the vessel, but slopes very much forward and aft. The barbette has steel armour, and the sponsons are similarly protected.

The main armament consists of one 32 cm.—12½in.—Canet gun, in an armoured barbette 12in. thick, forward, having an armoured trunk beneath for the ammunition hoists, which descends to the magazines. The secondary armament consists of eleven 12 cm.—4¾in.—Elswick quick-firing guns, eight of which are disposed in steel shield-protected sponsons upon the upper deck and superstructure with a very considerable arc of training on either beam, one astern and the other two pointing ahead. It was the presence of this enormously powerful battery of Elswick quick-firers upon the Itsukusima, Matsuchima, and Hasidate, which practically decided the current of events in the action at Yalu. The co-operation of the Yoshimo added, too, a most valuable assistance with her four 6in. and eight 4·7in. quick-firers of the same description. The hail of projectiles rained upon the Chinese vessels by these forty-five secondary quick-firers must have been truly awful in its effects. The lighter armament of the Itsukusima class consists of five six-pounder, and eleven three-pounder Hotchkiss guns upon the broadsides and superstructure, and six machine guns, some of them in the armoured tops. Four torpedo tubes are carried.

The Itsukusima has a maximum indicated horse-power of 5400, giving a speed under forced draught of 17·5 knots. She has one military mast with two armoured tops, one of which contains a search light, and a steel-armoured conning tower forward, which contains the engine-room telegraphs, voice tubes, &c. The whole of the well beneath the water-line is minutely subdivided into water-tight compartments.

## A SMOOTH GRIP PIPE WRENCH.

The illustration below represents a pipe wrench, for which the chief advantages claimed are, firstly, a smooth surface in contact with the pipe, certainly a valuable feature when used for galvanised pipe work, where the coating might be and often is destroyed by the ordinary tooth grip; secondly, it binds the pipe uniformly, and is therefore not liable to bulge or distort it. We think these qualifications alone should recommend it to users. Its action is obvious. One tool will take a number of sizes. The makers are Messrs. Lumsden, Smart, and Co., Bankwell-lane, Gateshead-on-Tyne.



## THE BACHELDER INDICATOR.

The steam engine indicator illustrated by the accompanying engraving is made by Messrs. Thompson, Bushnell, and Co., New York, and is being introduced into this country by Messrs. Rooper and Harris, Emery Works, Stafford. The object of this invention is the simplification of the indicator and reduction in the number of springs necessary to each indicator for a large range of pressures. A flat spring is used in place of the ordinary coil or spiral spring, and the indications of this spring are varied by varying the length free to bend under the influence of the steam pressure on the indicator piston. The indicator is shown in our engravings in section in Fig. B, and complete in Fig. A, with the exception of the removal of a milled nut or cover, which gives access to the piston for oiling. Fig. C shows one of the springs used to half full size. Two of these springs are sufficient for the full range of pressures usually met with in practice. By reference to Fig. B it will be seen that a horizontal cylindrical chamber projects from the piston cylinder, and carries an adjustable gripping piece and set-screw, by means of which the free end of the spring may be varied in length, and thus the pressure necessary to bend it through a given range also varied. The springs are calibrated in the instrument, and a pointer on the gripper piece slides in the index slot shown in Fig. A, by means of which the length of spring may be set to suit any pressure within the range of the one spring. The diagrams obtained by means of this indicator are much the same, even at high speeds, as those obtained by better known instruments. It is nicely made, the working parts being very light. The difficulty with the instrument is, of course, that introduced by the variation in flexure of the spring, which is not proportional to the variation in length of the free part, and to the difficulty in making the desired variation in sectional area.

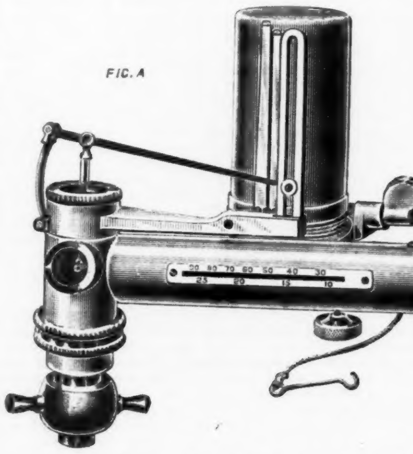


FIG. A

Although the spring is fixed by the sliding gripping piece, the flexure from the gripping point is not that of a parallel flexible bar rigidly held at one end, inasmuch as the flexure of the free part affects that part which is between the gripper and the pin fixed end. The character of the flexure is thus complicated as compared with that of ordinary flexible bars of different lengths. This, of course, makes it necessary to calibrate these springs for each instrument, and to do so by slight modification of their section or to compensate for it by use of constants. Once correct they no doubt remain so, but, of course, the difficulty of obtaining correct indications by the same spring at different lengths for any considerable range is not a small one, and some engineers who use their indicators for varied work may still prefer the larger number of separate springs required by the ordinary indicators.

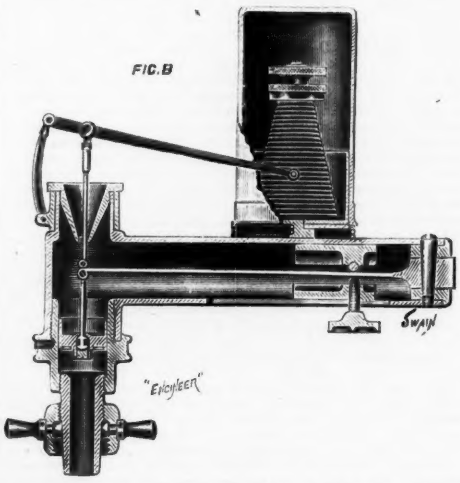


FIG. B

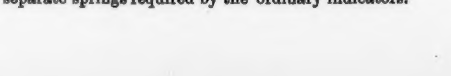
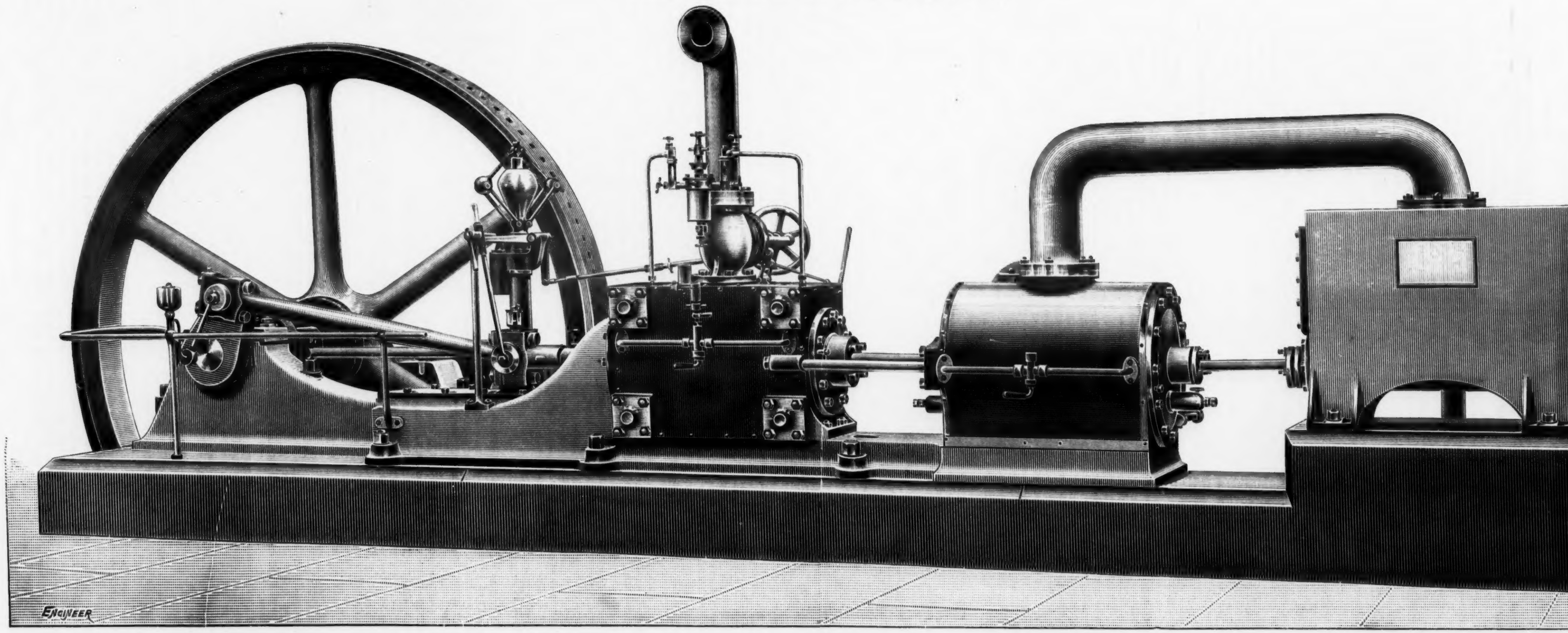


FIG. C

# HORIZONTAL COMPOUND MILL ENGINE

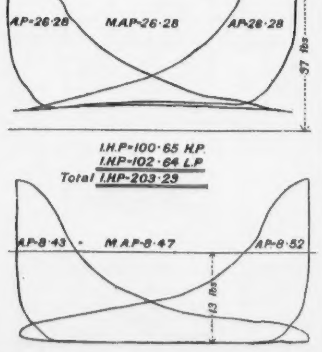
MESSRS. VICTOR COATES AND CO., BELFAST, ENGINEERS



## COMPOUND MILL ENGINES.

The engine illustrated on page 426 has a high-pressure cylinder 18in. diameter, and a low-pressure cylinder 32in. diameter, each 3ft. stroke, and is designed to indicate 350-horse power when running at ninety revolutions with 100 lb. boiler. Both cylinders are fitted with Corliss valves to steam and exhaust, the steam valves being actuated by Dobson's cut-off motion, that on the high-pressure cylinder being controlled automatically by governors, the cut-off on the low-pressure cylinder being regulated by hand so as to equalise the power on each crank. The Corliss valves have their spindles at right angles to the crank shaft, the cylinders being bolted together with a receiver between them; the high-pressure cylinder exhausting directly into this receiver, and the low-pressure cylinder taking its steam directly from it without having to pass through the usual connecting pipes, which, Messrs. Coates hold, cause an undue loss by wire-drawing and cooling the steam.

The double-throw crank shaft is built of steel, the body and pins being 8in. diameter. The pulley shaft is also of steel, and has bearings 9in. by 18in. All the main bearings of the crank shaft are lined with white metal, the bushes being made with round backs for easy withdrawal. The crank pin ends of the connecting-rods are of cast steel lined with white metal. The crossheads are guided by large slippers lined with white metal, and arranged for easy inspection without dismounting the guide slips or crosshead. Metallic packing is fitted to both piston-rods, and also to all the valve spindle stems. This packing is a great improvement as compared with fibrous packing, as the friction and resistance to the spindles turning being constant, lighter springs can be used in the dashpots. The air pump is worked off the crosshead of the high-pressure engine, and is placed sufficiently above the floor to permit of easy examination of the valves and bucket. The governor is of the quick-speed Porter type, driven by bevel wheels off the end of the crank shaft. The rope pulley is 12ft. diameter, grooved for ten 1¾in. ropes. The sides are sheeted with pitch pine, and spur teeth are cast on the circumference for engagement with the teeth of the automatic barring engine. The cylinders are covered with composition, felt, and planished blue steel, and fitted with the usual indicator and drain cocks and escape valves, and lubricated by means of double sight-feed lubricator, one pipe being taken to each cylinder. The main stop valve is fitted with a pilot valve in the centre to reduce the pressure required for opening it. We give herewith a set of diagrams taken from this type of engine when driving 200-horse power. These diagrams are, it will be seen, very good; the low-pressure being exceptionally excellent.



The horizontal tandem engine, illustrated above, 100 indicated horse-power, has a high-pressure cylinder 12in. diameter by 24in. stroke, fitted with Corliss valves, actuated by Dobson's cut-off motion and controlled directly by governor. The low-pressure cylinder is 20in. diameter by 24in. stroke, fitted with an ordinary D slide valve. The governor is of the quick-speed Porter type, driven by two ⅝in. ropes off a pulley on the crank shaft. The air pump is double-acting, with a barrel lined with brass, and having a brass bucket and rod, worked by a prolongation of the piston-rod. The suction and delivery valves are of india-rubber and of large area for working at quick speeds, usually 100 revolutions per minute. The framing is arranged for a slipper guide, and the crank shaft bearing has vertical and horizontal adjustment, and is lined with white metal. The fly-wheel is usually made for rope driving, and is then 10ft. in diameter, with six grooves for 1¼in. diameter ropes. The cylinders are neatly covered with blue sheet steel, and are fitted with the usual indicator cocks, &c., and oiled by means of sight-feed lubricator. These engines are made from standard patterns of 200, 300, 400, and 500-horse power, and have a vertical or horizontal air pump as required.

---

Admiral of the Fleet Sir Thomas Symonds.—We regret to have to announce that Admiral of the Fleet, Sir Thomas Matthew Charles Symonds, G.C.B., died on Wednesday evening at Torquay. He was second son of Sir William Symonds, who died a rear-admiral in 1856, in his 75th year, was born on July 15th, 1813. Sir William Symonds was himself the distinguished son of a distinguished naval officer, Captain Thomas Symonds, who died in 1793; but Sir William is best remembered in the service as having filled from 1832 to 1847 the office of Surveyor to the Navy. In the early part of the present reign his ships were by all nations regarded as triumphs of naval construction, and the Columbine, 18; Pantaloon, 10; Snake, 16; Vestal, 26; and Vernon, 50, served as types of vessels which long remained favourites for their sailing qualities and seaworthiness. His son, Thomas Matthew Charles, entered the Navy in 1825, passed his examination in 1831, and was made a lieutenant on November 5th, 1832. In October, 1837, he was promoted to the rank of commander. In November, 1860, he became a rear-admiral, and in 1862 was made admiral-superintendent at Devonport, with his flag in the Indus. In 1867 he was made a K.C.B., having in the previous year risen to vice-admiral's rank; and in 1868 he was given command of the Channel Squadron. An admiral's good service pension, which he held for rather over nine years, was conferred upon him in 1870; and in 1871 he reached full admiral's rank. His last command was as port admiral at Devonport, where he served from 1875 to 1878, with his flag in the Royal Adelaide. Seven months after relinquishing this office Sir Thomas was, on June 15th, 1879, promoted to be admiral of the fleet; and less than a year later he was made a G.C.B. Sir Thomas Symonds used to take the greatest interest in the development of the navy, and was always a warm advocate for the increase of the fleet, concerning which he addressed numerous letters to the columns of The Engineer.

The Water Supply of London.—The average daily supply of water delivered by the London companies from the Thames during the month of September was 105,954,467 gallons; from the Lee, 45,278,547 gallons; from springs and wells, 36,465,576 gallons; from ponds at Hampstead and Highgate, 4575 gallons. The last is used for non-domestic purposes only. The daily total was, therefore, 187,703,165 gallons for a population estimated at 5,465,957, representing a daily consumption per head of 34·34 gallons for all purposes.

# LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

## GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—I am afraid it is only since he saw Mr. Kuhne's illustrations that your correspondent's—Mr. Cameron—gear, has become free from the defect peculiar to single valve triple expansion apparatus, in which the valve lifters are closely confined by a bridle on the valve stem, for, although he now shows in his sketch the bridle as being lengthened, as in the latest Proell apparatus, it is only a week or two since I noticed in the *Mechanical World* an illustration of his gear, and that showed the bridle on the valve stem as closely confining the valve lifters. Nevertheless, as we cannot have the assurance that the defect never existed in his gear, we may take it for granted that the difference between the illustration I mention and the sketch he sent indicates that it will not exist in future.
JAS. DUNLOP.

240, Wallgate, Wigan, November 12th.

## BICYCLE MECHANICAL ENGINEERING.

SIR,—In an article relating to the Boudard gear for cycles—appearing in your issue of the 19th ult.—after a description of the mechanism it is remarked, "Why these additions are to make the propulsion of a bicycle easier is not shown." With your kind permission I should like to make the suggestion that a possible reason for this is, that in your illustrative diagram the chain wheel on the driver hub is shown as smaller than that on the crank bracket, while the reverse arrangement would be the correct one. In the machines I have seen, the former had ten teeth and the latter eight only. It is perhaps this arrangement that gives the Boudard gear its chief advantage. I should much like, however, to be permitted to point out several advantages which, I think, are to be obtained by the adoption of the principle of gearing up the bracket chain wheel.

The introduction of this principle permits of a larger chain wheel being mounted upon the hub of the driving wheel, without involving an abnormal increase in the size of that upon the crank bracket. It increases the rate of travel of the driving chain, but reduces the strain upon it in inverse proportion; with the important resultant advantage that the pressure upon bearings and consequent friction due to application of the driving power is thereby greatly reduced. The accompanying diagrams represent a machine with a 28in. driving wheel geared to 70in. The chain wheels are of 1in. pitch. In Fig. 1 the chain wheel mounted upon the driver hub has eight teeth and gears by chain with a 20-tooth wheel fast to the crank axle according to the usual method. In Fig. 2 a 16-tooth wheel is mounted upon the driver hub, gearing with one of the same size fast to a spindle running on the crank bracket, which, however, is by means of a suitable arrangement of gearing, made to revolve 2·5 times per revolution of crank. In the former case—Fig. 1—we have the chain moving slowly and subject to a considerable strain, while in the latter—Fig. 2—the chain travels twice as rapidly, but is subject to only half the strain.

Fig 1.

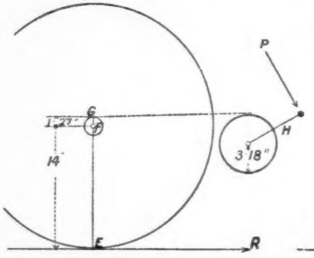


Fig 2.

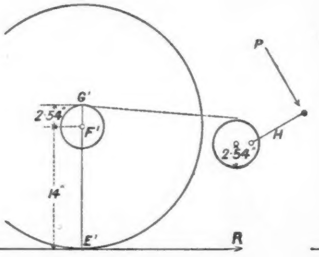
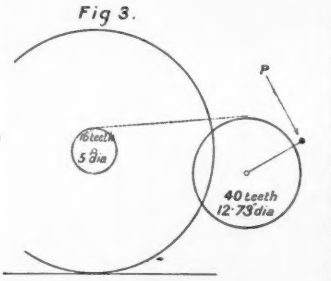


Fig 3.



Without going fully into the theory of the distribution of the driving strain, it may briefly be observed that—with a given power applied to crank H—the length of lever arm F G—Fig. 1—being 1·27in., the radius of 8-tooth wheel, and that of $F^1 G^1$—Fig. 2—2·54in., the radius of 16-tooth wheel, and the other arms E F and $E^1 F^1$ the same in each case, the pressure upon the fulcrum F—Fig. 1—will be twice as great as that upon $F^1$—Fig. 2. The strain upon the bracket bearings will also be less in Fig. 2, as the geared-up chain wheel has in effect forty teeth, and a radius of 6·36in., as compared with the 20-tooth bracket wheel in Fig. 1, with a radius of 3·18in.

Of course, against this advantage of the geared-up bracket wheel there has to be set the unavoidable friction caused by the additional working parts, but if the mechanism is simple in design, well made, and fitted with ball bearings throughout, the friction due to it will be but little compared with the important reduction of friction elsewhere that has been referred to. When it is considered what has been accomplished on the geared front driver and also on the Boudard—although the latter is by no means all that could be wished—it must be evident that the friction due to gearing up need not be very serious.

Your correspondent "J. G. H.," in your issue of 26th ult., suggests that the same advantage possessed by the Boudard gear may be obtained by making the ordinary plain gear wheels larger, but to obtain the advantage of a 16-tooth wheel or driver by this means, one of forty teeth and as large as 12·73in. in diameter would be required on the crank axle, as shown in Fig 3. The smaller the ungeared crank chain wheel is made, the smaller must be the chain wheel on the driver, and the greater the frictional pressure upon bearings.

Another advantage of the system under consideration is that the increased velocity of chain and chain wheels causes a continuity of momentum when the machine is under weigh, producing an effect similar to that of a fly-wheel. This is admitted by all who have tried the Boudard gear, including adverse critics. It is found that a machine fitted with the gear can be driven up a short incline with less effort—when under weigh—than a machine fitted with the ordinary chain gear. That it has a steadying and regulating effect upon the pace is undeniable. It has also been found that the chain runs better on equal sized wheels, if not made too small, than upon wheels of unequal size; less slack being required to ensure easy running. Another minor advantage is that the larger rear wheel permits of the more satisfactory fitting of a protecting case for the chain.

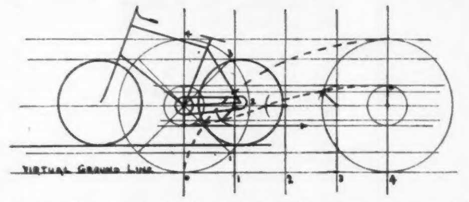
It is true, no doubt, that in bicycle construction, simplicity and fewness of parts are of very great importance; yet the simplest form or most direct method may not perhaps always prove the most efficient. If this were so, the front driver ungeared high bicycle would not have been superseded by the chain driven machine. The latter, however, although more complicated, is now the universal pattern, while the former has become practically obsolete.

I have little doubt that the Boudard gear, although in itself rather unsatisfactory, will prove to be the forerunner of an important innovation. While admitting, however, the merit of the principle involved in the Boudard patent, it is impossible to approve of all that is being put forward in support of it. In the prospectus of the company the opinion is given that the patent "establishes a monopoly commanding the whole trade, and laying every manufacturer under tribute," but this is altogether a preposterous claim, as it is pretty certain that whatever effective advantage is possessed by the Boudard gear may equally well be obtained by other arrangements of mechanism essentially different from those described in Boudard's specification. Already many designs have been produced, and among them it is very probable more than one will be found to be superior to the Boudard. An opportunity will, no doubt, be had of inspecting these at the forthcoming Cycle Trade Exhibitions at the Royal Agricultural Hall and the Crystal Palace.
RECORD.

Manchester, Nov. 10th.

## A BICYCLE PROBLEM.

SIR,—In reply to Mr. J. Harbottle's question in your issue of the 9th inst., the machine would move to the right, *i.e.*, backwards, in the direction of the motive force, the pedal revolving in a right-hand direction round its hub, but actually describing a prolate



cycloid with reference to the ground. This can be easily verified by experiment.
MARS.

Birkenhead, November 12th.

[We have received a large number of solutions, about one-half intended to prove that the bicycle will go forward. The other half that it will move backward. The preceding letter, however, covers the whole ground, and is correct. Whether the cord be pulled forward or backward, the bicycle will move in the direction of the pull.—ED. E ]

## LABOUR AND LUXURIES.

SIR,—I think it possible that your correspondents will find most of their objections dealt with in my letter of last week. In reply to "R. G. B." concerning Italy, I am not aware that I have said anything which applies specially to that country; I always have thought that its trouble was due, not to want of distributive powers, but to the want of gold to distribute. There is a very heavy debt, the interest on which is paid in gold; and it is credibly stated that nearly all the gold that goes into the country is taken there by tourists, and is sent out again to pay the interest. I have never said that gold sent out of a country can do the country good. That is entirely opposed to my view, which is, that the more gold there is in a country—I do not mean money, but gold—the better off and the more prosperous it will be. I am quite aware that this is not the view of many eminent political economists; but I think the whole progress of events, since the great Australian and Californian discoveries, proves its soundness.

Italy, like all agricultural countries, is poor; but I think your correspondent will admit that she is not so badly off as Spain which country does not maintain a costly army or navy. As to the reason why such a country as Italy is poor, I reply that it is partly because she has no manufactures, and no coal worth speaking about; and partly it is due to the national character. All Southern European countries are poor—Spain, Portugal, Sardinia, Italy, Greece, and Turkey—although the conditions as regards debt, armaments, &c., are widely different. But all this has really nothing to do with the functions of gold, as I have defined them. As to the wool corner in Australia, I have not heard that anyone in this country was injured by it, and I know that the whole affair was extremely popular with the wool growers of Australia, who profited by it considerably. Your correspondent fails to see that a rise in the price of a commodity must benefit someone. If, for example, he were engaged in trade, making steam engines, let us say, I take it that he would not object to a rise in the price of steam engines.
Y. X.

November 14th.

SIR,—So long as "Y. X." expects to find in the facts of business the simplicity of his unreal hypotheses, he is likely to mistake complexity for confusion. Gold has no economic powers whatever apart from human actions and desires. In what primer is this theory to be found?

He is "content with the assertion that as long as a sovereign changes hands often enough and quickly enough, the reason for the change matters nothing." Matters nothing to the gold perhaps, except for wear and tear; but to the community the reason for the change is the one material fact, not ethically or sentimentally, but economically; that is as affecting the production and distribution of wealth. Take his own favourite instance—robbery—it is notorious that production is hindered by the prevalence of robbery; that the more briskly gold passes from hand to hand by robbery, the less will be the production, and the less the total wealth of the community. Thus, on his chosen ground, the circulation of gold is not necessarily an economic benefit.

His answer to the question, "How can the production of more gold encourage trade?" might be instructive if he made it clear how, if at all, the case would be altered by supposing that A. finds in his rivulet not gold but platinum.

The best, if an undesigned, reply to his whole argument, and especially to his last paragraph, is to be found in Mr. John Inglis' most able address, printed on page 368 of your number for October 26th. It is not, however, simple.
W. A. S. B.

November 13th.

## THE THEORY OF THE STEAM ENGINE.

SIR,—Professor Smith's letter in your last issue is of an unfortunate type. I fail to see that he has given me any reason to withdraw any statement I have intentionally made. I find, however, that I have credited myself in your issue of the 2nd instant with the statement that "Clausius bases his exposition of Carnot's theory on the postulate that heat cannot be transferred from a hotter to a colder body without the expenditure of an equivalent in work." The adjectives hotter and colder are, of course, here transposed, as is sufficiently obvious to any reader of ordinary acumen from the context. Professor Smith's letters utterly fail to convey any idea of value to my mind. He is completely in error in asserting that I impute to him that he "undervalues Carnot's work." I have simply asserted that "I have no sympathy with those who undervalue Carnot's work," and here I am assuredly within my right. I note also that he stumbles awkwardly over the significance of the signature appended to a letter from a gentleman writing from Soho. "Ttaw" is simply "Watt" written backwards, whereas Professor Smith will, I have no doubt, have very much amused that versatile gentleman, by supposing him to have "hiccoughed" over a signature intended to represent a letter of the Greek alphabet not uncommonly used to denote absolute temperature. He does not himself, however, scruple to misquote "Ttaw" as well as your humble servant.
HENRY CHERRY.

Putney, S.W., November 9th.

SIR,—At various times engineers have written to THE ENGINEER combating views expressed by physicists and professors, and now at last after years it seems that the truth is going to prevail. On our side we now have Professor Smith and Professor Alexander, and I have good hope that we shall add to the list.

Thermodynamics have been complicated and invested with much mystery by ingenious mathematicians, who have drawn various deductions from more or less imaginary postulates and assumptions. Carnot's theorem, divested of all its enwrappings, simply means this: It is impossible to get any substance to do work in a heat engine without raising the temperature of the substance. After the substance has done work, it will still have a higher temperature than it had to begin with. In order that the substance may be used over and over again, its temperature must be reduced to its pristine temperature. This represents a loss. This loss bears a definite relation to the whole heat communicated to the working substance. It is entirely independent of the nature of the substance. The efficiency depends entirely on the difference between the highest and lowest temperatures encountered in the cycle. These propositions, instead of stating a universal truth, state a truth which has only a limited application, for a reason, which, with your permission, I wish to place before your readers.

In the first place, then, the proposition that the efficiency of a heat engine is independent of the nature of the working substance is untrue, because it takes no cognisance of the internal work done in the substance, which varies with the substance.

Clerk-Maxwell invented for a particular purpose certain intelligent little demons. I shall venture to use these demons to make my meaning clear.

In a cylinder with a piston are collected some thousands of demons; they are fairly quiet. Heat is applied to the cylinder, and they, not wishing to be roasted, try to get out. To do this they push the piston, which they regard as a door, and they exert all their energies in this way, and do all the work in their power on the piston. In another cylinder, I have, however, another lot of demons, who are as quarrelsome as the first were peaceable. When the fire is lighted, instead of devoting all their energies to pushing the door, they begin to fight fiercely with each other. Black eyes, and broken heads, and dislocated tails abound. Their energy is wasted on this strife, and the piston is not pushed with much force. We have here a homely but satisfactory illustration of the effect of internal work. Now, in the steam engine the internal work expended in making the fluid steam is enormous, and never can be utilised, and in like manner various other fluids, liquids, and solids might be named, all of which will give different results on the application of heat, depending on the amount of internal work done.

In order that Carnot's theorem may apply, it is clear that the rise in temperature of the working substance, brought about by the application of heat, must bear a definite relation to the quantity of heat supplied. Temperature admits of being used as a factor of efficiency, only because it is supposed to represent a definite quantity of heat, the proportion of which E available for work is represented by $\frac{T-t}{T} = E$. Temperature is, of course, merely a quality, and not a thing in the sense that heat is a "thing." It is supposed, as I have said, to be a measure of the quantity of the "thing" present. Double the temperature in a given weight of gas, double the "quantity of heat," and so on, but when we come to deal with such fluids as water, ether, petroleum, chloroform, &c., we soon find that temperature does not represent the quantity of the thing heat, and accordingly Carnot's theorem does not apply; and it is by no means certain that a reversible heat engine, such as Carnot devised, represents the maximum work that can be got out of a given quantity of heat, as measured in terms of $\frac{T-t}{T}$. Indeed, I have already shown that a steam engine working within normal limits of temperature may be actually twice as efficient as Carnot's theorem would make it appear to be.

I fear it will be said that I am going over old ground; but I cannot help thinking that some serious improvement in the teaching of thermodynamics is impending, and I would promote the good work by pegging away. So far no one has attempted to say that I have said that which is unsound, and now I have two professors on my side, so that great possibilities open up.

I know very little about gas engines, but I strongly suspect that their efficiency is higher than it would appear to be indicated by the temperature range in them. This is a point on which light might with great advantage be thrown by those who, like Mr. Dugald Clerk, Mr. Dowson, or Mr. Atkinson, have given the subject careful thought. I am credibly informed, indeed, that those engines in which the temperature ranges are least are the most economical. The question is, it seems to me, one of much importance for users of gas engines, and might be thrashed out with advantage. I think a satisfactory theory of the gas engine is wanted just as much as a theory of the steam engine. If I am not misinformed, Professor Smith has devoted recently a great deal of consideration to the subject. Perhaps he will say whether it is or is not true that the economical efficiency of the gas engine, other things being equal, is not much affected by the temperature range.
MAURICE CROSS.

November 12th.

SIR,—The problem of perpetual motion should present no difficulties to Mr. Haig. He evidently does not believe in the maxim *ex nihilo nil fit*. As, however, many thermodynamicians recommend the adoption of 500 lb. pressure, it may be of interest to practical engineers to know the difference between the maximum theoretical efficiency attainable with 150 lb. and 500 lb. boiler pressure calculated on the data and assumptions described in my letter of November 6th. Assuming the feed-water to be raised by the regenerator to 200 deg., the minimum weight of coal per hour in the case of 150 lb. pressure is 1·5 lb. per indicated horse-power. For steam of 500 lb. indicated pressure the temperature is about 470 deg., and $E = \cdot294$, and the theoretical work done by the steam $= 3\cdot1 \times \cdot294$-horse power $= \cdot91$-horse power; at 150 lb. pressure 1 lb. of coal will evaporate 7 lb. of water, and at 500 lb. pressure 6·3 lb. The work done in overcoming back pressure will be equal to $\frac{\cdot05 \times 6\cdot3}{7}$ horse-power $= \cdot045$-horse power, and the maximum attainable indicated horse-power per pound of coal ·865 indicated horse-power, or 1·16 lb. of coal per indicated horse-power per hour. With a pressure of 500 lb. there would have to be several more cylinders to bring the final pressure down to 7 lb. And we have to set against this theoretical gain in indicated efficiency—(1) Greater losses by conduction of heat; (2) diminished boiler efficiency, the rate of conduction of heat from the gases of combustion would be less, and more heat would pass up the chimney; (3) greater machinery friction. Brake horse-power, not indicated horse-power, is the true test of the efficiency of a steam engine. It is to increased boiler efficiency that we must look for increased efficiency in steam installations, not to increased pressures.
WILLIAM DONALDSON.

November 12th.

SIR,—It is taught, and no doubt properly, that for a perfect gas $p v t$ = a constant. If a gas expands without doing work $t$

remains unchanged, but $p$ and $v$ alter, their product remaining constant.

If, now, a gas is heated while expanding and doing no work, $v$ changes at a known rate, and both $p$ and $t$ will be augmented. Will any reader tell me how much? I have failed to find a formula which will apply; indeed, it seems that the problem has been entirely overlooked, and yet it is one of very great importance. Under no other conditions can heat be applied to a gas without doing work. LEX.

Batley, November 12th.

SIR,—In the third line of the last paragraph of my letter to you of 3rd inst., there occurs a misprint in the omission of the word "not" between the words "did" and "write."

ROBERT H. SMITH.

Mason College, Birmingham, November 10th.

### TRACTION ENGINES.

SIR,—I trust your able article championing the extended use of "Steam on Common Roads" will be the means of initiating a powerful combination of traction engine owners and makers, whose object shall be to get the present Highway Acts considerably improved. The fact of the Board of Trade having in hand the subject of light railways makes this an opportune time for taking up the matter in an energetic manner. What is, in my opinion, most necessary to develope or extend the use of traction engines, is for the Government to issue an universal licence—the money paid for such to be used as you suggest—which permits an engine to be used upon any public road in Great Britain, instead of as at present allowing local authorities to issue special licences for engines working in their respective areas or boundaries. This multiplicity of licences almost prohibits a traction engine from hauling for long distances, as every time it enters another borough or county the owner must take out a fresh licence, or is liable to be hauled up before a bench of magistrates, who as a rule have no affection for traction engines.

The above is only one grievance out of a great number, and I trust you will kindly allow your valuable paper to be the medium of exposing others and suggesting remedies. I. H. M.

Leeds, November 8th.

SIR,—As a user of traction engines, I feel that the thanks of all traction engine owners should be given you for the excellent article in your issue of November 2nd. At the same time I would like to point out one or two errors. First, the general impression that it is necessary for a man to walk in front of an engine carrying a red flag. This part of the Road Locomotive Act has been repealed, and it is not now necessary to carry a flag. This error is so general that I have known a case where an engine owner has been compelled to pay an extortionate claim where the judge would not believe this part of the Act had been repealed. Then again, the idea of stopping an engine over ten tons weight would mean preventing heavy haulage, such as large boilers, &c.; why in the interest of the roads should only a ten-ton engine be used, when, say, a thirty-ton load has to travel—surely what will carry the load will carry the engine.

I cannot see why it should be such a very difficult matter to get amendments to the Act, which should allow traction engine hauling to be conducted in the same manner as any other legitimate business, and not to be continually under police supervision. Town Councils do not seem to have much trouble in getting the Local Government Board to sanction most unjust bye-laws, which prevent the free use of "steam on the road."

Steam has revolutionised navigation, manufactures, and passenger traffic overland. There can be no doubt that if steam was only allowed, as your correspondent "I. W. B." says, "fair play and no favour," it would very soon do the same on our highways. Steam traction even under present restrictions is too powerful to be swept out of existence. I think that traction engine owners and makers should not be satisfied with any Act which did not abolish all restrictions as to working hours and mechanical arrangements, so long as weights and width of engine complied with the Act. I do not hesitate in saying that the steel cross bars on driving wheels have done more to retard the use of traction engines in towns than all other reasons put together. It is not an unusual sight to see an engine trying to travel on greasy pavement and utterly incapable of progressing, but sliding first to one side of the road and then to the other, to the danger of passers-by, alarming horses, and stopping the general traffic, so causing a real nuisance. If this can be prevented by using any improved wheel, then it becomes the duty of our lawmakers to legalise such improvement. I would suggest that for heavy traffic a speed of four miles an hour should not be exceeded, which is quite fast enough for heavy haulage. With suitable regulations there would be no necessity for more light railways and objectionable steel rails on the road. Properly-designed traction engines and wagons could be made to meet all requirements for cheap transport over long or short distances. I would propose that no restrictions as to time in which an engine might travel could be obtained by any authority, and that a licence fee of, say, £20 per annum be paid to Government for each engine used for hauling, and £5 per annum for each agricultural engine used only for agricultural purposes, this licence to permit travelling on any road in the kingdom and exonerating its owner from any claim for alleged damage to roads or bridges—the application for this licence to be accompanied by a report from a boiler insurance company, certifying the safe working condition of the boiler.

In Lancashire and Yorkshire the county hours allowed for working are the same, in Cheshire the hours are fixed for the whole year, you may travel in winter up to 7 p.m., then cross a bridge into Lancashire, and find you are two hours after stopping time in that county. Then in many of the county boroughs the sanction of the Local Government Board has been obtained to stop engines travelling in the daytime, as though workshops, factories, railways, &c., were kept open all night receiving and delivering goods, under the mistaken idea that horses and drivers who are alarmed at traction engines in the daytime are not at night. I think the Local Government Board before sanctioning "bye-laws" such as one County Borough has in force, viz., that under no circumstances, no matter how heavy a load may be, will two engines be allowed to work together—I know that one engine being overloaded will do more damage to streets than two engines will do working lightly—should submit them to some practical committee, who would also consider the men whose working hours are doubled by a stoppage of eight hours a day. This is hardly "up to date," when shorter working hours are being adopted in all trades and Government works.

It is pleasant to read in your last issue a letter from a "County Surveyor," saying that good roads will stand traction engine traffic, but surely he must be trying to amuse your readers when he speaks of stopping engines when fox-hunters are about. I am sorry the awnings on engines frighten Gloucestershire horses, as they do not in other counties, and the difficulty about the oil can easily be got over by adding to it some sweet-smelling perfume. I am glad that he can see that a suitable engine with proper driving wheels will cause the opposition to die out. TRACTION.

SIR,—Will you allow me a small space to reply to the letter of Mr. Robert Phillips, which appeared in your issue of the 9th inst. Mr. Phillips admits that the wear of the road in fair average repair, due to traction engine traffic, is nominal; in fact, as stated in your leading article a few weeks since, there is less damage done in hauling a given weight than would be caused by horse traffic, provided the engines are not excessively loaded; so that the objection to traction engines upon these grounds cannot have much foundation.

The remainder of his letter abounds in contradictions. Whilst professing to sympathise with the unfortunate agriculturist, he proposes an additional tax in the shape of a licence upon thrashing engines, the greater part of which must ultimately be paid by farmers hiring them, in the shape of an increased rate of hire. He also proposes prohibiting their use at all upon certain roads, and as a county surveyor is an autocrat upon all questions affecting highway bye-laws, the effect of this would probably be that many farmers would be unable to employ a traction engine for thrashing purposes at all.

I do not agree with the reason he gives for the difference shown by horses between meeting a steam roller and an ordinary traction engine. The horse is an intelligent animal, but I must confess I can hardly think he has discrimination enough to distinguish between a clean engine and a dirty one. The cheap oils so much used now are principally mineral, and are almost devoid of smell, much more so than the more expensive animal oils when heated by the boiler. The true reason is that the motion of a steam roller is not visible, and if the Legislature were to insist upon a circular plate to cover the spokes of the fly-wheel, and side plates mounted upon the barrel of the boiler to hide the motion of traction engines, I do not think owners would object to the small cost of these alterations.

As to Mr. Phillips' statement that he would not let traction engines run when fox-hunters are about, would it not be better to stop all trains in the district instead, as they are infinitely more dangerous to hounds than all the traction engines in the country would be? I should recommend him to study the fable of the boys and the frogs. The case against traction engines lies in a nutshell. Gentlemen often drive out with raw or imperfectly broken horses, and these naturally object to pass an engine. I have driven an engine many hundreds of miles upon the road, and my experience is that in the great majority of cases the driver is more afraid to pass than the horse is.

Traction engine owners simply ask the privilege accorded to other traders of carrying on their business without the persecution which has been dealt out to them in some counties, and if the law at present will enable the highway authorities to ruin any engine owner, it is only in accordance with English sense of justice that such alterations should be made in the Locomotive Acts as will prevent this.

AN AGRICULTURAL ENGINE OWNER.

Norwich, November 12th.

### THE INVENTOR OF THE BLOCK SYSTEM.

SIR,—I think the following extract from Mr. Edwin Clark's report of March, 1854, to Mr. Huish, will show that although the permissive block system was eventually adopted as sufficient for the then traffic on the North-Western, still my uncle described an absolute block system very much the same as that at present in use. LYONEL CLARK.

November 13th.

[Extract from Letter to Captain Huish, March, 1854.]

"The following would be the details of such a system:—The line should be divided into convenient sections the length of each section being from one mile to five miles, according to the traffic. In most cases the signal stations would be at the existing railway stations, and under the control of the station-master. Each station should be provided with a semaphore, and with two telegraphic instruments, one of which is devoted exclusively to the section of line on the up side of the station, and the other to the section of line on the down side. They are exactly similar in construction; we will therefore confine our attention to one of them. It has two dials and needles, with corresponding handles, and upon each dial are engraved the words 'Line Blocked' or 'Line Clear.' Both of these dials are in connection with an instrument in the next up station, which we will call A, our own station being termed B, and the next down station C. One of the dials indicates to the signalmen at A the condition of the line between him and B. If the line is clear, B keeps the needle permanently blocked over to the right, and if at this time a train approaches A, he does not hesitate to let it pass on to the next section towards B. Immediately, however, that he has done so, he gains the attention of B by vibrating the needle, and indicates that a train has passed on to his section—distinguishing it if necessary by an appropriate signal, as an express train, or goods, or ballast train. On receiving this B immediately changes his needle over to the left or 'Line Blocked,' thus indicating to A that his signals have been correctly understood. When the train approaches B he again reverses his needle to the right, informing A that the line is clear; he at the same time perceives, by the indication of the needle belonging to C, that the next succeeding portion of the line is clear, and allows the train to proceed onwards without interruption, but at the same time calls C, and having signalled the progress of the train towards him, does not rest till he perceives that C has changed his needle over to the left of 'Line Blocked.' In like manner a train approaching on the up line of rails has its way prepared before it, and the line closed behind it until it has reached the next station."

SIR,—The Norwich and Yarmouth single line of railway was worked on Mr. Cooke's—Cooke and Wheatstone—system of absolute block before 1845. It was on that line, and in that year, I commenced my telegraph life. By his method one could see at any station in what section the train was running. The plan was abandoned because of its great cost, except for tunnels. In 1846 Claycross tunnel on the Midland, among others, was signalled on Cooke's system. No second train was allowed to enter till the tunnel was clear.

Mr. Little is perfectly correct in his description of Edwin Clark's method. Though Cooke invented the telegraphic block, it is to Clark we owe the adoption of a general system of train signalling. His permissive method introduced, as it were, the thin end of the wedge by merely warning the drivers; had he proposed to stop the trains altogether, he would have so greatly alarmed the railway world as to lose all chance of success. R. S. CULLEY.

Weston-super-Mare, November 12th.

SIR,—I have read with much surprise the letter of Mr. C. J. Little—page 405—contradicting the statements relating to the late Mr. Edwin Clark, which appeared in your article—page 367. In 1853 Mr. Clark introduced on the London and North-Western Railway "block" instruments, having three positions "line clear," "train on line," and "line blocked." The absolute block system as used on the North-Western and other lines to-day, *is* the very same three-position system as introduced by Mr. Clark, and one of the original instruments used in 1854 at Crick station is still preserved at South Kensington Museum. It is quite absurd for Mr. Little to claim the invention in 1865, for I can myself well remember the absolute block long before that date, and it has been in use for certainly forty-one years on the London and North-Western Railway. CLEMENT E. STRETTON.

Saxe-Coburg House, Leicester, November 9th.

[We can publish no more letters on this subject.—ED. E.]

### LOCOMOTIVES, TRAINS, AND BRAKES.

SIR,—The letter from Mr. Edward J. M. Davies, in your issue of November 9th, is very interesting indeed, and as it touches on railway brakes, which are the most important preventatives of loss of life and property, perhaps you will allow me to point out that he has made a fundamental error in his calculations as to the distance the train of the Northallerton smash would have run—before being stopped by the brakes—at a speed of sixty miles an hour—assuming the mode of applying the brakes to have been theoretically correct, *i.e.*, just short of skidding, dry rails, &c.

He starts by assuming that every wheel of the coaches on this train was braked, whereas the East Coast Joint Stock being six-wheeled, only four out of six wheels can be braked, so that only two-thirds of the thirteen six-wheelers were braked, or only 112$\frac{2}{3}$ tons out of 169 tons. I take his weight for the carriages, but the East Coast Joint Stock weighs 14 tons.

The Pullman being on bogies was all braked, so 25 tons was correct for it, and taking his figure of 81 tons of braked weight on the engines, we have:—Thirteen six-wheelers = 112$\frac{2}{3}$ tons; one Pullman = 25 tons; two engines = 81 tons; total, 218$\frac{2}{3}$ tons; and the weight of the train being 356 tons, we have only 218$\frac{2}{3}$ tons braked out of 356 tons, against Mr. Davies' 275 tons; or 61·26 per cent. against his 77·24. In these days of high speeds and crowded main lines, it would seem imperative that all coaches should be built on bogies—either eight-wheelers or twelve-wheelers, certainly the latter for express trains—in order that every wheel may be braked, and stops made in the shortest possible time in case of danger. Mr. Davies gives only 50 per cent. of the engines and tenders as braked, but surely this is wrong, as the drivers and all the tender wheels are braked, leaving only the bogie or leading wheel unbraked. I should think this meant 80 per cent. of engine and tender braked.

It would be of great interest if Mr. Davies would take the above corrected percentage of braked weight on the Northallerton train and show (1) how far it would have travelled after the full application at 60 miles an hour, (2) how far if the coaches had been all bogies and so braked on every wheel, and (3) how far if it had been braked on all the wheels, including the leading wheel of the one engine and the bogie wheels of the other, *i.e.*, 100 per cent. braked.

I think Mr. Davies lays too much stress on a possible jar which might be caused by having the engine wheels all braked, as I never heard of this before, and they certainly do not suffer from such in America, where they are, for reasons of safety, braking the bogie wheels of their largest locomotives; and even if one were pitched on to the person opposite it would not matter so long as a collision was averted or lessened by a quick and fully applied brake force on every wheel.

In my letter which you printed last week the compositor has altered my "G.S.W.R." into "G.S. and W.R." twice over; it is the Glasgow and South-Western, which is, like the Caledonian, building nothing but eight-wheel bogie coaches.

I hope "Scrutator" will extract from Mr. Bowles some light on the mysterious Mr. Macdonell locomotive with water pick-up.

NORMAN D. MACDONALD.

November 12th.

SIR,—Referring to my letter on the above in your last week's issue, I notice that through inadvertence the quantities 11·6 and 15—as values of ($x$)—in the latter part of the letter, was stated as tons; they should have been per cent. Although it does not affect the subsequent working, I thought it best to call attention to this. EDWARD J. M. DAVIES.

24, Harrington-square, London, N.W.,
November 13th.

### THE UTILISATION AND PURIFICATION OF SEWAGE.

SIR,—Your current article on the above subject represents the view I trust that Parliament will take in considering the proposed Rivers Pollution Bill, which the president of the recent Sanitary Congress informs us will probably be passed at an early date, and that such legislation is required is abundantly proved by the facts given in THE ENGINEER.

To one or two of the chief facts permit a brief reference and endeavour to show how the difficulties of our present sewage procedure originate and, I believe, may be overcome, basing the belief partly on actual experience in support of the central fact connected with sewage and the soil, at the same time taking it for granted that under "normal conditions" the bacteriological system, which in nature operates through sewage in the air, the water, and soil, works in ordered sequence and design, and that any reversal or retardation of the normal course modifies the function and effect in a like degree. On this basis the cause of failure in sewage procedure become apparent, whilst the remedy required is open to demonstration by simple means, taking the normal function we know to operate on organic matter in water, sewage, and soil as affording the proof required.

Taking the definition of function from Mr. Warrington, F.R.S., we have two distinct orders of bacteria operating on soil—the one fixes the ammonia and lives on bicarbonates and converts them to nitrites, the other oxidises the nitrites to nitrates, the food of plants. Now, Sir, if sewage is taken—previous to putrefactive ferment setting in—and is thoroughly aerified and sufficient time allowed for bacteriological settlement, analysis of the effluent will exhibit almost equal proportions of bicarbonates and nitrites as organic matter or constituents wholly in accord with the function described, and I suggest the fact exhibits a sequence in function, in water, and soil. On the other hand, sewage either during or after putrefactive ferment subjected to the process named exhibits totally different conditions. Therefore, I suggest the facts named—which are open to demonstration—go far to prove that by adopting a sewage procedure of preventing putrefactive ferment in sewage—sewers—which is wholly feasible, we may remove the chief difficulty of purifying effluent sewage on the land for unlimited periods, whilst ensuring its utilisation for plant life to the maximum degree, while as regards the more solid matter the bulk and its cost would be reduced at least two-thirds compared with either a chemical or other method of production. But, Sir, there is another aspect of sewage which is, I suggest, of infinitely greater moment to populations than any question of utilising or purifying sewage, that is the ever-increasing organic pollution of the air. Cause and remedy in this case I believe to be involved in the cause and remedy already described; that is to say, by insuring normal conditions in sewers—which is possible only by continuous destruction of the volatile elements of sewage—we at the same time ensure a normal bacteriological function in the air just as much as in water and soil.

In conclusion, I believe the essential facts involved are open to demonstration in the widest sense, and as THE ENGINEER points out, both European nations and America also have already deemed the mere purification of sewage a question of sufficient importance for State experiment, and I beg to suggest our own Government might well endeavour to solve the problems involved in sewage pollution of the atmosphere, the water, and soil.

Sheffield, November 12th. HILL HARTLAND.

SIR,—Your leader on "Sewage Purification" has attracted my attention, and in reply to your criticisms as to chemical purification, I have pleasure in handing you herewith the chemical report of Mr. L. Vuaflart, and the microbiological report of Dr. Billet, relating to experiments they made at the Exhibition of Boulogne with my installation for the treatment of sewage by polarite.

As you will see, the experiments were carried out with the greatest care, and the results prove that polarite is a wonderful purifying agent; if in certain installations in England polarite only clarifies, but does not purify, as you say, the blame lies with the designer of the works or the management, and not with the material.

On page 10 of Mr. Vuaflart's report, he concludes as follows:—(1) That the effluent was at all times limpid and odourless; (2) that the effluent remained without alteration for at least fifteen days; (3) that in addition to the organic matter in suspension, from 84 to 88 per cent. of that in solution was removed; while Dr. Billet concludes thus:—(1) Crude sewage, 5,250,000 microbes per cent. cube; (2) crude sewage, after precipitation by ferozone, 812,500 microbes per cent. cube; (3) crude sewage, after filtered through polarite, 42,000 microbes per cent. cube. That is to say, a little more than 99 per cent. of the microbes were removed, or 992 per 1000.

If, then, this result can be obtained in Boulogne, it can be obtained in England. Polarite will do its work in any country if properly applied.

I hope that these reports will interest you.

ANDREW HOWATSON.

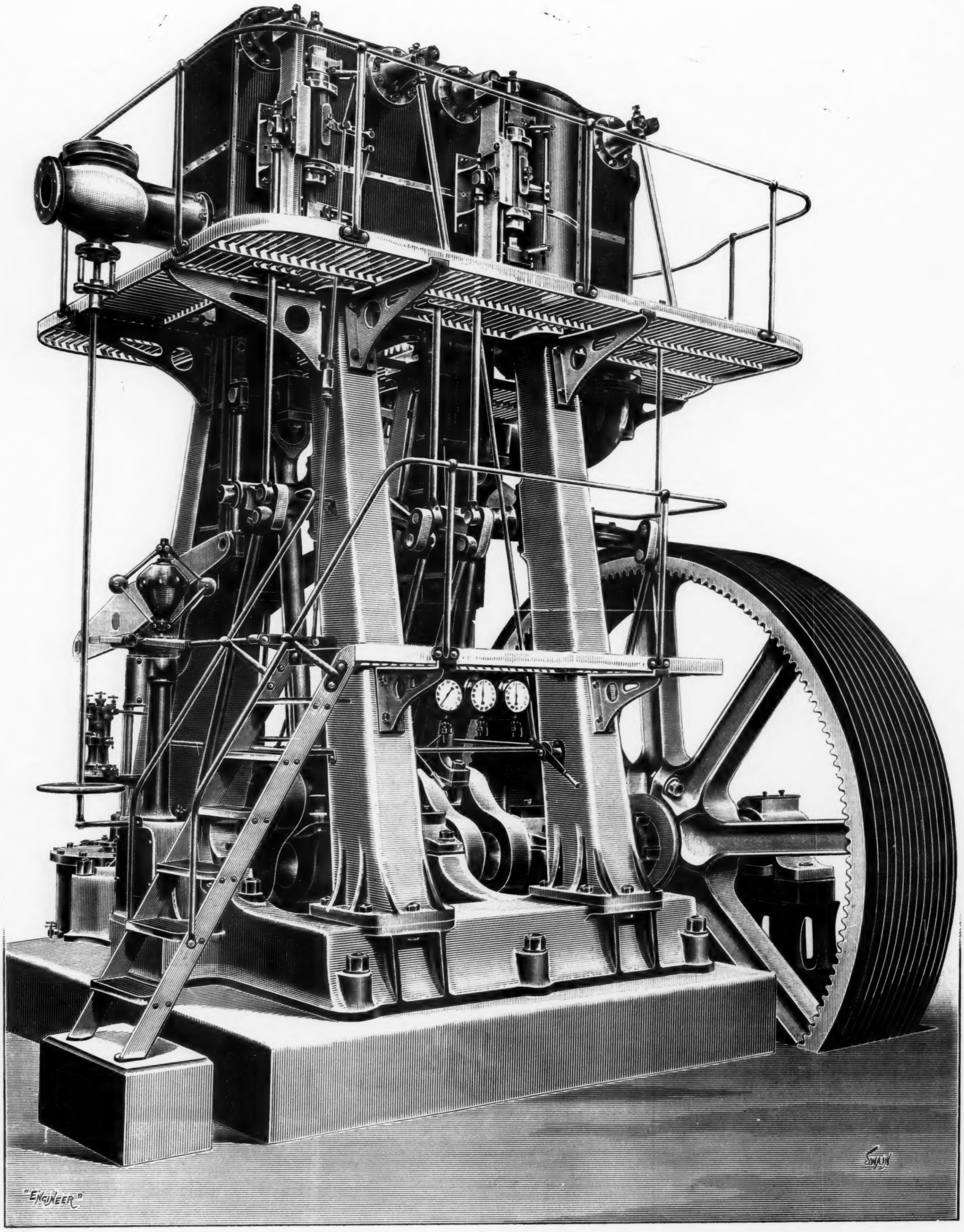
165, Avenue du Roule, Neuilly-sur-Seine, Paris,
November 13th.

(*For continuation of Letters see page* 432)

# 350-HORSE POWER COMPOUND MILL ENGINE

MESSRS. VICTOR COATES AND CO., BELFAST, ENGINEERS

(*For description see page* 423)


"ENGINEER"
SWAIN

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

**PARIS.**—Boyveau and Chevillet, *Rue de la Banque.*
**BERLIN.**—Asher and Co., 5, *Unter den Linden.*
**VIENNA.**—Gerold and Co., *Booksellers.*
**LEIPSIC.**—A. Twietmeyer, *Bookseller.*
**NEW YORK.**—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, November 16th, 1894. PAGE

The Proposed Cardiff Harbour Trust and South Wales Dock Extension. (Illustrated.) .. 417
A Curiosity in Boiler Repairing. (Illustrated.) .. 419
Proposed Railway Extension in Barbadoes .. 419
The Laundry Exhibition, Agricultural Hall .. 419
The Modern Development of the Gas Engine .. 420
Railway Matters—Notes and Memoranda—Miscellanea .. 421
Japanese War Vessels. (Illustrated.) .. 422
A Smooth Grip Pipe Wrench. (Illustrated.) .. 422
The Batchelder Lubricator. (Illustrated.) .. 422
Compound Mill Engines. (Illustrated.) .. 423
Letters to the Editor—Governing Electric Light Engines—Bicycle Mechanical Engineering—Labour and Luxuries—The Theory of the Steam Engine .. 424
Traction Engines—The Inventor of the Block System—Locomotives, Trains, and Brakes—The Utilisation and Purification of Sewage 426
Leading Articles—Light Railways for Farmers .. 427
Utilisation of the Nile—The Cyanide Case—The Sewerage Works at Paris .. 428
Improved Foreign Demand—Steel and Iron Steamers .. 429
Literature .. 429
Books Received .. 429
Leeds Association of Engineers .. 429
Manchester, Sheffield, and Lincolnshire Railway—Extension to London. (Illustrated.) .. 430
Abstracts of Consular and Diplomatic Reports .. 430
Contracts Open—Indian State Railways .. 431
Wilcox's Crank-pin Lubricator. (Illustrated.) .. 431
Legal Intelligence .. 431
Letters to the Editor—Railways and the Board of Trade—Coal Mining Explosives—English and American Locomotives in South America—The Pressure of Gases .. 432
Association of Cement Manufacturers .. 432
Cleveland Institution of Engineers .. 433
Lieut.-Colonel Barker on Explosives .. 433
London Association of Foremen Engineers and Draughtsmen .. 434
American Engineering News .. 434
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. 434
Notes from Lancashire—The Sheffield District—North of England 435
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. 436
American Notes .. 436
Launches and Trial Trips .. 437
The Patent Journal .. 437
Selected American Patents .. 438

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

G. A. H.—*The power required to propel a ship varies roughly as the cube of the speed, not as the square.*

W. D.—*You seem to have confounded pressure with work. There is no such difference as you presuppose between the efficiencies of boilers of diverse construction.*

### METALLIC PACKING.

(*To the Editor of The Engineer.*)

Sir,—Permit us to say, in reply to the letter of "Gland" *re* piston-rod packing in your last issue, the metallic packing we make being of phosphor bronze has no tendency whatever to corrode the rods, and appears to be what he alludes to. E. E. Baly.

Farringdon Works, Shoe-lane, London,
November 13th.

(*To the Editor of The Engineer.*)

Sir,—In reply to "Gland's" inquiry in last week's Engineer *re* metallic packing, if it has a tendency to corrode the rod, we would say that there are a variety of so-called metallic packings in the market, some in combination with a fibrous material, others in rings and springs to keep it in contact with the rod, so that unless "Gland" can say which packing he has in his mind, no satisfactory reply can be given. Haughton & Co.

110, Cannon-street, London, E.C.
November 14th.

### GRANITE, STONE, AND MARBLE QUARRIES.

(*To the Editor of The Engineer.*)

Sir,—In reply to a letter of "P. T. J., Burnley," I think there is no work published on the locality of any stone and marble quarries throughout the world, but there is a handbook on "Marble and Marble Workers," by Arthur Lee, published by Crosby Lockwood and Company, which gives full particulars relating to the principal marble quarries in the world. J. L. Williams.

Bristol, November 13th.

### BURY, CURTIS AND KENNEDY.

(*To the Editor of The Engineer.*)

Sir,—I am very desirous of ascertaining when the once well-known firm of Bury, Curtis and Kennedy, locomotive builders, of Liverpool, ceased to carry on business I have traced engines built by them down to 1849, but believe they built later than that. If any reader could inform me on the point through The Engineer I should be very greatly obliged. W. B. P.

Boscombe, Bournemouth,
November 12th.

## SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

| | |
|---|---|
| *Half-yearly (including double number)* .. .. | £0 14s. 6d. |
| *Yearly (including two double numbers)* .. .. | £1 9s. 0d. |

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

| | |
|---|---|
| Thin Paper Copies— | |
| *Half-yearly* .. .. | £0 18s. 0d. |
| *Yearly* .. .. | £1 16s. 0d. |
| Thick Paper Copies— | |
| *Half-yearly* .. .. | £1 0s. 8d. |
| *Yearly* .. .. | £2 0s. 6d. |

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

## ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

Newcastle-upon-Tyne Association of Students of the Institution of Civil Engineers.—Wednesday, November 21st, at the Durham College of Science, at 8 p.m. Paper: "The Irlam Section of the Manchester Ship Canal," by W. O. E. Meade-King, M. Inst. C.E.

The Institution of Junior Engineers.—Saturday, November 17th and 24th, at 2.30 and 3.30 p.m. Visit to the *Globe* newspaper printing-office and Linotype Machine Installation, &c., 367, Strand.

The Institution of Electrical Engineers.—Thursday, November 22nd, at 8 p.m. Paper: "Electrical Steep Grade Traction in Europe," by Charles S. du Riche Preller, M.A., Ph.D., member; "Notes on Electric Tramways in the United States and Canada," by H. D. Wilkinson, member; "Electric Traction, with Special Reference to the Installation of Elevated Conductors," by R. W. Blackwell, foreign member, and Philip Dawson, associate. Discussion.

North of England Institute of Mining and Mechanical Engineers.—Saturday, November 24th, at the Wood Memorial Hall, Newcastle-on-Tyne, at 2 p.m. General meeting.

Royal Meteorological Society.—Wednesday, November 21st, at 7.30 p.m. Papers: "Methods of Determining the Influence of Springs on the Temperature of a River, as illustrated by the Thames and its Tributaries," by H. B. Guppy, M.B.; "Some Effects of the Gale in the Highlands of Scotland on November 17th and 18th, 1893," by Eric S. Bruce, M.A., F.R. Met. Soc.; "History of a Waterspout," by Alfred B. Wollaston.

North-east Coast Institution of Engineers and Shipbuilders.—Saturday November 17th, at 6 p.m. Paper: "A Brief Outline of the Theory of the Rolling of Ships," by Mr. Andrew Young.

Society of Arts.—Wednesday, November 21st, at 8 p.m. First ordinary meeting. Opening address of Major-General Sir John Donnelly, K.C.B., Chairman of the Council.

The Institution of Mining and Metallurgy, London.—Wednesday, November 21st, in the Lecture Theatre of the Geological Museum, Jermyn-street, S.W., at 8 p.m. Paper: "The Practical Operation of the Cyanide Process on the Witwatersrand—Transvaal—Goldfield," by Mr. Manuel Eissler, member.

# THE ENGINEER.

*NOVEMBER* 16, 1894.

## LIGHT RAILWAYS FOR FARMERS.

History repeats itself. The "battle of the gauges," fought a quarter of a century since, seems in a fair way to be repeated. It is but yesterday, so to speak, that the Board of Trade issued a circular on which we have already commented, and the columns of the daily press are full of articles, correspondence, calculations, arguments, concerning light railways. We are told what they should be and what they should not be; how much they ought to cost and ought not to cost. The advice given would be bewildering if anyone paid the least attention to it. The latest development of the controversy is the use of light railways for the purpose of pulling down the House of Lords. They are to afford admirable political capital for the next Parliamentary campaign. They are to keep people in the country instead of glutting the towns. Engineers and others possessing common sense and some knowledge of railways are disposed to put their hands to their ears and fly from the nonsensical turmoil; but flight in this fashion is not consistent with the discharge of duty. It is well that someone should speak with authority and recall the world to its senses. It is proper that someone should insist on the truth that light railways are not heaven-sent gifts, competent to perform impossibilities, but merely more or less inefficient aids to locomotion; things useful enough in their way judiciously employed, yet possessing unfortunate powers of wasting money unless their proper position in the internal economies of a country is fully appreciated. The correspondence hitherto published in this connection seems to be the work mainly, if not altogether, of individuals who have no practical knowledge of railway management. They appear in the light of more or less amiable enthusiasts when they are not utilising the light railway as political capital, or as a promising subject for company-mongering in the future. The latest idea is that parish councils should take land compulsorily, reduce the sum to be paid as compensation on the plea of betterment, and then grant a concession to a syndicate. The scheme seems worthy of those who started the South Sea Bubble. The unlimited opportunities afforded for peculation commend it to unprincipled City men. The widow and the orphan will be supplied once again with the chance of accomplishing speedy starvation. Is it not time that engineers should lift up their voices, and warn and expostulate?

There are numerous situations in which a cheap railway would do a great deal of good, but, unfortunately, the situations in which a cheap railway can be constructed are by no means plentiful. The first essential to cheapness is an easy country. The cost of the permanent way is quite a small item as compared with that of earthworks, bridges, and such like. The favourite idea with the amateur is that embankments and cuttings are unnecessary. Why not let the line go up hill and down dale? If it is urged that this convenient method of construction cannot be employed in the case of a normal railway, we are at once met with the reply, "Oh! but you see this is only a light railway." Then we have the Festiniog Railway produced in evidence of what can be done with a 2ft. gauge line. This little railway has supplied a most mischievous precedent for amateur railway makers. They steadily ignore the circumstance that the whole of the heavy traffic in slates is carried down hill; that the engines have only to haul empty wagons back from Port Madoc to Festiniog; that slates are better suited for conveyance on a narrow gauge road than any other commodity, and that the passenger service consists almost exclusively of tourists in the summer season. The Festiniog line is in no sense or way a precedent. All this has been thrashed out years and years ago, and yet we find the Festiniog line dragged once more into publicity within the last week, and there is good reason to believe that another combat will be fought over it, its merits and demerits. The truth is, that a light railway can no more comfortably traverse hill and dale than a heavy one. Both can be made to do it, but at a stiff price. Thus, to cite a very well-known case, we may take that portion of the Midland Railway which traverses Derbyshire. A light railway could have been laid through the country, say, from Ambergate to Buxton. It would have cost less per mile, but it would have been comparatively inefficient, and as a matter of fact, the reduction in the cost would have been very small. It has been proved over and over again in every country under the sun in which a railway system exists, that the cost of a road is very little affected by the gauge. It is quite true, all the same, that there are numbers of light railways in existence which have cost very much less per mile than normal lines. But this was scarcely, if at all, due to the reduction of gauge. It is obviously wholly a consequence of the inferior character of the road. The inclines are steeper, the ballasting is worse, the curves are sharper, and so on. The difference is kindred in character to that between the price of a good horse and of a small pony or donkey; and the difference would have been very much the same whether the gauge was 4ft. 8½in., or 3ft., or 2ft. 6in. About this there is really no room for dispute. Every railway contractor in the kingdom, every civil engineer versed in railway work, knows all about it. There is no longer any question. There is nothing to discuss. There is a saving due to the narrowness of the gauge, but it is scarcely worth having. Reduced to its simplest aspect, the light railway is cheap because it is inferior in every respect to the normal railway. It is not, as some folks would have the world believe, just as good, but cheaper because it carries only four persons on a seat instead of five. The gauge of a line is the least important factor in determining its cost.

But we are very far from saying that because a line is cheap and inferior it must be useless. On the contrary, a light railway may do excellent service. So patent and prominent, indeed, is this truth, that it is apt to overshadow others quite as important, but much less obtrusive. Let us ask ourselves what a railway, cheap or dear, can do? The answer is, that it can carry goods and passengers from place to place. For the moment it is unnecessary to consider the extension of light railways into the mineral districts. "Light railways for the agricultural districts" is the watchword just now. Let us ask ourselves, Do the agriculturists want them, and how will they help them? A very considerable authority on agricultural subjects, a man who not only has the agricultural interest at heart, but one who possesses a special knowledge of the subject, and is a member of the recent Royal Commission on Agricultural Depression, has already in the pages of a contemporary pointed out that farmers are by no means likely to regard the cheap railway as an unmixed blessing; and he gives numerous reasons why they should not regard them with favour. In various parts of the country, again, farmers have come forward to oppose such railways. The time has long since passed away when such protests could be put down to prejudice. The modern English farmer understands what is and is not good for him better than anyone else. The relations of the farmer and the light railway have been discussed over and over again. It has been shown that an isolated cheap railway here and there can be of no great use; that in most agricultural districts of any importance there is already an excellent railway service; that the cartage seldom much exceeds seven miles to a station; that the cheap railway could only reduce this distance in a few instances; that, even if the contrary were the case, horses would still have to be used, carts would have to be loaded and unloaded, and that the necessary saving to the farmer would be very small, if any; that the cost of haulage on a cheap railway must be greater than on a normal line, ton for ton; and that if the cheap line was used as a feeder to a main line, transhipment must take place. This latter point is one of the utmost importance. Break of gauge has ruined the narrow-gauge system everywhere, and need not be considered. But the proposal to obviate transhipment by making cheap railways to the normal gauge is now being advocated by men who obviously know nothing of the conduct of railway traffic. In the first place, if the normal gauge is retained, the slight saving in earth works secured by the adoption of the narrow gauge is at once sacrificed, while nothing is obtained in return so far as transhipment is concerned. The rolling stock of a normal road could not be used on a light railway, and the wagons suitable to the latter would be cracked up like egg shells if mixed up with those of a normal goods train. All this is old information to railway men, of course, but it is none the less necessary to reproduce it here. Many years ago we suggested in these pages the only system of applying steam to the service of the agriculturist that appears likely to meet his wants. Briefly, this scheme consisted in taking to the farmyard a wagon so constructed that it would run equally well on a light railway or on a farm road. These wagons being loaded could be collected by a traction engine, also fitted to run on either road or rail, and a train of these being made up it could be hauled along the light railway to the nearest railway station. We need not go into detail; nor need we consider whether the system would pay or not. Its merit lies in the fact that the farmer would be saved the entire cost of hauling. It is in a modified form the system of collecting now employed by many of our great railway companies.

It will perhaps be urged that we have written in condemnation of light railways and of the movement in favour of their construction. We have in a limited sense. We do not believe that light railways can confer any universal blessings on farmers or allotment-holders. But we are, on the other hand, strongly in favour of the judicious construction of cheap railways to unite considerable villages and small towns, now some miles from a railway station, with one. There is, in a word, a sphere for cheap lines in this country, and a much larger sphere in Ireland and in many of our foreign possessions. As an example of what a cheap railway may be, we would, in conclusion, direct the attention of our readers to a proposal for a railway of the kind in Barbadoes, which will be found on another page.

### UTILISATION OF THE NILE.

After all it seems that a compromise is to be effected between the engineers and archæologists on the vexed subject of Philæ. The temples are not to be drowned or removed, and yet the Assouan dam at the head of the first cataract is to be built. The daily papers of last week announced "that the reservoir at Assouan is to be constructed at a lower level than was originally proposed, and the Philæ temples are not to be submerged." Our readers will remember the hot controversy that for some little while raged over Mr. Willcocks's advocacy of a high level reservoir at this site; and his proposal that the temples should be removed piecemeal and reconstructed on an adjoining island, where they would stand well above the level of the highest floods. But nothing short of an entire abandonment of the scheme seemed to satisfy the minds of a certain section of antiquarians, who held that any interference with the crumbling monuments of past generations would be an act of unpardonable vandalism, and therefore on no account to be permitted. Neither did the proposal of Sir Benjamin Baker, the English member of the Technical Commission, who sought to overcome the difficulty by raising the buildings bodily, *in situ*, seem to meet with acceptance.

Under the pressure put upon it, the Egyptian Government seems to have been obliged to give way, but being desirous to retain the best and most economical site for a Nile reservoir, have called on their Public Works to modify the plans in such a way that the wants of Egypt, in the shape of an increased and improved water supply, are in some measure to be provided for, while her interesting relics are to be left untouched by the desecrating hands of the engineers. But we believe that this so-called compromise means in reality a complete renunciation of the proper scope of the project; for we do not read it that a site for the dam farther down the river—that is, at a lower bed-level—has been discovered, and therefore its "construction at a lower level" will mean reduced storage, and consequently a diminished supply for the agriculturists at an increased relative cost, whose interests must therefore suffer, while the State is saddled with a less remunerative scheme.

Although such are our suspicions with regard to this compromise, yet, till the new scheme is made the property of the public—that is, we suppose, after Mr. Willcocks's consultation with Sir Benjamin Baker—we cannot say how far it will affect the whole question. Important interests are at stake in the effective utilisation of the Nile, and an early solution of the problem is highly desirable in the interests of England as the responsible nation, while it is of paramount importance to the Egyptians, who are threatened at closely recurring intervals with a "low Nile" and its deplorable and ruinous consequences.

One hopeful indication of healthy action in the interests of the agricultural class is the encouraging promise of the Egyptian Minister of Finance that funds will be provided for the commencement of the work next year; so that if all goes well, the dam ought to be in progress at the close of next inundation. We confess, however, to an amount of scepticism in this matter, for referring to the plan of Philæ, published in our issue of the 2nd of March last, it appears that a reservoir whose reduced level is 105 00 will swamp the island of Philæ and its temples. At the same time we learn from Mr. Willcocks's report—page 22 of "Perennial Irrigation and Flood Protection for Egypt"—that his design at this level will hold up only 928 millions of cubic metres of water, and as the wants of Lower Egypt are estimated to be at least 1500 millions of cubic metres, we see that unless the temples are swamped the needs of even Lower Egypt cannot be fully provided for. In our opinion, if we are correct in our inferences, the whole question must be reopened, and with it, we have no doubt, will be brought well to the front that of the Wady Rayan scheme, the enthusiastic advocate of which has addressed us the letter which we published some time back, and on which we may have some remarks to make on a future occasion.

### MINE EXPLOSION RELIEF FUNDS.

The recent controversy over the distribution of the funds raised for the relief of the women and children bereaved by the Albion Colliery explosion involves questions of abiding interest in other mining districts than South Wales. It recalls to mind the fact that similar difficulties, not to say squabbles, have occurred times without number, and all over the kingdom, whenever an exceptional mining disaster has caused an extraordinary outflow of public charity. It is a sharp reminder that despite the strenuous efforts of excellent men, extending over thirty years or more, it has not yet been found possible to establish a Relief Fund which can accurately be said to rest on a permanent basis. Such a fund, it is sometimes forgotten, ought to serve two purposes. It has to provide not only for the sufferers by the great catastrophes which arouse the horror and the compassion of the country. It must make provision also for the victims of the almost daily casualties and fatalities which seem to be inseparable from mining enterprise, and which maintain a steady average of about 1000 cases per annum. The general public only hear of explosions like those of the Hartley, the Oaks, or the more recent but equally deadly calamity at the Albion pit. But the managers of the Relief Funds are subject to a constant demand for relief from the survivors of the individual sufferers from "falls of roof," small explosions, and other like perils which environ the miners' life. The ideal fund, and that alone which could be called permanent, would need to be constituted on the same actuarial calculations as a sound insurance society, with a scale of contributions sufficient to meet all conceivable risks. To mention that fact, however, is at once to suggest the difficulty which has been experienced in most former attempts to solve the problem. If the Relief Fund is formed on the scientific lines of an insurance society, the miners' subscriptions are raised to a rate which they say they cannot afford to pay; they would prefer, as thousands of them indeed prefer now, to take the risk; and the very means designed to ensure thrift would lead to a greater degree of improvidence than prevails at present.

The case of the South Wales and Monmouthshire Provident Fund, in its relation to the Albion Colliery disaster, may be taken as an illustration both of the strength and weakness of these organisations. It is essentially a friendly society as distinct from an insurance society, and for every 1s. per month paid by the collier the employer adds 3d., or 25 per cent., the money being collected at the colliery office, but the management is left in the hands of a committee elected by the men. From the balance-sheet of 1893 it appears that in its short existence of about fifteen years it has amassed a capital of £144,614, and in that year had an income of £60,572, and made disbursements of £44,636. Members' contributions amounted to £42,693, the employers' percentage to £10,383, and interest on investments to £4000. There were then on the books 617 widows, and 1103 children who received £15,223, and there were 12,000 of the "accident" class which absorbed the still larger sum of £21,558. This is not at first sight a bad record for a local society of comparatively recent growth. It might, undoubtedly, have appeared still more creditable if a larger proportion of the miners of South Wales and Monmouthshire had made themselves contributors to the fund. But there came the Albion explosion. Nearly all the men employed in the mine were subscribers. There were 135 women and 350 children to be provided for at the stipulated rate of 5s. per week for each widow, and 2s. 6d. per week for each child. There was a nominal surplus on the accounts of 1893; but £14,311 of that had been added to the invested reserve. What, under these circumstances, were the managers of the Provident Fund to do? They were morally bound to the women and children whose lost bread-winners had been for years subscribing members. They could not meet that obligation without drawing on capital and weakening the capacity of the Fund to meet other obligations. It was frankly admitted that the society, to which the mining population looked for aid in just such a crisis as this, was not in a financial position to meet the strain upon it. But close at hand, and practically as yet untouched, was a sum of over £30,000, the result of the Mansion House collection and various public subscriptions for the benefit of the destitute Albion families. The Provident Fund said it could not do without that godsend; it made claim to it; and ultimately it secured it to reinforce its own coffers. There was naturally a loud outburst of indignation in the coal valleys, and particularly among the women most affected. It was called an act of robbery, a shameful example of "grab."

It is unnecessary now to tell of the local strife, or repeat the arguments for and against the annexation of the public donation. Something like a compromise was at last effected, which, if it does not give the Albion women and children all it was claimed that the public intended for them, at least secures them an increase of their weekly doles—the 5s. becoming 7s., and the grant per child a trifle higher, according to the number of the family. But this, though it puts an end to a pitiful scramble, cannot be regarded as a settlement of the whole question. It leaves the proposition still arguable, that all the Relief Funds which claim to be permanent are shaken to their financial foundations every time a sudden and severe demand is made upon their resources, and most people will be disposed to admit that this is a highly unsatisfactory state of affairs.

### THE CYANIDE CASE.

The judgment in this case, which was heard at the end of July last, was reserved at the conclusion of the hearing, and was not delivered until Thursday, November 8th. Mr. Justice Romer's decision was in favour of the defendants, on grounds that will be dealt with in due course. The history of the case and the contentions of the parties to the suit can be succinctly stated to remedy such lapses of memory on the part of the technical reader as are inevitable after a matter has been in abeyance for more than three months.

The action was brought by the Cassel Gold Extracting Company against the Cyanide Gold Recovery Syndicate, for infringement of the former's patent. The patent is that originally granted to Messrs. MacArthur and Forrest, and is for the extraction of gold from its ores by the use of potassium cyanide. The specific infringement complained of was the employment of a process devised by Mr. Pielsticker, an experimental plant for this process having been set up by the defendants. The MacArthur-Forrest patent claims the use of potassium cyanide *per se*, whereas the Pielsticker method involves the passage of an electric current through a cyanide solution, both to aid the solution of the gold and to cause its deposition and recovery. The case at first turned largely on the question whether the extraction of gold from its ores—or from tailings—by means of potassium cyanide, was novel at the date of the plaintiff's patent. It was admitted on both sides that the solvent action of potassium cyanide upon gold was known many years prior to the patent; but it was contended by the plaintiffs that this knowledge had never previously been applied in a practical and workable form to the recovery of gold from its ores. Certain earlier patents were unearthed which had prescribed the use of potassium cyanide, but never alone and unaided either by other substances or by the application of an external force such as a current of electricity. These patents had, moreover, failed in practice. It was also admitted that potassium cyanide as used in the Pielsticker process was the main cause of obtaining the gold in a soluble form; but an experiment put forward by the defendants went to show that a somewhat larger solvent action was secured by the simultaneous passage of a current of electricity. Cross examination, however, revealed the fact that the conditions in the two trials—viz., that with and that without a current—had not been strictly identical, so that the difference observed in the result may have arisen from some other cause. With admirable common sense, Mr. Justice Romer suggested that a further comparative trial, preserving identity of condition, should be made, the Pielsticker apparatus being used first with and then without a current; and approved the employment of an expert independent of both parties to carry out the trials. It is greatly to be regretted that this crucial experiment was not performed. The evidence had been, on the showing of the Court, eminently unsatisfactory up to this point, and a decisive settlement would have been valuable for larger reasons than those concerned in the winning or losing of this particular action. When the suggestion of a comparative experiment was mooted, it was decided to complete the hearing of the evidence already available and then to arrange for the test in question, if both plaintiff and defendant would agree thereto. As the case progressed, the electrical aspect of the matter receded rapidly, and the defendants, with an excellent appreciation of the situation, decided to take their stand on the original evidence, and not to agree to the introduction of a fresh element of possible uncertainty. The event justified this course, for when judgment was given the merit of the electrical part of the Pielsticker process was left undebated, and the action was dismissed with costs against the plaintiffs, save on one particular count, in which the Court considered that the plaintiffs had been put to needless expense by the defendants. The ground on which Mr. Justice Romer based his decision was that no invention was required to discover that gold could be extracted in a practicable manner by the action of potassium cyanide upon the finely divided ore, and that the publication of previous patents embodying this principle had taken place at a date earlier than that of the patent in dispute.

As matters stand now, therefore, the use of potassium cyanide for extracting gold is open to everyone. Valid patents for particular methods of use must rest either on a special mode of applying the solvent or on some process of recovering the gold from the cyanide solution. That this is good law no impartial person who appreciates the value of Mr. Justice Romer's decisions will be disposed to question, but we doubt whether those having a technical knowledge of gold extraction, and being at the same time wholly unbiassed, will be equally unanimous as to the want of originality of the invention of Messrs. MacArthur and Forrest, owned by the plaintiff company. No one who remembers the state of technical knowledge at the time when the "cyanide process" first came before the public would have much hesitation in saying that at that date no practical importance had been attributed to the few and vague references in chemical literature to the solvent action of potassium cyanide on gold, or that the commercial extraction of gold by means of potassium cyanide was then distinctly novel. The step from the observation in the laboratory of the thinning and dissolution of a gold leaf in a solution of potassium cyanide, to the successful and remunerative treatment of thousands of tons of tailings by the same solution, is chemically microscopic, but commercially gigantic, and we submit that it is just this turning to commercial use of facts, latent or esoteric, which is the very essence of a patentable invention. At the risk of being tedious, we would insist once more on the need for expert assistance given to the Court as well as to the parties to the action in all cases in which technical matters are in dispute. The ease with which, in many patent cases, false analogies between dissimilar processes are presented and their acceptance secured, and the success with which essential identity is concealed by a judicious exhibition of irrelevant addenda, are deplorable and disheartening to all who, though having no interest in a contested case at the moment, are nevertheless but too keenly cognisant that it may be their turn next, and that however strong their true position, whether as possessors of a valuable patent or as genuine crusaders against an invalid monopoly, they have no ground for confidence that a legal decision will be in their favour. We are not concerned with individual affairs of any person or association liable to suffer from the results of unenlightened litigation, but in the general interest of the professional and industrial part of the community, we venture to say that a legal system which leaves the upshot of a technical case dependent upon the dexterity with which facts are presented or perverted, and almost wholly uninfluenced by the facts themselves, is a serious hindrance to legitimate enterprise and a direct incentive to ingenious expropriation.

◆

### THE SEWERAGE WORKS AT PARIS.

The scheme that is being carried out for diverting the sewage from the Seine to the extensive farms that have been established on the outskirts of Paris has taken another step forward in the construction of the first section of the aqueduct of Achères. As is well known, the comparative success of the sewage farm at Gennevilliers induced the Government in April, 1889, to pass a law authorising the construction of an aqueduct to Achères, where an extensive area of land has been secured with a view of disposing of the sewage which at present flows into the Seine at Clichy. The first part of this undertaking is the driving of a tunnel underneath the river at Clichy, and this has been successfully accomplished by M. J. Berlier, who undertook to carry out the work at his own risk by the system with which his name is so closely associated. The tube has been constructed 15 m. below the level of the Seine. It is made of cast iron plates bolted together, and covered inside and out with a hard cement, which effectually prevents any water finding its way into the interior. Its length is 463 m. Entrance is gained by a vertical shaft on the right bank of the river at Clichy. This shaft is 3 50 m. in diameter and 24 metres in depth. From the bottom of this the gallery penetrates through the bed of the Seine with a gradient of 7 mm. per metre, and then after describing a curve of 100 metres the tube inclines upward 80 mm. per metre to the left bank of the river at Asnières. At the point at which the gallery is driven there is no order whatever in the geological formation, and the material met with was composed chiefly of mud, running sand, flints, and conglomerates that had to be blown up with dynamite. Once through the hard soil at the entrance, it was necessary to employ divers and dredges, while the men in the tube had to work under compressed air. The system employed by M. Berlier is known in France as the bouclier system. The principle is, of course, by no means new, as it was employed by Brunel in constructing the Thames Tunnel, but M. Berlier has simplified the system and greatly increased its efficiency. The shield used under the Seine has a length of 1·20 m. and a diameter of 2·56 m., and is furnished with a cutting edge which pierces the soil as it advances. A cylindrical prolongation in the rear, of a slightly smaller diameter, serves to protect the wall of the gallery while the plates are being firmly bolted in their places. The apparatus is provided with a door to allow of the workmen digging out the tunnel to facilitate the advance of the shield. This forward movement is effected by five hydraulic presses, and when the shield has advanced a little more than 50 cm. the narrow plates are bolted together in the form of a ring. A space of about 3 mm. is left between the newly formed conduit and the outer wall, and this is filled up with cement, which is driven through apertures in the plates by air compressed to three or four atmospheres. The progress has occasionally been as much as 2·50 m. per twenty-four hours, but at times the in-flow of water and sand made the work exceedingly difficult. The success of this system under such drawbacks is the more interesting as it affords practical proof of its efficiency for constructing the Berlier tubular tramway across Paris, while at the same time it is held to offer some solution of the difficulties raised by the Municipal Council, who insist that the proposed Metropolitan railway shall be constructed without interfering with the thoroughfares in the city. The importance of the work added naturally to the brilliancy of the inaugural ceremony, which took place on Sunday. In the absence of M. Charles Dupuy, President of the Chamber, the Government was represented by M. Barthou, the Minister of Public Works, while among those present were M. Poubelle, Prefect of the Seine; M. Bechmann, chief engineer of the Paris sewerage works; and M. Berlier. The visitors descended into the tube, which had been brilliantly lighted with electricity, and decorated with garlands. A part of the tube had been left uncovered to show the manner in which it had been constructed, and the water that rushed through the orifices thus left open gave those present some idea of the difficulties that had to be met with. After they had traversed the tube the visitors ascended the other side, where a lunch had been provided, and after a number of speeches had been delivered the Order of the Chevalier of the Legion of Honour was conferred on M. Berlier, the academic palms were given to the assistant-engineer, M. Alain-Amiot, and commemorative medals were distributed among the workmen.

### IMPROVED FOREIGN DEMAND.

It is very satisfactory to notice that after many months of expectation an improvement in our export business in various metalliferous branches has taken place. It is to be hoped that this improvement—which is deducible from the October Board of Trade Returns—will prove lasting. In miscellaneous machinery, the business done during October as compared with the corresponding month of 1893, increased 6 per cent. This was mainly due to larger textile machinery orders from the Continent. As contrasted with a year ago, the exports of iron and steel for last month exhibited a slight decline in quantity, but this has been accompanied by a marked rise in value. The amount of iron and steel shipped was 241,270 tons, compared with 243,717 tons last year, which is a drop of about 1 per cent. The value of this tonnage, however, is set down at £1,750,126, as contrasted with £1,608,708, being an increase this year of about 8 per cent. The request for iron bars, angles, &c., has improved in value to the extent of 41 per cent.; wire, 9 per cent.; unwrought steel, 47 per cent.; galvanised sheets, 3 per cent.; and tin plates, 43 per cent. In consequence of the reduced duty on the latter product coming into force on October 1st, the shipments to the United States were exceptionally large, being 24,854 tons last month, against 13,816 tons for the same time in 1893. Turning to metals, we find that copper and brass have been in better demand. The former has improved by over 7 per cent. in all, unwrought copper having increased by 33 per cent., and mixed or yellow metal sheathing by 7 per cent. It is also gratifying to find that hardware and cutlery show an increase of 14 per cent., the value of October's shipments being £117,936, as against £103,035 in 1893. It is very satisfactory, after the many complaints of continental competition, to observe that our shipments of hardware last month included augmented consignments to Germany, Holland, and Belgium, while with all these countries we have done a larger business also in the past ten months than in the corresponding period last year.

### STEEL AND IRON STEAMERS.

The question of the relative liability of iron and steel steamers to accident and loss is being very keenly canvassed in the north-east and in some other parts at the present time, and the experience of some of the mutual marine insurance clubs is being analysed to see how far the popular idea of the superior safety of the steel steamer is proved. Some of the figures that have been compiled certainly go far to show that the steel steamers, whether from age or other conditions, have cost much less so far than iron ships in similar trades. For instance, one northern club had last year 427 steamers, iron and steel, insured; and the average cost of the whole of these was about £9 2s. per cent. in the case of iron steamers of a certain value, whilst that of the steel steamers of the same value was £4 8s. 5d.—a difference that is startling, but one that is verified by the experience of vessels at other values, and is also confirmed by the experience of other clubs. It is found on analysis that the difference is most remarkable in the assessment to total loss, though it is also found in cost of repairs, &c., that are needed. For instance, in one year, the cost per cent. of steel steamers was only 8s., whilst that of the iron steamers was for the same year £5 9s. 10d., and the cost for particular average is to add to this. It is possible that the youth of the steel steamers may in some degree account for this great disparity; but as most of our vessels are now being built of steel, it is evident that the average age of the iron steamers will grow greater, whilst the average age of the steel steamers will be kept down by the constant addition of fresh tonnage. The matter is one that is now exciting very great attention, because so wide a difference means that the steel steamer has in the last few years been paying a considerable part of the cost of the insurance of the older iron vessel, and this is a condition of things that is not likely to be allowed to continue very long.

## LITERATURE.

*The Incandescent Lamp and its Manufacture.* By G. S. RAM. London: Electrician Publishing Company.

*Alternate Current Transformers.* By R. W. WEEKES. London: Biggs and Co. 1894.

*Alternating Currents.* By BEDELL and CREHORE. Second edition: New York, the W. J. Johnson Company; London, Whittaker and Co.

*A Manual of Telephony.* PREECE and STUBBS. London: Whittaker and Co. 1894.

The appearance of Mr. Ram's book upon the incandescent lamp seems to be chiefly due to the expiration of the Edison master-patent for the carbon filament, and to the consequent revival of public interest in the process of manufacture. There is very little literature upon the subject, the best account hitherto being the series of articles by Mr. Swinburne which appeared some seven years ago in the *Electrician.* This book is evidently written by a thoroughly practical man, as the details of the processes are carefully described. It appears that the original method invented by Swan for the treatment of cotton threads is still unsurpassed for the manufacture of filaments, although numerous processes have been invented by others. The author follows the whole process throughout, giving careful directions for the avoidance of damage to the filaments during manufacture. No satisfactory substitute has been yet discovered for platinum, but the supply of metal appears to keep up with the demand. In the chapter describing the flashing of the filament, the author gives curves showing the effect of the flashing upon the resistance of filaments of various diameters. A very full description of glass blowing as applied to this special work is included, and much of the matter is evidently condensed from notes taken in a lamp works by the author. Exhausting is best carried on while the lamps are heated to near the softening point of glass, as whatever mercury vapour and air is left in the bulb will of course be left at a much lower tension when the lamp becomes cold. We perfectly agree with the author that a great deal of valuable time has been spent in making life tests of incandescent lamps. In most of the recorded cases no actual tests of candle-power of the lamps at various stages are reported. The work is eminently adapted as a text-book for lamp manufacturers.

The small book upon transformers, by Mr. Weekes, is intended to facilitate the design of apparatus which shall be as efficient as possible at light loads. The principal point to which attention was at first given in alternating current distribution was efficiency at full load, but with improved knowledge that is now found quite insufficient. Higher mathematics have been avoided, which, of course, necessitates the acceptance without proof of some of the well-known formulæ. Free use has been made by the author of Dr. Fleming's work, and his results are given in tabular form. The vital difference between the number of watts required by a consumer from the central station in the case of an efficient and non-efficient transformer is well brought out by numerical examples.

Perhaps the most valuable part of the book is the description, with dimensioned sketches of various types, of apparatus now in use, and well-deserved praise is accorded to the results obtained with the Westinghouse transformer. The author states that if a station were equipped solely with Hedgehog transformers, at least 40 per cent. of the plant would have to be worked continuously. He points out that if the transformers of this type be placed close together the result is a closed circuit transformer. The work should be of interest to all electricians engaged on the alternate current system.

The volume before us, by Messrs. Bedell and Crehore, is a more ambitious work than that just alluded to; the authors do not attempt to shirk a full mathematical treatment of the subject. The preface is dated from Cornell University, and the book is divided into two parts, the analytical and the graphic. In the first part the discussion of circuits containing resistance and self-induction only is taken up, and the treatment is based upon elementary principles. The case of circuits containing resistance and capacity is then dealt with, and finally the subject of circuits containing resistance, self-induction, and capacity is taken up, the same order of treatment being followed as in the previous cases. The work can only be read by persons familiar with the differential and integral calculi, and a chapter is devoted to the discussion of harmonic functions. Few transformer manufacturers have received sufficient mathematical training to make use of the book.

The manual of which Messrs. Preece and Stubbs are joint authors is one of the books in the "Specialist's Series." In November, 1888, a volume entitled "The Telephone" was brought out by Messrs. W. H. Preece and Dr. Maier, and that work is practically incorporated in the present one. This volume is of a very complete character, beginning with a historical sketch of the telephone. The construction of receivers and transmitters is then described, and wherever possible the illustrations are not mere views of the exterior, but are line drawings to scale, and the scale is noted upon each figure. References are often given to the patent specifications, so that exact details may be obtained of the claims and novelty put forward by the inventors. One of the divisions of the book contains a considerable amount of information respecting simple exchanges. This is a subject of much importance, about which little has been published in book form in this country. In Part IV. the important subject of multiple switches is dealt with, and the authors lay great stress upon the desirability for a careful study of the best methods of installing a large exchange. The latter portion of the work deals with the construction of telephone lines of the aërial, subterranean, and submarine type, and the Post-office specification is given. The divergencies between authorities on the electrical and other qualities of the standard gauges of copper wire have led the authors to entirely re-calculate the tables given in the appendix. A useful scale for the joint resistance of two conductors will be found which obviates calculation. The authors are careful to give the exact data upon which they have calculated the tables, so that the reader can be under no misapprehension. The work is certainly the most complete we have seen on the subject.

## *BOOKS RECEIVED.*

*Integral Calculus for Beginners, with an Introduction to the Study of Differential Equations.* By Joseph Edwards, M.A. London: Macmillan and Company. 1894.

*Engineers and their Triumphs. The Story of the Locomotive, the Steamship, Bridge Building, Tunnel Making.* By F. M. Holmes. London: S. W. Partridge and Company.

*A Text-book of Mechanics and Hydrostatics.* By Herbert Hancock, M.A., F.R.A.S., F.R. Met. Soc. With nearly five hundred diagrams. London: Sampson, Low, Marston, and Co. 1894.

"*Direct Calculator*" (*Ds.*) Price 6s. 6d. By M. B Cotsworth. Showing at a glance the values for all weights from 7 lb. to 1000 tons at all rates to £100 per ton. Printed by McCorquodale and Co., Leeds, and published by Crosby Lockwood and Son, London. 1894.

*Electric Lighting and Power Distribution.* An elementary manual for students preparing for the preliminary and ordinary grade examinations of the City and Guilds of London Institute. By W. Perren Maycock, M.I.E.E. 282 illustrations and diagrams. London: Whittaker and Co. 1894.

*Electric Light Installations. Vol. I.—The Management of Accumulators. Vol. II.—Apparatus. Vol. III.—Application.* A practical handbook. By Sir David Salomons, Bart., M.A. Seventh edition, revised and enlarged. With illustrations. London: Whitaker and Co., George Bell and Sons. 1893.

*The Railway and Traders' Calculator.* Showing at a glance by index all rates from the 100th part of 1d. to £5 per ton, for all weights from 1 lb. to 1000 tons, in all over 250,000 direct calculations. By M. B. Cotsworth. Second edition. Printed by McCorquodale and Co., Leeds. London: Published by Crosby Lockwood and Son. 1894.

## LEEDS ASSOCIATION OF ENGINEERS.

### COLLIERY WINDING ENGINES.

At the last monthly meeting of this Association a paper was read by Mr. J. Clark Jefferson, A.R.S.M., on "Balancing the Load on Colliery Winding Engines." The most economical and perfectly developed type of steam engine, he said, was probably the marine engine. The very opposite was the case with most winding engines, owing to their intermittent action and the great alteration in the loads. The latter drawback was due to the variation in the lengths of the coiling and uncoiling ropes during the raising of coal, necessitating, in the case of shafts of comparatively moderate depth, an engine of double the power to what would be required were the load even approximately uniform. The attempts to render it so divided themselves into two classes: First, those which aimed at an actual balancing of the weight of the rope; and secondly, those which varied the leverage of the engine during the course of the winding, to counteract the alteration due to the changing lengths of suspended rope. The former class comprised balance chains, balance weights suspended in staple pits, or hauled up and down straight or curved inclines, balance ropes, the tail rope and Koepke system. All these methods—although the balancing might be perfectly effected—possessed two disadvantages. The total weight to be moved being greater, the frictional and other resistances were increased, and the deteriorating effect on the winding rope near its junction with the cage necessitated its more frequent shortening, and reduced the life of the rope. Meinicke's system, in which the balance rope is attached to auxiliary ropes, which are wound and unwound from a separate drum on the winding axle, obviated this difficulty, but required a larger amount of rope. This objection was more apparent than real, since discarded winding ropes could be used up as auxiliaries. The alteration of leverage was effected by using conical or spiral drums instead of cylindrical ones. Some degree of compensation always took place where the load was raised by a flat rope coiled upon itself. A probable reason why conical drums had only to a slight extent been used was that the principle of designing them had not been sufficiently known. The main point in their design was not in the proportion of diameter and breadth. These might be varied within very wide limits, and still agree with the conditions of keeping the load uniform. This could only be ensured by preserving a proper ratio between the large and the small diameter of the drum, such ratio being dependent only on the respective weights of the cage, empty corves, coal, and the fully unwound rope. Mr. Jefferson gave the required rules and formula, and, by means of diagrams of mean turning effort, the effect of improper design was illustrated.

The formula giving the ratio between the large diameter $D_1$ of the drum and the small diameter D is

$$\frac{D_1}{D} = \frac{B + \sqrt{B^2 + \frac{1}{2}} + 2}{B + \sqrt{B^2 + \frac{1}{2}} - 2}$$

in which $B = 1 + \frac{W + 2C}{R}$ and W = weight of coal raised at one winding, C = the weight of the cage and empty corves, and R = the weight of one of the ropes. The best method is to determine first the smallest diameter of drum suitable for the rope, and afterwards the large diameter by the above formula. A very close approximation to the above formula is obtained by making the effective turning moment at the commencement equal to the effective turning moment at the end of one winding, viz:—

$$\tfrac{1}{2}(W + C + R)D - \tfrac{1}{2}C D_1 = \tfrac{1}{2}(W + C)D_1 - \tfrac{1}{2}(R + C)D$$

$$\text{or } \frac{D_1}{D} = \frac{W + 2C + 2R}{W + 2C}$$

The smallest diameter of the drum $D = \frac{\epsilon\,\delta}{T - t}$ when $\epsilon$ = modulus of elasticity; $\delta$ = the diameter of one of the wires; T = the maximum allowable tension per unit sectional area—which occurs where the wires are on the outside of the rope; and $t$ the mean allowable average tension of the wires. Owing to the comparatively large value of D as given by the above formula, Mr. Jefferson said it was necessary to keep the piston velocity moderate—especially in the case of comparatively shallow pits—otherwise the piston stroke became excessively large relatively to the diameter of the cylinder.

A discussion followed, in which Messrs. Atkinson, Drake, Tempest, and Hargreaves took part. A vote of thanks was accorded to the author, on the motion of Messrs. Bowers and Lupton.

The approximate statement of traffic for October on the Manchester Ship Canal gives a total tonnage of 97,784 tons and £8200 receipts. From January 1st last to Octotober the total tonnage is given as 717,967 and the total receipts as £70,694.

## MANCHESTER, SHEFFIELD, AND LINCOLNSHIRE RAILWAY.

### EXTENSION TO LONDON.

BETWEEN eleven and twelve o'clock on the morning of Wednesday, the 13th inst., a large number of gentlemen arrived at St. John's Wood Station, and inquired for Alpha-road. The majority of them came from Yorkshire, of which county they represented the commercial, fishing, colliery, railway, agricultural, municipal, and other interests; but there were also visitors from Manchester, Nottingham, and other places on the new line, including Aylesbury, near which it is to make its junction with the Metropolitan. As had already been announced, at twelve noon the Countess of Wharncliffe was to turn the first sod of the extension of the Manchester, Sheffield, and Lincolnshire line to London, and thus denote that the efforts of the directors to connect their system with the metropolis had at last been successful.

The Earl and Countess of Wharncliffe arrived on the ground at five minutes to twelve, and were received by Sir E. W. Watkin, M.P., who has happily nearly recovered from his recent severe illness. Amongst the number of well-known men who were present may be mentioned Lord George Hamilton, the Marquis of Granby, Mr. Herbert Gladstone, M.P., Mr. Broadhurst, M.P., Sir F. Seager Hunt, M.P., Mr. J. S. Forbes, Sir Frederick Bramwell, Sir George Bruce, Sir Douglas Fox, Major-General Hutchinson, R.E., and Major Marindin, R.E., of the Board of Trade.

The proceedings commenced with a special prayer by the Rev. R. H. Pigott, rector of Grendon, near Aylesbury, who alluded to the coal, fish, and farm produce which would, by the instrumentality of the new line, be supplied more cheaply and abundantly to the millions of the metropolis. He also prayed that those engaged in the construction might be preserved from danger or accident. Sir Edward Watkin then rose, and was received with great applause. He commenced by asking the Countess to accept the barrow and spade, which he presented on behalf of himself and the other directors of the Manchester, Sheffield, and Lincolnshire Railway. These are both of English oak, beautifully carved, and ornamented with silver, of which metal the blade of the spade is also formed. In speaking of the ancestors of the house of Wharncliffe, he alluded to Lady Mary Wortley Montague, who first introduced inoculation into this country. The countess then entered the space railed off in the centre, and energetically dug up a piece of turf. With the assistance of Mr. Fox's umbrella, this was deposited in the barrow, which her ladyship then wheeled to the end of a 22ft. plank, and tipped the turf out. Lord Wharncliffe, in thanking those present for attending, and Sir Edward, on Lady Wharncliffe's behalf, for his speech, and for the barrow and spade, said that he was pleased to see his old colleague there. He remarked that he had been a director of the line since 1864, and though he had not always agreed with Sir Edward, he had always esteemed him greatly, and they had worked well together. He added, that when he joined the Board, he little thought he should ever be called on to preside at an occasion like the present. The idea of connecting the line with London, and the work entailed in carrying out that project, were both to be ascribed to Sir Edward, and he felt like the man who had assumed the credit of Virgil's verse, and of whom the poet wrote:—

> "Hos ego versiculos feci, tulit alter honores."

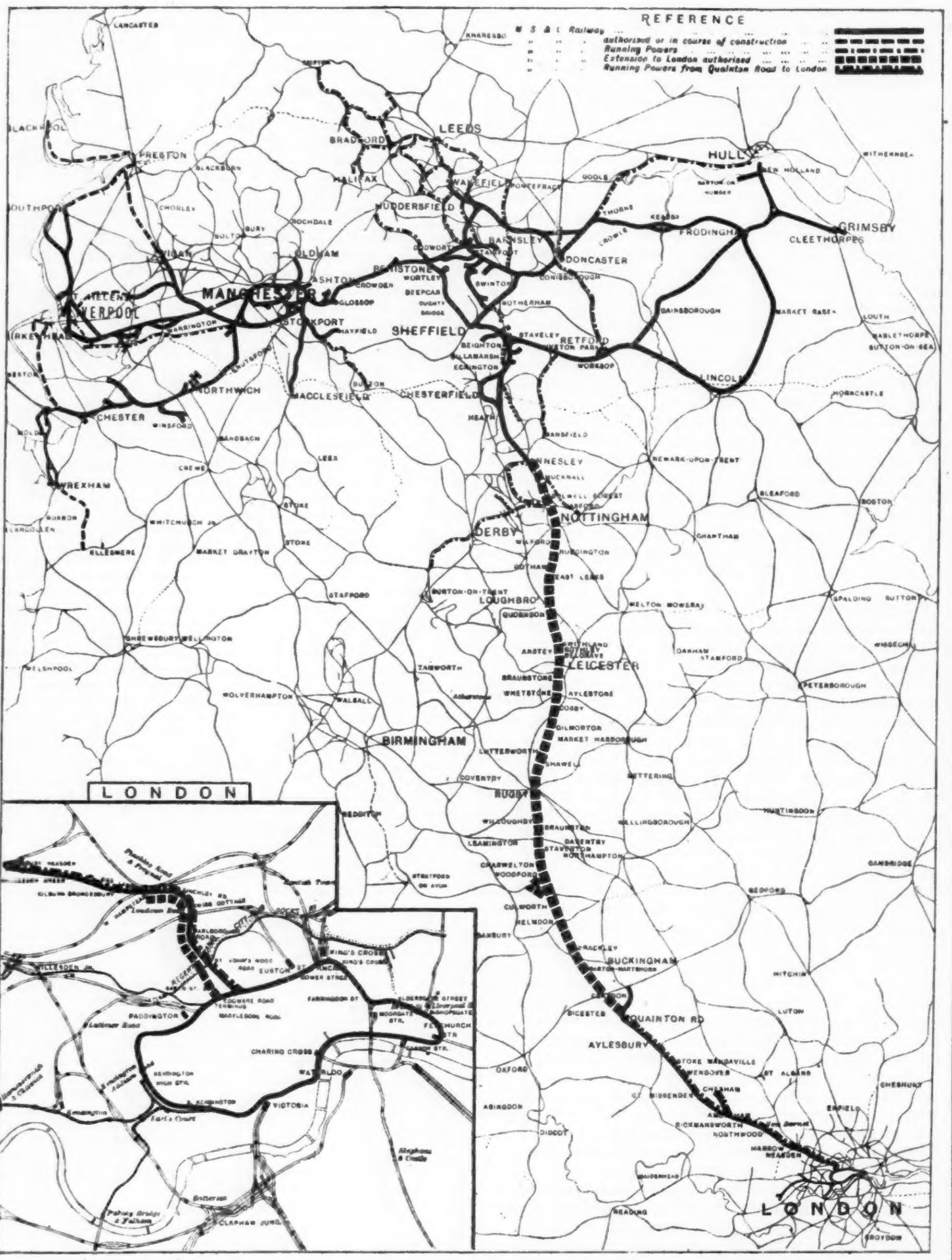
After a genial allusion to "another place," where he hoped shortly to meet all those who were present, he concluded; and that part of the ceremony terminated by the band playing "God save the Queen."

The visitors, who numbered about 500, were then driven to the new King's Hall of the Holborn Restaurant. After an elaborate banquet, and the usual loyal toasts, Lord George Hamilton proposed "Success to the New London Line." He said he doubted whether many of those present appreciated the nature, magnitude, and complexity of the difficulties that had been encountered and surmounted. Owing to the diversity of interests touched, the approach to the city had to be fought inch by inch, more after the manner of an invading army approaching a hostile capital than peaceful men in pursuit of business. He alluded to their difficulty with regard to Lords' Cricket Ground, and explained how it had been overcome to the benefit of both parties; and he pictured a Yorkshire County Eleven coming up over their line, and returning victorious as the premier county in England for cricket. He added that a railway company which could obtain a station in London received a pulsation through its system from that great heart, giving it prestige and vitality, which were felt in every part of its district.

The chairman, in replying, said that they had followed the example of the other great companies of England in extending their mileage. At present they had 355 miles of independent line, and 207 which they held jointly with other companies. The part to be constructed was 98 miles, from Annesley to Quainton-road on the Metropolitan, near Aylesbury. He then gave details of the part of their traffic which was sent up on other lines, and showed that it averaged 66 per cent., or two million tons, of which 80,000 tons was fish from Grimsby.

After the health of Lady Wharncliffe had been proposed by Sir E. Watkin, and that of the Chairman by Mr. R. D. M. Littler, Q.C., who was the leading counsel for the promotion of the Bill, there was a speech by Mr. J. S. Forbes, chairman of the London, Chatham, and Dover Railway, which was not on the printed programme. He said that this gathering was the visible manifestation of a great idea, conceived by a great man, and carried out with great tenacity of purpose. He expressed his admiration and friendship for Sir Edward Watkin, and amidst loud applause, proposed his health. The health of Mr. W. Pollitt, General Manager of the Manchester, Sheffield, and Lincolnshire Railway, terminated the proceedings.

From Annesley the new line will pass through Nottingham, Loughborough, Leicester, Lutterworth, and Rugby, to its junction at Quainton-road. From this station the Manchester, Sheffield, and Lincolnshire line have running powers over the Aylesbury branch of the Metropolitan. At a point between Wembley Park and Willesden they will branch off from the Metropolitan, and come into their independent terminus station, which is to be built near the spot on the north side of Alpha-road, where the first sod was turned. This terminus, including sidings, coal sheds, &c., will cover a space of about sixty-six acres. The contract for the new line has been divided into six sections, the time allowed for completion being two and a-half years, so that we may expect to see it finished in the course of 1897.


REFERENCE
M. S. & L. Railway
" " " authorised or in course of construction
" " " Running Powers
" " " Extension to London authorised
" " " Running Powers from Quainton Road to London
LANCASTER
KNARESBRO
LEEDS
BRADFORD
HULL
PRESTON
BLACKPOOL
SOUTHPORT
HALIFAX
WAKEFIELD
HUDDERSFIELD
GOOLE
GRIMSBY
CLEETHORPES
OLDHAM
BARNSLEY
DONCASTER
MANCHESTER
LIVERPOOL
BIRKENHEAD
STOCKPORT
SHEFFIELD
RETFORD
GAINSBOROUGH
LINCOLN
CHESTER
NORTHWICH
MACCLESFIELD
CHESTERFIELD
WREXHAM
WINSFORD
CREWE
LEEK
STOKE
STONE
WHITCHURCH JN.
ELLESMERE
MARKET DRAYTON
MANSFIELD
ANNESLEY
NEWARK-UPON-TRENT
NOTTINGHAM
DERBY
GRANTHAM
BOSTON
BURTON-ON-TRENT
LOUGHBRO
STAFFORD
SHREWSBURY
WELLINGTON
WELSHPOOL
WOLVERHAMPTON
WALSALL
TAMWORTH
LEICESTER
MELTON MOWBRAY
OAKHAM
STAMFORD
PETERBOROUGH
SPALDING
WISBECH
BIRMINGHAM
LUTTERWORTH
COVENTRY
RUGBY
KETTERING
WELLINGBOROUGH
HUNTINGDON
LEAMINGTON
DAVENTRY
NORTHAMPTON
CAMBRIDGE
BEDFORD
BANBURY
BRACKLEY
BUCKINGHAM
HITCHIN
BICESTER
QUAINTON RD
AYLESBURY
LUTON
OXFORD
ST ALBANS
CHESHUNT
ABINGDON
ENFIELD
RICKMANSWORTH
NORTHWOOD
HARROW
READING
LONDON
CROYDON
LONDON
WILLESDEN JN.
KILBURN
PADDINGTON
EDGWARE ROAD
EUSTON
KING'S CROSS
FARRINGDON ST
MOORGATE STR.
FENCHURCH STR.
CHARING CROSS
WATERLOO
VICTORIA
KENSINGTON HIGH STR.
S. KENSINGTON
Earl's Court
CLAPHAM JUNC.

THE MANCHESTER, SHEFFIELD, AND LINCOLN PROJECTED NEW LINE TO LONDON

## ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

*Japan: Coal in.*—In coal the Japanese are active competitors with English producers. In 1893 the export rose to 1,505,413 tons, an increase of 605,015 tons, or 67·1 per cent. over that of the previous year, while the value fell from 9s. 1¾d. to 8s. 2⅜d. per ton. Japanese coal is rapidly pushing its way westward, and is already largely used by ships coaling at Singapore. Last year about 480,000 tons of coal, and 173,000 tons of so-called coal dust were shipped to that place, Hong Kong, and British India. To this quantity must be added a large proportion shipped in steamers nominally for ships' use, but in reality for purposes of trade.

*Japan: Coal in Hiogo and Osaka.*—Last year the export of coal fell to 52,238 tons, a decrease of 5812 tons, or 10 per cent. under that of 1892, and in value from 12s. 8½d. to 9s. 11$\frac{1}{10}$d. per ton. The incalculable harm done by the recent lamentable struggle in the English coal trade has made itself felt in the Far East, and Japanese colliery owners are reaping temporary if not permanent advantages. The effects of the coal strike are felt even in Kobe, the price of Moji coal having risen considerably. Before the opening in 1888 of Moji, situated in Kiushire and opposite to Shimonoseki, Singapore was the last coaling station on the way home and the first on the way out. Until the strike English coal only was taken at Singapore, but now Japanese coal is principally supplied. The bad example set by Westerners in their manner of settling trade disputes is being followed by the Japanese, and during the past eighteen months there have been several strikes among them, one by the miners at Takashima, near Nagasaki.

*Japan: Coal in Nagasaki.*—Last year the import of Cardiff coal, solely for the use of foreign ships of war, fell to 2660 tons, a decrease of 3561 tons, or 57·25 per cent. under that of 1892, but increased in value from £1 8s. 1½d. to £1 9s. 5d. per ton. The total exports of coal from this port during the year were 381,631 tons, a decrease of 36,646 tons, or 8·75 per cent. The value fell to £156,459, a decrease of £63,834, or 29 per cent. Coal for ships' use increased by 20,651 tons, or 16·15 per cent., but decreased in value from 11s. 6¾d. to 9s. 5d. per ton. Coal other than for ships decreased by 44,943 tons, or 23·45 per cent., and in value from 10s. 2¾d. to 7s. 6⅜d. per ton. Dust coal decreased by 12,353 tons, or 12·65 per cent., and in value from 9s. 9¼d. to 7s. 2d. per ton. The net output of Takashima coal during the year was 252,320 tons, of which 127,016 tons were large, and 125,304 tons small coal. The sales were 286,784 tons, divided into 150,242 tons small, and 136,542 tons large coal. The destinations and quantities were:—

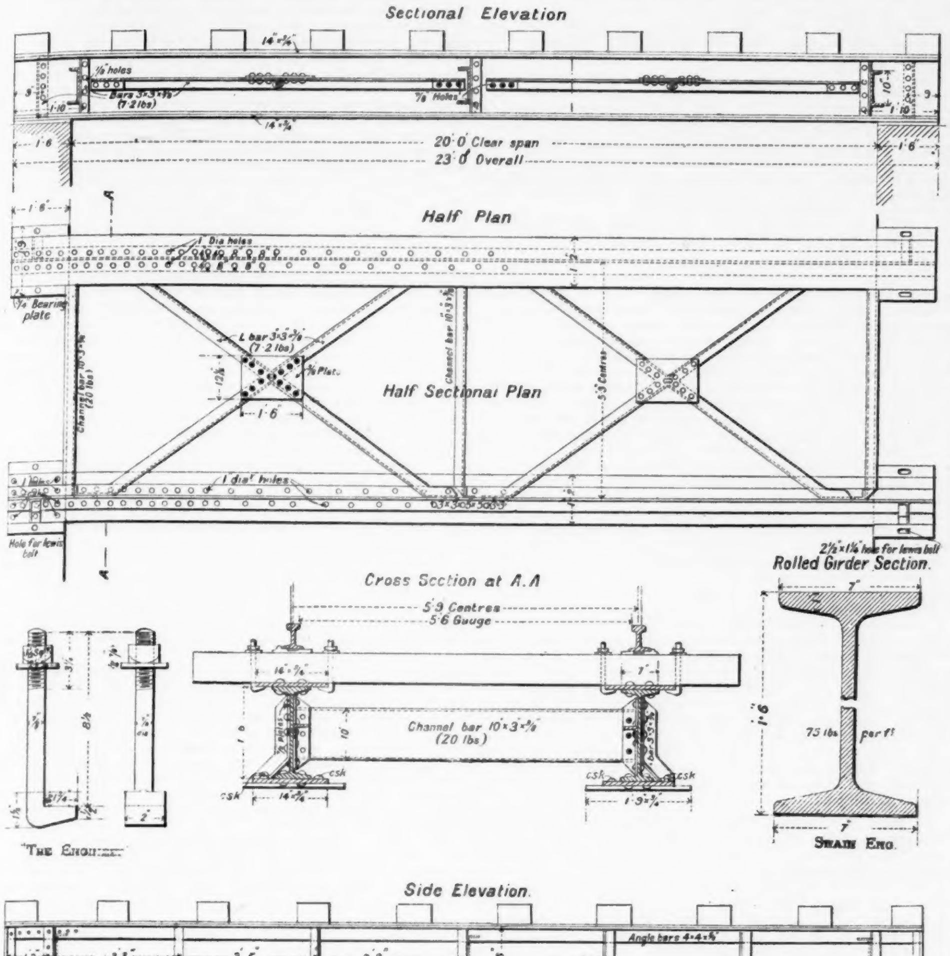
| Ports. | Quantity. | |
|---|---|---|
| | Small Coal. Tons. | Large Coal. Tons. |
| Hong Kong | 37,990 | 11,935 |
| Shanghai | 34,514 | 14,085 |
| Yokohama | 2135 | 25,175 |
| Osaka | 7001 | 584 |
| Singapore | 5270 | 11,627 |
| Three other ports | 391 | 4231 |
| Bunkersete | 62,941 | 68,925 |
| | 150,242 | 136,542 |

The stocks of Japanese coal available on December 31st, 1893, were only about 3000 tons, and through the year the mines were unable to meet the foreign demand, local shipping requirements consuming the greater part of the output. While the export of coal from this vicinity decreased, the export from the special ports rose to 990,112 tons, an increase of 281,378 tons, or 39·7 per cent., valued at 7s. 9¾d. per ton. The quantities exported from the various ports were:—Kutehrnotsu, 452,524 tons; Moji, 431,259 tons; Thimonoseti, 64,037 tons; Karatsu, 42,292 tons; total, 990,112 tons.

*China: Coal in Formosa.*—Last year the exports of coal from Tamsui and Ketung rose to 23,748 tons, an increase of 9245 tons, or 63·7 per cent. over those of 1892, but decreased in value from 12s. 2¼d. to 10s. 1½d. per ton. During the year the supply was altogether from private pits; the Government mine remaining idle, and the machinery, still *in situ*, being rusted and ruined owing to neglect, and to the water standing in the disused workings. The seams in the immediate neighbourhood of the Government mine have been — at least nominally—forbidden ground for private enterprise. Formosa coal is splendid house coal. It is also good, if smoky, steam coal, though not equal to Japanese; but it must be borne in mind that none but surface coal is available here, whereas that produced in Japan is mined from deep seams, and were mines of the same character allowed in Formosa the quality of the output would improve.

*China: Coal for Honyang Ironworks.*—Coke to the amount of 3000 tons has been ordered from Belgium to be used in smelting operations at these works. This seems somewhat curious considering that we have coal on all sides of us, but apparently none suitable for the purpose has yet been discovered, though there is said to be an abundance of the right sort in the Hunan province. The United States Consul at Hankow observes on this point:—Coal both hard and soft is mined in the neighbourhood in the crudest manner, no effort being made to drain the mines of water, which, once flooded, are abandoned and new ones opened. The coal has been pronounced by experts as not suitable for smelting, as it contains too much sulphur, but it is thought that coal of a good

## CONTRACTS OPEN—GIRDERS FOR INDIAN RAILWAYS



quality can be obtained hereafter from the mines now undeveloped. Mines of coal and iron are numerous in this section, and can be made to furnish all the material needed if mined systematically, and owing to the cheap labour obtainable they can be worked economically.

*China: Coal in Jehang.*—Last year 651 tons of soft coal were brought down from the mines in the west of this province, Hupei. None of these mines are worked scientifically, but are merely scratched in the old-fashioned Chinese manner. Hard coal is found at a place called Ching Mên Chow, about seventy miles below Jehang.

## CONTRACTS OPEN.

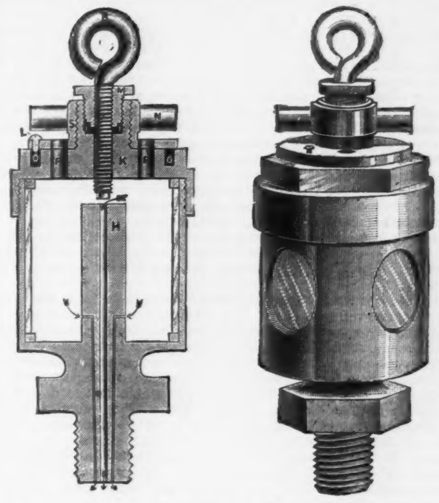
### INDIAN STATE RAILWAYS.—OUDH AND ROHILKUND RAILWAY FIVE FEET SIX INCH GAUGE.

The work required under this contract comprises the construction, supply, and delivery in England at one or more of the ports named in the tender — London, Liverpool, or Birkenhead — of the whole of the steelwork for 61 spans of 20ft. in the clear, including all bolts, rivets, &c., required to complete the erection of the bridges in India, together with an allowance for waste, &c., of 10 per cent. on the net quantity of bolts required, and 50 per cent. on the net quantity of rivets required of the proper sizes for the purpose. In addition to the above, the contractor is to supply with each span, service bolts and nuts and ordinary plater washers to be selected by the consulting engineer, for use in the erection of the work in India in the following proportions: —With each 20ft. span 28 lb. of bolts and nuts, and 14 lb. of washers. The work is shown on drawing No. A 1252, but firms are also at liberty to submit a tender for the alternative design drawing No. A 1253.

Firms tendering are to submit with their tenders the names of the makers from whom the steel for the various parts of the girders will be obtained, the character of the steel employed, *i.e.*, whether open hearth basic, or Bessemer, or open hearth acid, and the nature of the ores to be used in making it. Basic Bessemer will not be accepted, open hearth acid is preferred. Tenders are to be in by two o'clock on Tuesday, 20th November, 1894.

## WILLCOX'S CRANK-PIN LUBRICATOR.

The part H shown in Fig. 2 of the engravings illustrating this new lubricator is an easy fit in the lower part of the lubricator. When the lubricator is moved up and down as in the circular path of a crank-pin, this piece H pumps up and down by an amount which is adjustable by the screw R. Each time the piece H moves upwards through the permitted range, some oil finds its way round the stem of H and into it as indicated by the arrows, and the piece H thus acts as an induction pump. The cup is of glass, and is filled by turning the handle N, and placing holes P opposite each other in the piece K, and in the cover. It is made specially for the crank-pins of engines, pumps, &c. There is no waste of oil when the crank is standing, as the piston sits on to its seating, and thus closes the outlet. There is also no trouble in adjustment when once the screw is set, the re-filling not affecting this. The lubricator is simple and safe, and it is now being used on traction, portable, and fixed engines, and for gas and oil engines. It is made by Messrs. Willcox and Co., Southwark-street, S.E.



## LEGAL INTELLIGENCE.

### HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

*November* 10*th*, 1894.

(*Before* Mr. Justice Stirling.)

WISE *v.* THE METROPOLITAN ELECTRIC SUPPLY COMPANY.

In this case the plaintiffs had in April last obtained an injunction against the company, restraining them from carrying on their works at Manchester-street, W., so as to cause a nuisance to the plaintiffs by vibration. The operation of that injunction was, however, suspended until September 5th. It will be remembered that the defendant company have established a large electric-lighting station in the neighbourhood of Manchester-street, and the plaintiffs, who are householders and lodging-house keepers in the vicinity, complain of a nuisance caused by the vibration of the machinery. At the hearing of the action for an injunction, it was proved that such vibration did exist to a serious extent. Owing to the peculiar nature of the soil upon which the works are erected the task of prevening the vibration of the machinery from being communicated to the surrounding houses presents an engineering problem of great difficulty. At the time of the granting of the injunction the company were, under the advice of eminent engineers, endeavouring to overcome the difficulty by works intended to increase the rigidity of the bed or platform upon which the engines are rested, and, although their operations in that direction were partially successful, they do not seem to have been entirely so, for the company have, since the injunction, come to the determination to substitute for the reciprocating engines hitherto in use a new class of engines called steam turbines, which, it appears, can be used without causing any vibration. The company have accordingly removed some of their old engines to another of their stations, and have already erected one turbine and ordered two others, which, when in position, will it is hoped enable them to supply all the necessary electric energy without using any of the old class of engines. In the meanwhile, the plaintiffs alleged that, in spite of the injunction, the company have allowed the nuisance to continue, and they now moved for leave to issue a writ of sequestration against the company. A great mass of evidence was read on either side, that of the plaintiffs, as the *Times* reports, tending to show that there had been very little, if any, abatement of the nuisance, and that of the company being to the effect that, since the granting of the injunction, there had been no such vibration caused by the engines as amounted to a breach of the order, and that they had almost, if not altogether, succeeded in overcoming the engineering difficulties.

At the conclusion of the evidence on the 9th inst., his Lordship asked if the company were willing to undertake not to use more than one reciprocating engine, besides the turbines, for a period of three weeks, and, upon counsel for the company consenting to that, his Lordship said that it appeared to him, upon the evidence now presented to the Court, that if the company worked three engines of the reciprocating class a nuisance would be caused, but if they only used one there would be no such vibration as to amount to a breach of the injunction. He was anxious to be satisfied by a further experiment that that was so, and under these circumstances he should direct the motion to stand over for three weeks upon the above undertaking by the company.

The counsel appearing in the case were Mr. Hastings, Q.C., and Mr. Beaumont for the plaintiffs; Mr. Vernon Smith and Mr. Waggett for the company.

In an article on washing and conditioning wheat in *The Miller*, the writer, Mr. W. T. Bates, summarises a lengthy consideration of the different processes of machinery, saying a washer and drier is a useful auxiliary in every mill, because it enables every kind of wheat to be used to the best advantage. "Next to heat, and failing it, have a good arrangement for carefully damping any sample separately for re-cleaning, and also for damping the mixture whenever requisite. By the first process I should treat all palpably dirty wheat, such as Egyptian, Indian, Russian, River Plates—when necessary—and some kinds, like Chilian, which have mineral or stoney impurities difficult to get out by any dry process. By the latter—that is, simple damping—I should treat all other clean wheats, like North American, Australian, Californian, and any other which is likely to become pulverised in the break rolls. The degree of moisture can be regulated to their needs, and excellent results thereby obtained."

# LETTERS TO THE EDITOR.

*(Continued from page 425)*

## RAILWAYS AND THE BOARD OF TRADE.—ELECTRIC TRACTION FOR LIGHT RAILWAYS.

SIR,—I beg to express my thorough appreciation of and concurrence in the remarks in your editorial on "Railways and the Board of Trade" on page 345. While giving due credit for the good work which the Board has done in the interests of the public as far as main lines go, there is little doubt that it has most seriously retarded the construction of the less important lines which fill in, or should fill in, the spaces between the main routes. To what extent the Board and its agents—the inspectors—are limited by the railway laws as now existing, I am not able to say, and it would be worth while to have this part of the question taken up. Be this as it may, however, there is very evidently but one standard of railway construction considered by the Board, owing either to the limitations of the law, or its own limited conception of the principles of railway economics. It is as though a Government Bureau should say that any man wanting to keep a horse must keep blooded animals, and drive a carriage and pair. A few years ago, while travelling over a lightly but well-built and economically-operated railway in a thinly populated district, which railway connected an outlying small manufacturing town with a main line, I was talking with the engineer about the cost of construction and equipment. In answer to a comment upon the lightness of certain works, and the small total cost of the line, he said, "We could not afford to buy a horse, so we bought a donkey." In England, however, you must have a horse or you must walk.

It seems to me that a great deal of the trouble lies in the failure to recognise the true purpose of a railway, and to recognise the error of trying to place all railway construction on the same basis. Take roads, road vehicles, and steamships for instance. We have expensive paved streets for heavy city traffic, and cheaper macadamised roads for country traffic. Luxurious carriages convey the wealthy passenger, while the less wealthy ride in the democratic omnibus or the humble donkey cart. The magnificent fast steamers carry the first-class freight, which has perhaps been brought to Liverpool by a tub of a coasting steamer or a canal boat. So with railways, it is right enough to insist upon expensive construction, complete signal plant, &c., for main lines with fast and heavy traffic. But it is absurd to impose the same conditions upon a branch line with but few trains. If the law compels this, the sooner a new law is passed, based on a more accurate understanding of the purposes of a railway, the better, and those who are working in favour of better railway facilities should turn their energies in this direction.

As to the employment of military officers on railway work, the principle is wrong from the bottom, as experience has proved in England and India. It is the system that is wrong, not the men, who, in most cases, are no doubt conscientious and high-minded, but lack the practical experience and training which alone can fit men for such positions. Imagine a civilian—say a banker or merchant of high standing—appointed to the command of a military post. He might after a time be very well able to look after routine matters, but what sort of figure would he make in conferences as to the use of shields on light field pieces, or the advantages of bullet-proof breast-plates, or how would he handle men in the field? If, in the latter case, he moved his men always and only in the few formations he had seen on the parade ground—not understanding the importance of or being able to take advantage of local conditions—he would do no worse than the military officer who knows that certain very excellent railways are built and equipped in a certain way, and therefore decides that no railway must be operated unless built and equipped in a similar way. It is like requiring cavalrymen to wear full uniform while watering their horses or fetching forage, and having the band play an accompaniment to the work. Even the theoretical safety derived from a complete signal and block system equipment is not always obtained on the cross-country railway, for, as experience has shown in certain cases of accident, the railway companies do not feel disposed to pay wages to get the best class of men, or the men regularly and wilfully ignore the signals or orders.

A revision of the law, a revision of this one-standard system of railway construction, and a revision of the absurdly-expensive and tedious system of parliamentary procedure, are needed badly and needed at once. Supposing such revisions made, the practical possibilities of economical railways need little demonstration. Other countries have shown what can be done, and English business men, engineers, and managers can do as well if they will. But I wish to call attention to one special class of economical railway which is being developed very rapidly in this country, and that is the country electric railway. The extension of suburban railways has been a most important factor in the development of large cities, enabling the lower and middle working classes to live in healthy suburban houses instead of crowded city houses or tenement dwellings. This is even more true of the electric railway than of the suburban service on an ordinary steam railway, as the former gives a better accommodation owing to the almost constant service of cars and the greater number of stops, while high speed can easily be reached and reduced with a single car. Another special feature of such railways is their construction to outlying parks, pleasure resorts, or beaches, enabling the people to obtain pure air and new scenes for the expenditure of a few pence. In some cases, where the value of new building property will be greatly increased, the owners will give the land for the railway, which may then be operated to greater advantage than where built along the highway. Herein is matter for consideration by the public authorities and tramway companies of English cities.

In several cases suburban or interurban electric railways have been built approximately parallel with steam railways, and have absorbed a large proportion of the local traffic of the latter, owing to generally reduced fares, and to the fact that for the steam railway a man has to live up to a time-table and calculate his time to catch a certain train, while for the electric railway he knows that he has a car every few minutes. Many electric railways of this class now handle mail, parcels, and goods traffic. Mail sorting cars are run, exchanging bags with postmen at certain points. Parcels are carried in combination passenger and baggage cars, being collected and delivered at offices at the ends of the line. Farm produce, milk, &c., are brought into cities on special cars in the early morning, and at one town on the Hudson River special cars bring the milk cans from the farms to the wharf, where they are loaded on the steamer for New York city. On other lines, built as feeders, grain is hauled between the railway station and the flour mills, coal is carried—sometimes in ordinary railway cars—and raw material and finished product are carried between the railway and small manufacturing towns. Where there is much freight or goods traffic, electric locomotives are sometimes used, but otherwise motor cars are used, having motors on the axles, such cars hauling "trail cars." I know of one line, seven miles long, serving five or six suburban towns and villages, on which electric traction has been substituted for steam, ordinary tramcars being used. This line has two mail sorting cars. The construction and equipment of such lines are cheaper than for branch lines of ordinary type, while the accommodation is better, and the cost of operation usually much less. There is little objection to or difficulty with the overhead wires in country roads, and still less where the line is on its own land. Where such objection is insuperable, however, some form of independent motor operated by steam, compressed air, gas, &c.—such as the Rowan, Lamm-Francq, Mekarski, Luhrig, or other systems—may be used, the important requirements being that such motors must be light in weight, powerful, clean and noiseless, reliable, and economical in operation.

Your correspondent, Mr. Bowles, points out the uneconomical method of operating in using two engines and tenders, weighing in all 162 tons, to haul cars weighing 194 tons, and it may be of interest to give here the weights of some regular express trains in this country. The weights are net tons of 2000 lb.:—

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Weight of engine and tender, tons | 88 | 88 | 86 | 88 | 88 | 88 | 100 | 100 |
| Weight of cars .. | 222 | 292 | 432 | 237 | 309 | 320 | 475 | 321 |
| Weight of train .. | 310 | 380 | 518 | 325 | 397 | 408 | 575 | 421 |
| Speed, miles per hour .. .. .. | 49 to 55 | 35 to 60 | 43 | 45 to 57 | 40 to 60 | 40 to 73 | 40 to 60 | 47 |
| Length of run, miles | 134 | 117 | 132 | 90¾ | 90¾ | 90¾ | 440 | 148 |

Finally, to return to the first subject of this letter, I would suggest that some investigation be made to ascertain just how far the Board of Trade is limited by law, and how far by prejudice and lack of experience; and also that some steps be taken to remove obstacles in the way of *bonâ fide* projects for economical construction and operation of secondary railways.

E. E. RUSSELL TRATMAN, Assoc. Mem. Am. Soc. C.E.
Tribune Building, New York, U.S.A.,
November 1st.

SIR,—The letter which has been addressed to the Chambers of Commerce, railway companies, and other bodies interested in transport, by the Board of Trade, on the subject of light railways, should lead to serious consideration of the necessities of many country districts. As pioneers in the construction of light steam tramway locomotives, we should like to point out the advantages of steam tramways in districts now inadequately provided with railways for carrying passengers and produce to the trunk lines. Such tramways or light railways could be made at low cost, ordinary railway metals and sleepers being used, and the rolling stock would be about one-tenth the weight and cost of that used on main lines, while the speed need not exceed eight to fifteen miles per hour. Under such conditions, using covered-in tramway locomotives, there should be no objection to the lines being laid alongside country roads and through fields, there being practically no danger to ordinary road traffic. Such a line has been at work at Wantage since 1872, as a feeder to the Great Western Railway, carrying both goods and passengers. MERRYWEATHER AND SONS.

Greenwich, November 13th.

## COAL MINING EXPLOSIVES.

SIR,—Certain experiments with a German explosive named "Westfalite" were held near Wigan on the 24th ultimo, and reports of the results, signed by a committee, were published in THE ENGINEER and several other journals. The reports were accompanied by certain statements regarding Westfalite, which were no doubt based on information furnished by the syndicate which is endeavouring to introduce the explosive.

In order that your readers may form an opinion as to the accuracy of these statements, and the value of these experiments, I would ask you to be so good as to print the following paragraphs in parallel columns:—

| | |
|---|---|
| 1. Press Report. — "The Government of Saxony, who for many years prohibited the use of any kind of explosives on account of the dangerous nature of the Saxon coal mines, have made one exception in favour of Westfalite, and its use is now authorised in all coal mines in Saxony." | 1. Extract from letter from the Royal Saxon Mines Department, dated November 3rd, 1894:—"The use of explosives in the coal mines of Saxony is *not* prohibited. The explosive Westfalite has up to the present only been used *experimentally* in Saxony." |
| 2. Press Report.—"This new explosive — 'Westfalite' — has been the first to be allowed on the continental railways as ordinary cargo." | 2. German Railway Regulations for 1894, Anlage B, paragraph XXXVI., *c*—abbreviated—"Dahmenite and Westfalite are carried in tin-lined wooden cases containing 50 kilogrammes, marked and certified as to their contents." This regulation is a repetition of XXXVI., *b*, which refers to roburite, and has been in force for years. |
| 3. Committee's Report.—"No. 8 shot—16½ oz. carbonite, half cubic foot coal dust, without gas. No flame, no explosion. No. 1 shot—16½ oz. carbonite, half cubic foot coal dust, and 5 per cent. coal gas. No flame, no explosion." | 3. Report of experiments carried out by the Westfalite Company, at Sinsen, in Germany. on May 29th, 1893:—"No. 2, coal carbonite 178 grammes—less than 6 oz.—in 4 litres coal dust, without gas or benzine. Ignition, flame 15 metres long, strong charring." |
| 4. Committee's Report. — "Detonator used, No. 6 (Extract from programme, conditions of firing, paragraph 2. 'The detonator of each shot to be of the same number')." | 4. Pamphlet issued by the Westfalite Syndicate, p. 1:—"Westfalite can only be exploded with very strong detonating caps, charged with 1½ to 2 grammes of fulminate of mercury. Without these it is not an explosive." |

I would particularly draw the attention of the committee, Messrs. J. Burrows, D. H. F. Mathews, and Robert Isherwood, to paragraph 4. As they are no doubt aware, a No. 6 detonator contains only 1 gramme of fulminate of mercury. Either, therefore, the Westfalite Syndicate used a detonator which, by their own showing, was too weak to thoroughly detonate their explosive, in which case the safety tests were entirely illusory; *or* they used a detonator of a higher power, and thus violated the conditions which had been laid down by themselves, and which the committee supposed to be carried out.

H. A. KROHN,
Secretary,
The Roburite Explosives Company, Limited.
103, Cannon-street, London, E.C.

## ENGLISH AND AMERICAN LOCOMOTIVES IN SOUTH AMERICA.

SIR,—I think all who are interested—either scientifically or commercially—in the locomotive engine, must feel indebted to you for your timely article on "English and American Locomotives in the Argentine Republic," published in your issue of the 9th inst. The report of Messrs. Elordi and Esteves could perhaps scarcely fail to attract attention, in view, on the one hand, of the official position of its authors, and on the other hand, of the prompt and persistent means taken to give it the widest possible circulation. I do not mean to suggest that either of these factors ought in reality to have enhanced the document, or given it an importance beyond its mere intrinsic value, such as it is; and it is certain that, in the eyes of those competent by technical knowledge or by commercial instinct, to estimate its worth from the tone and character of its remarks, neither one or other of the two factors I have named could permanently raise it from the level of an unscientific and one-sided production, such as you have described it. In fact, it has been, I know, the frequent remark of men of sound judgment in such matters, that in their opinion both the matter of the report and the manner of its circulation partook too glaringly of a trade advertisement to warrant any serious importance being attached to it.

But I am aware that opinions differ on this point, and there is no doubt that whatever the original purpose and intention of its authors may have been in drawing up the document, it is clear that some parties, at all events, thought it would have an appreciable weight in certain quarters in influencing locomotive orders; otherwise they would hardly have gone to the expense of having it printed in pamphlet form, and sent broadcast over the globe, as I can testify to its having been sent, from information reaching me from friends in widely distant quarters of the world.

Who these are who have been distributing the pamphlet it is perhaps not difficult to imagine, although to suggest here the American locomotive makers whose name occurs to one in this connection would be unkind. At all events, it is not, I presume, the Argentine Government, for it is scarcely to be supposed that they would feel justified in spending public money in distributing it, either in the interest of science or in pushing the trade of North American locomotive builders. Nor can it be supposed that Messrs. Elordi and Esteves are so proud of their handiwork as to spend their private means lavishly for the sake of giving their offspring a world-wide circulation, because, on reflection, they must be keenly alive to the fact that their inability to distinguish between tractive power and adhesion—as exemplified in the sentence you quote, viz., "The high-pressure, 160 lb. per square inch, at which the boiler is worked, becomes necessary to overcome somewhat the lack of adhesion"—is not calculated to raise their scientific or technical reputation in the eyes of the engineering world.

So far as the English locomotive builders specially named in the report—and whose locomotives came under the dire condemnation of the authors—are concerned, I should imagine they need concern themselves but little about the matter, as judging from all I hear about the manner in which their reputation is established at home and abroad, I fancy it will take something weightier than anything Messrs. Elordi and Esteves have indicted to shake the confidence of railway men in the competence of the firm; and that this view of it is shared by the firm in question may be judged from the dignified silence they have maintained on the subject under considerable provocation.

But seeing that the American engineering press thought proper to give the report a place in their pages with laudatory comments—as though, forsooth, it were the work of some past-masters of science or of high-class locomotive experience—it seems only right in the interests of fair-play as between English and American locomotive makers, as well as in the interests of truth itself, that the occasion should be taken to criticise and dissect this remarkable document collaborated by Messrs. Elordi and Esteves.

It is to be hoped, therefore, that those who are in a position to do so will throw light on the subject. Mr. Gould is in the best of all positions to enlighten us, and I trust he may see his way to respond to your invitation. It must be remembered, however, that his official position may render it difficult for him, as one can well understand, to enter into the controversy. The Buenos Ayres Great Southern Railway Company has, as is well known, to approach the Argentine Government for concessions from time to time, for the extension or improvement of its railways; and assuming the company to be contented with the design and quality of its rolling stock as supplied to it by English makers—as we have every reason to assume it to be from the fact of its having again and again repeated it — the probability is that the railway company may regard Messrs. Elordi and Esteves' preference for American rolling stock as no concern of theirs, and continue to remain quiescent, leaving to Messrs. Elordi and Esteves a bloodless victory of words—"of sound and fury signifying nothing."

In fact, it is not improbable that it was the knowledge of this bar to a crushing rejoinder from the Buenos Ayres Great Southern Railway Company that led to what I may call the dimming of Messrs. Elordi and Esteves' official spectacles, and to the consequent one-sided treatment of the subject so characteristic of their report.

Time does not permit of my going more at length into the subject now, but, with your permission, I may have something further to say hereon on a subsequent occasion.

Manchester, Nov. 13th. VERITAS.

## THE PRESSURE OF GASES.

SIR,—When any two gases exist in a closed vessel, each exerts the same pressure as if the other was not present. Thus we might have a mixture of hydrogen and carbonic acid gas, in which the pressure of the hydrogen was 100 lb. on the square inch, and that of the carbonic acid gas 15 lb. on the square inch. Will any reader of THE ENGINEER who knows kindly tell me how this law was arrived at experimentally? I want to prove it to a class of students, but I do not know how. I cannot see how it is possible for the carbonic acid gas to have a less pressure than that of the hydrogen. I take it for granted that the total pressure will be 115 lb., and that the hydrogen will compress the carbonic acid to that pressure. How can the pressure of the two gases be measured separately? CLASS MAN.

November 13th.

# ASSOCIATION OF CEMENT MANUFACTURERS.

IN response to the circular issued by Messrs. Renshaw, Kekewich, and Smith, solicitors, of London, to which we referred last week, a meeting of cement manufacturers, which was largely attended, was held at the Cannon-street Hotel, on Monday last. An association was formed, and it was made a *sine quâ non* to membership that a statutory declaration in the following form should be made by the managing partner and resident manager of every firm desirous of joining the association:—

> I, &c. &c., do solemnly and sincerely declare that I am well acquainted with the practical manufacture of cement as carried on by the said firm or company, and that, according to the best of my knowledge, information, and belief, the said firm or company have not on any occasion during the last three years, or within my knowledge at any other time, brought to and added to the calcined product of the kiln, in passing through the crushers or mill stones or grinding machinery or any other subsequent process, a separate supply of raw Kentish rag stone, other stone, furnace or oven ashes, disused or exhausted fire bricks, or any other material, so that such added material would be ground, sifted or mixed together with the cement, and form part of the cement powder, and sent out, and sold the cement in this state. And I make this solemn declaration conscientiously believing the same to be true and by virtue of the Statutory Declarations Act, 1835.

The form of declaration was signed at once on behalf of several firms. It was clear from what passed at the meeting that adulteration on a much larger scale than was even supposed had been going on for some time at many factories.

SHEPHERD, HILL AND CO.—It is impossible, we think, to bear without regret that the contents of the Union Foundry Hunslet, Leeds, are to be sold by auction, the sale taking place on the 20th instant and following days. Probably no firm except Whitworth's has enjoyed a higher reputation than did Messrs. Shepherd, Hill and Co. for machine tools. Messrs. Wheatley Kirk, Price, and Goulty sell, be it observed, not only all the plant and tools, but the patterns, drawings, and designs of the firm, which practically means the goodwill of the business. The death of one of the principal partners a few years ago, followed lately by the sudden death of the acting manager, together with the age and increasing infirmity of the remaining partner, who has been ailing for some time, have been the main causes of the break-up. But this is not all. The last three years have been terribly bad for the machine tool trade. How bad the impending sale testifies. It is a deplorable fact that a firm which has supplied tools to the British and most of the foreign Governments, and our own railways, should have to succumb.

## CLEVELAND INSTITUTION OF ENGINEERS.

### BASIC OPEN-HEARTH STEEL FURNACES.

THE annual meeting was held at Middlesbrough on Monday evening, Mr. Charles J. Bagley—Moor Iron and Steel Works, Stockton—occupying the chair, owing to the illness of Mr. William Hawdon—Newport Ironworks, Middlesbrough—the retiring president. The Council reported that five members had been elected since last meeting.

The thirtieth annual report stated that six ordinary meetings had been held during the past year, and an excursion had been undertaken in the summer to the Middlesbrough and Stockton Corporations' Waterworks, in Baldersdale. There were 230 ordinary members of the Institution, five life members, and two honorary members—in all 237. All the retiring members of the Council had been re-elected, and Mr. F. H. Marshall—Ormsby Ironworks, Middlesbrough—had been elected a vice-president. Mr. Samuel Marston had been added to the Council. Mr. John E. Stead, Middlesbrough, had been elected president. The report was adopted, as was also the balance-sheet.

Mr. Bagley, in introducing the new President, said he was a man of world-wide reputation as an analytical chemist, and in accepting that position he conferred an honour on the Institution.

Mr. Stead, in taking the chair, said he was not that evening going to deliver an address, as he thought it would be better to give that at some other meeting, and Mr. Dawson's paper would take up the whole evening. He acknowledged the honour that had been conferred on him by his election as president, when he was not a trained engineer. As an excuse for accepting the position, he pleaded that chemistry, both theoretical and applied, was becoming more and more the useful handmaiden of the engineer, and it was very few engineering societies where the transactions did not show a good sprinkling of papers relating to chemistry applied to the arts and manufacture. He then called upon Mr. Bernard Dawson, of Malvern Link, to read his paper—of which the following is an abstract—on

### DIFFERENT TYPES OF BASIC OPEN-HEARTH STEEL FURNACES.

The author at the outset remarked that the Cleveland district owed both its past and present to the existence of the local iron ore. It would successfully compete with the West Coast of England in the production of pig iron from hematite ores, but the wisdom and policy were doubtful of continuing more and more to depend upon the importation of foreign ores. Were England to be involved in a war with countries which might easily interfere with the ready importation of hematite ores from abroad, the possibility of producing steel from Cleveland ores at a remunerative price would immediately receive considerable attention. Last year's production in the North of England of ordinary Cleveland pig iron was 1,338,043 tons, and of hematite, spiegel, and basic pig 1,336,141 tons. Deducting 260,000 tons from the latter as being basic pigs, this showed that Cleveland, with its unbounded supplies of native ores, had been making over 100,000 tons of hematite and spiegel iron entirely from ores derived from foreign sources, except perhaps a very small proportion from the West Coast, Ireland, or the Forest of Dean. Even if there were no fear of interference by a hostile foreign navy, Mr. Dawson asked whether it was not a questionable practice to comparatively ignore the local resources and seek for others afar off. To those local firms who had not only furnaces, but also ironstone mines in Cleveland, it would be worth while to think whether the most possible was being done to use these native ores. The excellencies and good qualities of basic steel had been freely admitted, and one had only to notice what the basic patents had done for Germany, to reflect whether Cleveland had benefited by them to the extent that might have been expected. In addition to British ores, there were many foreign ores available for basic working; among others the ores of Scandinavia.

The objection had been raised to the increase in the production of basic steel, that although in inland districts, such as Staffordshire, it might be possible to make basic steel where the cost of acid steel from foreign ores would be prohibitive, still the margin of difference in cost of production of a steel ingot from acid or basic materials upon the sea coast was a trifle if anything in favour of the steel made by the acid process from a hematite pig. That might be true at present, but it would be well to get particulars as to how they might best turn their attention to basic steel whenever circumstances might render it either compulsory or advisable so to do.

The author then called attention to the paper which Mr. H. H. Campbell recently read in Chicago on "Open Hearth Furnace Practice," which he said was most comprehensive and minute in its details, but devoted only a small portion to the basic side of the question, and to this branch of open hearth work he—Mr. Dawson—intended to confine himself in his present paper, to the exclusion of both ordinary acid working, and also what had been called the pseudo-basic processes, viz., those of adding lime to the charge in ordinary acid-lined furnaces, and also of melting hematite iron in the basic hearth. He would dwell chiefly upon the construction of the various furnaces in which successful basic working on the open hearth had been hitherto conducted.

In dealing with the types of basic open-hearth furnaces the author showed diagrams of a furnace of the Siemens type in use at Wärtsilä in Finland, which gave excellent results; also of a basic Siemens furnace at Ruhrort, which had comparatively flat arches to the regenerators; also of a furnace of novel design and construction at Witkowitz; also of a 10-ton furnace at Alexandrovsky Works. A diagram was exhibited of a furnace with Darby's patent basic backing—a layer of chrome ore and tar, magnesia and tar, or other carbonaceous and neutral refractory substances between the acid bricks and the metal casing.

It had been found at Brymbo that when the bricks were fluxed away, so that the layer of refractory material was reached, it had become so dense and hard that it would protect the metal casing for a sufficiently long period to considerably prolong the life of the furnace. The author showed diagrams of a 17-ton basic Siemens furnace designed by himself with a view to embody as many advantages and as few defects as might be of existing furnaces. Such a furnace had been in work for some months, and gave good results as regarded output, fuel consumption, and durability. A diagram was shown of a firebrick lining, forming a backing to the basic lining, carried right down to the bottom of the furnace. This provided for the weight of the crown being carried from the furnace bottom.

Mr. Dawson referred, at considerable length, to furnaces of the Batho type, with which, for purposes of comparison with the ordinary Siemens type, he included those of Messrs. Riley, Dick, Hilton, and Wailes. Among the advantages claimed for the Batho type of furnaces were less expense in excavations below normal ground line; weight of furnace proper and its charge not carried upon the arches of the regenerators; no danger of loss of metal through bottom of furnace into regenerators; workmen had not to stand upon plates heated by regenerators below; easy access to different parts, and consequent simplification of repairs; absence of danger from gas and air becoming mixed and burning in the vertical passages leading from regenerators to the "blocks" at each end of the furnace; the chequer work in the regenerators could be changed much more quickly and with less severe labour than in ordinary Siemens type regenerators.

It was mentioned that Mr. Riley had had a Batho furnace working for some years lined with his patent neutral lining between the acid shell and the basic—dolomite—lining. It had run usually 220 to 250 charges without any repairs other than those usual to the ends of the ports at the close of a week, and Mr. Duff's improvements for catching the droppings from the fluxed brickwork. Another improvement of Mr. Riley's had preserved the arches or crowns of the regenerators by preventing their injury by slag and dust. These had all proved very useful and of great value. The author then proceeded to show that the advantages claimed for the modifications of the Batho furnace were not so great, but he remarked that Mr. Dick's furnace and the Riley and Dick furnaces, which are on the Batho principle, gave satisfactory results, both as to time and cost of repairs, as well as convenience in working. With respect to the Hilton furnace, it would probably be found to embody the best features of the various Batho types of furnace, although it was perhaps a somewhat costly one to build. Some were of opinion that this furnace only required to be better known to be adopted, both for acid and basic working, inasmuch as the cost of maintenance per ton of steel made was only about a fifth of that of a furnace of the ordinary Siemens type. Some twelve of the Lash type of furnace had been in use at Pittsburg since 1887, of sizes varying from 15 tons to 40 tons capacity. That furnace worked quickly, was economical in labour, and was probably one of the most successful constructions of open hearth furnaces working in the United States. The best results had been obtained in that furnace with natural gas. A somewhat similar furnace was designed and patented by Mr. Thwaite some eighteen years ago. The Lash furnace proper was carried on rockers, and could be tilted by a hydraulic cylinder so that all or part of the charge could be poured out. The advantage of being able to tilt a furnace of that character was that a portion of the slag, which with all basic working was present in such large quantities, could be poured off during the working of the heat, and some economy of fuel would result, as slag being a bad conductor of heat, a thick layer of it would prevent the heat of the gas passing through the furnace being conducted as quickly into the bulk of metal as would otherwise be the case.

In treating on the sizes of furnaces, the author held that one of 20 to 25 tons was as large as would usually be found really economical, both as regarded labour and convenience of repairs. With very small furnaces, such as those of two to four tons capacity, the quantity of fuel per ton of steel cast was larger than in case of furnaces of 20 tons capacity.

Mr. Dawson then proceeded to discuss the question of materials used for building and lining basic furnaces. In England, the materials for the basic hearth and lower portion of side walls had usually been some form of limestone. In Germany dolomite bricks, but the use of magnesite bricks was extending. The Swedish practice would apparently be to use magnesite to the exclusion of anything else, were it not for the prohibitive price. Mr. Wailes had recommended the use of a lining of shrunk lime containing about 6 per cent. of small wire croppings, which were said to help to glaze the surface and bind the material together. As regarded the making of the bottom of the furnace there was indeed a multitude of counsellors. Calcined magnesite, dolomite and limestone had been used in German furnaces. Hearths of magnesite and anhydrous tar might be depended upon to give no trouble, and to last for 700 heats. The continental practice was largely that of burning in the hearth in layers, which were found to stand better than rammed ones as regarded magnesian hearths. Hearths so made might require gas in the furnace for forty to forty-eight hours to prepare them, and probably also required more care than was the case with a hearth the whole depth of which was rammed in at once. Very good work had been done in England, with magnesite, dolomite, and limestone.

The defects in the design of many open-hearth melting furnaces were referred to at considerable length. It was said that the rectangular bath or hearth of a furnace had taken the place of the circular or elliptical forms which had been tried with more or less success, both in basic and acid working, because if the outside of the furnace was circular or eilliptical, it became both awkward and expensive to brace and to tie, and if the rectangular form of the exterior were preserved, then a circular or elliptical interior meant so much less area of hearth than would be the case if the rectangular shape of the outside were adhered to with regard to the bath. Dealing with the methods of working, it was stated that no doubt a considerable time ought to be saved by pouring liquid pig iron into the open-hearth furnace, and it was to be hoped that some information would be forthcoming before long with regard to the continental practice carried out by a combination of basic Bessemer and basic open-hearth working, so that the obvious disadvantages of the present uncertainty as to the composition of the liquid metal and the extra waste and the wash and destruction of the hearth of the furnace, and also the cost of the extra plant and machinery involved, might be correctly ascertained. It was possible that a considerable reduction in the time occupied in the ordinary open-hearth basic process might possibly be made by the employment of Mr. Saniter's process to reduce the sulphur and the silicon in the charge; and that process might render it to a great extent unnecessary to require the owners of blast furnaces to make any special basic pig iron. It was admitted that the ordinary basic lining did not assist in the elimination of any great proportion of sulphur from the materials charged into the furnace. Thus it was natural to turn to Mr. Saniter's—or some other kindred process—for riddance from the finished steel of that objectionable element. Attention was called to Mr. Talbot's process for the preparation of molten pig iron for the open-hearth furnace, and to Mr. Darby's re-carburisation process. A long and interesting discussion took place on this important paper, a report of which is held over till our next issue.

---

NAVAL ENGINEER APPOINTMENTS.—The following appointments were made at the Admiralty:—Staff engineer: Charles W. Thorne, to the Abyssinia, to date November 9th. Chief engineer: Thomas C. E. Hughes, to the Indefatigable, to date November 9th. Engineers: W. R. Apps to the Bruiser, and William Onyon to the Dasher, to date November 14th; M. Sennett, to the Speedwell, Edward G. Guyatt, to the Plassy, T. H. Hutchings, to the Lapwing, and William W. Pearce, to the Rambler, to date November 9th. Assistant Engineers: W. E. Townsend, to the Devastation, and Owen A. Morris, to the Speedy, to date November 9th.

THE INSTITUTION OF CIVIL ENGINEERS.—On Tuesday evening Sir Robt. Rawlinson, K.C.B., delivered a short address, as president. He referred to the rebuilding of the greater part of the Institution House now taking place after nearly fifty years, and he then traced the growth of engineering works from 1610 to the present time. "Of all the branches of civil engineering, no more remarkable progress has been made during the last half-century in any one department than in that which is concerned with the health and personal well-being of mankind. Sanitary science is, in a sense, as old as civilisation, but it may puzzle a lexicographer to give a satisfactory definition of it. Sanitary science does not necessarily meddle with medicine, nor with surgery, but bases its results on scavenging, town sewering, house-draining, and on insisting upon all means for domestic and personal cleanliness. Among the principal of the improvements brought about by the progress of sanitary science, after main-sewering, house-draining, water supply and scavenging, have been the establishment of public baths, wash-houses, and disinfecting apparatus. Some of these establishments have, however, been too grand and costly, as also placed too remote from the poor, and have consequently been failures. It has become usual to credit sanitary works, such as sewerage, drainage, and improved supplies of water, with the observed reduction of deaths in the district; and I know that good sanitary works do tend to promote comfort, to prevent sickness, and to prolong life. In 1846 I proposed the area of North Wales as a source from which to draw water for Liverpool and Manchester, and subsequently for Birmingham. The scheme at that time was thought to be too costly. Liverpool now draws water from the head of the river Severn; Manchester brings, for a distance of ninety miles, water from Lake Thirlmere. Glasgow is provided with water from Loch Katrine. Birmingham will presently be supplied from the hills of Radnorshire. The supply of water to London is still derived mainly from open rivers, the Thames and the Lea."

---

## LIEUTENANT-COLONEL BARKER ON EXPLOSIVES.

ON the evening of Saturday week, at a meeting of the Birmingham Association of Mechanical Engineers, Lieutenant-Colonel Barker, honorary member, superintendent of the Royal Small-arms Factory, Sparkbrook, and formerly assistant superintendent at the Royal Gunpowder Manufactory, Waltham Abbey, read a paper on "Explosives under Control." Mr. E. Hazel, president, was in the chair, and among those present were Colonel Cameron, commanding the district; Dr. Drury, and Messrs. S. B. Allport, Proofmaster; J. Mills, A. Fairley, Hands, C. Sendey, W. H. Bushill, A. Driver, H. Garbutt, J. Cox, W. Deakin, L. O'Brien, secretary, &c.

Lieutenant-Colonel Barker said that the energies of mechanical or civil engineers are nearly always devoted to efforts of construction. "They, as you are well aware, usually leave demolition and destruction to their military brothers. Civil and mechanical engineers are content to overcome difficulties which Nature presents by the exercise of mechanical skill, scientific arrangement of forces, and patient and untiring energy. We, on the other hand, of the military profession, are often forced to adopt rougher and more expeditious methods, when we see Nature's laws and scientific skill arrayed on the side of our enemies. We, I say, have to bring to bear in a more violent manner the greatest forces which are known to science, either to destroy combinations of mechanical and engineering skill united against us, or so to array our own forces that any possible enemies may understand and remember that "Though we are not splenetic and rash, yet have we something in us dangerous, which let their wisdom fear." Hence, gentlemen, I do not propose to deal generally with explosives—either as regards their manufacture or their characteristics—as merely uncontrolled destructive agents, but to discuss their properties this evening chiefly as motive forces of the highest order, and I have, therefore, adopted as the title of this paper, "Explosives under Control." All of us are too well acquainted with explosives not under control to need more than a passing reference to them in this lecture. Our old friend steam, even in the present day, occasionally breaks loose, as so frequently happened in the infancy of its use, and plays havoc with those who do not hold the reins with sufficient care, or who overlook or neglect the precautions which its employment demands. The ruined engine house or blown-up boiler tells its own tale of control for the moment lost of our best known motive force. Again, coal-gas is a good servant, but a bad master, either in domestic use, with engines, or in mines. So we might go through the list until we arrive at what the general public only recognise under the title of explosives, namely, the group of propellants derived from gunpowder, gun-cotton, nitro-glycerine, tri-nitro phenol, or picric acid, and kindred compounds. I propose, therefore, to devote the time at our disposal this evening to the consideration of these explosives from the point of view indicated in the beginning of this lecture. Gunpowder, from even a recent point of view, was looked upon as a violent and uncertain explosive, which when used in guns of great strength would send a shot through the air with tremendous but unknown speed. It was also credited with the propensity for blowing everything to pieces. The new propellant modern gunpowder was regular in its action, capable of complete control, and achieved results which compared favourably with those of steam." Having ignited a grain of "S.B.C." powder—9600 of which go to a charge for one of our big guns—in order that the audience might see for themselves that the powder was not very violent in its action, the lecturer said that this gunpowder nevertheless, in a charge of 960 lb., would send a projectile nearly a ton weight through space at rates of over 1300 miles an hour, the speed being calculated to a foot, and regulated with as much care and as little variation as that of a railway express. Having explained by means of tables the conditions which must be fulfilled by gunpowders before they can be accepted for the British service, and the methods employed in a powder factory to obtain regularity of results, the lecturer referred to an interesting result obtained since the new breech-loading guns and brown powders were introduced, when a 9 2in. gun was fired at a high angle of elevation. If they could imagine the highest mountain in Europe, Mont Blanc, placed between Birmingham and Wolverhampton, a shot which was fired not very long ago would, if discharged from the former place, have passed 5482ft. above the summit of the mountain, and lodged at the other side in Wolverhampton. This gave some idea of what modern guns with modern gunpowder would accomplish. They could not yet say what would be done when smokeless powder was further developed. This result suggested that we might possibly enable a projectile to leave the earth, as suggested in one of Jules Verne's stories; but practical gunnery had not yet approached to this. A velocity of between five or six miles a second would be required for the purpose, while about 4980ft. per second was our present maximum. Possibly in the next few years we might succeed, and attempt to disturb the equilibrium of the planetary system by sending messengers to the moon or elsewhere. The still more modern propellants or explosives under control had nearly all been evolved from what were usually called "high explosives," of which gun-cotton, nitro-glycerine, and picric acid were the types. These "high explosives" developed enormous pressure, and were intensely violent and uncertain in their action, and until very recent years they were considered quite out of the range of control, and all efforts to use them as propellants met with but scant success. Messrs. Nobel and Co., however, discovered some years ago that a union of nitro-glycerine and nitro-cellulose—gun-cotton—produced a compound which was under control and capable of marvellous developments for propelling purposes. Just as unions—matrimonial or otherwise—in human affairs frequently tamed down turbulent individuality of disposition—so these two chemical compounds and violent explosives had submitted themselves when combined to an existence of quiet discipline and useful co-operation. These two most violent explosives, developing when ignited separately instantaneous pressures of 150 tons or more per square inch, and destroying everything in the vicinity, became, when united in the proportions of 58 of nitro-glycerine and 37 gun-cotton, with 5 per cent. of mineral jelly, valuable members of the propellant community. Having shown by experiment the safety of the new combination—"cordite"—by burning it and by striking it violently with a hammer without any explosive results, the lecturer mentioned an experiment carried out a few weeks ago at Shoeburyness with a 12in. breech-loading gun and smokeless powder. Three shots were fired at a target at 2000 yards, and all three projectiles passed through the same hole in the target—equal to sending three bullets of nearly an inch diameter in succession through a hole the size of a shilling at 400ft. distant. If sufficient steam pressure could be developed to give a similar velocity to the shot, it would take a very well regulated set of valves and a very careful engineer to turn them on and off, to obtain results of such accuracy. With regard to the risks attending the manufacture of these new propellants, it must be admitted that even "explosives under control" were, in the early stages of their manufacture, attended with considerable risk, as they had been too frequently reminded during the present year. Those who, like himself, had for years been associated with these substances fully realised the dangers involved, and were constantly alive to the necessity for the utmost precaution. But as the stages of manufacture proceeded the risk of explosion diminished, until in the finished prism of gunpowder, or the accepted unit of cordite or other smokeless propellant, were found substances which were very safe to handle, use, or store. The recent terrible explosion of nitro-glycerine at Waltham Abbey, close to buildings containing tons of the smokeless powder, cordite, none of which was in the least affected by the explosion—though the buildings containing it were wrecked—was only a further proof of the stability of the new compound. Having shown photographs recently taken at Waltham Abbey as examples of what explosives can do when they escape from control, Colonel Barker said that the keeping qualities of modern gunpowder and service propellants were pretty well assured now cordite had been subjected to the Arctic cold of a Canadian winter and to severe tests in the tropics, and had stood each ordeal well, and he had while at Waltham Abbey exceptional opportunities for observing and noting the perfect keeping qualities of cordite when exposed to a high temperature in a closed building, and also to all the vicissitudes of an English climate in an open doorway. There were many other smokeless propellants whose claims had been brought before the public, but the most promising and successful ones consisted either of mixtures of gun-cotton and nitro-glycerine or of a nitro-compound of the gun-cotton type by itself. Comparing the results of steam with those of gunpowder and its kindred explosives, the lecturer said that when one stood on a railway platform and saw an express train rush past at sixty miles an hour, it was difficult to avoid a feeling of amazement at the rapidity of its movement and the propelling power which drove it. Keeping this example in view, they could better realise the significance of the velocities recently attained, and which represented velocities of over 2700 miles an hour. Lord Armstrong mentioned last month a velocity achieved of 4980ft. per second. Before an express train going at full speed from Birmingham could reach London a shot travelling at the rate now accomplished would pass beyond the North Pole, or if travelling towards America could announce its presence in New York before the train arrived at Northampton. Again, the working pressure of steam generally ranged between 30 lb. and 250 lb. per square inch, while the working pressures of the new propellants ranged from about 35,000 lb. to 40,000 lb. But though these high pressures were essential for artillery purposes, they were capable of almost unlimited reduction, if required, by various expedients—air-spacing, use of water, &c.—which could be adopted. As to the possibilities of the application of "explosives under control" to peaceful uses, this had long been dreamt of, and had been attempted on various occasions unsuccessfully with gunpowder. There were, however two insuperable objections to the old explosive in this connection. First, it only developed during its combustion about 280 volumes of permanent gases; secondly, the solid residues of explosion were very considerable, and would soon clog any machine. At the same time, it should be remembered that 1 lb. of gunpowder was capable of developing about 170,280 foot-pounds of energy. The recent discoveries of smokeless powders, however, had placed at our disposal a new material capable of developing still higher energy, also more under control, and giving off about 1000 volumes of permanent gases against the 280 of gunpowder, while it left no solid residue. The temperatures developed by all these propellants were high; but it was very possible that this difficulty could be obviated by invoking the aid of water, which, during its conversion into steam, would utilise, render latent, or absorb much of the excessive heat. Water in this way might be able to render its valuable assistance as an older or more trusted servant, taming and bringing under discipline its more youthful companion. "It may be well now to recapitulate some of the results of recent experience and research as to the quantity of heat and volume of gases per gram, and energy per pound developed by our modern propellants. The results which I now quote were only published a few weeks ago in the "Proceedings" of the Royal United Service Institution.*

| Name of explosive. | | Calories per gram. | Total volume of gases at 0 deg. C. and 760 mm. c. c. per gram. |
|---|---|---|---|
| Gunpowder | | 720 | 280 per cubic inch. |
| E. C. | English | 800 | 574 ,, |
| S. S.<br>Sporting powder | English | 790 | 734 ,, |
| Cordite, English | | 1250 | 882 ,, |
| Ballistite, German | | 1291 | 822 ,, |

Note:—1 Calorie = 2·2 thermal units.

The temperature of gunpowder on explosion is about 4000 Fah. (2200 C.), and that of the smokeless powders is believed to be considerably higher, though not as yet fully determined. The calculated energy of gunpowder per pound is 76·02 foot-tons, or 170,284 foot-pounds; while if infinitely expanded—or in a gun of infinite length—the theoretical work = 486 foot-tons per pound. Also a 100 lb. shot from a 6in. gun has recently developed—with 3000ft. muzzle velocity—an energy of 5884 foot-tons. Further, the actual muzzle energy developed in the projectile—1800 lb.—of the 111-ton gun is 5523 foot-tons, or over 123 million foot-pounds, and the projectile will pass through 32in. of wrought iron at 1000 yards. I submit, therefore, that these results give some idea of the stupendous forces placed at our disposal by the introduction of modern propellants. Energy of a railway train of 100 tons going at 60 miles an hour = 12,100 foot-tons. Theoretical work obtainable from 1 lb. coal = 4980 foot-tons. A "powder engine" was already in existence, called the American ram, for pile driving, and worked with surprising efficiency. This, of course, was a very primitive engine; but so also were those which first brought steam and electricity into use. When they compared the early attempts of their illustrious countryman, James Watt, in the use of steam with a present-day marine engine, or a new railway locomotive, it could hardly be said that a new and better use for "explosives under control" was altogether outside the range of practical possibilities. These suggestions may or may not be of interest to those present, and may possibly provoke a smile. I cannot, however, forget that I am addressing an audience whose professional ancestors have made fire and steam their most useful servants, and whose scientific brethren have tamed and utilised the lightning flash of electricity, and recognised and developed the motive power contained in the loadstone and the magnet. I feel, therefore, that this aspect of the subject, "Explosives under Control," could not well be brought before an assembly more capable of considering and of developing the idea in a practical form, if they desired to do so, than the Mechanical Engineers who have listened so kindly to the paper which I have had the honour of reading this evening."

A discussion took place, in the course of which some practical questions were asked. The President, on the question of gunpowder engines, pointed out that the fusibility of metals, the effect of the enormous expansion on valves, joints, &c., were among the difficulties to be overcome. Lieutenant-Colonel Barker, replying to Mr. Allport, agreed in the probable correctness of the theory that in the case of certain cartridges the effect of the unusually large cap in driving the projectile forward a few inches before the powder was fairly ignited might account for the reduction of the breech-pressure 40 per cent., which was claimed as one of the advantages of the powder. As the Thunderer investigation proved, the old story as to "ramming home" being a preventive of bursting was incorrect. Indeed, it had been demonstrated that the diminution of pressure on the barrel was in a direct and calculable ratio to the air space.

On the motion of Mr. Driver, seconded by Mr. Deakin, and supported by Mr. Allport, a hearty vote of thanks was given to Lieutenant-Colonel Barker for his paper.

## LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.

THE usual monthly meeting of this Association was held in the K room of the Cannon-street Hotel, on Saturday, the 3rd inst., at 7 p.m., when the president, Mr. Wm. H. Bale, occupied the chair, and the vice-president, Mr. R. J. Cook, was in the vice-chair.

After the conclusion of the general business a paper was read by Mr. Andrew King on "Drilling Square and Angular Holes." Mr. King said a machine had been patented in 1888 for drilling square holes, and improvements on it introduced and patented in 1890 which greatly increased its usefulness and enabled them to drill holes of almost any shape and any number of sides over three. The first machine worked on the principle that if a triangular spindle rotates in a square hole some point in the spindle will describe a square, and if an equilateral triangle rotates so that one of its angles is always in contact with the sides of the square, then that angle will describe a square. Instead of a triangular spindle a round one with triangular cams on is more convenient in practice, and as the sharp corners of the triangles would soon wear, the outlines of the cams is a combination of circular arcs which rotate smoothly within a square die plate. To determine the outline of the cams an equilateral triangle is described with sides equal to the sides of the square required. From each corner of the triangle, with a radius equal to half the length of a side, describe arcs outside these corners; then from each corner, with a radius equal to one and a-half sides, describe arcs, joining those previously drawn to complete the outline of the cam, and on this a circumscribing square is formed to represent the die plates. The tool used with this machine was triangular in section, and set with the cutting edge in line with the apex of the originating triangle. With this arrangement it was difficult to produce square holes with perfectly flat sides and sharp corners; and as cams and dies had to be provided for each size of hole, it was not well suited for general use.

The latest improved machines work on the copying principle, by which, if a roller is moved round a die with its surface in contact with it, its centre will describe a figure of similar shape, but smaller in size than the die. The drilling spindle is held by and revolves in a ball-bearing placed somewhere in the middle of its length, the top end being controlled by the roller and die plate, while the drilling tool oscillates as it revolves, the cutting point describing a figure similar in shape to the die at the top, but smaller or larger in proportion as the ball-bearing is below or above the centre of the spindle. The tool used with this arrangement is triangular in section, and shaped to clear itself when turning in the corners, and the cutting edge must be exactly in the centre of the spindle when holes with flat sides are produced, but convex or concave sides can be produced as desired by setting the tool a little on either side of the centre of the spindle. The size of the holes is varied by altering the distance between the ball-bearing and the cutting edge of the tool by using a conical roller at the top end of the spindle and varying its height, or by using expanding dies and a spherical-edged roller on the top end of the spindle, the latter being the system more adopted on the best machines. Mr. King explained the details of the mechanism by which the various movements and adjustments were obtained, and said those machines were used successfully for such work as hoe spanners of different shapes and sizes, locking plates for locomotives, moulds for prismatic powder, torpedo work, &c. Several members expressed opinions on different details, and a hearty vote of thanks was awarded to Mr. King for his interesting paper.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Railway operating statistics.*—The annual report of the Rio Grande Western Railroad shows a reduction in operating expenses of 226,133 dols. accompanying reduced earnings of 395,000 dols. This reduction has been effected by the practice of economies without lowering the standard of the road bed or track, both of which are in excellent condition. With the restoration of business prosperity it is expected that the only important business in expenses will be in maintenance of rolling stock. Of paying freight there were hauled during the year 635,561 tons, a decline of only $4\frac{3}{4}$ per cent. from the previous year; but it was hauled an average distance of 164 miles, against 151 miles last year—so that the tonnage carried one mile shows an increase of 3 per cent. The average earnings per ton were 2·30 dols., against 2·56 dols. last year, and the average rate per ton per mile 1·405 cents, against 1·69 cents. An increased receipt of about one-fourth of a cent per ton per mile would have given as large freight earnings as last year. This reduction in average rate was not caused by competitive "cutting," or even chiefly by the carrying of any particular class of goods at a lower rate than the previous year, but mainly by the carriage of a larger proportion than usual of the cheaper classes of freight and of those which pass a longer distance over the line, and a much less proportion of general merchandise and other better paying freight. Of passengers there were hauled 213,540, a decline of $27\frac{1}{4}$ per cent. from the previous year. But the average distance travelled was 141·8 miles, as against 113·7 miles last year; and the average fare received was 2·44 dols. per passenger, as against 2·25 dols. last year, so that the decrease in passenger earnings was 21 per cent. The average rate per passenger per mile, however, was but 1·72, against 1·99 cents last year. This was due to a larger proportion of cheap-rate tours. The abridgment of passenger earnings proved to be more severe than was expected.

*Railway operating statistics, Louisville and Nashville Railway.*—The following table shows the results of operation on the 2956 miles of the great Louisville and Nashville system for the year ending June 30th, 1894:—

| | |
|---|---|
| Total mileage operated, L. and N.R.R. system | 2956 |
| Total mileage owned, controlled, and interested | 4831 |
| Gross earnings, dollars | 18,974,337 |
| Operating expenses (62·53 per cent), dollars | 11,863,785 |
| Net earnings from traffic (37·47 per cent.), dollars | 7,110,552 |
| Gross earnings per mile, dollars | 6419 |
| Operating expenses per mile, dollars | 4014 |
| Net earnings per mile, dollars | 2405 |
| Steel rails, miles | 2766 |
| Iron rails, miles | 167 |
| Locomotives | 568 |
| Cars in passenger service | 450 |
| Cars in freight service | 20,133 |
| Passengers carried | 5,152.130 |
| Passengers carried one mile | 192,098,210 |
| Fare received per passenger, cents | 85 |
| Passengers per train | 35 74 |
| Passengers per car | 10·42 |
| Distance travelled per passenger, miles | 36·10 |
| Rate per mile per passenger, cents | 2 35 |
| Net earnings per passenger train mile, cents | 35·91 |
| Freight carried, tons | 9,433,698 |
| Tons carried one mile | 1,398,679,019 |
| Rate per ton, cents | 71 |
| Rate per ton per mile, cents | 0 889 |
| Net earnings per train mile, cents | 54 944 |
| Cars per train | 19 14 |
| Tons of freight per train | 165 38 |
| Tons in each loaded car | 12 51 |
| Average haul per ton, miles | 79 |
| Earnings, per cent. of gross earnings— | |
| Passenger | 24·248 |
| Mail | 3·325 |
| Express | 2·191 |
| Train privileges | 0·150 |
| Freight | 67·993 |
| Rent of passenger cars | 0·132 |
| Rent of freight cars | 0·892 |
| Rent of engines | 0·504 |
| Rents | 0·380 |
| Car detentions, storage, &c. | 0·092 |
| Wharfage and storage, Pensacola | 0·049 |
| Bridge tolls | 0·006 |
| Telegraph | 0·022 |
| Storage, St. Louis | 0·006 |
| Total (gross earnings) | 100·000 |

*New York rapid transit.*—The engineer of the Rapid Transit Commission, who made a brief visit to Europe last summer, has made a report on some of the foreign systems of rapid transit, including the London underground railways—steam and electric—the Glasgow subway and underground railway, the Liverpool overhead railway, and the tunnel of the Sceaux Railway in Paris. His conclusions may be summarised as follows:—First, an underground railway operated by steam, even with the best mechanical ventilation, would be intolerable in New York. Second, a railway with a steady, frequent service can be worked successfully and economically by electricity. Third, an underground railway worked by electricity has a comfortable atmosphere, and in it great changes in temperature can be avoided. Fourth, the rail level should be kept close to the surface, as excavation from the surface is cheaper and safer than tunnelling. Fifth, if, however, conditions demand, a deep tunnel can be constructed, in which the circular form is best. Sixth, an underground railway can be so designed as to be attractive in appearance. Seventh, the work can be carried on through a busy street without endangering the houses, and without seriously impeding travel. New York is in great need of better facilities for handling city and suburban traffic, but the commission has been in existence for some years without having attained any decision.

*Tramway motors.*—While electric traction is coming into more and more extensive use for city, suburban, and country tramways, there is still a field for independent motors, but steam locomotives are not now very much used. The Mekarski compressed air system has been proved successful in many ways, but the objection has been the great weight of the engines. Improvements of importance have been introduced, by which the weight has been materially lessened, and the new motors are being given thorough tests in regular service. A superheated water machine is also being brought out, which is probably somewhat similar to the Lamm-Francq system in use in France.

*Tramway track.*—The growing tendency to a better and more permanent system of paving for city streets is leading to a more substantial system of track construction. At Terre-Haute, Ind., a 72 lb. flange rail is used—having a plain, ungrooved head—spiked to wooden sleepers 7in. by 5in. and 7ft. long, or bolted to corrugated steel sleepers 7ft. long, 7in. wide, and ½in. thick. The street is excavated to sub-grade—or formation level—and the earth compacted by a steam roller. A bed of concrete is then laid, and the track is then laid, the joints keyed up, and the line brought to correct surface and alignment. Concrete is then filled around the sleepers and under the rails, giving the rails a continuous bearing. When this has set a bed of sand is laid, and upon this the brick paving, a bevel-edge brick being used against the inside of the rail-head to form a groove for the wheel flanges. The joints are then thoroughly grouted.

*A city viaduct.*—At Cleveland, Ohio, a new steel viaduct 1542ft. long, connecting the high ground on each side of a flat valley, has recently been completed. There are fifteen truss spans of 56ft., separated by trestle towers 28ft. wide; an arch truss span of 168ft., one approach span of 72ft., and at the other end two approach spans of 42ft. In some of the towers the bottom panel of diagonal bracing at each side is replaced by plate arches, thus effectively connecting the columns, while at the same time affording easy access from adjoining property to a road which runs under the viaduct. The viaduct roadway is 29ft. 6in. wide, with a 12ft. sidewalk on each side. Trusses 28ft. long connect the ends of the 56ft. spans. Transversely between the tops of the columns are plate-girder floor beams 3ft. 6in. deep, while plate girder triangular brackets or cantilevers carry the sidewalks. The 3in. oak floor planking is carried by 12in. I-beams or rolled joists; except at the street railway tracks, where channel bars are used. Under each girder are two 12in. channels, back to back, with saddle pieces riveted between them, the rails resting upon oak blocks or longitudinals, resting upon the saddles. The truss arch is 168ft. span between end pins, and $55\frac{1}{2}$ft. rise. The lower chord or boom is curved. The upper chord is horizontal for 84ft., and then inclines down to the top of the end posts, which are $19\frac{1}{2}$ft. high above the skewback end pins. The structure is calculated for a moving load of 1000 lb. per square foot.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE iron market has recovered from the temporary relapse noted in last letter, and the position and prospects are both again more satisfactory. A furnace has been blown out at Tipton, but it is a question whether curtailment of production at a time like the present is not more of a benefit than an evil to the trade of the district as a whole. Pig iron prices are rather better, from 6d. to 9d. more than the figures mentioned last week being now generally asked.

In Midland iron trade circles conflicting reports have lately been current with reference to the manufacture of best iron until lately carried on by the New British Iron Company, of the Corngreaves Works. I have referred to this matter before. All doubt on the subject has now been set at rest by the issue this week by Messrs. N. Hingley and Sons, of the Netherton Ironworks, near Dudley, of a circular definitely announcing that they have become the sole proprietors of the registered trade marks and goodwill of the business lately carried on by the British Iron Company, at Corngreaves, including the well-known "Lion brands." Messrs. Hingley's works are in close proximity to those at Corngreaves, and their ironstone and coal mines adjoin and are of a similar kind. They are, therefore, in a position to make and supply "Lion" iron of the superior quality formerly produced. They will also continue at their works the manufacture of chain of that brand. Their works and machinery are of the most modern description, specially designed to produce iron of the highest quality and finish. The firm will use the "Lion" pig iron in the manufacture of "Lion" bar iron.

This special brand of pig iron will be made—along with other brands—by the Corngreaves Furnace Company, which is now the owner of the Corngreaves furnaces. As yet this last-named company has started only one of the furnaces under blast, but a second one will probably follow shortly. Depending upon the particular quality of iron which is being at the moment produced, I am informed that the output of each furnace will, as a rule, vary from 350 tons to 450 tons per week. The "Corngreaves" brand of cold-blast pig iron will be one of the qualities regularly produced in one of the furnaces. This is a brand, the excellence of which has long been known and appreciated in Staffordshire and other parts of the kingdom, whilst considerable quantities have for many years past been exported to most of the countries on the Continent. The "Lion" brand—referred to above—which will also be regularly produced, will not only continue to be the basis of Lion finished iron, but will continue to be used as a high-class foundry iron. It is the intention of the Corngreaves Furnace Company to make also commoner qualities both of foundry and forge pig.

Manufacturers doing business with Australia are glad to find that in the metal market in Sydney tin-plates are in brisk request, which is probably explainable by the circumstance that some very large contracts for tinned meat have been placed in that town for the supply of the Japanese army at the seat of war. Engineering and hardware stocks are low at Melbourne, and will require replenishing ere long, while galvanised sheets are in moderately good demand, and hoops are in fuller inquiry. The tone of business at Adelaide is reported fairly brisk. Sheep shears have been in request, for the wool trade has progressed since the passing of the American tariff admitting wool into the States duty free. The demand from the Australian goldfields for mining tools and machinery is satisfactory.

The railway wagon and carriage-building firms of Birmingham and neighbourhood are, I find from inquiries this week, only moderately engaged. The Oldbury Railway Carriage and Wagon Company, Oldbury, has just taken an order for one of the Indian railways, of which more information may be available for next letter. Brown, Marshall, and Co., are fairly occupied. The Metropolitan Railway Carriage and Wagon Company has no special work in hand calling for particular comment, and the same is true of the Midland Railway Carriage and Wagon Company.

---

* In the very interesting table quoted, compiled from researches carried out by Mr. W. Macnab, F.I.C., F.C.S., and Mr. E. Ristori, A.M.C., C.E., F.R.A.S., the gunpowder results were not included, as they had been previously recorded by Sir F. Abel, K.C.B., and Sir Andrew Noble, K.C.B., of Elswick.

The Birmingham Railway Carriage and Wagon Company, Smethwick, has lately been building dining saloons for South America, and other vehicles for the same country. It has otherwise been engaged principally upon English work.

The interests of the engineering and kindred trades of the district, as well as those of the numerous other industries which find a home in the Midlands, will, it is to be hoped, be served by the new Chamber of Arbitration, which was declared open by the Mayor of Birmingham a few days ago. The headquarters are at the offices of Mr. A. Addinsell, registrar of that city. The rules are somewhat similar to those of the London Chamber of Arbitration. Some two hundred gentlemen, experts in various trades, have consented to act as arbitrators if called upon. The Court expenses of one arbitrator and of chamber fees in a case of one hour's duration will be £2 2s.; for two hours, £3 3s.; and for three hours, £4 4s., with an addition of 10s. 6d. for each subsequent hour during the same day. In the case of the Tribunal of Commerce in Paris appeals are limited to amounts of over £60 in value. In the Birmingham case there is no limit. What seems strange is that the legal profession have given the matter their support. Anything which facilitates industrial peace is good for trade.

The prosperity of cycle engineering in the Midlands, as far as the domain of Humber and Co., of Beeston, Coventry, and Wolverhampton, is concerned, is evidently, as far as that concern can secure such a result, to be maintained. At this week's annual meeting, when the 12½ per cent. dividend mentioned last week was declared, it was announced that the company had found it necessary to protect its rights in France and in Spain, and was prepared also to spend money freely hereafter with the same object. The directors had not been able to recommend construction of works in the United States, but had arranged for the sale of the Humber rights, reserving certain powers over the management of the American company. Regarding the progress of this branch of manufacture as reflected in the experience of other firms, it is noteworthy that the Coventry Machinists Company has this week passed certain resolutions for reconstruction.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—A continued absence of improvement is still the general report, as regards the position of the engineering and iron trades of this district. The condition of the engineering industries is, however, no worse; if anything perhaps it is a shade better, and most of the works—with the exception of locomotive builders—are kept moderately employed, stationary engine builders being as a rule fairly off, and some of them busy; but there is still no move towards anything like general activity, and prices have to be cut very low to get hold of orders. In the iron trade the tone all through continues extremely dull, and no expectation is entertained of any real improvement until the turn of the year, or the commencement of next spring—makers and manufacturers in the meantime looking forward to a continued unsatisfactory business at unremunerative prices.

The Manchester Iron Exchange on Tuesday brought together about an average attendance, but there was again only a dragging sort of hand-to-mouth business doing. In pig iron buyers still give out orders only for very small quantities, and these are comparatively limited in number. For the most part makers' quotations remain nominally unchanged, but where there is any business to really test prices, a weakening tendency becomes evident. Lancashire makers, who are booking very little business of any weight, have had to give way slightly in their list rates for forge qualities, which are now being quoted at 39s., less 2½, at the works, with foundry qualities remaining at about 42s. For district brands makers' quotations remain about the same as those given last week; it can, however, scarcely be said that even at 38s. 6d. for Lincolnshire forge, delivered Manchester, orders of any moment are being secured, but there are moderate offers at about 6d. under this figure, which seems to be the buyers' idea of what forge qualities will have to come to. Foundry Lincolnshire remains at about 40s., and foundry Derbyshire ranges from 43s. 6d. and 44s. up to 45s., net cash, delivered Manchester. With regard to outside brands offering here, Middlesbrough is firm at about 44s. 4d. to 44s. 9d., net cash, for good foundry qualities delivered Manchester. Scotch iron is still quoted about 47s. 6d. for Eglinton, and about 50s. 6d. for Gartsherrie, net prompt cash, delivered at the Lancashire ports, but to get hold of business sellers in some instances would no doubt give way something on these figures.

Finished iron makers report no improvement whatever in their branch of trade, if anything the tone is perhaps rather quieter, with more eagerness to get hold of orders, owing to forges being kept only partially employed, and there is a considerable amount of underselling in the open market. Delivered Manchester or Liverpool, prices average £5 6s. 3d. to £5 7s. 6d. for Lancashire, up to £5 10s. for Staffordshire bars; £7 to £7 5s. for Lancashire and Staffordshire sheets, and £5 17s. 6d. for random, and £6 2s. 6d. for special cut lengths of hoops.

The steel trade continues quiet in all departments. For ordinary foundry hematites quotations remain at 52s. 6d., less 2½, and for ordinary basic billets £4 net cash, with steel bars offering at £6, and steel boiler plates £6 2s. 6d. to £6 5s. delivered in this district.

Business continues very slow in the metal market, with a weakening tendency, but list rates for manufactured goods so far remain unchanged.

The returns of the Engineering Trades Union Societies are, if anything, this month of a rather more satisfactory character, both the Amalgamated Society of Engineers and the Steam Engine Makers' Society showing a slight decrease in the number of unemployed members, and this is regarded as a specially encouraging feature, in that there should be even a small decrease in the number of unemployed members at a time of the year when the returns usually show an increase. The decrease, however, does not appreciably affect the general position, the Steam Engine Makers' Society having still about 5¼ per cent., and the Amalgamated Society of Engineers about 9 per cent. of the total membership in receipt of out-of-work benefit.

Representatives of the Lancashire engineering industries have come out pretty strongly this year as regards municipal honours. Sir Wm. H. Bailey, who has filled the Mayoralty of Salford with so much distinction during the past year, is succeeded in this office by another well-known engineer, Mr. Alderman Mottram, who for many years has occupied a prominent position in connection with the well-known firm of Messrs. Galloways, Manchester, and who is also a member of the Iron and Steel Institute of Great Britain, and throughout the whole of his career Mr. Mottram has devoted close attention to everything affecting the interests of the mechanical engineering profession to which he belongs. Bolton has, in Mr. Alderman B. A. Dobson, also elected a prominent engineer of the district to the office of mayor. Alderman Dobson is not only well known throughout the district by his close connection with the important firm of Messrs. Dobson and Barlow, the eminent machinists, who employ some 3700 hands, but he is perhaps quite as well known throughout the Continent of Europe, United States, Canada, Egypt, and India, and a few years back the French Government conferred upon him the Order of Chevalier of the Legion of Honour, in recognition of his valuable services to French industry. Mr. Dobson was also at the annual meeting of the Iron Trade Employers' Association, held in Manchester last July, elected, for the third year in succession, President of the Association. Another engineer, Mr. Alderman John Hall, of the firm of Messrs Robert Hall and Son, machinists and power loom makers, of Bury, has been elected to the office of mayor for that important industrial centre. Mr. Hall has been connected with the engineering trade throughout his business career, and is the head of the firm, which was established fifty years ago by four working men from the well-known engineering establishment of Messrs. Walker and Hacking, of Bury.

Mr. William Watts, F.G.S., the newly-elected president of the Manchester Geological Society, in his inaugural address delivered before the members at their meeting on Tuesday, dealt with "Waterworks Construction, and the use of Concrete and Earthwork in forming Embankments." Referring to the growing interest which had been taken in concrete embankments since the Vyrnwy dam was made, he remarked that when a new departure had been successfully introduced, ideas had a habit of becoming infectious, and might be adopted by others on the score of novelty, if for no other reason. He did not, however, think that concrete would ever entirely supersede earthwork for reservoir embankments in England, and as a substitute for earthwork concrete was not free from objection. The foundations must be increased, as the whole weight of the superstructure was confined to much narrower limits, and the centre of gravity was brought much nearer the factor of danger than in earthwork embankments made on modern principles. The use of concrete in the trenches below the surface of the ground was, however, an improvement on clay filled trenches, and he believed they were indebted to two Manchester engineers—Messrs. Bateman and Hill—for having recognised its advantages, and being the first to use it as a water-tight core in this class of work. There was another use to which it could be put, where it was superior to clay, in the use which could be made of it for pillars, to enable the refilling to proceed with one part whilst other parts were being excavated or refilled, which meant a saving in time, money, and timber.

The important question of the most suitable class of fittings for electric lighting installations was dealt with by Mr. H. A. Henderson, in a paper read before the Northern Society of Electrical Engineers, at their meeting in Manchester on Monday. During the course of his paper, Mr. Henderson expressed his opinion that the most satisfactory way of wiring was that which now commonly obtained in London, and had also been adopted by a few provincial contractors, viz., the distribution system, confined as far as possible to five ampère sub-circuits, each controlled by a double pole fuse; the advantage of this arrangement to consumers being considerable, as it allowed extra lights to be attached without much additional cost, providing, of course, the contractor had allowed for this in his mains. As to general fittings the use of good material was, of course, essential, but he feared that in these days of cheap continental rubbish this important point was often neglected, adding that at the present time there were continental firms who might be said to "run" English contractors. That was they got hold of a contractor who was short of capital and financed him by supplying him with inferior materials, mainly fittings, at a low price.

In the coal trade the position shows no improvement upon the very unsatisfactory outlook to which I referred last week. Supplies of all descriptions of fuel continue excessive, notwithstanding very few pits are working more than four days per week, and prices show a persistent weakening tendency. The better qualities of round coal still meet with only a very moderate demand for house-fire consumption, with prices cut very low to get rid of surplus quantities; best Wigan Arley can be readily bought at 10s. 6d. to 11s.; Pemberton 4ft. and seconds Arley, 9s. 6d. to 10s.; and common house coals, from 7s. 6d. to 8s. per ton. Steam and forge coals still meet with only a very slow demand, and inferior descriptions can be bought as low as 6s. 6d. to 7s. per ton at the pit. Engine fuel also continues a drug, with common Lancashire slack readily obtainable at 3s. 6d. to 4s., and best qualities quoted 5s. to 5s. 6d. at the pit; whilst common slack from other districts is offering at 1s. 6d. to 2s. per ton at the pit mouth.

In the shipping trade only a limited business is reported, with common round coal obtainable from 8s. and 8s. 6d. up to 9s. per ton, according to quality, delivered at the ports on the Mersey.

The Chatterley Whitefield Collieries are now being supplied with an extensive electric lighting installation, including arc and incandescent lighting. The work is being carried out by Messrs. J. P. Hall and Co., Oldham, who are also fitting out a large steamship for Messrs. Harland and Wolff.

*Barrow.*—There is no change to note in the demand for hematite pig iron. Business remains very quiet, and there are no indications of improvement from any quarter. On the contrary, there has been an increase in stocks in the Furness district, which, to say the least, is unsatisfactory; 6277 tons of pig iron have been added to warrant stocks at Barrow during the week, leaving stocks at 164,727 tons, or 70,104 tons increase since the beginning of the year. The explanation for this increase may probably be found in the fact that the steel works at Barrow were closed last week, and the output of the furnaces has probably gone into warrant stocks. Prices are easy at 43s. 5d., net cash, sellers; 43s. 4d. buyers. Makers still ask 44s. 6d. to 45s. 6d. for parcels of mixed Bessemer Nos., net, f.o.b.; 33 furnaces are in blast, as compared with 34 in the corresponding week of last year; 42 furnaces are standing idle.

Iron ore is still very depressed. Ordinary qualities are at 8s. 6d. and best at 13s. 6d. The local demand is very quiet, and the shipping demand is small.

Steel makers are in a rather more hopeful state. The order has been placed with the Barrow Steel Company for 5000 tons of steel ship-plates by Messrs. Hannay and Clarke, Barrow agents for Messrs. Neilson and Sons, Glasgow. Prices are easier for plates. There is a slow trade in ordinary rails, although some good orders are in the market, particularly on Indian States Railway account. The tin-plate bar trade is quiet, but is likely to revive. Very little is doing in billets, slabs, and wire rods. Shipbuilders are very busy, and are likely to be busier, as not only are they well off for orders, but others are expected. Marine engineers are well off for work, as also are boilermakers.

Coal and coke quiet at late rates, which are low.

Shipping is very quiet indeed. During the past week only 1970 tons of pig iron were shipped from West Coast ports, compared with 8281 tons in the corresponding week of last year, a decrease of 6311 tons. The shipments of steel were 4762 tons, compared with 12,120 tons in the corresponding week of last year, a decrease of 7358 tons. The aggregate shipments to date this year represent of pig iron 303,485 tons, and of steel 346,846 tons, comparing with 242,498 tons of pig iron and 416,630 tons of steel in the corresponding period of last year, an increase of 60,996 tons of pig iron, and a decrease of 69,784 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Not much change has occurred in the South Yorkshire coalfield since last week. Trade is in a quiet condition, which is very unusual for this time of the year. The pits, on the whole, are working moderately; stocks, however, in some classes of fuel are rapidly increasing, and the good winter's business, which was anticipated during the early part of 1894, is rather doubtful of being realised now. The United States Tariff, it was expected, would stimulate the coal trade, by increasing the call for manufacturing sorts. This hope has been entirely disappointed. There are still a few minor disputes in the coalfield, but they are too unimportant to make much difference to business. House coal is not in such good request as it ought to be in November. The metropolis is taking a fair tonnage, but nothing like what the season trade ought to be. The usual winter advance, which was anticipated with the beginning of October, and again in November, does not seem to have been obtained; indeed, coalowners in this district find it hard to keep up summer prices, and in some cases it is reported that a decline of 6d. per ton has had to be conceded. The present quotations are as follows:—Silkstone make from 9s. 3d. to 11s. per ton; Barnsley House, 8s. 6d. to 9s. 6d.; other qualities from 7s. 9d. per ton upwards. In spite of the Hull returns exhibiting a large trade in export fuel from that port, business in steam coal is not so brisk—in fact, several "blocks" have been placed on local pits during the week. Railway companies are taking a fair tonnage, mostly on contract account, but from other sources the demand is reported as considerably weaker. Barnsley hards are up to 7s. 9d. to 8s. 3d. per ton; Parkgate and other sorts from 7s. upwards. Gas coal is having a good sale, and prices are steady at from 7s. to 8s. per ton. All sorts of small stuff are depressed. A good demand continues for manufacturing fuel, and prices range from 3s. 6d. to 5s. per ton. Smudge and small coal at 1s. 6d. to 2s. 6d. Coke remains unchanged at from 9s. to 11s.

In the heavy trades, reports this week are of a more cheerful nature. The large establishments engaged in the production of files, saws, and all kinds of tools are busily employed, and several firms are exceptionally pushed for deliveries. Some of the smaller firms are also well up in orders, although not so much pressed as the larger houses. A good demand is reported for stove grates, an industry which Sheffield shares largely with Rotherham. Orders are coming in freely for grates of the Louis pattern, which are highly ornamented stoves with graceful outlines. The general public have at last recognised the fact that there is abundant room for the exercise of artistic taste in this extensive branch of Sheffield industry. Some of the work sent out by our large establishments is extremely beautiful. Another design which is much sought after is the Stevens pattern, and the Adams festoon decoration is in greater favour. An improvement has also taken place in fenders. Bronze figures of an expensive description are a prominent feature of this trade. Placed on pedestals, or reclining at the corners of the fenders, they have a charming effect, and form a great addition to the decoration of the house. Most of the Sheffield establishments are busily engaged on stoves and fenders.

The rolling mills are now fairly well employed. Full time is in most cases being worked, which shows that the general business is looking up, the rolling mills being largely the key to most of the lighter trades. Boiler makers are also fully engaged, and the demand is growing every day.

In the lighter industries business is at present in better condition. Increased orders are reported to have come in from Brazil, Argentina, and Paraguay for cutlery. Since the change in the American tariffs there has not been any "boom," as was anticipated, but in its place we have had an ever-increasing trade, which has proved both more regular and useful to our manufacturers. Case goods for presents for Christmas and the New Year are in large request, and manufacturers are very busy on this account. A large quantity of inferior and cheap horn and bone, which has long lain idle in the warehouse, has been recently bought up for hafting purposes; fine and expensive ivory and other hafting material is not in such brisk demand—a sign that the Americans are neither buying nor making any considerable quantity of high-class goods. It is believed, however, that the American trade will assume large dimensions early next year. Silver and electro-platers are extremely busy on season orders, which are more numerous than usual. Sterling silver ware is in good demand, both for the home and foreign markets, the cheapness of silver having given a welcome impetus in this respect to the manufacturers. The progress of this important industry in Sheffield is proved by the number of cutlery establishments to which of late years this trade has been added. There are many novelties this year, the silver and electro-platers recognising more widely than ever that they must vary their designs and present fewer of the accustomed patterns season after season. Messrs. John Round and Son, Tudor Works, Sheffield, have just completed an admirable piece of artistic workmanship in the shape of a massive silver cup, the whole forming an excellent example of the silversmith's art. It was produced for the Liverpool Cup, is 33in. high, has a diameter at the widest part of 14in., and the total weight is 250 oz. Another noteworthy production is from the firm of Messrs. Walker and Hall, Howard-street. This consists of a wheelbarrow and spade, made to the order of the directors of the Manchester, Sheffield, and Lincolnshire Railway, for presentation to the Countess of Wharncliffe, on the occasion of the cutting of the first sod of the new line to London last Tuesday. The barrow, which is of polished English oak, elaborately carved, is decorated with a number of silver shields, which are richly engraved. The trundle, or wheel, has a sterling silver tire. The feet are made of solid silver, and the handles are mounted with silver. The barrow has a shield on each side bearing the arms and crests of the Earl of Wharncliffe and the railway company. The spade is also of oak, with a blade of solid silver.

The Board of Trade returns for October exhibit a decided increase in the exportation of hardware and cutlery. For the month the total value sent was £171,589, as compared with £167,949 for October of 1893, and £189,688 for October of 1892. The largest value was sent to Australasia, £22,778, an increase over that taken in 1893, but a large decline on the value sent in 1892. The United States, who occupy second place for the month, took a value of £19,962, an advance of £4000 on October of 1893, but £2000 less than in 1892. The increasing markets for this month are Germany, Brazil and Holland—which has jumped from £6947 to £15,602. The decreasing markets were Russia, Sweden and Norway, France, Spain and Canaries, Foreign West Indies, Chili, Argentine Republic, British Possessions in South Africa, British East Indies, and British North America. For the completed ten months of the year the total amount exported was £1,524,347, as compared with £1,729,389 for the corresponding period of 1893, and £1,822,666 for that of 1892. The largest value for the ten months was sent or Australasia, which country took hardware and cutlery to the amount of £200,421. Increases are reported for the ten month, from Russia, Sweden and Norway, Germany, Holland, Belgiums and Brazil. Decreases are shown by France, Spain and Canaries, United States, Foreign West Indies, Chili, Argentine Republic, British Possessions in South Africa, British Possessions in East Indies, Australasia, and British North America. In steel, unwrought, an advance is shown both on the total for the month and the ten months. The aggregate exported to foreign countries was £189,676 as compared with £128,414 for the same period of 1893, and £147,593 for October of 1892. Russia is the largest buyer this month with a total of £36,166. All countries except four—Holland, British East Indies, Australasia, and British North America—exhibit a satisfactory increase. For the ten months the total was £1,617,197, which is a material advance over the business of 1893 and 1892. For the ten months increases were also reported by all countries except Holland, United States, British East Indies, and British North America.

On Saturday night the workpeople of Messrs. Walker and Hall, Electro Works, Sheffield, to the number of 1500, were entertained at dinner by the Master and Mistress Cutler, Mr. and Mrs. C. H. Bingham. The workmen's dinner is usually held in the Cutlers' Hall; but owing to the large number employed by this firm, the Norfolk Drill Hall had to be engaged for the occasion. Advantage was taken of the dinner to present to the Master and Mistress Cutler a silver tea and coffee service and tray, together with an illuminated address. This is the third time the Master Cutlership has been held by members of the firm of Walker and Hall; the senior partner, Colonel J. E. Bingham, J.P., having worthily occupied the office for two years.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

Last week's improvement quickly disappeared, and traders gained little by it, because it affected pig iron alone, and only one quality of that. No doubt a good deal of business might have been done in that, but unfortunately the demand was for prompt delivery, and very few makers were in a position to sell No. 3 for delivery at once, seeing that their stock is almost cleared out; in fact, except during the Durham strike, it is many years since there was so little No. 3 unsold in makers' hands. Thus producers did not profit much by the spurt, and were able to sell very little iron at the advanced price; and the pressure to buy having gone off, the price has dropped back to the old rate, because second hands offer small lots at less, though neither they nor makers could supply large quantities. There is no disposition now to buy for forward delivery, and consumers are extra cautious after the spurt of last week. Still, taken as a whole, the amount of business doing this month is not so much as it was last month, and shipments are better than are usual in November.

The general price this week for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. pig iron has been 35s. 9d., or 3d. below the quotation of last week, but some producers are still getting 36s. for their brands. Most firms can secure 35s. 9d., but among merchants 35s. 7½d. was accepted early in the week for a few small lots. Cleveland warrants have been about 35s. 8d. cash. The quantity of Cleveland pig in Connals' warrant stores on Wednesday night was 88,698 tons, or 67 tons increase this month. No. 4 Cleveland foundry pig can be bought at 3d. less than was being taken last week, viz., at 34s. 9d., but grey forge has not fallen below 33s. 9d., a price which is said to be unprofitable. If it bore the same proportion to No. 3 as it usually does, grey forge should be realising 34s. 9d., but it is extra plentiful, while No. 3 is very scarce. Mottled iron is 33s. 6d. and white 33s. It may be stated that since re-opening their works after making a number of alterations and extensions, Messrs. Dorman, Long, and Co., of the Britannia and West Marsh Steel and Ironworks, Middlesbrough, have been using the commonest quality of Cleveland pig iron, viz., white iron, to make steel by the basic open hearth process, and they appear to have succeeded very well, as it is said that the steel produced has stood more severe tests than steel made from hematite by the acid process. This certainly is a new departure, and is of importance to the district. As the supply of white iron is very limited, if very considerable quantity should be required for use at the steel works, the price would quickly be enhanced. The old acid furnaces were employed in the experiments with a basic lining. The difference between the price of the white iron used and that generally employed for basic steel making is at least 3s. per ton, and that is a consideration in times like the present, when so little profit is to be made out of the business. The difference between the cost of basic steel and ordinary hematite steel might by the use of this cheaper pig be brought in favour of the former, and thus lead to the utilisation of more of our native ores, and reduce the importation of foreign ores.

The hematite pig iron trade is much depressed, and prices have touched figures that can leave no profits. Ore and coke are almost as dear to-day as they were when the price of hematite pig iron was 3s. per ton dearer, and as long as the production of the latter is kept up, materials are not likely to get cheaper. The output of hematite pig iron would seem to be in excess of the consumption, and if selling prices are to be maintained and cost of production reduced, it would apparently be the better policy to blow out some of the furnaces rather than turn them on to Cleveland iron, for the output of that is already more than equal to requirements. The quotation for M. Nos. of Cleveland hematite pig iron is 42s. 9d. per ton, with a few still asking 43s.

The Cleveland mine owners have had to refuse the claim of their men for a 5 per cent. advance of wages, for prices realised for pig iron have not improved materially since the last application was made. The men adopted new tactics to support their claim—they did not base their arguments as previously upon any advance in selling prices, for they would have had no ground to stand on there, but they wanted the advance because they said they were inadequately paid for the work they had to perform, considering the dangerous character of their employment, and the conditions under which such employment is carried on. Yet the conditions of their employment have not been altered for many years. To increase the cost of Cleveland iron ore at present will only tend to further limit its use, as it will make it more difficult to compete with the cheap foreign ores. The output of Cleveland ore, by reason of this competition, has been reduced over 30 per cent. during the last ten years.

All departments of the finished iron and steel industries are depressed, and manufacturers have brought prices down until they yield in many cases no profits; yet producers cannot meet with orders enough to keep their mills fully occupied. The bar trade is affected the least by the depression, and makers have been able to maintain their quotations at the same figures for a long time. Sheet does not compete much with iron in the bar trade, because consumers still prefer iron bars, for the reason that they are more readily welded. Common bars are quoted £4 17s. 6d., less 2½ per cent., f.o.t. Plates and angles are quoted the same prices for steel as for iron, ship plates being at £4 15s. and angles at £4 12s. 6d., less 2½ per cent. and f.o.t. Heavy steel rails are somewhat dearer nominally, but there is hardly any business done to fix prices. The quotation is £3 15s. net at works. Shipments of rails and railway materials have recently been better from the Tees, especially for India.

Ironfounders have probably never experienced a worse time than the present, and some do not produce more than a third the quantity of material they turned out in good times. Owing to depression of trade, Messrs. Sutherst and Southorn, Cleveland Steel Foundry, Guisbrough have had to cease operations. They have recently executed part of the steel castings for the eight cruisers building for the Admiralty at Chatham, Devonport, and Portsmouth, as well as for the Magnificent now building at Chatham. Bridge and wagon builders are fairly well off, but some of the locomotive shops are ill-supplied with work, as are also the general engineering works.

On Tuesday in the Council Chamber, Middlesbrough, in the presence of a numerous and distinguished company, including the Earl of Carlisle, Earl Grey, Sir James Kitson, Sir Raylton Dixon, Sir Matthew Gray, and Sir Joseph W. Pease, Bart., M.P., on behalf of the subscribers, presented a portrait in oils of Sir Lowthian Bell, Bart., F.R.S., to the Corporation, to be hung in the Council Chamber. This is the outcome of a movement set afoot early in the year by some of the principal traders in the Cleveland district to mark their appreciation of the eminent services Sir Lowthian had rendered to the various industries of the district, and the iron trade in particular. Subscriptions were received not only from the North of England, but from all other British iron-making districts, and also from the Continent and the United States, the total amount reaching £700. With this the committee were able to have not only a portrait for the Corporation, but also a replica for Sir Lowthian's family, and this was presented on Tuesday also. At the same time the mayor conferred the freedom of the borough upon Sir Lowthian and his eldest son, Mr. Hugh Bell, who has been for twenty-four years a member of the Council, for seventeen years as alderman. He was mayor in 1874, and again in 1883.

Among the new mayors in the North of England, Mr. Robert Redhead, the well-known shipbuilder, has been elected at South Shields; Mr. C. A. Head, of the Teesdale Iron and Engineering Works, at Thornaby-on-Tees; Mr. John Price, late general manager of Palmer's Shipbuilding and Iron Company, at Jarrow; Mr. William Haswell Stephenson, coalowner, &c., at Newcastle. The new Mayor of Stockton, Mr. Jonathan Samuel, was till within the last few years an ironworker.

The Durham coal trade continues very brisk, as is usual at this time of the year, when so much gas and house coal is required. In Northumberland, however, the best season is over with the close of the northern navigation, and some of the collieries have had to reduce their production, while prices generally are lower by 1s. 3d. per ton than they were a short time ago, best steam being now obtainable at 9s. 9d. per ton.

The directors of the North-Eastern Railway have decided to utilise their mineral branch from Cargo Fleet to Normanby for passenger traffic, merchandise, &c., and to extend the line to South Eston, provided they can obtain land for the extension on terms which appear to them reasonable.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been quiet this week. Scotch warrants were in moderate demand at about the closing rates of last week, with now and again a slightly easier tendency. The inquiry for Cleveland warrants has been dull, and only a small business took place in hematite warrants. The market does not possess any speculative interest at the moment.

Since last report four additional furnaces have been put in blast, and there are now 66 in operation, compared with 62 last week and 53 in the corresponding week of last year. Of the four additional furnaces lighted, three have been placed on hematite and one on ordinary.

The values of makers' special brands are fairly steady as follows:—G.M.B. f.o.b. at Glasgow, No. 1, 44s.; No. 3, 42s. 6d. per ton; Carnbroe, No. 1, 46s. 6d.; No. 3, 45s.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie, No. 1, 52s.; No. 3, 48s.; Calder, No. 1, 52s. 6d.; No. 3, 48s.; Summerlee, No. 1, 53s. 6d.; No. 3, 48s.; Coltness, No. 1, 55s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 51s. 6d.; No. 3, 47s. 6d.; Eglinton, No. 1, 48s.; No. 3, 46s.; Dalmellington at Ayr, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 58s.; No. 3, 50s. 6d.

The shipments of pig iron from Scottish ports in the past week amounted to 5951 tons, compared with 5828 in the corresponding week. There was sent to Italy 357 tons, Germany 774, India 265, Canada 12, Australia 245, France 60, Holland 100, Belgium 40, Spain 45, China 218, other countries 1058, the coastwise shipments being 2777 tons against 1205 in the same week of 1893.

The manufactured iron and steel branches are dull, business generally coming short of what was anticipated at the end of the strike. Of steel a very considerable quantity is used daily in the shipyards, and this is likely to be maintained during the winter; for while some firms are slack, others have been obtaining new orders for vessels which will require fair quantities of raw material.

Locomotive engineers are in several cases busy with good prospects, but at the railway works there is less doing, the workmen in the Caledonian employment in Glasgow being on short time.

The coal trade keeps steady, the current output of the collieries being apparently fully absorbed. As a consequence of this, manufacturing consumers are having to pay higher prices than they expected, and some of the miners are endeavouring to get up a fresh movement in favour of an advance of wages. The coal shipments in the past week reached 151,397 tons, being 9437 tons more than in the preceding week, but still about 50,000 tons behind those in the corresponding week of last year.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE weather has again told seriously upon the coal trade, and I am assured that the storms of the week will total up a series of grave losses to colliery shipping.

Exchange news at Cardiff continues favourable to the outlook of the future, when better weather is experienced. For the present both prompt and forward business is dull, and the only satisfaction given is that prices remain tolerably firm. So far prices cling to 11s. for best steam. Last Cardiff figures are: Best steam coal, 11s. to 11s. 3d.; seconds, 10s. 3d. to 10s. 6d.; best Monmouthshire, 10s. 3d. to 10s. 6d.; small, 4s. 6d. to 5s.

There is only a moderate business going on in house coal, though the time is at hand for something more pronounced. Cardiff prices this week are:—Best households, 10s. 9d. to 11s.; No. 3 Rhondda, 10s. to 10s. 3d.; brush, 8s. 3d.; small, 6s. 3d. to 6s. 6d.; No. 2 Rhondda, 8s. 3d. to 8s. 6d.; through, 6s. 3d. to 6s. 6d.; small, 4s. 6d. to 4s. 9d.

The coke market remains fairly active, but prices are unchanged, there having been a good deal of over-production of late. Patent fuel is selling at 10s. to 11s.; Swansea, 10s. 6d. to 11s.; Cardiff anthracite coal at Swansea is now quoted 8s. 9d. to 9s. for ordinary large, to 12s. to 12s. 6d. for best samples. Trade generally at Swansea has been affected by the violence of the weather. To this is due the exceptionally small export of tin-plates last week, only amounting to 23,380 boxes. The quantity received from the works totalled 70,155 boxes, and this naturally intensifies the situation, which is becoming critical.

Mid-week on 'Change, Swansea, the opinion was expressed in substantial quarters that unless an improvement should set in a general stoppage of works was inevitable. Perhaps this is taking too gloomy a view, yet mention was made at the meeting of several works that were preparing to close unless a change took place. It was also stated that the owners of these works thought that the expenses of keeping the works idle would be less than to keep on manufacturing plates at a loss.

A consideration of the tin-plate returns, just issued, should not strengthen existing depression, I submit. During the ten months ended October, 1893, 328,768 tons have been exported from Wales, the joint make of South Wales and Monmouthshire, and the value amounted to £4,336,882. During the same period this year the shipment was 283,763 tons, and the value £3,498,253. So if this shows a falling off, there are the improvements of October to fall back upon, showing an increase of 14,844 tons, and the value £153,592.

Very meagre returns come to hand in connection with the iron and steel trades, and the general dulness has been intensified of late by the depression in tin-plate.

Pig iron, too, is weaker. Swansea quotations this week: Glasgow warrants were down to 42s. 6½d., and Middlesbrough 35s. 10d. Other quotations were: Welsh bars, £5 2s. 6d.; sheet iron from £6; sheet steel from £6 5s. Steel rails, heavy, from £3 15s.; light from £4 10s. Bessemer and Siemens tin-plate bars from £4 to £4 2s. 6d. Bessemer tin-plates from 10s. to 10s. 3d.; Siemens, from 10s. 3d. to 10s. 6d.; ternes, 20s. to 24s.; and best charcoals, 12s. to 12s. 3d. Cardiff quotations are still lower than those of Swansea in some respects. Bessemer bars, for instance, are quoted at £3 18s. 6d. to £4; and Siemens best from £4 to £4 2s. 6d. This reduction is solely due to the lower figures quoted by the North of England.

Timber continues to droop. The latest quotations Cardiff, is from 14s. 10d. Iron ores are moderately inquired for, but at lower values; Rubio, best, selling at 11s. 1½d. to 11s. 3d. Cardiff; Tafna, 10s. 9d.; Garucha, 10s. 9d.; Porman, 10s. to 10s. 3d.

The agitation against the transfer of the Albion Fund to that of the Miners' Provident Fund continues. I am afraid this will tell against the expression of practical sympathy in the case of future calamities. At all events the public will be warned how to direct the disposition of their charities.

The Conway Waterworks are to be "inaugurated" this week. They have cost £40,000.

Arrangements, I am glad to note, have taken place between Captain Phillips and his employés, which have resulted in a concession of ten boxes per hundred until December 31st.

This will affect the works at Nantyglo, Blaina, Abertillery, Pontymister, and Waterloo.

The Cardiff Electric Works are to be opened on Saturday.

There is an impression that parliamentary business from the Cardiff district will be considerable next session. The Barry, it is understood, will make another attempt to obtain powers for tapping the Rhymney and other Monmouthshire valleys. The Bute Docks Company too will have an important Bill to promote, though of its nature little is known outside a small circle. The Taff and Rhymney Railways will also have Bills it is stated.

It is intended to double the line of the Brecon Railway between Pengam and Machen, a distance of about eight miles. This step is regarded as imperative on account of the marked increase in coal traffic over a good deal of the district in question. The opinion is current that an early start will be made next year, and that a large force of men will be put on to carry it out expeditiously.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE reports that come in from the different iron markets all bear a more or less unfavourable character. Instead of improving, iron business appears to become even more dull, and consumers as well as dealers are more than ever inclined to hold back with their orders; the state of both the raw and the finished iron trades is most discouraging. Of the Silesian iron business poor accounts are given in general. Makers of pig iron continue very weakly engaged, and there is no hope for increasing activity in that department until the demand for finished iron has improved. Extremely few orders are also forthcoming in the steel trade, and restrictions of output have already been reported in several instances.

Demand and sale continue fairly good on the Austro-Hungarian iron market, only for some articles of manufactured iron, such as bars and girders, a lessening inquiry has been noticed. The scarcity in pig iron, as well as the slight rise in quotations caused thereby, has led some dealers to order their supplies from foreign, especially English, firms, and large quantities of English pig iron, amounting to several hundred wagons in one case, are said to have been sold to an Hungarian works. The endeavours which German firms are constantly making to sell their products on the Austrian market have been successful of late, chiefly, no doubt, on account of the exceedingly low prices they quote.

In France the amount of business done on the raw and finished iron market is certainly not large, but fairly satisfactory. Prices continue low, as there are, on the whole, more offers than inquiries, and competition, especially that of Belgian works, is again rather disagreeably felt. In Paris merchant bars are at present being offered at 140 to 145f. p.t., and girders fetch 150 to 155f. p.t.

The tendency is to firmness on the Belgian iron market, and a pretty lively business is doing in most sorts of iron. Demand for home requirements is tolerably good, and foreign, especially transmarine orders, have likewise been more numerous lately. The Belgian State Railways have granted an order for 15,000 t. steel rails to Belgian works at the price of 119·90f. p. t., Krupp and the Bochumer Verein asking 124f. p.t. A Liége arms factory is reported to have booked a contract for 10,000 rifles and 1,000,000 cartridges for the Chinese Government.

It is as yet impossible to notice any change for the better in the Rhenish-Westphalian iron business. On the contrary, a tone of uncertainty and even depression is gaining ground. Iron ores are in limited request. The proposed convention of the Siegerland ore mines is expected to have a beneficial influence on the ore trade, particularly with regard to prices. Up to date, spathose iron ore is offered at M. 7·20 to 7·50 p.t. at mines, while roasted ditto fetches M. 10 p.t. Nassau red iron ore stands at M. 90 p.t., free Dillenburg, Luxemburg-Lorraine minette sells at M. 2·60 to 2·70, and 3·30 p.t. net at mines. A steady business is done in Spanish ores, though requirements are small generally; prices show no change whatever.

In the Siegerland the blast-furnace works are with but few exceptions in regular and some even in lively employment, a good amount of orders having been booked recently. In the Rhein and Ruhr district the physiognomy of the iron industry is less favourable; the dulness in demand continues, and there is no alteration perceptible with regard to quotations. Spiegeleisen, 10 to 12 p.c. grade, fetches M. 52 p.t.; Rhenish-Westphalian forge pig, No. 1 M. 46 to 47; No. 3, M. 40 p.t.; Siegerland, good forge quality, M. 44 p.t.; hematite, M. 63; foundry pig, No. 1, M. 63.; No. 3, M. 54, p.t.; basic, M. 45; German Bessemer, M. 49 to 50 p.t. Iron for making steel, M. 44 to 47 p.t. at works. Luxemburg forge pig is sold at 48f. p.t., free Luxemburg.

The outlook in the malleable iron trade continues anything but favourable. Bars and all sorts of sectional iron are in weak request, and only fetch very low prices. Hoops are rather brisk of sale, and heavy plates are also in tolerably good request, while sheets remain entirely neglected. Quotations for both plates and sheets have shown much weakness. The rivet business is also quiet just now. At the foundries and machine factories activity continues irregular, and altogether far from satisfactory; the wagon shops are generally in fair employment.

The following are the latest list quotations, per ton at works:—Good merchant bars, M. 102 to 105; angles, M. 120; girders, M. 90 to 95; billets in basic and Bessemer, M. 73 to 77; hoops, M. 108 to 113; heavy plates for boiler-making purposes, M. 150; tank ditto, M. 130 to 135; steel plates, M. 120 to 125; tank ditto, M. 120; sheets, M. 115 to 135; Siegen thin sheets, M. 125; iron wire rods, common quality, M. 115 to 120; drawn wire in iron or steel, M. 105 to 120; wire nails, M. 125; rivets, M. 145, in some instances M. 150; rivet iron, M. 130; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 110 to 120; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230.

In 1893 the output of the mines in Italy was, in tons, as under:—Iron ore, 191,305; maganese ore, 810; iron manganese ore, 8805; copper ore, 96,299; zinc ore, 132,767; lead ore, 29,004; silver ore, 1236; gold ore, 7393; antimony ore, 1193; quicksilver ore, 19,450; pyrite, 29,460; sulphurous ore, 417,671; mineral salt, 16,790; mineral coal, 317,249. The production of the blast furnace works, mills, and melting houses was, in tons:—Pig iron, 8038; bars, 138,046; cast iron, 8159; steel, 71,389; tin-plates, 2500; lead, 19,898; mercury, 273; antimony, 376; copper, 6911; zinc plates, 250. In silver 40,095 kilogs. were produced, and in gold 362 kilogs. About 56,314 men were employed at the mines, value of output amounting to 57,906,180 lire, while at the 501 foundries and smelting houses 19,013 men were employed, and value of production amounted to 168,807,406 lire.

## AMERICAN NOTES.

NEW YORK, Oct. 31st, 1894.

THE vigorous protest of the commercial and industrial interests of the United States to the present administration will be recorded next Tuesday, after which a general but gradual improvement in business is assured. Business has declined for two weeks. Prices in iron and steel are perceptibly weaker because of the temporary withholding of orders. Brokers and manufacturers have personal knowledge of extensive requirements for the coming winter for iron and steel, but no orders of any magnitude have been heard of lately. Mill production is restricted to orders in hand. Railroad building has reached its lowest limit. Projected mileage for 1895, if undertaken, would furnish steady employment single turn for the rail capacity. Orders for girder rails keep five or six mills quite busy. Billets have weakened still further. Bar iron has sold at 18 dols. per ton. Pig iron production is promptly absorbed. Commercial conditions are unfavourable. Distribution of merchandise is restricted. Consumers, retailers, jobbers, and all middle interests adhere to the hand-to-mouth course they have been following for eighteen months.

THE report of her Majesty's ship Champion, which recently surveyed Neckar Island, shows that the island is not well adapted for a cable station. Bird Island, 250 miles from Honolulu, which was visited by Mr. Fleming on his recent trip, possesses greater advantages.

## LAUNCHES AND TRIAL TRIPS.

The Campbeltown Shipbuilding Co. launched from its yard at Campbeltown, Clyde, on Friday, a handsomely modelled steel screw steamer of 2000 tons deadweight. The engines, which are triple expansion, are being supplied by Messrs. Kincaid and Co., Clyde Foundry, Greenock. The steamer has long raised quarter deck aft, and part awning deck forward, water ballast in cellular double bottom, complete and speedy pumping arrangements, steam and screw steering gears, and all the latest improvements for navigating the ship economically, and for the speedy loading and discharging of cargo, including large steam winches. Steam will be supplied by a large boiler working at a pressure of 160 lb. The average speed, loaded at sea, is to be 9½ knots on a small consumption of fuel. The vessel has been built to class 100 A1 at Lloyd's under special survey for Welsh owners and is intended for their general trade. The steamer was named Refugio by Miss Bessie Morrison, Altnacraig, Greenock.

On Wednesday there was launched from the Cleveland Dockyard of Sir Raylton Dixon and Co., Middlesbrough, a very fine steel screw steamer which has been built to the order of Messrs. David MacIver, Sons, and Co., of Liverpool and London, for their River Plate Line. This is the last of three sister vessels which these builders are now constructing for the same owners, all of which are specially designed and fitted for the Plate trade; comfortable and well-ventilated accommodation for the passengers being fitted up in the poop. The vessel is of the partial awning deck type with long raised quarter-deck and poop, and has been built under special survey for Lloyd's highest class, the principal dimensions being:—Length, 305ft.; beam, 41ft. 3in.; depth, moulded, 30ft. 3in., with a deadweight carrying capacity of over 3500 tons on a very light draught of water, and all the deck houses and other deck erections are so arranged that the steamer can be promptly adapted for the carrying of cattle. She will be rigged as a fore and aft schooner, and fitted with Sidgwick's patent hinged topmasts, which can be quickly lowered when the steamer is required to pass under such obstructions to navigation as the permanent bridges over the Manchester Ship Canal. The engines will be fitted by Messrs. Blair and Co., of Stockton, the cylinders being 23in., 37in., and 61in. by 42in. stroke, with two large steel boilers working at 160 lb. pressure, and as the vessel is of fine lines, a good sea speed will be economically maintained. The steamer has been built under the superintendence of Mr. P. H. Roscoe, of Liverpool, superintending engineer to the owners. As the vessel was leaving the ways, she was named the Lombardy by Mrs. Charles Livingston, of Liverpool, the wife of one of the directors, who was presented by Sir Raylton Dixon with a beautiful bouquet of choice flowers.

The s.s. Severus, the third large steel screw steamer built by Messrs. W. Gray and Co. to the order of Mr. C. Andersen, of Hamburg, recently went on her trial trip. Her dimensions are:—Length over all, 340ft.; breadth, 44ft.; depth, 27ft. 2in., and she is classed 100 A1 at Lloyd's. The principal deck erections are a long bridge, topgallant forecastle, and half poop. Large deck houses are built at each end of the bridge to contain the two powerful refrigerating machines, which have been supplied by the Haslam Foundry Company, of Derby, the vessel being fitted out for carrying frozen meat from the Australasian Colonies, and having all her holds insulated for that purpose. The saloon and cabins are tastefully fitted up in the poop and have the entrance through a deck house, which forms a comfortable smoke-room. The engineers' rooms are in deck houses built for them on the bridge, and the sailors' and firemen's berths are in the forecastle. As the Severus is intended to go regularly round the world she is square rigged on the fore mast to benefit by the trade winds, the currents of which are on her course. She has large water ballast capacity in her cellular double-bottom and after-peak tanks. Her boats are carried on beams overhead, and she is fitted with a direct steam windlass, steam steering gear amidships, and screw hand gear aft, steam winches, stockless anchors, and all improved appliances for her special trade, and also for general trading. The engines are of 1200-horse power, of the triple-expansion type, by the Central Marine Engine Works of the builders, who also supply three large steel boilers working at a pressure of 160 lb. per square inch, and which are of ample capacity to supply the freezing engines with steam as well as the main engines throughout the voyage. A day or two before the trial trip both the large refrigerating engines were tried for several hours, and ran in a satisfactory manner. On Saturday last steam was got up and the main engines were moved whilst the vessel remained in dock for the inspection of the head surveyor of the German Lloyd's, from Hamburg, who found everything in connection both with the boilers and engines to his entire satisfaction. The vessel left the harbour at an early hour, and had her compasses adjusted by Mr. Berry, after which the engines were fully opened out and run at a high speed without any hitch or trouble of any kind arising, everything working perfectly well. The speed of the ship was found to be 11½ knots per hour in the trim in which she starts on her Australian voyage, and she will probably average 11 knots around the world. The engines possess all the latest improvements that have been developed at the Central Engine Works, and their steam economy will not be behind any of the well-known examples that have left these works. There is fitted on board a very large sized Mudd's evaporator for making up the supplementary feed, and which is made with a boiler-plate steel shell of neat design and large steam capacity. The propeller is of the loose-bladed type, fitted with blades made of Stone's manganese bronze, and the tail shaft is protected from corrosion by Mudd's patent tail shaft preserver. The vessel is in charge of Captain Berndt. The shipbuilders were represented by Captain J. Murrell, and the engine builders by Mr. T. Mudd.

---

A CONTEMPORARY states that the United States Government is about to make or order 700 6-pr. quick-firing guns as armament for auxiliary cruisers.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

⁂ When patents have been "communicated" the name and address of the communicating party are printed in italics.

1st *November*, 1894.

20,908. Lamp Holders, H. Lea, London.
20,909. Automatic Attachment for Labels, C. B. Clarke, Norwich.
20,910. Fittings for Holding together Angles of Bedsteads, J. Talbot, Birmingham.
20,911. Steam Joints, W. M. Walters, Liverpool.
20,912. Jewellery Cases, J. C. Roper, Chesterfield.
20,913. Differential Brake for Lorries, R. Mitchell, Glasgow.
20,914. Golf Clubs, W. Park, jun., Glasgow.
20,915. Filling Moulds, &c., with Plastic Fluids, J. Gelder, Manchester.
20,916. Detachable Button and Necktie Holder, E. A. Brown, Keighley.
20,917. Incandescent Electric Lamps, H. H. Hall, Liverpool.
20,918. Preventing Glue-pots, &c., Boiling Over, J. Smith and R. Clayton, Deepfields, near Bilston.
20,919. Securing Detachable Tires to Rims, J. W. Fletcher, Derby.
20,920. Inkwell Covers, J. Wollman, Rotherham.
20,921. Metal Tubes for Boilers, W. B. Thompson, Dundee.
20,922. Self-cleaning Tramway Points, G. H. Winsor, Newport.
20,923. Rudders for Steering Steamships, W. J. Vincent, Cardiff.
20,924. An Aquatic Roundabout, A. J. Budge, Sunderland.
20,925. Golf Clubs, C. Spinks, Glasgow.
20,926. Valve for Washing Machine, F. O'Rorke, Dublin.
20,927. Device for Advertising, P. and F. McGlade, Belfast.
20,928. Fastening Arrangement for Glass, E. Richter, Glasgow.
20,929. Turning Over Music, J. M. Smith, West Bromwich.
20,930. Water-closet Basins, J. Merrill.
20,931. Storing Cycles, W. Kyle, Glasgow.
20,932. Cleaning Boiler Flues, D. Morrisey and F. H. Thomas, London.
20,933. Manufacture of Paper Bags, The Burnley Paper Works Co., and J. Bradley, London.
20,934. Smoke-arrester, J. J. Rendleman, London.
20,935. Valve Stopper for Bottles, J. H. Gault and C. F. Schrader, London.
20,936. Hooks and Eyes, A. L. Milburn, London.
20,937. Tobacco Pipes, J. Roslin, London.
20,938. Racks, F. W. Maishman, London.
20,939. War-ship, G. W. Thomas, London.
20,940. Furnace Tubes, H. C. Ashlin, London.
20,941. Gas Carburetting Apparatus, W. Ritchie, Liverpool.
20 942. Twisting Yarns, S. H. and J. S. Brooks and R. A. Doxey, Manchester.
20,943. Treatment of Water, W. M. Williams, London.
20,944. Telephonic Switch, G. L. Anders, London.
20,945. Can-labelling Machines, E. W. Cornell and F. H. Knapp, London.
20,946. Signalling Apparatus, C. Warren and R. S. J. Fothergill, London.
20,947. Moulding Confections, J. A. Baker.—(*C. H. Grebenstein, United States.*)
20,948. Polishing Metal Plates, S. O. Cowper-Coles, London.
20,949. Turbine Propellers, A. W. F. G. Linnenbrügge, London.
20,950. Axle-boxes, I. Metzger, London.
20,951. Traps for Throwing Targets, R. Millar, London.
20,952. Dress-button, J. Downey, London.
20,953. Mouth-pieces for Pipes, H. O. Thorp, London.
20,954. Production of Motive Power, E. L. Long, London.
20,955. Mowing Machines, E. E. Bentall, London.
20,956. Extraction of Precious Metal, A. E. Morgans, London.
20,957. Replacing Derailed Cars, W. J. Knight, London.
20,958. Ships' Anchors, J. Verity, London.
20,959. Electric Apparatus, A. E. Williamson, E. L. Joseph and The Electric Light Regulating Syndicate, London.
20,960. Engine Governors, A. S. F. Robinson, London.
20,961. Decomposition of Alkaline Chlorides, M. Guthrie, London.
20,962. Connecting Pipes, S. W. Carlton, London.
20,963. Nut Locks, J. T. Drew, London.
20,964. Production of Tiles, F. V. Hardmuth, London.
20,965. Alarum Clocks, E. Edwards.—(*H. Ahlgrimm, Germany.*)
20,966. Packing Railway Sleepers, H. Sadler, London.
20,967. Cigarette Making Machines, F. J. Ludington, London.
20,968. Arranging Sleeping Berths, R. H. Froude, London.
20,969. Air and Liquid Motor Engine, L. Aulit, London.
20,970. Deadening Nerves, D. Young.—(*A. B. Jones, United States.*)
20,971. Making Fertile Materials, C. H. Thompson, London.
20,972. Curing Tobacco, H. A. Wickham and H. Niell, London.
20,973. Stilts, E. Ewerbeck, London.
20,974. Maturing Alcoholic Liquors, H. A. Leverett, London.
20,975. Coal, &c., Grabs, G. J. Hone and C. Wilson, London.
20,976. Finger Protector for Doors, J. W. Rodwell, London.
20,977. Billiard Tables, H. Sale and F. H. Rake, London.
20,978. Wind Motors, A. J. Boult.—(*C. Hoeck, Belgium.*)
20,979. Gullets of Saddle-trees, J. and B. Beebee, London.
29,980. Means for Jointing Rail Ends, W. Lewis, London.
20,981. Dividing House Refuse, J. Eaton and C. R. Powell, London.
20,982. New Steeplechase Game, G. E. A. Fursdon, London.
20,983. Driving Gloves, G. E. A. Fursdon, London.
20,984. Cycles, J. G. Wilkinson and J. Fitzgerald, London.
20,985. Braiding the Strands of Wire Ropes, J. T. Selby, London.
20,986. Fastening the Covers of Umbrellas, H. Pratt, London.
20,987. Combined Collar Studs and Tie-clips, H. Pratt, London.
20,988. Apparatus for Cooling Beer, J. T. Poplawsky, London.
20,989. Gas Meters, H. A. Hicks, London.
20,990. Jugs, F. E. Forteath, London.
20,991. India-rubber Sandal for Boots, J. M. Carter, London.
20,992. New Game, G. L. Prior and B. J. Hyde, London.

2nd *November*, 1894.

20,993. Gearing for Cycles, A. Tracy, London.
20,994. Bag Locks, G. F. Redfern.—(*Messrs. Huppe and Bender, Germany.*)
20,995. Chaff-cutters, E. Scales, London.
20,996. Forming Under-cut Surfaces in Tiles, T. W. Jarrett, London.
20,997. Lubricators, C. Koerte, Leeds.
20,998. Apparatus for Producing Gas, J. Morrison and T. Booth, Stockton-on-Tees.
20,999. Advertising on Sculls, A. W. Loveland and J. and G. Hart, Norwich.
21,000. Infants' Food Warmers, W. Snelgrove and H. Ryland, Birmingham.
21,001. Expelling Moisture out of Bottles, T. Hill, Hull.
21,002. Apparatus for Curling Hair, E. Entwistle, Manchester.
21,003. Safety Carrier, H. Joyner, Stairfoot, near Barnsley.
21,004. Punching and Stamping Machines, W. Rourke, Withington, near Manchester.
21,005. Placquet Closer, A. Nicholson and J. Hall, Staffordshire.
21,006. Brushes for Cleaning Cycles, F. A. Powell, Birmingham.
21,007. Velocipede Saddles, E. Woods, Liverpool.
21,008. Portable Oil Lamps, G. Birch and W. Birchall, Manchester.
21,009. Metal Rims and Pneumatic Tires, A. Dugdale, Manchester.
21,010. Pocket Protectors, J. and E. L. Kavanagh, London.
21,011. Reversing Screw-propellers, F. O. Prince, London.
21,012. Drying Refuse, R. Cunliffe and E. W. Adamson, Manchester.
21,013. Gas Economisers and Purifiers, J. Howarth, Manchester.
21,014. Mules for Spinning, W. Partington, Manchester.
21,015. Mechanism of Pianofortes, P. Nugent and P. Nugent, jun., Carmyle, near Glasgow.
21,016. Indicating Height of Water in Boilers, J. Carter, Stalybridge.
21,017. Starting Trams, J. Milnes and H. J. Champion, London.
21,018. Flexible Shafts, H. Döring, Manchester.
21,019. Metallic Letters, A. J. E. Hill, Kingston-on-Thames.
21,020 Hydraulic Valves, C. Scriven and J. Scriven, Leeds.
21,021. Billiard Cues and the like, J. Hughes, Manchester.
21,022. Locking Cycle Wheels, F. C. Wild, jun., and and J. K. Starley, London.
21,023. Rain, &c., Shade for Vehicles, A. M. Mendoza, London.
21,024. Captive Balloons and Kites, P. S. Pilcher, London.
21,025. Process for Extracting Gold, H. R. Angel, London.
21,026. Folding Box, M. M. Cleckley, London.
21,027. Meat-cutting Machine, M. Lytch, London.
21,028. Internal Combustion Engines, H. F. Foster, London.
21,029. Manufacturing Linoleums, W. G. Thomson, London.
21,030. Carpet Rod Fasteners, &c., A. T. Hughes, London.
21,031. Seams of Waterproof Garments, T. Birnbaum, London.
21,032. Automatically Lighting Gas, J. F. Duke, London.
21,033. Pneumatic Malting Apparatus, E. Larsen, London.
21,034. Motive Power Gear, W. E. Simons, Glasgow.
21,035. Storing Eggs, T. R. C. Christianson, Glasgow.
21,036. Golf Clubs, Sir W. H. Dalrymple, Glasgow.
21,037. Spring Bearings for Cycles, G. R. Sisterson, London.
21,038. Curtain-rod Holder, J. Kott, London.
21,039. Removing Pneumatic Tires, A. J. W. Lambon, London.
21,040. Clips for Garments, J. Hewitt and F. R. Baker, London.
21,041. Mechanism for Rotating Shafts, O. Wernick, London.
21,042. Tires for Wheels of Velocipedes, D. Doig, London.
21,043. Damping Galvanometers, T. Clark and T. E. Weatherall, London.
21,044. Toe Pad for Football Boots, C. Storer, London.
21,045. Dynamo-electric Machines, M. Hutin and M. Leblanc, London.
21,046. Velocipedes, C. E. Stredwick, London.
21,047. Advertising, W. S. and W. F. S. Chenhall, London.
21,048. Tires for Wheels of Velocipedes, D. Doig, London.
21,049. Seed-sowing Machines, C. Gheorghescu, London.
21,050. Closing Preserve Jars, W. P. Thompson.—(*The Conserven-Fabrik Mombach-Mainz von Dr. W. Naegeli, Germany.*)
21,051. Charging Gas Retorts, J. Ruscoe, Manchester.
21,052. Boiler and other Furnaces, J. Sutton, Liverpool.
21,053. Hydraulic Intensifiers, J. C. Etchells, Manchester.
21,054. Increasing Speed in Walking, J. Evans, Liverpool.
21,055. Driving Mechanism of Cycles, G. H. Cook, W. H. Brown, and A. Winsor, London.
21,056. Bricks, S. I. Adams, London.
21,057. Cycles, W. and H. Guest, London.
21,058. Stair Treads, W. Gooding, London.
21,059. Improved Safety Bicycle, G. B. H. Austin, London.
21,060. Coating Metal Plates, P. Rogers and J. Player, London.
21,061. Trivet for Heating Sad Irons, G. Steel, London.
21,062. Flower Holder, G. Inngk, London.
21,063. Launching Locomotive Torpedoes, E. W. Lloyd and C. W. Hutchinson, London.
21,064. Raising and Lowering Lamps, E. W. Abbott, London.
21,065. Fixing Screws to Stones, J. Boeddinghaus, London.
21,066. Pneumatic Tires, G. W. and H. Panzetta, London.
21,067. Roll Paper Holders, A. J. P. Brown and J. R. Brough, London.
21,068. Water-closet Flushing Apparatus, J. Montagner, London.
21,069. Air Gun, J. Montagner, London.
21,070. Wheels, E. J. Pinnock, London.
21,071. Picture Frames, S. D. S. Ross and A. Docker, London.
21,072. Attachments for Pianos, &c., W. Barker, London.
21 073. Curtain Pins or Fasteners, R. D. Moody, London.
21,074. Device for Fastening Jewellery, R. D. Moody, London.
21,075. Railway Signalling, C. V. Craster, G. L. Imeson, and J. C. Imeson, London.
21,076. Lock for Cycles, C. Sangster, London.
21,077. Starting Stamping Presses, H. C. Sanders and F. W. Rumball, London.
21,078. Armoured Hose, J. E. Howard, London.
21,079. Lighting Gas Lamps and the like, G. Heckert, London.
21,080. Secondary Batteries, C. Laugie, London.
21,081. Packing for Steam Machinery, P. Hulburd, London.

3rd *November*, 1894.

21,082. Holding Velvet, &c., W. Junge and W. E. Murray, London.
21,083. Archimedean Drills for Cycles, J. H. Smith, London.
21,084. Manhole and other Covers, F. G. S. Ham, London.
21,085. Soles of Boots and Shoes, H. D. Ingle, Manchester.
21,086. Utilisation of Waste Force, P. Nugent, Carmyle, near Glasgow.
21,087. Protecting Heels of Boots, J. Holman, London.
21,088. Joint Connector for Lead Pipes, F. Albon, London.
21,089. Supporting the Shafts of Wagons, W. Jones, Liverpool.
21,090. Wire Mattresses, T. M. Hewitson and G. and H. J. Lane, Birmingham.
21,091. Method of Decorating Tiles, T. H. Stubbs, Longport.
21,092. Estimating Water in Butter, R. H. Wilkinson, Limerick.
21,093. Shelf-hook, A. Woodmansey, London.
21,094. Locking Cycles, H. Keys, Birmingham.
21,095. Scutching and Roving Frames, J. Hoyle, Manchester.
21,096. Children's Mail Carts, J. T. B. King, Manchester.
21,097. Steamships, J. Patton.—(*N. Etick, New Zealand.*)
21,098. Obtaining Electrical Energy from Gases, W. Borchers, London.
21,099. Construction of Road Pavements, W. Purdy, Leeds.
21,100. Trunk, H. A. Norman, Liverpool.
21,101. Woven Driving-belts, J. Taylor, Manchester.
21,102. Portable Irrigator, W. E. Bracey, Birmingham.
21,103. Disinfecting Apparatus, F. M. Woolcock, Torquay.
21,104. Grooved Mouldings or Casements, G. Grant, London.
21,105. Warning Bell, &c., for Vehicles, J. Boyd, Dublin.
21,106. Portable Derrick, J. C. Murphy.—(*T. J. Burns, United States.*)
21,107. Brakes for Velocipedes, A. Farnell, Bradford.
21,108. Prepayment Gas Meters, W. and W. H. Cowan, Glasgow.
21,109. Supporting Mirrors for Tables, R. H. Taylor, E. Whitfield, and C. Phillips, Birmingham.
21,110 Controlling Supply of Steam, &c., G. Glydon, Birmingham.
21,111. Combination Garden Tool, E. H. Bruton, London.
21,112. Pneumatic Tires for Wheels, G. Challiner, Manchester.
21,113. Letter boxes, R. Hainsworth, Leeds.
21,114. Ropes and Cables, J. T. Haase, Manchester.
21,115. Wire Sieves, T. H. Turner and J. Turner, Sheffield.
21,116. Reversing Gear for Pumps, W. Cadman, Sheffield.
21,117. Extermination of Insects, H. F. Brown, London.
21,118. Cigarettes, G. C. Dixon, London.
21,119. Bleaching Straw, T. Lye and W. T. Lye, London.
21,120. Colouring Straw, T. Lye and W. T. Lye, London.
21,121. Paper Cutting Machinery, &c., D. Payne, London.
21,122. Umbrellas, J. J. W. Behrens, London.
21,123. Walking-stick, J. J. W. Behrens, London.
21,134. Gearing for Bicycles and the like, E. Saurel, London.
21,125. Preventing Ignition, A. J. Boult.—(*A. Shörke, Germany.*)
21,126. Stencil Plates, J. H. Holmes, Liverpool.
21,127. Combined Seat and Folding Berth, P. Fraser, London.
21,128. Metal Packages, W. P. Thompson.—(*C. L. Coffin, United States.*)
21,129. Knitting Machines, J. A. A. Barfoot and J. Johnson, London.
21,130. Metal Packages, W. P Thompson.—(*C. L. Coffin, United States.*)
21,131. Separating Oils and Fats, A. L. G. Dehne, London.
21,132. Equatorial Reflecting Telescope, G. Calver, London.
21,133. Pointing or Sharpening Pencils, J. Lyle, London.
21,134. Straightening Cutting Surfaces, J. Jackson, London.
21,135. Portiere Rods, G. H. Brown and J. Whitfield, Birmingham.
21,137. Adjustable Spanners, J. Winkless, sen., and W. J. Sturgess, Birmingham.
21,138. Boilers, W. Schmidt, London.
21,139. Heels of Boots and Shoes, C. Olandt, jun., London.
21,140. Controlling Electrical Illumination, Siemens Brothers and Co.—(*Messrs. Siemens and Halske, Germany.*)
21,141. Controlling Induced Currents, Siemens Brothers and Co.—(*Messrs. Siemens and Halske, Germany.*)
21,142. Starting and Reversing Electromotors, Siemens Brothers and Co.—(*Messrs. Siemens and Halske, Germany.*)
21,143. Solid Manure Stimulants, C. E. Booty, London.
21,144. Closing the Doors of Elevators, J. M. Elder, London.
21,145. Button Drilling Machinery, J. Webb, London.
21,146. Variable Driving Gear, S. T. Wentworth, London.
21,147. Umbrellas, J. H. V. Jacobsen, London.
21,148. Mode of Stoppering Bottles or Jars, J. Pugh, Birmingham.
21,149. Steam Diggers, J. McLaren and H. McLaren, London.
21,150. Spiral Staircase, J. Mallett and C. Anckorn, London.
21,151. Syphon Head, J. Macek, London.
21,152. Obtaining Motive Power, J. L. Osborn and A. Good, London.
21,153. Aprons, J. Leighton, London.
21,154. Anti-leakage Metal Packing, P. Foster, London.
21,155. Whip-thong Holder, J. K. Stewart and W. Marchant, London.
21,156. Washing and Grading Refuse, W. Cole, London.
21,157. Razor Strop, J. H. Grogan, London.
21,158. Pneumatic Tires, G. J. Stevens, London.
21,159. Vessels for Containing Water, P. G. Typke, London.
21,160. Thread Packages, B. L. Armstrong, London.
21,161. Screw Nuts, Tubular Washers, &c., S. Hampton, London.
21,162. Saddles for Bicycles, &c., J. A. Lamplugh, London.

5th *November*, 1894.

21,163. Keys for Locks, A. R. Tonks, Willenhall.
21,164. Lantern-slide Clamps, J. F. Hall-Edwards, Birmingham.
21,165. Weaving Weft Pile Fabrics, A. F. Barrett, Keighley.
21,166. Drawing Designs, W. Birks, A. Cullen, and J. Taylor, Nottingham.
21,167. Pulley Block Mechanism, E. W. Sant, Stockton-on-Tees.
21,168. Handles for Velocipedes, J. W. Thompson, Lancashire.
21,169. Steering Lock for Cycles, F. Eason, Nottingham.
21,170. Collecting Dust from Grain, E. T. Nicholson, Rochdale.
21,171. Entrapping Steam in Pipes, G. Bennett, Birmingham.
21,172. Hair-pin Holder and Box, T. Geddes, Harrowgate.
21,173. Ventilating Floors, J. Sheppard and F. Dashwood, London.
21,174. Sharpener for Scissors, J. G. Rollason, Birmingham.
21,175. Valves for Power Motors, J. Anderson, Newcastle-on-Tyne.

21,176. Probing Tobacco Pipes, W. Lack and O. Ling, Derby.

21,177. Fire-lighters, J. Maynes and C. L. Watchurst, London.

21,178. Bottles for Poisonous Liquids, A. Winks, Halifax.

21,179. Bevelling Templates, H. Parker, Birmingham.

21,180 Cycle Cranks, G. Pirnie, Dundee.

21,181. Ships' and like Berths, W. P. Hoskins, Birmingham.

21,182. Portiere Rods, F. Hoskins and T. Smith, Birmingham.

21,183. Brushing Sewer, &c., Pipes, W. J. Bosley, Surrey.

21,184. Velocipedes, C. T. Cooper, Leicester.

21,185. Electric Light Pendants, C. T. Powell, Birmingham.

21,186. Steam Engines, W. E. Heys.—(*J. J. Heilmann, France*)

21,187. Cleaning Safety Lamps, G. Grossmann and F. W. Ruhfus, Manchester.

21,188. Blind-cord Racks, A. E. Harris and H. J. Luckock, Birmingham.

21,189. Stiffener for Collars, A. Vorwerk, Germany.

21,190 Cycle Bosses, T. Middlemore and C. Rossiter, London.

21,191 Stamping Notches in Tiles, J. Adams and J. Sherwin, Manchester.

21,192. Box Bedstead, W. H. Hardidge, Weston-super-Mare.

21,193. Automatic Pencil Cases, M. Carmody, Birmingham.

21,194. Sheet-metal Trunks, J. Chilton, Wolverhampton.

21,195. Cycle Chain Gear, The Birch Pneumatic Tire and Wooden Rim Company, Leeds.

21,196. Cycle Wooden Rims, The Birch Pneumatic Tire and Wooden Rim Company, Leeds.

21,197. Fair Lead for Steam Trawlers, T. Sudron, London.

21,198. Folding Boxes, A. C. Moll, London.

21,199. Bookbinding with India-rubber, T. McN. Soul, London.

21.200. Felt-grinding Machines, W. Büttner, London.

21,201. Burning Petroleum, C. Burkill, London.

21,202. Electric Type-writers, G. C. Walker and T. S. Paynter, London.

21,203. Fastenings for Corsets, &c., J. H. Dearle, London.

21,204. Locking Nuts or Bolts, S. J. Cluff, London.

21,205. Starting Races, A. J. Boult.—(*A. Gray, Australia.*)

21,206. Aerating Liquids, R. L. Crawford, Liverpool.

21,207. Railway-signal Apparatus, C. R. and L. C. Alsop, London.

21,208. Score Indicator for Billiards, O. O. Rothwell, Manchester.

21,209. Work-boxes, S. F. B. O'Leary, London.

21,210 Metallic Wheel Tires, J. E. Buckingham, London.

21,211. Enamel Glass-ware, E. Böhm and J. Burchell, London.

21,212. Window-sash Holder, W. Z. Mockett, London.

21,213. Casting Metals, P. Huth, London.

21,214. Locks, &c, L. B. Moreton and J. Stockes, London.

21,215. Spinning Fibrous Substances, W. S. Bancroft, Halifax.

21,216. Gas Burner for Heating, C. Maule, Birmingham.

21,217. Fuel for Fire-places, &c , J. Carter, Bournemouth.

21,218 Electrical Switches, C. P. Ehmann, Manchester.

21,219. Bread, C. G. Jacobsen, London.

21,220 Driving Mechanism for Bicycles, J. Weil, London.

21,221. Wheels, T. and J. Whittingham and M. H. Wilkin, London.

21,222. Manufacture, &c., of Gas, T. L. Willson, London.

21,223. Clasps, R. T. Joy, London.

21,224 Manufacture of Cattle Food, W. Schwartz, London.

21,225. Wire Mattresses, A. H. Gale, London.

21,226 Wire Mattresses, A. H. Gale, London.

21,227. Diazo-compounds, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany*)

21,228. Speed Indicator, E. Ducretet and L. Lejeune, London.

21,229. Novel Dice or Game Box, G. Hayes, London.

21,230. Construction of Loom Pickers, J. Rubirola, London.

21,231. Adjustable Spanner or Wrench, C. Becher, London.

21,232. Railroads and Sleepers, A. Henry, London.

21,233. Field Equipment, J. Wetter.—(*J. Zinn, Denmark.*)

21,234. Guards for Carving Forks, A. S. Daintrey, London.

21,235. Perambulator or Mail-cart, H. E. Murdoch, London.

21,236. Fixing Toilet Glasses, &c., H. A. Burke, London.

21,237. Polling-booth, T. W. Strype and F. Selby, London.

21,238. Attaching Trucks to Ropes, A. Lauenroth, London.

21,239. System for Advertising, &c., J. Henderson, London.

21,240. Cut-off for Lantern Dissolvers, C. G. Norton, London.

21,241. Filtration of Rain Water, &c., J. Clark, London.

21,242. Fireplace and Air Heater, G. Phillips, London.

21,243. Raisin Stoning Machinery, C. L. Spencer, London.

21,244. Locomotive Electric Signal, M. Z Levy, London.

21,245. Smelting, R. Fegan, London.

21,246. Speed Measure, J. F. C. Abelspies and G. H. Rayner, London.

21,247. Game, I. M. Butt and H. S. Whiteside, London.

21,248. Point Locking Apparatus, L. B. Stevens, London.

21,249. Garment Supporters, &c., E. N. Gaillard, London.

21,250. Multiple Telegraph Apparatus, A Piedfort, London.

21,251. Flying Machines, J. L. Osborn and A. Good, London.

21,252. Riddling Apparatus, R. Drake, London.

21,253. Penholders, T. R. M. Byrne, London.

21,254. Cycles, H. Woodier, London.

21,255. Agricultural Implement, A. Warr, London.

21,256. Holding Open Music Pages, W. C. Hamilton, London.

21,257. Braces and Suspenders, A. L. Tighe, London.

*6th November*, 1894.

21,258. Driving Gear for Bicycles, &c , B. R. Mills, London.

21,259. Cutting Confectionery, W. Hart and W. C. Child, Ramsgate.

21,260. Ploughs, J. Hornsby, J. Money, and W. Grice, Grantham.

21 261. Bicycles, &c , J. R. Dedicoat and H. Waterson, Birmingham.

21,262. Construction of Printers' Galleys, T. W. Smith, London.

21,263. Shoot for Loading Coal, W. C. Lockwood, Derby.

21,264. Oil Lamps, G. Moore, Loughborough.

21,265. Signalling on Railways, A. L. M. Edoux and R. Beal, Derby.

21,266. Motive Power for Engine, A. and F. A. Fiddes, Bristol.

21,267. Lever Stair-eye, E. Banks and H. Davis, Birmingham.

21,268. Sliding Chair for Children, H. Robinson, Liverpool.

21,269. Sliding Seats for Carts, J. G. Harrison, Birmingham.

21,270. India-rubber Mats, &c., H. P. Lavender, Walsall.

21,271. Beams and Rollers for Looms, J. G. Harrison, Bingley.

21,272. Waistcoat Cigar Case, A. Sydenham, Birmingham.

21,273. Preventing Colliery Cages Falling, T. Collier and F. R. Smith, Nottingham.

21.274. Badges and Cap Ornaments, H. M. Feinberg, Manchester.

21,275. Construction of Sewers, T. H. Vercoe, London.

21,276. Puff and Powder Container, F. S. Oxborrow, Birmingham.

21,277. Turret for Saddles, F. S. Oxborrow, Birmingham.

21,278. Billiard Ball Collector, F. S. Oxborrow, Birmingham.

21,279. Flanges for Beams for Weaving, J. Steel, jun., Bradford.

21,280. Combined Latch and Lock, G. J. Bowcock, London.

21,281. Temples for Weaving, C. Hahlo, C. E. Liebreich, and T. Hanson, Bradford.

21,282. Making Hinges, J., J., and J. Pritchard, Birmingham.

21 283. Attachment for Beer Engines, A. E. Langley, London.

21,284. Tube Joints, W. M. Walters, Liverpool.

21,285. Trucks, H. O. Thomas, London.

21,286. Keys, A. R. Tonks, Willenhall.

21,287. Producing Patterns on Fabrics, J. A O'Loughlin, Glasgow.

21,288. Cycle Saddles, J B. Brookes, Birmingham.

21,289. Wheels of Road Vehicles, H. W. James, Birmingham.

21,290. Velocipedes, J. M. and W. Starley and F. Westwood, Birmingham.

21,291. Looms, G. and W. B. Richardson, Manchester.

21,292. Looms, G. and W. B. Richardson, Manchester.

21,293. Taps and Valves for Gases, W. A. McCormick, London.

21,294. Machines for Making Pills, &c., L. Thomas, London.

21,295. Pocket-knives, J. Luckock, Birmingham.

21,296. Lock, J. Perks, Stourbridge.

21,297. Opening Soda-water Bottles, G. Moore, Loughborough

21,298. Valves for Liquids or Gases, F. W. Kent, London.

21,299. Playing Balls, R. H. and J. R. Sharples, Manchester.

21,300. Combination Walking Stick, E. Gräbener, London.

21,301. Fork Crowns for Cycles, S. Tweedale and J. Clegg, Rochdale

21,302. Hooks, J Joplin, Sunderland.

21,303. Manufacture of Playing Balls, T. M. Cockroft, Leeds.

21,304. Manufacture of Pouches, T. M. Cockroft, Leeds.

21,305. Disinfecting Water-closets, O. B. Whitehead, Norwich.

21,306. Horse-feeder, A. Cargill, Edinburgh.

21,307. Handles for Buckets, A. Younie, Glasgow.

21,308. Window-sashes, T. Marshall, Glasgow.

21,309. Socket-spanner, W. Tarring, Portsmouth.

21 310. Driving gear for Cycles, S. Farnsworth, Derby.

21,311. Toy Hoop, E Ombler, London.

21,312. Appliance for Use with Pen Nibs, E. C. Wilson, London.

21,313. Ball Cocks, A. Clifford, Dartford.

21,314. Wheel Tires, W. Robin, Glasgow.

21,315. Rack for Letters, J. McHarrie, Glasgow.

21,316. Steam Boilers, W. Glendinning, jun., Glasgow.

21,317. Lamp Extinguisher, G. Butwell and E. Roberts, Birmingham.

21,318. Dandy Rolls, Henderson, Craig, and Co. and E. Rutley, London.

21,319. Propulsion of Cycles, C. C. de Rossetti, London.

21,320. Cycle Gearing, J. F. and D. H. Lewin, London.

21,321. Steam Expansion Engines, A. Eastwood, Liverpool.

21,322. Sewing Machines, W. P. Thompson.—(*C. A. Hill, United States.*)

21,323. Welding Electrically, W. P. Thompson.—(*C. L. Coffin, United States*)

21,324. Printing of Aniline Black, F. Scott and R. J. Flintoff, Manchester.

21,325. Fastenings for Laces, H. W. Clarke, Liverpool.

21,326. Muffle Furnaces, W. P. Thompson.—(*J. Fürbringer, Austria.*)

21,327. Head Coverings, B. W. and H. Russell, London.

21,328. Kettle, E. J. Jones, London.

21,329. Cycle Frames, R. L. Philpot and W. Radford, London.

21,330. Galvanic Batteries, G. Hübner, London.

21,331. Pyroxylin Compounds, R. C. Schüpphaus, London.

21,332. Bottom of Golf Bags, W. Woodhouse, London.

21,333. Water-waste Preventer, T. Jenkins, London.

21,334. Marine Signalling, H. E. G. Earle, London.

21,335. Type-composing Machines, O. Imray.—(*The Cox Type-setting Machine Company, United States*)

21,336. Hair Dye, A. Lumière, London.

21,337. Diaphragm Pumps, O. Imray.—(*F. Syberg, Sweden*)

21,338. Self-fitting Tap for Barrels, W. Sharp, London.

21.339. Moat Dish, W. H. and T. H. Finney, London.

21,340. Double-acting Pump, E. Heuschkel, London.

21,341. Typewriters, A. Sweetser, London.

21,342. Cycles, W. Sutton, Birmingham.

21,343. Angle or Mitre Grip, W. Bazeley, Northampton.

21,344. Treating Cereals, S. Briggs.—(*H. Vuylsteke, Belgium.*)

21.345. Pads for Horseshoes, &c , S. E. Chipperfield, London.

21,346. Valve, H. Birkbeck.—(*The F. Wesel Manufacturing Company, United States*)

21,347. Systems for Telegraphic Exchanges, W. Childs, London.

21,348. Gas Burners, H. E. Newton.—(*R. N. Oakman, jun., United States.*)

21 349. Table Requisite, W. J. Foot, London.

21,350. Knitting Machines, H. H. Lake.—(*J. Millar, United States*)

21.351. Paper Boxes, R. P. Brown, London.

21,352. Paper Boxes, R. P. Brown, London.

21,353. Electric Motors for Vehicles, H. S. Park, London.

21,354 Self-threading Shuttle, H. H. Lake.—(*J. H. Nason and H. M. Hewes, United States*)

21,355. Machines for Hulling Coffee, D. B. Fraser, London.

21,356. Driving Mechanism for Bicycles, E Bellan, London.

21 357. Carpet Lining, C. C. Stewart, London.

21,358. Combination of Materials, G. McDonald, London.

21,359. Boots and Shoes, T. F. Marshall, London.

21,360. Windows, F. C. von Heydebrand und der Lasa, London.

21,361. Embroidering Machines, A. M. Clark.—(*The Kursheedt Manufacturing Company, United States.*)

21,362. Curtain Sticks, C. A. Day.—(*The Brussels Tapestry Company, United States.*)

21,363. Elevator Safety Attachments, C. B. Labatt, London.

21,364. Can-making Machine, R. D. Hume, London.

21,365. Coal and Mineral Washers, E. Ramsay, London.

21 366. Electrically-propelled Vehicles, F. King, London.

21,367. Connections of Battery Receptacles, F. King, London.

21,368. Hauling Apparatus, P. Jensen.—(*M. Langner, Germany.*)

21,369. Folding Scissors, J. Hewitt and F. R. Baker, London.

21,370 Gearing for Measuring-tape Winders, D. G. E. Davies, London.

21 371. Securing Pneumatic Tires to their Rims, G. H. E. and T. Cooke, London.

21,372. Evaporating Apparatuses, B. Abeil, London.

21,373. Chain-making Machines, R. Haddan.—(*P. H. Standish, United States*)

21,374. Dumping Cars, W. G. Lane, London.

21 375. Machines for Cutting Wood, W. J. Perkins, London.

21,376. Flying-machine, J. D. Roots, Teddington.

21,377. Type-writers, J. S. Foley, London.

21,378. Making Infusions, &c , J. R. Fothergill, London.

21,379. Cycle Driving Mechanism, T. Bourne, London.

21,380. Fastening Windows, F. C. B. Robinson, Surrey.

*7th November*, 1894.

21,381. Car Ventilators, A. J. Walker, London.

21.382. Device for Lighting Cigars, P. J. Morris, London.

21,383. New Hood for Ladies' Use, E. L. Dack, London.

21,384. Door Checks, C. H. Mannon, London.

21,385. Hat and Coat Pegs, H. E. H. Borgström, London.

21,386. Water-gauges for Boilers, H. Degener, London.

21,387. Railway Smoking Carriages, C. H. Davy, London.

21,388. Bicycle Handles and Brake-gear, M. Macer, Middlesex.

21,389. Stripe and Check Cloths, R. Fitton, Manchester.

21,390. Music-holders, W. L. Brydges, Norfolk.

21,391. Spindles for Spinning Machines, H. Cruse, Manchester.

21,392. Fog-alarms, W. Hickin, Birmingham.

21,393. Mechanical Counters, W. James-ashburner and R. Knox, Manchester.

21,394. Tobacco Pipes, T. and A. J. Bartlam, Birmingham.

21,395. Fog-signal Apparatus, W. B. Wilmer, Huddersfield.

21,396. Gas Engines, A. R. Bellamy and R. Onions, Manchester.

21,397. Draught Excluder for Doors, T. D. Chandler, London.

21,398. Cleaning Flues, J. P. Burns and W. T. and J. Liddle, Glasgow.

21,399. Steam-boiler Furnaces, &c , J. Murrie, Glasgow.

21,400. Inflated Last, G. J. Day, Northampton.

21,401. Vent-peg, W. Morford and A. M. Harrison, London.

21,402. Washing Clothes, J. Johnson.—(*The Sächsische Metallwaaren Industrie Gesellschaft, Germany.*)

21 403. Clips or Cramps, S. Tweedale and J Clegg, Rochdale.

21,404. Cutting Tubes, J. H. Laidman and T. L. Mitchelmore, Southampton.

21,405. New Bit for Horses, E F. Dunne, Dublin.

21,406. Stereoscopic Photographs, T. Brown, Salisbury.

21,407. Heating Tires, H. H. Mulliner and H. Austin, London.

21,408. Tube Manufacture, &c., G. Hookham, London.

21,409. Badges, &c , T. A. Vaughton, London.

21.410 Electrical Apparatus for Signalling, W. J. Rawson, London.

21,411. Construction of Furnaces, J. Thompson, Newcastle-on-Tyne.

21 412. Safety Action for Watches, C. J. Hewitt, Liverpool.

21,413. Apparatus for Flushing Purposes, J. C. Morris, Sheffield.

21 414. Preventing the Rattling of Window Sashes, A. Beckett, Sheffield.

21,415. Spindles, C Fitton, Manchester.

21,416. Boot Tree, E. H. Girling, London.

21,417. Chimney Shafts, J. Rae, Glasgow.

21,418. A Railway Station Indicator, W. Milne, Glasgow.

21,419. Conveying Liquid Refreshments from the Bulk to the Measure, J. L. Fort and G. E. Hoey, Barnsley.

21,420. Speed Indicating Apparatus, H. Simpson, Liverpool.

21,421. Ironing and Polishing Machines, W. Yuill, Glasgow.

21,422. Diaries, &c., C. Bauer, London.

21,423. Lids of Metallic Boxes, R. Scrivner and J. J. Woodhall, Birmingham.

21,424. Golf Clubs, W. Park, jun., Glasgow.

21,425. Operating Deep Well Pumps, W. Allman and J. Millward, Birmingham.

21,426. Hook and Eye, T. Biggs, Co. Kildare.

21,427. Conveying Mineral Oils to Lamps, H. R. Beckett, Kent.

21,428. Folding Easel Stand, J. S. Robinson and F. Bartlett, London.

21,429. Bottle Stoppers, F. W. Lacey and G. H. Marshall, London.

21,430. Fittings for Corsets, &c, R Heaton, Birmingham.

21,431. Selvedge Motions, L. Bulcock and W. J. Threlfall, London.

21,432. Cycle Cranks, H. Dewey and C. E. Ladbury, Birmingham.

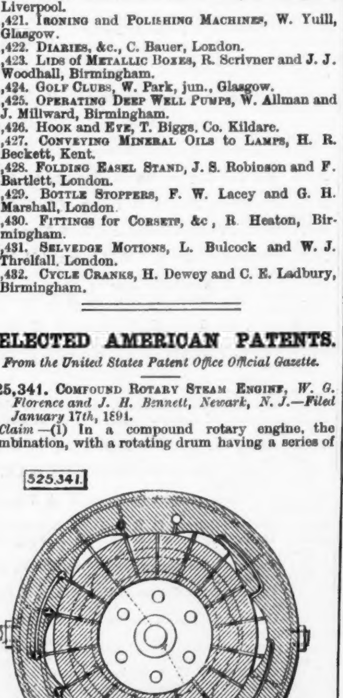
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**525,341.** Compound Rotary Steam Engine, *W. G. Florence and J. H. Bennett, Newark, N. J.—Filed January 17th, 1894.*

*Claim.*—(1) In a compound rotary engine, the combination, with a rotating drum having a series of radial sliding pistons, of a succession of corresponding chambers in a shell around the periphery of the drum into and out of which the pistons move successively, with external passages connecting the chamber in series, and thus leading the same steam in succession through the series of chambers, substantially as herein set forth. (2) In a triple expansion rotary engine, the combination, with a drum having eighteen radially sliding pistons, of a shell formed with six segmental chambers arranged in two groups, with the pistons at the end of the chamber in one group, when in the intermediate position in the other group, heads embracing the drum and closing the ends of the chambers, opposite steam inlets to the first chamber of each group, opposite steam outlets from the last chamber of each group, passages connecting the chambers of each group in each series, and a casing covering all of such passages and forming a steam jacket over the same, substantially as herein set forth.

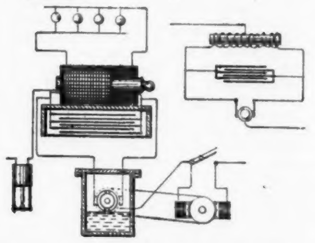
525,341.



**525,369.** Electric Lighting System and Apparatus, *E Thomson, Lynn, Mass.—Filed February 21st,* 1887.

*Claim.*—(1) The herein described system of electric lighting, comprising electric arc lamps run in series on a line or circuit carrying current of high electromotive force, and incandescent lamps supplied with current inductively transferred from the main by an induction coil whose primary is included in the main circuit while its secondary is connected to the circuit of the incandescent lamps. (2) The herein described system of electric distribution consisting of electric arc lamps in series, incandescent lamps in multiple arc, and an induction coil having its primary in the main line and its secondary connected to the line supplying the incandescent lamp branches. (3) In a system of electric distribution, a main or principal circuit having translating devices arranged in series upon it and supplied with current of proper electromotive force for operating such devices in series, a transformer device properly constructed to convert the high tension current on the main circuit into a current of lower tension on the secondary circuit, and incandescent lamps or other translating devices connected in multiple arc to said secondary circuit. (4) In a system of distribution having a main or principal circuit operating translating devices in series therein, an induction coil having its primary connected to said circuit, means whereby the magnetic condition of the mechanism may be changed rapidly so as to be alternately of positive and negative conditions, a secondary coil or coils for the same, and incandescent lamps connected to said secondary in multiple (5) In a system of combined electric arc and incandescent lighting a main electric circuit having arc lamps arranged in series thereon and supplied with current of proper electro-motive force for varying such lamps in series, branches of such main circuit each containing the primary of an induction coil, a continuity preserving circuit changer for closing the circuit through the branches alternately, and incandescent lamps fed in multiple by secondary currents of less tension than those flowing through the arc lamps, as and for the purpose described. (6) In an inductorium, primary or secondary helices either or both of which are suitably mounted, so as to be separated from one another and from the iron mass of the apparatus by a free air space.

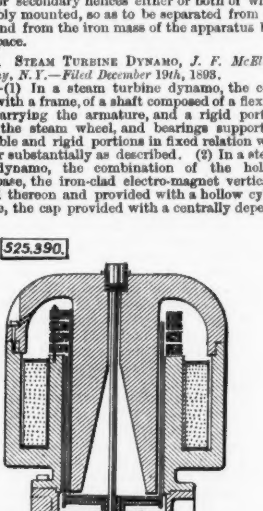
525,369



**525,390.** Steam Turbine Dynamo, *J. F. McElroy, Albany, N.Y.—Filed December 19th,* 1893.

*Claim.*—(1) In a steam turbine dynamo, the combination with a frame, of a shaft composed of a flexible portion carrying the armature, and a rigid portion carrying the steam wheel, and bearings supporting said flexible and rigid portions in fixed relation with each other substantially as described. (2) In a steam turbine dynamo, the combination of the hollow annular base, the iron-clad electro-magnet vertically supported thereon and provided with a hollow cylindrical case, the cap provided with a centrally depending hollow pole piece forming with the case an annular cylindrical field of force within the magnet, the tubular armature forming a suitable electric conductor, the armature shaft extending upwardly into the depending pole piece and flexibly carrying the armature in its axis of rotation, the ball bearing supporting the upper end of the armature shaft, the steam turbine casing secured in the hollow base, the shaft of the steam wheel supported in ball bearings in the casing and united with the armature shaft, and the steam wheel and its flexible connection with the shaft, substantially as described.

525,390.



Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided for our breakfast and supper a delicately flavoured beverage which may save us many heavy doctors' bills."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled, "James Epps and Co, Homœopathic Chemists, London.'

## PRACTICAL STEAM ENGINEERING.

Much has recently appeared in our pages on the theory of heat engines in general, and on that of the steam engine in particular. It is open to doubt, indeed, whether undue prominence has not been given by us to questions which are after all more or less abstract. We believe, however, that such articles as those of Dr. Lodge, and such letters as those of Professor Smith, Professor Alexander, Mr. Cross, and others, can scarcely fail to prove serviceable, notwithstanding the fact that they go over very old paths. More than thirty years ago a tremendous controversy took place in our correspondence pages on the relative merits of high and low-pressure steam. This correspondence was subsequently collected and reprinted in the form of a book. It is interesting and instructive to turn over its pages. The contents of most of them might be printed now in The Engineer without producing the least idea that an anachronism was being perpetrated. Nothing is more curious, indeed, than the way in which the theory of the steam engine has been disputed and re-disputed through a long series of years, without the least prospect of a settlement of any of the questions raised. It is advisable, we think, under the circumstances, that a little should be said now concerning the practical aspect of steam engineering in its most modern presentment.

For many years the philosopher, the scientist, and the mathematician, have been working hard at thermodynamics as applied to "heat engines" or motors. They have taken one road or track and travelled industriously along it. Practical engineers have worked with equal steadiness along a parallel path, on which they have generally managed to keep considerably in advance of the other party. We may suppose, indeed, that the engineers, proceeding in a train, have from time to time thrown out of the windows facts which the philosophers have stopped to pick up, examine, and possibly utilise for their own purposes. It may be said, we think without fear of contradiction, that the steam engine as we have it now owes virtually nothing to the mathematician or the physicist. It has been developed by a method of trial and error by the engineer, and the most that the man of pure science has done is wrangle over the merits of points of practice, the true inwardness of which he in many cases fails to understand. In the practice of steam engineering, moreover, many puzzles present themselves for explanation. They have not been solved yet, and it is doubtful if they ever will be. But amid a great deal of confusion certain facts are available, and it is these facts which, whether they know it or not, are utilised by most engineers who are improving the steam engine.

The steamship owner, the cotton spinner, the locomotive superintendent, care nothing about theoretical questions, their merits or demerits. They want their coal bills kept down. They want the smallest consumption of fuel per horse-power per hour, and they do not care how this desirable end is attained. It is a noteworthy circumstance that no mathematician or natural philosopher has ever been able to devise or even suggest an improvement in the steam engine previously unknown to engineers which would promote economy. It would be useless at this moment for a mill owner, for example, to turn to such a man as Clausius was and ask him for help to save coal. No thermodynamic information exists which can do more for us than the engineer has known, and knows now, without any instruction whatever in pure thermodynamics. If we look back on the history of the steam engine, we find one prominent fact always turning up, namely, that every increase in economy has gone hand in hand with an increase in the working pressure. It may be said that the saving is due to the use of more expansion; so it is, but we prefer to put the proposition as we have put it. The best of the old 10 lb. pressure marine engines required 5 lb. of coal per horse per hour. Then the pressure was raised to 35 lb., and the consumption fell to 4 lb. or 4½ lb. Next came the compound engine, and the consumption fell to 2½ lb. and 3 lb. This was not due to compounding, but to surface condensing—which made the boilers more efficient—and to the augmentation of pressure to 80 lb. Then came the triple-expansion engine, and 120 lb. pressure, and a fuel consumption of about 2 lb. per horse per hour. This was followed by a rise in pressure to 160 lb. and a drop of about half a pound in the coal. The latest development is a quadruple expansion engine working at a pressure of 200 lb. or 250 lb., with a further saving of fuel. Now we wish our readers to dissect these facts out of all the mass of statement, and surmise, and theory connected with the steam engine. Broadly, the truth is that no advance in economy has been secured by alterations in the structure or design of the steam engine unless they have been supplemented by augmented pressure. Of course, we do not mean that there are not bad and good engines to be found working at all pressures. What we do mean is that having hit on a good design, say, of compound engine, no modification in that design, no change in cylinder proportions, &c., will do any good or make the engine more economical, save in a very trifling degree perhaps, while a rise in the working pressure will at once make a change for the better in the coal bills. It is somewhat strange that this truth is constantly overlooked, and nothing is more commonly heard, perhaps, than the assertion that the improvement is not due so much to the use of high-pressure steam as it is to a number of other causes, such, for example, as steam jackets, a diminution in initial condensation secured by reduction of range of temperature in the cylinder, and so on. It so happens that it can be shown that low-pressure steam is just as economical as high-pressure steam. But men forget that this is true only within limitations. We think it will be of service here if we state concisely the reason why high-pressure steam is more economical than low-pressure can be, and in doing so we shall avoid theory, and adhere only to every-day facts.

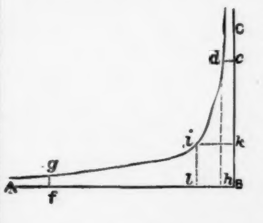
In the first place, then, it is obvious that the indicated power is not a thing of so much importance as the net or brake horse-power; and it should also be clear that a point in expansion must ultimately be reached where the pressure in a cylinder would be so small that it would only suffice to move the engine. A point, in other words, beyond which the indicated power would not represent any brake or useful power whatever. In practice this point is reached in condensing engines when the cylinder pressure falls to 8 lb. absolute per square inch. The average back pressure will be about 3 lb. per square inch, that in the condenser being about 1½ lb. per inch. We are here shutting our ears to theory, which tells us to expand our steam still lower. We are dealing with facts, and as a fact a great body of experience proves that the gain secured expressed in terms of brake horse-power by exhausting at 8 lb. instead of at 10 lb. is very small indeed.

We have here, then, a limit beyond which we cannot carry expansion with any benefit. That is the teaching of practice. In the old low-pressure days it was virtually impossible to use much expansion, because the net horse-power was little increased by it, although there was some small gain per indicated horse-power. The reason why high-pressure steam is more economical than low is simply that the higher the pressure of steam the greater may be the range of profitable expansion, for reasons which have been so fully and so often explained that it is unnecessary to re-state them. The gain due to any measure of expansion is represented by 1 and the hyperbolic logarithm of the range. Thus, for example, if the work of a pound of steam of any pressure be represented by 1 when used without expansion, it will be 1·6931 if expanded twofold, 2·3863 if expanded fourfold, 3·3026 if expanded tenfold, and so on. Now, it will be observed that the logarithms take no cognisance of the pressure; whether it is high or low they remain unchanged. The ratios of expansion are obtained by dividing the initial by the terminal pressure. If, then, we take the terminal pressure as 8 lb. and the ratio tenfold, the initial pressure must be 80 lb. If, however, the terminal pressure was 4 lb., then the initial pressure need only be 40 lb.

Thus, then, those who argue that the economy of a steam engine depending only on the ratio of expansion, it matters nothing what the pressure is, are perfectly right; but their contention overlooks the circumstance that a terminal pressure of 4 lb. is not practical, and that it contemplates an engine whose net power will be too small for the size of the machine. The coal bill may be high per brake horse-power, while the bill per indicated horse-power is small. In practice, an engine too big for its work is always wasteful. But while we see that too low a terminal pressure is a mistake, we also see that too high a one may be very bad. Thus, for example, if we doubled the terminal pressure in the case stated, raising it to 16 lb., we should also have to double the initial pressure, raising it to 160 lb., in order to be able to retain the same tenfold ratio of expansion; and the terminal pressure must not be confused, as it is sometimes, with the condenser pressure.

The moment the exhaust valve opens the engine is done with the steam, notwithstanding what any thermodynamic man, Professor or otherwise, may like to think. We see, then, that if we desire to have large ranges of expansion we must have high initial pressures, simply because low terminals are inadmissible in practice; and the greater the range of expansion the more strongly does this truth enforce itself. If, for example, we expand 20 times, thus getting nearly four times the work out of steam that it can give without expansion, we find that our 8 lb. terminal pressure means 160 lb. initial; while a rise of but 2 lb. in the terminal would mean 40 lb. rise in the boiler pressure. Each pound of terminal pressure multiplied by the ratio of expansion represents the initial pressure; and when, as is the case in some quadruple expansion engines, the ratio of expansion is 30 to one—the hyp. log. of which is 3·4012—we see that the initial pressure cannot be less than 30 × 8 = 240 lb. per sq. in.

To illustrate all this graphically is interesting and useful. It is only necessary to construct a hyperbolic curve, such as that shown roughly in the annexed sketch. A B represents the stroke of a piston. B C the pressures, *d e* = 250 lb., let us say, *g f* 8 lb. The rectangle *d e h* B represents the volume of steam admitted per stroke; the area *d e* B *f g*, the work done. If we halve the initial pressure, making it 125 lb., we shall have the rectangle *i k e* B, which is in area double that first named, and *g i k* B *f* is the work area. Thus, in fact, having constructed our diagram, we can cut any portion we please out of it, working our steam towards one end or the other of it; such lines as *d e* or *i k* always showing the proportion of the piston stroke accomplished before the cut-off closes. Of the effects of clearance, condensation, re-evaporation, &c., we say nothing here. They in no way affect the general terms of our argument, and their full discussion would occupy an enormous amount of space; we only propose to show that the higher the pressure the greater the economy.



Returning now to the consideration of the net as different from the indicated horse-power, it is easy to see that the back pressure will probably be a constant quantity as far as the vacuum is concerned, but it will not be constant as regards the facilities provided for exhaust. Let us suppose that we have a triple expansion engine, the low-pressure cylinder of which is 50in. in diameter, and the piston speed 600ft. per minute. A pressure of 1 lb. on such a piston means 34-horse power, a back pressure of 3 lb. means 102-horse power. Let us suppose that the initial pressure is 160 lb. absolute, and the ratio of expansion twentyfold, the average pressure will be 32 lb. on the square inch, representing 34 × 32 = 1088-horse power. But from this we must deduct 102, leaving 966-horse power effective. If, now, the consumption of fuel was, say, 2176 lb. per hour, the rate per indicated horse-power would be 2 lb. Let us augment the back pressure to 7 lb. per square inch—which we found to obtain in a triple expansion marine engine which we indicated not long since—and the indicated power falls at once to 840, and the consumption becomes 2·6 lb. nearly. But a saving of half a pound per horse per hour is keenly sought for; considerable complications, expense, and trouble will be willingly incurred to secure it. It may represent the whole difference between a cheap compound engine and a dear triple expansion engine, occupying much more room, and yet whether the saving is or is not obtained may all depend on the design of the exhaust valve. Of course, the lower the terminal pressure, other things being equal, the larger will be the low-pressure piston and the greater the influence of back pressure. It is, indeed, not too much to say that in many instances a drop of 2 lb. in the back pressure would confer a much greater benefit than an increase of 40 lb. in the boiler pressure. But we fear it must be admitted that in the best modern engines the back pressure has been brought down to the lowest possible limit, and nothing remains for those who seek a higher economy than higher boiler pressures.

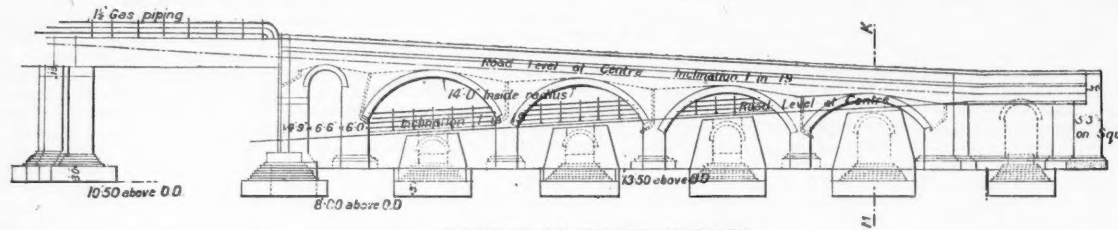
We confess that in all that we have written we have had the marine engine in mind, but much that we have said will of course apply to any engine. The practical engineer has learned by experience that it will not do good to reduce his terminal cylinder pressure much below 8 lb.; of course the pressure at the precise end of the stroke will be less, but this does not affect our argument. He also knows by experience that every augmentation of the range of expansion is, within limits, conducive to economy. We have shown that it is impossible to augment this range downwards. Looking at the sketch diagram, we see that we cannot utilise any portion of it beyond *g f*, but at the other end we can go very much farther than we have gone yet. The difficulties and objections which interfered with the adoption of high pressures years ago are being disposed of by degrees. The tubulous boiler has made great progress during the last ten years, and it is now quite possible to generate steam of 250 lb. pressure with safety and economy. Metallic packing has been so far improved that piston-rods can be run steam-tight for long periods without giving much worry to the engineer in charge. Lubricating oils are made which will endure the great heat. The greatest difficulty met with at present consists in getting gauge glasses which will not soften and dim. Mr. Perkins worked up to 400 lb., using talc, and no doubt the difficulty may be overcome in time. As matters stand now we find that practical marine engine builders care little, if at all, for jacketing or superheating. They are now and have been for some years depending entirely on increased ranges of expansion for increased economy, and it has never failed them yet. In a tentative way other expedients, such as superheating, have been and are being tried. But marine engine builders know that such things do not mean serious business; they do not count in competition for orders from shipowners. Higher pressures "mean money;" the other things do not—at least at present; and this is the reason why so much is being heard just now both in this country and abroad concerning quadruple expansion engines. It is very easy to argue that other expedients than quadrupling are available; that they would be cheaper and better. That may be, but up to the present it is a suggestive and remarkable fact that nothing but increase of pressure has been found to stand the test of practical work. Whether or not this state of things will continue to the end we do not pretend to say; but that is quite another subject. We have endeavoured to write of steam engine practice as it is, and not as it may be.

---

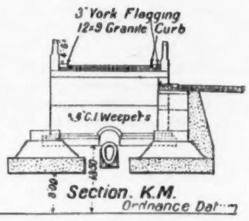
Engineering Society, King's College, London. — A general meeting was held on Friday, November 16th, the President in the chair. Mr. Kelly read a paper on "Continuous Railway Brakes." He first gave a short historical sketch of the brake question, and then described the various typical forms of brake. The rest of the paper consisted of detailed descriptions of the vacuum automatic and the Westinghouse brakes, aided by models and diagrams lent by the brake companies.

A Dead Industry.—Next Monday evening at a meeting of the Lantern Society, at 20, Hanover-square, London, will be an exhibition of relics of the past by Mr. J. Hay Taylor, likely to carry the memories of many of those present back to their childhood's days, the curiosities being none other than the original old dissolving view lanterns of the palmy days of the Polytechnic Institution, and a selection from among the great painted lantern slides which once delighted the the juvenile population. Practically speaking, photography has about killed lantern-slide painting as an art, although colourists are now numerous. Great skill was required in the work, from the magnification to which the results were afterwards to be subjected, and men who could paint those pictures well were few and far between. The late Mr. Westley, of the firm of Carpenter and Westley, encouraged those who had skill in the work, among whom were Messrs. S. H. Baker, J. Smith, Thomas Clare, Thomas Kearnan the cleverest painter of architectural slides, Henry Childe an expert at scenic effects, such as rippling water, summer and winter landscapes, and moonlight effects, Charles Simpson a miniature painter by profession, and C. Constant, who made himself immortal by painting the original of the world-famous slide of the sleeping man swallowing rats. Nearly if not quite all of these have gone to their rest. Kearnon and Simpson were buried in the same grave in Brompton Cemetery by the late William Westley. The first to make magic-lanterns in this country was Philip Carpenter, who began their manufacture in Birmingham, about 1808. He was the uncle of the late Dr. W. B. Carpenter, the physiologist. The old Polytechnic lanterns and some of the slides have been lent to Mr. Hay Taylor for exhibition next Monday by Mr. Edmund Wilkie, who had much to do with the Polytechnic, and who, at the sale by auction of the effects of the company, bought up many hundreds of the slides, and the lanterns. The condensers of the lanterns are 10in. in diameter. The size of the actual pictures on the slides is 7in. by 6in. In a parody of the Incantation Scene in "Der Freyschutz" at the Polytechnic, sixteen slides were employed. All the six lanterns were working at once, and four operators were engaged in producing the effects. Is it possible that the public taste for the glory of colour artistically applied to lantern slides may revive? About the best coloured slides seen in this country within the past two years were painted in Japan by native artists, and were exhibited at a meeting of the Richmond Camera Club.

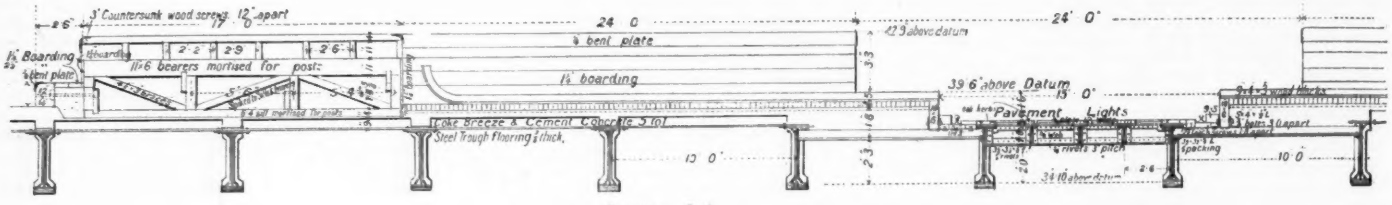
# THE GREAT NORTHERN RAILWAY COMPANY'S NEW GOODS DEPOT, FARRINGDON ROAD


1½ Gas piping
Road Level at Centre Inclination 1 in 19
14' 0" inside radius
Road Level at Centre
5' 3" on Square
10·50 above O.D.
8·00 above O.D.
13·50 above O.D.
K
M

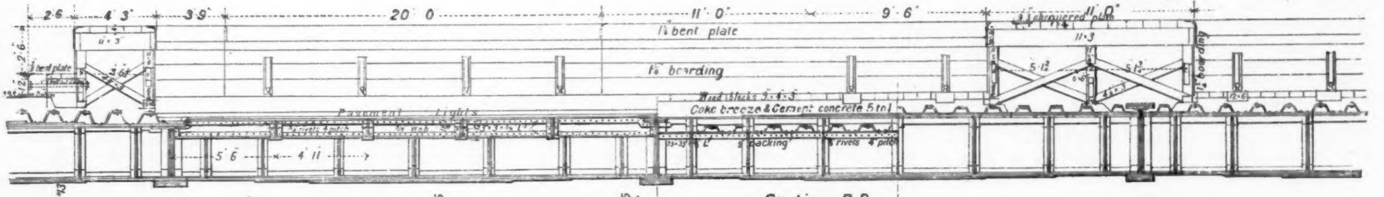
ELEVATION OF INCLINED APPROACH


3" York Flagging
12×9 Granite Curb
4" C.I. Weepers
Ordnance Dat.

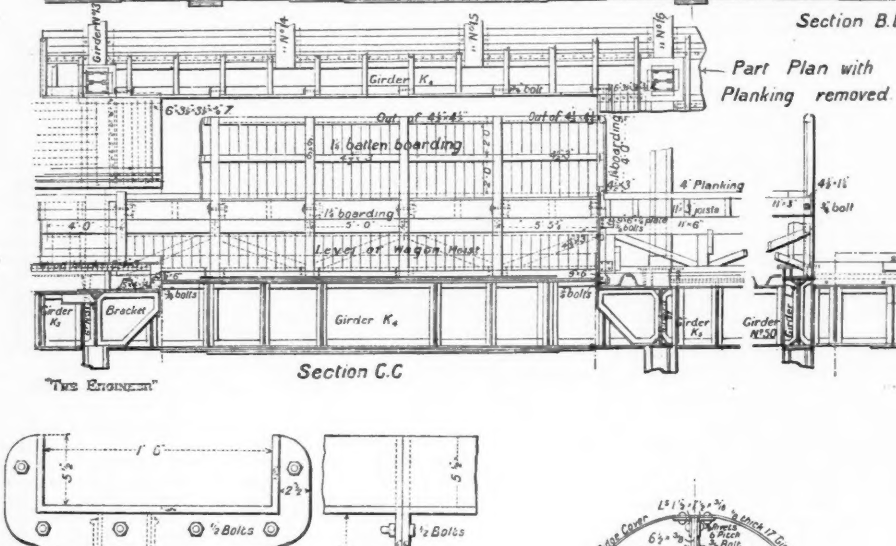
Section. K.M.


3" Countersunk wood screws 12" apart
24' 0"
24' 0"
¼ bent plate
1½ boarding
1½ Boarding
¼ bent plate
11×6 bearers mortised for posts
Coke Breeze & Cement Concrete 5 to 1
Steel Trough Flooring ⅝ thick
10' 0"
39' 6" above Datum
15' 0"
Pavement Lights
10' 0"

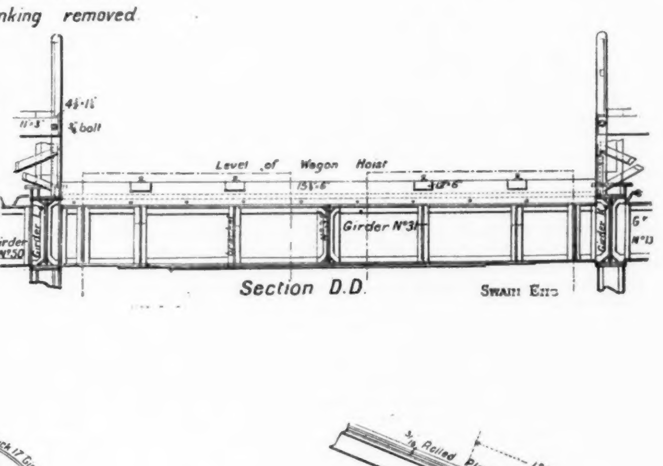
Section A.A.


2¼ countersunk wood screws 12 apart
20' 0"
11' 0"
9' 6"
¼ bent plate
1½ boarding
Pavement Lights
Coke breeze & Cement concrete 5 to 1
Packing
rivets 4" pitch

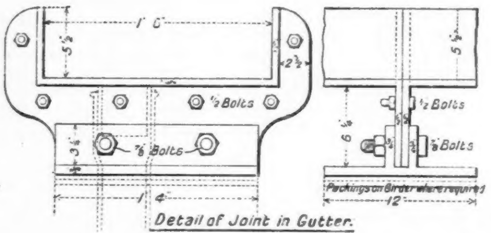
Section B.B


Girder No. 13
No. 14
No. 15
No. 16
Girder K₄
Part Plan with Planking removed
Out of 4½×4½
1½ batten boarding
4" Planking
1½ boarding
Level of Wagon Hoist
Girder K₃
Bracket
Girder K₄
Girder K₅
"THE ENGINEER"

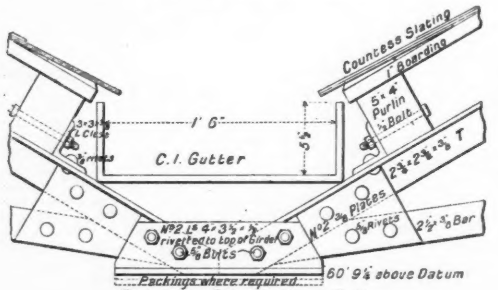
Section C.C


4½×1½
⅝ bolt
Level of Wagon Hoist
Girder No. 50
Girder No. 31
SWAIN ENG.

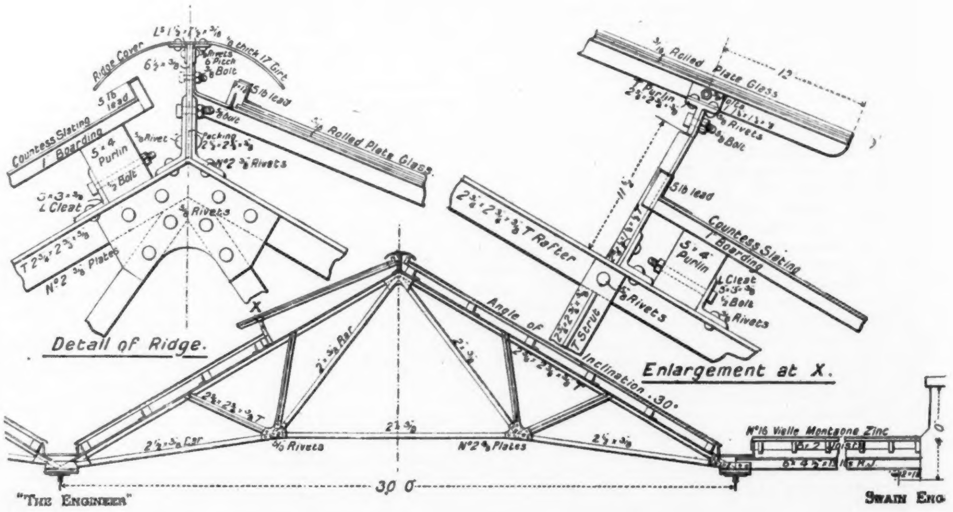
Section D.D


1' 6"
½ Bolts
⅝ Bolts
½ Bolts
⅝ Bolts
Packings on Girder where required
12"

Detail of Joint in Gutter.


Countess Slating
1" Boarding
5×4 Purlin
1' 6"
C.I. Gutter
2⅜×2⅜×⅜ T
No. 2 ⅜ Plates
⅝ Rivets
2½×⅜ Bar
No. 2 L's 4×3½×½ rivetted to top of Girder
⅝ Bolts
Packings where required
60' 9¼ above Datum

Enlarged Section thro' Gutter.


Ridge Cover
Countess Slating
1" Boarding
5×4 Purlin
L Cleat
Rivets
No. 2 ⅜ Plates
Rolled Plate Glass
5 lb lead
Detail of Ridge.
Rolled Plate Glass
Purlin
Rivets
Bolt
5 lb lead
2⅜×2⅜×⅜ T Rafter
Strut
Countess Slating
1" Boarding
5×4 Purlin
L Cleat
⅝ Bolt
Rivets
Angle of Inclination 30°
Enlargement at X.
X
2½×⅜ Bar
2½×⅜ Car
⅝ Rivets
No. 2 ⅜ Plates
2½×⅜
No. 16 Vielle Montagne Zinc
30' 0"
"THE ENGINEER"
SWAIN ENG.

## THE GREAT NORTHERN RAILWAY COMPANY'S GOODS DEPOT, FARRINGDON ROAD.

In view of the enormous increase of goods traffic to and from the metropolis which has of late years developed itself, and will in the future undoubtedly go on increasing, the Great Northern Railway Company has found it imperatively necessary to enlarge the goods station at Farringdon-road. The existing warehouse, which consists of a basement, with a floor at street level and two floors above, which we described and illustrated in our issues of February 11th and 18th, 1876, at that time in course of construction, is situated on the north side of Charles-street adjoining the Farringdon-street Station of the Metropolitan Railway Company, and has a frontage extending along Farringdon-road of a little over a hundred yards, the frontage to Charles-street being 92ft. for the warehouse and 42ft. for the offices, which join the Metropolitan Company's station.

At the times when the Corporation of the City of London built the markets now known as the New Fruit and Vegetable Market, the General Produce Market—formerly the fish market—and the New Fish Market, they excavated the ground beneath these markets to the level of the rails of the Metropolitan and London, Chatham, and Dover Railway, or to a depth of about 28ft. below the level of Farringdon-road. The whole of this area beneath the markets has now been leased by the City Corporation to the Great Northern Railway Company, and the depôt now extends from Snow-hill on the south to the familiar chimney at Vine-street on the north, a total length of about 700 yards, or nearly half a mile.

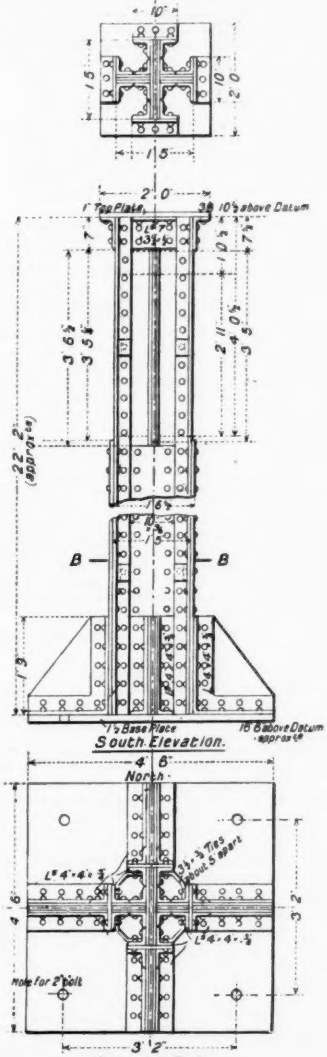
The basement of the new portion of the depôt, therefore, extends from Charles-street southwards to the New Markets, and underneath them and Charterhouse-street to Snow-hill, occupying the space between Farringdon-road and the Metropolitan and London, Chatham, and Dover Railways, a total area of about 3½ acres. Access to this basement has been provided by two inclined roadways, one from Charles-street on the north, which was constructed by the Great Northern Company, the other from Snow-hill on the south being constructed by the Corporation at the time the markets were erected. The northern inclined roadway to the basement is constructed on a viaduct, the first opening of which is about 45ft. span, built of steel girders and steel trough flooring, and of sufficient headway for the passage of fully loaded vans in the basement. The remainder of the viaduct is of brick arches, which have been made use of for the purposes of stables, mess-rooms, &c. The roadway is on a gradient of about 1 in 20.

To connect the new with the old portion of the depôt, a steel bridge, 60ft. span and 40ft. wide, had to be built under Charles-street. It was also necessary to build another steel bridge 150ft. span and 60ft. wide under Charterhouse-street, each of these bridges being constructed half of its width at a time, so as not to interrupt the vehicular traffic in those thoroughfares—no easy matter in such crowded and busy thoroughfares. The new portion of the depôt between Charles-street and the new fruit and vegetable market consists at present of the basement, and a floor at street level with a roof over. It being in contemplation to erect three more floors at some future date, when the exigencies of the traffic demand it, all foundations, stanchions, &c., are therefore calculated and built of sufficient strength to take the additional loads which will then be brought upon them. The present roof stanchions and roof will then be taken down and re-erected at a higher level. The floor of the new depôt at street level will furnish a superficial area of nearly an acre, and will be occupied, like the basement, by docks and platforms for the loading and unloading of goods, and by carting space for the accommodation of vans engaged in the collection and delivery thereof.

This floor is carried on girders supported on forty-one steel stanchions, the foundations for which it was found necessary to carry down to a depth of 10ft. below the level of the rails in the basement, in order to get a firm bearing on the solid clay. Whilst the excavations for the foundations of the stanchions were in progress, a number of sewers and drains were unexpectedly discovered, crossing the ground in many directions. Some of these, which were still in use, had of course to be diverted, and the disused ones filled up or removed before the work could proceed. As in the old depôt, during the progress of the excavations a vast quantity of bones, evidently of horses or cattle, were discovered, doubtless having been buried many years ago.

In constructing the inclined roadway to the basement from Charles-street, which runs parallel to and adjoining Farringdon-road, it was found necessary to underpin to a depth of 5ft. the high retaining wall which was built several years ago by the Metropolitan Railway Company, which difficult operation was successfully carried out in very short lengths at a time. Great care was necessary during this part of the work to avoid any settlement which might have affected the safety of the Fleet sewer, which runs in close proximity.

The foundations for the stanchions vary slightly in size, and consist of a bed of Portland cement concrete in the proportion of six to one, 3ft. thick, covering an area on the average of 235 superficial feet each; on the top of the concrete to a height of 3ft. 6in. Staffordshire blue brick footings are built, the area at the top being about 60 superficial feet, resting on which are the bedstones of grey Cornish granite, 2ft. in thickness, and 6ft. square, having sinkings 4ft. 6in. square to receive the ends of the stanchions, which are held down by No. 4 bolts of 2in. diameter. The greatest working load per superficial foot on the solid clay has been taken at four tons, that on the concrete at ten tons, on the Staffordshire blue brickwork at twenty tons, and on the granite bedstones about forty-five tons.



Section B-B.

DETAILS OF ORDINARY STANCHION

The whole of the stanchions, girders, and flooring are made of Siemens-Martin mild steel of first-rate quality, and capable of sustaining a tensile strain of not less than twenty-eight tons and not more than thirty-two tons per square inch, with an elongation of 20 per cent. in 8in. in the direction of its fibre. The working stresses for the steel have been calculated at six tons on the square inch for the stanchions, and as regards the girders, seven tons per square inch in tension, and six tons per square inch for shearing stress.

The stanchions in the basement are 22ft. long, and average about 1ft. 8in. square, calculated to carry about 900 tons each, which will be the load upon them when the warehouse is completed in the future. Hitherto the usual box or hollow section has been used, but these have been found to be objectionable on account of the impossibility of ascertaining the amount of oxidation going on in the interior, consequently no certainty existed as to the actual serviceable condition of the stanchions. In these stanchions, however, a new departure has been wisely taken as regards the shape or cross section. They have been designed and built in the form of two double T girders crossed, and connected together at the centres by angles. A reference to the engraving will at once explain the form more clearly. As will be seen, in this form, the whole of the surfaces are exposed to view, and can be easily painted and their serviceable condition ascertained at any time. The bases are spread out to about 4ft. 6in. square, having a base plate 1½in. thick bedded on two thicknesses of asphalted felt, and let into the sinkings of the granite bases. The top plates of the stanchions are 1in. thick, planed perfectly true to receive the stanchions on the ground floor level.

The main girders are of the ordinary plate girder type; they are forty-seven in number, varying in span from 30ft. to 40ft., and in depth from 3ft. 1½in. to 4ft. To these—and in some cases to the stanchions—are attached the cross girders, also of the ordinary plate girder type, 114 in number, 10ft. apart, mostly in 26ft. and 30ft. spans, and 3ft. in depth; the lower plate of the top flange of these cross girders projects on either side for the purpose of riveting the trough flooring to them.

The steel trough flooring, of which about 300 tons has been used, covers the whole area between Charles-street and the new Fruit and Vegetable Market, except where the traverser and wagon hoists occur. It is 6in. in depth, and ⅜in. thick, and weighs 24 lb. per foot super of area covered. The connection of the girders to the stanchions has been effected by continuing the web of the girder through into the stanchion, thus practically forming part of the stanchion itself, and making a good firm connection, the result being that the whole of the immense overhead network of girders is securely combined into one substantial whole. The steel trough flooring is filled in with Portland cement concrete in the proportion of 5 to 1 to a few inches above the top of the troughs, on which, for the carting space, is laid a bed of cement 1in. in thickness to receive the Val de Travers asphalte, which is 2in. thick.

The whole area of the basement, except under the platforms, has been paved with granite setts laid on a 6in. bed of concrete, and sidings and turntables have been laid in, and connections made through the new bridge under Charles-street with the old depôt. The carting space at street level, access to which is obtained by two entrances from Charles-street, runs round three sides of the platform, so that a great number of vans can be unloading or loading, as the case may be, at the same time. Provision is made on this floor for the reception of fourteen trucks, which are brought up from the basement by two hoists provided for this purpose and worked by hydraulic power, each capable of lifting twenty tons. The trucks are then transferred to a traverser, also worked by hydraulic power, which runs across the centre of the floor and deposits them in any of the bays or sidings which may be empty to receive them. Advantage has been taken of the space between the rails on which the traverser works to admit light to the basement, by inserting pavement lights for its whole length of 125ft. and 9ft. in width. The platforms, or "banks" as they are called, are constructed on timber framing, those in the basement being covered with light steel troughing filled with concrete and asphalte, while those on the street level floor are covered with 4in. planking, securely bound at the edges with wrought iron bent plates ¼in. thick.

The stanchions to carry the roof are twenty-eight in number, and are of similar shape to those below, but of a much lighter and smaller section, and about 22ft. in length. These are bolted to the ones below by No. 4 bolts of 1¼in. diameter.

The girders carrying the roof trusses are plate girders, thirty-one in number, nineteen of which are in spans of 30ft. with a depth of 2ft. 6in. It was found necessary to make the remaining twelve girders, which are over the carting space, of spans varying from 42ft. to 64ft., and of a uniform depth of 4ft. 6in., so as to avoid having any stanchions standing in the carting space in the way of the traffic. All these roof girders are attached to the stanchions in a similar manner to the main girders below, with this exception, that the webs are continued right to the centre of the stanchions, being riveted to the outer angles of them and fastened to the inner angles —where it would be difficult to rivet up—by No. 9 ¾in. bolts in the case of the long girders, and No. 7 ¾in. bolts in the case of the shorter girders. Across the tops of the girders, every 6ft., are riveted two pieces of angle 1ft. 4in. long by 4in. by 3½in. by ½in., with a ⅜in. space between them, and packed up where necessary, so as to bring all up to the same level, to receive the ends of the T rafters of the roof trusses.

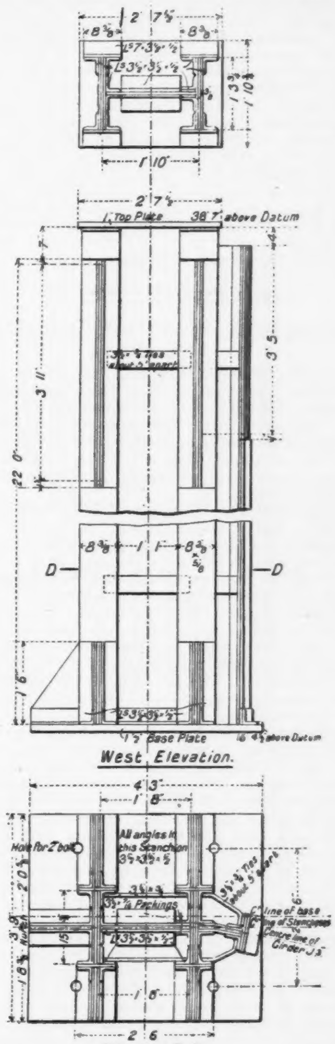
Each of the five rows of roof stanchions are tied together transversely at the top by means of light lattice girders 2ft. deep, riveted to the outer angles. Two more of these lattice ties are fixed across the building, where the large span roof girders occur, thus giving seven continuous ties running transversely across the whole width of the building. The roof, the trusses of which are constructed of steel, covers the new depôt, with the exception of the inclined roadway to the basement, in five bays; the irregular shaped piece between the last bay and the Metropolitan Railway on the eastern side of the depôt being covered over by a zinc flat supported on rolled steel joists. The roof principals, placed 6ft. apart, are of T steel 2¾in. by 2¾in. by ⅜in. thick. The struts are are also of T steel of the same section, and the tie-bars are 2in. by ⅜in., and 2½in. by ⅜in. flat bars. The roofs have broad skylights, admitting of ventilation on either side of the ridge, the remainder being covered with best Bangor Countess slating, on 1in. matched and beaded boarding, wrought one side. The gutters are of cast iron, 18in. wide and 6in. deep, and have been made in 6ft. lengths with flanged joints, resting in cast iron shoes bolted to the girders. The down pipes to carry off the rain water are placed in the angles of the stanchions—see page 444—and are collected together underneath the platform at street level, and thence taken down the eastern wall of the depôt direct into the sewer.

Before the wall on the eastern side of the depôt could be built, it was necessary to remove the old brick and concrete retaining wall, built many years ago by the Metropolitan Railway Company, which being done, an entirely new warehouse wall 270ft. long and 54ft. in height, with blue brick piers to receive the girders, was erected in its place, having numerous window openings fitted with "Moline's" patent wrought iron sashes.

The western side of the new portion of the depôt between Charles-street and the new fruit and vegetable market, and adjoining the inclined road down to the basement, is enclosed by a timber screen attached to the stanchions and to vertical steel joists carried on the floor girders and placed about 10ft. apart, there being in each 10ft. bay a window 9ft. high by 4ft. 6in. wide, with casement at top. Beneath the girders under this screen are vertical pavement lights for the purpose of admitting light to the basement. When, as has been contemplated, a row of handsome shops or offices is built over the half of the inclined roadway next Farringdon-road, this screen will be hidden from view from that thoroughfare.

Consequent upon the enlargement of the depôt, it was found necessary to provide extra office accommodation for the largely increased clerical staff. This has been accomplished by erecting a convenient block of offices of three floors on the Charles-street front of the depôt, between the two entrances to the carting space. The front wall of these offices, which is carried upon three heavy steel box girders, each about 30ft. long and 4ft. deep, is faced with Fletton buff bricks, the arches over entrances and window openings being turned in red Leicester bricks, having a keystone of Portland stone. The pilasters are rusticated for a height of 22ft., and the string courses are of Portland stone and moulded bricks, the plinth course being also of moulded bricks. The general tone, as regards colour, and the character of the ornaments are very pleasing in effect. Pavement lights, both vertical and horizontal, have been introduced in front of the offices, in order to give as much light as possible to the basement of the depôt.

For the convenient working of the new depôt there have been provided in the basement ten new cranes, with a lifting power of 30 cwt. each, and fourteen capstans; and on the ground floor seven cranes of the same lifting capacity, all being worked by hydraulic power. Besides the two wagon or truck hoists before described, two smaller hydraulic hoists have been erected, to connect the basement of the new depôt with the new fruit and vegetable market. These have each a lifting capacity of 2¼ tons, and will prove a great and invaluable convenience in conveying consignments of fruit and vegetables directly from the trucks below to the market overhead. The whole of the hydraulic cranes, capstans, hoists, and the accumulator, with all the necessary pressure and return pipes, &c., have been supplied and fixed by Messrs. Tannett Walker and Co., Leeds.



Section D-D.

STANCHION UNDER FRONT OF OFFICES

The present hydraulic station at Vine-street was found to be totally inadequate to work all these extra hoists, cranes, and capstans; it is therefore being enlarged to treble its former capacity. A new pair of engines, supplied by Messrs. Tannett, Walker and Co., are being erected, also three new Babcock and Wilcox boilers, each containing 2920 square feet of heating surface, and rated at 450 indicated horse-power each, and one Babcock and Wilcox fuel economiser, with necessary dampers to put it out of work without affecting the working of the boilers. A new chimney has been built, 120ft. in height, 13ft. 6in. square at the base, tapering to 7ft. 3in. square at the top, being 5ft. square inside; it is lined to a height of 20ft. with fire-brick 9in. in thickness, and for the next 20ft. with a similar lining 4½in. thick. The cap of the chimney is of cast iron of ⅝in. metal, weighing over three tons, and is filled in with concrete faced on the inside with bricks, alternately headers and stretchers. New flues had also to be constructed leading to the new chimney shaft, all of which work had to be carried out without interfering with the working of the old engines and boilers. A new accumulator has been erected at the north-east corner of the new portion of the depôt. The water is delivered for work at a pressure of 700 lb. to the square inch.

In the several contracts for the construction of the before-described works in the new portion of the depôt, about 35,000 cube yards of excavation had to be done, a great quantity of which consisted of old walls and foundations of hard concrete, and which cost on the average about 5s. per cubic yard to remove. There has also been used in the new work about 7500 cubic yards of Portland cement concrete in foundations, &c., and about 4200 cubic feet of granite in stanchion bases, &c. The area of granite paving laid down is no less than 10,500 superficial yards, and the quantity of steel used in stanchions, girders, flooring, rolled joists, roof trusses, &c., reaches the large amount of nearly 1800 tons.

About 2200 lineal yards in permanent way in sidings has been laid in the new depôt, making a total of nearly 2¼ miles of sidings in the whole depôt. Twenty-two new turntables have been laid in for the more convenient working of the basement. About 22,000 superficial feet of platform area has been provided in the new depôt, making, with that in the old depôt, a total platform area of about 37,500 super feet.

The above facts and figures unmistakeably show the vastness of the works which have been undertaken, and which are now nearing completion. There can be no doubt that this depôt can now be ranked as one of the, if not the most convenient and commodious goods station in all London. Situated as it is for the greater part within the boundary of the City, and yet within easy access of the most important business thoroughfares of the West End, the Great Northern Company will now be able to considerably relieve the congestion of traffic which has faced them for some time past. Already the basement of the new depôt is in full working, and the works are being so rapidly pushed forward that the remainder will shortly be opened for traffic.

It is characteristic of the completeness with which the work has been carried out that the whole of the depôt, both old and new, is to be lighted by means of the electric light. It was originally contemplated to bring the electric current for this purpose from the company's new electric light station at Holloway, but, after mature consideration, it has been decided either to establish a separate installation near the hydraulic station at Vine-street, or to obtain it from one of the City electric supply companies. The company has also established a system of telephone communication, connecting all their London depôts, including Farringdon-street, Bread-street, Whitecross-street, &c., with their goods yard at King's Cross, as also with their chief goods offices at that station.

The new works have been designed and carried out under the direct supervision of Mr. Richard Johnson, M.I.C.E., the chief engineer of the Great Northern Railway Company. All the steel and ironwork has been supplied and erected by Mr. Matthew Pitts, of Stanningley, near Leeds, the whole of the remainder of the works being undertaken and executed by Messrs. Atherton and Co., of Poplar.

## PENETRATION AND ACTION OF SMALL-ARM BULLETS.

THE October number of the United States Institution "Proceedings" contains extracts from the report of the Small-arms Penetration Committee—president, Colonel Fraser, R.E.—and also from a paper by Lieut. Benet, Ordnance Department U.S. Army, on "The Effect of Small-arm Bullets on Animal Tissue." Thus, we have before us the effects which we may expect of our new rifle fire on *matériel* and on men.

It appears that the Mannlicher 0·256in. bore, with a 160 grain bullet, and a muzzle velocity of from 2300 to 2400 foot-seconds was tested in comparison with a Lee-Metford 0·303in. bore firing a bullet of 215 grains with a velocity of from 1975 to 2000 foot-seconds, also a Martini-Henry 0·450in. bore with a bullet of 480 grains and a velocity of from 1270 to 1300 foot-seconds. The Mannlicher velocities fell off rapidly during the firing of 1000 rounds owing to erosion of barrel. The Lee-Metford fired 3000 without being affected; 150 rounds of the Mannlicher weighed 7·271 lb., against 8·807 for the Lee-Metford. The trajectory of the Mannlicher was naturally flatter than that of the Lee-Metford, and the accuracy of the former was also slightly superior.

As to penetration, the bullets perforated a 9in. brick wall with ½in. boards at the joints, though the bricks resisted the bullets. At 100 yards the joints of a 9in. wall and seven ¾in. deal boards were penetrated, and at 400 yards even some of the bullets got through the joints and two ¾in. deal boards, and even of a 14in. wall and two ¾in. boards. At 600 yards the joints of a 4½in. wall and seven ¾in. boards were perforated. At 200 yards 200 bullets were sufficient to breach a 9in. wall so as to allow a man to pass through—the hole measuring 24in. by 15in.; 1028 rounds were needed to make a smaller breach in a 14in. wall. The firing was chiefly in volleys of fifty. Brick walls 9in. thick, with ⅜in. joints of hard mortar, resisted the bullets, so that such walls set in cement may be used for defence, but joints should be broken horizontally as well as vertically, it is said; but it appears as if this would make any bond difficult. Sun-dried brickwork 18in. thick is bullet proof, except to very long-continued firing. Curiously, at very short ranges, bullets set up and penetrate less than at 400 yards. A wall 9in. thick, made of burnt tiles set in mud, was perforated by the smaller bores, but kept out the Martini-Henry bullets. Volleys produced better effect than independent firing. Fresh mud walls required to be 4ft. thick to stop the bullets.

Mild steel or wrought iron 0·44in. stopped bullets, and at ranges over 60 yards a 0·206in. plate of hardened steel stopped the Lee-Metford bullet, and a 0·25in. hardened steel plate stopped the Mannlicher at short ranges, and is recommended for sap shields. At 500 yards a hardened steel plate less than $\frac{1}{10}$in. thick, weighing only 3 lb. 10 oz. per square foot, stopped everything, and might serve for field artillery shields. So great is the penetration of small-bore bullets through both wet and dry timber that standing trees and timber balks will seldom offer much protection at ranges under 1000 yards. On the other hand, sand has high resisting power against bullets with high velocity. The Lee-Metford bullets will not penetrate 18in. of sand at any range. The Mannlicher at short range breaks up and penetrates less than the Lee-Metford. Three inches of large flint shingle between boards smashes and stops all bullets at all ranges. Fine shingle is rather less effective. The new bullets penetrate 3½ft. into moist clay at close distances, and 28in. into loam. A cotton bale 20in. thick, end towards firer, stopped all bullets ever fired at 25 yards distance, but some perforated the bale side on. At 500 yards, bullets penetrated 7½in. end on and 13in. side on. Stockades of double planks with sand or macadam of roads between will probably replace heavy timber. A coal sack 12in. thick is impenetrable.

It may be seen that the key to these effects appears to us to be that as the velocity increases, resistance due to inertia tells much more than resistance due to cohesion. Wood is easily perforated, because a bullet of small calibre with a high velocity is suited to cut it through easily, but in sand and shingle the actual particles have to be displaced, which becomes more difficult as the velocity increases. Hence the bullet fails to make way and breaks up.

As to flight, the Martini-Henry bullet travels faster than sound up to 800 yards, the Lee-Metford and Mannlicher are both overtaken by the sound at about 1600 yards—the former bullet overtakes the latter at about 1500 yards, which is remarkable, the latter having the greatest sectional density.

We now pass to the United States experiments on animal tissue and bones, as reported by Lieut. Benet. The rifles used were the 0·45in. and 0·30 Springfield with 500 and 220 grain bullets respectively. The "Cadaver"—apparently a human body—was placed fifty-three yards from the rifle, and the charge was reduced to give the striking velocity corresponding to 100, 150, 200, 250, 350, 500, 800, 1200, 1500, and 2000 yards. Two hundred rounds were fired. The 0·45in. bullet gave what is termed explosive effects up to 250 yards range, and the 0·30in. up to 350 yards, the bullet being generally badly deformed and the jacket more or less stripped off. Explosive effect is less when the bullet is not deformed. Bones were less shattered by the 0·30in. bullet than by the 0·45in. Sometimes bones were completely perforated without splintering. In joints and soft parts the smaller bullet also inflicted less severe wounds. This is contrary to results obtained in England with horse bones, which, being harder, were broken and splintered in a terrible way. This is easily accounted for, but at the same time it could not have been foreseen. As is pointed out, the action of the bullets may have been considerably affected by the fact that the rotation was only proportionate to the velocity, whereas a bullet fired at a high velocity loses its onward velocity out of all proportion to its velocity of rotation, and the latter may increase the shattering effect. As to flesh wounds, we may add what perhaps many of our readers may know, that animals may be shot through fleshy parts without knowing that they have been struck at all. It is questionable if determined men could be stopped in a rush at close distances as well with small-bore as larger ones, but we think that experiments are needed to determine the influence of rotation as well as velocity before we can build on the United States experiments.

## THE INSTITUTION OF CIVIL ENGINEERS.

### THE MACHINERY OF WAR-SHIPS.

AT the ordinary meeting on Tuesday, the 20th November, 1894, Sir Robert Rawlinson, K.C.B., the President, in the chair, the paper read was on "The Machinery of War-ships," by Mr. Albert J. Durston, Engineer-in-Chief of the Navy.

In this communication the particulars were given of the ships with forced draught which preceded the Naval Defence Act of 1889, and of those of the seventy ships ordered under that measure; while in an appendix were tabulated the details of the several vessels referred to. In regard to the period preceding 1889, a salient feature was the gradual adoption of steel tubes for the boilers, in place of those of iron, which had previously superseded the brass ones formerly universal in the Navy. Between the years 1884 and 1889 considerable changes had taken place in the types of engines used for propelling the ships, the two-cylinder compound engine having generally given place to that with three cylinders and triple expansion, the steam pressures rising from 90 lb. in most battle-ships to 155 lb. for the heavily-powered cruisers of the Blake class. During this period the type of vessel known as the "torpedo-gunboat" had appeared.

The seventy vessels built under the Naval Defence Act of 1889 included ten first-class battle-ships, nine first-class cruisers, twenty-nine second-class cruisers, four third-class cruisers, and eighteen torpedo-gunboats. Of the hulls, thirty-two were built by contract, and thirty-eight in the Royal Dockyards. Of the machinery, that for sixty-three vessels was supplied by contract, and that for seven was built by the State. A general description of the machinery of each type of vessel was given. In the battle-ships the ratio of volumes of the high to the low-pressure cylinders was 1 : 4·84, with the exception of the Barfleur and the Centurion, where it was 1 : 5·37. The natural draught power was 9000 indicated horse-power, the full power being 13,000 indicated horse-power, although the valves—except in the case of the Royal Sovereign — were afterwards arranged for a maximum of 11,000 indicated horse-power.

In the first-class cruisers the dimensions of the cylinders were identical with those of the battle-ships—except the Barfleur and the Centurion. These vessels were designed for a full power of 12,000 indicated horse-power, but, as in the case of the battle-ships, the propellers and valve-gear in most of them were subsequently arranged for a lesser power, so as to enable them to steam more economically at the low power usual when cruising. The higher power could, however, be developed at any time by suitable modifications in the valve-gearing and propellers. The ratio of cylinder volumes in the first-class cruisers was also 1 : 4·84.

The machinery of the second-class cruisers was similarly arranged to that of the first-class, the ratio of cylinder volumes being 1 : 4·88 for nineteen of these vessels, and 1 : 5·03 for the remainder. The full power was 9000 indicated horse-power, the natural draught power 7000 indicated horse-power. Certain modifications were made in the arrangements of the boilers of this class, the object being to spread the wear due to steaming for auxiliary purposes over the whole of the boilers, rather than to confine it to one or two of them.

The third-class cruisers had a cylinder ratio of 1 : 4·97, the full power being 7500 indicated horse-power, and the natural draught power 4500 indicated horse-power. In the torpedo gunboats the engines were arranged as in the cruisers. The engines were of the three cylinder triple-expansion type with a cylinder ratio of 1 : 5 37, the full power being 3500 indicated horse-power, and the natural draught power 2500.

Having described the general characteristics of the machinery, some comparative remarks followed. As regarded steam-pressure it was not considered advisable to exceed 155 lb. per square inch for vessels having boilers of the water tank type. In the water-tube boilers of the Speedy a boiler pressure of 210 lb. was employed. The machinery of most of the battle-ships built under the Naval Defence Act was lighter than of corresponding vessels built previously. But in recent vessels the auxiliary machinery was considerably more powerful than in vessels of the Admiral class, and was therefore heavier, consequently the saving in weight arising from the employment of triple-expansion engines and of higher steam-pressures was even greater than the figures appeared to show. Contrasting the first-class cruisers built under the Naval Defence Act with seven tried in 1887-88, a slight increase in power per tonnage was shown at the natural draught powers which was not maintained when the forced draught powers were compared. This arose chiefly from the altered ratio between the natural draught and the forced draught in the two instances. The object aimed at in the design of the latter built vessels was to maintain a high continuous steaming power, less regard being paid to the possible performances for short periods under forced draught. The same remarks applied generally to the second-class cruisers, though in a somewhat more marked degree, the horse-power at forced draught per ton of machinery being considerably less than in the earlier vessels.

The machinery of all the battle-ships built under the Naval Defence Act was arranged in a similar manner, namely, in six separate water-tight compartments, the twin engines being abreast and the boilers being stoked athwartships. In all the cruisers the engines were arranged on a similar plan, but the boilers were in two compartments stoked in the four-and-aft direction. The valve gear in all the seventy vessels consisted of the ordinary link motion working in most cases piston slide valves in the high-pressure cylinders, either piston or flat slide valves for the intermediate, and usually flat slide valves for the low-pressure cylinders. Experience had shown that leaky boiler-tubes arose primarily from overheating due either to forced combustion or to the presence of oily or other deposits on the surface exposed to heat. This inconvenience might be mitigated (1) by interposing plate heating surface to absorb the heat before the flames impinged on the tube-plate and the tube-ends; (2) by the employment of a tube ferrule, so constructed as to prevent the flame from impinging on the tube-ends and tube-plate, and also to prevent conduction of heat to those parts by means of the air space between them and the protecting ferrule; and (3) by reducing to a minimum the oil employed for internal lubrication, and by the employment of filters or other processes for its extraction. In the Sharpshooter water-tube boilers of the Belleville type had been used. No increase of horse-power per ton had accrued, but an advantage resulted from there being no tube-ends to choke up, and the whole of the fire-side of the heating surfaces was readily cleaned when under way. Extended use of the water-tube type of boiler was being made in the torpedo-boat destroyers built and under construction. A table was given showing a few particulars of what had been accomplished with this type of boiler. Trials of the Martin system of induced draught had resulted in certain advantages in regard to the temperature of the stokeholds. Several of the vessels forming the subject of the paper had been sufficiently long in commission to have made passages at powers approaching their natural draught, and these indicated that the vessels were capable of maintaining without any special effort, and with their own complement of stokers, a high percentage of their natural draught powers.

The appendix contained the names, horse-power, weights of boilers and machinery, heating-surface, indicated horse-power per ton of machinery and boilers, indicated horse-power per square foot of grate, heating-surface per indicated horse-power, and the material of the boiler-tubes of all the vessels built under the Naval Defence Act of 1889, and to those of a similar class which immediately preceded them.

## TRACTION ENGINES AND BYE LAWS.

THE following Circular has just been issued by the National Traction Engine Owners' and Users' Association:—

> "Under the new Act, Highway Boards are abolished at any time up to December, 1897, and their duties taken over by 'District Councils.' If the 'District Council' fails to maintain and repair any highway in a good and substantial manner, the Parish Council may apply to the County Council to remedy their neglect. It is therefore important that engine owners should be represented on both the Parish Council and the District Council. Influence can then be exerted to see that the highways are maintained up to "traction engine" standard, which should be claimed to be the ordinary traffic of the district. Before taking over any highways the District Council may insist on the highways being placed in proper repair, and if they are not so done to their satisfaction, the District Council may themselves do the work and charge the expenses to the old Highway Board District. An application from a Parish Council setting out that traction engine traffic is ordinary and necessary traffic would have considerable influence. Parish Councils might also petition the County Council to modify the licence for engines. Very extensive powers for drainage and sanitary purposes are conferred on Parish and District Councils. It is therefore important to see that in any new drainage schemes the sewer and water mains are laid at a sufficient depth under the road to avoid the risk of fracture by reason of traction engines passing over. Contracting for transporting materials for repairs of roads and bridges in the immediate neighbourhood of the contractor, or supplying from his own land materials for making and repairing highways or bridges, does not disqualify from election."

The Great Western Railway Company has given the following notice:—

> "In pursuance of Section 67 of the Great Western Railway—No. 1—Act, 1884, application has been made to the Board of Trade by the Great Western Railway Company for approval of the following Bye-laws—namely: Bye-laws as to bridges over the railway (being public highways).
>
> "1. Every person who acts in contravention of Section 6 of the Locomotive Act, 1861 (which Section is as follows:—'It shall not be lawful for the owner or driver of any locomotive to drive it over any suspension bridge or over any bridge on which a conspicuous notice has been placed by the authority of the surveyor or persons liable to the repair of the bridge that the bridge is insufficient to carry weights beyond the ordinary traffic of the district, without previously obtaining the consent of the surveyor of the road or bridgemaster under whose charge such bridge shall be for the time being, or of the persons liable to the repair of such bridge; and in case such owner of the locomotive and surveyor of the road or bridge or bridgemaster shall differ in opinion as to the sufficiency of any bridge to sustain the transit of the locomotive, then the question shall be determined by an officer to be appointed on the application of either party by one of her Majesty's Principal Secretaries of State, whose certificate of sufficiency of such bridge shall entitle the owner of the locomotive to take the same over such bridge'); or of any enactment substituted for the same in the case of any bridge over the railways of the company which the company are liable to repair, shall be subject to a penalty not exceeding five pounds for every offence.
>
> "2. No engine, machine, vehicle, or article of traffic weighing—inclusive of any load, matter, or thing carried or resting thereon—more than five tons, or carrying—inclusive as aforesaid—a greater weight than two tons on any one pair of wheels, or drawing a weight of more than four tons, shall be taken upon or across the bridge, being a public highway, over the railways of a company, on or near which a notice to the effect that such bridge is unsafe for heavy traffic is for the time being affixed or published.
>
> "Every person who takes or sends any such engine, machine, vehicle, or article of traffic upon or across any such bridge as aforesaid in contravention of this bye-law shall be subject to a penalty not exceeding £5 for every offence.
>
> "This bye-law does not extend to locomotive engines, to which the preceding bye-law extends."

The bye-law would, it appears, prevent the Great Western Railway from being crossed overhead by any bridge the property of the company, and it is more than likely that the example thus set may be extensively followed by other railway companies throughout the kingdom.

---

AT a recent meeting of the Berlin Meteorological Society, Dr. Schwalbe spoke of his endeavours to utilise for scientific purposes the curves of temperature obtained from the "Uranus" pillars. He found among the many meteorological pillars in Berlin which had given continuous records during the years 1892 and 1893, very few whose readings corresponded with those of control instruments. Taking the month of July for each year, he had endeavoured to arrive at the mean daily temperature by taking the mean of the temperatures registered every hour of each day in the month. He found this mean temperature to lie between the values of the expressions $(6 + 2 + 10) \div 3$ and $(7 + 2 + 9 + 9) \div 4$.

## RAILWAY MATTERS.

The electric underground railway at Budapest will be two miles long. The line is to be completed by April 1st, 1896.

The Prussian State Railroads in 1892 had in their service an average of 188,958 workmen entitled to insurance payments in case of accident. The payments to these men for insurance amounted to 411,552 dols., which is equal to 2·18 dols. per employé. The year before these payments had been at the rate of 1·70 dols. per man.

The London Chamber of Commerce, in response to the invitation from the Board of Trade, have nominated Sir Edward H. Carbutt, Bart., chairman of the Engineering and Allied Trades' Section, and Mr. Emil Garcke, chairman of the Electrical and Allied Trades' Section, as the delegates of the Chamber to the conference on light railways, which is to meet early next month.

The first section of the Salonica-Constantinople Railway, 54¾ miles in length, and having six stations—Salonica, Salmanbi, Sariguerri, Kilindir, Karasouli, and Dairan—has been completed and opened for general traffic. There will be one train each way daily, running the distance in 5 hours 35 minutes, including stoppages. The construction of the next section—Dairan to Serres—about 62¼ miles in length, will be completed in December.

We are not alone in our sufferings from inundation. In consequence of recent rains, the railway service between Genoa and Ventimiglia has been completely interrupted for some hours, a tunnel between Voltri and Arenzano having been flooded. Communication has been, however, restored. In many places shops and cellars were submerged, while the railway station at Santa Limmiana was invaded by the water, which rose at some points to a height of 3ft.

In defending the administration of the French railways, M. Barthom, the Minister of Public Works, on the 18th inst. said England alone attained greater security for its railway travellers. Speaking of the hours of labour on the railways, he mentioned that they had now been fixed as far as possible, and those of station-masters so arranged that they will in future get eight hours' rest. That is sixteen hours of responsible activity per day, or double the number that our Board of Trade inspectors, or some of them, consider proper for even the inferior servants of our companies.

A report has been presented to the Board of Trade by Major-General Hutchinson, on an accident which occurred on the 14th July, on the Swansea and Mumbles Railway, when as a train was proceeding at a slow rate of speed along the side of one of the streets in Swansea, a young female child, about 2½ years old, suddenly ran out on to the line through the opening between the railing and the end of the school building, just after the engine had passed, was caught by a rear vehicle, and had one of her legs so severely injured that it had to be amputated. Major-General Hutchinson, even in this case, manages to get in some demands for shorter hours, the total number being nine, just because a youngster suddenly gets through a railway fence, and after the engine has passed, gets itself caught by the train. Because of this, the hours of drivers and stokers are to be reduced, presumably so that they may have spare energy to watch the sides of the train as well as the road in front of them. "The hours of duty of drivers and firemen on this railway—twelve in the present case, with seven or eight intervals of rest of twenty-five minutes each are too long, and the company should, I submit, be called upon to reduce these hours."

Amongst the private Bills in Parliament, Session 1895, the preamble of that of the North British Railway is rather a heavy one, and involves the construction, deviation, or alteration of no less than fifteen lines. New railways and works are projected in its own county and in the adjacent one of Chester, by the North Staffordshire Railway, and the "Taff Vale" is, as usual, also a petitioner. The Glasgow and South-Western, the Lynton, the Midland, and the Lancashire and Yorkshire are also in the field, and a new company seeks to be incorporated under the title of the Neath, Pontardawe and Bryn-Aman Railway, for the construction of new lines in the county of Glamorgan. It may be mentioned that notice has been issued under the head Metropolitan Outer Circle Railway, for the abandonment of railway, release of deposit, winding up and dissolution of company. Bristol and Bridlington both seek for powers in connection with waterworks, the Ambleside Local Board adds gas to similar provisions, and York, Whitby, and Felixstowe may be included in the same category. The North Middlesex, Newmarket, and the South Metropolitan petition only for gas lighting powers. Board of Trade: For Provisional Orders of electric lighting, we find the Bootle Corporation, and the Liverpool Electric Supply Company.

Some additional particulars are now to hand with regard to the proposed second Simplon Tunnel, which will be of interest. As soon as it was known that the Swiss authorities had decided in favour of the enterprise, a mixed firm of German and Swiss contractors met in conclave to consider the question of submitting a tender for the great work of tunnelling under the Alps. The estimate was the first question, and the result of their deliberations was to prepare and submit one, which completely threw into the shade all the others that had previously been put forward. The difference was twofold, relating both to the time required for the execution of the work and the amount of the total cost. To start with, the cost of the plant, machinery, and appliances is valued at rather more than half a million sterling. In commencing the tunnel, which will be worked from both extremities, only one line of track will be proceeded with, but at the centre the width will be enlarged, so as to allow room for a bye-pass. For this part of the work a sum of £1,900,000 is demanded, which is at the rate of £110 per yard run. Should the company determine to make it a double track tunnel, it binds itself to give the order, before the expiration of the first four years of work, and to pay an extra £600,000, on condition of being put into possession four years after the giving of the order. The total cost of a double track will thus amount to £2,500,000, which will allow £145 per lineal yard.

In concluding a report on the accident which occurred on the 5th September, at Towyn station on the Cambrian Railways, Lieut-Col. H. A. York says:—"This accident must be attributed to the fact that the facing-points at the south end of the loop line were not properly closed when the engine of the down train reached them. The result being, as already stated, that the engine and tender, and six out of eight vehicles composing the train left the rails, and ran along the ballast for about forty yards before coming to a stand." No passengers were injured or even complained. The labour leader style of remark completes this report. The total number of hours of men on duty being the basis for more complaints. In this case there seems to have been rather more work for one of the porters than he could always get through, but no allowance is made in these complaints for the hours in the day when there is little work in hand, when there is practically a resting time. Common fairness, however, forces the Board of Trade Inspector to point out that the station master's hours must be proportionately long, by which he probably means that they are longer than those of the porters. The usual request that the company shall alter these hours is made, as well as suggestions as to signalling and locking arrangements which are already in hand. It is not, however, admitted that the completion of these arrangements will relieve one at least of two porters referred to from the work which now much interferes with their ordinary duties. It is something, perhaps, that the Board of Trade Inspector does not ask the railway company to appoint two station masters because the hours are too long.

## NOTES AND MEMORANDA.

In Brooklyn the use of cement pipe for sewers in preference to vitrified still continues. This is due in a measure to the smaller sizes of cement pipe being less expensive than the corresponding sizes of vitrified pipe.

The deaths registered last week in thirty-three great towns of England and Wales corresponded to an annual rate of 17·1 per 1000 of their aggregate population, which is estimated at 10,458,442 persons in the middle of this year. The rates varied from 10·7 at Leicester to 26·3 at Newcastle-on-Tyne.

M. Henri Moissan has recently read another paper before the Paris Academy of Sciences on "The Evaporisation of Carbon." The heat of the electric furnace enables carbon to be volatilised; the sublimed carbon is always deposited under the form of graphite at ordinary pressures, and there is no evidence whatever of the liquefaction of the carbon; for instance, the lid of a carbon crucible did not adhere when the whole mass had been converted into graphite, and a carbon needle heated in a carbon tube did not in any case become attached to the latter. *Nature* points out that previous experiments have, however, shown that under great pressures carbon may be fused, and diamond is then formed.

In contrast to the very large generators of electricity—batteries and dynamo-electric machinery—in such common use to-day, it may be interesting to note what is perhaps the smallest electric battery ever constructed, and no doubt also the smallest generator of electrical or mechanical energy. This battery was constructed some years ago by one of the electricians of the Boston Telephone Company, and consisted of an ordinary glass bead, through which two wires, one of copper and the other of iron, were looped and twisted so as to prevent their coming in contact. The wires acted as the electrodes, and all that was necessary to cause a current to flow was to place a drop of acidulated water in the bead. Certainly such a minute battery furnished but an infinitesimal current, but could be easily used in a delicate telephone, and, according to *Cassier's Magazine*, it is said to have actually been used in signalling to a distance of nearly 200 miles.

In a letter to a contemporary on the floods in the Thames Valley, Mr. F. C. Clutterbuck gives some figures in comparison of this flood with the great floods of this century. "Its height, of course, will differ locally. The data given are from memorandum in my possession made by my father, the Rev. J. C. Clutterbuck, vicar of Long Wittenham, Berks, from 1830—1885, who was a careful observer of these matters, and also a careful collector of evidence of bygone years. The greatest floods of this century are 1809, 1821, 1852, 1875, and the present year 1894. From these memoranda, and from my own observation this year, these floods were the following measurements above navigation high-water mark:—1809, 9ft. 1in.; 1821, 8ft. 10in.; 1852, 7ft. 10in.; 1875, 8ft. 1in.; 1894, 8ft. 8in. The flood this year was caused by heavy rains, from 4in. to nearly 5in., in this district from 8 p.m. on November 11th to 8 p.m. on November 14th, there being 24 hours out of the 72 without rain. It is a curious coincidence that the three floods of 1852, 1875, and 1894 were at their height within a few hours of each other on November 15th and 16th."

In the report on the composition and quality of daily samples of the water supplied to London, for the month ending October 31st, 1894, Mr. William Crookes, F.R.S., and Professor Dewar, F.R.S., say:—The rainfall during the month at Oxford, representing the Thames Valley, has been 3·97in., and as the twenty-five years' mean for the month is 2·56in., it follows that there has been an excess of rain amounting to 1·41in. Most of the rain fell at the latter part of the month, no less than 3·27in. falling on five days, the 24th, 26th, 27th, 28th, and 30th, the rest of the month only having 0·7in. of rain. The effect of so much sudden downpour was to wash a certain amount of clay into the river and cause discolouration. Analysis shows that the turbidity is not caused by excessive organic impurity, but by purely inorganic and harmless matter. The Grand Junction waters, as well as those of the other companies, were practically free from microbes, and in the least clear sample of water drawn from the stand pipe at Shepherd's Bush into a sterilised tube, there was detected only twenty colonies per cubic centimetre after cultivation for forty-eight hours in nutritive gelatine.

Mr. G. J. Symons has contributed to Part II. of the Report of the Chicago Meteorological Congress an interesting summary of early English meteorological literature, embracing the years 1337-1699. He only deals with some fifty books and pamphlets contained in his own library, but his special knowledge of meteorological bibliography enables him to give some useful particulars about these old works. We can only briefly refer to a few of them here. In the Bodleian Library at Oxford there is—as far as is known—the earliest continuous weather record in in the world, containing observations by one W. Merle from January, 1337, to January, 1344. A few copies of a translation of this work were printed in 1891. These observations show that the weather at that time was very similar to what it is now. In 1670, "The Shepheard's Legacy" was printed. This work is excessively scarce, and is the earliest edition of what has since been reprinted many times as "The Shepherd of Banbury's Rules for Judging the Weather." In 1671 appeared "A Discourse concerning the Origine and Properties of Wind," &c. This treatise is noteworthy as being probably the first in which the theories of the winds are compared with details of the trade winds, monsoons, &c. In 1696 a work entitled "New Observations on the Natural History of the World of Matter," &c., by the Rev. T. Robinson, was published. It gives the earliest description yet known of the strong local wind known in Cumberland as the helm wind.

At the last meeting of the Physical Society a paper was read by Dr. J. Larmor on "The Significance of Wiener's Localisation of the Photographic Action of Stationary Light Waves." The experiments by which Wiener demonstrated that when stationary plane-polarised optical undulations are produced in a photographic film, by reflexion of a stream of plane-polarised light at a metallic or other backing, the photographic action occurs at the antinodes of Fresnel's vibration vector and not at the nodes, have been employed by its author and others to decide between the various theories of light. Using the terminology of the electric theory of light, we may say that the photographic action takes place at the antinodes of the electric vector, which corresponds to Fresnel's vibration, and not at the intermediate antinodes of the magnetic vector, which corresponds to McCullagh's and to Neumann's vibration. The crucial experiment of Wiener relates to the case when the angle of incidence is 45 deg., so that the direct and reflected waves which interfere are at right angles to each other. When the light was polarised in the plane of incidence, the photographic plane developed a series of bands; but when it was polarised in the perpendicular plane, these bands were absent. The argument employed is that the photographic effect will be greatest at those places in the stationary wave train where the vibration is most intense; and the conclusion has been drawn from it that the actual vibration is represented by Fresnel's vector and not by McCullagh's; in other words, that the vibrations of polarised light are at right angles to the plane of polarisation. The force of this argument, as against McCullagh's theory, would, however, be evaded if the vector of that theory were taken to represent something different from the linear displacement of the ether, or if vibrations were excited in the molecule by rotation instead of translation, or by stress. Now there are about $10^3$ molecules of the sensitive medium in the length of a single wave of light—thus in the stationary wave train all the parts of a single molecule would at any instant be moving with a sensibly uniform velocity, which increases and diminishes periodically. It does not seem clear, however, that alternating stress might not be as potent a factor in disintegration as alternating motion.

## MISCELLANEA.

In a recent number of the *Comptes Rendus* is a paper on "The Relations between the Vapour Pressures of a Body in the Solid and in the Liquid State: Influence of Pressure on the Temperature of Fusion," by M. A. Ponsot.

Several of the small torpedo boats intended for the depôt ship Foudre have now been delivered to the French naval authorities. "A" is 62ft. 4in. long, 14¼ tons displacement, 210-horse power, giving her a speed of 16·3 knots. Only one of the Foudre's boats is built of aluminium, being that recently supplied by Messrs. Yarrow and Co.

The unsatisfactory results which persistently attended the trials of the Halcyon, gunboat, have been traced to the improper plating of her under parts, which were out of line owing to the inability of the Devonport Dockyard hands to do the work under test measurement. A remedy is now being applied by sheathing the bottom with wood—an expensive undertaking. Test measurement will be discontinued for the present.

The Union Steamship Company's twin screw Royal mail steamer Norman, which left Southampton on Saturday, November 10th, with the outward Cape of Good Hope and Natal mails, arrived at Madeira at 5.0 p.m. on Wednesday, November 14th, and proceeded for Cape Town at 7.0 p.m. Passage, 3 days 10 hours, net steaming time. Average speed, 15·6 knots per hour. Experienced very heavy weather, steaming slow for twelve hours.

At a meeting of the cement trade held at the London Chamber of Commerce on Tuesday last, it was resolved—"That a committee be appointed, with power to engage experts to investigate into the question of the admixture of Kentish Rag Stone, other stone or other material with Portland cement, so far as carried on at home and on the Continent, and to report and advise thereon." Representatives of eleven firms were appointed upon the committee. The formation of a Cement Manufacturers Association, with the object of stopping adulteration, was reported in our last impression.

A little steamer of a hundred tons is at present, according to a Dalziel telegram, being constructed at Argenteuil according to the invention of M. Bazin, which consists in rolling the ship over the water instead of forcing it through as at present. To this end a number of enormous copper cylinders are fixed to the vessel, the speed attained depending upon the speed of the metal cylinders, and it is computed that 31 knots an hour can be easily made. The steering is done by a kind of hydraulic pump, and an advantage claimed is that no way is lost in altering the course. It is hoped the vessel will be built without much loss of time. The trial trip will be made between Dieppe and Newhaven.

The Champagnac Collieries, situated in the communes of Champagnac, Ydes and Bassignac, Arrondissement of Mauriac, in the French Department of Cantal, with the concessions of Bort and Sarroux in the Arrondissement of Ussel, Corrèze, are announced for sale by auction on the 9th of November at the upset price of one million francs—£40,000. The property in question comprises the mine concession, surface property, houses and other buildings, washing floor and briquette works, plant, tools, and machinery, now belonging to the Société Rougier, Pochat et Cie. The stocks, stores, change parts of machinery, &c., are to be taken at a valuation, and possession will be given on completion of the purchase. Full particulars may be obtained from M. Perlia, engineer, liquidator of the above-named company at the colliery.

Last year a fifth blast furnace, of larger dimensions than the four already existing at Pont-à-Mousson, in Meurthe-et-Moselle, was, as reported by the *Revue Industrielle de L'Est*, completed and blown in. Last February one of the old furnaces was blown out, pulled down, rebuilt on the new lines, and blown in four months later, when a second furnace was blown out, pulled down, and reconstructed to the same scale for immediate blowing in, these two new furnaces being provided with Cawper stoves 30 m. (98ft.) high. The two old furnaces still remaining are to be reconstructed next year, so as to bring the total daily out-turn at Pont-à-Mousson to 300 tons. It appears that this quantity will be rather in excess of local requirements, so that when the furnaces are at full production some grey pig will be in the market.

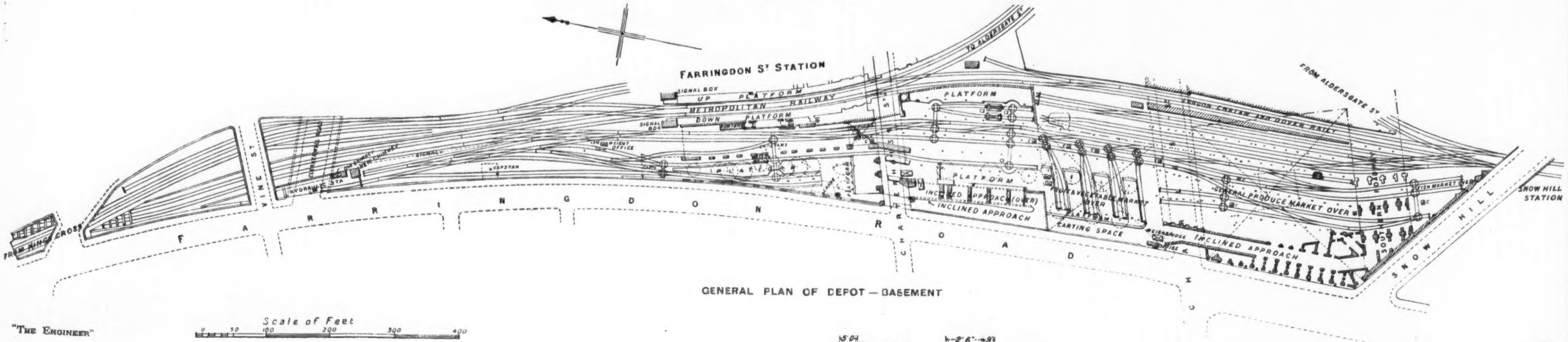
The Gainsborough Local Board of Health have now received the sanction of the Local Government Board to a loan of £5750 for their proposed new boring. This boring will be somewhat remarkable on account of its great diameter and depth. It is to be 1450ft. deep, and not less than 18in. diameter in the sandstone, and will take the best part of two years in execution. The whole scheme, as designed by Mr. Jabez Church, M.I.C.E.—see The Engineer of July 6th, 1894, page 4—has been approved by the Local Government Board, and as soon as the new boring is sufficiently advanced to confirm the engineer's opinion as regards the quantity of water to be obtained from it, the remainder of the amount appliedfor will be at once sanctioned in order to complete the scheme. As regards the probable success of the new borehole, it will be situated only a few yards from the one now supplying the whole of the water required by the town, and will be carried 600ft. lower than this, and 18in. instead of 10in. minimum diameter. Consequently there cannot be any doubt but that the new supply will prove ample for the needs of the town for many years to come.

During the course of the inquiry into the cause of the electrical accident at Cannon-street, Mr. David Cook, chief engineer and manager to the City of London Electric Lighting Company, said the primary cause of the accident was the crossing of two high-pressure cables, which were being tested, and put to work for the first time. One of these cables was for the supply of current to the Watling-street transformer station, and the other for the Milk-street transformer station. The Milk-street cable was inadvertently put into the Watling-street terminals at Bankside, while the Watling-street cable was laid with its inner conductor touching the lead covering of a third cable. For convenience the Watling-street cable was made alive by current from the transformer station. When the signal was given, the man at the transformer station switched on. The inner of the conductor was against the lead covering of another cable; therefore, the inner of the whole high-pressure system was put to earth, throwing an unusual strain upon the insulation of the primary mains. The cause of the breakdown appeared to have been due to a mechanical abrasion of the outside covering, and the leak in the junction-box developed into a short circuit, thus firing some gas which was in the conduit, and blew up the cover of the box. He should propose to his directors at their next meeting to provide a complete system of ventilation of conduits at a cost of some £2000. Major Cardew said the Electric Light Company came after the Gas Company, and their regulations required them to keep their conduits free from gas. Mr. G. F. L. Foulger, chief distributing engineer of the Gas Light and Coke Company, said he thought the scheme of ventilation suggested by Mr. Cook would be a very bad one. He considered that if the Electric Lighting Company used their arc lamp-posts, which were 20ft. high, and if they were to fill them up with earth or sawdust to prevent the gas firing back, and carried, say, a 1½in. or 2in. pipe as a ventilating pipe, with an outlet to the atmosphere of about one-half the height of the post, then there would be no danger whatever of the gas firing back from the arc light through 10ft. of atmosphere. The earth need not go right through the column. The ventilating pipe ought to be about 10ft. high, so as to be beyond the reach of passers by.

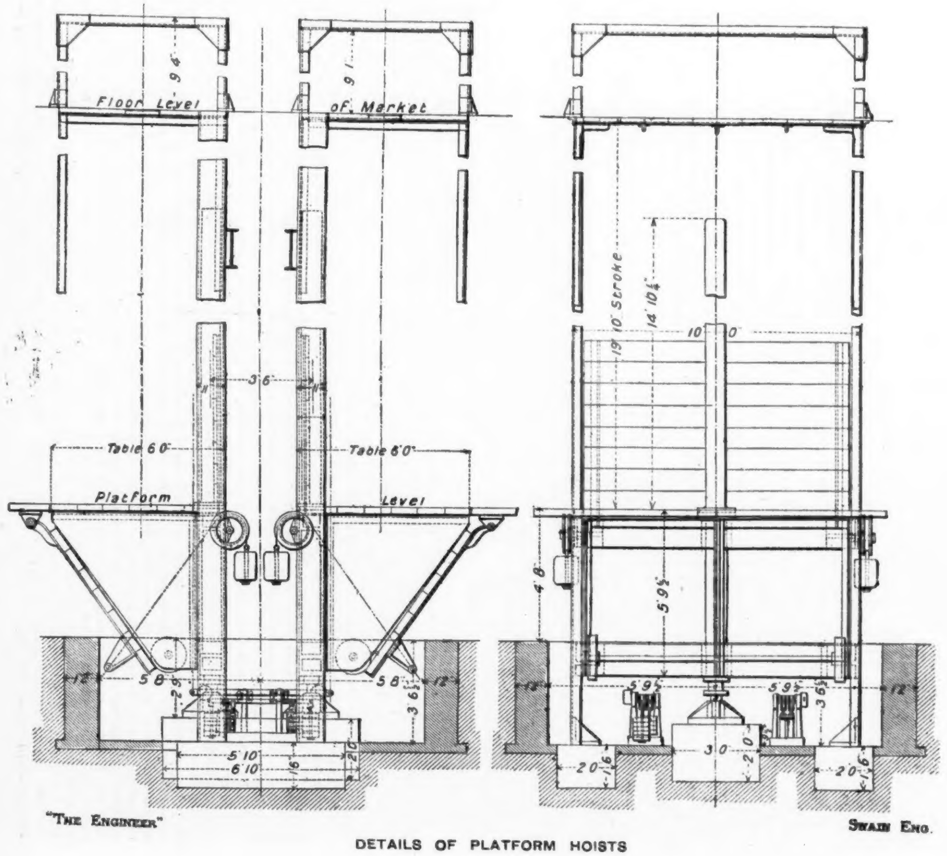
# THE GREAT NORTHERN RAILWAY COMPANY'S NEW GOODS DEPOT, FARRINGDON ROAD

MR. RICHARD JOHNSON, M. INST. C.E., CHIEF ENGINEER

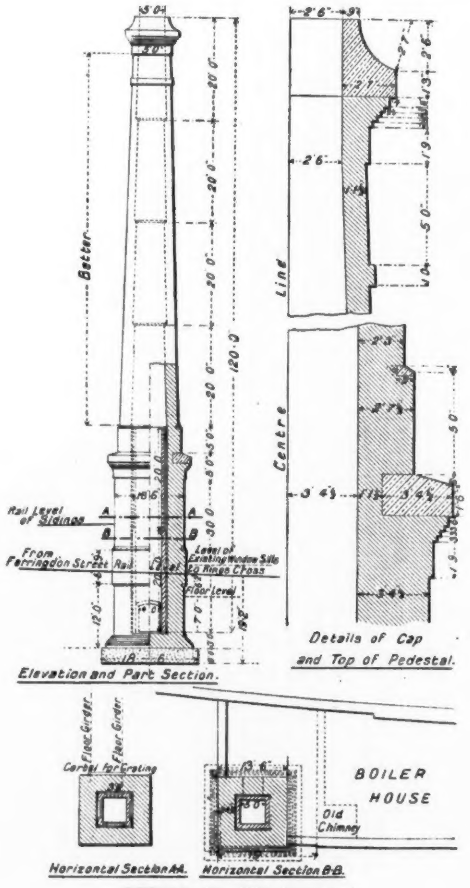
*(For description see page 440)*


FARRINGDON ST STATION
SIGNAL BOX
UP PLATFORM
METROPOLITAN RAILWAY
DOWN PLATFORM
SIGNAL BOX
TO ALDERSGATE ST
FROM ALDERSGATE ST
LONDON CHATHAM AND DOVER RAILY
PLATFORM
INCLINED APPROACH (OVER)
INCLINED APPROACH
CARTING SPACE
GENERAL PRODUCE MARKET OVER
FISH MARKET OVER
INCLINED APPROACH
SNOW HILL STATION
SNOW HILL
FARRINGDON ROAD
VINE ST
CHARLES ST
FROM KINGS CROSS
"THE ENGINEER"
Scale of Feet
0 50 100 200 300 400
Eng

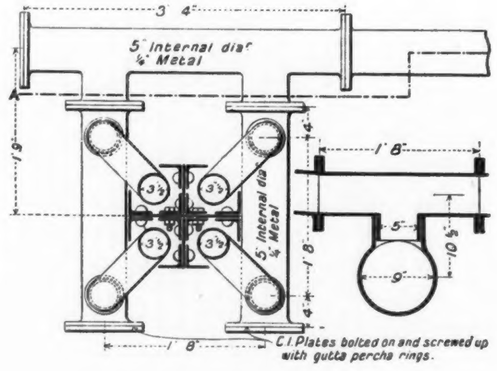
GENERAL PLAN OF DEPOT — BASEMENT

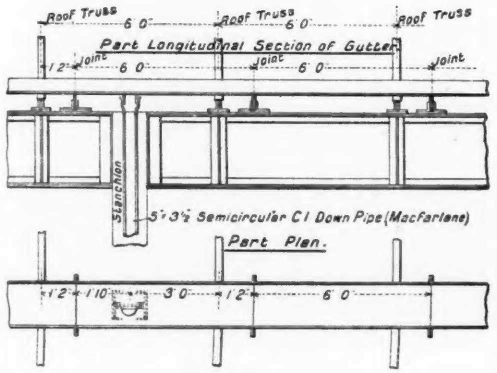

Floor Level
of Market
9 6
9 1
3 6
Table 6 0
Platform
Level
19 10 Stroke
14 10½
10 0
5 9½
4 8
5 8
5 10
6 10
2 0
3 0
"THE ENGINEER"
SWAIN ENG.

DETAILS OF PLATFORM HOISTS


Batter
120 0
20 0
Rail Level of Sidings
From Farringdon Street Rail
Level of Existing Window Sills Kings Cross
Floor Level
A
B
Line
Centre
Elevation and Part Section.
Details of Cap and Top of Pedestal.
Floor Girder
Corbel for Grating
BOILER HOUSE
Old Chimney
Horizontal Section A.A.
Horizontal Section B.B.

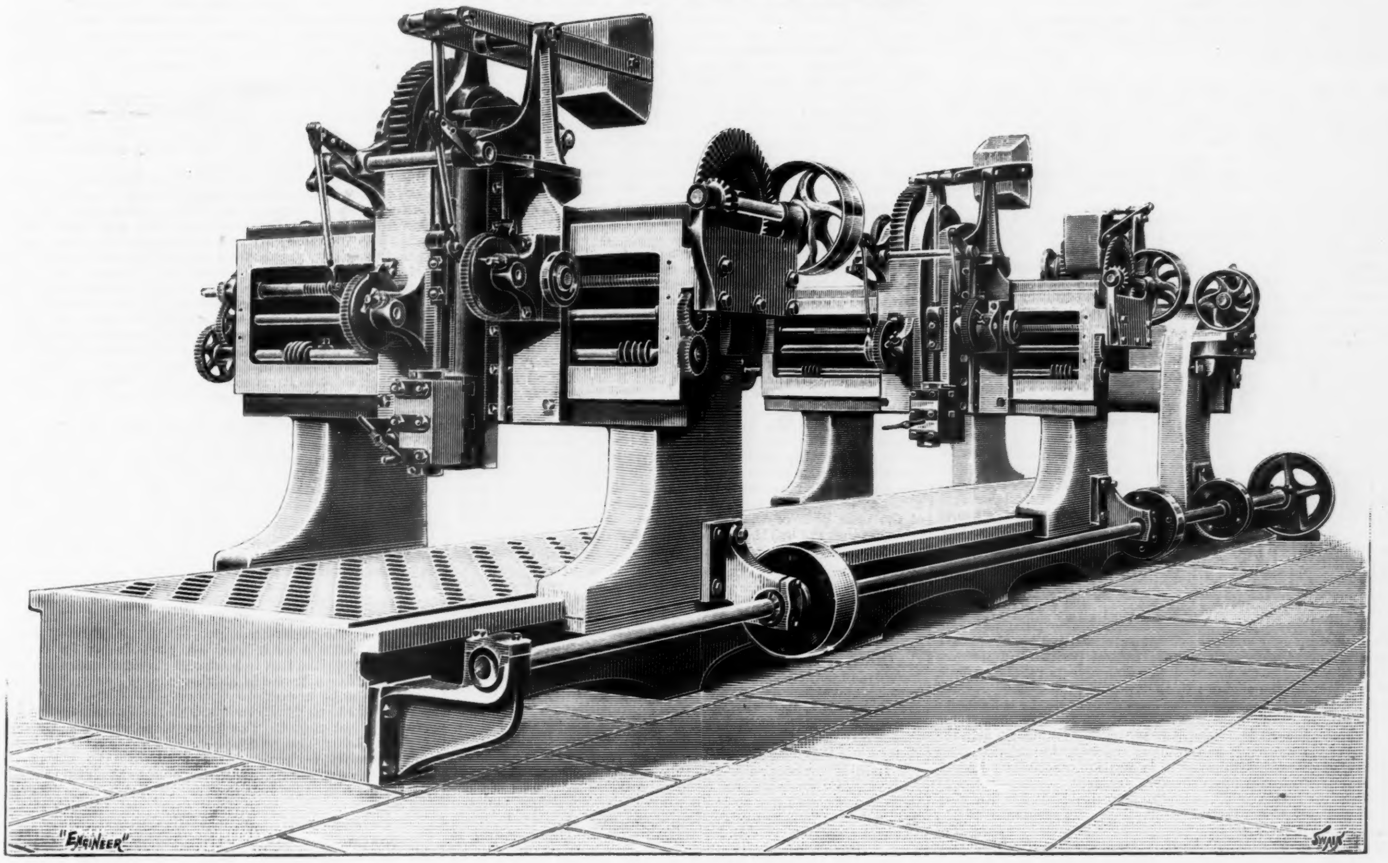
DETAILS OF NEW CHIMNEY


3 4
5 Internal diar ½ Metal
5 Internal dia ½ Metal
1 8
1 9
3½
9
10½
C.I. Plates bolted on and screwed up with gutta percha rings.


Roof Truss
6 0
Part Longitudinal Section of Gutter
Joint
Stanchion
5 3½ Semicircular C.I. Down Pipe (Macfarlane)
Part Plan.
1 2
1 10
3 0

# LOCOMOTIVE FRAME-PLATE SLOTTING MACHINE

MESSRS. CRAVEN BROTHERS, MANCHESTER, ENGINEERS

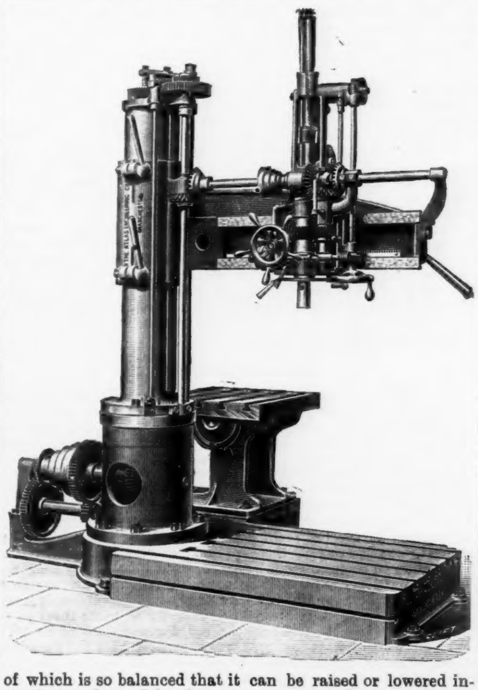


## LOCOMOTIVE FRAME-PLATE SLOTTING MACHINE.

DURING a recent visit to the Vulcan Foundry Company, Newton-le-Willows, near Manchester, we noticed amongst new plant that had been put down in connection with the extension of its locomotive works, a specially designed frame-plate slotting machine, made by Messrs. Craven Brothers, of Manchester, containing several new features, a brief description of which will be interesting. The accompanying illustration shows the general arrangement of the machine, which has a massive bed 36ft. long, admitting plates 5ft. wide, and there are three heads, each with a ram having an adjustable stroke up to 15in. deep. The heads, which are all identical in construction—so that the following description applies to each—can be worked all together or stopped and started separately, and the self-acting feed motions are self-contained on each carriage, thus enabling each head to work independently, or the three heads can be operated all together. The self-acting feed motions are timed to feed before the cutting tool starts at the top of stroke, and the feed is regulated for fine or deep cuts, this being effected by a circular plate alongside the catch wheels. This plate is arranged with part of its circumference the full diameter to the top of the catch-wheel teeth, and the outer part of its circumference to the same diameter as the bottom of the teeth, and the plate is regulated in position by a small worm-wheel motion to allow the feed-catch to ride on the full diameter or on the smaller diameter, so as to shield or expose the teeth in the catch-wheel to the action of the catch. The plate can thus be regulated to allow the catch to take one tooth or many without altering the position of the studs in the levers. Two self-acting feed motions are provided on each head, one for the longitudinal, and the other for cross traverse motions of the cutting tool. When it is required to slot the horns of locomotive framing taper, there is an arrangement by which the longitudinal and cross traverse motions are in gear at the same time, and by means of change wheels various tapers can be slotted self-acting, the cutting rams being thus enabled to slot parallel or at right angles to the bed or taper. The cutting rams are worked first by a shaft the full length of the bed, having a key groove its full length, with a large three-speeded cone pulley at the driving end, and three broad pulleys, one for each head. These pulleys have a long boss working in a collar bearing on each head, and moving with the head; the boss is fitted with a long steel key working in the key groove in the long shaft, and each of the three broad pulleys drives a pair of fast and loose pulleys on the heads, whilst a strap-lever arrangement is provided at the front side of the machine to enable the workmen to transfer the driving belts to the fast or loose pulley to start or stop each head. The pulleys on the head drive a pinion working into a large bevel wheel upon a shaft; this shaft has a pinion with a steel key in the boss working in the key groove in the shaft, and the pinion works in a bearing on the carriage, and drives a large spur wheel on a shaft with a forged steel disc at one end. This shaft runs in two bearings, the driving wheel being between the two, the disc being supported in a bearing at its outer diameter and made with a planed slot across it, and fitted with a strong stud or crank pin, which is altered in its position on the disc by a screw to regulate the length of the stroke, and when adjusted is secured to the disc by a large nut. The stud or crank pin is provided with a hardened steel block which works into a hardened steel vibrating link on a fixed stud on the carriage at one end, and a connecting-rod at the other connected to the cutting ram, which is raised at a quick speed in the up-stroke and slower at a uniform speed in the cutting or down stroke, and the position of the ram is variable to suit the height or thickness of the work to be slotted. The bottom end of the ram is provided with a tool-holder which can be rotated by a worm-wheel motion for slotting curves, and the ram is balanced by a weight and levers to facilitate the quick return motion and relieve the strain on the crank disc and link.

## UNIVERSAL RADIAL DRILLING MACHINE.

THE engraving below illustrates a new radial arm drilling machine made by the Atlas Engineering Company, of Levenshulme, Manchester, and containing several features of interest. It is a 4ft. radial drilling machine, the radial arm of which is so balanced that it can be raised or lowered instantaneously, and for the same reason can be swung round very easily, the balance being inside the vertical column. The machine will admit a piece of work 5ft. high between the spindle and base plate, or can be lowered until the spindle is within 9in. of the base. The apparatus for raising or lowering the arm is very simple, and is operated by the lever shown at the bottom of the pillars. The pillar is made sufficiently strong to withstand the strain of heavy drilling, when the carriage is at the end of the arm. The spindle is 2¼in. diameter, runs long bearings, and has a self-acting feed of 15in. It is provided with a quick release and return motion, being balanced by a flat coiled spring. The spindle is also reversible for tapping by means of the clutch bevel gear shown, the lever for this purpose being placed in a convenient position beneath the carriage. The gearing is all machine-cut, the smaller pinions and racks being in steel. A convenient counting table for angular work is fitted to an off-set from the bed-plate. This table has a top 30in. by 30in., with T grooves. It can be set at any angle from a horizontal to a vertical, one side being indexed in degrees for the purpose of setting work easily to the required angle.

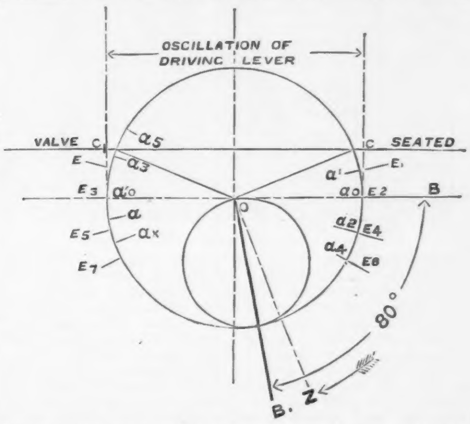


## LETTERS TO THE EDITOR.

*We do not hold ourselves responsible for the opinions of our correspondents.)*

### GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—Allow me briefly to reply to Mr. Dunlop. In regard to his relating to mine of 29th ult., I do not consider it calls for any reply, but I shall be glad of a little of your valuable space to endeavour to show what, practically, this discovery of your correspondent amounts to—which thing, by the way, has been known for years to those who have had any experience with this type of gear, which it is very evident that Mr. Dunlop has not had. In practice the negative angle of advance is 80 deg., and the diagrammatic sketch herewith enclosed will, I think, more clearly show than the one invented by him the mare's-nest he has discovered.



The circle represents the total oscillation of the driving lever. The lines inside the circle denote some of the positions of the angle lever or bell crank edges, those outside the positions of the detent latch or lifter edges. When in mid-position, and the detents are not gearing with the angle lever faces, the detent faces are at C $C_1$, whilst those of the angle lever are at $A_0$ $A_0$, the valve being closed. Suppose the excentric to be moved back until it lies on the line O Z when the active edge of the angle lever will be at C, the idle edge being at A X, the detent faces remaining at $C_1$ C. On the excentric moving to $B_1$ the active edges of the lever and detent will be at $A_1$ $E_1$, which is zero, and the valve will be open by the amount C E, the idle edges of the lever and detent being at A and E respectively. If release occurred, there is nothing to prevent the edge of the latch arriving at C when the valve is seated. On the arrival of the angle lever edges at $A_0$ $A_0$, the active face of the detent is at $E_2$, the idle face being at $E_3$; it is possible, but problematical, that if the edges be released the valve might be arrested here, but, as the governor has lifted the active edge clear, it will have placed the idle edge in the same position, the point $E_2$ to $\frac{1}{64}$th cut-off. On the angle lever edge arriving at $A_2$, which corresponds to $\frac{1}{16}$th cut-off, the idle edges of the lever and detent are at $A_3$ and $E_5$ respectively; on release, the idle edge of the detent would strike the idle edge of the lever at $A_3$, and the valve would not be closed by the amount $C_1$ $A_3$—in reality it will be less, as the edge $A_3$ is not stationary. When the lever edge arrives at $A_4$ = one-eighth cut-off, the idle edge of the lever is at $A_5$ and that of the detent is at $E_7$; on release, the valve seats at the idle edge of the lever is above $C_1$. The interval in which arrestment of the valve is from $A_0$ to $A_3$, a matter of less than 5 per cent. of the total range, viz., from zero to five-eighths, which is ample for a compound engine. Mr. Dunlop will probably now see the reason why the loose bridle has not been brought forward sooner, the arrestment being of no practical importance. I consider it only necessary in special cases.

I am afraid your correspondent will require to look elsewhere for the cause of the ineffectual governing of electric light engines.

Maryport, November 19th. WM. CAMERON.

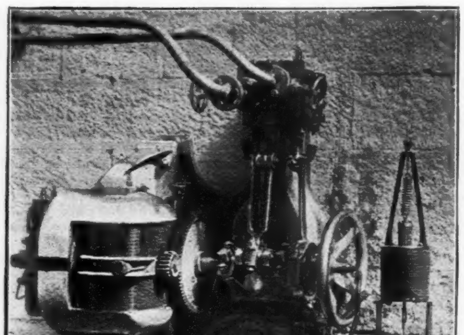
---

SIR,—I have followed with very great interest the correspondence in your paper regarding governors for steam dynamos, and judging from the various opinions expressed therein, it seems to me that the gentlemen who have been discussing this question are on a false track, or do not seem to understand the matter thoroughly. There is no doubt that the governing of electric light engines is still in its infancy, and a very arduous problem not as yet solved.

The difficulty of governing the speed of steam engines, and especially on board ship, is very great, and up to the present the real effective governor has been a fireman, who is placed at the throttle valve to open and close the stop valve, so that a constant current as near as possible may be kept. Naturally this form of governor is rather expensive. The call on a governor for electric light on board ship is far greater than for land installations. The durability of the lamps depends principally on the regularity of the electric current. It is therefore a great boon to have an electric governor; moreover, a constant current of electricity is not only economical, but at the same time it produces a steadier light.

I have lately had the satisfaction of overcoming the difficulty, and have been able to keep a constant voltage by using a fluid regulator. The type of centrifugal governors keyed on the shaft, and other systems offered in the trade, are not employable, for they only begin to govern after the engine has arrived at an irregular speed, and the existent governors which are efficient in this respect are so very delicate that they cannot stand the strain of hard work demanded from them. For instance, a Swiss firm produce a very good governor, but its great fault is that it has to to be taken to pieces every fortnight to be cleaned and adjusted, thus making it impracticable on board ship. I have, jointly with Mr. David Joy, patented a governor, which has been fitted to four different electric light installations; the results obtained are equal to all demands. The principle of this governor is as follows: On the crank shaft of the engine there is placed an excentric of Mr. Joy's patent oil gear type, the sheave having plungers which are actuated upon by hydraulic oil pressure, which gives the sheave a variation of excentricity from the central position to full throw of the excentric. The throw of the excentric is regulated by a pump, driven by the engine; this pump sucks the oil from a small receiver, inside of which the governing valve is placed; if the valve is opened, the pump sucks the oil out of the receiver, but if the valve closes, the oil is forced through another opening into the plunger of the excentric sheave, thus reducing the travel of the slide valve. The governing of this valve is effected by an iron core, which is placed inside a solenoid.

The various functions take place as follows:—Through the closing off of a part of the incandescent lamps, the resistance of the main current is increased; consequently the voltage rises. The solenoid being intercalated in the current, draws the iron core downwards, and reduces the valve opening to which it is attached. The oil pumped into the valve cannot return, and is driven into the plunger, which in turn reduces the travel of the slide valve, and giving an earlier cut-off. This diminishes the revolutions of engines and gives a constant voltage.



In the installations carried out by us we have found that 40 per cent. of the incandescent lamps may be turned off without increasing the voltage. At the moment of interruption there is only a very slight increase of voltage visible, which disappears instantly through the rapid action of the governor, and with a greatly diminished number of incandescent lamps the voltmeter shows a lower rather than a higher pressure, which is all one can wish for.

The sensibility of the governor can be regulated by a set screw so as to keep whatever pressure is required, and the engine will constantly keep the same revolutions. The governing has been also tried on a generating engine of a central station for the transmission of electromotive power, and also in this case gave favourable results. The motor dynamos were stopped and started, and the voltage of the generator almost kept constant for all practical purposes. With this system I believe to have found the proper way of governing efficiently electric light engines, and have also used a sound principle. The obtained favourable results will amply prove this statement.

F. KADVEITSCH, Managing Director.
Austrian Lloyd's Steam Navigation Company,
Trieste, November 17th.

## THE THEORY OF THE STEAM ENGINE.

SIR,—I cordially agree with much that Mr. Maurice Cross has stated in his letter, dated November 12th; but disagree, *toto cœlo*, with his views about the results of the activity of Maxwell's little demons. In the case of steam engines, the actual results certainly exceed the efficiency represented by the ratio $\frac{T-t}{T}$, if the value of this is calculated on the assumption that equal increments of volume correspond with equal increments of heat, and the absolute temperature of melting ice is assumed to be equal to the difference between the temperatures of melting ice and boiling water, divided by the coefficient of expansion of volume between the two temperatures. If the coefficient of expansion per increment of unit of heat is constant, we have, on the assumption stated for temperatures on the constant coefficient scale, $\frac{T-t}{T} = \frac{a}{a}$. I have, however, demonstrated—and no one has been able to point out any flaw in the demonstration—that the Carnot cycle cannot be carried out in the way described by Carnot, if Carnot's own theory is true; and that, if heat and work are convertible, the ratio $\frac{T-t}{T}$ deduced from the direct Carnot cycle has nothing to do with the efficiency of a heat engine, and has no place in the science of thermodynamics. The reverse Carnot cycle is an impossibility, if heat cannot be transmitted by conduction from a cold to a hot body. The direct Carnot cycle is an excellent graphic illustration of the convertibility of heat and work in isothermal compression and expansion, but it is nothing more.

If Mr. Maurice Cross believes in the principle of the convertibility of heat and work, how can he—consistently with this belief—affirm that the work done by Maxwell's little demons in punching each other's heads, blacking each other's eyes, and throwing about limbs and tails, does not generate heat? I have demonstrated that the increased efficiency of high-pressure compound engines is principally due to the partial utilisation of the so-called latent heat caused by the motions of these little demons—in sober language, the molecules of steam. Can Mr. Cross point out any flaw in the demonstration? When heat is received by a liquid or gas, molecular motion instantaneously takes place, and continues as long as the liquid or gas continues to receive heat. As soon as heat ceases to be received or given out the molecular motion is gradually destroyed by molecular friction, and as soon as such molecule attains the same common temperature, intermolecular motion ceases, and every molecule of the body remains at rest. Molecular *vis viva* is the cause of heat, heat is the cause of molecular *vis viva*; but molecular *vis viva* is not a form of heat. In the phrase, "motion is a form of heat," by the term motion *vis viva* must be meant. When heat is applied to one part of a solid body no intermolecular motion is produced. The heat is transmitted from one part of the body to the other wholly by radiation, none by molecular convection.

In the case of the gas engines, the greater the fall of the temperature in the cylinder, the less the amount of the waste heat which passes up the chimney. How does Mr. Cross reconcile his belief in the principle of the convertibility of heat and work with his belief that the less the fall in the temperature the greater is the efficiency of the gas engine, if that efficiency is estimated in terms of the total heat of the operative substance? It is extremely probable that the less the temperature of the explosion the greater the efficiency. Do gas and air combine chemically in varying proportions?

Professor Alexander rightly dissents from the theory that in the perfect heat engine the heat must be received at a constant temperature and given out at a constant temperature. He states that he has proved this to be true by proving that the cycle in Sterling's air engine, where the temperatures vary, is as perfect as the Carnot cycle. I cannot admit the validity of the proof, as I have demonstrated that the Carnot cycle has nothing to do with heat engines of any description; but surely the falsity of the theory is self evident. How can the nature, properties, or mechanical powers of the heat received depend upon the temperature of the source of heat? In the extract from the work of Clausius units of heat are described as being of varying temperatures. What in the name of common sense can a unit of heat, *i.e.*, a number of foot-pounds, have to do with temperatures? The number of units of heat possessed by a unit of Carnot's heat substance varies in accordance with Carnot's definition as the absolute temperature of the heat substance, so that the mechanical work corresponding to a fall of $T - t$ degrees varies as $\frac{T-t}{T}$, but this has nothing to do with the Carnot cycle. It follows at once from Carnot's definition.

It seems almost incredible that Professor Smith should have affirmed that the abstraction of heat from a body in tension increases its mechanical power. The statement is a flat contradiction of the truth of the principle of the convertibility of heat and work. The tension is increased, and if it is sufficiently increased to overcome the forces which keep it in tension, these forces will be drawn towards each other until they again become equal to the tension. The total loss of mechanical power by the body in tension will be equal to the sum of the work done in drawing the resisting forces towards each other plus the equivalent of the heat abstracted by the conduction. Professor Smith seems to be in this case in the same "quandary" as one of your correspondents, who could not understand why a given weight of gas compressed up to a given pressure by adiabatic compression should have more power to do work than the same weight of gas compressed to the same pressure isothermally, the temperatures before compression being in each case the same. Professor Smith states that Carnot's theorem represents the "mathematical demonstration of an all-important law in thermodynamics." Will he kindly explain how a theorem can represent a demonstration, and describe the all-important law demonstrated?

I have demonstrated that under no possible condition can a gas expand without doing work, and have given several illustrations of the truth of this statement. Can "Lex" evolve out of the depth of his own inner consciousness an imaginary case of expansion unaccompanied by the doing of work?

The disciples of Clausius, whose doings must have sorely troubled the spirit of Carnot, should not imitate the showman's ostrich of the desert, which, according to the showman, buries its head in the sand, and because it can see nobody, thinks nobody can see it. The only thing lacking, needed to set the steam question at rest, seems to be the wish to get at the truth and set it at rest. WILLIAM DONALDSON.

November 19th.

## TRACTION ENGINES

SIR,—We have heard much of the question of light railways running along the common high roads. Now, it must be evident to anyone that the cost of permanent way alone will spoil all chance of a decent dividend, and that after all the benefit derived will be extremely limited. What is wanted is a new code of laws, or the repeal of all existing laws, relating to traction engines, also one general and universal law instead of all the bye-laws, which are different in almost every district. Some local boards say an engine shall not pass our borders during the day, and another not far distant during the night. If the Board of Trade will take steps to sweep away all these prohibitory laws and give steam locomotion on common roads a chance, we shall certainly hear no more of the demand for light railways. Traction engines are now made heavy because the law says they must travel slowly, and consequently must carry heavy loads in order to make them pay. What is the man in front with a red flag supposed to be for? With regard to horses shying, I would suggest that the time has come when all horses should be broken in to traction engines, just as now to pass any ordinary object. Some horses object to pass a heap of stones, or a donkey, or a sweep, but they have to. Why should our locomotion on common roads cost five times as much as steam traction locomotion only because horses shy at these engines? Let a horse follow a traction engine for a day, and he will no longer be frightened. Anyone who has travelled in America will have observed that horses and engines are on the most friendly terms. Besides, what will become of shying horses when we have light railways on common roads? What railways did for the remote parts of England, traction engines can do for places distant from railway stations. If there were no restrictions against traction engines any farmer with 300 acres could use one to advantage. If we are to have progress in this direction, traction engines must be able to move from place to place on equal terms with horse carriages. A traction engine running in, say, three counties, has to pay £30 a year in order that it may pull a load. Now, traction engines do not do so much harm to the roads as the feet of heavy horses. As a matter of fact they do the work of a steam roller. As is proved where traction engines are most common, the roads are undoubtedly the best. See the roads in Kent. Engineers will not design a lighter or more pleasing-looking engine until there is a demand, and there can be no demand until the laws are altered. I hope every member of the Local Government Board will fully consider traction engines and the laws and bye-laws. This vital question should be fully ventilated. J. E. S.

November 20th.

---

SIR,—The letter of your correspondent "Traction" is a fair one, but sets up claims on behalf of traction engine owners far from fair. First, as to the licence: If the Government repaired all the roads they would be entitled to the fee, but they do not; when this is re-adjusted district councils will have something to say. The fees for licences in this county amount to about £60 per annum, the damage done by locomotives of all sorts about £1500. I agree with him that the working hours should be the same as other out-door trades. During the hunting season I am worried with complaints about road locomotives—hence my personal wish to stop them during the hunting season.

"An Agricultural Engine Owner" is of the usual type, and it is these that have done as much as anything else to cause such opposition to traction engines—men who cannot give one a civil answer, who renew their licence six months after date, who evade the law by only having the maker's name on the engine and trucks. When their dirty, snorting old engine stops they have to tear the road to pieces to start the load, and steal stones to put under the wheels; who stop on bridges and knock holes in the parapet because their suction pipe is too short, and no more can be got on the purchase hire system. I never conveyed the idea that the little harmless engine used for threshing machines should be licenced, as they bear the same proportion as a perambulator to a brougham; but other vehicles are taxed if not licensed, and I fail to see any comparison between these and a railway. The one purchases the land and makes its own highway, the other uses the public highway.

Why should agriculturists be exempt from paying for a licence? The farmer takes his barley to the malthouse with his two locomotives: he pays no licence; the malster must pay a licence for his one engine to haul it out. My statement as to stinking oil is the result of ten years' observations. Your correspondent is welcome to hold a different opinion: observant readers may judge for themselves. The judgment in the case of The Queen *v.* Savin enables any highway authority to ruin any traction engine owner damaging a weak road. Surely it would be better for the highway authority to prevent the damage. Any alteration in the statutes on the present temper of the public would be against traction engine owners.

That the laws require alteration is admitted. We have not heard what the owners require. What the highway authorities require is roughly as follows:—A joint licence for county and district council, the fees to be shared; a time licence for itinerant engines holding a licence in another county; annual inspection of every engine by a competent official, the engine to be indicated and the load to be drawn endorsed on the licence, no licence to be given to a bad engine. The driver to be examined by the same official, and only those holding his certificate to be employed. Any road authority to have power to prohibit the use of traction engines on weak roads. Traction owners to be placed in exactly the same position as other owners of vehicles for damage done to roads and bridges. ROBERT PHILLIPS.

November 21st.

---

SIR,—I am very glad to see the discussion in your columns on traction engines, and hope it will be the means of inducing more engine owners and users to take combined and well-directed action to effect what all desire. An association such as "I. H. M." writes about was initiated last year at the Smithfield Club Show. The makers give hearty support to it, so do a good many owners, including many of the largest, most experienced, and best known men in the country. But the numbers are not what they ought to be, if engine-owners really feel the present regulatous to be oppressive.

The subscription is low as the strength of such an association should be in its numbers. The committee will only spend money in law expenses when any important question of principle can be decided. It cannot help members to pay the fines they incur or the damages awarded against them for repairs of roads, &c., but every case brought before them receives careful consideration from the men who have been in every traction engine case for years past and useful practical advice given.

You, Sir, know well enough how impracticable any attempt at private legislation would have been last session. It is for engine owners to form public opinion in their own districts among their customers, employés and others, so that their members of Parliament or their candidates for the next Parliament will support this association in the Bill which it intends to bring forward at the proper moment. To carry on a parliamentary "agitation" costs money, and it is useless throwing away the slender resources hitherto provided by engine owners in efforts which must be fruitless.

The Smithfield Club have granted us the use of a room at the Agricultural Hall on Wednesday, December 14th, at 4 p.m., for our annual meeting, and I hope every engine owner who has a grievance will come to that meeting.

H. R SUMMERS, Secretary.
The National Traction Engine Owners' and Users' Association,
135, Upper Thames-street, E.C.,
November 21st.

## LOCOMOTIVES AND TRAINS.

SIR,—I have read your leading article, and also the correspondence on this subject, with some interest. I believe on the Great Northern Railway it is the custom never to take a pilot; and I am quite sure that, if such were not the case, drivers who at present will take fifteen or more coaches up to Potters Bar with every confidence and success would, if the pilot could be had for the asking, take him on occasions to help to do what they can at present do so well alone; and is not the foregoing a probable explanation of much of the piloting at present done on other lines?

Mr. Macdonald talks of the inability of the old North-Eastern engines to cope with the present-day coaches and the greater booked speed now required. With regard to the coaches, except for a few eight-wheel sleepers which count as one and a-half, and which Mr. Macdonald says are easier to haul, the Great Northern six-wheeler has for years been the standard East Coast coach. As to greater booked speed, the 1.42 a.m. ex Newcastle is given 108 minutes from Newcastle to York, with the stop at Darlington. In 1881 it took only five minutes longer; and long before that date the up Flying Scotchman had for some years been leaving Newcastle at 12.50 p.m. and reaching York at 2.35, with a stop at Darlington. I have therefore not the least doubt that No. 905, the old engine built by Mr. Fletcher—which was piloting the train which came to grief at Northallerton—could have worked the train unaided with the greatest ease. On June 16th, 1893, No. 904, a sister engine, took the day Scotch with thirteen on from York to Newcastle in 1 hour 38 minutes, with a bad start for a few miles out of York owing to adverse signals.

Mr. Rous Marten gives a run with another engine of the same class from Newcastle to York in ninety-two minutes with nearly 180 tons, stopping at Darlington and gaining ten minutes; the 44¼ miles from Darlington to York being run in forty-eight minutes. Mr. Pattinson gives a run from Newcastle to York by No. 269 with 15½ coaches in just under 100 minutes. From such examples as the above I form my conclusion. You recently illustrated two fine Great Western engines, which you described as the standard express engines. You remarked on the performances of twenty engines similar to the Agamemnon class—by which, I suppose, are meant engines of the 3001-3030 class, which differ from the class under discussion in having no leading bogie, and also cylinders 20in. by 24in. instead of 19in. by 24in. Eight of this class were built as broad gauge convertible engines, and were, on the abolition of that gauge, converted to narrow; and you illustrated one of the engines, both as converted and unconverted. This class is now being assimilated to the Agamemnon class by having the cylinders reduced and a bogie added. Again, are several engines of the Armstrong class new—*e g.*, Nos. 7 and 8 and 14 and 16? Were not Nos. 7 and 8 built as a narrow gauge and broad gauge compound respectively, the latter being convertible? And were not Nos. 14 and 16 built as broad gauge convertible engines, with only a leading pair of wheels, and not as now on a leading bogie

November 14th. E. B. D.

SIR,—In view of the comparisons between English and American express railway speeds which have from time to time appeared in your columns, I trust that a brief account of my experiences on a fast American train last month, during a visit to the United States, may be of interest to your readers. The journey in question was from Buffalo to New York by the Empire State express, on the New York Central and Hudson River Railroad. As the traveller "boards" the train at Buffalo he is confronted by a large placard announcing that this is the "fastest train in the world." That such a bold claim should have been allowed to go uncontested seems at first sight remarkable, if we assume that England can boast the fastest speeds, if not the most luxurious travelling. I hope to show, however, that the claim is not entirely unfounded, however unpalatable it may be.

I append below a tabular statement showing the mean speeds between stations and over the whole run of the train in question. For comparison with the best English practice, I show the corresponding details of the Scotch express between London and Edinburgh—a distance nearly equal to that covered by the American train—extracted from the time-tables of the current month :—

*Empire State Express, October 2nd*, 1894.

| Miles. | Stations. | | Time. | Mean Speed between Stations. Miles per Hour. |
|---|---|---|---|---|
| 0 | Buffalo | dep. | 1 0 p m. | 50 5 |
| 69 | Rochester | arr. | 2.22 p.m. | |
| | | dep. | 2 25 p.m. | 53 3 |
| 149 | Syracuse | arr. | 3 55 p m | |
| | | dep. | 4 0 p m. | 53·0 |
| 202 | Utica | arr. | 5.0 p m. | |
| | | dep. | 5 5 p m. | 51 8 |
| 297 | Albany | arr. | 6.55 p m. | |
| | | dep. | 7 0 p.m. | 44 |
| 440 | New York | arr. | 10.15 p m. | |

Mean speed, including stops, 47 6 miles per hour.

*Scotch Express, November*, 1894.

| Miles. | Stations. | | Time. | Mean Speed between Stations. Miles per Hour. |
|---|---|---|---|---|
| 0 | King's Cross | dep. | 10 0 a m. | 51·8 |
| 105½ | Grantham | arr. | 12·2 p m | |
| | | dep. | 12.7 p.m. | 50·5 |
| 1·8 | York | arr. | 1 45 p m. | |
| | | dep. | 2 5 p.m. | 49·5 |
| 268½ | Newcastle | arr. | 3 42 p.m. | |
| | | dep. | 3 47 p.m | 49·6 |
| 335½ | Berwick | arr. | 5.8 p.m. | |
| | | dep. | 5.13 p m. | 44 8 |
| 393 | Edinburgh | arr. | 6 30 p m. | |

Mean speed, including stops, 46·3 miles per hour.

From these tables it will be seen that the highest mean speed between stations of the Empire State express is 53·3 miles per hour, against 51 8 of the Scotch express; while the average over the whole distance, including stops, is 47·6 miles per hour for the American train, against 46 3 for the English train. In the latter case twenty minutes is allowed at York for lunch. If this prolonged stop were reduced to, say, five minutes, the mean speed would be raised to 47·6. In the United States, where trains carry so much of what we should consider station accommodation with them, this stop for meals is unnecessary, and, in my opinion, the train under consideration deserves full credit for the increased speed thereby rendered possible.

In the length of run without stop also the American train takes the lead—viz , 143 miles from Albany to New York, against 105½ from King's Cross to Grantham. So far as I am aware, this run of 143 miles is nowhere equalled at the present time. Being anxious to ascertain the highest speed attained over short distances, I timed mile after mile, and observed a speed of over 60 miles per hour for considerable periods. The fastest speed I recorded was 70½ miles per hour. This, I believe, does not equal speeds on the Great Northern Railway, which habitually reach 72, and occasionally 74 miles per hour, between Grantham and King's Cross. At Syracuse and New York the Empire State express arrived two minutes before "schedule" time, and at the remaining stations absolutely punctual. In all cases the start was "on time." The train consisted of a locomotive weighing, with the tender, about 90 tons, and a train of four cars weighing about 120 tons. The line has four tracks the whole distance, with numerous water troughs to save the weight of a large water supply on the tender.

It must be borne in mind that the two trains under comparison are in regular daily operation. If exceptional trains, such as the "Exposition Flyer," which was run during the World's Fair, and accomplished the journey from New York to Chicago in nineteen instead of the usual twenty-four hours, were compared with the Scotch express during the famous race to Edinburgh in 1887, when the time was reduced from 8½ to 7½ hours, different results might be obtained. My object is rather to show that the best regular express service in the United States is, apart from the superior comfort, at least as fast as that of our own country, which probably means of the world. I may be wrong in choosing the Scotch express as representing this side. If so I shall be glad to learn my error. I send herewith a photograph of the locomotive which hauled the Empire State express for a portion of the journey. The cylinders are 19in. by 24in., and the two pair of drivers 6ft. 4in. in diameter.* ARCHIBALD P. HEAD.

47, Victoria-street, S.W.

[We published a large engraving of Mr. Buchanan's engine in our impression for June 17th, 1892.—ED. E.]

SIR,—The engines so tenderly inquired after by "Scrutator" were built by Hawthorn, I believe, in 1882, and are still running; they had 6ft. 8in. coupled wheels, 3ft. 3in. truck wheels, and about 1100 square feet of heating surface, and weighed 38 tons. Such relics of the economical epoch of railway management as tenders with the pick-up are only to be found on the London and North-Western and Lancashire and Yorkshire Railways. A section is given on the sheets of drawings brought out by Mr. Theodore Smith, of Darlington, a few years back. Mr. Norman Macdonald's remarks as to weight of coaches and speed of train are quite beside the question, as the weight of the whole train has already been given by one of your correspondents as 194 tons, and the speed is not so high as that of many other trains. Besides, the North-Eastern steed does not usually make up any time on this stage of the road, knowing that the Great Northern Black Bess is willing to shoot sky-rockets from its funnel all the way to London—and finally expire with a burnt-out fire-box if necessary—to make up time lost by other companies, and to keep up a costly reputation for punctual arrivals at King's Cross.

In conclusion, I wish to apologise for taking up your valuable space for this the last time; and I should like to ask those railway men who resent outsiders writing to your columns on railway matters, to show us any railway in England except the London and Brighton which has lowered its working expenses by the use of modern locomotives. Everyone knows that heavy engines would show splendid results if employed to haul a large number of passengers; but they can only increase expenses per train mile as long as traffic managers continue to run such a number of light trains in response to some imaginary demand for more trains. To say that Manchester demands more than forty fast trains to London every day, or that such towns as Nottingham, Sheffield, Leicester, or Birmingham, are crying out for an extra service of trains, in addition to numerous express trains already run by the Great Northern, Midland, London and North-Western, and Great Western Railways, only shows what ridiculous excuses railway directors will give for embarking on a policy which has already nearly ruined one of our great railways. F. BOWLES.

November 19th.

### GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—It is difficult to keep one's temper in the face of such a string of ill-judged criticisms. assumptions, and conclusions, as Mr. James Dunlop again puts forth in your issue of the 9th inst.; and all this for the sole purpose of drawing your readers' attention to the stirring fact, that he has "invented a system or trip-gear diagram." I should feel intensely grateful for his gratuitous assistance to improve my knowledge of the gear I have introduced, but for several good reasons: (1) Ever since I had anything to do with the Proell apparatus I have been taught all about its action by a diagram constructed by Dr. Proell himself—he would not have been conceited enough to call it an invention. I hand you herewith a Proell prospectus, issued 1886, containing this diagram, which is the oldest printed illustration on which I can lay my hands. (2) Mr. Dunlop's own diagram is perfectly unintelligible from his own description, except possibly to those who already understand such diagrams, and therefore stand in no need of his "invention." (3) Mr. Dunlop bases his diagram on an entirely wrong angle of advance, viz., 38 deg. negative, while for the obsolete Proell apparatus a positive angle of 80 deg. was used.

Fig. 1

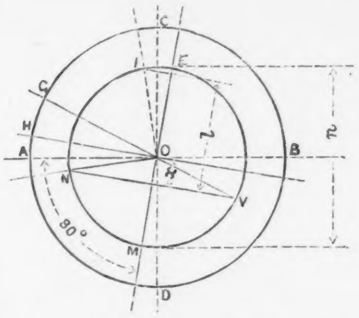


Fig. 2

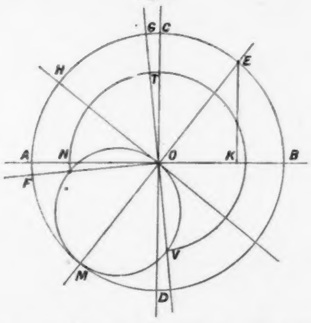
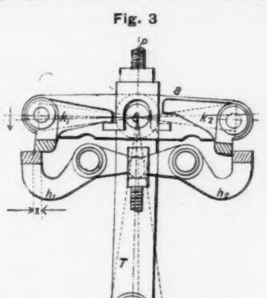


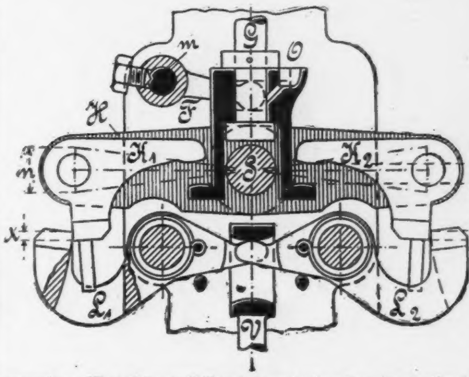
Fig. 3



I beg to hand you herewith the correct Proell diagram—Fig. 1—which I will not go to the length of explaining for those of your readers who are not familiar with such graphic demonstations; others will not require it. I have used the same letters as Mr. Dunlop, and it will be seen how the mere insertion of the correct advance angle influences the diagram, and reduces the wicked arc H G from the length, as Mr. Dunlop draws it in Fig. 2, to the correct one in my own Fig. 1. This shows the theoretical possibility of the inactive parts engaging between about 1 per cent. to 7 per cent. of the stroke, but not, as Mr. Dunlop maintained, between 16 per cent. and 43 per cent. In Mr. Dunlop's illustration, Fig. 3, particular stress is laid on the dimension $x$, the "overlap," as we call it. Every reader will, of course, expect that this dimension is an important function in Mr. Dunlop's diagram, while, as a matter of fact, his $x$ has nothing to do with it, but it is the dimension $x$ in my illustration Fig. 4, the "hang through" which is at the bottom of all the alleged misbief. It is certainly not to be wondered at that none of the engineers to whom I have submitted Mr. Dunlop's invention could reconcile it even with his own description, the mistakes of which can only be found out by somebody who is a good deal more conversant with the subject than the inventor of the Dunlop diagram. If Mr. Dunlop expected anybody to appreciate his addition to modern science, he should at least have been careful enough to avoid such mistakes as that he once calls O E the position at which the descending bell-crank comes in contact with its lifter, while later on he represents the same position O E as the extreme position, and besides he might at least have told your readers what all his circles and intersections mean.

As it stands, Mr. Dunlop's diagram will be of no use to anyone. But even supposing that Mr. Dunlop had re-invented the proper form of the diagram, and that he had been able to explain it intelligently to the uninitiated, and that you had given him sufficient space for the purpose, what would have been the result of all this waste of energy? That a theoretical diagram shows on paper the possibility of a certain action—but in a much reduced degree than Mr. Dunlop made out—in an obsolete form of the Proell apparatus. That this possibility does not take place in practice is absolutely proved by the indicator diagrams I handed you with my last letter, and which I shall thank you to print with this one. The reason is simply this, that in addition to the kinematic motion—which is alone shown in such valve diagrams—there are in the Proell apparatus, which has a free falling valve, dynamic influences, as the time the valve requires to fall, the action of the air buffer, &c., which upset all such paper conclusions. Having learned this simple fact, I trust Mr. Dunlop will set to work and invent another diagram which takes these important factors into account, unless he prefers to accept the indicator diagrams as conclusive.

Fig. 4



Mr. Dunlop's insinuations that we had allowed a fault to remain, because we either did not know of its existence or else did not know how to overcome it, is perfectly uncalled for. No user even of the obsolete construction has ever complained to me about the fault—which Mr. Dunlop has invented—because in practice it did not exist, and the construction would certainly not have been altered in this detail if the improved Proell gear had not made such a course desirable. HERMANN KUHNE.

25-35, New Broad-street, E.C., November 19th.

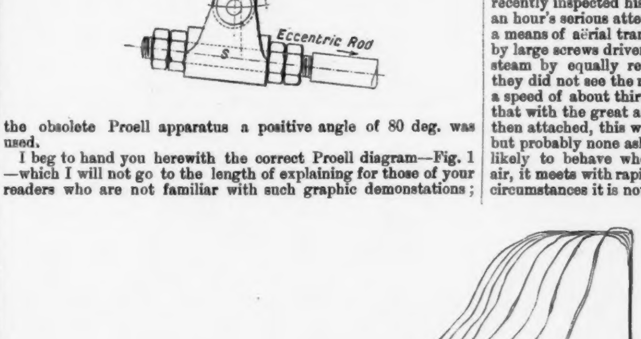
### PIVOTED ARCHED BRIDGES—HARLEM BRIDGE.

SIR,—In your article on "Pivoted Arched Bridges" in THE ENGINEER of October 26th, page 355, there is an obvious error in the reference to the Harlem Bridge, New York, which bridge has not "solid cast steel" arched ribs. There are several bridges over the Harlem river, the one referred to being the Washington Bridge at 184th Street. This has two arched spans of 510ft., each composed of six plate girder arched ribs, the depth of the girders being 13ft., which is a good size for the web plates, which are ⅜in. thick, except at the skewbacks, which are ⅝in. thick. At the skewbacks each girder bears against a steel hinge pin, 18in. diameter and 3ft. long. Your article referred to bridges mainly, but it may not be amiss to state that several of the buildings at the Chicago Exposition had pivoted and three hinged arched roof trusses—including one of 368ft. span—while a similar style of construction has been adopted for the roofs of some large new armouries—or drill-halls—and railway stations.

New York. E. E. RUSSELL TRATMAN, C.E.

### THE FLYING MACHINE.

SIR,—At the invitation of Mr. Maxim a larger number of people recently inspected his flying machine than had probably ever given an hour's serious attention to his development of the aëroplane as a means of aërial transit. They saw the great machine propelled by large screws driven by remarkable steam engines supplied with steam by equally remarkable and ingenious boilers. Although they did not see the machine lifted upon and by the air—although a speed of about thirty miles an hour was reached—many realised that with the great aëroplane, aided by those of smaller size not then attached, this would be possible. Comments were numerous, but probably none asked the question how is such an apparatus likely to behave when, propelled at a high speed through the air, it meets with rapid air currents from either side? Under these circumstances it is not quite obvious that the aëroplanes would not "scoot" like a kite and take advantage of tilting side winds to dive and make other erratic movements, in spite of the weight of the car and its machinery.



DIAGRAMS FROM ENGINE WITH PROELL VALVE GEAR

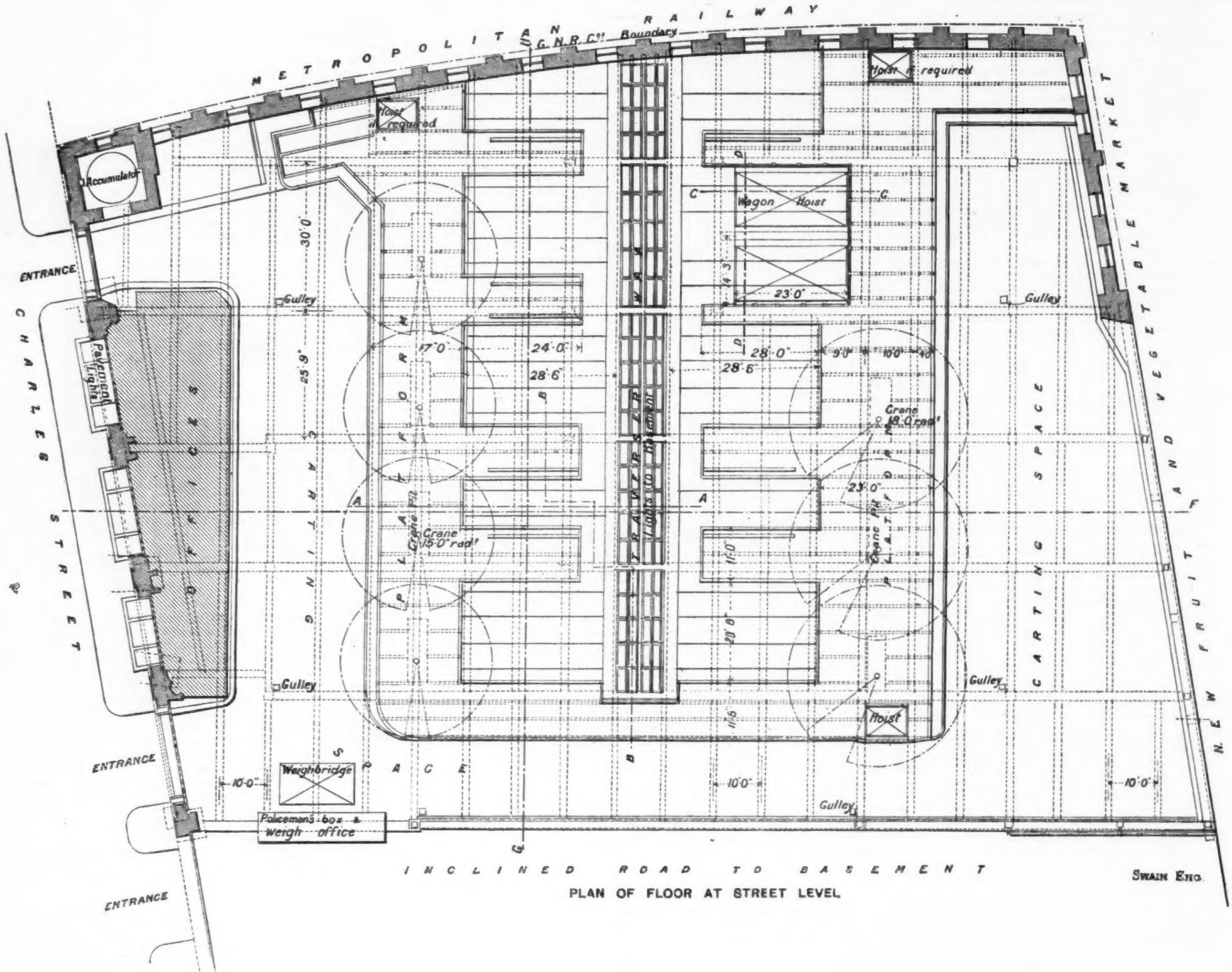
Some experiments made with small aëroplanes launched from an altitude rather indicate that this would happen. The tendency of the weight suspended from the aëroplane is, of course, to right the machine, but driven through the air at thirty miles an hour there seems little to prevent the aëroplane from acting indifferently in a vertical or more or less horizontal plane, once from any extraneous cause it got an inclination; and the question arises, would not this happen much more quickly than gravity could act as a righting force? Let the aëroplanes once receive a considerable tilt and take to erratic plunging and diving, there seems to be the possibility that the whole machine could turn over. Instantaneous reduction of the horizontal speed of propulsion would no doubt enable the righting tendency of the car weight to come into play after the manner of a parachute. It is difficult, however, to imagine this reduction of speed of horizontal translation taking place as quickly as a sudden dive due to the action of a side gust. No doubt Mr. Maxim has considered these questions, which seem to point to the use of propellers on vertical spindles as the means of maintaining the required altitude independently of the horizontal propulsion.

London, November 20th. B.

(*For continuation of Letters see page* 453)

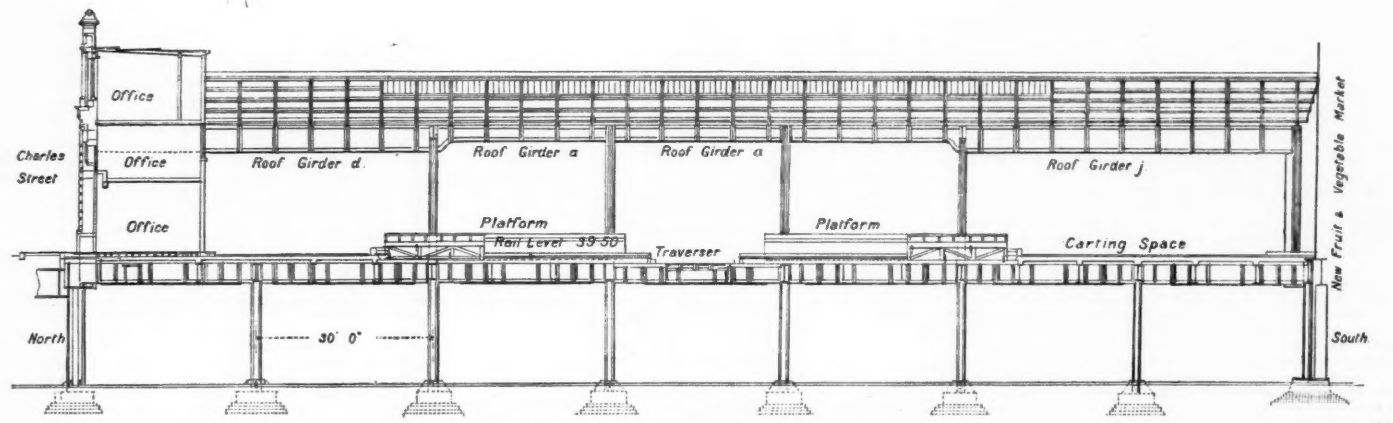
# THE GREAT NORTHERN RAILWAY COMPANY'S NEW GOODS DEPOT, FARRINGDON ROAD

*(For description see page 440)*

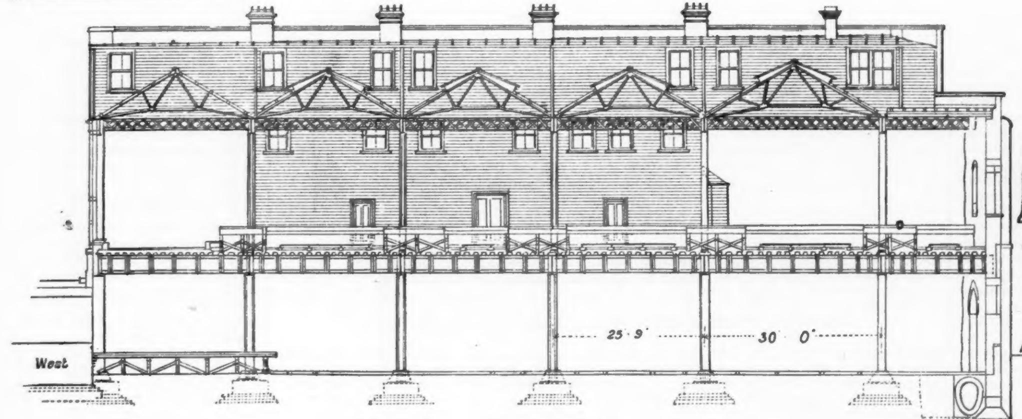

METROPOLITAN RAILWAY
G.N.R.Co. Boundary
Hoist if required
Hoist if required
Accumulator
ENTRANCE
ENTRANCE
ENTRANCE
CHARLES STREET
Pavement Lights
OFFICES
CARTING SPACE
Gulley
Gulley
Gulley
Gulley
Gulley
30'0"
25'9"
17'0"
24'0"
28'6"
PLATFORM
Crane 15'0" rad
TRAVERSER WAY
Lights to Basement
Wagon Hoist
14'3"
23'0"
28'0"
28'6"
9'0"
10'0"
Crane 19'0" rad
23'0"
PLATFORM
11'0"
20'8"
11'6"
Hoist
CARTING SPACE
NEW FRUIT AND VEGETABLE MARKET
10'0"
10'0"
10'0"
Weighbridge
Policeman's box & weigh office
INCLINED ROAD TO BASEMENT
A
A
B
B
C
C
D
D
E
F
G

PLAN OF FLOOR AT STREET LEVEL

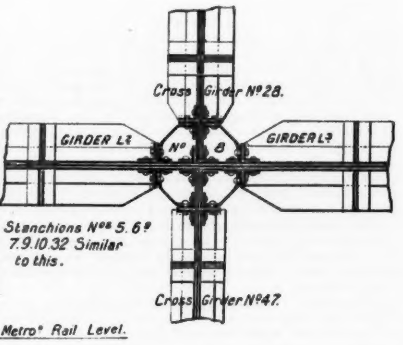
SWAIN ENG.


Office
Office
Office
Charles Street
Roof Girder d
Roof Girder a
Roof Girder a
Roof Girder j
Platform
Rail Level 39.50
Traverser
Platform
Carting Space
New Fruit & Vegetable Market
North
30' 0"
South

Longitudinal Section on Line E.F.


Datum Line (Ordnance)
West
25' 9"
30' 0"
Metro. Rail Level.
East
Datum Line (Ordnance)

Cross Section on Line G H.


Cross Girder No. 28.
GIRDER L3
No 8
GIRDER L3
Stanchions Nos 5. 6. 7. 9. 10. 32 Similar to this.
Cross Girder No 47.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, November 23rd, 1894.

| | PAGE |
|---|---|
| Practical Steam Engineering | 439 |
| The Great Northern Railway Company's Goods Depot, Farringdon-road. (Illustrated.) | 440 |
| Penetration and Action of Small-arm Bullets | 442 |
| The Institution of Civil Engineers | 442 |
| Tract on Engines and Bye-laws | 442 |
| Railway Matters | 443 |
| Notes and Memoranda | 443 |
| Miscellanea | 443 |
| Locomotive Frame-plate Slotting Machine. (Illustrated.) | 445 |
| Universal Radial Drilling Machine. (Illustrated.) | 445 |
| Letters to the Editor—Governing Electric Light Engines | 445 |
| Governing Electric Light Engines—The Theory of the Steam Engine—Traction Engines—Locomotives and Trains | 446 |
| Locomotives and Trains—Governing Electric Light Engines—Pivoted Arched Bridges: Harlem Bridge—The Flying Machine | 447 |
| Leading Articles—The Utilisation of the Nile—Traction Engines | 449 |
| New Railway Projects—Trades Union Wages and Old Age—The Future of Coal Working | 450 |
| Literature | 450 |
| The Electrical Accident in Cannon-street | 451 |
| Canet Guns at Yalu | 451 |
| A Remarkable Boiler Explosion. (Illustrated.) | 451 |
| Narrow Gauge Locomotive. (Illustrated.) | 453 |
| New Galvanic Element. (Illustrated.) | 453 |
| Letters to the Editor—Train Speed | 453 |
| Metallic Piston-rod Packing—Bicycle Mechanical Engineering—Labour and Luxuries | 454 |
| Launches and Trial Trips | 454 |
| Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts | 454 |
| Notes from Lancashire—The Sheffield District—The North of England | 455 |
| Notes from Scotland—Wales and Adjoining Counties—Notes from Germany | 456 |
| American Notes | 456 |
| The Patent Journal | 457 |
| Selected American Patents | 458 |

Paragraphs.—Engineering Society, King's College, London, 439—A Dead Industry, 439—The Laundry Exhibition, 451—Institution of Electrical Engineers, 451—Boilers and Thermal Storage, 451—The Civil and Mechanical Engineers' Society, 452.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

H. B.—*Gustave de Laval, Stockholm. The Parsons Turbine Company, Newcastle-on-Tyne.*

H. J. D. (Hammersmith).—*We have not yet published any further particulars of the engine to which you refer.*

E. J. B.—*There are no recent books on the English locomotive which are comprehensive. You will perhaps find Mr. Hughes' book just published by Messrs. Spon answer your purpose.*

W. J. W.—*Your letter has been received, statements and diagrams correct, but the problem only referred to the effect of an extraneous force. That of a contained force is obvious, and is proved constantly by every locomotive or bicycle running on the roads.*

T. P. (Retford).—*We regret that we are quite unable to assist you to obtain the address you want. We can only suggest that you should advertise in some South American paper, or apply to the head offices of the railway companies in London.*

J. (Govan).—*It can do no possible good to publish generalities. The facts are apparently or really against you. You will find it very difficult to persuade anyone behind the scenes that our great ocean companies persist in building a class of ships that will not pay, or that Board of Trade restrictions prevent English, Scotch, and Irish shipbuilders from turning out from their yards the finest ships in the world.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 8d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, November 27th, at 8 p.m. Paper: "The Machinery of Warships," by Mr. Albert J. Durston, Engineer-in-Chief of the Navy. Friday, November 30th, at 8 p.m. Students' meeting. Paper: "Sub-aqueous Excavation at Newry," by Mr. Charles H. Olley, Stud. Inst C.E. Mr. J. Wolfe Barry, C.B., member of Council, will take the chair.

Society of Arts.—Wednesday, November 28th, at 8 p.m. Paper: "Experiments in Aeronautics," by Hiram Maxim. Sir Richard Webster, G.C.M.G., Q.C., M.P., will preside.

---

# THE ENGINEER.

*NOVEMBER* 23, 1894.

### THE UTILISATION OF THE NILE.

We were not far wrong in our forecast regarding the Assouan Dam, for in the *Times* of Monday its Cairo Correspondent tells us that Mr. Garstin, the Under Secretary to the Ministry of Public Works in Egypt, presented a note on the 8th instant, proposing modifications in the Assouan work, and stating that the scheme will most likely now consist of the construction of a dam having its crest at a reduced level of 106 metres. Thus the dam will be 26ft. lower than that—at a R. L. of 114 metres—originally approved of by the Government, and will retain water sufficient for either Middle or Lower Egypt, but not for both. It is further stated that this concession has been made by the Egyptian Government in deference to the strongly expressed protests of many of the European archæological societies, and that the Ministry "has endeavoured to reconcile the material interests of the country with those of science." It is clear that this is a retrocession on the part of the Government, and that it will delay the reclamation of the uncultivated and salted lands, as well as many other improved conditions of the country hoped for from the original proposals; but it will spare from submersion all but a portion of the island of Philæ and its celebrated temples. The smaller monuments, which are below the full supply level, are capable of being protected by special works to be planned in accordance with the wishes of the learned societies. The same correspondent announces the discovery of another favourable site for a reservoir, about 150 miles South of Wadi Halfa, but this being outside the limits of Egyptain protection, political considerations preclude the immediate examination and, possibly, the future construction of the work. The urgent necessity of early action in the duty of constructing a reservoir was made very apparent in the season that has just past by the difficulty which the Irrigation Department experienced in supplying the cultivators with a sufficiency of water. The Nile flood also, although not a maximum one, gave occasion for much anxiety by the persistent maintenance of an abnormally high level during the critical month of October. The former of these facts accentuates the necessity of an increased storage, and the latter the desirability of a relieving or controlling reservoir, such as might be looked for in the direction of a project such as that of the Wadi Rayan.

As, owing to a misprint in our earliest notice on this subject, some difficulty may occur to our readers in following our figures, we here quote the paragraph of Mr. Garstin's note from which we obtained our data. He writes:—"For the whole of Egypt we therefore need a reservoir with a storage capacity of—Upper Egypt, 1,160,000,000 cubic metres; Middle Egypt, 950,000,000 cubic metres; Lower Egypt, 1,551,000,000 cubic metres; total, 3,661,000,000 cubic metres." This separation of Upper Egypt into two divisions of Upper and Middle is quite arbitrary, and has been adopted by Mr. Garstin for facilities of reference, as he writes: "I divide Egypt into three parts—Upper Egypt, or the country south of Assyut; Middle Egypt, or the country between Assyut and Cairo; Lower Egypt, or the country north of Cairo." As matters now stand with the Assouan reservoir full supply at R.L. 106 00 only a metre higher than our assumption of last week—the Egyptian Government will be able to supply only 1065 millions of cubic metres to meet the above total, and the question at once arises. How will this supply be distributed, and what further steps can be taken towards the solution of the economic problem, and to advance the prosperity of the country? It will probably be found expedient to devote this reduced supply to the irrigation of Upper Egypt, for, besides being insufficient for all the wants of Lower Egypt, there would be much waste on its way to the greater distance. Its diversion, moreover, from the upper country might cause a not unreasonable jealousy among a population whose interests had suffered from the storage of the water, were it allowed to pass on to lands beyond their immediate ken without benefit to them or their neighbours. It may also be assumed that the use of the water will be confined to those parts called Middle Egypt, because there the preparations for irrigation are in a more advanced state, its most difficult and costly canals having been already constructed, while the more southern parts need both weirs and canals, and, as Mr. Willcocks puts it, "should naturally be dealt with after the others." If this view be taken by the Government of Egypt, attention is at once called to the Waddy Rayan scheme, which, although perhaps not to be supported in the face of a completely satisfactory project like the original Assouan reservoir, yet providing as it does a storage of 1000 millions of cubic metres, in the circumstances as they have developed themselves would with the surplus of the Assouan supply, go far towards serving the needs of Lower Egypt, thereby freeing the reduced storage at Assouan for the benefit of Middle or Upper Egypt. It would also in same degree help to reduce the anxieties and dangers of an abnormally high Nile. It cannot be concealed that the cost to the country of this dual project will be far in excess of that of the original plans, if carried out; but the blame of this must rest with those who have forced, as it were, the Philæ compromise from the Government of Egypt.

That the scheme is not considered as devoid of merit by the Egyptian Public Works officers is proved by the following extract from Mr. Garstin's note:—"I conclude by saying that the Wadi Rayan reservoir project is a feasible one, although, even under the most favourable conditions, the element of doubt to which I have already called attention must always exist. As compared with some of the Nubian reservoirs, it is a very costly work. It could at first be filled by a canal from the Nile, and afterwards maintained at a working level by means of the Bahr Yusuf through the agency of a barrage at Assyut. At a cost of not less than £E.2,727,420, it would be capable of assuring the water supply of Lower Egypt. It would take not less than ten years from the date of commencing work before use could be made of it; but, at the same time, there would never be any question of danger to the country connected with it. Were it not for the doubts expressed above, its excessive cost, and the fact that it would only serve Lower Egypt, I should not have hesitated to recommend its execution to Government. As matters stand, however, certain of the Nubian reservoirs are considerably less costly, and capable of relieving a far larger area of country. I am compelled, then, to abandon the Wadi Rayan project in their favour." This, be it remembered, was written while the construction of the Assouan dam, as originally proposed, was a more than possible contingency. How much more value must the project now possess since its advantages have been enhanced by the restriction of the Assouan project.

### TRACTION ENGINES.

The article on Steam on Common Roads which appeared in our issue of Nov. 2nd has elicited a considerable number of highly unsatisfactory letters from owners and users of traction engines. The writers make vague complaints; they denounce the existing system of legislation; they demand parliamentary interference, and in no one case do they even attempt to define what changes in the Highway Acts they deem desirable. They manifest the most delightful oblivion concerning the generally accepted fact that the highways of a country have not been specially constructed or reserved for steam locomotives. They make demands which are utterly exorbitant and absurd. Thus one of our correspondents insists that every highway bridge shall be so constructed that it may be habitually crossed and recrossed by loads of 30 tons. Another will have it that road locomotives weighing 15 tons are to be allowed to run where they like; and these are not the least of the suggestions and demands which have reached us. No possible good could arise from the publication of literature of this sort, and it has gone into our waste basket. But a good cause should not be made to suffer because of the wrong views of those who advocate it, and we have no doubt that sensible men exist who are competent to deal with the very complex questions at issue, and formulate something that might be utilised as a guide in framing new regulations for the use of steam on highways.

It is very easy to suggest a dozen questions which should be attacked and settled by builders and users of road locomotives. One of the very first that presents itself is the external appearance of the engine. It has been said, and said with truth, that horses are not afraid of steam rollers, because the latter are not ugly, noisy, or evil smelling. Not long since, at 9 a.m., might be seen in a London suburb a steam roller at work. It was in perfect order, very clean, the engine works boxed up, absolutely no smoke, no steam, no fire visible, no noise save that made by the roller in dealing with the whinstone road metal. There was nothing here to offend horses, and accordingly the considerable traffic of the road was carried on without trouble. About half a mile further on we found a traction engine of large size. By the maker's name-plate, deciphered with difficulty under a coat of grime, we learned that the engine was seventeen years old. All the gearing was exposed; part of the ash-pan was gone, and fire dropped on the road. There was a considerable leak between the saddle of the cylinder and the boiler, from which steam escaped in offending volumes. The safety-valve was leaking. The wheel rims were worn and patched. The dirt of the whole was indescribable. Behind the engine were two heavy covered vans. What they contained we are unable to say. The decrepit old engine was sorely beset to haul these wagons up a moderate hill. The noise of the exhaust resembled small-arm practice, and fire was flung freely from the chimney, in the side of which there was more than one hole. Everything down to the firing-tools appeared to be adrift more or less, and the clanking and banging were indescribable. The wheels slipped every now and then, to the great detriment of the road. It was not to be expected that horses could pass this engine and its load; nothing more abominable could be put on a highway in a civilised town. It was only necessary to compare the proceedings of the traction engine and the action of the road roller to understand why different views may be taken concerning the expediency of permitting steam to be used on our highways. It may be said that the case we have stated is exceptional; it is nothing of the kind. A tolerably extensive acquaintance with traction engine work suffices to convince us that it is not. Mr. Phillips, whose letter will be found in another place, does not exaggerate in the least concerning the abuse of steam on common roads. But let us ask ourselves why it is that engines so unutterably offensive should be used? Our answer is, that the law is mainly responsible. If, for example, nothing had been said about a red flag, and the traction engine owner had been made responsible for damage caused by his engine, he would long since have taken great care that it should be as little offensive as possible. Thus the whole of the machinery might have been placed between side frames under the barrel of the boiler, as in a railway locomotive. There would be a silencer on the exhaust, or else the engine could have compound cylinders, which greatly soften the blast. It is unnecessary to go into detail; everyone who is versed in steam road locomotives will understand what we mean. But such an engine would be a little more expensive to build, and a little more costly to work than the ordinary engine. Why should the extra expense be incurred, when a dirty red flag carried by a dirty little boy a hundred yards ahead of the engine entirely exonerates the owner? It has been much cheaper and less troublesome to comply with the Act of Parliament, than it would have been to make engines which would give little or no offence. In this way the nominally stringent and oppressive regulations of which our correspondents complain have been in the long run blessings in disguise, and not a few traction-engine builders have grasped the full significance of this fact, and acted accordingly. Let but a few rules as to working powers, &c., be complied with, and the design and condition of the engine may be whatever the maker and user please. If there is to be a change in the Highway Acts, our readers may rest assured that it must be preceded by evidence that a radical change—a return to old-time practice in many respects—will be made in the design of traction engines. Here then is a question for free discussion—What is the least offensive form that a common road locomotive available for heavy haulage can take?

Another most important question is the construction of the wheels. We do not allude to the old and time-worn question of spring wheels, a puzzle solved every year—for that year—and turning up always with the freshness of youth. We ask what kind of wheel is least likely to damage roads? The best wheel for traction on the highway ever produced was Thomson's, with an india-rubber tire. It was only necessary to see an engine fitted with these tires at work to know that nothing more mechanically perfect could be devised. But then those tires were exceedingly expensive. The cost was prohibitive. Can no substitute be found? What about the pit rope tires used fifteen or more years ago by Mr. Leonard Todd between Leith and Edinburgh? How does wood answer? Why is it that ribbed tires are used, unless it be that they are on the whole the worst things available.

We mention only two out of at least a dozen subjects which clamour for discussion. The National Traction Engine Owners' and Users' Association propose to hold a meeting during the Smithfield Club Show to discuss various questions of interest. We dare venture to say that every speaker will contemplate the use of the traction engine as it is, and deal with it as though existing designs were final. There is reason to believe, however, that the hands of the traction engine users will be forced, and that they will be driven to adopt such changes in design and construction of their engines as will disarm opposition. There is nothing very dreadful in this, we may add, for the changes need not be of a very radical character, at least as regards the engines made by some firms. In another page we reproduce a circular just issued by the Association, and a notice issued by the Great Western Railway Company. We commend them to the consideration of our readers. They are eminently suggestive.

◆

### NEW RAILWAY PROJECTS.

THE notices of intention to apply for additional powers or for new Bills are this year very limited so far, so that it would seem that there will be only a scanty crop of projects to undergo the revision of the parliamentary committees. The North-Eastern Railway has one proposal for additional powers, which includes the making of a short railway from its main line near Cramlington to Newsham to facilitate the shipment of coal; another short line near to Normanby, to open out the passenger traffic there, and several widenings of the line in various points. The Lancashire and Yorkshire Railway desire powers to make new railways in Manchester, and a series of comparatively small works in the West Riding of Yorkshire—at Halifax, Bradford, and other points. The London and North-Western Railway has in view an addition to its works in the West Riding—at Heckmondwike, Batley, and neighbouring parts. But the works that are contemplated are by no means large in the aggregate; so that the projects that affect the North are limited. There are signs that Scotland will furnish some important projects over which there will in all probability be a strong parliamentary fight; and there will also be some proposals in regard to the South-West—Cornwall, Devon, and South Wales—that may also be keenly contested. But so far the area of the parliamentary proposals is one that is limited, and it would seem that there is for some cause a check to the pugnacity of the promoters. It may be that that check arises from the feeling that at the present time legislation presses hardly upon railways, both in enforcing the employment of a larger staff, the payment of continually-increasing sums for rates and taxes, and in other ways the putting of additional burdens upon them. It is evident that the growth of population will enlarge the traffic on the railways, both passenger and goods, and if the projects of new lines and works be kept limited, there will be of necessity a fuller bulk of traffic on the lines and a better return. It is the decision of capital, and it is one that is forced upon it, though it is one that must be regretted. It would have been interesting to trace the effect of the creation of new works on the yield of capital, but this is not now needed. The projects certainly seem to point to a diminished rate of expenditure of capital for many lines in the early future.

### TRADES UNION WAGES AND OLD AGE.

IN his monthly report to the United Society of Boilermakers and Iron Shipbuilders, the secretary, Mr. R. Knight, comments on the changed relationship of employer and employed. "We live," he says, "in a time of trade competition so severe that many of the best features in the old relationship of master and servant have been crushed out of sight, and old age and loss of service now count for nothing in the race for profit. In nine cases out of ten the approach of old age is the signal for dismissal, and grey hair or spectacles are often fatal objections. Thus the number of our superannuated is increased, and the number of paying members reduced." This is most unfortunate for the Society's funds, no doubt, but it is only what Mr. Knight and the members generally should expect; only, indeed, what a superannuated fund is meant to provide for. The slur, therefore, upon employers, which is implied in the secretary's remarks about "old age and long service" counting for nothing, may well be repudiated and resented by every employer in the kingdom. Allowing that grey hairs and spectacles are so positively the "signal for dismissal," as is here maintained, the blame—if blame there be—assuredly rests with the trades unions themselves, and the hard-and-fast lines which they lay down and enforce for the payment of their members. Employers maintain that it is impossible in these days of keen competition to pay the full rate of wages to old men who are unable to do the same day's work that they did when younger. Many employers, we know, would gladly keep on their old hands at slightly reduced rates of wages, and many men would gladly accept such terms, but the Union's officials or members step in and say "No! You must pay the full rates to all the men employed." No doubt the younger members do not regard with regret the discharge of older men, since that discharge gives employment to younger hands. Examples of how the inflexible wages rate operates are within the experience of almost every firm of employers. To instance one case will be enough. The employers in a large engineering works on the Clyde being desirous of retaining several old hands whose physical infirmities rendered them incapable of earning the full trades union rate of wages, kept them on at a reduced wage. The consequence was that the other men hearing of this, promptly threatened to put the works "on strike," unless the union rate were restored to the old men. As the amount involved was trifling, and the annoyance threatened serious, the employers gave in. Humanely enough, they did not retort by throwing their aged operatives out of work, and a burden, in consequence, upon the funds of the Union. All employers, however, have not got it in their power to act thus generously, and it is little to be wondered at, or even deplored, that the funds of the Society are more and more being drawn upon. If the younger and abler workmen, who are of course always the more numerous section, insist upon the maintenance, under all circumstances, of a hard-and-fast and irreducible rate of wages, they must make up their minds to bear, without grumbling, the cost of maintaining the aged and absolutely superannuated of their number. They must recognise, too, that when their own day of old age and physical decay comes, the prospect is that they will be denied work, which under a less inflexible system of wages might have been given them, and they must become a burden on the funds of the Union. It will thus be seen, and the sooner Mr. Knight and those for whom he acts as "guide, counsellor, and friend" recognise it the better, that the responsibility for crushing out of sight "the best features in the old relationship of master and servant" rests very largely with workmen themselves, and the rigid and inequitable rules by which they coerce employers.

### THE FUTURE OF COAL WORKING.

A FEATURE of the coal trade, which does not obtain the attention it deserves, is the rapid development of the coal country, concurrent with the diminished demand for the output. There has rarely been a time when so many coal enterprises have been in course of energetic initiation. Take Yorkshire as an example. There is within the memory of middle-aged men a most extensive tract of country, which was at one time entirely given over to pastoral pursuits, and which is now dotted here and there with colliery shafts, flying all day long what the Duke of Portland called "the black flags." A few farm hands may be seen labouring on the surface of the land, but they are as nothing to the thousands of men burrowing underneath for "the black diamond." To-day the colliery extensions are more important than ever. The trend of the new coal projects is towards the East. Immense fields have been opened in the wide district ranging from Mexbro' and Swinton towards Doncaster. The pleasant slopes opposite Conisbro' Castle, once sacred to lovers of "Ivanhoe," are no longer the favourite hunting grounds of students, who went there to muse in solitude over the days of Athelstane the Unready, and to revive in their imagination the struggles of the dead past. The Cadeby collieries, amongst the most extensive in England, now stand on the banks of the Don, opposite the grey old Keep, and, underneath, the ground is being worked for its precious deposit, which has been found in payable seams for many miles. All the district between there and Doncaster is believed to be a coalfield, and there is no telling how far further the mineral beds may extend. A similar remark applies to Derbyshire, Nottinghamshire, and other counties where boring operations have confirmed the expectations of mining engineers. All this enterprise suggests the question—Where are customers to be found for the vast quantities of coal which must, in a very short time, be brought daily to the surface? Although English fuel is preferred upon the Continent, there is a limit to the requirements of that market, and the tendency of scientific experiment, as well as the exigency of business experience, points to there being less use made of the raw material for heating purposes in the future than in the past. The position is simply this—that while the demand for coal as it comes from the pit is not sensibly increasing, the supply of the valuable material is advancing at an enormous rate. England is not again likely to resume her place as the workshop of the world, and other countries are more bent than ever upon developing their own resources. Each nation naturally aims at being "self-contained"—that is, being able to make for its people all her people need. Several of them, indeed, are not only able to supply their own inhabitants, but to compete with England in the open markets of the world, as well as at her own doors. Thus it is that British trade is attenuating, and we are face to face with the grave problem of British work decreasing while British workers increase. This is now being complicated by that other problem, which must soon demand solution—what to do with the surplus coal of which modern enterprise is robbing Mother Earth. Our export trade, important as it is, suggests a further question, and that is the wisdom or unwisdom of scooping out our national coal cellars for the advantage of our continental competitors. However that may be, the outlook at the present seems to point to the coming of a time when there will be more coal than customers, and that period is not only fraught with difficulty for colliery owners, but for all who make a livelihood by and through working in the mine.

## LITERATURE.

*The First Principles of Building.* Being a Practical Handbook for Technical Students. By ALEX BLACK, C.E., architect. London: Biggs and Co. 1894.

*Specifications for the Use of Surveyors, Architects, Engineers, and Builders.* By J. LEANING, F.S.I. London: Sampson Low, Marston, and Co. 1894.

*The Sanitary Arrangement of Dwelling Houses.* A Handbook for Householders and Owners of Houses. By A. J. WALIS-TAYLER, C.E. London: Crosby Lockwood and Co. 1894.

MR. BLACK's book is a small octavo volume of 329 pages. It is fairly well illustrated. It may be regarded as a species of enlarged dictionary of elementary architecture, the author describing briefly most of the materials and processes used in building. A great deal of information is thus supplied; but Mr. Black has not attempted to do too much, or to handle any one of his multifarious subjects exhaustively. The title describes the book very fairly. There is a good index.

Mr. Leaning tells us in his preface that these "Notes" were originally published in the *Building News* in 1893. They have been augmented and improved in the present little volume of 140 pages. The book contains instructions for drawing specifications, and each set of instructions is supplemented by specimen clauses. No doubt even the practical architect will find in its pages useful hints and suggestions which will refresh his memory.

We are not at all sure that the average householder can gain much useful information from a book such as Mr. Walis-Tayler's. It is neither better nor worse than a host of treatises on sanitary matters. It contains a great number of engravings, principally referring to the products of one sanitary engineering establishment. It is more calculated, perhaps, to satisfy curiosity as to the construction of traps, closets, &c., than anything else.

*The Water Supply of Towns and the Construction of Waterworks.* By W. K. BURTON. London: Crosby Lockwood and Son. 1894.

THE author is Professor of Sanitary Engineering in the Imperial University, Tokio, Japan, and consulting engineer to the Tokyo Waterworks, and he states that the volume is largely based upon his own practice, and the conclusions expressed therein are the result of careful study of the various questions dealt with. He hopes that the work may prove of special interest to Japanese students, but the matter which applies to Japan alone is relegated to foot-notes, so that the continuity of interest to the general reader is not interfered with. The work consists of some 280 pages, and is copiously illustrated.

The author states that from the time—nearly three centuries ago—that Tokio, the capital of Japan, was supplied with water by the Tamagawa Canal, supplemented by a complete system of ingenious wooden pipes of square section, till about the beginning of this century, it had a better supply of water than either London or Paris, or probably any town in Europe of which the natural supply was not exceptionally good. It must be remembered that wooden pipes for the distribution of water were used in London up to about 1820, and pieces of these pipes are constantly being dug up in the streets at the present day, most of them being trunks of trees bored out and fitted end to end with taper joints.

With regard to the requisite supply of water per head of population, the author alludes to the great difficulty of making exact calculations, and considers past practice the only trustworthy authority. It has been possible in some cases to reduce the mean consumption, even in water-closet towns in Europe, to as little as two cubic feet per head per day for domestic supply; while in the case of American towns the figures approximate occasionally to 20 cubic feet per head per day.

In the earlier chapters the author deals with the gauging of streams and rivers, and the estimation of storage capacity, and refers to actual works to illustrate his subject. In dealing with dams he refers to the use of concrete for the bulk of the dam, and cites the case of the Tytam Waterworks, Hong Kong. Mr. James Drage, the engineer, finding Chinese masons untrustworthy, or unable to do a style of work of the excellence necessary for masonry dams, constructed a considerable dam entirely of rubble concrete, with a cut stone facing. This has already been in existence several years, and has given satisfaction. The chapter upon the filtration of water is very complete, and the details of construction are well illustrated; the author states that beautiful sands for filtration are found in Japan. Two sands in particular, from Niijima and Shikene, in the district of Idzu, are the most perfect sands for the purpose which he has ever seen. These are pure white sands with occasional little black spots. When looked at with a magnifier, the white grains are seen to be as clear and transparent as glass, and the black spots consist of magnetic oxide of iron.

The report made on the "Filtration of River Waters for the Supply of Cities, as Practised in Europe," by James P. Kirkwood, is justly spoken of by the author, who says that since the date of this work most of the matter which has appeared in text books, &c., has been copied from it, usually without acknowledgment. At that date the English filters were considered deficient as regards any arrangement for regulating the precise flow from each, or the precise head of water on each filter while in action. In considering the question of obtaining fresh water by driving a tunnel through porous strata and parallel to the course of a river, the author points out that in most cases the water in the gallery is not obtained direct from the river except in very dry weather, but by the interception of underground streams flowing to the river. In Japan, however, where commonly the rivers have been embanked, so that in many cases the beds are above the surface of the surrounding land, this source of supply would not be available, and the river itself would probably be drawn upon.

At the end of the book is an appendix by Professor John Milne, F.R.S., entitled "Considerations Concerning the Probable Effects of Earthquakes on Waterworks, and the Special Precautions to be taken in Earthquake Countries." As applied to the dams of reservoirs, the investigations point to the advisability of using the English rather than the American plan; also there is a strong argument for the adoption of a dwarf wall as a "breakwater" along the top of an earthwork dam in an earthquake country, and it may be further advisable to pitch with stones the top and lower slope of the dam, as well as the upper slopes, to prevent the action of the water on the surface if earthquake waves were formed. The work should be especially valuable to civil engineers engaged in work in Japan, but the interest is by no means confined to that locality.

## THE ELECTRICAL ACCIDENT IN CANNON-STREET.

On Saturday, the 10th November, 1894, an electrical accident took place in Cannon-street, at the point where Budge-row and Walbrook branch off. This accident was of such a serious nature that a Board of Trade inquiry was held by Major Cardew at Winchester House, Old Broad-street. The proceedings were opened at 11 a.m. on Monday, the 19th inst. Mr. R. W. Wallace represented the City of London Electric Lighting Co. Mr. Baylis appeared for the City Commissioners of Sewers, and Mr. R. Griffiths for the Aldermen and City Commissioner of Police. In this inquiry the evidence of witnesses was taken, but not on oath. The witnesses were all allowed to be present while the inquiry was being held, which seems, in our opinion, to tend to a certain degree of similarity in the accounts which were given of the details of the case. Hall 174 does not appear very well adapted for the purpose of such an inquiry, as the noise caused by persons passing in the corridors somewhat interferes with the comfort of those occupied in the case.

Time would have been saved to a large extent, and a more accurate idea obtained of the evidence if a large, boldly-drawn plan of the site had been used, and the witnesses asked to point out the spots by means of a pointer. Without this aid it was often uncertain as to which side of the street was referred to by a witness, and the exact spot could not be ascertained within a few yards. As will be seen later on, it is very important to be able to determine with certainty where the particular occurrences took place.

The first witness was one George Clark, who stated that he was driving a brougham belonging to Mr. Boutland, and at about one p.m. on Saturday, November 10th, he was passing along Cannon-street in an eastward direction and turned into Budge-row. Hardly, however, had the horse turned the corner when it fell on its knees, and then on its side, bled at the nose, and after struggling for a few minutes, died. The witness jumped off the box and immediately received a shock which he described as like pins and needles. The site of the accident is shown in Fig. 1, and the position of the horse after falling is also shown. The carriage-way at this point is paved with wood, and there is no plate to be seen. It appears that the surface of the road was very wet at the time. The witness stated that he had not been able to work since the accident, but he did not see any smoke or hear any noise when the mare was killed. The position of the junction boxes is shown on the plan, and they are marked A, B, C, and D, and the mains belonging to the City of London Electric Lighting Company cross Cannon-street and Budge-row, connecting the boxes together. Box A is at the corner of Dowgate-hill, next to Cannon-street station; box B is at the corner of Budge-row and Cannon-street; box C is at the door of No. 20, Budge-row; and box D is at the corner of Walbrook, just outside a hosier's shop.

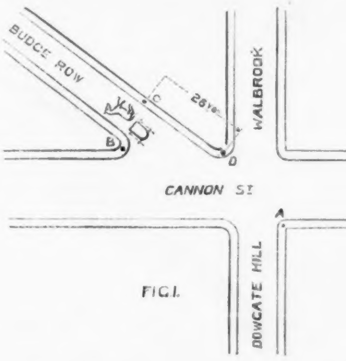


FIG. 1.

James Hutchings, warehouseman, employed at 21, Budge-row, was standing at the loophole looking into Cannon-street, and saw the horse fall. He went to try and assist and received a powerful electric shock when he approached the horse, and was brought to the ground. He has been under medical advice since. About ten minutes after he saw the horse fall he heard an explosion, and, on looking at the junction box outside No. 20, Budge-row, he saw the lid was blown about 2ft. into the air, and a blue flame escaping, with a good deal of black smoke. This witness stated that he heard a rumbling noise underground while the horse was lying in the street.

A postman stated that he was going along Cannon-street, and when he reached the corner of Budge-row he received a shock. This he explained occurred when he had one foot on the cover of the junction box B and one off. The shock did not cause him to fall. A few minutes after this he heard an explosion, and was struck by a piece of stone and was hurled across Walbrook. None of these witnesses had smelt any escape of gas before the explosion. It turned out in the course of the inquiry that after the death of the horse there were two separate explosions. One at box C, whence bluish flames were seen to issue, and thick black smoke, which lasted several minutes. The cover of the box did not appear to be injured. The other explosion occurred almost simultaneously at box D, and this caused much more danger, as four or five persons were standing either upon or close to it. Several witnesses were called who described the occurrence in the same way, and it appeared that two men were so injured that they were still unable to leave their homes at the date of the inquiry.

Mr. Haslett, a mining engineer, of 64, Cannon-street, said he received a smart shock when crossing the road, and he saw the explosion and heard three reports in close succession. He was taken to Guy's Hospital. Mr. Withers, at the hosier's shop at the corner of Walbrook, said: The explosion in box D broke the lid of the box into pieces, and forced the brickwork inwards, and the kerbstone outwards into the road, it also broke a window and a shop blind. One of his assistants had smelt a smell as of india-rubber burning in the basement of the shop about an hour before the explosion took place.

Various policemen were then called to give evidence as to previous explosions in the City of London. One stated that while he was on duty on October 14th, 1892, in Great Tower-street, at 8.55 p.m., he heard the noise of an explosion near 17, Great Tower-street, and when he went to the spot he saw a man apparently insensible. Two street junction box lids, about five yards apart, were displaced, and he saw the lid of one box at a height of about 20ft. in the air. Another policeman stated that on January 8th an explosion took place in a test box in front of No. 3, St. Paul's-churchyard, blowing the cover into the air. A report of a similar occurrence at Creed-lane was also given.

Mr. David Cook, chief engineer and manager to the City of London Electric Lighting Co., was then examined, and he produced a diagram showing all the mains affected by the accident. He said that the cause of the accident was the crossing of two high-pressure cables, which were being tested and put to work for the first time. One of these cables was for the supply of current to the Watling-street transformer station, and the other for the Milk-street transformer station. The Milk-street cable was by mistake put into the terminals for the Watling-street cable at the Bankside generating station, while the Watling-street cable was laid, so that its inner conductor touched the lead covering of a third cable. The cables were of the concentric type. For convenience current was switched on to the Watling-street cable from the transformer station. When the signal was given the attendant at the transformer station switched on, and as the inner conductor of the cable was against the lead covering of the other cables, therefore all the inner conductors of the high-pressure service were put to earth, thus throwing an unusual stress upon the insulation of the primary mains. The actual cause of the breakdown appeared to be the abrasion of the outside covering. When the attendant discovered the breakdown he switched out the cable, but before this was done the leak had developed into a short circuit, and this fired some gas which had collected in the box and caused the two explosions. Mr. Cook explained that since the explosion which occurred in St. Paul's-churchyard the company had had men constantly looking for leakages of gas. Four times since March last they had written to the gas company about leakages in Cannon-street within 100 yards of the spot where the explosion took place, and since January last they had written to the gas company eighty-eight times, calling attention to similar leakages all over the City. He stated, however, that the gas company had attended promptly to the communications sent to them. The gas leakages were so important that he intended to propose to his directors a system for ventilating the conduits which would cost about £2000; and he desired to draw the attention of the Board of Trade to the responsibility of the gas company in respect to these explosions.

Major Cardew said that as the electric light company had arrived after the gas company, it was the business of the former to see that gas did not leak into the electric light conduits.

The inquiry was continued last Tuesday, and Mr. Cook continued to give evidence. The cable which actually broke down was the one feeding the Benetfink sub-station, and this only broke down in the place already alluded to—that is, in box C, outside the offices of the Liberator Company in Budge-row.

Major Cardew remarked that if the only method of dealing with such accidents was by means of a fuse which might allow 2000-horse power to pass, then serious consequences might ensue. It appeared that there were about 46,000 lamps wired in the district supplied by this cable, and that 70 per cent. of these have been on at one time. Such accidents as the present one had taken place through arcs being formed, and Mr. Cook did not know of any means for cutting out the arc. It must be remembered that when the scheme of supply is completely carried out there will be a separate pair of primary mains from the generating station to each sub-station, and the system of interconnection of mains would not be continued. At present the sub-stations are connected together.

Orders have been given to cover all the parts of the cable between the ends of the pipes with copper strips securely fastened to the iron pipes. The present system is to run the high-pressure cables in iron pipes and the low-pressure mains in Callender conduits covered outside with sheet iron. The high-pressure cables are of the concentric type. The new cables are lead-covered, but not armoured. The boxes are constantly inspected to see that all is right. Mr. Cook said that far more persons were injured by slipping on orange-peel than were ever likely to be injured by accidents caused by electricity.

Much attention has been devoted to the question of the proper ventilation of the electric conduits, and, in reply to Major Cardew, Mr. Cook said that if the Commissioners of Sewers would give permission to erect ventilating standards, he had no doubt all the present difficulties could be got over. Mr. Cook's suggestion was that the guard posts at the corners of the streets should be used as inlets and outlets for air.

Mr. G. L. Foulger, distributing engineer to the Gas Light and Coke Company, then appeared, and stated that it was quite incorrect to say that the explosions were caused by the escape of gas, as he had had careful tests made in the locality immediately after the accident, and no traces of gas were found. His own suggestion as to the ventilation was that the arc lamp posts should be used as ventilating columns by placing, say, a 2in. iron pipe inside the post, connecting the pipe to the electric conduits below, and by means of a bend to an opening at, say, 10ft. above ground level, so that the mixed gases would pass out about 10ft. below the arc light, and therefore would pass away without danger. In order to prevent the gas lighting back, he would fill the lamp posts with earth or sawdust.

Although on the first day no witness had appeared who could say that he smelt gas at the time of the explosion, yet the Electric Lighting Company are so satisfied that gas alone was the cause that they employed Mr. Wagner, an analytical chemist, of Leadenhall-street, to make a chemical analysis of gases collected from the test-boxes, and this was done on the evening of the 19th. It must be remembered that the covers of these boxes consist of iron frames filled in with concrete, so that it was necessary to drill a hole through the cover of each box. Two samples were taken from one box, each sample being about 1½ pints, and one sample of about four pints from the other, all by means of an aspirator. These samples were tested to discover the presence of coal gas, and no trace could be found in box D at the corner of Wallbrook, while in the sample from the Dowgate-hill box A the presence of 12 per cent. of coal gas was detected.

It has been very generally thought that the accident to the horse was caused when its fore feet were placed on the exposed surface of a street junction box, while its hind feet were on the surface of the ordinary carriage way. But this does not appear to have been the case, as the driver distinctly asserted that the horse did not stand upon a junction box at all. The inspection or junction boxes are in the footway, so that another explanation must be sought for in the presence of a considerable difference of potential between two points on the surface of the carriage way, say about 4ft. apart. The much more serious effect of an electrical shock upon a horse than upon a man must be due, in the first place, to the far better contact which is made with the ground through horse-shoes than through boot soles, and also to the possibility of a greater difference of potential occurring between the fore and hind legs of a horse than between the two feet of a man. It is to be hoped that the Board of Trade will authorise further tests under varied conditions, as it is obvious that at present the dangers of the streets are increased by the use of buried conductors at high pressure.

## CANET GUNS AT YALU.

M. Canet has received a letter on the behaviour of his guns on board the Japanese fleet in the battle with the Chinese, from which we give the translation of an extract:—

> Tokio, Sept. 29th, 1894.
>
> With regard to the naval battle which took place in the Yellow Sea, the Chinese fleet consisted of fourteen ships, six torpedo-boats, and the Japanese fleet of eleven warships and a packet vessel converted into a cruiser, on board which was the Admiral Kabayama.
>
> The battle began at a quarter to one in the afternoon, and lasted till nightfall, when it became impossible to lay the guns. In this fleet were the Matsushima, carrying the flag of Vice-Admiral Ito, the commander-in-chief; the Itsukushima, and the Hashidate. Your three guns behaved well in the battle. After five hours of bloody fight, the enemy's fleet lost the Ping Yuen armoured ship, of 2830 tons, two cruisers of the class Ching Yuen, of 2300 tons, and the Tshao Young, of 1350 tons—that is to say, four ships. Three others were set on fire, which the crews were probably able to extinguish.
>
> Happily we have not lost a single ship. The Matsushima appeared to suffer the most, but the big Canet gun has escaped injury, except that a bursting shell has slightly injured the breech mechanism. One of the 12 cm. guns in the fore part of the ship has been bent by a shell. This is likely to be very trying, because the gun port must be injured.
>
> The Ping Yuen was crushed by the blow of a 32 c.m. projectile, which struck the water-line in the after part. The armoured deck was probably perforated, because it was observed that the ship began to sink stem first, and actually sank end on, a phenomenon which has never before been witnessed.
>
> To-day I am pressed with work, and cannot complete this letter until the next mail.

With regard to this extract, it may be noticed that the King Yuen, which was the vessel actually sunk, is mistaken for the Ping Yuen. She has in a former Japanese account been mistaken for the Lai Yuen. The fact is that these three ships are sisters, and were all present in the action. It may also be observed that the Japanese are stated to have ceased firing not from failure of ammunition, as we have hitherto assumed, but because the light became insufficient to lay the guns. At a long range doubtless this might be the case, but we still think it probable that failure of ammunition was the principal cause for terminating the action. The expenditure of shells seems to have been very great. The Chinese ships were struck in hundreds of places on their armour, and apparently peppered indiscriminately. Seeing that the fighting was on the move and at long ranges, this means also a very great quantity of ammunition thrown away. The Japanese officers may not like to admit it, but this fact, coupled with the circumstance, if it can be credited, that the Chinese endeavoured to follow the Japanese and continue the combat, points, we think, to the very natural conclusion that we drew, that the Japanese quick-firing guns had but little ammunition left. This in no way affects the fact that M Canet has every reason to be satisfied with the behaviour of his guns. The 32 cm. gun is abundantly able to perforate the belt of the King Yuen—which consists of 9½in. compound armour—with armour-piercing shell; indeed, common shell, if they are made of steel with pointed heads, might even do this, and these would be the most powerful projectiles for the attack of such a ship. The Japanese themselves, however, only know what they fired. Common shell of cast iron, or even of steel, with ordinary heads with fuse holes, would not perforate the belt, but might burst close to it and do great damage, while an armour-piercing shot without a bursting charge would hardly sink the vessel by simply perforating her belt.

The Laundry Exhibition.—In our report on the machinery at this Exhibition reference was made to Messrs. Joseph Evans and Sons' steam pump, which, by an error, was mentioned as a "Cornish" steam pump, with Tonkin's patent valves—tappet motion. This should have been "Cornish" steam pump, with Tonkin's patent valves, having *no* tappet motion.

Institution of Electrical Engineers.—At the sixth annual dinner of the Institution of Electrical Engineers was held on Wednesday evening last at the Freemasons' Tavern, the president, Mr. Alex. Siemens, in the chair, we heard a good deal about the "supremacy" of electricity and the wane of steam. This sounds pretty, but is at the same time a little irreconcileable with the statements made the same evening by Dr. H. E. Armstrong, president of the Chemical Society, one of which was that electricians were too much the slaves of the dynamo; in other words, of power. Among those present were Mr. Bryce, M.P., President of the Board of Trade; Sir John Pender, M.P., Sir Robert Rawlinson, Mr. W. H. Preece, General C. E. Webber, Professor W. G. Adams, Dr. John Hopkinson, Professor W. Crookes, Professor Hughes, Mr. C. Spagnoletti, Mr. W. H. M. Christie, Astronomer Royal; Professor A. B. W. Kennedy, Sir David Salomons, Bart., Mr. R. E. Crompton, and Professor J. Perry.

Boilers and Thermal Storage.—In the Cantor lectures delivered by Professor Unwin at the beginning of last year, before the Society of Arts, he described the system of "Thermal Storage," which had lately come under his notice. In our issues of the 20th and 27th of January, 1893, we also referred to this matter, and described its mode of operation. We have been informed lately that the first set of plant was put to work about a month ago; and, although this time is too short to arrive at the actual saving in fuel, it has afforded an opportunity of definitely demonstrating one of the advantages claimed by the system, viz., that the water is purified before being put into the boiler. In the instance to which we refer, the boilers were working for two months before thermal storage was put in—owing to delay in completion of the plant—and as the water available for feeding the boilers was exceedingly hard, an unusually large amount of deposit was found when the boilers were stopped for cleaning out. This deposit in the boilers has now ceased, the whole of the deposit being thrown down in the thermal storage vessel, out of which it is blown once a day, and where, of course, owing to the absence of the baking temperature existing in the boiler, it has not been able to harden. The evaporation without the thermal storage system was already very good; but even on the high duty obtained a considerable saving has been effected in fuel, although we are not in a position to give accurate figures at present.

# A REMARKABLE BOILER EXPLOSION

Fig. 1.

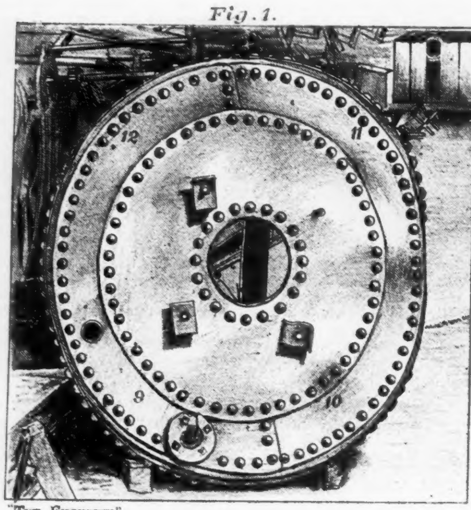
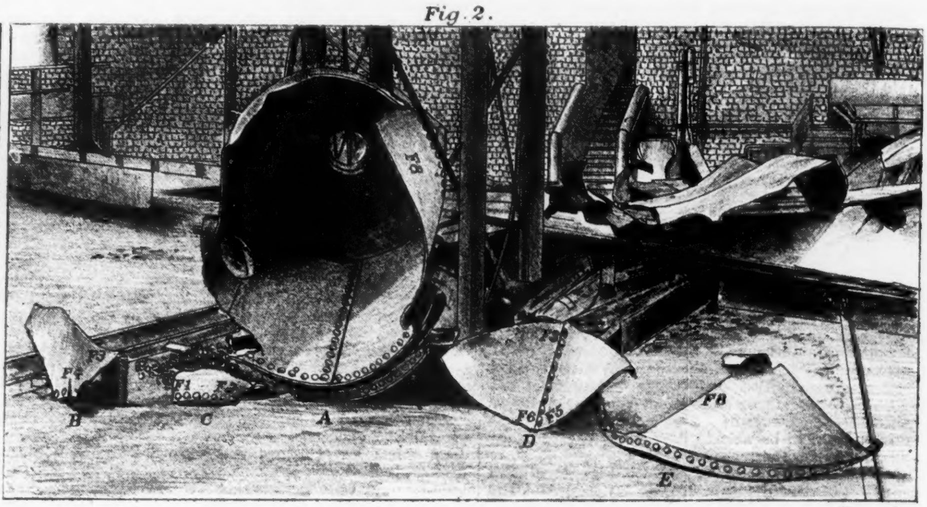


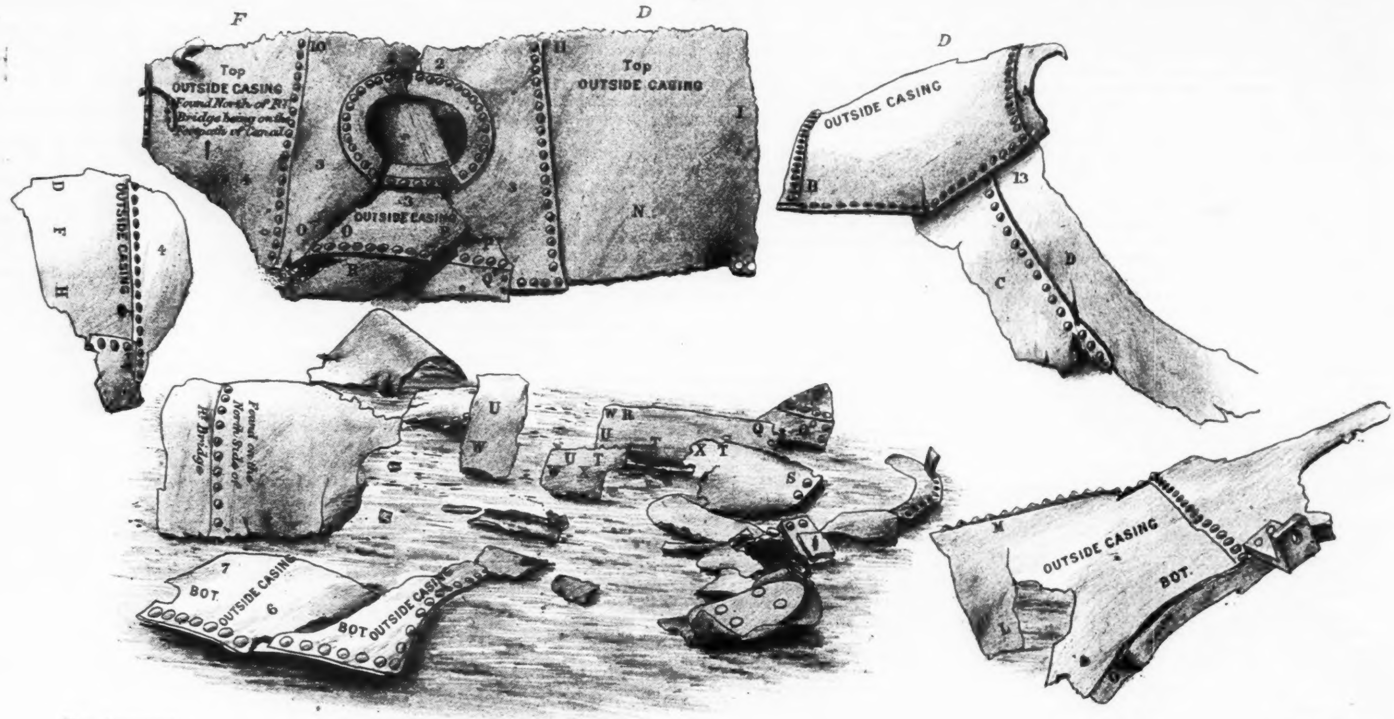
Fig. 2.



"The Engineer"

Swain Eng

Fig. 4

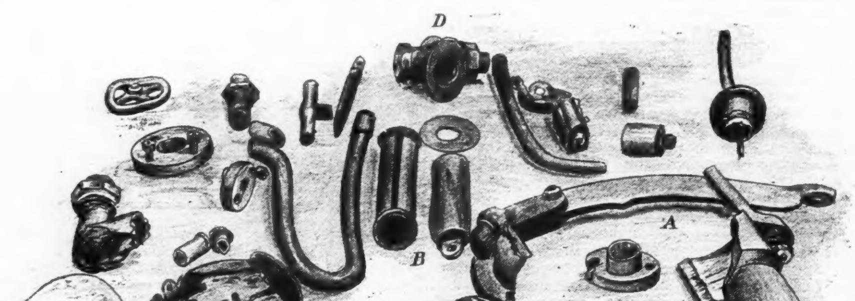


"The Engineer"

Swain Eng

## A REMARKABLE BOILER EXPLOSION.

The accompanying engravings are reproduced from a Board of Trade report on a boiler explosion which took place at Woodside Ironworks, Dudley, on the 27th of July, 1894. It will be seen that the effect on the boiler was what might have been expected if a moderate charge of dynamite had been exploded inside it. It is by no means easy to account for this general smash up. It is extremely difficult to explain the successive explosions with great rapidity of nearly all the boilers in a battery of twenty which is said to have occurred recently at an ironworks in the United States.



"The Engineer" Fig. 3. Swain Eng.

The boiler, the remains of which we illustrate, was of the cylindrical vertical type, and was made throughout of iron. The shell was 4ft. 4in. in diameter and 8ft. 2in. in height, and was made up of two rings of plates with four plates ⅜in. thick in each ring. The top, which was flat, was made up of three plates, the outer portions of which were ½in. and the central portions ⅜in. thick. Its outer edge was attached to the shell by means of an angle-iron ring 3¼in. by 3¼in. by ½in., and its centre was secured to the uptake by an internal angle-iron ring 3¼in. by 3¼in. by ⅜in. The fire-box was 3ft. high and 3ft. 9¼in. in external diameter. Its sides were made up of two plates each ⅜in. thick. Its bottom was attached to the outer shell by means of a ring ⅜in. thick, the vertical flanges being 2½in. deep, and the horizontal portion 3in. in breadth. The uptake was 9¼in. in internal diameter and ⅜in. thick. Its vertical seam was welded, and its lower end was secured to the fire-box crown by means of an angle-iron ring. The boiler was single-riveted throughout by rivets ¾in. in diameter pitched 2in. apart.

The mountings consisted of one safety valve loaded by means of a lever and spring balance, one steam pressure gauge, one injector, one steam pipe, one glass water gauge with the usual fittings, two test cocks, one blow-off cock. There were one manhole door 16in. by 12in., and three mud holes. The boiler was broken into fragments, which were hurled great distances. The fracture commenced in the shell-plate near the firehole, and having spread, ran in various directions horizontally and vertically, dividing the shell into numerous pieces. One man was killed and several injured. The explosion was caused by over-pressure, the safety valve being inoperative at the time by reason of the nut of the spring balance having been screwed down so as to prevent the valve from lifting. The working pressure was 25 lb. only on the square inch.

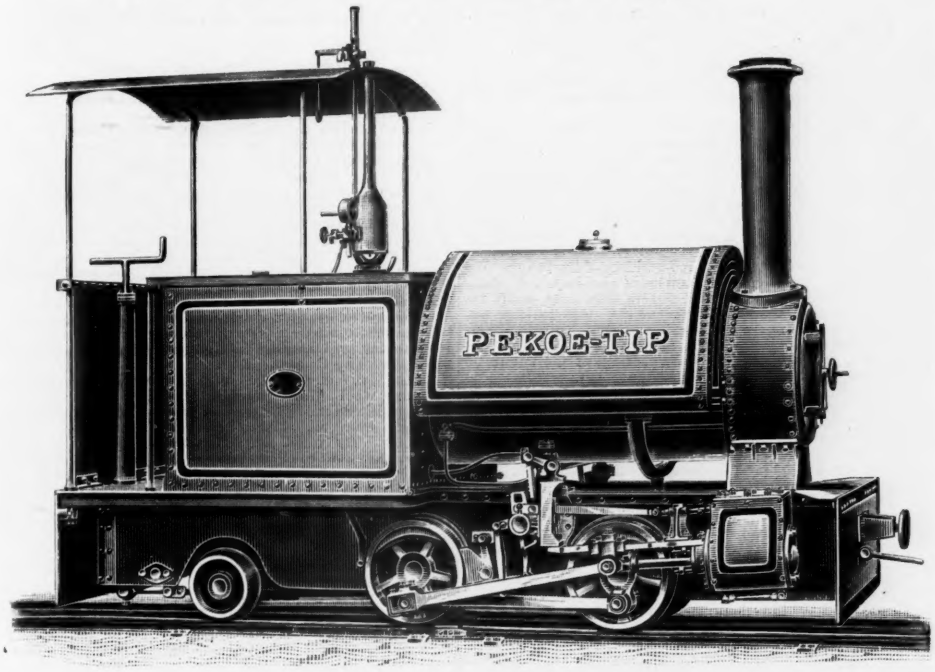
Fig. 1 is a view of the top of the shell after the explosion. This was hurled about 25 yards. Fig. 2 is a view of the fire-box. The main piece A remained in the position in which the boiler had stood. The pieces marked B, C, D, and E are portions broken from the side of the fire-box by the explosion. Fig. 3 shows the fragments of the boiler mountings as found after the explosion:—A, portions of the valve chest, the valve lever, and joint; B, the outer and inner case of the spring balance; C, remains of the steam gauge; $C_1$, remains of the steam gauge dial; D, the blow-off cock. Fig. 4 shows portions of the shell plates as they appeared after the explosion. The pieces marked with the large letters D were hurled about 69 yards; F was thrown about 40 yards. The small letters and the figures were marks used for identifying the various pieces when fitting them together after the explosion. The numbers 10 and 11, for instance, indicate that the vertical seams near which they are placed coincide with the positions in the top plate denoted by the same numbers.

---

THE CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—On the 15th inst. this Society visited the works of Messrs. Bullivant and Co., Isle of Dogs, where the processes of making steel wire cables and ropes, torpedo-catching nets, and wire-netting is carried on. The members of the Society were taken over the works by one of the partners. They were shown every detail of the manufactures, from the testing of the wires before they are made up into ropes to the testing of a finished heavy cable. The various machines in the cable shop were carefully explained as was also the process of galvanising the wires. The process of making the torpedo-catching nets was examined. The ingenious wire-net making machines were next examined, machines which had made many thousands of miles, sent to all parts of the world. The testing-house in which tests are made by special machines—designed by a member of the firm—of the finished cables was inspected, and a portion of a 4in. cable was tested to destruction. The machines for testing the wires before they are made into ropes were also in this house, the testing being both for tensile stress and torsion, and the method of conducting these was gone into. Many interesting details as to cables made and making were given.

## NARROW GAUGE LOCOMOTIVE

MESSRS. W. G. BAGNALL, STAFFORDSHIRE, ENGINEERS



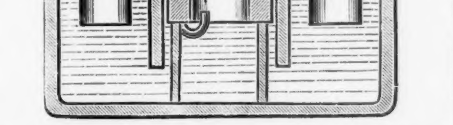
### NARROW GAUGE LOCOMOTIVES.

We illustrate above a little locomotive constructed by Messrs. W. G. Bagnall Limited, Stafford. The dimensions are as follows:—Cylinders—diameter, 5½in.; stroke, 9in.: wheels, four-coupled—diameter, 2ft.; centres, 3ft.; wheels, bogie, diameter, 1ft.; total wheel base, 6ft.; boiler, Siemens steel; fire-box, Siemens steel, circular; tubes, steel, 1½in. diameter; heating surface—tubes, 80 square feet; fire-box, 10 square feet; total, 90 square feet; grate area, 3·28 square feet; fuel capacity, 7 cubic feet; water capacity, 140 gallons. The engine is made for a 2ft. gauge, and is fitted with Baguley's patent valve gear.

### NEW GALVANIC ELEMENT.

At the first annual meeting of the German Electro Chemical Society, which was held at Berlin on the 6th of October last, a new form of galvanic element was brought forward by Dr. Borchers, of Duisburg, which is a notable advance in the direction of the conversion of the chemical energy of fuel into electricity without employing an intermediate thermal transformation. The method is based upon the absorptive power of an aqueous solution of cuprous chloride for carbon monoxide and oxygen, a well-known reaction which is utilised in the analysis of gases, and proceeds in the following manner:—

Carbon monoxide CO forms with cuprous chloride $Cu_2\ Cl_2$, the compound $Cu_2\ CO\ Cl_2$, which in the presence of water tends to split up into metallic copper, hydrochloric acid, and carbon dioxide. Thus



$$Cu_2\ CO\ Cl_2 + H_2O = 2\ Cu + 2\ HCl + CO_2.$$

On the other side, cuprous chloride in the presence of atmospheric oxygen and hydrochloric acid passes into cupric chloride and water, or

$$Cu_2\ Cl_2 + 2\ HCl + O = 2\ Cu\ Cl_2 + H_2O.$$

After the taking up of carbon monoxide on one side, and oxygen on the other, the reaction between cupric chloride and metallic copper comes into play. $Cu\ Cl_2 + 2\ Cu = Cu_2\ Cl_2$, whereby the electrolyte is regenerated. The only permanent change, therefore, is the conversion of carbon monoxide into dioxide, which is effected by atmospheric oxygen as in ordinary combustion, but with the difference that the combustion being a "cold" or wet one, as it is effected in a fluid, the surplus energy resulting from chemical action is converted not into heat but into electricity. The result is the same when mixed gases containing hydrocarbons and hydrogen are used instead of carbonic oxide, the products in this case being carbon dioxide in water.

The circumstance that only the gases, and not the metallic parts of the battery, are acted upon and dissolved in the electrolyte renders it possible to use electrodes of copper on the side that the gas is introduced, *i.e.*, the anodes in the electrolytic cell itself may be made of some metal serving as well as a conductor, the cathode being made of carbon or platinum. The experimental cell, with which Dr. Borchers has demonstrated the feasibility of making a battery based on the above principles is represented in the annexed figure.

A glass vessel of rectangular section is divided into three parts by glass plates reaching nearly down to the bottom. In each of the outer divisions a tubular copper bell passes down through an air-tight cover into the electrolyte and serves as an electrode as well as for the introduction of the gas into the solution which is brought in through the tube at the top. The cathode in the central division is a carbon bell into which air is introduced by the curved pipe at the bottom; the permanent gases, however, are taken off by the pipes through the covers on the anode sides. The electrolyte is a solution of cuprous chloride acidified with hydrochloric acid, which has been found to be preferable to the alkali solution used at first.

The first experiments were conducted with impure carbon monoxide containing a notable quantity of carbonic acid, when a current of 0·5 ampère was obtained with an interposed resistance for measuring. Subsequently, as a matter of convenience, coal-gas containing 7 per cent. of carbon monoxide was substituted, and the absorptive power of the outer cells was increased by filling them with copper turnings, when, with a low resistance, 0 64 ampère was obtained, which, by increasing the external resistance, became constant at a maximum potential of 0·56 volts, which as the theoretical tension—after allowing for all necessary reactions going on in the battery—corresponding to the reaction $CO + O = CO_2$ is 1·47 volts, represents a transformation of 38 per cent. of the fuel into electricity in the most favourable condition, while the energy of the lowest result was 26 per cent.

The experiments have extended to the substitution of coal in a powdered state for carbon gases in the battery, with results which, however, are not so good, the highest tension attained having been 0·3 volt, the theoretical yield of $C + 20 = CO_2$ being 2 volts, or a proportion of 15 per cent. As, however, the intensity of the current rapidly fell off in spite of the maintenance of energetic movement in the electrolytic fluid, the experiments in this direction have for the time been given up.

When, however, it is remembered that only about 12 per cent. of the total energy of coal can be realised by the agency of steam, and 20 per cent. by the gas engine, the figures realised by this rough experimental apparatus are sufficiently remarkable, and we may agree with an opinion expressed at the meeting that should it be found possible to construct this battery in a practical working form it is likely to effect a revolution in manufacturing industries at least of equal importance to that caused by the invention of the steam engine for the production of energy at a low cost, the new battery taking the place of the boiler, and the electromotor that of the steam engine.

In the paper sketches are given of two forms of the battery as it is proposed to construct it on the working scale. In these the anode cell is a V-shaped copper trough, partially filled with copper scrap and turnings, while the cathodes are contained in perforated stoneware cells filled with fragments of coke or gas carbon, the current being collected by a rectangular bar of carbon running along the bottom of the inner cell. The cells are intended to be arranged in series one above another, with the electrolytical fluid circulating by gravitation from above downward.

Two first-class Russian battleships, of 10,960 tons and 10,600-horse power, were launched last week on the Neva, where, had the events been delayed much longer, the ice would have blockaded the vessels for the winter. These ships have 15·8in. belts, and on each of their two principal turrets 10in. armour. Each turret has a couple of 12in. guns. There are four other turrets, each with 4·7in. armour and a pair of 8in. guns, and there are twenty-four smaller guns. The ships are named Poltava and Petropaulovsk. The expected maximum speed is 17·5 knots. The new German third-class battleship Odin, previously known as "V," was launched on the 3rd inst., by Count Haugroitz. She is similar to the Siegfried, Beowulf, Frittijof, Hagen, Heimdal, and Hildebrand, and to a vessel, "T," still unlaunched at Kiel. These ships were originally designed as coast defence vessels, but are now regarded as suitable for a wider sphere of action.

## LETTERS TO THE EDITOR.

(*Continued from page 447*)

### TRAIN SPEED.

Sir,—The question of train speed is always an interesting one; interesting to those specially engaged in working the vast traffic now daily carried upon our railways, and interesting to the general public to utilise the trains, and which may without exaggeration be said to include everybody. In countries outside Great Britain, the demand for high speed seems of late years to have been pushed forward with more than usual emphasis. Whereas so late as six years ago an average booked speed of fifty miles an hour was only to be found within the British Isles, we now find America, France, and Germany all claiming the right to be placed within the fifty miles an hour category. Indeed, I do not doubt that if severe gradients do not prove too great a hindrance, we shall before long be told that Japan claims a premier position with her "Flying Chinee" at fifty-five miles an hour.

Meanwhile, we in England look upon the progress made in the same period with somewhat doubtful eyes. Fifty-six miles an hour is still our maximum booked speed. Our Scotch expresses have no doubt greatly improved in one respect, namely, the reduction in the total time occupied from point to point; this has, however, been chiefly effected by cutting down stops. The heavy loads usually associated with these trains seem to preclude a higher average speed than fifty-three miles an hour. The Great Western during the past six years has increased its express mileage from 8000 to 9000; but the solid old Dutchman still tramps along at fifty-three miles an hour between Paddington and Swindon. In an article on this subject in your issue for October 26th, you referred to the great increase in the weight and dimensions of our express engines. We now find Caledonian, Midland, Lancashire and Yorkshire, and South-Western, all running 19in. cylinders; we have Greater Britains and Worsdell compounds weighing approximately 90 tons when fully equipped; and the Great Western now go one better with a cylinder 20in. in diameter.

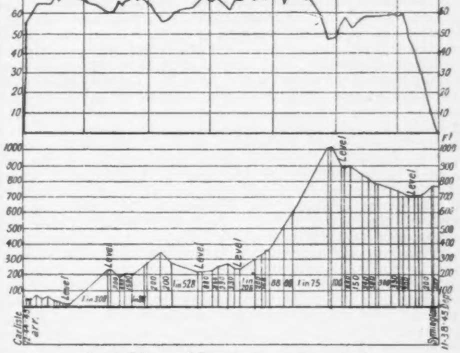
Now the questions which present themselves are: (*a*) Have trains so increased in weight as to necessitate these ponderous productions? (*b*) Are those engines capable of running at a higher speed than their predecessors?

Speaking generally, I may say without hesitation that the answer to the first question is in the affirmative. It is no doubt true that on some lines there is very little difference in the weight of trains now and ten years ago. On the Great Western, though the individual coaches are much heavier, so many more trains are now run that the actual weight is even less than it used to be. Expresses totalling up to 300 tons used to be quite a feature of the Great Western; now, as the table of train loads published by you, Sir, on November 2nd shows, the maximum may be taken as about 200 tons. On the London and North-Western loads have increased all round. Take the Scotch mail, which used to be the heaviest train. In 1864 it weighed 54 tons; in 1874, 75 tons; in 1884, 165 tons. Now, in 1894, the corridor train, which is probably the heaviest express in the Kingdom, is made up as follows:—

*W. C. J. S. Corridor Train.*

| | | Tons. | Cwts. |
|---|---|---|---|
| 1. | Eight-wheel brake van with two compartments .. .. | 22 | 10 |
| 2. | ,, third-class with lavatories .. .. .. .. | 22 | 10 |
| 3. | Twelve-wheel third-class dining car.. .. .. .. .. | 30 | 10 |
| 4. | ,, first-class dining and kitchen car .. .. | 33 | 10 |
| 5. | ,, ,, dining car .. .. .. .. .. .. | 30 | 10 |
| 6. | Eight-wheel first-class with lavatories .. .. .. .. | 22 | 10 |
| 7. | ,, composite ,, ,, .. .. .. .. | 22 | 10 |
| 8. | ,, third class and brake van .. .. .. .. | 22 | 10 |
| 9. | ,, composite with lavatories .. .. .. .. | 22 | 10 |
| 10. | ,, third-class and brake van .. .. .. .. | 22 | 10 |
| | Total .. .. .. .. .. .. .. .. .. .. | 257 | |

During the summer months this train has frequently totalled 300 tons. In fact, it may be safely said of all L. and N. W. expresses during the summer months, that they are loaded to their fullest capacity, and I think it very doubtful if the Precedents could successfully tackle the loads without a great deal of pilotage.



*Load-4 Bogies 3 Six-wheelers 1 Four-wheeler.*

On the Midland and Great Northern I likewise note a steady increase in the weight of the best trains. The 8 p.m. Great Northern Scotch express has, during the busy time, often to be run in three portions, and the 10 a.m. has been booked in duplicate —10 and 10-8—for the best part of the last six months. As for the East Coast Corridor train, the normal load is approximately: Two six-wheel brake vans, three six-wheel composites, one six-wheel kitchen car, and two eight-wheel bogie dining cars. Total weight about 136 tons. During the summer this train is run in duplicate as far as Newcastle. The train which ran into the buffer stops at St. Pancras station on August 12th last, may be taken as an average load for a Midland express. It was made up as follows:—One Pullman car, one N. B. third, one M. S. J. S. van, one N. B. composite, one Pullman sleeping car, two Midland composite, two M. S. J. S. composite, one Midland third, two vans twelve coaches; total weighing altogether 153 tons. From these figures it will be seen that individual coaches are steadily increasing in weight, though we are still a long way behind our American cousins, who deal in 80ft. cars weighing something like 50 tons. The following are the heaviest now run in Great Britain:—

| | Tons. |
|---|---|
| M. S. J. S. corridor dining 12-wheel bogie .. .. .. .. | 33½ |
| W. C. J. S. ,, ,, ,, ,, .. .. .. .. | 33½ |
| E. C. J. S. ,, ,, 8-wheel ,, .. .. .. .. | 25 |
| South-Eastern 12-wheel bogies .. .. .. .. .. .. .. | 26½ |
| Manchester, Sheffield, and Lincoln 12-wheel bogies .. .. | 25 |
| Great Western corridor 8-wheel bogies .. .. .. .. .. | 24 |
| London and South-Western 8-wheel bogies .. .. .. .. | 22 |

The difficulty of the whole matter lies in the fact that during three or four months in the year trains are about twice the weight of those run during the remaining eight. The engines, of course, must be constructed with a sufficient margin of power to efficiently work the heaviest possible traffic. The result is that very light trains have frequently to be run with an excess of engine power out of all proportion to the work required. I remember on one occasion recently travelling in a West and North Severn Tunnel express. From Bristol to Shrewsbury the gradients are very severe—1 in 80, 1 in 75, and 1 in 50. The train consisted of ten eight-wheel bogie coaches, weighing close upon 200 tons. The engine to Shrewsbury was an old one, having 17in. cylinders and 6ft. 6in. coupled wheels. From Shrewsbury, where the train was divided, a London and North-Western compound of the latest type, "John Hicks," took on four coaches over the comparatively easy road to Liverpool. In this case the power and weight of the engine was out of all proportion to the load, which probably did not weigh as much as the engine itself. But the 17in. engine had the aid of a pilot up the banks, a proceeding which might have been avoided had an engine as powerful as the "John Hicks" been employed.

Turning now to the second question—that of high speed. We know that years ago on the occasion of a special speed trial eighty miles an hour was obtained. Latterly, I believe, higher speeds have been noted in everyday work; I fancy Mr. Rous Marten could give us some interesting information on this point. Personally I have never noted with certainty a higher speed than 78½ miles an hour. We have Mr. Worsdell's authority for a speed of eighty-six miles an hour with one of his giant locomotives; and in America there seems positively to be no limit to the authenticated records. But whatever figure may represent the true maximum speed of the modern locomotive, there can be no doubt that it is capable of reaching that maximum with a much greater load than was possible to the earlier engines. Further, they are capable of tackling steep banks in a style quite beyond the powers of their predecessors; and the possibility of obtaining a high average speed is increased accordingly.

The race to Edinburgh in 1888, though decried by a good many people blessed with over sensitive nerves, taught us a great many valuable lessons. It showed us, first, that our lines are with absolute safety adapted to a speed greatly in excess of that hitherto imagined possible. A considerable variety in the type of engine employed gave us some idea of their respective merits. From Euston to Crewe the West Coast train was worked by an old engine of the Waverley class. The best performance on this run was:—Euston to Crewe, 158 miles in 166 minutes, giving an average speed of fifty-seven miles an hour. Had a modern engine been employed to work that section there is no doubt double the load—the West Coast train weighed 77 tons—might have been taken at an average speed of sixty miles an hour. The East Coast train, which weighed 120 tons, ran at an average speed of sixty miles an hour on at least three occasions, namely: King's Cross to Grantham, 105½ miles in 105 minutes; York to Newcastle, 80¼ miles, twice in eighty minutes. These trains were worked by modern engines.

In your issue for March 13th, 1891, you gave a diagram of the performance of Caledonian engine No. 123. This engine took the West Coast racing train from Carlisle to Edinburgh, 100¾ miles, in 102 minutes 33 seconds; an average speed of 58·9 miles per hour. I am now able to name another remarkable achievement by a Caledonian engine, and this run was accomplished not on a special occasion, such as the race to Edinburgh, but in ordinary everyday work. For some time past the West Coast Scotch express, which leaves Aberdeen at 6.50 a.m., has been timed to run from Symington to Carlisle—a distance of 66 miles 69 chains—in 74 minutes, or an average speed of 54·1 miles per hour. On the day in question this run was accomplished in exactly 66 minutes = 60·7 miles per hour. The train was made up as follows:—4 W.C.J.S. eight-wheel bogies, 77 tons; 3 six-wheelers, 45 tons; 1 four-wheeler, 12 tons; engine and tender, 80 tons; total, 214 tons. The engine was one of the latest type in use on the Caledonian, having cylinders 19in. by 26in. Driving wheels 6ft. 6in. four-coupled.

The gradient profile—which for convenience is placed beneath the speed diagram—shows graphically the features of the road. At first sight it would appear to be mostly downhill; but as a matter of fact 38¾ miles are downhill, 4½ are level, and the remaining 23½ uphill. Many of our main lines are much more favourable to fast running than the one in question. The East Coast route so far as Newcastle is considerably less hilly; or the Great Western main line from Swindon to London; so that it cannot be said the route was especially cut out for such work. One or two points of particular interest may be referred to.

The most extraordinary feature in the run is the fact that the maximum speed only reached seventy-two miles an hour. Here was a fine stretch of fourteen miles solid downhill, which includes six miles of 1 in 75; the engine was one of a most powerful type, and the weight of train certainly not excessive; yet withal this run, which gave an average speed of over sixty miles an hour, included nothing higher than the very moderate figure of seventy-two miles an hour. I would emphasise this fact very strongly, because it shows that if the weight of trains be only kept within reasonable limits, the average speed of our best trains might well be timed considerably higher than at present. Further, those timid people who, during the Scotch race, cautiously travelled by the sober-minded Midland—where, needless to say, seventy-two miles an hour is by no means the limit—may well take comfort from the fact, and learn that with modern engines excessive speed along the banks is quite an unnecessary feature. Here also, I think, will be found an answer to those people who denounce the ponderous locomotives of the day as incapable of giving any better results than their predecessors. An older class of engine, having cylinders 17in. diameter and 135 steam pressure, and weighing about 35 tons, would most certainly have been incapable of achieving such a high average speed. It may be also interesting to estimate what would have been the gain in time had a really high speed been maintained down the banks. From post 46 to 38, eight miles were covered in 6 minutes 53 seconds = 69·5 miles per hour. Had this piece been run at, say, 80 miles an hour, it would have required exactly 6 minutes to cover the 8 miles, a saving of but 53 seconds. Again, post 12 to post 7 might have been run at 80 miles an hour, and a further 40 seconds would have been saved; making a total difference on the run of 1 minute 33 seconds. A few of the best pieces may be detailed:—

| | | | | | |
|---|---|---|---|---|---|
| Mile post | 61 to 1 | = 60 miles in | 57 minutes | 18 seconds | = 62·8 M.P.H. |
| ,, ,, | 48 to 2 | = 46 ,, ,, | 42 ,, | 5 ,, | = 65·5 ,, |
| ,, ,, | 46 to 39 | = 7 ,, ,, | 6 ,, | 0 ,, | = 70 ,, |
| (Uphill) | 61 to 50 | = 11 ,, ,, | 11 ,, | 55 ,, | = 55 4 ,, |
| (Uphill) | 26 to 24 | = 2 ,, ,, | 2 ,, | 0 ,, | = 60 ,, |

Permanent Way.

London, November 19th.

### METALLIC PISTON-ROD PACKING.

Sir,—Our attention has been called to the letter upon the above subject which appeared in your issue of November 9th, and as makers of metallic piston-rod packings, we may perhaps be permitted to say a few words in reply.

The term "metallic packing" is about as comprehensive as a Socialist's programme. Every device for filling the stuffing-box with some arrangement consisting partly or wholly of metal is dignified with the name of "metallic packing," and the number of such devices patented since Edward Cartwright led the way in 1797 would astonish those not conversant with the facts. Many of these productions should be dubbed "semi-metallic packings," for they consist simply of the old fibrous substances--hemp, asbestos, &c.—with perhaps a metal core or binding. As the effect of these upon the rods will be very similar to that of ordinary "soft" packing, we presume your correspondent requires no information in regard to them.

Packings which are purely metallic may be divided into two classes, viz., "rigid" packings and "self-adjusting" or "floating" packings, which terms denote the general principles of design. The number of rigid packings is enormous, and it is astonishing and amusing with what steady persistency inventors continue to "protect" the ideas which occurred to those first in the field nearly a century ago.

The number of successful self-adjusting or floating packings, can almost be reckoned on the fingers. To this class belong the packings manufactured by us, and having, in conjunction with the parent company in the U.S.A., fitted nearly 60,000 on all types of engines and in all parts of the world, we can speak "from experience" without entering into details of construction. We may say that our packing is so designed that the rod comes in contact only with blocks or rings of the finest anti-friction metal, such parts also being arranged to "float" with the rod and so prevent any binding. Now this anti-friction metal, so far from having any corrosive or injurious effect upon the rod, acts in quite a different way. The surface of the rod is in a manner "tinned," and so presents a beautifully smooth and bright surface, equally pleasing to the engineer and the packing maker. The packings cannot of themselves injure the rod.

Even with metallic packing the rods do sometimes show marks of some corrosive agency, but these can readily be accounted for when the surrounding circumstances are inquired into. Bad lubricant and bad water are the two principal delinquents, but of course their failings should not be put down to the account of the packing. We have seen some sad instances of stuffing-boxes eaten away by tallow, and we have a vivid recollection of one "engine tenter" who regularly used a compound of tallow and emery to "polish the rod."

Metallic packings are the piston-rod packings of the future. We have witnessed the gradual extinction of the prejudice which existed against devices of this kind, and we take some credit for having, by our success, assisted in the process. Soft packing was long ago exiled from the piston head, and with increasing temperatures and pressures it ought soon to be exiled from the stuffing-box, and replaced by metallic packings of the automatic self-adjusting type.

In your issue of the 9th inst., when describing the engines of the Union Steamship Company's mail steamship Norman, you state that the high-pressure rods are packed with the "American" metallic packing.

As the makers of the packings referred to, we desire to make a statement which may possibly correct a misapprehension. This company consists entirely of English shareholders, and the packings are all made at Bradford, Yorks, by local labour. The parent company, of Philadelphia, though still maintaining friendly relations, has been for many years an entirely separate concern. Hence you will see that practically the only American connection of the company is the name.

We would particularly like this to be known in view of the fact that at the present time we have orders for a large number of packings to be fitted to various vessels of the British Navy and to stationary and locomotive engines under the War Department and Colonial Governments. Englishmen naturally think that articles for Government use should bear no other legend than "Made in England."

W. M. Kermode, Secretary.

The United States Metallic Packing Company,
Bradford, November 20th.

Sir,—In reply to "Gland's" inquiry in your issue of 9th inst., we beg to say that a purely metallic packing, such as the "Tripp," for example, does not in any way corrode the rod, but it is quite possible that a semi-metallic packing, *i.e.*, one made partly of metal and asbestos, would have that effect, and experience has taught us that there is no middle path between a fibrous and metallic packing, a combination of the two never leading to satisfactory results.

Green and Boulding.

London, November 17th.

### BICYCLE MECHANICAL ENGINEERING.

Sir,—Your remarks about the Boudard gear appear to be borne out in practice, judging by the results of the races held recently by the Boudard and Whitworth companies between Boudard and plain-geared machines.

But this subject of bicycle mechanical engineering reminds one of the great want in the trade, namely, the want of standard screw threads for bicycles. It is surprising in these days, when standards and interchangeability are receiving so much attention in nearly all branches of mechanical engineering, that this important subject should have been neglected by the cycle trade.

It is no common thing in a cycle repairing shop to make special taps for tapping one cone or nut, the only alternative being to make a complete new spindle or what-not.

Cannot some of the large cycle firms take up this subject? We have standard gas and hydraulic threads, and there is a talk about standard threads for watches, and surely, now that the cycle trade has reached its present proportions, it is time that some attention was given to this important matter.

C. K. Dumas.

New Swindon, November 19th.

### LABOUR AND LUXURIES.

Sir,—It appears that the head and front of my offending has lain in the assertion that political economy has nothing to do with ethics. Perhaps the following quotation from an address delivered by Lord Farrer on the 20th instant, before the members of the Royal Statistical Society, in Jermyn-street, will serve to convince "W. A. S. B.," and "R. J. B.," that I have not spoken without warrant. Lord Farrer said: "That political economy had been taken to be more than it was or claimed to be. At any rate, there had been a revolt against it. It seemed to him that, whatever might be said of sociology or social science, and however strong might be the links by which that science connected ethics and economics, yet, in the present state of our knowledge, ethics and economics were on a different plane, and could not conflict, because they never met. Ethics was a science of art and duty which taught men what they ought to do or to aim at. Economic science had nothing to do with duty, was not an art, nor was it a code or system of laws. It was the branch of human knowledge which treated of the manner in which material wealth was produced and distributed; it endeavoured to ascertain the laws and conditions under which production and distribution took place, and pointed out that a certain course of action would have such and such effects on production and distribution. It was within the province of economics to tell us that families and nations who were weak and lazy were likely to starve. It was for ethics to say that such starvation would serve them right. It was for political economy to tell us that good work was not to be expected without good wages. It was for ethics to say that it was the duty of the employer to give adequate remuneration to those in his employ. Ethics appealed to man's conscience, emotions, and affections, while the business of economic science was purely intellectual, and taught what would be the probable result on material wealth of any given set of external conditions, or of any particular course of human action." Bearing in mind that these and kindred statements were made before leading political economists, and that they were received with acclamation, I venture to hope that they will have due weight with your correspondents, not one of whom has advanced a single statement of fact as yet to controvert my propositions.

Y. X.

November 21st.

Sir,—By a strange chance the gold actually imported into England in the last four completed years amounted almost exactly to the sum which "Y. X." invited us to suppose added to the gold in this country. It is, therefore, open to us to examine the reality of what has happened instead of indulging in hypothesis piled upon hypothesis. The greater part, of course, was re-exported, but the enormous sum of £26,000,000 on balance was added to our stock, an addition by far greater than any I can find record of in a similar previous period, amounting, it may be, to 20 per cent. of our gold currency. Unhappily no such prosperity has come with it as should have on "Y. X.'s" theory, so I am not yet persuaded to revert to the almost forgotten opinions of the mercantilists, which were exploded by Adam Smith.

While on the subject of gold, I wonder if "X. X.," who eighteen months ago was perplexed at the temporary excess of imports into the United States, and who "knew they could not pay for it in specie," has observed how the year's figures worked out, and how by July, 1893, they had paid away specie to the tune of 105,000,000, dols., or 70,000,000 dols. more than the excess of merchandise imported in the twelve months?

W. A. S. B.

November 20th.

## LAUNCHES AND TRIAL TRIPS.

On the 15th inst. the s.s. Tokomaru, built by Messrs. C. S. Swan and Hunter, Wallsend, and purchased by Messrs. the Shaw, Savill, and Albion Company, London, for their New Zealand trade, and which has received extensive additions, and has been fitted with insulated holds by Messrs. C. S. Swan and Hunter for the New Zealand frozen meat trade, to carry about 100,000 frozen sheep, left the Tyne for her trial trip and afterwards proceeded to London, the trial trip having been satisfactory in every respect. The dimensions of the Tokomaru are; Length over all 440ft., breadth 53ft., and depth moulded 34ft., and her deadweight capacity is about 9000 tons. The main engines, built by Messrs. the Wallsend Slipway and Engineering Company, are 31in., 50in., 80in. diameter by 54in. stroke, with three large double-ended boilers, 160 lb. working pressure, fitted with Serve tubes. The refrigerating machinery has been supplied by the Haslam Foundry and Engineering Company, Derby.

On the 15th inst. was successfully launched from the East Yard of Messrs. C. S. Swan and Hunter, shipbuilders, Wallsend, a finely modelled steel screw steamer of the following dimensions:—Length over all, 445ft.; breadth, 49ft.; depth moulded, 32ft. 10in. The vessel, which has been built to the order of Messrs. the Shaw, Savill, and Albion Company, London, has been specially constructed for the Colonial frozen meat trade to the highest class at Lloyd's, under special survey, and contains insulated holds capable of carrying about 100,000 frozen sheep. She is built of the three-deck type, with full poop, bridge house 250ft. long, and a long topgallant forecastle, with cellular double bottom throughout, and she has six water-tight bulkheads. The deck machinery includes ten powerful steam winches, with derricks on each side of the ship on steel derrick posts. The engines have been built by the Central Marine Engine Works, West Hartlepool, the sizes of the cylinders being 30in., 47½in., and 80in. by 48in. stroke. The boilers will be worked with forced draught on Howden's principle, and the refrigerating machinery has been supplied by the Haslam Foundry and Engineering Company. The vessel and machinery have been superintended during construction by Captain McKirdy, marine superintendent, and Mr. C. T. Young, superintending engineer, and Captain Scotland, of the Shaw, Savill, and Albion, and was named the Aotea by Miss Scotland, daughter of Captain Scotland.

On Thursday, November 15th, Messrs. Furness, Whitby, and Company launched from their shipbuilding works at Hartlepool a large steel screw steamer, built to the order of Messrs. Lunn and Maccoy, Newcastle-on-Tyne. The vessel is a substantial type of a modern cargo boat, measuring over 320ft. in length, and built throughout of Siemens-Martin steel, with a large measurement and deadweight capacity, and built to the highest class at Lloyd's. She is an exact duplicate of the s.s. Birdoswald, built by Messrs. Furness, Whitby, and Company for the same owners, and which has given such excellent results. Every care has been taken in designing this ship to construct her as strong as possible for the heavy deadweight trade. The vessel is built on the web frame system, with cellular double bottom all fore and aft, and subdivided at intervals, the after peak being also available as a tank. The main and fore holds are divided by iron water-tight bulkheads efficiently stiffened by an iron longitudinal division. The greater portion of the shell plating is in 24ft. lengths, which is efficiently backed up by strong sectional framing to the top of vessel all fore and aft, the topside plating being extra thick to withstand the heavy Atlantic trade. The bottom plating is also thicker in way of the ballast tanks to allow for the vessel lying aground whilst loading. The whole of the weather decks, tank tops, floor plates, &c., are also of extra thickness, and the hatchways are of extra size to take in the bulkiest cargo; large winches to hatches, patent steam steering gear amidships, with hand gear aft, steam windlass, large donkey boiler, and patent stockless anchors. The vessel will be rigged as a pole masted schooner, and to make her available for bridges and canal work, the topmasts are telescopic. The engines and boilers have been constructed by Messrs. T. Richardson and Sons, Hartlepool, and are of massive design, with every provision for economical working. The ship and engines have been constructed under the supervision of Mr. Maccoy. On leaving the ways the vessel was named Ailsawald by Miss Daisy Maccoy.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The iron trade shows no decline on the week.

In further reference to the position of the railway carriage and wagon building trade, Brown, Marshalls, and Co., inform me that they have in hand an order for ironwork and fittings for 105 carriages for the Assam-Bengal Railway Company for shipment to India. They have also secured a contract for thirty-four large bogie carriages for the London, Brighton, and South Coast Railway. They lately shared an order for fifty tramcars for the Glasgow Corporation with their neighbours, the Metropolitan Carriage Company. Brown, Marshalls, and Co. are also just now shipping two trains of first-class corridor carriages for the Egyptian Government railways. These trains consist of five carriages, each carriage having four compartments, and communicating with lavatories, &c. They are intended for the expresses running between Cairo, Alexandria, and Ismailia.

A question of interest to the engineering and iron and steel trades of this district, where the road transit of heavy loads has frequently to be undertaken, is just now before the Board of Trade. I refer to the application of the Great Western Railway Company to that Department for their approval of bye-laws relating to the railway company's bridges. The railway wishes to limit the heavy traffic to loads of five tons. The Birmingham Chamber of Commerce—at the instance of Messrs. Danks, of Smethwick, the well-known boiler and bridge making firm—have memorialised the Board of Trade to raise the limit to eight tons. The lower figure would seriously hamper the engineering trades of this neighbourhood.

Much satisfaction is expressed hereabouts with regard to the reduction of canal tolls on coals, secured by the Birmingham Canal Order Confirmation Act, 1894, which has recently received the Royal Assent. This Act, which was promoted by the Birmingham Coal Merchants' and Consumers' Association, shows a substantial reduction of the tolls upon coal brought into Birmingham from the Dudley and Cannock Chase districts. The toll into Bordesley and Upper Birmingham has been reduced from 1s. 3d. a ton to 9½d., and into Perry Barr and Aston from 1s. to 9d. These rates compare with from 3d. to 6d. per ton in the Winson Green and Smethwick district, and will be a considerable relief to manufacturers and other large consumers. It is estimated that the reduced tolls will benefit consumers in Birmingham to the extent of nearly £50,000 a year, and the Corporation will itself derive advantage of the value of some thousands of pounds annually.

Electrical engineers will be interested to note that new electric machinery and plant is likely soon to be wanted upon a portion of the system of the South Staffordshire Tramways Company. For some time the West Bromwich Corporation have been urging the company to adopt some alternative method upon its lines running from Darlaston to Handsworth and from Dudley to Handsworth. The licence for the use of steam expired on the 1st inst. The Corporation have, however, consented to the licence being extended until January next, the company in the meantime to make some definite arrangement. The Corporation favour cable traction, so that cars may run right through to Birmingham without changing at Handsworth as at present, but the initial expense would be heavy. The West Bromwich tradesmen object to the overhead electric system on account of the poles on the sides of the footpaths. The manager of the company—Mr. Dickenson—has, however, invented a pole upon which the present-street lamps could be fixed, and which could support the electric wires at the same time. The tramway company leans towards electricity, and points to its successful working upon its other lines.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The position throughout the engineering, iron, and coal trades of this district remains without material change or improvement. Here and there one comes across a rather more hopeful tone amongst engineers, but this would seem to be based rather on more or less vague anticipations as to the future than upon any really definite prospects of present improvement. The iron trade in all departments continues extremely quiet, but there is one feature in the present position, the excessive lowness of stocks, either in the hands of consumers or makers, or in the public stores, that should not be lost sight of in estimating possible eventualities in the future, as the slightest indication of general reviving activity would almost to a certainty very rapidly force up prices. The condition in the coal trade continues about as unsatisfactory as it could possibly be, and very gloomy anticipations as to the future prevail in many quarters.

A depressed tone continues throughout the Manchester iron market, and the Change Meeting on Tuesday was practically a repetition of the extremely quiet markets for the last month or so. In pig iron it is quite exceptional where business of any weight is being put through, users hanging back as long as possible before placing out further orders, and when they do buy it is only at some concession upon previous quoted rates. Lancashire makers still nominally quote on the basis of 39s. for forge, up to 42s. for foundry, less 2½, at the works, but these figures are altogether out of competition with district brands, and it is only where local makers have specially favourable rates of carriage that they are booking occasional orders with regular customers. With regard to district brands, forge Lincolnshire is becoming somewhat of a drug upon the market, owing partly to the very restricted requirements of consumers, and partly to the irregular working of some of the furnaces, which are just now turning out a considerably larger proportion of forge as compared with foundry numbers, and to get rid of surplus supplies of forge very low prices are occasionally quoted. Business has been done during the last few days at about 38s. net cash for forge Lincolnshire, delivered equal to Manchester, but there are sellers at under even this low figure. Foundry qualities are fairly steady at recent quotations, Lincolnshire averaging 39s. 6d. to 40s., and Derbyshire ranging according to brand from about 43s. to 45s. net cash, delivered here. Outside brands are about as last quoted, but it is exceptional where more than 44s. 4d. net cash is being got for good foundry Middlesbrough, delivered Manchester. For Scotch iron quotations average about 47s. 6d. for Eglinton, 48s. 6d. for Glengarnock, and 50s. for Gartsherrie, net prompt cash, delivered Lancashire ports.

Finished iron makers still report new business coming forward very slowly, and forges for the most part scarcely kept on more than about two-thirds their normal production. Delivered Manchester district, Lancashire bars average about £5 6s. 3d. to £5 7s. 6d., and Staffordshire £5 7s. 6d. to £5 10s., but as low as £5 5s. f.o.b. Liverpool has been taken by Lancashire makers on shipping orders. Lancashire and Staffordshire sheets remain at about £7 to £7 5s., and Lancashire hoops £5 17s. 6d. for random to £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Nut and bolt makers also report trade in a very unsatisfactory condition, with few orders of any moment stirring, but prices, which seem to have got to about their lowest point, remain stationary.

The steel trade continues generally in a very lifeless condition, with prices about as last quoted; good ordinary foundry hematites remain at about 52s. 6d., less 2½, with low-class billets obtainable at about £3 17s. 6d. to £4, and best billets quoted £4 7s. 6d. to £4 10s., net cash; steel bars average £6 to £6 2s. 6d., according to quality, and steel boiler plates £6 2s. 6d. to £6 5s. per ton, delivered in this district.

In the metal market business drags on from hand to mouth. There was a general expectation that some reduction in list rates for manufactured goods would be made during the past week; but so far they remain without alteration.

The condition of the engineering industries remains very much as I have reported for some time past. Stationary engine builders, as a rule, are fairly off for work, and some of the machinists are tolerably busy, whilst the leading machine tool makers are also tolerably well off for orders; but it is exceptional where establishments have any work far ahead. Generally the most that can be said is that they are just kept going, with not a few establishments extremely slack. This is especially the case with locomotive builders, whilst boilermakers report a considerable falling off in this branch of trade as compared with a few months back.

I hear of some friction which has arisen here and there between masters and their workmen in this district on the overtime question, with regard to which the men are endeavouring to impose further restrictions, whilst there is also an attempt to prevent a workman attending to more than one tool at the same time. So far, the action which the men have taken upon these matters has not rendered necessary any combined general movement on the part of the masters, but it is being strenuously resisted by individual employers, where attempts are being made to introduce these restrictions.

Messrs. Galloways Limited, of Knott Mill, are just now very busy on several large special orders, one of these including exceptionally powerful rolling-mill engines for a steel works in the United States, to which I may possibly make further reference later on, as a noticeable feature is that they are being completed in the space of not more than three or four months.

Messrs. Hulme and Lund, Pomona Works, Manchester, have recently completed a pair of horizontal pumping engines of the girder type, specially designed for colliery work, which contain several features of interest. The cylinders are 34in., the stroke being 30in., and the engines are to work in combination with quadruple-acting ram pumps, with 12in. by 30in. stroke, and having a capacity for raising 60,000 gallons per hour 480ft. One special point in these engines is that the connection with the pumps, which is by long distance pieces and coupling boxes, so that the pump rod does not enter the steam cylinders, can be readily removed to allow of a thorough examination of the piston, all that is necessary being to take out the nuts and bolts in the distance pieces, and remove the coupling-boxes, when the connection can be easily taken out without disturbing the engines or the pumps. Amongst other work, Messrs. Hulme and Lund have in hand the construction of a pair of horizontal pumping engines to force 900ft. high with 20in. cylinders, the pumps working behind, this being the third pair the firm have had on order from the same firm, who require them for colliery purposes, and they have recently sent out a set of 10in. quadruple vacuum pumps of special design, for cop-drying in cotton mills.

Extreme depression continues to be reported throughout the coal trade of this district, with pits only in exceptional cases working more than four days per week, and prices showing a persistent weakening tendency. The better qualities of round coal still meet with only a very poor demand for house-fire purposes, and although quoted list rates are unchanged, specially low figures are frequently quoted to clear away anything like quantities. The average current prices scarcely exceed 10s. 6d. to 11s. for best Wigan Arley, 9s. 6d. to 10s. for Pemberton four-feet and seconds Arley, with common house coals obtainable at from 7s. up to 8s. per ton. As regards the lower qualities for iron-making, steam, and general manufacturing purposes the position is equally unsatisfactory, owing to the restricted requirements of the principal coal-using industries. Supplies of steam and forge coal are largely in excess of the demand and prices excessively low, 6s. 6d. to 7s. being about the average figures at the pit mouth.

As an illustration of the exceptionally depressed condition of the coal trades not only in this, but in other districts, I may mention that a contract has just been settled for the supply of 60,000 tons of gas coal for Belfast. The Lancashire coalowners have usually had the supply, at any rate, of a considerable portion of this contract, and their quotations were about 13s. per ton for delivery at Belfast. The contract has, however, been secured by a Yorkshire firm at, it may be presumed, under even 13s. per ton, and a further not very pleasing feature for Lancashire owners is that the coal is being shipped *viâ* the Manchester Ship Canal at Partington, whilst the price at which the contract has been secured will probably scarcely leave more than 6s. per ton at the pit mouth in Yorkshire.

Engine classes of fuel continue a general drug upon the market, with sellers at all sorts of prices, where contracts can be made or orders of any weight secured. Good ordinary Lancashire slack has been sold as low as 3s. to 3s. 6d., with best qualities scarcely averaging more than 4s. 6d. to 5s. per ton at the pit mouth, and slack from other districts continues to come in here at prices which do not leave more than about 1s. 6d. per ton at the pit mouth.

The shipping trade continues very quiet, with low prices ruling, ordinary steam coal being obtainable at from 8s. to 8s. 6d., whilst better qualities are quoted at 8s. 9d. to 9s. per ton, delivered at the Garston Docks or the High Level, Liverpool.

*Barrow.*—The hematite market is still very much depressed, and orders are coming to hand slowly. On home account there is really less doing, and business with foreign countries is less than it has been for years. Prices are easy at 43s. 4½d. cash sellers, buyers 1d. less. Makers ask 44s. to 45s. for Nos. 1, 2, and 3, Bessemer iron. Stocks have again increased this week by 1500 tons, and now represent 166,227 tons, being an increase of 71,604 tons since the beginning of the year. One furnace has been blown out this week, and there are now only thirty-two in blast, compared with thirty-three at the same time last year. There are seventy-five furnaces in the district.

Iron ore is very quiet, and even local sales are on the wane. Prices are, however, steady at late rates, 8s. 6d. for ordinary and 13s. 6d. for best descriptions, net at mines.

Steel makers are short of orders, generally speaking. The demand for rails keeps very quiet, and makers have little in hand. The mills are worked only at intervals. The plate mills are busy on the new orders recently booked, and other work is expected. Tin-plate bars are a quiet trade. There is practically nothing doing in blooms, billets, slabs, hoops, or wire rods, but heavy steel castings are still in demand.

Shipbuilders and engineers are very busily employed and are likely to remain so. The Naval Construction and Armaments Company last week booked an order for a duplicate of the sand pump dredger Brancker, built by it for the Mersey Bar. The Brancker has proved such a satisfactory ship, and has done so much to improve the approaches to the Mersey, that the Dock and Harbour Board determined to have a duplicate ship, and this will be built at Barrow.

The coal and coke trades are very quiet, and the consumption is less. Prices, however, are very steady.

Shipping shows a slight improvement. The exports from West Coast ports during last week represented 11,950 tons of pig iron, and 6405 tons of steel. In the corresponding week of last year 2355 tons of pig iron and 4752 tons of steel were shipped, showing an increase of 9595 tons of pig iron and 1653 tons of steel. The aggregate shipments to date this year amount to 315,435 tons of pig iron and 353,251 tons of steel, comparing with 244,844 tons of pig iron and 421,382 tons of steel in the corresponding period of last year, an increase of 70,591 tons of pig iron and a decrease of 68,131 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

TRADE is again rather weaker in coal. The continued mild weather has kept down the demand for household sorts, which would soon be exceedingly active if a sharp frost were to set in for a few days. Coalowners report that there is literally no business doing. The coalfields in this district are nevertheless being energetically opened out, particularly in the direction tending towards Doncaster, and there is every probability that the present generation will live to see the headquarters of the South Yorkshire coal trade transferred to the Doncaster district. The winter quotations, with the advances usually imposed in October and November, have not been maintained. Silkstones are now at 9s. 6d. to 11s. per ton; Barnsley House, 8s. 3d. to 9s. 3d. per ton; second qualities from 7s. 9d. per ton. To the Humber ports a large weight of steam coal is sent, but as the output of this class of fuel is continually increasing the prices are weaker, and are not likely, at this period of the season, to advance. Barnsley hards are now supplied at 7s. 6d. to 8s. 3d. per ton, other qualities from 7s. 6d. Gas coal is being briskly delivered on account of contracts, but sales made in the open market are unusually light, the prices obtained in the latter instances being from 7s. to 8s. per ton. Manufacturing fuel is in diminishing request, with the result that stocks accumulate and values do not vary much from 3s. 6d. to 5s. 6d. per ton. For coke, 9s. to 11s. per ton is being obtained; business quiet.

The directors of the Roundwood Colliery Company have just issued their fifth annual report, which shows a loss on the year's working of £235 0s. 5d. Deducting the balance of £10 9s., brought forward from last year, the balance to carry forward to this year is £222 11s. 5d.

In the iron market there is no improvement to be noted. The low price of material prevails all round. The fall in hematites of 1s. per ton, which has been already noted, still continues. West Coast brands are now quoted at 52s.; North-east Coast brands at 50s. per ton, delivered in Sheffield. Lincolnshire iron, which is very depressed, stands at 38s.; Bessemer billets, £5 7s. 6d.; bar rods, £5 5s. per ton at manufacturers' works. A little improvement is reported in the demand for the shipbuilding yards. Freights are getting somewhat firmer, and if the stiffening tendency continues, there is certain to be some new ships given out. Marine specialities, such as boiler flues, &c., are again being actively called for by shipbuilders.

In the heavy steel departments there is a satisfactory amount of work doing, all the hammers and presses in the great establishments of Attercliffe and Brightside being now fully employed.

Orders for stores have been placed well during the last fortnight by several of our large railway companies. These are usually followed by more important contracts for railway material. As yet Birmingham has alone benefited by the development that is going on in India; but if it continues, as is expected, the Sheffield firms are certain to reap the advantage before long. The makers of wheels, tires, axles, springs, and buffers are doing fair work, with every expectation of increased pressure later on.

As the season progresses the trade in specialities for Christmas and the New Year gets increasingly brisker. All our leading establishments in the lighter staple trades are now working full time, and many of them extra time. The demand is mainly for the novelties which are most popular for presentations and friendly offerings. The wet season has told somewhat against business at the seaside and other watering-places, but this may be compensated for, in some extent, by the open winter, which, if continued, will encourage landlords of hotels and hydropathic institutions to replenish their stocks. A rather better order has been received from Ireland, the unfailing index of trade there being that while political questions, particularly *the* political question, which disturbs the country are to the front business gets weak, and while politics are little heard of it revives. The Scotch trade has been fairly good through the season, particularly in the West Coast and central districts.

A season trade of exceptional importance now is the manufacture of presentation cups, shields, trophies, vases, and all the other various forms in which prizes and competitions in cricket, football, golf, tennis, &c., are required. The steady drift of the silver trade to the Sheffield district has caused this department to receive exceptional attention of late, and many most artistic designs have been produced for these purposes. A considerable number of artists are now employed on these specialities, and the extraordinary popularity of football and golf has added quite an important branch to the silver, plating, and cutlery trades, chiefly to the former.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

MANUFACTURERS generally in this district speak very despondently about business. They are getting few orders to take the places of those they complete. and have no reason to look for any brisker state of affairs—at least, until the winter is over. They have, as a rule, reduced their prices in most departments until they yield no profits, and in many cases they do not cover cost of production; yet consumers are even loth to pay them, and seem to think that they will be still lower. They have, therefore, not enough confidence to buy for forward delivery, and confine their purchases to small lots for prompt delivery. It must be confessed that the tendency of prices is rather downward than upward for nearly all manufactured iron and steel products, and the pressure to sell is considerable, because producers have difficulty in finding anything like regular work for their men, and at most places a portion of the plant is laid off altogether.

Some of the steel manufacturers do not realise any profit on the steel they produce, and state that all the profit they do get is from the slag which they produce when making basic steel. This they can readily dispose of to those who crush it up and sell it for manurial purposes. A large quantity is shipped from this district to Germany, where it is used as a manure by the growers of beetroot. This utilisation of what was formerly a waste product enables the steel manufacturers to keep their establishments going without loss, where otherwise they would not be able to continue operations. This year over 58,000 tons of basic slag manure have been shipped over sea from the Tees, and the quantity consumed at home is increasing rapidly, as its peculiarities and suitability for various lands are becoming better understood.

Heavy steel rails are quoted as low as £3 12s. 6d. net per ton at works; but no very important orders are offered, and there is keen competition when quotations are asked. Ship plates can be bought at £4 15s., less 2½ f.o.t., and the buyer can have his choice whether he will have them of iron or steel, though the producer would prefer him to take the latter, because they cost less than the iron to manufacture. Some little business is said to have been done as low as £4 12s. 6d.. less 2½ f.o.t.; but even that does not meet the views of some consumers. Iron and steel angles are also about the same figure—£4 12s. 6d., less 2½ f.o.t.—and relatively a better price is obtained for them than for plates, as the cost of production is less; but the competition in this department is not so keen as it is in plates. Common iron bars continue at £4 17s. 6d., less 2½ f.o.t.

The exports of pig iron this month are unexpectedly heavy, but that does not in any way add to the strength of the market; indeed, it has failed to prevent a further fall in the price of No. 3. Usually in November the exports are greatly curtailed, as nominally the navigation season proper is over, but occasionally when the weather is favourable, as it is this month, large quantities are shipped, more especially after October has been a bad period for delivering iron abroad, and in one November upwards of 100,000 tons of pig iron were shipped from the Tees, almost the largest quantity ever reported in any month. This month's shipments up to Wednesday night from the Tees were 59,418 tons, as compared with 54,735 tons last month, and 46,021 tons in November last year to 21st. It is probable that under these circumstances the stocks, which have in every month since June shown an increase, will this month exhibit a decrease, just reversing what ought to be the experience. In Connal's warrant stores on Wednesday, 89,078 tons of Cleveland pig iron were held, or 447 tons increase this month.

Though such good pig iron shipments have been recorded, and they are chiefly of No. 3 Cleveland G.M.B., and though this quality is undoubtedly very scarce, yet lower prices have this week been accepted—35s. 7½d. per ton for prompt f.o.b. delivery, and 35s. 9d. for the first quarter of next year, some makers taking this as they think it unlikely that there will be a rise before the spring, seeing that the dullest period of the year will have to be passed through, and the prospects of the consuming industries are not encouraging. Cleveland warrants are quoted 35s. 5d. cash, but business in them, as in all other warrants, is lifeless, because speculators have not confidence enough to risk their money in them, and place it where it is safe, though bringing in next to no interest. No. 4 Cleveland pig iron is sold at 34s. 9d., and grey forge is readily got at 33s. 9d., and some business is reported at 33s. 7½d. Better prices will be secured for white iron if steel makers follow the example of Messrs. Dorman, Long, and Co.; at present very little white is made, and little is in stock, but if a demand for the quality arose, pig iron makers would specially burden some of their furnaces for it. The hematite pig iron trade is very unsatisfactory, as make continues in excess of consumption, and stocks increase, as they have been doing for some months, and yet no move is made to reduce the output. Producers complain of the low and unremunerative prices, but nothing more can be expected when there is an excess of iron turned out.

The situation for makers of hematite is not good, for while their selling price declines, their cost of production does not; in fact, foreign ore is dearer than it was last month, and most of the merchants are quoting 12s. 1½d. per ton delivered Tees for good Rubio over next quarter. Very large quantities have recently been received; in fact, on Monday over 15,000 tons arrived. Coke is no cheaper, the combination of coke manufacturers providing against this, and they have no difficulty in maintaining their rates when no reduction in the consumption is made. Mixed numbers of East Coast hematite pig iron have been sold this week regularly at 42s. 9d. per ton.

Cleveland long had the reputation of producing the cheapest pig iron in the world. A short time ago Mr: Jeremiah Head, who was on a professional visit to the United States, informed the ironmasters of the North of England that in Alabama pig iron was being made at a cost several shillings below the figures reported in Cleveland. It was costing 23s. to 24s. per ton, and was sold at works at from 26s. to 27s. per ton, whereas the selling price of Cleveland No. 3 was 36s. The British ironmasters were not inclined to believe this statement, but it has been fully confirmed by one of the managers in the district referred to, who offers to deliver his No. 3 at Pensacola, f.o.b., at 30s., and his grey forge at 29s. per ton. Pensacola is the nearest port to Birmingham, Ala., but is 260 miles away. It is stated that the ore only costs 3s. per ton delivered, and requires no lime, while it contains 38 per cent. of metallic iron. The coke costs 7s. 6d. per ton at the furnaces, and labour is cheap. The cost of materials is thus considerably below what it is in Cleveland. Mr. Bowron, the manager referred to remarks that they are prepared so far as pig iron is concerned, and also steam coal, to compete with English producers at any points where they can obtain equally favourable rates of freight for the use of marine tonnage. This condition of affairs is not due either to the existence of Free Trade or to its near approach, but is due to the favourable natural conditions pointed out by Sir Lowthian Bell twenty years ago, and carefully examined into by Mr. Bowron's father and Mr. Thomas Whitwell. Mr. Bowron is a native of Stockton-on-Tees, and was connected with the iron trade there before he went to Alabama twenty years ago.

The death took place last Friday of Mr. Tnomas Siddell, one of the oldest employés of the Consett Iron Co. He was 78 years of age. From an ordinary workman he rose to be manager of the puddling department when puddling was in the height of its prosperity, and since he has been manager of a portion of the establishment known as the Tin Mill Works. Mr. Siddell was one of the representatives of the Consett Iron Co. on the Board of Conciliation and Arbitration for the Manufactured Iron and Steel Trades of the North of England, and Mr. W. Whitwell, the president of that organisation, as well as several oi the employer and operative representatives, attended the funeral.

The quantity of ore exported from the Gellivara iron ore mines in Sweden this year has amounted to 523,000 tons, against 259,826 tons in 1893, and 138,943 tons in 1892. This ore is sent to Germany, Belgium, and the North of England. It is shipped from Lulea, and the shipping season lasts from May to the end of October.

It has been mentioned several times in these columns that the commercial men of Sunderland were agitating for better railway station accommodation. It was in June of last year that a deputation from the Town Council waited upon the directors of the North-Eastern Railway Company. Since then the subject has been frequently under the consideration of the directors, but the difficulties which would have to be encountered in making any material alterations in the arrangements at the station have prevented a satisfactory scheme being devised. A special committee of the directors has now been appointed to give further consideration to the question. The West Hartlepool Railway station is to be enlarged, and arrangements made so that the through traffic can be worked on an independent cut line.

A new railway is proposed through the dales of West Yorkshire; it is practically a resuscitation of the scheme promoted nine or ten years ago in an amended form. The line is intended to form a junction with the Midland at Hellifield, and will pass through Kettlewell, Middleham, Caverham, Leyburn, Richmond to Darlington, where a junction will be formed with the North-Eastern Railway. Powers are to be sought to utilise the Bank Top station there.

The patternmakers' strike which has existed in the North of England since last May still continues, the men claiming 3s. 6d. per week advance in wages. A conference of masters and men was held at Newcastle on Monday, but nothing was definitely settled.

A marine, electrical, and engineering exhibition was on Tuesday opened at Sunderland by the Mayor, and is to remain open for two months. There are over 300 exhibitors. Part of the proceeds of the Exhibition will be given to the Sunderland Infirmary.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been comparatively steady. Whatever changes occurred has been rather in an easier direction. The amount of business done has been limited. Little speculative feeling exists in the market at present. Scotch warrants have sold from 42s. 6½d. to 42s. 5d. cash, the demand being comparatively poor. Cleveland iron is quiet, warrants being worth about 35s. 6d. cash. Hematites are dull at 43s. 4d. for Cumberland, and 42s. 3d. for Middlesbrough warrants.

A fair demand exists for the special brands of maker's iron. The cheaper qualities have about maintained their value, but the principal brands are 6d. per ton cheaper. G.M.B. f.o.b. at Glasgow, No. 1, is quoted 44s. per ton; No. 3, 42s. 6d.; Monkland, No. 1, 45s. 6d.; No. 3, 42s. 6d.; Carnbroe, No. 1, 47s.; No. 3, 44s. 6d.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie and Calder, No. 1, 52s.; No. 3, 48s.; Summerlee, No. 1, 53s.; No. 3, 48s.; Coltness, No. 1, 55s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 52s.; No. 3, 48s.; Eglinton, No. 1, 48s.; No. 3, 45s. 6d.; Dalmellington at Ayr, No. 1, 48s.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 56s.; No. 3, 50s. 6d.

There are 46 furnaces producing ordinary and 20 hematite pig iron, the total of 66, comparing with 54 at this time last year. Two furnaces have been transformed from ordinary to hematite, the latter being in better demand for steel making purposes. The manufacture of basic iron is still suspended.

The shipments of pig iron from Scottish ports in the past week have been 7712 tons, compared with 5606 tons in the corresponding week of last year. There was sent to the United States 110 tons; South America, 245; India, 550; Australia, 580; Italy, 525; Germany, 320; Holland, 550; Belgium, 50; Spain, 66; China and Japan, 268; other countries, 685; the coastwise shipments being 3793 tons against 1166 tons in the same week of 1893. The foreign demand is small; but the season of the year is unfavourable for an expansion of the export business.

The finished iron and steel trades are without material alteration. Business in manufactured iron has been improving slowly, and the demand for steel is also on the increase, but prices in both cases are deemed unsatisfactory.

The shipbuilding trade is fairly employed. A number of fresh orders are reported, among these being two steamships of about 4500 tons each, to be built for a Spanish firm by Messrs. Charles Connel and Company, Whiteinch. The vessels will be fitted with triple-expansion engines, the order for which has been placed with Messrs. Dunsmuir and Jackson, Govan. Two swift steamers are also to be built for the Caledonian service on the Firth of Clyde, to be ready for next tourist season.

The exports of manufactured iron and steel from Glasgow in the past week embraced sewing machines worth £1183, locomotives £545, other machinery £31,750, steel goods £12,100, and general iron manufactures £24,360.

There is a rather easier feeling in the coal trade. The demand has now been fully overtaken by the output of the collieries, with the result that prices have been easing off. The coal shipments in the past week amounted 147,970 tons, compared with 151,397 in the preceding week. There was a large falling off at Grangemouth. The demand for the Baltic is now practically ceased for the season. A little more business is being done with Ireland. Household coals move off slowly for home consumption.

The miners' delegates are endeavouring to get up a fresh agitation in favour of an advance. At a conference in Glasgow a few days ago they adopted a resolution in support of 6d. per day advance, and deputations are now being sent to employers to make this demand. The men can have little hope of success, especially as prices are rather going back at present.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE weather has continued to tell adversely against the coal trade, for if a fine day or two is experienced, allowing tonnage to come in, and sidings relieved, it has been followed by gales that have again caused prices to droop. On the whole there is a firmer tone in prices of best steam coal than existed last week. Prices, which appeared to be settling down into 11s. for best, have gone up 3d. to 6d., and the latest quotations for this week are 11s. to 11s. 6d for best, with a slight improvement in all kinds. Thus, midweek, at Cardiff, seconds were quoted at 10s. 3d. to 10s. 6d., best Monmouthshire the same; best small, 5s. to 5s. 3d.

For best house coal prices are firm and demand improving. Cardiff prices this week are:—Best house, 10s. 9d. to 11s.; No. 3 Rhondda, 10s.; brush. 8s. 3d.; small, 6s. 6d.; No. 2 Rhondda, 8s. 3d.; through, 6s. 3d.; small, 4s. 3d. to 4s. 6d.

Similarly at Swansea and other ports, the weather has produced a great change in the prosperous condition of things. The total import and export trade of Swansea last week was only 39,851 tons, as compared with 42,104 tons the previous week, and 52,927 tons the corresponding week last year. A few items will show the falling-off. In coal, for instance, the export was limited to 21,651 tons; patent fuel, which has touched 10,000 tons and even more, 890 tons; and tin-plates and general goods, 6911 tons. The shipments of tin-plates alone were 47,382 boxes, while there was received from works nearly double—83,739 boxes.

Two good points may be noted in Swansea Harbour trade. Thus 5000 tons of Spanish ore came in last week, and for this and next week seven sailing ships will go out with anthracite coal to San Francisco. Total tonnage, 12,825 tons.

Competitive works in the North of England and Scotland continue to send into Wales large quantities of pig iron. Middlesbrough, Barrow, and Millom, figure amongst the largest.

Patent fuel shares the fortunes of coal, and is only in moderate demand, 10s. 6d. to 11s. Cardiff, and 10s. to 11s. Swansea. Coke prices remain the same Swansea and Cardiff, and not much improvement is expected until the iron and steel trades improve. Of this the signs are very faint. Quotations, Swansea Exchange, mid-week, are little altered from those of last week. Glasgow pig warrants are at 42s. 6½d.; Middlesbrough, No. 3, 35s. 6d. prompt. Welsh bars, £5 2s. 6d. Rails, heavy, from £3 15s.; light, from £4 7s. 6d. Sheet was £6 to £6 10s. Steel sheets, £6 5s. to £6 10s. Bessemer steel bars, £4 to £4 2s. 6d. Siemens, £4 to £4 2s. 6d., all delivered in district; cash less 2½. Rail prices 2s. 6d. easier at Cardiff.

Tin-plate remains in only moderate demand at last prices. Bessemer cokes are quoted at 10s. to 10s. 3d.; Siemens coke finish, 10s. 3d. to 10s. 6d.; ternes per double box, 28 by 20 c., 20s. to 24s.; best charcoal, 11s. 6d. to 12s. 6d., according to finish of brand; wasters, 6d. to 1s. less than primes; odd sizes, usual extras.

Copper and block tin are receding in price.

Pitwood commands, perhaps, the most notice of the week. In part owing to the stormy weather and the limited quantity on hand at Spanish and French ports, the great accumulations in Cardiff have been nearly cleared off, and for some days there was quite a timber famine, and prices advanced from 15s. to 22s. per ton. Midweek things are getting easier, and with the arrival of cargoes the late quotations of fifteen shillings will, I believe, be resumed.

It is much to be feared that a crisis of no ordinary magnitude is approaching in the tin-plate industry of Wales. So far action is disjointed, and if ominous news comes from one district tidings of better import reaches from another. Still, the fear is that as we near the end of the year, to the close of which amicable arrangement in a few quarters extend, the great body of the plate workmen may be brought into accord, and a wage conflict ensue, which, unless a great change takes place in the condition of things, can have but one ending, and that a disastrous one.

This week a conference of owners and men was arranged at Llanelly, and the attendance was a large one, but when it was announced by two leading representatives of the men that no reduction of wages would be allowed, the employers at once arose and left the meeting. The forecast is a gloomy one.

Abercarn Tin-plate Works will be brought to the hammer this week consequent upon the death of Mr. Whitehouse, J.P.

I see that the new form Siemens' steel ingot heating furnaces has been adopted by the Cwmpelin Tin-plate Company, which has two, and the Copper Miners' Tin-plate Company has two, and now the Albion Steel Company at Briton Ferry is building two on the same plan. In the Newport district I must also note that J. J. Cordes and Co., of Newport, and the firm of Tinn and Co., of Pontnewynydd, are building furnaces of this new type for heating and welding iron piles.

In the Cyfarthfa district the new industry, the brick-making, is assuming large proportions, and the coke ovens will soon, to all appearances, enable the able manager to meet the fullest demands, for I hope to announce, the requirements of a large bar trade. There is a steady make at present, and the circle of buyers appears to be widening.

I referred last week to the certainty of important Bills from Wales being brought forward for next session, and am now enabled to confirm it.

Rhymney will apply for powers to construct a railway from Ystrad Mynach Station to Gellygaer Common. Also for power to abandon the construction of railways authorised by the Rhymney Act of 1888. Parliament also will be asked to sanction the creation and issue, in substitution of the ordinary stock of the company, other stock of such nominal amounts as the company think fit or the Act may prescribe. A large majority of the shareholders, I learn, are in favour of the division of stock.

The Barry Company notify its intention to apply for powers to construct a line from Pontypridd, along the Taff Valley, and into the Rhymney Valley, where it is proposed to form a junction with the Rhymney Railway near Bargoed Station. A branch will connect the line with the Brecon and Merthyr Railway, near Gilfach. In the event of the Barry securing powers, it will give connection with the North-Western, Great Western, and Brecon and Merthyr systems. The same company also applies for power to make a short line from the existing Barry line up the Rhondda Valley as far as the Cymmer Colliery.

Notices have been issued by the Great Western, Taff Vale, Rhymney, and other railways, of opposition to the Bute Docks Bill. The present arrangement is that the railways in question are under obligation to convey traffic over the Bute lines to the staiths and sidings, for which it is stated they receive no payment. The Bill now being prepared by the opposition aims to secure relief from this by the payment for services, the same to be settled by arbitration.

The Vale of Glamorgan Railway Company will apply for powers to make certain deviations and to extend the time for compulsory purchase of land, &c.

The Rhondda and Swansey Bay will seek powers to construct certain short railways at Swansea, Neath, and Briton Ferry, &c. Altogether a busy time is forecast and a keen contest is almost assured.

I regret to announce the death of Mr. E. H. Watts, of Newport. He was a member of the firm of Watts, Ward, and Co., and one of the largest coal-exporting firms in the country, having branches at London, Cardiff, Newport, Newcastle-on-Tyne, Blyth, and several foreign stations. He was a member of the Newport County Council, and also a prominent figure in the social and intellectual life of Newport.

Pontypool is preparing to apply to the Board of Works for a provisional order to supply the electric light in the district.

The Cardiff electric lighting is now in operation, and extensions poration.

Rumours of a great colliery undertaking are rife in Cardiff, and are supposed to refer to the amalgamation of existing companies, but particulars are kept scrupulously private. A local authority, referring to the rumour, states that they do not refer to Locketts, which has been taken over by a syndicate at £200,000, or to the rumoured amalgamation of the Albion—Colfynydd—and the Universal, now being sunk at Aber, near Caerphilly, an adjoining coal property.

I shall refer next week to the Bute Dock Bill, which contains many interesting and important clauses. One clause is the enforcement of the use of the electric light upon all vessels coming in or going out, and in view of the periodic explosions on coal vessels, this is an excellent suggestion for legal enactment.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

IRON business is reported all round rather bad in this country. Only in exceptional cases are establishments at all busy, and this mainly upon work of a special character. A general holding back from placing out further orders has been noticeable in all branches, which is partly due to a prevalent expectation of a still further reduction in prices, and very little business has consequently been doing upon the week.

In Silesia a quiet or rather lifeless tone characterises the iron trade. The blast furnace works are on the whole poorly employed, and very little pig iron has been sold of late, so that an increase in stocks is reported from several parts. Demand for the different sorts of malleable iron is also but small. Buyers do not come forward with their orders until at the very last moment, and then only purchase what is actually required. Under these circumstances business in iron and steel cannot be otherwise than extremely unsatisfactory for both producers and consumers. Whether the proposed Silesian rolling mill convention will be formed remains to be seen; for the present the parties concerned have not come to an agreement. Prices are reported to have not altered, but are in fact anything but firm.

Austro-Hungarian iron business, though not particularly brisk, has, on the whole, been quite satisfactory, the different branches of the iron and steel trade remaining in sufficient employment. Pig iron is still scarce, and large lots come in from foreign markets. Manufactured iron shows a firm tendency, bars and plates being rather briskly called for, and even girders have been in somewhat better request, owing to a fair activity that is still to be perceived in the building line. The railway and engineering department is poorly employed generally. There is a good retail business doing in hardware, and an increase is noticeable against last year. Although the state of the iron industry in France is rather unsettled for the present, there is, nevertheless, a very confident tone prevailing among ironmasters in general. A good activity is noticeable at the works, but, as stocks are still rather large, an improvement in prices cannot, as yet, be ventured upon, and in a number of cases makers even had to go down a few francs, especially for bars and sectional iron. The proposed forming of a syndicate for plates has made no further progress, as some of the larger mill owners cannot make up their minds to join the convention.

Though a little more life is undoubtedly manifested in most branches of the Belgian iron trade generally, the improvement is progressing but slowly, and there are still some departments where orders are very scarce and activity insufficient. Prices have been tolerably well maintained in most instances, although, of course, makers are still in the habit of under quoting each other whereever a contract of some weight is offering. Finished iron makers, especially, have to submit to reductions pretty frequently. The price which Belgian works realised at a late tendering for rails was 119·90f. p.t. Import in pig iron to Belgium has this year been uncommonly brisk, Germany, Luxemburg, and North France having thrown large quantities of iron on the Belgian market. During the first nine months of the year import in pig iron was:—

| | 1894.<br>Kilos. | 1893.<br>Kilos. | 1892.<br>Kilos. |
|---|---|---|---|
| | 170,482,460 | 99,471,928 | 108,815,094 |
| From Germany | 32,328,921 | 26,175,634 | 28,329,815 |
| „ Luxemburg | 42,965,610 | 3,478,660 | 979 |
| „ France | 54,875,437 | 34,356,965 | 38,228,065 |

The aspect which the Rhenish-Westphalian iron industry continues to present is unfavourable in the extreme. As makers are not the least anxious to buy for forward delivery, and hold back with their orders as much as possible, the iron market is in a state of stagnation almost, the hand-to-mouth sort of business that is done being insufficient to keep the works in constant employment; while competition prevents a rising in quotations. In pig iron a fair amount of orders has been secured by the Siegerland blast furnace works, and pretty large lots are sent abroad. All sorts of malleable iron remain in very quiet demand, as home consumption is extremely limited, while there is next to no inquiry experienced on foreign account. Girders and also bars are to be bought at prices considerably below list rates, whereas hoops remain in fairly satisfactory demand, consumers being ready enough to buy at the low prices which are ruling at present. Orders for sheets continue to come in very scantily. All sorts of wire and wire nails as well as rivets are depressed. A poor activity is reported at the foundries and machine factories, while the locomotive shops are tolerably well employed, and hope to remain so for the next months, as there are orders for 340 locomotives and 1000 freight cars to be given out by the Government. The Erfurt Railway Administration recently invited tenders for the supply of fish-plates, and the prices asked ranged between M. 110, M. 125, and M. 135·50 p.t. at works.

It has been statistically stated that during the first three quarters of 1894 output of pit coal in Prussia was 52,008,870 t., against 49,668,001 t. in the year before; consumption was 50,281,751 t., against 47,867,922 t. for the same period last year. The number of men employed was 266,348, against 257,128 in the previous year. The production of brown coal during the first three quarters of present year amounted to 16,626,905 t., against 12,721,529 t. in 1893, while consumption was 9,993,619 t., against 10,315,469 t. for the corresponding period of last year; the number of mem employed was 28,576 this year, against 29,519 in last year. Total output of coal in the Ruhr district was, for the first ten months of present year, 28,496,250 t., against 26,716,220 t. for the same period the year before; in the Saar district production was 4,262,310 t., against 3,747,160 t. last year, and in Upper Silesia 9,869,270 t., against 9,801,190 t. in the preceding year. In the three districts together 42,627,830 t. were produced within the first ten months of present year, against 40,264,570 t. for the same period last year, which shows for the Rhenish-Westphalian district an increase of 1,780,030 t. or 6·7 p.c., for the Saar district 515,150 t. or 13·7 p.c., for Upper Silesia 69,080 t. or 0·7 p.c., and for the three districts together an increase of 2,364,260 t. or 5·6 p.c. against the corresponding period in 1893.

## AMERICAN NOTES.

NEW YORK, Nov. 16th, 1894.

THE American iron markets are quiet, and very little inquiry is made concerning winter deliveries. Production is sufficiently heavy in all branches to insure a continuance of present quotations. Girder rails are in good request at 23 dols. to 25 dols.; standard rails at 24 dols. Large orders for 100 lb. rails will soon be placed in the Pennsylvania Rail Mills. Pig iron is quiet. Southern is freely offered here at 10 dols. to 10·25 dols. Bessemer is dull. Steel billets are quiet. Merchant bar mills are short of orders in Eastern Pennysivania, but the Pittsburgh district is well supplied with orders for all kinds of material except steel rails. Prospects are more favourable for large winter delivery orders, especially for billets, skelp, bars, rods, and track supplies. The crushing condemnation of the economic policy of the present Administration has imparted a buoyancy to the trade that will soon be felt in better markets.

THE new Russian ironclads Rostislav and Rossia, building respectively at Nicolaieff and at the Baltic Yard on the Neva, are to be supplied with furnaces suitable for the combustion of petroleum. If experiments with them be successful, similar furnaces will be supplied to other new vessels.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*7th November*, 1894.

1,433. Lamps, J. S. Done and R. B. Done, Birmingham.
21,434. Manipulation of Skylights, &c., T. Moy, London.
21,435. Soup Spoon, F. W. Brearey, London.
21,436. Chemical Pipe Cleaner, T. D. Patmore, London.
21,437. Pneumatic Tires, W. T. Robbins, London.
21,438. Bending Annular Plates, C. E. Henroid-Baehni, London.
21,439. Electrical Sewer Ventilators, E. M. Lacey, London.
21,440. Appliance for Testing Yeast, A. Cecetka, London.
21,441. Petroleum Blocks, R. Denormandie and H. Hennebutte, London.
21,442. Apparatus for Syringing, &c, F. Jourdes, London.
21,443 Brushes, H. N. Baux and L. J. Glaenzer, London.
21,444. Hooks and Eyes for Clothing, J. C. Newey, London.
21,445. Bottle Labelling Machine, E. Schwickert, London.
21,446. Electric Meters, C. J. Barley, London.
21,447. Alkaline Salts, J. Y. Johnson.—(*N. Bassett and W. de Baranoff, France.*)
21,448. Teapots, W. B. Michaelsen, J. H. Rohlwink, J. Schröder, and G. A Lulmann, London.
21,449. Axle-boxes, S. Fox, London.
21,450. Water Elevators, A. J. Welcker and J. Allen, London.
21,451. Combined Spool and Needle-case, E. Greenfield, London.
21,452. Electric Fire-alarms, P. R. J. Willis.—(*L A. and C. L. Werner, United States.*)
21,453. Reflectors for Pianos, L. Kilner, London.
21,454. Construction of Clamps, H. de Haven and J. E. McMurray, London.
21,455. Shields for Steam Water Gauges, R. T. Preston, London.
21,456. Heating and Purifying Water, W. H. Blackeney, London.
21,457. Device for Ladies' Muffs, W. Hazlitt, London.
21,458. Doublet Lenses, C. P. Goerz and E. von Höegh, London.
21,459. Coulters, W. H. Sleep and R. H. Sleep, London.
21,460. Wheels, S. E. Saunders, London.
21,461. Electric Motors, C. Riordon, London.
21,462. Mounting Bicycle Wheels, P. Amjörn, London.

*8th November*, 1894.

21,463. Emptying Vessels Containing Treacle, J. S. Green, F. R. Syms, and W. Adams, London.
21,464. Lighting Hydrocarbon Lamps, R. H. Cotter, Co. Limerick.
21,465. Leverage Gearing, G. P. Bartlett, London.
21.466. Adjustable Watch Keys, J. Vale, Birmingham.
21,467. Stop-cock with Draining Outlet, J. F. Whiteside, Lancashire.
21,468. Blacking Bottle and Applier, G. C. Lake, Leamington Spa.
21,469. Combined Lawn Mower, &c , W. J. Stephenson-Peach, Derby.
21,470. Oil Lamps, J. Paul, Glasgow.
21 471. Securing Nuts to Screwed Bolts, W. Harrington, Kidderminster.
21,472. Construction of Portmanteaus, &c., W. P. Cochrane, Newcastle-on-Tyne.
21,473. Key-board of Type-writer, F. and A. Besson, London.
21,474. Support for Infants' Cribs, M. L. Barlow, London.
21,475. Golf Clubs, R. Simpson, Dundee.
21,476. Means of Sanitation, M. E. Melsom, London.
21,477. Acid-resisting Lining for Metallic Vessels, R. Preston and T. Thornley, Manchester.
21,478. Seats of Tramcars, S. Newton, Manchester.
21,479. Milk Measurer and Tester, T. Bevington, Bristol.
21,480. Postcard Advertising Box, T. G. Scott, Liverpool.
21,481. Printing Colours, W. I. Iliffe, J. J. H. Sturmey, and J. Ward, Leicester.
21,482. Apparatus for Ships' Telegraphs, E. Fletcher, Liverpool.
21,483. Lubricant, J. W. Glover and T. Bagnall, Kidderminster.
21,484. Warning Apparatus for Cycles, J. Speir, Glasgow.
21,485. Shuttle Guards, D. and J. H. Pilkington, Rochdale.
21,486. Pearl Button with Inlaid Small Glass Mirrors, W. Frese, Berlin.
21,487. Tires for Road Vehicles, F. B. Biddiscombe, Manchester.
21,488. Bicycles, C. E. Bell, Manchester.
21,489. Railway Track System, E. Deming, Manchester.
21,490. Boots and Shoes, J. Dick, Glasgow.
21,491. Looms for Weaving, The Anderston Foundry Company, Ld., and J. Reeves, Glasgow.
21,492. Cans, R. Read, A. Read, and W. A. Read, Liverpool.
21,493. Cutting the Teeth of Bevel Wheels, J. H. Gibson, Liverpool.
21,494. Joint for Drain and other Purposes, T. E. Coleman, Hampshire.
21,495. Fire-proof Lath for Building Purposes, T. E. Coleman, Hampshire.
21,496. Portiere Rods for Curtains, E. Ward, Southampton.
21,497. Cycle Saddle Elevator, H. Larkings, Warwick.
21,498. Signalling Apparatus, S. R. Kirby and G. W. England, York.
21,499. Making Fishing-rods, E. Perks, Birmingham.
21,500. Draw-bar Attachment, W. Graham, Whitehaven.
21,501. Hair-curling Tongs, L. Myers, Birmingham.
21.502. Manufacture of Churns, H. W. Ludlow, Birmingham.
21,503. Axle Box with Rollers, W. G. H. Sedwell, London.
21,504. Construction of Drums, A. Grey, London.
21,505. Water Bottle, A. E. Wardroper, London.
21,506. Metallic Ends of Lathes, W. Walmsley, London.
21,507. Seamless Steel Tubes, R. Wootton, Birmingham.
21,508. Construction of Ellipsographs, T. Moy, London.
21,509. Apparatus for Ice-making, A. Glasson, London.
21,510. Fog-signalling on Railways, H. A. L. Barry, London.
21,511. Adjustable Wire Gauge, H. V. James, Manchester.
21 512. Grates, E. Scanlan, F. W. Keifel, jun., and J. Zipp, London.
21,513. Dealing with Smoke, F. W. Stevenson, London.
21,514. Draught Excluder for Doors, H. C. Evans, London.
21,515. Files for Letters, C. Durey, London.
21 516. Loom Shuttle Checking Apparatus, J. Woods, London.
21,517. Projectiles, A. Reynolds, London.
21,518. Scaffolds for Buildings, H. Drimer, London.
21,519. Treatment of Wastes, T. H. Cobley and D Scott, London.
21,520. Waste for Papier-mache, T. H. Cobley and D. Scott, London.
21,521. Filtering Appliance for Tobacco Pipes, A. G. Goodes, London.
21,522. Boxes for Storing Parasols, T. H. Simmonds, London.
21,523. Pneumatic Tires, J. Dring, London.
21,524. Thrust Block, S. Pethers, London.
21,525. Paving and Flooring Block, T. H Lewis, London.
21,526. Shelling Eggs, H. Owen, London.
21,527. Apparatus for Cooling Acids, F. W. Berk, London.
21,528. Feed Gear for Ratchet Braces, E. O. Seale, London.
21,529. Production of Vinegar, E. Andreoli, London.
21,530. Doors, A. Sinclair, London.
21,531. Electric Sash Balance, W. C. Hodgkins, London.
21,532. Converting Reciprocating in Rotary Motion, T. Beach, London.
21,533. Production of Curved Printing Plates, A Sauvée, Liverpool.
21,534. Forging Wrought Metal, W. P. Thompson.—(*J. B. West, United States*)
21,535. Aprons, A. W. Hancock and J. Leighton, London.
21,536. Roller Bearings, The Steel Forging and Ball Bearing Company and P. Holyoake, London.
21,537. Mechanical Kneeding Troughs, C. Somasco, London.
21,538. Bottle-cleaning Machines, T. Prioux, London.
21,539. Adjusting Sheets of Paper, H. H. Lake.—(*T. C. Dexter and J. C. Willett, United States*)
21,540. Mechanical Milking Cans, C. G. P. D. Laval, London.
21,541. Ships, S. H. M. Killik and A. Elgar, London.
21,542. Steam Generator, Simpson, Strickland and Co. and F. Strickland, London.
21,543. Water-closets, E. E. Lefevre, London.
21,544. Rotary Paper-cutting Machines, G. Heerbrandt, London.
21,545. Pneumatic Tire, W. Mackintosh, London.
21,546. A Puzzle, B. A. Spaull, London.
21,547. Machine for Bevelling, W. Bridgewater, Leicester.
21,548. Supports for Club Carriers, J. W. Price, London.
21,549. Electrically Heated Robes, H. G. O'Neil and E. Jewell, London.
21,550. Tanning, J. Y. Johnson.—(*F. Kornacher and Diesel and Weise, Germany.*)
21,551. Combined Type-writing Case and Table, F. C. Wood, Philadelphia.
21,522. Water-pressure Feeder, T. B. Smith, Philadelphia.

*9th November*, 1894.

21,553. Cycle Clips, The Roulette Cycle Company and H. Cook, Coventry.
21,554. Velocipedes, F. Ellis, London.
21,555. Secondary Batteries, I. A. Timmis, London.
21,556. Mooring Pipes, J. W. Sampson and T. L. Mitchelmore, Southampton.
21,557. Purifying Chemical Bye-products, A. Walker, Blackburn.
21,558. Adding Machines, G. Browning, Manchester.
21,559. Attachment to Saucers, M. Goffey, Liverpool.
21,560. Laundry Gloves, J. A. Fox and G. J. Moulton, Manchester.
21,561. Tool Holder for Lathes, T. W. Haddon, Birmingham.
21,562. Cheque Value Indicator, W. Triggs, Preston.
21,563. Billiard Marking Board, E. Kaltenach, Wigan.
21,564. Loom Shuttles, J. Riley, Bradford.
21,565. Cast Metallic Chain, E. F. H. Barnsley, Birmingham.
21,566. Valve or Clack Seating for Pumps, B. E. Goddard, Newcastle, Staffs.
21,567. Tire Covers, W. H. Cresswell, H. E. Cohen, and A. W. Latimer, Cheshire.
21,568. Round Tin Frame, J. Harvey, Cornwall.
21,569. Address Cards, E. H. Godbold and F. Westwood, Birmingham.
21,570. Washers for Bolts, W. E. Heys.—(*C. Bristow, New Zealand.*)
21,571. Steam Traps, W. Geipel, London.
21,572. Pneumatic Cycle Tires, A. T. Andrews, Birmingham.
21,573. Photographic Dark Slides, E. A. Whitby, London.
21,574. Gas Burners, C. B. Voisey, E. W. T. Richmond, and Richmond and Co., Liverpool.
21,575. An Automatic Arithmometer, O. A. Elias, London.
21,576. Heeling Machinery, W. H. Dorman, Stafford.
21,577. Washing Printers' Blanketing, W. Hadfield, J. J. Sumner, and H. Hadfield, Manchester.
21,578. Flexible Tubing or Hose, F. Reddaway, Manchester.
21,579. Safety Pins or Hooks, C. Crowther, Manchester.
21,580. Fixing Watertight Sheets, H. D. and J. A. Hope, London.
21,581. Starting of Gas Engines, E. A. Cunningham, Nailsworth, Glos.
21,582. Gas Globe Holder, S. H. Keeling and H. M. Picken, Birmingham.
21,583. Link Belting, J. D. Walton, Glasgow.
21,584. Engine Governors, J. Buchan, Glasgow.
21,585. Watch Guard, D. Fulton and J. Robertson, Lanarkshire.
21,586. Manufacture of Asphalt Blocks, M. Williams, Liverpool.
21,587. Hanging Window Sashes, H. Champness, Bishop's Stortford.
21,588. Sewing Thimbles, T. S. Greenway, Wolverhampton.
21,589. Pills, T. Tildesley, London.
21,590. Fencing, T. S. Greenway, Wolverhampton.
21,591. Mounting of Tinted Photographs, A. Findlow, London.
21,592. Printing Waterproof Fabrics, T. Birnbaum, London.
21,593. Bicycle Driving Apparatus, T. W. Stockhill, Hull.
21,594. Paper Coating Apparatus, A. W. Loveland, London.
21,595. Portiere Rods, G. H. Brown, Birmingham.
21,596. Cycle Lock, F. Hofmanrichter, London.
21,597. Clip for Composite Collars, E. B. Styring, Poole.
21,598. Apparatus for Shipping Coal, &c., J. P. Roe, London.
21,599. Appliances for Conveying Coal, J. P. Roe, London.
21,600. Almanac, G. Siller, London.
21,601. Ship Manœuvring Apparatus, W. S. Simpson, London.
21,602. Making Fishing Lines with Floats, F. P. Dobell, Isle of Wight.
21,603. Bread Tins, W. Hammill, W. A. Servant, A. J. Fish, and C. Mould, London.
21 604. Boxes for Tobacco and Snuff, G. H. Williamson, London.
21,605. Lamps for Burning Oil or Spirit, A. Kiesow, London.
21,606. Locking Nuts, T. C. Roussel, London.
21,607. Printing Textile Material, S. H. Sharp, London.
21,608. Construction of Wheels for Vehicles, R. Storey, London.
21,609. Portable Folding Game Tables, D. S. Grant, London.
21,610. Frames for Holding Pictures, H. C. Vinicombe, London.
21,611. Windows, T. M. Houghton, Glasgow.
21,612. Lacing Eye for Boots and Shoes, W. Brown, London.
21,613. Telephones, E. C. Parker, London.
21,614. Manufacture of Carpets, &c., J. S. Baxter, London.
21,615. Construction of Thermometers, J. B. Lee, London.
21,616. Boot Sewing Machines, J. Y. Johnson.—(*The Deutsch-Amerikanische Maschinen-Gesellschaft, Germany*)
21,617. Brake Blocks, G. T. Mackley, London.
21,618. Opening and Closing Joints, W. McCowan, Reading.
21,619. Ball Bearing, J. W. Howard, London.
21,620. Tooth-brush with Movable Back, L. Ehrlich, Berlin.
21,621. Lamp Chimneys, C. Günther, Berlin.
21,622 Fire Blower, R. W. McGregor and G. A. McDowall, London.
21,623. Stamps, H. Bernert, London.
21,624. Musical Apparatus, A. V. Tims and J. H. Holmes, London.
21,625. Appliances for Signalling at Sea, W. H. Owen, London.
21,626. Construction of Studs, &c., A J. B. Church, London.
21,627. Storm Lanterns, E. Sommerfeld, London.
21,628. Regenerative Gas Burner, J. Haeussler, London.
21,629. Electric Railways, L. Hanisch and the Hoerder Bergwerks and Hütten-Verein, London.
21,630. Electric Meters, H Leupold.—(*H. Leupold, Italy.*)
21,631. Drying Kilns, E. Orval, London.
21,632. Cycle Handle Bars and Forks, E. Verschave fils, London.
21,633. Evaporating Apparatus, H. H. Lake.—(*H. See, United States.*)
21,634. Clothes Washing Machine, F. G. Sherer, London.
21,635. Sewage Precipitation, W. E. Adeney and W. K. Parry, London.
21,636 Carriages for Lawn Mowers, W. P. Green, London.
21,637. Clip for Holding Papers, &c., B. F. Bryant, London.
21.638. Trawling Nets, A. Johnson and C. A. Nielsen, London.
21,639. Knitting Machines, W. F. Fair, London.
21,640. Electric Switches, G. J. Gurl, London.
21,641. Gear Cases for Velocipedes, P. Hunaeu London.
21,642. Mud Guards for Velocipedes, P. Hunaeus, London.
21,643. Corrugated Strip, C. J. Smart and F. Gwynne, London.
21,644. Corrugating Cardboard Strips, C. J. Smart, London.
21,645. Steam Engines, H. Cambridge, London.
21,646. Attaching Purses to Wrists, L. Edwards, London.

*10th November*, 1894.

21,647. Umbrella Identifying Device, J. S. Martin, London.
21,648. Bread, W. Adair, Waterford.
21,649. Bread, W. Adair, Waterford.
21,650. Bakers' Ovens and Apparatus, W. Adair, Waterford.
21,651. Adjusting Governors, J. Hughes and C. Hill, London.
21,652. Fly-wheel Governor, J. Hughes and C. Hill, London.
21,653. Tobacco Pipe, W. B. Wallace, Woolwich.
21,654. Syphon Flushing Cistern, W. Wheeler, Langley.
21,655. Gas Producers, E. J. Duff, Manchester.
21,656. Placing Detonators on Railways, A. Flory, Knowle.
21,657. Hat Fastener, M. Martin and G. Gregg Nottingham.
21,658. Treating Brewers' Spent Hops, J. J. Adkins, London.
21,659. Toasting Fork Handles, &c., G. A Savile, Harrogate.
21,660. Atmospheric Gas Heaters, F. W. Zimer, London.
21.661. Dress Suspenders, A. G. Horne and J. Samuel, Glasgow.
21,662. Collapsible Boxes, D. Y. Annan, Dundee.
21,663. Spring Floor, T. Freeman, J. H. Shaw, and W. A. McCrum, Dublin.
21,664. Boot, W. J. Nash, Dublin.
21,665. Sugar Boilers' Rock Chopper, H. Cooper, Rhondda Valley.
21,666. Parts of the Wheels of Vehicles, H. W. James, Birmingham.
21,667. Carrying Tanks, J. McL. McMurtrie and Lucal, Glasgow.
21,668. Conveyors for Coal Dross, &c., T. Thomson, Glasgow.
21,669. Drilling Machines, W. A. Smith, P. Rottenburg, and W. C. Fischer, Glasgow.
21,670. Padlocks, T. C. Dowd, Wednesfield.
21,671. Rear-driving Geared Bicycles, E. Jackson, Prescot.
21,672. Crochet and Knitting Needle, J. A. Burton, Nottingham.
21,673. Securing Pneumatic Tires, S. J. Cockbain, Halifax.
21 674. Manufacture of Boots and Shoes, H. Tilley, Leicester.
21,675. Wheel Rims, S. Morgan and F. T. Jackson, Leicester.
21,676. Latches for Doors and the like, C. Showell, Birmingham.
21,677. Hair Curlers, H. W. Tonks, Birmingham.
21,678. Hame Tackle or Fittings, T. W. Mills, Birmingham.
21,679. Gas Fittings, J. Grubb and W. Robinson, Birmingham.
21,680. Perrymeters, J. P. O'Donnell.—(*L. F. Johnson, United States.*)
21,681. Filtering Boiler Feed-water, R. Risk, Glasgow.
21,682. Water-closet, J. Shanks, Glasgow.
21,683. Corliss Valves, J. H. Hargreaves and J. G. Hudson, Glasgow.
21,684. Indicator, H. Dando.—(*H. A. Dando, New Zealand.*)
21,685. Anti-syphon Pipes for Water-closets, W. Tate, London.
21,686. Gear for Swings, E. Williams and G. F. Pennington, Castleford.
21,687. Reel, Needle, and Thimble Holder, W. R. Manders, Hoylake.
21,688. Accordion Valves, T. R. Shillito.—(*O Spaethe, Germany.*)
21,689. Vices, B. Mountain, Leeds.
21,690. Friction Clutches and the like, B. Mountain, Leeds.
21,691. Portable Letter Copying Presses, J. Marshall, Glasgow.
21,692. Crest Tiles, R. N. Allen, Birmingham.
21,693. Knife-cleaning Machine, E. E. and A. W. Boothby and G. J. A. Comont, London.
21,694. Legging Fasteners, H. A. Wickham and S. Edwards, London.
21,695 Re-squaring Plates, W. Williams and W. G. Morris, London.
21,696. Washing and Wringing Machine, J. Miles, London.
21,697. Gas Stoves, T. Hadfield, London.
21,698. Gas-fired Steam Boilers, G. H. Taylor, London.
21,699. Filling Bottles, W. P. Thompson.—(*J. C. Gelly, Australia*)
21,700. Typewriters, J. S. Foley, London.
21,701. Cycle Fittings, H. Lucas, London.
21,702. Funnels, F. Rudd, London.
21,703. Tobacco Pipe Cleaner, W. Simon, London.
21,704. Floors for Billiard-rooms, W. W. Burnett, London.
21,705. Cycle Saddles, R. S. Lovelace, London.
21,706. Velocipedes, G. L. Morris, London.
21,707. Electric Conductors, A. Slater.—(*J. Platt, United States.*)
21,708. Starch and Starchy Substances, C H. Meyer, London.
21,709. Showing Signals All Round, G. Blakeley, Bournemouth.
21,710. Cheese, C. F. Hope, Weymouth.
21,711. Exhibiting Device, H. H. Leigh.—(*The Celluloid Company, United States*)
21,712. Liquid Meters, C. S. Brough and W. Brough, London.
21,713. Wire Chains, F. W. Smith.—(*The Smith and Egge Manufacturing Company, United States.*)
21,714. Sewer and Surface Box Covers, E. J. Preston, London.
21,715. Washing Machine, P. K. J. Willis.—(*A. A. Wright, United States.*)
21,716. Continuous Rolling Process, &c., O. Klatte, London.
21,717. Blind Pulleys, T. W. and F. C. Tidmarsh, London.
21,718. Fashion Plates, P. M. Justice.—(*D. A. Morse, United States*)
21,719. Treadle or Crank Movement, L. S. Manning, London.
21,720. Vertical Rolls for Grooved Rails, G. Trasenster, London.
21,721. Rolling Grooved Rails, &c., G. Trasenster, London.
21,722. Finger Plates and Panels, J. C. Woolstone, London.
21,723. Freezing Machines, W. G. Scott, London.
21,724. Advertising, A. F. E. de St. Dalmas, London.
21,725. Stands, A. F. E and W. H. E. de St. Dalmas and A. F. Cholerton, London.
21,726. Boots and Shoes, E. J. Hammond, London.
21,727. Knitting Machine, L. N. D. Williams and R. W. Scott, London.
21,728. Type Matrices, J. Y. Johnson.—(*A. S. Capehart, United States.*)
21,729. Manufacture of Nitro-cellulose, J. W. Swan, London.
21,730. Perfumes, B. Willcox.—(*M. Otto and A. Verdi, France.*)
21,731. Arc Lamps, C. A. Day.—(*G. J. Schoeffel, United States.*)
21,732. Alkali Cyanides, H. Y. Castner, London.
21,733. Writing Pad, C. E. Gunn, London.
21,734. Stone Cements, E. Weckwarth and M. Hoeft, London.
21,735. Lime Mixtures, E. Weckwarth and M. Hoeft, London.
21,736. Groynes, H. E. Stilgoe, London.
21,737. Machines for Printing Linoleum, C. H. Scott, London.
21,738. Packing Matches, C. J. Bolinder, O. L. Borg, and M. Kjellberg, London.
21,739. Balling Yarns, Threads, &c., E. P. Alderson, London.
21,740. Locking Devices for Cones, G. Gibson, Newcastle-on-Tyne.
21,741. Motive Power Engines, J. G. L. McLachlan, Glasgow.
21,742. Whips, M. Müller, Cologne.
21,743. Typewriting Machines, E. Fitch, London.
21,744. Metallic Strapping for Boxes, H. de Haven, London.
21,745. Surveying Instruments, &c., D. Arámburn, London.
21,746. Milk Cans, H. Fearncombe and Co. and A. Evans, London.
21,747. Receptacles for Holding Labels, W. Jones, London.
21,748. Steering Lock, F. Maly and G. Valencsak, London.
21,749. Combination Corn Sacks, M. F. Rimington, London.
21,750. Arc Lamps, J. W. Rogers, London.
21,751. Spoons, J. Earle, London.

*12th November*, 1894.

21,752. Device for Holding Watches, A. D. Blaxland, London.
21,753. Retaining Hats on the Head, M. H. Jackson, London.
21,754. Button-hole, M. H. Jackson, London.
21,755. Suspenders for Miners' Lamps, T. L. James, Pontypool.
21,756. Coin-freed Mechanism, G. S. Smith, G. Haydon, and F. H. Urry, London.
21,757. Velocipedes, F. Westwood, Birmingham.
21,758. Looms, R. Wilkinson, Manchester.
21,759. Stereophotorama, W. Ashton, Southport.
21,760. Metallic Fittings of Waistbelts, W. M. Harris, Birmingham.
21,761. Bedsteads, W. E. Nichols and R. Pitt, Birmingham.
21,762. Holders for Twine, Cord, or Tape, A. Cole, Dublin.
21,763. Portable Water-container for Birds, H. Edge, Longport.
21,764. Tramway Vehicles, J. Darling, A. R. Harvey, and R. C. Lyness, Glasgow.
21,765. Pneumatic Tires and Covers, J. Hague, Manchester.
21,766. Sad Irons, W. J. Fox, Manchester.
21,767. Vertical Grand Pianos, F. Schimmel and S. F. Nelson, Manchester.
21,768. Hair Curlers, G. H. Twigg, Birmingham.
21,769. Safety Pins, H. W. Tonks, Birmingham.
21,770. Velocipede, J. B. Johnston, Manchester.
21,771. Device for Printing Machines, J. S. Howden, Liverpool.
21,772. Aerial Navigation Apparatus, A. J. Lehmann, Liverpool.
21,773. Tubes for Velocipedes, R. Howarth, Wolverhampton.
21,774. Production of Caustic Soda, M. N. d'Andria, Stretford.
21,775. Drilling Boiler Shells, A. Muir, Manchester.
21,776. Letter-boxes, E. Miles, Swansea.
21,777. Paper Tubes for Cartridges, G. Kynoch and Co. and E. Jones, London.
21,778. Concentration of Sulphuric Acid, I. S. McDougall, London.
21,779. Adjustable Bearings, R. Wallwork, Manchester.
21,780. Apparatus for Testing Drain Pipes, &c., A. Harkess, Edinburgh.
21,781. Oil or Gas Heating Apparatus, G. Quadling, East Dereham.
21,782. Automatic Electrical Rheostats, T. Caink, Worcester.
21,783. Moulding for Framing Cards, J. Fallas, Wakefield.
21,784. Non-slipping Pneumatic Tires, T. P. Hennessy, Dublin.
21,785. Handles for Children's Carriages, G. J. Smith, Birmingham.
21,786. Colouring Matters, A. G. Green and R. Jansen, Manchester.
21,787. Colouring Matters, A. G. Green and F. Jansen, Manchester.
21,788. Colouring Matters, A. G. Green and R. Jansen, Manchester.
21,789. Music Leaf-turners, S. Stephenson and C. Wilson, Sheffield.
21,790. Firelighters, S. Vint, London.
21,791. Key-ring, H. A. Long, London.
21,792. Doors and Gates, J. T. Lane and F. Albon, London.
21,793. Shooting Swivel Tube, W. Brookes, Cardiff.
21,794. Boots and Shoes, J. W. Ellis and W. J. Burrows, Leeds.
21,795. Picker Presses, J. Muir, Glasgow.
21,796. Shafts for Bassinettes, W. S. Dove, Glasgow.

21,797. Window Fastener, E. L. Godfrey and W. C. Butlin, Stonehouse.
21,798. Converting Reciprocating Motion, E. Rollason, Birmingham.
21,799. Measure-graph, H. J. H. Graves, Devonport.
21,800. Final, A. Jeffery, Bradford-on-Avon.
21,801. Ladders, C. A. Sabow, London.
21,802. Speed-changing Gear Trains, J. Thomson, London.
21,803. Shoal Indicators for Bridge Alarms, S. H. James, London.
21,804. Money Holder, W. A. Torge, London.
21,805. Pickers and Picker Staves, J. Rubirola, London.
21,806. Determining Altitudes, O. Eckenstein and L. A. Legros, London.
21,807. Affixing Taps or Valves, F. P. Munro, London.
21,808. Observing the Aspect of the Heavens, R. A. Gregory, London.
21,809. Fish-plates, &c., for Railways, R. Meusel, London.
21,810. Beating Fibrous Substances, T. Burrows and D. Radclyffe, London.
21,811. Spinning Fibrous Substances, T. Burrows and D. Radclyffe, London.
21,812. Vehicle Wheels, J. Bonn, London.
21,813. Locks, A. T. Tucker, London.
21,814. Electric Arc Lamps, J. Torge, London.
21,815. Making Parasite Tincture, A. B. F. Wegemund, London.
21,816. Heating Furnaces with Coal Dust, F. de Camp, London.
21,817. Tobacco Pipe, C. Hyatt-Woolf and A. E. Hayman, London.
21,818. Improved Pneumatic Inkstand, J. Stibor, London.
21,819. Heating Apparatus, R. E. Roberts, Essex.
21,820. Armour Plates, A. H. Smith, London.
21,821. Electro-motors, T. Parker, Ld., and T. Parker, London.
21,822. Alloying of Metals, J. C. Mewburn.—(*The Firm of F. Hornig and W. Borchers, Germany.*)
21,823. Safety Bolt Stirrup, T. H. Duncombe, London.
21,824. Belts, W. B. Fosdick, London.
21,825. An Improved Claw Hammer, W. H. Burgess, London.
21,826. Taps for Steam, &c., Liquids, J. Rombach, London.
21,827. Exciting Dynamo-electric Generators, J. Imbray.—(*La Société Anonyme pour la transmission de la force par L'électricité, France.*)
21,828. Moulding Tees, J. Osmond, London.
21,829. Working Gas Engines, C. D. Abel.—(*The Gasmotoren Fabrik Deutz, Germany.*)
21,830. Milk Separators, C. D. Abel.—(*Messrs. Drosse and Ludloff, Germany.*)
21,831. Buttons, E. J. Stonier, London.
21,832. Manufacture of Boots, J. Robinson and G. Wilson, London.
21,833. Grinding Machine, G. Heerbrandt, London.
21,834. Cash-registering Apparatus, H. H. Lake.—(*The Victor Cash Register Company, United States.*)
21,835. Safety Roller-brake, A. Bradford, London.
21,836. Surveying Instruments, M. H. P. R. Sankey.—(*F. W. Moffitt, India.*)
21,837. Apparatus for Boiling Sugar, T. Moore, J. A. Sanders and W. H. Percy, London.
21,838. Electrolysing Chemical Combinations, W. Bein, London.
21,839. Dumping Wagons, D. Young.—(*W. R. Bell, South Africa.*)
21,840. Bolts, W. M. Levering, London.
21,841. Combined Cushion and Syringe, P. R. J. Willis.—(*Joseph La Londe, Canada.*)
21,842. Device for Taking of Pills, A. Bowles, London.
21,843. Photographic Cameras, A. J. Boult.—(*A. Lefebure, France.*)
21,844. Devices for Holding Tools, W. Chandler, London.
21,845. Dry Batteries, R. Myers, London.
21,846. Spooling Machines, J. Wales, London.
21,847. Cryptograph, W. P. Thompson.—(*G. Strömdal and J. von Ditten, Norway.*)
21,848. Fixing Adhesive Labels, F. Meyer, London.
21,849. Roundabouts, J. W. Radford and H. Hallam, London.
21,850. Inducing Custom in Shops, M. M. Dessau, London.
21,851. Rolls for Grooved Rails, G. Trasenster, London.
21,852. Gripping Device, F. Harrington, London.
21,853. Fabric Receiver, P. Dunn, Birmingham.

13th *November*, 1894

21,854. Venetian Blind, T. Brown, Essex.
21,855. Tools for Trueing-up, W. P. Adams and R. E. B. Crompton, London.
21,856. Automatic Railway Engine, T. Pearson, Middlesbrough.
21,857. Abacus, J. H. Towers, Southsea.
21,858. Cycles with Springs, C. Hassel, Manchester.
21,859. Appliance for Boiling Water, G. H. McKay, Glasgow.
21,860. Endless Bands, J. T. Southworth and C. Macintosh and Co., Manchester.
21,861. Damping Warps, A. Sutcliffe, Blackburn.
21,862. Draught Excluders, A. Gregson, Manchester.
21,863. Cycle Lamp Bracket, J. E. Meredith, Birmingham.
21,864. Making Buckets or Pails, D. Potts, Liverpool.
21,865. Cycle Tires, R. A. Vogt and L. P. Vogt, Glasgow.
21,866. Fencing Wire Fixings, W. T. Eades and H. W. Henley, Birmingham.
21,867. Speaking Tubes, H. A. Cutmore, London.
21,868. Wheel Tires, J. Andrew, Glasgow.
21,869. Boat-launching Arrangement, J. B. Forster, Newcastle-on-Tyne.
21,870. Culinary Utensils, C. E. Challis, London.
21,871. Securing Taps in Casks, H. Edwards and E. S. Smith, Bristol.
21,872. Vulcanising India-rubber, J. T. Southworth and C. Macintosh and Co., Ld., Manchester.
21,873. Driving Gear for Cycles, W. G. Harris, Bristol.
21 874. Wind-resisting Match-box Case, W. H. Salmon, Kent.
21,875. Sheep-shearing Machine, C. W. Pitman, London.
21,876. Bolts for Fastening Doors, J. Whitehead, Birmingham.
21,877. Steel Band and Wire Clip, W. Chivers, Bristol.
21,878. Displaying Advertisements, R. D. Bailey, London.
21,879. Electro-fusion of Metals, B. H. Thwaite and H. Allen, London.
21,880. Rocking and other Chairs, W. S. McLennan, Glasgow.
21 881. Wheels for Cycles, &c., F. Day and J. Jones, Dudley.
21,882. Revolving Theatrical Bed, T. B. Stuart, Salford.
21,883. Bottle Stoppers, J. G. Liversidge and W. Snowdon, Leeds.
21,884. Roller Brake, J. Drew and R. McVittie, Edinburgh.
21,885. Brake for Pneumatic Wheels, J. Ayliffe and W. H. Davies, Cardiff.
21,886. Velocipedes, E. Immer, Manchester.
21,887. Drinking Glass Stands, J. H. F. Kickhefel, Glasgow.
21,888. Driving Chains, S. T. Richardson, A. Smallwood, and R. Price, Birmingham.
21,889. Gear Cases, S. T. Richardson, A. Smallwood, and R. Price, Birmingham.
21,890. Cycle Cranks and Connections, F. E. Jones, Birmingham.
21,891. Top Boot and Shoe for Horses, &c., T. Clegg, Leeds.
21,892. Envelopes and Post-cards, W. H. Schwartz, London.
21,893. Autographic Telegraphs, J. O'Neil, London.
21,894. Garment Stretcher, L. Mallory, London.
21,895. Button Fastener, C. A. Allison.—(*I. J. Saunders, United States.*)
21,896. Target Facings, A. J. Altman, London.
21,897. Fire Escapes, W. Threlfall, London.
21,898. Slate Cleaner, J. E. Phillips, London.
21,899. Weft-fork Holders for Looms, J. and J. Nutter, London.
21,900. Loom Checking Appliances, T. Fielden and D. Askham, London.
21,901. Dolls' Houses, H. F. Robinson, London.
21,902. Steering of Vessels, A. J. Boult.—(*H. Demnitz, Germany.*)
21,903. Pianos, W. P. Thompson.—(*M. H. McChesney and J. G. Kunze, United States.*)
21,904. Gates, S. J. Smith, London.
21,905. Metallic Keys for Railways, P. Colombier, Liverpool.
21,906. Passenger Vessels, W. F. Hart.—(*A. McDougall, United States.*)
21,907. Fastening Driving Belts, D. Michie, London.
21,908. Burner for Essences or Perfumes, H. Krey, London.
21,909. Sectional Neckties, D. Sanguinette, London.
21,910. Brushes, W. Wallach, London.
21,911. Locomotive Draught Apparatus, R. Weatherburn, London.
21,912. Quoins for Printers' Formes, T. Ashford, London.
21,913. Treatment of Locust Beans, C. D. Ekman and C. Christian, London.
21,914. Feed-water for Steam Boilers, T. Wigley, London.
21,915. Lamp Brackets, J. Nelson and C. H. Edmed, London.
21,916. Lamp Shade Carrier, J. Nelson and C. H. Edmed, London.
21,917. Looking-glass and Writing-desk, J. Weeks, London.
21,918. Shifting Wrenches or Spanners, J. Brown, London.
21,919. Chinebrite, M. Borgenicht, London.
21,920. Washing Casks, C. Pontifex and A. Pontifex, London.
21,921. Destroying Refuse, W. Smethurst and J. Van der Crab, London.
21,922. Pianoforte Actions, G. Hermann, London.
21,923. Steam Whistles, R. Haddan.—(*J. G. Hermes, United States.*)
21,924. Brake Gear of Velocipedes, M. Macer, London.
21,925. Apparatus for Rolling Ink, J. E. Y. Hindle, Wolverton.
21,926. Tobacco Pipes and the like, H. W. C. Harvey, London.
21,927. Apparatus for Recording Music, A. Rivoire, London.
21,928. Heeling Boots and Shoes, H. B. Corney, London.
21,929. Electric Current Regulators, H. V. Keeson, London.
21,930. Card Receptacles, W. Fullerton.—(*H. G. Klenze, United States.*)
21,931. Method of Washing, &c., Ores, C. F. Pike, London.
21,932. Cowl for Railway Carriages, E. Buchholz, London.
21,933. Bookbinding, W. Wilson, London.
21,934. Cask-making Machines, H. H. Lake.—(*W. Ritter, Germany.*)
21,935. Cask-making Machines, H. H. Lake.—(*C. W. O. Erichson, Germany.*)
21,936. Water Meters, J. E. A. Bel, London.
21,937. Ventilating Drains and Sewers, J. Barber, London.
21,938. Connecting Horses to Carts, T. H. Brigg, London.
21,939. Fountain Pens, J. P. Bayly.—(*A. Horstmann, South Africa.*)
21,940. Cycle Driving Gear, A. J. Boult.—(*H. Steudel, Germany.*)
21,941. Hollow Walls, H. Shepherd, London.
21,942. Hydraulic Drawing Press, L. Schuler, London.
21,943. Making Roofing Tiles, G. Krebs and A. Wiel, London.
21,944. Crankshafts and Bearings, A. A. Pope, London.
21,945. Decomposing Apparatus, W. Thomson and P. J. Worsley, London.
21,946. Furnaces, W. Thomson and P. J. Worsley, London.
21,947. Drying Textile Fabrics, J. B. Jackson and G. Bentley, London.
21,948. Electric Lamp Holders, J. Y. Johnson.—(*A. Swan, United States.*)
21,949. Case for Advertising Medium, J. T. Lawrence, London.
21,950. The Ball-bearing Castors, F. A. S. Foale, London.
21,951. Lamps and Bells for Cycles, J. P. Rees, London.
21,952. Construction of Ships, R. and L. Roper, London.

14th *November*, 1894.

21,953. Riding Breeches, F. Heafield, London.
21,954. Boxes, E. H. Durnford, Dartford.
21,955. Locking Drawers, Cabinets, &c., F. Ransom, London.
21,956. Waste Preventer for Taps, F. W. Ventris, London.
21,957. Photographic Lenses, G. Prescott, Dublin.
21,958. Remedy for Sea-sickness, W. G. Waldron.—(*H. Brown, England.*)
21,959. Cycles, T. H. Collingbourne and W. H. McLauchlan, Coventry.
21,960. Nap-raising Machines, W. Holland, Manchester.
21,961. Sick-room Indicator, W. G. Webb, Lichfield.
21,962. Making Ferric Sulphate, W. Wyld and J. H. Cox, Bradford.
21,963. Making Ferric Sulphate, W. Wyld and J. H. Cox, Bradford.
21,964. Tires, E. H. Seddon, Manchester.
21,965. Apparatus for Games, W. D. Bellasis, Birmingham.
21,966. Hook-and-eye Tape for Dresses, W. Lumb, Leeds.
21,967. Music Leaf Holders, J. Dighton, Manchester.
21,968. Photographic Cameras, C. C. Vevers, Leeds.
21,969. Levelling Rollers, C. E. Roberts, W. T. Kirkman, and H. Doughty, Liverpool.
21,970. Gully Dish and Grate, F. Thackeray, Darwen.
21,971. Fireplaces and Stoves, E. H. Shorland, Manchester.
21,972. Vehicle Jack, R. H. Foster, Hebburn-on-Tyne.
21,973. Supporting Vessels on Globes, F. H. and H. Barwell, and H. P. Kimberley, Birmingham.
21,974. Securing Glass Founts, F. H. and H. Barwell, H. P. Kimberley, and J. F. Smith, Birmingham.
21,975. Wrapping Card Fillets, F. G. Dransfield, Manchester.
21,976. Drawing and Measuring, T. F. Johanson and H. R. Kerr, Glasgow.
21,977. Axle-box Caps for Vehicles, J. Latham, Sheffield.
21,978. Pocket Knives, J. Wingfield, Sheffield.
21,979. Extracting Metals, H. Blackwell, jun., A. Schimmel, and G. A. Warburton, London.
21,980. Frames for Baking Purposes, T. Fletcher, London.
21,981. Dough-kneading Machinery, T. Fletcher, London.
21,982. Candle Holder, J. P. Croft and J. C. Phillips, London.
21,983. Cycle Fittings, J. M. and W. Starley, London.
21,984. Centrifugal Churns, S. Cheeld, Bucks.
21,985. Cushion-tired Skates, &c., F. Jones, London.
21,986. Storage Chambers, A. Smith, London.
21,987. A Book for Tracing Music, J. M. Bell, Glasgow.
21,988. Potato Raising Machine, H. Hope and R. Paxton, Glasgow.
21,989. Set Collar for Shafting, &c., G. R. Phipps, London.
21,990. Saddles for Cycles, &c., W. Brampton, Birmingham.
21,991. Electric Tramways and Vehicles, H. Edmunds, London.
21,992. Coal Mines, G. Pickhardt, London.
21,993. Boots and Shoes, D. Tuley, London.
21,994. Refrigerators for Liquids, B. Böggild, London.
21,995. Measuring Substances, T. Christy.—(*K. Tschanter, Germany.*)
21,996. Extractors for Drawing Beer, S. F. Cousins, London.
21,997. Game, W. B. Bust, London.
21,998. Toasting Fork, H. Fairbrother, London.
21,999. Roller and other Wheel Skates, C. Holt, London.
22,000. Fog-signalling Apparatus, F. Fish, London.
22,001. Fireproof Construction, &c., W. Youlten, London.
22,002. Armour-plates, A. J. Boult.—(*P. R. de F. D'Humy, United States.*)
22,003. Ventilating Ships' Cabins, S. V. Walters, Liverpool.
22,004. Finishing Textile Fabrics, T. R. Hanmer, Manchester.
22,005. Safety Lamps, R. Hay, H. Toal, and T. Lowther, London.
22,006. Hats, P. Garton, Liverpool.
22,007. Valves, Pipe Couplings, &c., C. H. Gray, London.
22,008. Kilns, C. D., A. D., and S. D. d'Enghien, London.
22,009. Injectors, L. Gunn, London.
22,010. Toy, L. A. L. and A. L. Delatour, London.
22,011. Utilising the Flow of Tidal Waters, J. E. Liardet, London.
22 012. Fire-grates, H. Hunt, London.
22,013. Developing Photographic Plates, C. E. Hearson, London.
22,014. Preparing Objects for the Microscope, C. E. Hearson, London.
22,015. Saw-horses, E. T. Hughes.—(*C. D. Snell, United States.*)
22 016. Links for Securing Traces, &c., A. Wood, London.
22,017. Tires, G. J. Stevens, London.
22,018. Making Margarine, J. H. Theberath and A. de Kunwald, London.
22,019. Making Nitro-cellulose, F. Greening, jun., London.
22,020. Preserving Ships' Bottoms, A. Tolhurst, London.
22,021. Cycles, G. B. H. Austin, London.
22,022. Machinery for Propelling Vehicles, H. Lane, London.
22,023. Manufacture of Alloys, &c., H. Moissan, London.
22,024. Joints of Earthenware Pipes, J. Farler, London.
22,025. Velocipede Pedals and Boots, J. Keen, London.
22,026. Spinning-mules, P. Jensen.—(*A. Kremer, Luxemburg.*)
22,027. Lanterns, J. Guiraud, London.
22,028. Manufacture of Humic Acid, L. Gautreau, E. Charbonnier, and E. Serrant, London.
22,029. Fans, J. H. Pickup and J. H. Hindle, London.
22,030. Electrically Propelled Carriages, F. King, London.
22,031. Envelopes or Wrappers, &c., G. Porter, London.
22,032. Gravity Motors, L. Gunn and M. G. E. Cuddon, London.

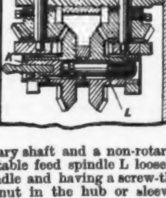
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**525,385.** Pipe-drilling Device, *J. E. Feeling, Malden, Mass.—Filed May 16th*, 1894.

*Claim.*—The herein-described pipe-drilling device consisting of a frame having journalled therein a drill rotary shaft C and a drill feed shaft D combined with a rotary and longitudinally adjustable drill spindle K arranged within the sleeve or hub of a gear actuated by the drill rotary shaft and a non-rotary and longitudinally adjustable feed spindle L loosely connected to the drill spindle and having a screw-threaded end working in a nut in the hub or sleeve of a gear actuated by the feed shaft substantially as and for the purpose set forth.

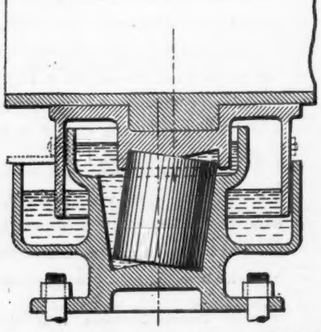
525,383



**525,411.** Sealing, Lubricating, and Bearing Support for Gyrating Screens, &c., *P. W. Gates, Chicago, Ill.—Filed November 10th*, 1893.

*Claim.*—(1) The combination of one or more connecting and supporting plates, each having a dust sealing flange, and an upper seat for a gyrating bearing, a base portion constructed with a chamber for holding a sealing fluid, and a lubricant holding and bearing chamber having a lower seat for a gyrating bearing, substantially as and for the purpose set forth. (2) The combination of the upwardly flared bearing chamber having a seat for a gyrating bearing, and an enlarging upward extension, with a plate having an upper seat for a gyrating bearing, said seat being formed in a downwardly extended projection which is laterally enclosed or surrounded by the upper extension of the bearing chamber, substantially as described. (3) The combination of a gyrating screening device attached to supporting and sealing plates forming upper seats for gyrating bearings, base-supporting portions forming lower seats for the gyrating bearings, and a bearing and oil bath-lubricating chamber, substantially as described.

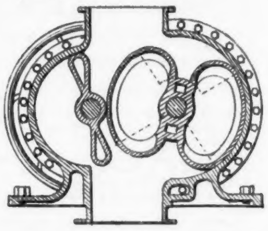
525,411.



**525,532.** Rotary Motor, *A. Clement, San Francisco, Cal.—Filed May 22nd*, 1893.

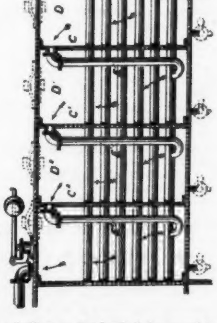
*Claim.*—An improved rotary motor consisting of a shell or case consisting of opposing segments of different radius and curvature with an inlet passage at its upper end and an outlet passage opposite to it at its lower end, a piston mounted in the smaller segment of the case and composed of oppositely radiating wings, each of which is convex near the point, concave in the base, and convex again in the hub; a drum revoluble in the larger segment, having recesses on diametrically opposite sides provided with convex walls to coincide with the ends of the piston wings which are curved to make a rolling contact there with when they pass, while the intermediate connecting curved surfaces of the piston are adapted to conform to the convex portions of the drum with a continuous rolling contact.

525,532



**525,551.** Feed-water Heater, *H. G. Kreasbey, Ambler, Pa.—Filed January 18th*, 1894.

*Claim.*—A feed-water heater and purifier consisting of the shell A, having flues therein, one extremity of said flues terminating in a chamber at one end of said shell, said chamber being provided with a stack G, the other end of said shell being in communication with the flues of a boiler, and adapted to receive the products of combustion therefrom, portions C, C′, and C² in said shell-forming water chambers D, D′, and D², &c., and pipes, E, E′, and E² leading from the top of one water chamber to the bottom of another, a water supply pipe leading into the water chamber adjacent to the stack, and an outlet pipe leading from the water chamber nearest the inlet end of said flues, said parts being combined substantially as described.

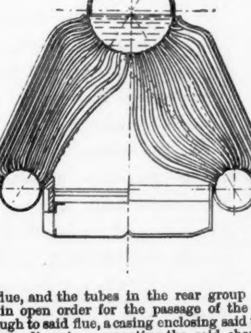


525,551

**525,614.** Steam Boiler, *A. Normand, Havre, France.—Filed March 15th*, 1894.

*Claim.*—In a steam generator, the combination with an upper chamber and lower chambers, of two or more groups of curved pipes of small diameter connecting said chambers and arranged in the form of an arch, the innermost and outermost tubes of the group over the grate being arranged in close juxtaposition to form a return flue, and the tubes in the rear group being arranged in open order for the passage of the gases therethrough to said flue, a casing enclosing said tubes, flues of large diameter connecting the said chambers outside of the casing, a smoke flue communicating with the return flue near the front of the generator, a smoke box connecting the return flue and the combustion chamber, and an inverted bridge M for diverting a portion of the products of combustion into said smoke box, substantially as described.

525,614



Throat Irritation and Cough.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d.; tins, 1s. 1½d., labelled, "James Epps and Co., Homœopathic Chemists, London."

## ENGLISH AND FRENCH QUICK-FIRE ARMAMENTS.

Public attention has been called to the fact that the French have succeeded in equipping their fleet with quick-fire guns with great rapidity. It has further been stated that the French fleet is now far ahead of us in this class of equipment in the Mediterranean, and it is hinted that although matters are better if we consider the Channel fleet, we are now behind them, and that they have reversed the relative position in which our fleet stood in this matter. It may be interesting to our readers to see how this question stands, as shown by "Brassey's Annual" of the present year.

First, as to actual numbers. We have taken ships "building," as well as those completed, but have excluded ships only "projected" and not commenced. This gives us the following figures:—British ships, total number armoured, 80; unarmoured, 208. French armoured, 63; unarmoured 99. The quick-fire guns for these are,

*British Armoured.*

| | | |
|---|---|---|
| 6in. | 144 | 213 |
| 4·7in. | 57 | |
| 12-pounders (3in.) | 12 | |
| 6 „ | 464 | |
| 3 „ | 565 | |
| Total | 1242 | |

*French Armoured.*

| | | |
|---|---|---|
| 16 cm. (6 3in.) | 16 | 258 |
| 14 „ (5 5in.) | 163 | |
| 10 „ (3 9in.) | 79 | |
| 6·5 (8·8-pounders) | 37 | |
| 4·7 cm. | 235 | |
| 3·7 „ | 124 | |
| Total | 654 | |

*British unarmoured.*

| | | |
|---|---|---|
| 6in. | 187 | 617 |
| 4·7in. | 368 | |
| 25-pounder (3 5in.) | 6 | |
| 12-pounder (3in.) | 56 | |
| 6-pounder | 445 | |
| 3-pounder | 498 | |
| | 1560 | |

*French unarmoured.*

| | | |
|---|---|---|
| 16 cm. (6·3in.) | 74 | 279 |
| 14 cm. (5 5in.) | 88 | |
| 10 cm. (3·9in.) | 117 | |
| 6·5 cm. | 32 | |
| 4·7 cm. | 213 | |
| 3·7 cm. | 161 | |
| | 685 | |

If these quick-fire guns be considered irrespective of their calibre, it will be seen that the average number per armoured ship is, for England 15·5, against 10·3 for France; and for unarmoured 7·5 for England, as compared with 6·9 for France; but it may be seen that in the armoured ships France has a great prepondrance of heavier and more powerful quick-fire pieces, having in fact 258, against 213 of the English, and those of heavier metal, for we have included the 12-pounder among the English pieces. This gives 2·66 for heavy quick-fire guns per English armoured ship, and 4·1 per French armoured ship. On the other hand, England is stronger in her unarmoured vessel armaments, these having 617 heavier quick-fire pieces, as compared with 279 French, which makes 2·96 per English unarmoured ship, and 2·81 per French unarmoured ship. Thus France has an absolute advantage in one respect, that is in heavy quick-fire guns in the equipment of her armoured ships, while she is inferior in the total number of quick-fire guns of all calibres per ship in her armoured fleet, and in her unarmoured fleet she is slightly inferior both in the heavier quick-fire pieces and in total numbers. When we take into account the fact that we have to deal with 288 ships of all kinds, France with only 162, involving a total of 2802 pieces as compared with 1339, it will be seen that it could not with any justice be said that France is in advance of us in the work of supply if bare numbers only be considered. A mere statement of numbers may, however, be misleading. We have included many ships which are small and obsolete, which would only receive quick-fire guns under special circumstances, and, on the other hand, ships under construction. Both these may affect the results unfairly. The obsolete ships, which naturally have not been well supplied, may pull down the average, and the nation that builds its ships more slowly therefore has more in hand in proportion to her rate of turn out, benefits unfairly by reckoning ships building, yet it seems desirable to take some total number that has been arrived at without reference to our immediate object and on good authority, in order to be clear of bias. It must be understood, however, that our vessels going into action would naturally be so far selected that they would have a much larger number of guns than this average. To pass on next to the character of the pieces. Our own heavier guns are of the Elswick types, with light Hotchkiss 6 and 3-pounders and Nordenfeldt 6-pounders. The French pieces consist in a great measure of converted guns, the remainder being new pieces, chiefly those of Canet. The French converted guns have certain distinct disadvantages, both in being of older type and inferior power to the new pieces, and also in power of quick-fire. The Canet guns are excellent, but there is no justification for the recent attack made on our Elswick pieces in the press. We have brought quick-fire guns to conform to the conditions of service before our neighbours. If a lower rate of fire is claimed for our guns, we believe it will generally be found to be due to the fact that our guns performing at sea under service conditions are compared with continental guns firing on a practice ground.

It may be instructive to compare the case of sample vessels of about the same displacement and date. The Centurion, of 10,500 tons, completed in 1893, carries ten 4·7in., eight 6-pounder, and twelve 3-pounder guns. The Brennus, of 11,000 tons, launched in 1891, carries ten 16 cm., four 6·5 cm., and eight 4·7 cm. guns. The French ship with rather more displacement has a decided advantage in weight of metal, but fewer light pieces. The Royal Sovereign, of 14,260 tons, completed in 1892, carries ten 6in., sixteen 6-pounder, and twelve 3-pounder quick-fire guns. As there is but little difference between the 16 c.m. and 6in. guns, this equipment is decidedly more formidable than that of the Brennus; but the vessel is much larger.

The Charles Martel—building—11,882 tons, is to carry eight 14 c.m., four 6·5 c.m., twelve 4·7 c.m., and eight 3·7 c.m. guns. She is therefore less powerful in weight of metal than the Brennus, but has more light guns. Her quick-fire is decidedly inferior to that of the Royal Sovereign. Let us now turn to useful vessels of obsolete type. Our Dreadnought, 10,820 tons, completed in 1875, carries only six 6-pounder and twelve 3-pounder quick-fire guns. The French Duperré, 10,487 tons, launched in 1879, carries eleven quick-fire guns of unregistered calibre—probably light and not yet supplied, and not included in our tables above. Probably these will be of heavier metal than the Dreadnought's 6 and 3-pounders; but it is hardly fair to say much of guns not yet supplied, as we cannot but suppose that the Dreadnought may receive heavier quick-fire guns bye-and-bye. The French Devastation, 9639 tons, launched in 1879, carries only two quick-fire guns, calibre not given. Our own Devastation, 9330 tons, completed in 1873, carries six 6-pounder and eight 3-pounder quick-fire guns. In this instance our vessel, much older and smaller than the Frenchman, is the better equipped.

Passing to unarmoured ships, the Thames, 4050 tons, completed in 1885, carries three 6-pounder and eight 3-pounder quick-fire guns. The Sybille, 3400 tons, completed in 1890, carries six 4·7in., eight 6-pounder, and one 3-pounder quick-fire gun. These are the vessels most nearly comparable perhaps with the French Cecile, 5766 tons, launched in 1888, which carries six 4·7 c.m. quick-fire guns only. Our first-class cruisers of 9000 tons are too large to compare with the French, our second-class too small. The Brilliant may be taken as a representative modern second-class cruiser, 3600 tons, launched in 1891. She carries two 6in., six 4·7in., eight six-pounder, one three-pounder quick-fire guns. It will be seen, then, that our unarmoured ships more than hold their own well; they are superior to the French in quick fire.

On the whole our readers will probably concur with us in concluding from the foregoing figures, that France has by no means overtaken us yet in the matter of quick-fire equipments; nevertheless we think that good work has been done in calling attention to the rapid strides that she has made, enabling her to compare as well as she does with us, seeing what a start we had of her.

## WIND PRESSURE.

There can be but little doubt that it was owing to the deplorable disaster which resulted in the collapse of a portion of the Tay Bridge, with its attendant lamentable consequences, that engineers felt themselves obliged to examine theoretically and practically, and more closely than they had previously done, the phenomena associated with the action of the wind. It is not that the force, the violence, the impactive and the concussive effect of winds varying both in velocity and pressure upon bridges, roofs, chimneys, and, in fact, all engineering and architectural structures exposed to its fury, were not previously recognised by scientific and technical writers, and even some allowance made for them by their designers; but the whole question, which is exceedingly important, had certainly not received that attention and consideration which it unquestionably both deserves and demands. Engineers were accustomed to regard its effects in the light of perhaps possible but barely probable contingencies, which in the majority of instances were too remote and uncertain to be included as a factor in the calculations. It must be admitted that at that time there was a great paucity of real information; that is, of information of a character which would permit of trustworthy deductions being made, and upon which could be based mathematical analyses and investigations resulting in tangible and workable conclusions. At the present time, notwithstanding the value of the evidence afforded by the construction of the Forth Bridge, there is a great deficiency in the experimental data connected with the subject; although now sad experience has amply demonstrated that what were formerly considered as possible, or extremely improbable occurrences, have passed into the category of those which have actually happened. For years past most valuable and interesting meteorological observations have been undertaken and accurately recorded, both in our own and other countries, which constitute a mass of highly useful data. From these, in conjunction with other known facts, the relation between the velocity and pressure of the wind has been ascertained with a precision and fidelity which does not admit of controversy. But while establishing this generally received relation, the exact values of the coefficients are left undetermined. As a proof of the large amount of uncertainty which even now besets the calculations attending the pressure of the wind upon a surface obstructing its motion, let us notice the terms employed. In the first place, selecting a roof for example, the wind is "assumed" to blow horizontally. By another assumption, which neglects one of the components—which, though undoubtedly very small, yet exists—into which the horizontal pressure is resolved, a supposed normal pressure is produced upon the surface of the roof. If the amount of the horizontal pressure could be accurately ascertained for each separate instance, the problem would be very fairly solved, at any rate so far as practical requirements were concerned. But this is exactly where the necessary data are incomplete and indeterminate, so that another assumption has to be made, which may vary between the somewhat wide limits of 9 lb. and 93 lb. per square foot.

The complete immunity which the Menai tubular bridge—a form of structure opposing the maximum amount of resistance to the force of the wind—enjoyed both during its construction and erection, when it was in a condition of obvious unpreparedness, and when it was completed, probably led to the pressure of the wind being underrated. The introduction of the open web or lattice girders about this time, which gave their *congé* to the tubular system for ever, and also to the solid-sided girder for future large spans, conduced to accentuate the same idea of false security. It was fairly, and not illogically, argued something after this fashion: Experience has shown—recent experience—that a hollow wrought iron box, into the interior of which—and this is a feature to which we shall subsequently draw attention—the wind cannot find access, has withstood with perfect impunity, and without the presence of any especial precautions, the whole force and violence of the wind-currents, gusts, eddies, and storms which proverbially sweep through Straits of the contracted dimensions characterising the channel separating the island of Anglesey from the main land. Such being the facts of the case, the erection of open-sided girders in similar, and even in more exposed situations, should be attended with a still greater margin risk, on the supposition that any risk was admitted by the engineer of the bridge alluded to. As a matter now of professional history, Stephenson attached little or no importance to the action of the wind on his great tubes, and there is no doubt that he has been fully justified in the opinions he entertained. It is not so much the application of a single sudden impactive force upon a structure that is to be feared, as the isochronous repetition of it; and the observations which the engineer made while building his bridge, caused him to arrive at the conclusion that there was no evidence of isochronism in the erratic and fitful blasts that at one time threatened his great design. During one of the heaviest gales which had ever been known, while one of the tubes was supported solely on some loose balks, at an elevation of over 100ft. above sea level, the lateral deviation scarcely exceeded one inch, although, so long as the storm prevailed, it was impossible for any one of the workmen to maintain himself on the top of the tube without holding on. The pressure of a hurricane, at the period when the Menai tubular bridge was erected, was estimated at about 46 lb. to the square foot, which would amount in the aggregate to 280 tons on each tube. It is worth noticing that the *vis inertia*, or the insistent weight of the tube itself before it became united to its fellows, was calculated to be adequate to resist this force of impact, and the result confirmed the truth of the calculations. It is clear that the oscillations of a tubular, or of any other type of girder, would depend first of all upon whether the action of the wind currents was isochronously repeated, and secondly, whether they would coincide with the structural vibrations set up. In the latter event the result might be very serious, and if unchecked, would probably entail the downfall of the bridge. Fortunately there is no good evidence to support this supposition, that the two antagonistic forces might act in combination, so that all apprehension of danger from this source may be put aside. This coincidence in the separate and distinct vibrations being avoided, it is satisfactory to know that with respect to the Britannia tubes, "the heaviest gales do not produce so much motion as ten men."

When a wind wave encounters an obstacle in its course there is more than one mode of action open to it. It may sweep the impediment bodily away, literally annihilate it, as is the manner of hurricanes, and then pursue its tempestuous career in search of another victim. It may push it with more or less violence out of its path, as occurs when it urges on the swelling canvas of the ship, or turns the sails of the windmill. Again, should the obstacle prove too strong to yield to either of these attacks, the wave of air will be broken up into two or more currents, and—according to the nature of the obstruction—will pass over, under, through, or around it, until it finds one or more avenues of discharge. Before, however, the wave is able to adapt itself to perhaps the only avenue or path for escape available, it may be caused to deflect or to rebound from the surface exposed to it, although eventually it must get free. When the wind impinges against a long high wall, which it is powerless to remove, it is in the first instance made to recoil or rebound from the surface exposed to it, split up into numberless eddies, currents, fitful blasts and gusts, which drive here, there, and everywhere, until rising upwards—for they cannot go downwards—they mingle with the upper strata and regain their original conformation, impetus, and direction. That wind waves are thus deflected and diverted from their original course by the resistance of exposed surfaces is evident from what occurred at the Britannia Bridge, where a heavy gale was diverted from its horizontal course, and descending in an oblique direction, ploughed up the surface of the water below in clouds of spray for some distance from the tubes. It is impossible, with the incomplete and limited amount of data at our command, to arrive at any sound solution of many of the difficult and complicated questions regarding the actual pressure of the wind on railway bridges and other structures. Under what circumstances the maximum pressure would obtain depends upon so many conditions, so varied in character, that even an approximate answer cannot be put forward with any amount of confidence. The manner in which the wind wave is affected by the surface against which it strikes exercises a considerable influence upon its future force and behaviour. Sir Benjamin Baker remarks as follows, with respect to some of the valuable and interesting experiments carried out by him during the construction of the Forth Bridge:—"As a matter of fact, so far as my experiments extend, it would seem that the eddies caused by the front surface extend to a great distance in all directions, and in a complex structure the innumerable and conflicting eddies would almost appear to neutralise each other as regards some of the sheltered surfaces." It would be unwise to make any allowance practically for this neutralisation, as frequently the very contrary action takes place. The separate and distinct currents formed by the interposition of an immovable surface to the natural path of a wind wave, in their attempts to find an outlet, very often re-combine, and aided by continuous reinforcements, ultimately assume a condition analogous to that of an accumulated head of water. It is well known that tremendous local pressures are produced from this cause, and it is possible that the unknown maximum may be yet found under these conditions, though they are fortunately more exceptional than general.

There is another point in connection with the subject of our article which is also enveloped in the same mystery and uncertainty surrounding the whole question. What is the law, if any, which determines the relation between the pressures and the altitude of the wind—for it is certain that no one pressure is constant for all degrees of altitude? The authority we have quoted assigns a different value to the wind pressure at the high level of the lattice top member, and at the level of the bottom tubes of the Forth Bridge. Assuming the rule of the Board of Trade, that a pressure of 56 lb. per square inch must be allowed by engineers in designing their bridges, it may be asked, Is this pressure calculated as being the most appropriate and exact for any particular height above sea-level or ground line, or other selected datum; is it to be regarded as a kind of general average, or the absolute permissible minimum for all elevations? If this limit be correct for an altitude of between 150ft. and 200ft., the equivalent pressure at the level of an ordinary road bridge would barely amount to 20 lb. per same unit of surface, an item too insignificant to be taken into calculation. This established standard, arbitrary as it is, of the wind pressure, while no doubt, similar to all the rules of the same authority, framed for the safety of the general public, is frequently adopted by local authorities, and insisted upon in instances where a dispensation, or what might be fairly termed a suspension of the standing orders, would be freely accorded. In The Engineer of November 3rd of last year we drew attention, in commenting upon an open competition for a bridge over a navigable canal, to the manifest incongruity of specifying in the list of instructions to competitors that a wind pressure was to be allowed for of exactly the same amount as was adopted in the design of the Forth Bridge. In other words, the pressure of the wind was assumed to be identical at the summit of the Inch Garvie pier and at the level of a bridge at a height of a few feet over mean sea level. We have noticed the same preposterous stipulations stringently enforced in the case of small road and street bridges, and in other examples, where the structure is situated literally *à fleur de terre* or *à d'eau*, as the location might assign. Some more discrimination should be observed in apportioning, not only this excessive unit pressure, but also as regards other barely possible exceptional concentrated loads. It would not be a matter of surprise to us if competitive designs were invited for a bridge, to be erected in a mine some thousand feet deep, to find that a wind pressure of 56 lb. per square foot was rigorously insisted upon.

We have not space to do more than allude to one or two other interesting features respecting wind waves. In a "through" bridge of the open web type, with an open platform, it was, until recently, not unreasonably assumed that the windward girder bore the whole brunt of the wind force, and that but very little, if any, took effect upon the girder to leeward. It is evident that in the case of a plate girder, if the platform be solid, the conditions approach more nearly to those characterising the tubular system. The report of the "Wind Committee" was to the effect that a front plate girder gave complete shelter to its fellow to leeward. This conclusion is not borne out by actual experience unless the two girders are very close together—much closer than obtains in ordinary bridges. The degree of protection or shelter afforded by the front girder to the other will depend, *cæteris paribus*, upon the description of bridge, whether open or solid sided, the depth of the girders, their distance apart—and this is a very important detail—and the nature and position of the platform. The idea once entertained, that one bar in the web of a lattice girder would shelter its neighbour in the rear, has been renounced as untenable. Wind or air is a perfect fluid, and essentially a live or moving force, and from the earliest days of the application of cast and wrought iron to railway bridges, the efficacy of opposing deadweight to the *vis viva* or impactive violence of moving loads has been recognised too universally to admit of dispute. Without for an instant advocating the employment—as was by no means uncommon in the days just referred to—of factitious dead loading, yet there is no doubt whatever that the security and stability of a railway bridge, or, in fact, of any structure subjected to the action of violent live loads, is in the ratio, though not necessarily direct, which exists between the insistent or dead and the live or moving load. Paradoxical as it may appear, the dead load kills the live.

## HARBOURS AND WATERWAYS.

*The Mersey.*—The Marine Committee of the Mersey Docks and Harbour Board have advised that tenders be asked for the construction of a second dredger of similar capacity to the Brancker, and capable of holding 3000 tons. The chairman, in bringing this matter before the Board, stated that the quantity of sand removed from the bar up to the present time was 8½ million tons, of which the Brancker had removed 4¾ millions. The depth attained over the whole length of the bar, and over a width of 1600ft., is on an average 23ft. at low water spring tides. There are, however, places where the depth is only 20ft., and this at present constitutes the navigable depth. It is considered that a depth has now been reached when the two smaller dredgers which have been acting with the Brancker can no longer work advantageously. Latterly the progress of removal has been at a slower rate than it was formerly. This is due to the fact that the particles of the sand now raised are much finer, and the material also being of a more mixed quality takes longer to settle in the hoppers. At the depth of 20ft. the Brancker could raise 3000 tons in forty-five minutes, whereas at the present time it takes from two and a-half to three hours to load the same quantity. The cost of removing the sand by the Brancker is only about half that by the smaller dredgers. In point of economy, therefore, it is advantageous to work only with large dredgers and to withdraw the smaller ones. It is estimated that within twelve months after the proposed second large dredger is procured a minimum depth of 26ft. will be attained over a width of 2000ft. It is the general opinion that the expenditure of the £58,000 which the Brancker cost has been fully justified by the results obtained, and that with the aid of a second dredger such a depth throughout the entrance and channel of the Mersey will be permanently secured as will allow the largest American liners to navigate the river at all states of the tide. It is also proposed to spend £400,000 in carrying out an extensive system of lairages for the landing and reception of foreign cattle on land northward of the Alfred Dock at Seacombe, including slaughter-houses, chill-room, and a floating landing stage 1000ft. in length. The present lairages can accommodate 3200 animals, those proposed will be arranged to hold 18,500 head of cattle in addition to reception lairs for 2500 others. While thus cattle are to receive the most extensive and luxurious accommodation, it is hard that no provision is proposed for the comfort and convenience of passengers using the large American and colonial liners. Embarking from Liverpool involves the discomfort of being conveyed in a tender, or else enduring nearly an hour's ride in a cab from the railway station to the docks, over perhaps the roughest pavement to be found in any town in England, and then a delay of about the same time while the steamer is warped round the numerous turnings and locks which have to be encountered from her berth to the Mersey. On coming home the unfortunate passenger has, perhaps in a pouring rain, to get from the steamer on to a small tender where saloon and steerage passengers are all mixed together, and to wait patiently while the luggage is transferred from the steamer to the tender, an operation which consumes a considerable amount of time; then there is the transfer of passengers and luggage to Prince's landing stage, and the removal thence to the Custom House. It ought not to be a work of very great difficulty to provide a deep water berth alongside the landing stage, and to bring the train on to this, as is the case at Southampton and Dover. If something is not done to provide better accommodation for passengers, Liverpool may certainly expect to find Southampton become the favourite port of embarkation.

*The Tyne.*—The new deep-water entrance to the Tyne Dock has been completed and opened for traffic. This work was undertaken by the North-Eastern Railway Company, the owners of the dock, about three years ago, after a vigorous agitation by the shipowners and merchants using the dock, its progress having been delayed longer than was anticipated owing to unforeseen difficulties. For several years it has been necessary for large vessels loading in the Tyne Dock to take in only so much coal as would enable them to get over the sill and complete their cargoes in the river, entailing loss of time and expense. The new entrance removes this drawback to the usefulness of the dock, and there is now sufficient water over the sill to float out large vessels at neap tides. With the recent addition of the Dunston coal staiths and the new deep-water entrance to the Tyne Dock, the Tyne can now claim to afford adequate facilities for the loading of coal, which will enable the district to maintain its hold upon the trade which has so long been connected with the Tyne ports. The Tyne Dock was constructed for the North-Eastern Company, under the direction of the late Mr. T. E. Harrison, their engineer, and was opened for traffic in 1859. It is 55 acres in extent, and has boasted of being the largest coal shipping dock in the world. The shipments of coal and coke from this dock have risen from about 1½ million tons in 1860 to over 6 millions last year. The sailing vessels which formed a large part of the coal fleet in former days are now almost entirely superseded by steamers, and, while the total number of vessels has decreased, the tonnage and size of each vessel has considerably increased. The provision of improved facilities for landing coal commenced five years ago, when a contract was let to Mr. John Jackson for the erection of staiths for eight additional coal spouts, making in all thirty-eight spouts. The new staiths are fixed 10ft. higher than those already in use. The railway sidings were at the same time considerably extended. The sum expended on these works amounted to £70,000. Following on this, and acting under the advice of Mr. Wolfe Barry, a deeper entrance has been made, and the dock and approaches deepened by dredging. This work has been carried out by Messrs. Lucas and Aird. The new entrance is 70ft. wide, and has 27ft. of water at neap tides and 32ft at springs. There are now three entrances—the new lock on the west; the old central lock having a width of 80ft., but with only 22ft. on the sill at springs; and the eastern lock 60ft. wide, and capable of locking a vessel 300ft. long. The gates of the new lock are worked by the direct action of a hydraulic ram, chains being dispensed with. Although coal forms the chief shipment, there are other trades carried on in this dock, the imports consisting of iron ore from Bilbao, and grain, for the storage of which two large warehouses have been erected.

*The Humber.*—As already referred to in previous notices, the condition of the Humber has recently excited considerable attention. The alleged shoaling which is said to have taken place appears to have affected the local newspapers and landsmen more than the Conservators, the pilots, and the captains of the boats using the river. However, the agitation has been sufficient to attract the attention of the Corporation of Hull, who passed a resolution calling on a committee to ask the Conservancy to put into force the powers vested in them by the Ouse Lower Improvement Act of 1884 for the protection of the river. The powers here referred to relate to the improvements carried out by the Aire and Calder Navigation Company in training the river from Goole downwards, by which a very great improvement in the navigation of the river has been effected. There is, however, a clause in the Ouse Improvement Act to the effect that if as the result of these works any damage or impediment should arise to the navigation of the Humber, the Humber Conservators are authorised to require the undertakers to removes the damage and restore the river to its normal state, the question as to whether any such damage had occurred being left to the determination of the Board of Trade. From the proceedings at the meeting of the Corporation, and also at a subsequent meeting of the Pilotage Commissioners, it would appear that an entirely false alarm had been raised. It was stated on the authority of Captain Perry, of her Majesty's surveying ship Triton, which is engaged in a new survey of the river, that the navigable channels were never in a better condition than at the present time. There is a permanent depth of 35ft. in Hull Roads over a sufficient width for vessels to swing. Captain Hume, the chief conservator of the river, also confirmed this, and said the channels were as deep as they were fifty years ago. The general opinion of the pilots appears to be that the river has improved during the last few years, and that the water is now deeper than formerly, a statement borne out by the fact that the steamers going to and from Goole never attempted formerly to come down the river drawing more than 12ft., but that now they load down to 16ft. The scare originated by the removal of H.M.S. Edinburgh, which has been lying in the same berth near the Middle Sand for several years. Owing to some alterations in these sands, it was found that there was not sufficient room for her to swing safely, and she was moved to another berth. Rumour says that she and the previous ships which have occupied this berth for a great number of years have caused the shoaling by the cinders, beef bones, and rubbish thrown overboard. The salvors of the steamer which was wrecked in the Ouse about three months ago do not appear to have been very successful in their endeavours to remove her, as she still lies in the same position as when run on the training wall. They are now blowing her to pieces with dynamite.

*The Bristol Channel ports.*—It is stated that an agreement has been settled between the Harbour Trust Committee of the Cardiff Corporation and Sir William Lewis for the acquisition of the Bute Docks on behalf of the proposed Cardiff Harbour Trust. The amount required, which includes the purchase of the Bute Docks and Glamorganshire Canal, also extensive royalties belonging to the Marquis of Bute, is £6,000,000. From this it would seem that the Cardiff Harbour Trust, if ever carried out, will be a very extensive undertaking, as it is proposed also to include both the Taff and Barry undertakings.

At Bristol the long-expected report of Mr. McCurrich, the dock engineer, has been made public. Mr. McCurrich does not consider that the same facilities for the large American liners can be given at Avonmouth as now exist at Southampton, as the construction of a low water pier, capable of taking vessels at all states of the tides, cannot be carried out at a reasonable cost. That it is practicable to construct works at Avonmouth to give facilities equal in character to those at Liverpool; that such facilities could be afforded by the construction of a lock and dock at a cost of £1,070,000. If a breakwater be added the cost would be £30,000 more; that it is practicable to dockise the river, and that the best scheme for this purpose would be by constructing an entrance lock on the Gloucester side of the river, a dam from this to the other side, with sluices at its extremity. The cost of these and other attendant works is estimated at £1,520,000, or, if a breakwater be added, £30,000 more. To this has also to be added £700,000 for additional accommodation at Bristol, and for sewage works and for floods, making the total cost of dockising 2¼ millions. Even if this scheme be carried out, provision would still have to be made for vessels of the largest class at Avonmouth. Although very guarded in his remarks, it is evident that Mr. McCurrich does not favour the scheme of dockisation. He admits that although practicable from an engineering point of view, the works would be very difficult to carry out and very costly; they would take much longer to execute than the other scheme; and that it would be a more difficult matter to get from Parliament the necessary powers. With regard to the effect of excluding the large volume of tidal water which now flows up the Avon on the deep-water channel at King Road, although he thinks that this would not lead to injury of the channel, he expresses the opinion that it would be a very difficult matter to convince the Admiralty that such would not be the case, and that very considerable opposition, backed by the opinion of engineers of eminence, would have to be encountered.

*The Thames.*—There is a very large export of chalk from the quarries at the lower part of the river, and this trade has recently considerably increased, especially the shipments to America. About four years ago the quarries at Northfleet, near Gravesend, which, with the adjacent land cover a considerable area, were purchased by Mr. Arthur Tolhurst. To meet the increasing size of the vessels which come for the chalk, he has recently constructed a deep-water pier which extends 240ft. into the river, and has a T-head 230ft. long and 32ft. wide. The railway lines laid down in the quarries are continued to the end of the pier, where the trucks discharge the chalk through shoots into the holds of the vessels. The front piles are 80ft. in length and 18in. square. The shorter piles are 12in. square, and all have been driven from 16ft. to 18ft. into the chalk, of which the river bed is composed, the approximate force required to drive them being about 50 tons. At the face of the pier the depth of water is 25ft. at low-water springs and 45ft. at high-water. The cost of the pier has been £10,000. Vessels of 5000 tons burden have been loaded at the pier since its completion.

Extensive alterations are about to be made at the Surrey Commercial Docks, principally for the purpose of meeting the increased requirements of the timber trade. This system includes sixteen different water areas, the docks covering 84½ acres, and ponds 71½ acres. There are four entrances from the Thames. About thirty years ago the Surrey Docks and Canal Company was united with the Commercial Docks, and for the purpose of improving the connection between the two systems the Canada Dock was constructed in 1876. Formerly the timber trade, of which the docks on the south side of the Thames have practically a monopoly, and which constitutes about 75 per cent. of the whole imports into these docks, was carried on in sailing vessels of small tonnage, but for the last twenty years these have been gradually giving place to steamers requiring a much greater depth of water. These timber steamers have to pass through the Surrey Lock, which is 250ft. long, 50ft. wide, with 28ft. on the sill at H.W.S.T. The South Lock, which is 220ft. long, 48ft. wide, with 28ft. on the sill, is principally used for ships carrying grain. The Greenland and Lavender Locks have only 18½ft. on the sills. The former, which was rebuilt in 1808, it is now proposed to reconstruct with a wider outlet to the Thames, and also to make a new canal lock to complete the junctions of the two systems commenced by the construction of the Canada Dock. Powers to carry out these works were obtained in the last session of Parliament, the amount authorised to be raised being £220,000. The plans for the alterations have been made by Mr. M'Connochie, the company's engineer.

The deepening of the Sault Ste. Marie Canal, on the Canadian side, is to be proceeded with, under a new loan of £500,000 just secured in England by Mr. Geo. E. Foster, the Canadian Minister of Finance.

# RADIAL ROLLING STOCK, BELGIAN STATE RAILWAYS

M. LEON BIKA, ENGINEER

Fig 5.

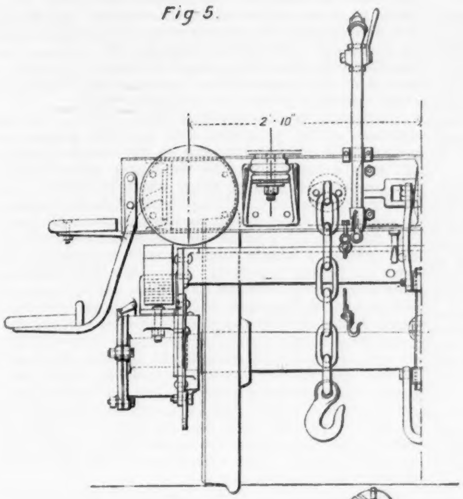


Fig 7

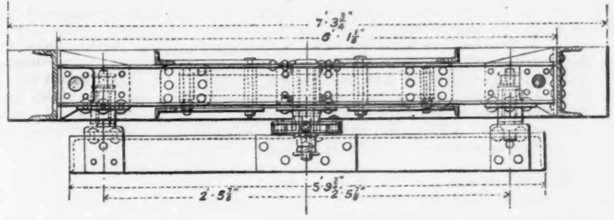


Fig 8.
Elevation

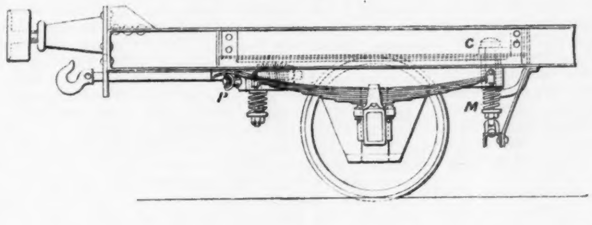


Fig 9.
Section at A.B.

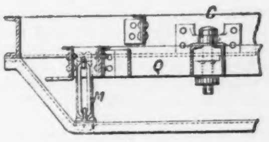


Fig 10.
Plan

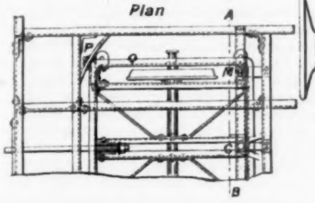


Fig 3

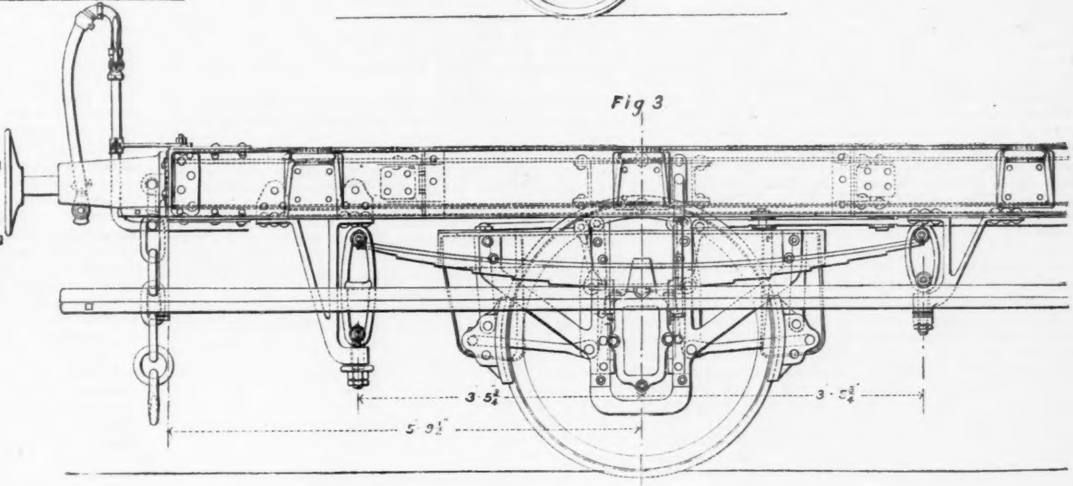


Fig 1.

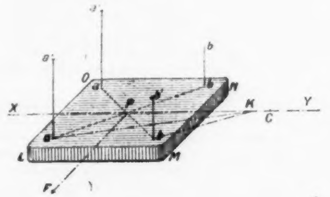


Fig 2.

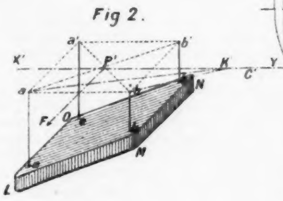


Fig 4.

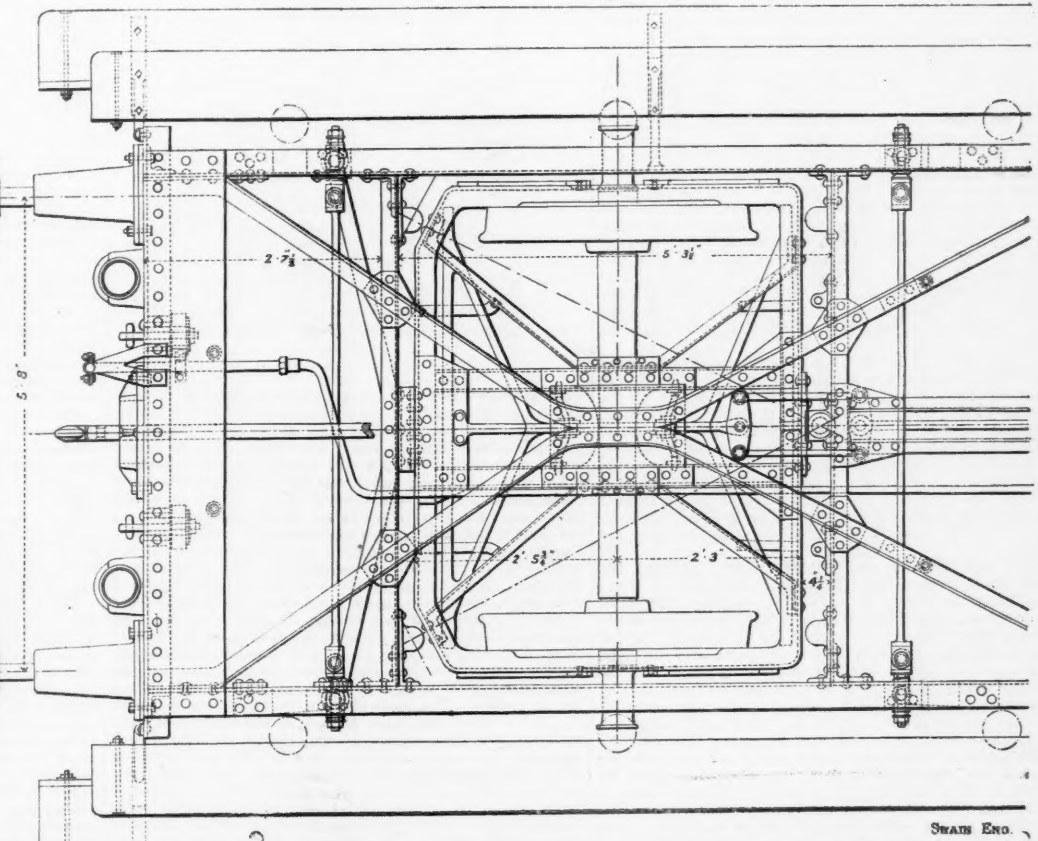
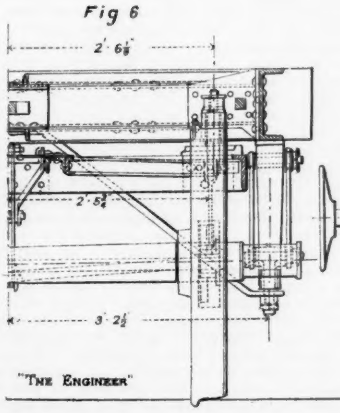


Fig 6



"The Engineer"

Swain Eng.

## DE RECHTER'S RADIAL SUSPENSION FOR RAILWAY CARRIAGES AND TRAMCARS.

We illustrate above part of the under frame of a railway carriage exhibited at the Antwerp Exhibition by the Administration of the Belgian State Railways. The extreme length of the frame is 39ft. 9in., and the width 7ft. 4in. It is carried on three pairs of wheels, of which the axles of the outer pairs are articulated, on the system invented by Mr. F. De Rechter. In this system, which is applicable to vehicles with two or more pairs of wheels, the radial displacement of the end axles is obtained by means of separate frames or trucks, which carry the horn plates, and are supported by the suspension springs, which they serve to brace together. The latter, which are fixed to the oil boxes, carry the main frame of the carriage, just as in ordinary rolling stock.

The principle on which this new system of suspension is based, is founded on the fact that a heavy body suspended by two pairs of jointed rods will turn round an imaginary point, if a force is working on it, in a direction at right angles to the axis of the figure, formed by joining the points of suspension of these rods. Thus, the block L M N O—Fig. 1—suspended by the rods $a\ a^1$, $a\ a^1$, $b\ b^1$, $b\ b^1$, which are arranged symmetrically to the axis X Y, and of which each pair are of equal length, will turn round the point $c$, if a force F working at right angles to the axis X Y is applied at P. The position of this point $c$ is more or less that of the point K, which can be found by setting out the lines K $a$, K $b$, in which the distances K $a$, K $b$ are proportional to the lengths of the rods $a\ a^1\ b\ b^1$. And the heavier the block L M N O is, the more nearly will the two points coincide. It is evident that the number of suspension rods need not be limited to four, if only they all have lengths which are in proportion to the distances that separate them from the point K.

If, instead of applying the force F to the body L M N O itself, it is applied at $P^1$—see Fig. 2—the point where the two lines $a^1\,b^1$ intersect, and if we suppose L M N O to be immovable, but weighing on the rods, it is clear that the figure $a^1\,a^1\,b^1\,b^1$ will turn round the point $C^1$, whose position with regard to the four rods is similar to that of C, as described in Fig. 1. Now the above represents what takes place in a railway carriage, when it passes from a straight line to a curve. The heavy body L M N O represents the frame and upper part of the vehicle, the swing links of the springs are represented by the rods $a\,a^1$ and $b\,b^1$, whilst the figure $a^1\,a^1\,b^1\,b^1$ represents the whole rolling apparatus, *i.e.*, the pair of wheels, with axle, springs, &c.

When the vehicle passes from a straight line to a curve, it has always a tendency to take a tangential direction; whilst the wheel, coming against the edge of the outer rail, is driven back at right angles to this direction, towards the centre of the curve, and this is what constitutes the force F. We see, therefore, that to oblige the axle to take of its own accord a suitable position, when going round a curve, it is sufficient to make the links of unequal lengths, and of dimensions so proportioned that they shall cause the axle to pivot round a point suitably chosen on the longitudinal axis of the vehicle. This point should evidently not be too far from the axle, so that the end of the vehicle should not go too far outside the curve, and so that the axle should always be in a radial position to the curvature of the line, whatever this might happen to be. When the vehicle leaves the curve, to enter the straight part of the line, the force F will disappear, and the weight of the carriage will be sufficient to cause the axle to return to its normal position.

The springs are connected at one end to the main frame by vertical bridles, which terminate at the supports of the fixed links, and at the other by movable curved supports, which can roll on the gusset plates. The fixed supports are at the ends nearest to the gudgeons, whilst the curved movable supports, or "sectors," are at the other end. The gudgeons, as in the Bissel bogie, are in the longitudinal axis of the main frame. The draw-bars are hinged at a point near each gudgeon, so as to allow of horizontal angular displacement. They pass through mortices in the cross pieces of the truck frame, and follow all the movements of the latter with regard to the main frame. The brake apparatus is so arranged that the blocks move sideways with the wheels, the point of application of the brake power for each truck being close to the pivot of that truck. Thus the angular movement of the wheel axles is not hampered by the action of the brakes.

The bridles of the links which join the fixed supports to the ends of the suspension springs turn on rollers, as also do the bridles which are connected with the sectors, and which correspond to the ends of the springs the furthest removed from the gudgeons. The gusset plates have ribs on them to guide the sectors, and these ribs are placed at right angles to the line joining the centre of the gudgeon with the centre of the eye of the spring—see dotted line on plan, Fig. 4. These gussets also serve to connect the intermediary cross-pieces with the longitudinals of the main frame. The curve of the sectors is struck from a centre situated below that of the bolt, which passes through the the roller of the suspension bridle. This excentricity will, by the weight of the carriage itself, tend to bring back the springs, and consequently the truck frames, into their normal positions. The inclination which the bridles of the fixed supports take, when going round a curve, will also have the same tendency. Stops are placed on the sides of the sectors; these enter slots on the ribs which are on the gusset plates, and prevent the sectors from going over too far on either side. Fig. 3 shows the elevation of one end of the carriage frame, and Fig. 4 is the plan of the same. Fig. 5 is a half end elevation, and Fig. 6 a half section, taken through the axle. Fig. 7 is a section through the main frame outside the truck, and showing the pivoting arrangement.

When the truck needs repairing, it is only necessary to remove the gudgeon, disconnect the end of the draw-bar, and unbolt the gusset plates; when the main frame can be lifted from the trucks, so that they can be repaired, or replaced by others in good order. If it is merely requisite to take out the wheels, it is sufficient to take off the lower caps and to lift the main frame, the same as with any ordinary railway carriage. The trucks would remain attached to the main frame, and the pair of wheels with their axle would be left on the rails.

Another exhibit at Antwerp is a platform car, which is also fitted with De Rechter's radial suspension. It is shown by Messrs. Ragheno and Co., of Mechlin. The length of the platform is 34ft., and the width 8ft. It stands on two bogie trucks, and has steel tubes, instead of girders or channel irons, for the side frames. It is loaded with bricks, which, according to a certificate signed by the engineer of the machinery hall, weigh forty tons. In several points of detail this car differs from the one shown by the Administration of the Belgian State Railways: but the long and short link, as shown on Fig. 3, and the rest of the pivoting arrangements are similar.

When used for tramcars, or narrow gauge railways, the system has to be modified. On a main line railway, where the radius of the curves is usually not less than 220 yards, and where the floor of the carriage is sufficiently high above the rails, there is nothing to prevent the links being made of suitable lengths. But with narrow gauge railway carriages, or tramcars, the wheels being of small diameter, brings the platform nearer to the rails, and the curves being usually much sharper than on main lines, it would not be possible to make the links of the proportions that would be required. For this reason, Messrs. Botey and Moreau, of Brussels, who exhibit the under frame of a metre gauge carriage, have introduced the modifications shown in Figs. 8, 9, and 10. Instead of the large links, curved rubbing pieces—P, Figs. 8 and 10—have been substituted and have the same effect. The suspension springs thus form part of a movable frame, which carries the horn-plates, and is connected with the main frame on the one side by the two short links, and on the other side by the rubbing pieces, which take the place of the long links. The truck frame also carries the draw-bar and pivots round a vertical gudgeon fixed to the main frame at the imaginary point of rotation, as described above. This gudgeon is shown at C, and the short links at M, whilst Q represents the frame of the truck.

We are indebted for the drawing, from which Figs. 3 to 7 have been prepared, and for most of the information given in the above description, to M. Léon Bika, M. Inst. M.E., general inspector and chief engineer of the Belgian State Railways.

## PEKING.

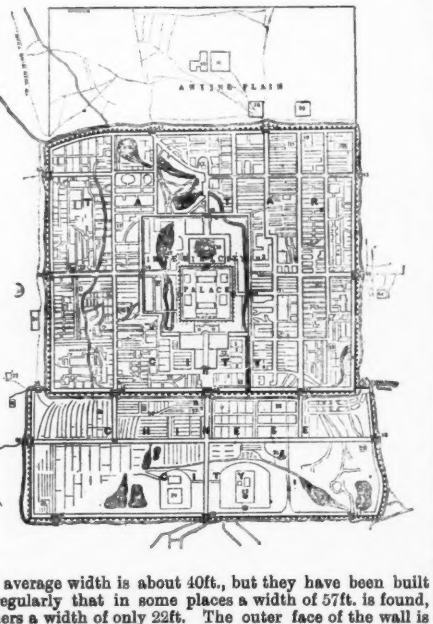
INASMUCH as the capital city of China will probably play an important part in the very near future, some information concerning it will be acceptable, we think, to our readers.

By far the most striking approach to the capital of China is that by the Tung-chow paved way. A fine high road of some hundred yards in width extends for two miles outside the city walls, its sides lined with respectable-looking shops, and in a state of cleanliness which contrasts favourably with most of the roads in the neighbourhood. Peking is situated in a sandy plain about thirteen miles N.W. of the river Peiho, and 110 miles W.N.W. from its mouth. A canal called the Yun-liang-ho runs from under the city walls to Tung-chow, where it enters the Peiho.

The city formerly existing on the site of the southern portion of Peking was the capital of the Kingdom of Yen, about 222 B.C. This kingdom was overthrown by the Tsin dynasty, and the seat of government was removed elsewhere. The court was restored to Peking by the fourth sovereign of the Kin dynasty in 1151, and named the celestial residence. In 1215 it was captured by Genghis Khan. In 1264 Kublai Khan fixed his residence there, the city being transferred one mile to the north of its former site. Thus the old portion became what is now known as the "Chinese city," and the terms "northern" and "southern" city, or more commonly nei-ching—within the walls—and wai-ching—without the walls—came into use. Under the native emperors who succeeded the Mongol dynasty, the court was removed to Nanking, which was considered the chief city of the empire, until, in 1421, Yung Lo, the third emperor of the Ming dynasty, again removed the seat of government to Peking, since which date it has remained the capital of China. Under the Mongols the city was called Khanpalik—corrupted into Cambalu: hence the name given to it by Marco Polo and early writers. The Tartars call it Pei-King-Cheng—northern, royal, residence, but generally omit the "Pei."

Peking was at first surrounded by a single wall pierced with nine gates. A part of the southern portion was subsequently enclosed, and the city now consists of two portions—the northern or Tartar city, and the southern or Chinese. The former contains about twelve square miles of ground, and in it are situated the palace, the Government buildings and barracks for the troops. The southern city is inhabited almost exclusively by Chinese. At the time of the Manchu conquest, all their officers were billeted in good houses within the inner city, but the wily Mongols have, in the course of time, got possession of them again, and Northern Peking is now largely tenanted by them.

The walls of the Tartar city are of an average height of 50ft., but portions of the north wall reach the height of 61ft. Their average width is about 40ft., but they have been built so irregularly that in some places a width of 57ft. is found, in others a width of only 22ft. The outer face of the wall is perpendicular, whilst its inner face slopes, in some places very considerably. Parapets are erected on both inner and outer faces of the wall, that on the latter being loopholed and crenellated. At intervals of about fifty or sixty yards are large buttresses, every sixth being of much larger size than the others; the smaller ones are about 15ft. to 20ft. square. Part of the inner brick lining having fallen away from the north wall, an opportunity was afforded of observing its construction. Near the gates the walls are occasionally faced with stone, but in other parts by immense bricks which bear a strong resemblance to stone. The space between the facings is filled up, first by a solid foundation of concrete of some 10ft. in depth, then by a layer of well-rammed earth, another layer of concrete, and another of earth succeed, the latter being paved with large blocks of granite, which form the *terre-plein*. The earth to fill in the wall was taken from the ditch which surrounds the city. The concrete resisted all the efforts of our sappers to form a trench on the *terre-plein* during the last war. Each of the gates has a buttress on either side connected by a semicircular wall, which thus forms an *enceinte*. That of the central south gate is larger than any of the others, and is the only one with three entrances—the central gate being for the use of the Emperor or his family alone. The arches of the gateways are well built.



The wall surrounding the Chinese city, and joining the other at the eastern and western extremities of its south face, is about 30ft. in height, 25ft. thick at the base, and, owing to the great slope inwards, only about 15ft. wide at the *terre-plein*; it is parapeted and buttressed.

The Tartar city wall is $14\frac{1}{2}$ miles in circumference. From east to west its total length is $4\frac{1}{3}$ miles, and from north to south $3\frac{2}{3}$ miles. The circumference of the wall surrounding the Chinese city is nearly 14 miles, or 10 miles from its points of junction at the east and west ends of the Tartar city wall. The total girth of the two cities is therefore 20 miles. The Tartar city appears to be composed of three squares, one within the other. The innermost of these is the area containing the palace, called the "Nei-kung," and known as the "Prohibited City." The walls surrounding the palace grounds, which enclose a space of about a square mile, are built of red brick, and crenellated. The terraces and glacis are also of brick, while the walks within the enclosure are stone paved. The gate forming the outer barrier of the palace is situated in the south wall of the Imperial city. It is a low ugly building with three doors, so constructed as to be in accordance with the usual Chinese custom, that interior magnificence should in no way be indicated outside.

Further on is the Meridian Gate, which is the southern entrance of the prohibited city, and the second from the palace itself. Before this gate on the east is a solar, and on the west a lunar, dial. In the tower above it, called the Teng-wen-ku, is a large gong, which is said to have been used in the time of the Ming dynasty—in the same manner as the drums to be found at the entrances of magistrates' Ya-meens at the present day—by would-be petitioners who, having failed to obtain justice through the ordinary channels, were permitted, by striking it, to draw the attention of the Emperor himself to their grievances; death, however, being the penalty of a needless or frivolous appeal. At the present day it is struck when the Emperor passes through the gate.

Inside is a courtyard, through which runs a small canal, crossed by five bridges with carved balustrades, lions, &c., all in fine marble. Enclosed is a building called the Tai-ho-Tien, which has five avenues of fine marble like the bridges. It is upon a basement 20ft. high, and rises to a total elevation of 110ft. The ascent is by five flights of forty-two steps each, with balustrades, ornamented with tripods and other figures in bronze. The central avenue is very broad, and is used by the Emperor alone.

At the back of the Tai-ho-Tien is the gate leading to the palace proper, which consists of four large and two smaller buildings, the latter of which are allotted to the Dowager-Empress and suite. According to native descriptions, the palace used as the actual residence of the Emperor has its floors painted of a vermilion colour, disposed in a square pattern. The centres of the rooms are covered with native yellow velvet carpet, and in most of them the furniture is constructed of the best southern wood, which takes a high polish. They assert, however, that the Emperor's own room contains sofas, &c., of which the frames consist of solid gold. The official reception-room has a carpeting of rough velvet worked with yellow dragons, and it contains no seats, except the throne itself—none, however, high his rank, being permitted to assume any other than a kneeling position while in the presence of the sovereign. The throne itself is placed on an elevated dais 90ft. high, and ascended from behind by staircases. Beneath, and supporting it, is a large gilt copper dragon, with five claws. On either side of the hall is a music gallery. It was in this palace that Kanghi celebrated a singular festival in 1722, for all the men in the empire over sixty years old, that being the sixtieth year of his reign. His grandson, Kien-Lung, in 1785, in his fiftieth year of reigning, repeated the same ceremony, on which occasion the number of guests was about 3000. Beyond the Emperor's palace, stands the palace of "Earth's Repose," where the Empress, or "heaven's consort," rules her miniature court in the Imperial harem, and between which and the northern wall of the forbidden city is the Imperial flower garden. The gardens are adorned with pavilions, temples, and groves, and interspersed with canals, fountains, pools, and flower beds. Two groves, rising from the bosoms of small lakes, and another crowning the summit of an artificial mountain, add to the beauty of the scene.

In the eastern part of the prohibited city are the offices of the Cabinet and of the Imperial Treasury. To the north is the "Hall of Intense Thought," where sacrifices are presented to Confucius and other sages. Not far from this stands the Hall of the "Literary Abyss," or the library, the catalogue of whose contents is published from time to time, forming an admirable synopsis of Chinese literature. North of the Imperial Palace enclosure is a square walled space more than a mile and a-half in circuit. This contains the King-Shan, an artificial mountain, composed of coal brought long ago from the mines at Ping-Yang to the northward of the province. This remarkable mound is about 150ft. high, and is covered with earth, in which a number of trees are planted, which line the paths to the summit and border the base. The top, crowned with pavilions, presents a splendid view, whilst animals and birds in great numbers occupy and enliven the enclosure. The earth and stone to complete this mountain were taken from the ditches and pools dug in and around the city, and near the base are picturesque tanks, surrounded with trees and flowers, from which materials were also excavated.

The western part of the prohibited city is chiefly occupied by a park, in and around which are found some of the most beautiful objects and spots in Peking. An artificial lake, shown on the engraved plan, more than a mile long, and averaging a furlong in breadth, occupies the centre. It is supplied by the Tung-Hwui river, and its waters are adorned with the splendid lotus. A marble bridge of nine arches crosses it, and its banks are shaded with trees, beneath which are paved walks. Artificial hills of rockwork, and summer-houses on marble bridges in the midst of lovely gardens, are seen everywhere.

The next enclosure surrounding the prohibited city is the Imperial wall. This is built of brick, roofed with yellow varnished tiles, is some 25ft. high and about 6ft. in thickness. It has four gates. The walks within the Imperial city are wide and well kept, and afford a favourite ride to the foreign inhabitants, except during heavy rain, when they are almost impassable. The bridge before alluded to is the only public road for crossing the Imperial grounds. On the eastern bank of the lake is a large white pagoda, built in Indian style. It is said to have been erected on the rising ground where the last of the Ming Emperors, with the flames of his burning palace in view, hanged himself to avoid the degradation of falling alive into the hands of his conquerors. There will probably be within the next few months an opportunity for the last Manchu Tartar Emperor of China to perform a similar ceremony, in handing over the keys of his empire to the Japanese field-marshal Oyama, who appears at present to have every intention of occupying Peking.

We refrain from giving our readers a description of the many and interesting temples to be seen in Peking, but the Observatory in the Tartar city cannot be passed over. Near the eastern end of the south wall, looking north, we perceive at 500 yards distance a sort of square tower abutting on the inner face of the wall, and some 12ft. higher, which is the much-talked of observatory at Peking. This observatory, built by the Emperor Kanghi, and furnished with instruments constructed under the direction of Ricci and other

Roman Catholic missionaries—who at that time, in spite of all difficulties, had managed, not only to penetrate to the then hermetically-sealed capital of the middle kingdom, but to become the advisers and authorities of the Imperial Government upon all points of science—is a stone building of two stories, the lower one being now unused. The upper and exposed portion, which still retains the frameworks of the magnificent instruments originally placed there, is the chief point of interest. The courtyard contains two planispheres, each supported on cast bronze dragons of exquisite workmanship, inferior to nothing producible in Europe. The instruments on the summit consist of a celestial globe, on which are laid down all the principal stars visible in the latitude of Peking; various quadrants and other instruments for determining altitudes, and lastly a species of transit instrument, which appears to have been extensively made use of. The telescopes, glasses, &c., belonging to these have long since disappeared, having been appropriated by those in charge.

To the west of the observatory is the examination hall of the vast number of the literary candidates who resort to the State examinations. It contains an enormous number of cells—said by the Chinese to be 10,000—and in these, upon periodical occasions, may be seen students from the age of twenty-five to that of sixty, patiently plodding away at copies of the sayings of Confucius and Mencius, the test of handwriting being the most serious one in the whole synopsis.

The Chinese city is principally occupied with hotels, municipal buildings, temples, merchants' dwellings and shops. It is here that visitors usually stay whilst at Peking. The legations are mostly between the gate of the Imperial enclosure and the outer portion. The accompanying figures have reference to the map:—(1) British Legation. (2) German Legation. (3) Russian Legation. (4) French Legation. (5) United States Legation. (6, 7, 8) French Mission Churches. (9) Foreign Customs. (10) Lama Temple. (11) Confucian Temple. (12) Corean Embassy. (13) Mahomedan Mosque. (14) Observatory. (15) Imperial Temple. (16, 17) Temples. (18) King-Shan. (19) Examination Hall. (20) Russian Mission. (21) French Church Mission. (22) Mongol Market. (23, 24) Temples. (25) Golden Fish Ponds (26, 27) Picture Street and Theatre. (28) Book Street. (29) Foundling Hospital. (30) Hospital. (31, 32) Soup Kitchens. (33, 34, 35) Temples. (36) Graves for Criminals. (37) White Ming Pagoda. (38) Russian Cemetery. (39, 40, 41) Temples. (42) Drum Tower. (43 to 51) Gates of Tartar city. (52 to 55) Gates of the Imperial city. (56 to 62) Gates of the Chinese city, exclusive of wall dividing Chinese and Tartar cities. (64) Temple. (65) Execution Ground.

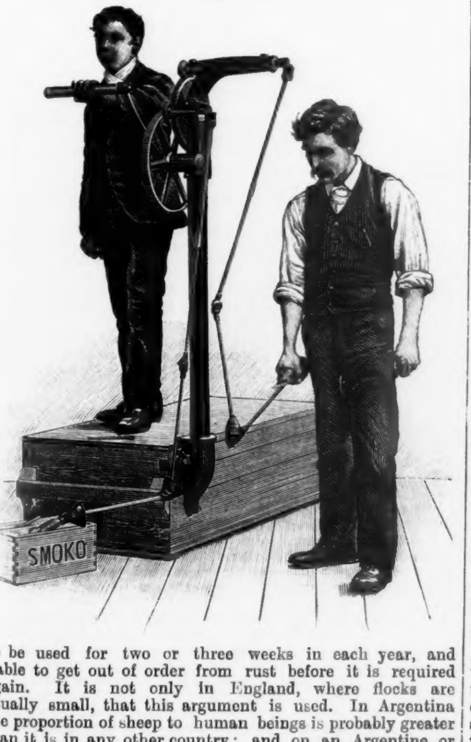
For much of our information, and for the sketch map, we are indebted to the "Treaty Ports of China and Japan," a work printed in Hong Kong, and to Dr. Williams' well-known works.

## THE NEWALL-CUNNINGHAM SHEEP SHEARING MACHINE.

A HAND-power double sheep-shearing machine, the invention of Mr. J. W. Newall, was shown at work on Tuesday, the 20th inst., at the Great Northern Horse Repository, Caledonian-road.

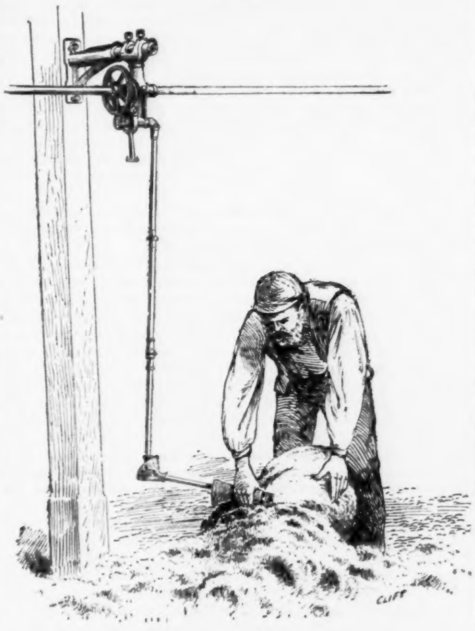
The use of sheep-shearing machines has been more general in Australia and New Zealand than in other parts of the world, and there is no doubt that with a machine which is well made, and kept in good order, shearing can be done more evenly than with shears, with less risk of injury to the sheep, and less fatigue to the operator. But as shearing is an operation which only takes place once a year, many farmers are not prepared to put up a line of shafting to be used for two or three weeks in each year, and liable to get out of order from rust before it is required again. It is not only in England, where flocks are usually small, that this argument is used. In Argentina the proportion of sheep to human beings is probably greater than it is in any other country; and on an Argentine or Uruguayan *estancia* sheep-shearing is the event of the year. There is no country where threshing and baling machines have come into more general use; and this is a proof that the farmers are not prejudiced against machinery. But though some of them have started sheep-shearing machines, they have not been adopted to any great extent. It may fairly be said, whether we consider the small flocks of England and France, or the gigantic ones of Australia and Argentina, the first requisite in a shearing machine is that it should be movable.

Fig 1



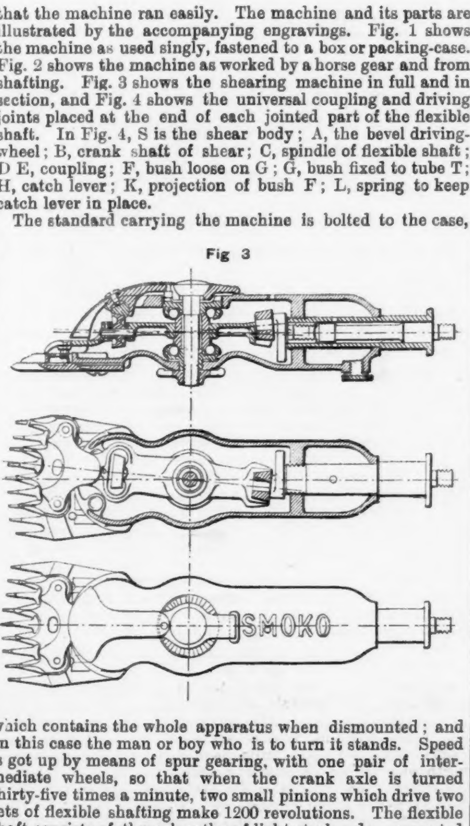
The next point is that of speed. There are authenticated instances in Australia of 200 sheep being clipped by one man in twelve hours, but ten per hour may be taken as a fair average. As the shearers are paid by the piece, they will not take kindly to any machine which does not enable them to clip a larger number than they could with shears. Mr. Newall estimates that a good shearer should be able to shear 130 sheep per day with his machine, as he says that they have frequently been sheared in 3½ to 4 minutes each by skilled men. On Tuesday six sheep were sheared, two at a time. The average for each was 8½ minutes, but the shearers were not endeavouring to make a time record; their object was rather to show the neatness with which the whole of the wool could be removed, including that on the head and legs. They were also slightly delayed by several of the gentlemen present, who wanted to turn the handle, to assure themselves that the machine ran easily. The machine and its parts are illustrated by the accompanying engravings. Fig. 1 shows the machine as used singly, fastened to a box or packing-case. Fig. 2 shows the machine as worked by a horse gear and from shafting. Fig. 3 shows the shearing machine in full and in section, and Fig. 4 shows the universal coupling and driving joints placed at the end of each jointed part of the flexible shaft. In Fig. 4, S is the shear body; A, the bevel driving-wheel; B, crank shaft of shear; C, spindle of flexible shaft; D E, coupling; F, bush loose on G; G, bush fixed to tube T; H, catch lever; K, projection of bush F; L, spring to keep catch lever in place.

Fig. 2



The standard carrying the machine is bolted to the case, which contains the whole apparatus when dismounted; and on this case the man or boy who is to turn it stands. Speed is got up by means of spur gearing, with one pair of intermediate wheels, so that when the crank axle is turned thirty-five times a minute, two small pinions which drive two sets of flexible shafting make 1200 revolutions. The flexible shaft consists of three lengths of light steel rods, connected together by swinging bevel gearing, and fixed in a jointed sheath made of steel tube. At the top of the sheath is a universal joint, which allows movement in any direction without interfering with the free running of the internal driving shaft; and at the lower end of the shaft another universal joint connects it to the clippers. The swinging bevel gearing, which is the invention of Mr. Newall, is one of the chief specialities of the machine. In this gearing the teeth have a curved sharp edge, terminating in a point, and they are bevelled in such a manner that they are always in contact at any angle. Consequently, whether the shaft is allowed to swing freely, or held straight, or in any position, the motion from the machine is transmitted uninterruptedly to the cutter.

Fig 3

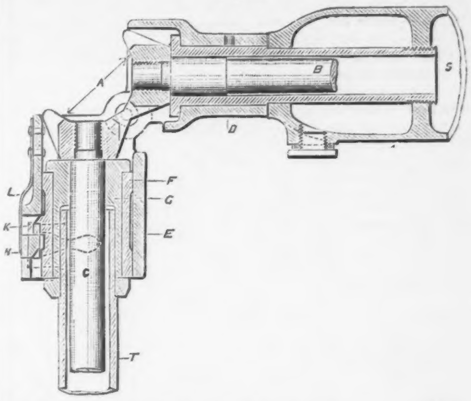


This has four teeth. It measures 1¾in. from point to point, or 2in. over all; and it works over a rounded steel comb 2½in. wide. The cutter pivots on a steel cap which runs on small steel balls, and the comb can either be held down so as to shear as closely as possible, or by distance pieces being fixed to the back of it, it can be arranged to leave all the wool of a certain length, say, half an inch or three-quarters. When once the date of shearing has been fixed, and the men engaged, it is impossible to postpone it; and it frequently happens in Scotland, and also in warmer localities, that if the sheep are sheared too closely, many of them are lost. Sheep-shearing machines would have succeeded better in Argentina if the first ones sent out had been provided with these guides.

It would be an interesting experiment to see how many sheep could be sheared in eight hours by two men and a boy with one of these machines, with the distance pieces set to leave half an inch of wool all over, and not trimming the heads and legs with that care which was displayed on Tuesday.

A useful modification of this machine would be one by which a number of them could be driven by steam, electricity, or horse-power, without the need of overhead shafting. At shearing time on a large estate there is work for every man or boy than can be had, without requiring one to set the clippers in motion for every two shearers. The machines run so easily, that it would be possible to join a number of them by a line of shafting running along their bases, and connected at each machine by universal joints, so that the floor of the shed would not need to be perfectly even. Of course this would only be advantageous where a number of shearers are employed, the hand-power machine now exhibited being all that most British farmers will require.

Fig. 4



## THE IRON GATES OF THE DANUBE.

By BELA VON GONDA, Chief of the Department of Navigation of the Interior.

(*Continued from page* 378)

BOTH dykes of the Iron Gate Canal are projected to be 0·5 metre high above the highest known water level. The dyke of the right side, being intended to serve also as a towage path, is to have a crown breadth of 6 metres, while the crown breadth of the left dyke is only 4 metres. The slope of both dykes on the canal side will be 1 : 1·25 towards the Danube, and 1 : 2 towards the shore. The bank of the left side of the canal leaning against the dyke as a foundation will be constructed of mixed gravel and earth, and on the canal side it will be covered with a stone pavement. The inner part of the dyke on the right side is constructed also out of mixed material, surrounded on both sides by corresponding strong stone dykes, the surface of which will be paved to protect it against water and ice.

As to the systematic deepening of the bottom of the Iron Gate Canal, it was arranged in the projects that after the construction of the left dyke to the rock bank Prigrada, the upper mouth of the canal being blocked by a corresponding stone dyke, the blasting of the rock necessary for the deepening of the canal should be executed by damming out the water, at least where it is shallow and quiet, as this will considerably diminish the costs of the works.

The works were begun in accordance with these proposals, and as the contractors succeeded in pumping the channel dry, and thereby facilitated the deepening of the canal in the rocky part, the present Hungarian Minister of Commerce, Mr. Bela Lukács, was induced to further increase the depth, in order to make the part of the Danube below the Iron Gate accessible to larger ships of 2000 to 2200 tons, drawing 2·5 to 2·75 metres, and to bring the great traffic of the Lower Danube in direct communication with the Black Sea, as far as Orsova, situated on the Hungarian frontier, and consequently creating a transit station connecting it with the lines of the Hungarian State Railways. For these reasons he determined to take advantage of the opportunities to construct the Iron Gate Canal 3 metres deep below the lowest water-mark, instead of 2 metres, and this, of course, caused the deepening of some of the shallow places of the Danube between the Iron Gate and Orsova. The velocity of the stream is calculated to be $\frac{4}{5}$ metre per second on the canal constructed in this manner, and the quantity of water per second at low-water mark to 2000 cubic metres, and at high water to 3000 cubic metres. Against this the quantity of the down running water in the channel at low water is 2000 cubic metres, just half of which has to be led into the Iron Gate Canal, so as to supply the calculated water depth.

In order to be able to form an idea of the size and extension of the works of construction of the Iron Gate Canal, we must mention that 367,000 cubic metres of rocks had to be blasted out of the bottom of the canal, and 297,000 cubic metres of stone laid and 270,000 cubic metres mixed material used for the construction of the dykes, besides the section of the lower and upper mouth, the final settlement of which will depend upon the modified state of the water and of the progress of the work.

The relative fall of the low-water surface on the Iron Gate Canal is calculated to 0·00249, which is especially at low water, considering the smoothness of the channel of the canal, being partly cut into the rocky bottom, partly amongst dykes covered with stones, is so considerable that it will give a water velocity of 4 to 5 metres, for the surmounting of which they will be obliged to establish a special towage service on the length of the canal, about which studies are already made. This towage will be such a one as to satisfy the greatest demands of the navigation on the Lower Danube.

It was impossible to avoid the above-mentioned extraordinary great fall of the canal, because by the difference of water surface of 4 to 5 metres prevailing in the channel above and below the Iron Gate, the water surface of the canal is a result of natural barriers, including the rock walls, which cannot be more favourably formed by an open canal.

The disadvantage resulting from the fall of water surface is, however, not so great as it would have been by the construction of a lock canal, which would have hindered the navigation in a larger measure—not considering the wear and tear of the lock, which would cause interruptions of the navigation for a longer or shorter time. For the removal of this—the most considerable hindrance to navigation on the Lower Danube—formed by the cataracts of the Iron Gate, the projected open canal, provided with an apparatus for the towage of ships, is to be regarded as the best solution of the question, and satisfies the greatest demands of modern navigation.

Thus, the cataracts of the Lower Danube will, by the above described improvements, become navigable. But among these cataracts—though spread over considerable length—there are shallow places, prominent rock peaks, which will be deepened, viz., blasted to 2 metres below the lowest water surface. For this purpose 10,000 cubic metres of rocks are to be blasted away under the water.

*Statement of Quantity of the Work to be executed to render the Iron Gate and the other Cataracts on the Lower Danube Navigable.*

| No. | Cataracts. | Rock removal in the open river. | Rock removal on dry or in shallow water. | Stone placed. | Mixed material. | Stone pavement. | Stone laying. | Costs of construction. |
|---|---|---|---|---|---|---|---|---|
| | | cu. m. | cu. m. | cu. m | cu. m | sq. m. | sq. m. | Florins. |
| 1. | Stenka .. .. | 7,400 | — | — | — | — | — | 111,000 |
| 2. | Kozla-Dojke .. | 76,586 | — | — | — | — | — | 1,147,250 |
| 3. | Jzlas-Tachtalia-Greben .. | 46,800 | — | 505,600 | — | — | 106,300 | 2,613,750 |
| 4. | Jucz .. .. .. | 30,000 | — | 70,000 | — | — | 29,000 | 724,300 |
| 5. | Iron Gate .. .. | 27,840 | 368,000 | 196,000 | 260,000 | 80,000 | — | 4,765,000 |
| 6. | Between the cataracts .. | 10,000 | — | — | — | — | — | 150,000 |
| | | 198,626 | 368,000 | 771,600 | 260,000 | 80,000 | 135,300 | 9,511,300 |
| For supplementary works, supervision, and control .. .. .. | | | | | | | | 938,700 |
| | | | | | | | Total .. .. .. .. .. | 10,500,000 |

The regulation works to be executed to render the cataracts of the Lower Danube navigable having been finally established, and the financial situation ameliorated, the Hungarian Government, viz., Gabriel Baross, the Minister of Public Works and Communications of that time, presented in 1888 to the Legislature the general projects and estimates of the regulation works necessary for the re-moval of the navigation hindrances existing at the Iron Gate and at the other cataracts. In consequence it was decided by the XXVI. Law of 1888, that the Hungarian State takes upon itself the execution of these works, exercising the right of levying customs temporarily, such right being conferred upon it by the LVII. Art. of the Berlin treaty of 1878, and the VI. Art of the London treaty executed the 13th March, 1871. The law states, that the Minister of Public Works has to execute the above-mentioned works on the basis of the projects presented to the Legislature, and undertakes to make such dispositions as may be necessary in the interest of the successful execution of the works, and for their conservation and administration. The cost of these works—which are to be finished at the latest at the end of 1895—was fixed, with the proportions to be paid during progress, at nine million florins. By the Law Bill the Minister of Public Works was further entitled to fix, in conjunction with the Minister of Finance, the time and the way of levying the customs which Hungary will have the right to charge in virtue of the LVII. Art. of the Berlin Treaty on the trade ships for covering the expenses of the works. Finally, the law states that after the execution of the works an exact account is to be rendered to fix the cost of execution. The fixed amount, its annual interests and percentage of amortisation, the costs of administration and maintenance of the works, and the revenue resulting from the levied taxes, shall be the object of a special account.

The XII. Law of 1889 also provided that the costs of the works should be covered by the advances from the money stocks at disposition in the State treasury. The sum of 500,000 florins, required to begin the works, to procure the tools and machinery, to organise the direction of works, having been put to the disposal of the Minister of Public Works, all preparations and dispositions were made to begin these great works, which works had suffered so many long delays.

The largest part of the regulation works extending in the territory of Servia, it was the first thing to arrange between the two Governments for the free and uninterrupted movement for men and materials. As soon as this was done, the Minister of Commerce organised a technical bureau for surveying and controlling the execution of the works. This bureau had its seat in Orsova, and was constituted in the following manner:—Chief of the bureau, Ernest Wallandt, ministerial councillor; assistant, Alois Hoszpotzky, chief engineer; members: Ernest Jzsaky, ministeral engineer; Eugène Gruber, and George Kherndl, royal engineers. Later the minister delegated Francis Herbert captain of engineers.

The so organised technical bureau had at first to elaborate the particular plans, and to study the hydrographical condition of the section which was to be regulated. In the same time the minister made dispositions as to the modus and means to be employed in the most difficult part of the work, viz., the blasting of the rock under the water in the open river. He proposed to give a prize for explosive material to blow up the rocks under the water, and for the best systems with which the removal of the rocks under the water could be executed with success. The offers presented were put before a special commission, which examined the explosives and made several experiments on the spot. Moreover, the minister sent Mr. Béla Gonda—technical councillor and reporter of the Iron Gate business in the ministry—and Mr. Alois Hoszpotzky—chief engineer and assistant of the said technical bureau—to Bingerloch in order to study the works of blasting which were in execution. The result of this journey was a particular report, which contributed much to fix the practical execution of the works in question.

After a careful study of the nature of the works and modes of execution, the minister was convinced that it would be the best to execute this heavy work by contract. On the 5th December, 1889, he opened a public competition, and the advertisement in question was published which had regard to these works, without precedent in Europe and of an international importance. This was published on the Continent and abroad, and the plans and stipulations were put at the disposition of foreign contractors through the embassies. The date was fitted at 31st March, 1890, so that the competitors had four months to study the plans and the local conditions.

During this time the technical bureau finished the new survey and the elaboration of the plans, which were to form a completing part of the contract.

Moreover a great and difficult task was to be solved before the beginning of the work; the technical bureau had to determine on the whole length of regulation, the fixed points, and marks of low water, which the engineer, Paul Vásárhelyi; the author of the first plans of regulations, has fixed. With the aid of these old and somewhat defective data the bureau had to indicate the height of the lowest water in 1834, and fix them definitely afterwards by levelling, which was to furnish the basis of the large works in question, and to serve in future the requirements of those who will need to study the hydrographical condition of this section, and also for those who would execute these new works. The technical bureau thus accomplished a work of lasting value, and caused it sending copies of the lithographed plans to be sent to several scientific institutions and authorities. In view of the special nature of the works and of their great difficulties, care had to be taken to arrange so that some works might be executed under State supervision, and such precautions taken as were deemed necessary to ensure the execution of the works, notwithstanding any possible eventualities.

On the 31st March, 1890, four contractors presented their tenders. Two of these tenders concerned only a part of the works, and the two others demanded exorbitant prices, so that their tenders could not be accepted; but after long negotiations, one of the syndicates offered to accomplish the proposed works for nine million florins. In consequence of this, on the 22nd May, 1890, the final contract was let with the syndicate composed of Julius Hajdu, Hungarian hydro-technical engineer; Hugo Luther, manufacturer at Braunschweig, and the Berlin Discount Society. With this contract these contractors obliged themselves to finish the whole work by the 31st December, 1895. It was stipulated that the syndicate should begin the works within two months. The contractors took charge of the works on the spot on the 16th and 17th June, and began the same on the 18th September, 1890. They took charge of the grounds which were necessary for the working yards and quarries; this was not without difficulty, because the largest part of them are situated on the Servian territory; then lodgings for the workmen, offices, workshops, storehouses, &c., were soon erected. They began also to equip and manage the quarries, ordered tugs and pontoons necessary to the works, boats for measuring and surveying the rocks below the water stipulated in the contract, further boring machines, derocheurs, used for the removal of the rocks, ships, dredges: in one word, all dispositions were made in order to begin the works and to finish them in a comparatively short time. The question of the navigability of the cataracts on the Danube formed the object of international negotiations, several States being directly concerned, and had a universal importance.

(*To be continued.*)

## THE GENERAL SKINNER.

We illustrate this week a mining steamer, the fourth of the kind built by Messrs. Cox and Co., of Falmouth, for H.M. War Department. The boat has a length of 86ft.; beam, 18ft.; depth, 9ft. 4in.; the bunker capacity is 15 tons. She carries of water ballast 5½ tons. Lifting appliances consist of a bow davit derrick and two mast derricks, worked by steam capstans and engines manufactured by the same firm. The twin screw main engines are compound, with cylinders 11in. and 22in. by 15in., having one condenser with 400 square feet of cooling surface, in the centre and supporting both sets of engines. There is a separate auxiliary pumping engine, with cylinders 5½in. and 11in. by 10½in. stroke; the air pump is 10in. diameter; the circulating pump is 7in. diameter. There are double-acting feed and bilge pumps 2½in. diameter each; all pumps are 10½in. stroke. The main pumping engines are fitted with Marshall's valve gear; the propellers are of gun-metal 5ft. 9in. diameter, 6ft. 6in. pitch, and a total area of 9·9 square feet; the boiler is horizontal, multitubular, 10ft. 1½in. diameter by 9ft. 0⅛in. long; working pressure, 100 lb.; indicated horse-power is 320; revolutions, 220. This vessel is used for laying and raising submarine mines for defensive purposes and blowing up wrecks.

The Polytechnic Optical Relics.—Last Monday night two of the six old lanterns of the late Royal Polytechnic Institution, and a considerable number of specimens of the old hand-painted slides, were exhibited in the hall of the Lantern Society by Mr. Hay Taylor, with Sir Slingsby Bethel, president, in the chair. There was an overflowing attendance, including Mr. W. R. Hill, one of the lantern-slide painters to the Polytechnic. Although some good projection lenses were available, Mr. Taylor preferred to use the earlier ones employed at the Polytechnic, consisting each of a pair of plano-convex lenses, with their curved surfaces towards each other, on the ground that they gave a softer picture, more pleasing to the eye than if the pictorial outlines were sharper. By way of a change, it was a treat to see once again upon the screen lantern pictures not of quaker-like garb, but glowing with all the beauty of colours artistically laid on. The general result tended to raise the question in the mind whether photographic slides need necessarily be divorced from good colouring, and from the ideal side of art. For instance, outline pictures might be drawn on paper on a large scale by good artists, these outlines then photographed on glass, and painted by skilled artists as distinguished from ordinary colourists. Another plan would be to print excessively thin photographic transparencies on glass, merely to serve as a guide to the painter, and to be practically almost lost to sight by reason of his overlaid work. Most of the rising generation have never seen phantasmagorian effects produced on translucent screens by lanterns running on rails, nor the optical effects which can be produced by six lanterns working at one time, and such providers of popular entertainments as the Crystal Palace Company, who like attractions which involve little or no expense after the first cost, might do well in these days of lantern projection to consider whether the glory of artistic painting cannot be restored by their aid in these times to optically projected pictures. Anything of this kind should be done well or not at all. Mr. Edmond Wilkee, who, as we mentioned last week, bought up a vast number of the Polytechnic slides, and lent some of them for last Monday's display, was unfortunately unable to be present himself last Monday through illness.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### LOCOMOTIVES AND TRAINS.

Sir,—In reply to the letter from Mr. Norman D. Macdonald in your issue for November 16th, I beg to say that I simply took what I believe is the usual practice, namely, 50 per cent. of the weight of engine and tender, and the whole weight of carriages, &c., as brake pressure. I did not know anything about the composition or distribution of brake pressure on the train in question, excepting what I gathered from Mr. F. Bowles' letter of the 19th ultimo, so I simply took the brake pressure on the above assumption, upon which I based my calculations. I thought a comparison would be of interest in showing the relative retardation when only 50 per cent. and the whole weight of the engine and tender was taken as brake pressure, in the latter case the train would be equally braked. I stated "fully," instead of "equally," in my previous letter of the 5th inst., but, as I shall endeavour to show later on, the latter term is the most suitable to apply.

Of course the maximum efficient brake pressure, that is to say, the maximum pressure which can be applied without skidding the wheels, and which, as previously shown by me, varies according to the speed of the train, does not bear a constant ratio to the weight on the wheels braked, thus it has been found that at a speed of 7½ miles per hour—or 11ft. per second—a pressure of 1·04 of the weight on the wheels braked would produce skidding, whereas at a speed of 60 miles per hour—or 88ft. per second—the pressure might rise to 3·47 of the weight on the wheels braked before skidding took place. Let ($\mu$) and ($\mu_1$) represent the coefficients of friction in the former and latter cases respectively, then

$$1\cdot04\ W\mu = 3\cdot47\ W\mu_1$$

$$\therefore \frac{\mu}{\mu_1} = \frac{3\cdot47}{1\cdot04} = 3\cdot33.$$

Now ($\mu$) has been found to be about 0·24, and

$$\therefore \mu_1 = \frac{0\cdot24}{3\cdot33} = 0\cdot072.$$

Assuming the average coefficient of friction as 0·15, and $y$ as the average proportion of weight on wheels braked which may be applied as brake pressure without skidding the wheels, then

$$0\cdot15\ y\ W = 1\cdot04 \times 0\cdot24\ W = 3\cdot47 \times 0\cdot07\ W$$

$$\therefore y = \frac{1\cdot04 \times 0\cdot24}{0\cdot15} = \frac{3\cdot47 \times 0\cdot07}{0\cdot15} = 1\cdot6.$$

In taking the three cases proposed by Mr. Macdonald, I will assume that the weight on the wheels braked of the engines and tenders is 80 per cent. of the whole weight of these, as suggested by him.

We have therefore

(1) Engines and tenders. Pullman. Carriages.

$$\begin{aligned}\text{Brake pressure} &= 1\cdot6\,(0\cdot8 \times 162 + 25 + \tfrac{2}{3}\,169)\ \text{tons.}\\ &= 1\cdot6\,(129\cdot6 + 25 + 112\cdot66)\ \text{tons.}\\ &= 1\cdot6 \times 267\cdot26 = 427\cdot616\ \text{tons.}\end{aligned}$$

But $\frac{427\cdot616}{356} \,.\, 100 = 120\cdot1$ per cent.

and $x = 120\cdot1 \times 0\cdot15 = 18$ per cent.

$$\therefore 18 = 3\cdot34\,\frac{(60)^2}{d}$$

whence

$$d = \frac{3\cdot34 \times 3600}{18} = 668\text{ft., or } 222\tfrac{2}{3} \text{ yards.}$$

(2) Engines and tenders. Pullman. Carriages.

$$\begin{aligned}\text{Brake pressure} &= 1\cdot6\,(0\cdot8 \times 162 + 25 + 169)\ \text{tons.}\\ &= 1\cdot6\,(129\cdot6 + 194)\ \text{tons}\\ &= 1\cdot6 \times 323\cdot6 = 517\cdot76\ \text{tons.}\end{aligned}$$

But $\frac{517\cdot76}{356} \,.\, 100 = 145\cdot43$ per cent.,

and $x = 145\cdot43 \times 0\cdot15 = 21\cdot81$ per cent.

$$\therefore 21\cdot81 = 3\cdot34\,\frac{(60)^2}{d},$$

whence

$$d = \frac{3\cdot34 \times 3600}{21\cdot81} = 551\cdot3\text{ft., or, say, } 552\text{ft.} = 184 \text{ yards}$$

(3) Tot. w'ht of train.

$$\begin{aligned}\text{Brake pressure} &= (1\cdot6 \times 356)\ \text{tons}\\ &= 569\cdot6\ \text{tons,}\end{aligned}$$

But $\frac{569\cdot6}{356} \,.\, 100 = 160$ per cent.,

and $x = 160 \times 0\cdot15 = 24$ per cent.

$$\therefore 24 = 3\cdot34\,\frac{(60)^2}{d},$$

whence

$$d = \frac{3\cdot34 \times 3600}{24} = 500\text{ft., or } 166\tfrac{2}{3} \text{ yards.}$$

This gives a saving in stopping distance of (668 − 552) = 116ft. in the (2) over the (1) case, and (668 − 500) = 168ft. in the (3) over the (1) case, or (552 − 500) = 52ft. in the (3) over the (2) case. The (3) case appears to agree very well with the results of an experiment recorded in a paper read by Captain Douglas Galton, before the Institution of Mechanical Engineers in 1879; the quickest stop which had then been made was in the case of an experimental van, fitted with the Westinghouse automatic brake, which was slipped from a train travelling at a speed of sixty miles per hour, and stopped in a distance of 167 yards. We have in this case

$$x = 3\cdot34\,\frac{(60)^2}{167 \times 3} = \frac{4008}{167} = 24 \text{ per cent. as the average retardation.}$$

The above figures are based on the assumption that the average coefficient of friction is 0·15, and that the frictional resistance, or retardation, is a constant quantity, and also that the brake force, or pressure, is acting at its maximum efficiency. It is quite possible for all the wheels of a train to be braked, including those of the engine and tender, and yet if the brake pressure is not applied at its maximum efficiency, the retardation may be less than if only a proportion of the wheels are braked, but at a maximum efficient pressure corresponding to the speed of the train, as before explained.

Now the weight on the wheels braked may be 80 per cent., or thereabouts, of the whole weight of engines and tenders, but the applied pressure would according to the general practice stated by me, be about 50 per cent. of the total weight, or 62½ per cent. of the weight on the wheels braked; whereas, in the case of carriages, the brake pressure would be equal to the weight on the wheels braked, assuming the pressure to be equally distributed on all the wheels, or if only four out of six wheels are braked—or 66⅔ per cent. of the whole weight—then the brake pressure would be one and a-half times the weight on the wheels braked; the engine being braked less to give a certain amount of drag on the train, as previously shown.

There is one point I should like to call attention to, viz., the sudden increase of friction between the wheels and rails—when the former are skidded—at the moment of just coming to rest. In this case the coefficient of friction is about 0·24, whereas at a speed of 10ft. per second it is only 0·088, at 20ft. per second 0·072, and so on, decreasing as the speed increases. It is no doubt due to this fact that the sudden jerk or jar is sometimes experienced when a train is stopped; the general rule with drivers is to release the brake pressure just before coming to rest, and then, if necessary, to finally apply it by means of the hand-brake to prevent the train rolling away, such as would occur on an incline.

With regard to the American practice of braking all the wheels, even of the bogies of engines, as stated by Mr. Macdonald, and their non-experience of jar on the application of the brake, I would suggest that it is quite possible, even under such circumstances, to so distribute the brake pressure—by means of the brake cylinders and brake gear—that less pressure in proportion to the weight on the wheels braked should be applied to the engines and tenders as compared with that applied to the cars, &c., so that the necessary drag of the engine and tender on the following coaches is obtained. I do not know for certain if this is the case, but it may be possible that it is so. Perhaps Mr. Macdonald, or some of your correspondents, can enlighten us on this point.

24, Harrington-square, **EDWARD J. M. DAVIES.**
London, N.W., November 19th.

SIR,—Mr. Macdonald appears to overlook the fact that old North-Eastern types of engines are very frequently used as substitutes—in fact, there seems to be a greater number of the Tennant's working the main line trains than all the other types together—for the compound and 1622 classes. If Mr. Macdonald will make a few inquiries he will learn that one at least of the Tennant's has for a considerable time run in the regular No. 1 or North link, and manages, generally speaking, to keep time, whatever the train may be to which it is attached. If a comparative statement could be obtained, showing (1) the number of turns missed by the different types (2) their average consumption (3) time lost on journey and weight of train, it would be very instructive, I have no doubt; it would give a very good index to the increased cost of working. I think it would not show that any great improvement had been made in the North-Eastern locomotives.

Will Mr. Macdonald kindly say where and upon which train the booked time has been reduced? I am afraid that he will find "the reduction" is more fancied than real. I think the weight or number of the carriages has not increased in the same ratio as the engines. My experience is, that whilst the weight of the train has remained almost stationary, the engines have increased at least 10 per cent. If this deduction is correct, there must be an increase in the wear and tear of the permanent way, beside the first cost of the engine. I hope Mr. Bowles may be persuaded to divulge the whereabouts of the mysterious "McDonnell." **H. FRANK.**

Gateshead, November 22nd.

SIR,—I have read your correspondence on the above subject with much interest, and with your permission I should like to say a few words about the matter. The use of pilot engines has now become so frequent that the comparison in weight between our trains and those of other countries is hardly fair, despite the general greater speed of the former. I cordially agree with "E. B. D." that were it customary to take pilots on the Great Northern, many of the trains that are taken with ease by one engine would be assisted, were they to be had for the asking. I believe I am right in saying that the Great Northern is the only line on which this rule holds good. Even the South-Western, with their coupled leviathans, find it necessary to pilot their heaviest trains, and in the summer train after train may be seen leaving St. Pancras terminus with two engines. During the holiday season 11.25 a.m. ex Paddington generally consists of ten eight-wheelers and two engines, the 3 p.m. nearly always two for about the same load. That the engines can take the load without a pilot there is little doubt, because I have seen an ordinary 7ft. single take weights considerably in excess of this with trains nearly as fast. A short time ago, the up South Wales corridor, due at 2.35 p.m., arrived with eleven eight-wheelers, among them five heavy corridor coaches, two six-wheelers, and one four-wheeler, or at least 240 tons, with one engine. Again, 5.45 p.m. into Paddington sometimes consists of eleven eight-wheelers and one six-wheeler, with only one engine. Now, if engines of old design can take the heavy trains mentioned above—and they are not the only instances by any means—unassisted, it is surely rather a hopeless confession of failure to say Mr. Dean's new singles are unable to take lighter trains at a slightly higher rate of speed without a pilot. Perhaps his latest productions, the Armstrong class, may distinguish themselves in weight pulling. They seem to be doing but little at present. **A. HOCKLEY.**

5, Westcombe Park-road, Blackheath, November 26th.

SIR,—Your correspondent, Mr. Archibald P. Head, is right in his conclusion that the best regular express service in the United States is at least as fast as that of our own country, but the trains he has chosen as representative examples do not do full justice to either side. The down Empire State Express runs from New York to Buffalo in thirty-five minutes less time than the corresponding up train by which Mr. Head travelled.

Mr. Head is also certainly wrong in choosing the East Coast down Scotch express to represent this country. The West Coast up Scotch express is distinctly faster, and most people will probably agree that it is the best long distance train which we possess. I append a tabular statement, which your readers may compare with Mr. Head's figures:—

*Empire State Express.*

Down.

| Dist. | | | a.m. | Speed |
|---|---|---|---|---|
| — | New York | dep... | 8.30 | 52⅓ |
| 143 | Albany | arr. .. | 11.15 | |
| | ,, | dep .. | 11.20 | 53 |
| 237¾ | Utica | arr. .. | 1.7 | |
| | ,, | dep... | 1.10 | 49 |
| 290½ | Syracuse | arr. .. | 2.15 | |
| | ,, | dep... | 2.20 | 57½ |
| 371 | Rochester | arr. .. | 3.44 | |
| | ,, | dep... | 3.47 | 50 |
| 440 | Buffalo | arr. .. | 5.10 | |

Speed, including stops .. .. 50¾
,, excluding stops .. .. 52⅓

*West Coast Scotch Express.*

Up.

| Dist. | | | a.m. | Speed |
|---|---|---|---|---|
| — | Edinburgh | dep... | 10.15 | 49½ |
| 100¾ | Carlisle | arr. .. | *12.18 | |
| | ,, | dep... | 12.23 | 53 |
| 191 | Preston | arr. .. | 2.5 | |
| | Twenty mins. for dinner. | | | |
| | ,, | dep... | 2.25 | 51 |
| 242 | Crewe | arr. .. | 3.25 | |
| | ,, | dep... | 3.30 | 52 |
| 317½ | Rugby | arr. .. | 4.57 | |
| | ,, | dep... | 5.2 | 52⅔ |
| 394¾ | Willesden | arr. .. | 6.30 | |
| 400¼ | Euston | arr .. | 6.45 | |

Speed, including stops .. .. 47
,, excluding stops .. .. 51

* Including one short stop.

November 26th. **NORTH WESTERN.**

SIR,—Your correspondent "Permanent Way," gives this week "an answer to those people who denounce the ponderous locomotives of the day as incapable of giving any better results than their predecessors." I am not aware that anyone has maintained anything so fatuous as this general proposition. It has been said that *certain* recently built locomotives of great weight and high cost seem unable to do their work any better than, or even as well, as the cheaper and lighter engines they were intended to replace. This is a very different matter.

In connection with the brilliant running on the Caledonian railway, "Permanent Way" seems unaware that, though the actual engine may have been new, the *design* is as nearly as possible that of the North British "Waverley" class, which has been at work for eighteen years, so that, in this particular case the argument in favour of the modern engine completely falls to the ground. In this list of heavy British rolling stock, your correspondent leaves out the Great Northern dining cars, after which it is scarcely surprising to find that in speaking of engines with 19in. cylinders, he omits all mention of the company which in this respect has had more experience than any other in the kingdom. **W. B. THOMPSON.**

London, November 28th.

SIR,—The letter by "Permanent Way" in your last issue, was most interesting, especially the account of the run from Symington to Carlisle at a mean speed of 60·7 miles an hour, by a four-coupled Caledonian engine with 6ft. 6in. wheels and 19in. by 26in. cylinders. "Permanent Way" says, "the most extraordinary feature in the run is the fact that the maximum speed only reached 72 miles per hour." Here I cannot agree with him, however. I consider that 72 miles an hour is a remarkable performance for a locomotive with only 6ft. 6in. wheels. The piston speed of the engine at this velocity must have been 1343ft. per minute. At such a speed as this it seems probable that the internal resistance of the engine due to friction, back-pressure, &c., must have become so great as to counterbalance the propelling forces due to the engine and gravity. Were a similar engine with 7ft. wheels used, the piston speed at 72 miles an hour would be reduced to 1248ft. per minute, with 7ft. 6in. wheels to 1165ft., and with 8ft. wheels to 1092ft. per minute. Or suppose we consider 1343ft. per minute as the maximum piston speed, then the 7ft. engine would run at 77, the 7ft. 6in. at 82, and the 8ft. engine at 88 miles an hour. On the other hand, the tractive power per pound of mean effective pressure would be as follows:—6ft. 6in., 120 lb.; 7ft., 112 lb.; 7ft. 6in., 104 lb.; 8ft., 96 lb. This would mean a loss of time up the banks for the larger wheeled engines, but on the run in question, where 38¾ miles are downhill, and the worst bit of uphill is a short piece of 1 in 100, a 7ft. coupled engine would probably have made better time.

London, November 27th. **U.**

SIR,—I am sorry to see Mr. Bowles's statement that he has written for the last time, as we have not yet had an answer to my question, "On what railway the locomotives with pick-up he mentioned were to be found?" **SCRUTATOR.**

London, November 23rd.

### GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—I am sorry your correspondent, Mr. Kuhne, finds my letter so trying to his temper, but he appears to have been in such an unusual hurry to lose it when he read my first letter that he has quite overlooked the statement—"If the range of cut-off were limited to 55 per cent. and with the allowance of 6 per cent. for condition of edges, &c., the negative advance angle for this range would be such that there would be no break in the control throughout"—and might have spared himself the mortification of being a "little too previous," as the negative advance angle for 55 per cent. range—with the above allowance—is just 12 deg., and he states in his last that the apparatus under discussion is, at all times, limited to 10 deg. negative advance angle, so that actually he had nothing to lose his temper over. Of course he does not distinctly state that the negative advance angle is 10 deg., but allowing for his error of statement that is what his positive angle of 80 deg. really means. I notice, however, from the diagram he sends that the latest trip is arranged to occur about 20 deg. before the extreme position of the apparatus excentric, and as 10 deg. negative advance angle gives a theoretic range of 58 per cent., this allowance of 20 deg. reduces the range to 41 per cent.—that is, to position I of the diagram—a magnificent result truly for an independent excentric gear.

I do not think anyone who at all understands these gears will expect to find X of Fig. 3 as an important function of my diagram, and I might mention that the figure in question accompanied what I take it was an inspired article on the Marshall construction in the *Practical Engineer*. I am obliged by his spreading the knowledge of my diagram amongst the engineers he mentions, and am sorry for the result, but as he is no doubt aware there are engineers and engineers, and I am not greatly surprised to find him pointing out the misprint of O E for O F, although the sequence of the positions noted might have set him right, even when the diagram did happen to be a quarter turn out of phase and $R_2$ misprinted for $K_2$. Little matters trouble great minds.

I will not doubt his sincerity when he says he does not understand my diagram, but it appears strange when he says he understands Dr. Proell's diagram—Professor Sweet's in America—for in the same way that Dr. Proell's diagram is a modification of Reuleaux's diagram, so is my diagram a modification of Professor Zeuner's diagram, and in intelligent hands both may be made to show the same results, but as in the originals, with much less trouble in the case of my diagram. The outer circle of the Proell diagram is quite superfluous, except it be used to indicate leverages, the whole action being obtained from the inner circle, &c. If Mr. Kuhne will describe on M O of Dr. Proell's diagram a circle, and through the point where the lead angle cuts this circle describes a circle with O as centre, then he has my diagram, and very little reflection will show that all openings or distances moved may be measured direct on the lines indicating the various crank positions, a result not obtained previously except by a separate geometrical construction for each different position. Coming to your other correspondent, Mr. Cameron, if one judges by the statements in his last letter, his is a most remarkable apparatus. In the *Mechanical World* of 10th August last his apparatus was stated to give a range of three-quarters of the stroke when driven by an independent excentric.

This my diagram showed to be impossible when the valve lifters were closely bridled to the valve spindle. Now he states that the range is from zero to five-eighths of the stroke, with a negative advance angle of 80 degrees. As in Mr. Kuhne's case, this last is an error of statement, and really means a negative advance angle of 10 degrees, but the remarkable part is that this angle is expected to give the range of five-eighths, when, as shown in the case of the Proell apparatus, the range is only 41 per cent. No doubt Mr. Cameron will explain this to his own satisfaction, but nothing but sheer perversity will account for his statement, as also that of Mr. Kuhne, that entirely different considerations to that of lapse in the control prompts the use of an open bridle on the valve lifters. At any rate, I shall be much surprised to hear of either of them having the hardihood to offer to anyone an apparatus with a close bridle, and of which the certainty of action depends on some uncertain time interval that alters with the governor height, for although the statement I have quoted from my first letter at the commencement of this says, that with an allowance of 6 per cent. of the stroke there would be no break in the control, it was more with the object of directing attention to the necessity of such uncertain allowances that the statement was made at all, for I have watched a Proell apparatus, which I presume was erected according to proper instructions, and in it the action I mention actually takes place, the owner being much surprised when I pointed it out to him. **JAS. DUNLOP.**

240, Wallgate, Wigan,
November 26th.

### MINE EXPLOSION RELIEF FUNDS.

SIR,—In your very interesting and instructive leading article in your last week's issue, upon "Mine Explosion Relief Funds," you state that the dispute over the Albion funds has been settled by a compromise which gives the widows an additional 2s. per week to the 5s. they get from the South Wales and Monmouthshire Permanent Relief Society, making it up to a total of 7s. per week, and also an increased grant to the children. I am sorry to say that this statement is not correct, for there has been no compromise; although the Permanent Society have secured from £25,000 to £30,000 of the money that has been contributed by the public for the relief of the Albion widows and children; and, according to the statement made by the Permanent Society's solicitor—at the Pontypridd meeting—the fund would give no additional payment to the 5s. for the widows and the 2s. 6d. for the children, no matter how much of the public money they may get. Since then, owing to the great indignation shown by the public, the Permanent officials have offered—unofficially—to adopt the Llanerch Colliery scheme if all the money collected is given to them to distribute. The widows, workmen, and their leaders refuse to accept this offer, as they contend it would not be doing justice, because the Llanerch widows if they have six children only get 6d. per week in addition to what they are legally entitled to from the Permanent fund; if they had four children they would get 1s., if no children at all they would get 2s., which would make their weekly payment up to 7s. per week. To my mind the Llanerch scheme is a most unfair one, and is not one that I could recommend the widows to accept; for although the fact of the widow having six children would reduce her increased grant from 2s. to 6d., still she would not get a farthing extra for either of the children in addition to the 2s. 6d. she would be entitled to. Whether the deputation of miners' leaders selected to meet the board of management of the Permanent Society will be able to agree upon a fair compromise, I am not at present in a position to say; but it is sincerely hoped that all controversy will be put an end to by adopting some scheme with a central trust, which would act as receiver and guardian of all money that would be subscribed by a generous public out of fulness of heart for the relief of those widows and orphans who lose their bread-winners by colliery explosion; and unless some such scheme is devised, which would put mine explosion relief funds upon a satisfactory basis, the result will be, I am afraid—if this squabbling between interested parties is continued—that, no matter how great the distress or serious the disaster, the public will be so disgusted as to close their pockets against all appeals for relief that may be made in the future. **WILLIAM BRACE,**
Newport, Mon., November 22nd. Miners' Agent.

### EXPLOSIVES FOR MINING PURPOSES.

SIR,—I have read a letter from the Secretary of the Roburite Explosives Company, Mr. Krohn, which appeared in your paper of November 16th. It is absurd to suggest a doubt of the report signed by Messrs. Matthews, H.M. Inspector of Mines, R. Isherwood, J.P., miners' agent, and J. Burrows, of Messrs. Fletcher, Burrows, and Co., who in the public interest superintended the experiments at these collieries on October 24th, when Westphalite undoubtedly proved to be the safest for use in coal blasting, carbonite and Ardeer powder being out of the running on account of their much inferior power.

From the results of experiments which I have since conducted in the presence of other managers connected with collieries, I am perfectly satisfied that either a No. 6, 7, 8, 9, or 10 detonator will completely detonate and explode Westphalite, and without igniting a highly inflammable mixture of coal dust and fire-damp when fired under the severe conditions of an untamped shot. The Westphalite I have experimented with has been in our magazine about two months, and it is in excellent condition and perfectly dry, the experiments we made underground being very satisfactory.

From a pamphlet of the Federated Institution of Mining Engineers, being a reprint of the report of the French Commission on the use of explosives in the presence of firedamp in mines, page 143, Roburite has been proved to produce flame with tamping, particulars of which are as follows:—"Experiments at Anzin on the flame produced by explosives: Roburite, 3247 grains—under 21 oz.; length of stemming, 7·87; result, flame."

I am not interested in any explosives company, but as manager of extensive collieries it is my duty to use that explosive which offers the greatest safety combined with efficiency. I have had the advantages of the most perfect experimental station for testing explosives hitherto erected in this country, and, having due regard to weights and quantities as they are used in the pit, I am compelled to admit that Westphalite has never failed under the most stringent conditions, when fired by any of the detonators previously mentioned; whilst Roburite, under similar and more favourable conditions, has invariably ignited and exploded coal dust and mixtures of coal dust and gas, producing flame from 30ft. to 50ft. long. **JOHN KNOWLES,**
The Pearson and Knowles Coal and Iron Company,
November 24th. Ince, Wigan.

### LABOUR AND LUXURIES.

SIR,—The main contention of "Y. X.," that gold is a benefit to society, if spent no matter how, is so clearly stated, and yet so clearly wrong, that I am surprised this Goliath has not been slain by your able correspondents. With your leave, Sir, I would remind them that "Y. X." in, I think, his second letter, says you cannot refute him without introducing "a time limit." I take it the following is a fair illustration of the point. A man buys a £1 air-gun, and slily breaks the windows of a number of rooms occupied by poor tenants, who paper them up. The man gets into gaol for a fortnight; his arrest, trial, and nearly all his keep is dead loss to the ratepayers; he only returns them the oakum picked. The £1 for the gun does good at the start, and a fortnight after the landlord puts the glass in; the money for the glass does good, but the landlord has a corresponding loss.

Will "Y. X." contend that the £1 could not have been spent without the loss as a necessary result? And if so, what of his contention? Allow me, in conclusion, to point out that THE ENGINEER usually deals with problems involving the use of time, weight, and distance, and I do not think an argument on this subject sound which calls for the surrender of a time element. **J. C. S.**

Dudley, November 26th.

### AN ANCIENT FORGING.

SIR,—In the forecourt of the Royal United Service Institution, Whitehall-yard, among the few relics that are too big to be stored inside, there is to be seen in the place where it has lain for many years an anchor which—as the tablet upon it tells—formed part of the equipment of one of the Spanish Armada ships, sunk to the bottom of the sea in 1588. The anchor was dredged up more than a hundred years later, covered inches thick with a conglomerate of shells and pebbles. The anchor is about 10ft. long and 5ft. across the flukes, and as far as one can guess the dimensions of the iron, it must weigh fully 10 cwt. The anchor was no doubt forged in the Navy yard at Cadiz; it is extremely interesting as a specimen of the blacksmith's art of three hundred years ago. One is curious to know what kind of tools were then available. The immediate object of this letter is to save this relic from destruction. The present house of the institution is shortly to be pulled down, and at the handsome new building now nearly completed in Whitehall, next door to the Chapel Royal, there is no forecourt in which to exhibit the anchor to the passer by. Even if the anchor be moved to some safe place it will have to be handled tenderly, or the coating of barnacles will be injured. Let us hope that it will be reverently treated by its present guardians, that it be neither lost nor thrown aside; and if a place be wanted for it there are doubtless many engineers or ironworkers who would gladly possess it. As the emblem of the Royal Navy, could not this anchor with its tablet be placed in the centre of the forecourt of the Admiralty close by? **EWING MATHESON.**

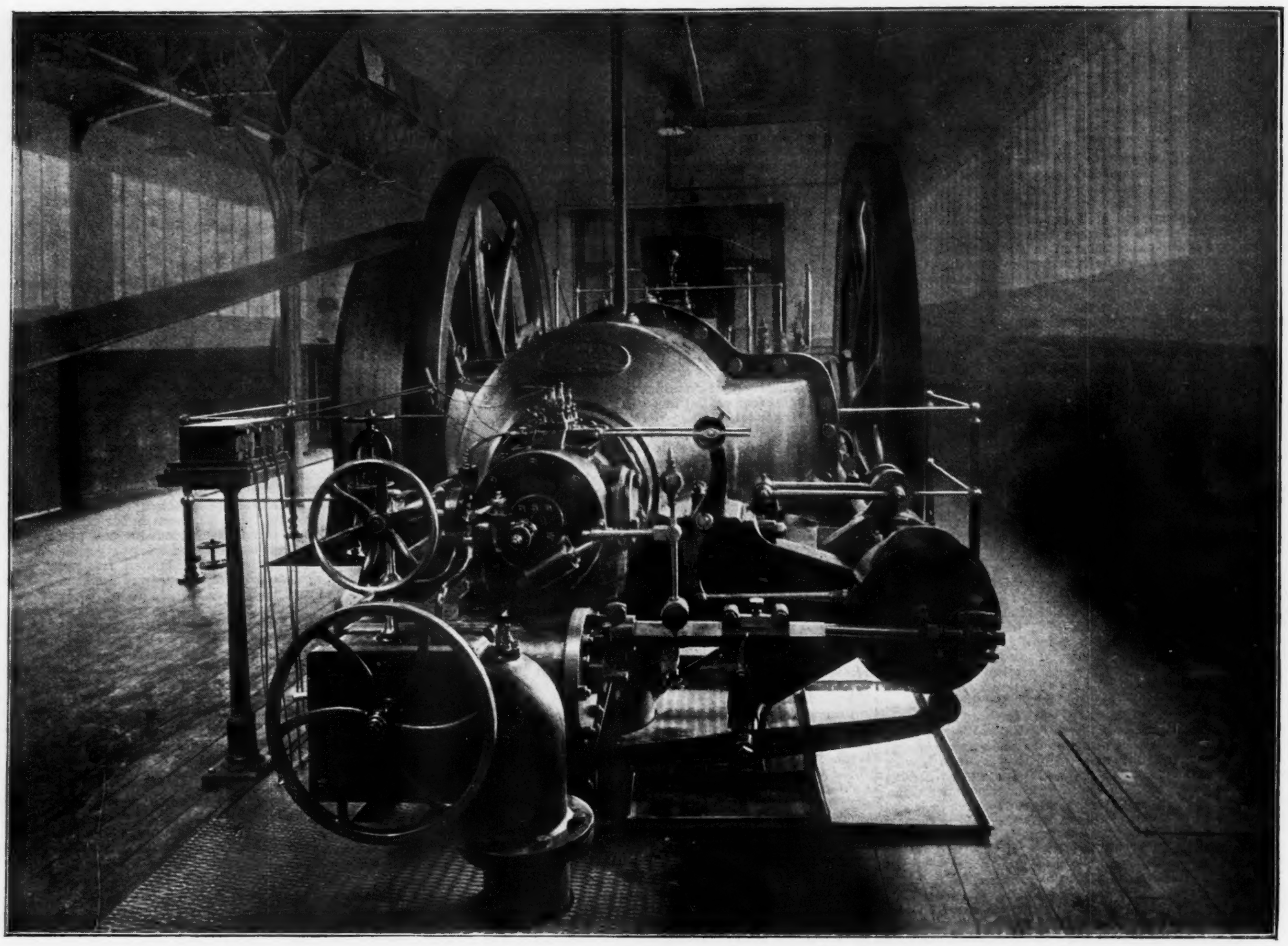
November 26th.

(*For continuation of Letters see page* 467)

RAILWAY ECONOMIES AND DIVIDENDS.—A certain large railroad has saved during the past year enough to pay a small dividend, by economising in what are usually called small details. This statement, the *Railroad Gazette* says, was recently made on good authority, and "we asked an officer of the road to tell us what these details were; concrete facts make mighty interesting reading in such a case. He will not do this, but his answer is worth reading, nevertheless, and we print it in this issue, headed: "The Day of Small things." While the article consists mostly of generalities it must be remembered that it is from a man who has applied these to particulars and found that the process paid. It sometimes seems as though the railroad era in this country might be divided into two periods; the first when the roads were small and could manage details economically, but did not need to, because they were rich; the second when they are in pressing need of every cent that can be saved, but are so big that it is impossible to watch the leaks. The success of our correspondent may be said to be due to the adaptation to a large institution of methods which are well known and familiar in smaller ones."

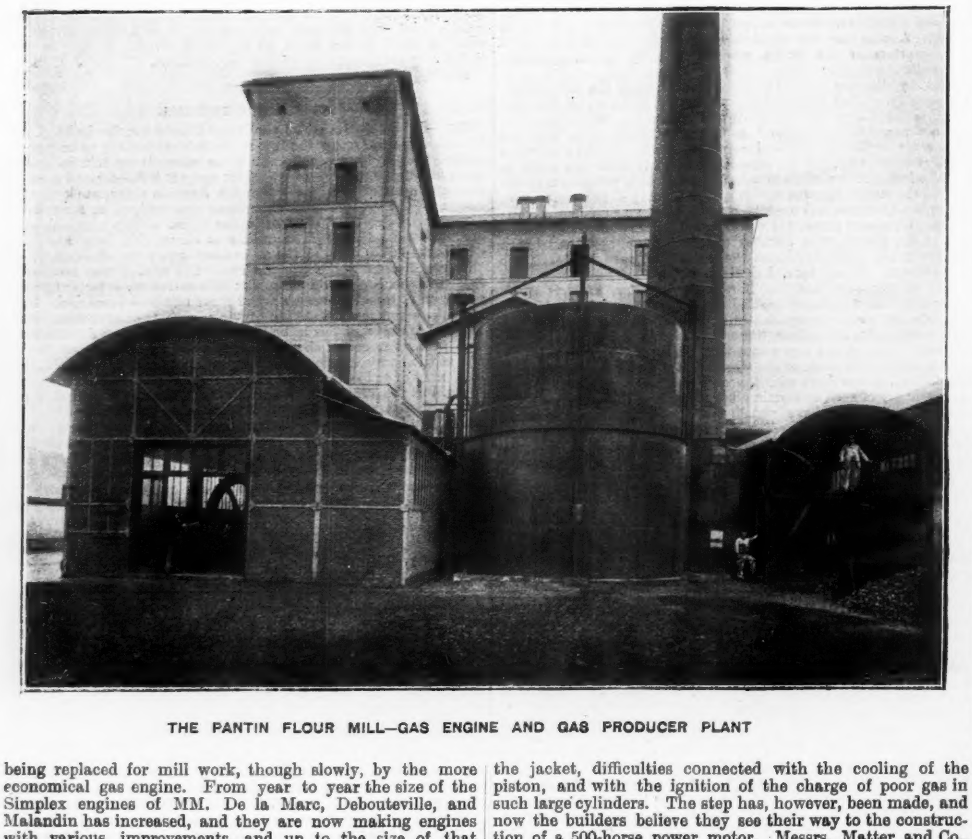
# THE SIMPLEX GAS ENGINE—PANTIN FLOUR MILLS, FRANCE

DELAMARE DEBOUTEVILLE AND MALANDIN SYSTEM—M. MATTER ET CIE., ROUEN, CONSTRUCTORS



## 320-HORSE POWER SIMPLEX GAS ENGINE AND THE PANTIN FLOUR MILL.

One of the largest, if not the largest, gas engines yet in actual regular work is the Simplex engine, now and for some time driving the large flour mills of M. Le Blanc, at Pantin. It is worked by producer gas, and affords another illustration of the certainty with which the steam engine is being replaced for mill work, though slowly, by the more economical gas engine. From year to year the size of the Simplex engines of MM. De la Marc, Debouteville, and Malandin has increased, and they are now making engines with various improvements, and up to the size of that we now illustrate. They made a great advance when they constructed and successfully worked the 100-horse power engine which we illustrated two years ago, but the jump to 250-horse power still in a single-cylinder was an even greater stride, and now they have made the further advance to 320-horse power. The difficulties are not in the construction of an engine which will withstand the heavy pressures, but which will withstand these when aggravated by the differential stresses which result from the high temperature of combustion, and the unequal effect of the cooling water in the jacket, difficulties connected with the cooling of the piston, and with the ignition of the charge of poor gas in such large cylinders. The step has, however, been made, and now the builders believe they see their way to the construction of a 500-horse power motor. Messrs. Matter and Co., of Rouen, the licencees under the Simplex patents, are quite satisfied on this point, and are to be congratulated upon their successful introduction of the gas engine and gas producer in the fine new mill we illustrate, which is fitted up with most of the new kinds of milling machinery.



THE PANTIN FLOUR MILL—GAS ENGINE AND GAS PRODUCER PLANT

*Production of the gas.*—The gas producers of the Buire-Lencanchez system, constructed by Messrs. Matter and Co., are in two parts, coupled in such a manner that they can be worked together, or independently when it is necessary to clean them or their fires.

The engine runs day and night without stop, because the mill cannot be stopped except for accident or reasons beyond control, and hence the double arrangement of producer is essential.

Each gas producer is supplied with the necessary quantity of air for gas production by a fan according to the demand.

From the gas producers, the gas passes through a series of cooling pipes to a washer, consisting simply of a column of coke through which water trickles, gas being thus filtered, cooled, and robbed of much of its tar. From this it passes away to a purifier, filled with dry coke, and thence to the gas holder.

By means of the arrangements adopted the employment of gas regulator bags of india-rubber is no longer necessary.

*The gas engine, construction.*—The engine is of the Simplex type, but it has been re-designed by the inventors with respect to the sections and the arrangement of the valve gear, &c.

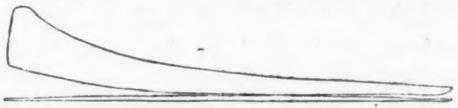


DIAGRAM FROM SIMPLEX GAS ENGINE

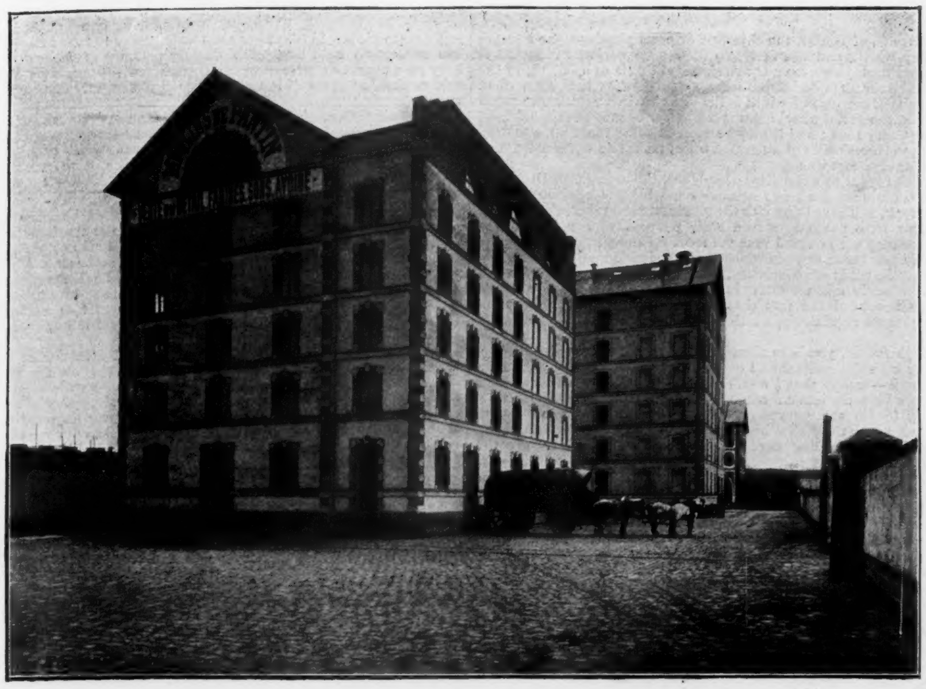
The diameter of the cylinder is 0·87 m. or 34·5in., and 1 m. stroke, or 39·37in. With the poor or producer gas it gives 320 indicated horse-power, or 250 brake horse-power.

With such large dimensions and large forces, the questions concerning the temperature of the cylinder, the thickness of the metal, that of the jacket, the exhaust valves, and of the piston become difficult, and great care has to be taken to prevent over-heating, and to secure as near as possible a regular mean temperature of cylinder walls. The running day and night adds to these difficulties.

*Consumption of fuel.*—The fuel employed is the dry coal of the Anjou mines. As a brake trial of so large an engine, and in the place where it is fixed was almost impossible, and also because the stopping of the mill for the purpose would be necessary for some hours, the makers had to be content to make a trial with the engine doing its ordinary work, but as this trial was carried on for a long time, it is deemed to be of equal practical value. The figures obtained relate to complete day and night runs, no stops having to be allowed for, and variations of load from one instant to another neutralise each other. A first trial was made in the month of February in the following manner.

Two wagons of 10,000 kilos. each, were set apart for the trials, and the gas producers having been filled up to the top with other coal, the hour of starting was taken. The mill being worked according to a determined invariable load, there

# THE PANTIN FLOUR MILL, FRANCE



was no necessity for constant observations of brake load or to take frequent indicator diagrams. When the two wagons had been emptied of their contents, the gas producers being filled up to the top with the last coal, the time was noted, and it was found that the run had lasted 194 hours.

The diagrams taken from time to time gave a maximum of 280-horse power, corresponding, it is stated, by reference to other experience, to 220 brake horse-power. The gross consumption of coal, no deduction being made for cinders or ash, was thus:— $\frac{20,000}{194 \times 280}$ = Ok. 368 grammes per indicated horse-power, or 0·788 lb. per Fr. horse-power and 0 803 per British horse-power; $\frac{20,000}{194 \times 220}$ = Ok. 468 grammes per brake horse-power, or 1·028 lb. by Fr. brake horse-power, or 1·043 lb. per British brake horse-power.

The consumption of jacket cooling water during this trial was 6100 litres per hour and less than 3000 litres for the washer and the two gas producers combined. This is a consumption total of 41·3 litres, or 58·3 lb. of water per brake horse-power hour, or very much less than the best condensing steam engines would use, but more than double the water that would be required for the best non-condensing engines. In most cases the water costs little or nothing, and the results as to coal consumption need no comment. Even if a different relation is assumed between the indicated and brake horse-power the cost of the horse-power hour from a gas engine and gas producer is, as has been shown in this country, so much less than by the steam engine that it is remarkable that the cheap gas system has not made more rapid progress, or that the designers of gas producers have not succeeded in making an apparatus which will comply with the requirements as to uniformity of quality of product, and at the same time either uniformity of quantity or conformity of quantity with variable requirements.

Three months after the above-mentioned trials, others were made which confirmed the results previously ascertained.

*The mill.*—The Patin mills were completely reconstructed in 1890. They are exceptionally well placed, the grain and the products being easily taken from or to Paris; they are on the Canal de l'Ourcq and on the Chemin de Fer de l'Est. On arrival by either road, rail, or water the wheat is received into a large building of silos, where the wheat is cleaned, graded, seasoned, and mixed by the necessary machinery and conveyors. From this building the grain is carried by a belt conveyor, where, after passing through a further cleaning in a cleaner and brusher, it passes to the first and following roller mills arranged in two long series, all connected to the scalpers, sifters, purifiers, and germ separators, which form the complete and regular automatic series of a modern flour mill.

From this building the products finally emerge into a third, where the sacking and despatch is carried on chiefly to Paris, and the hand labour is reduced to a very few beyond those required for the last-mentioned work. The lighting of the mill is by 300 incandescent lamps and dynamos driven by the gas engine, which also drives the pumps necessary to provide water for its own use and for grain cleaning. The mill, we are informed, is one which does great credit to those who own it, and those who have built, arranged, and equipped it.

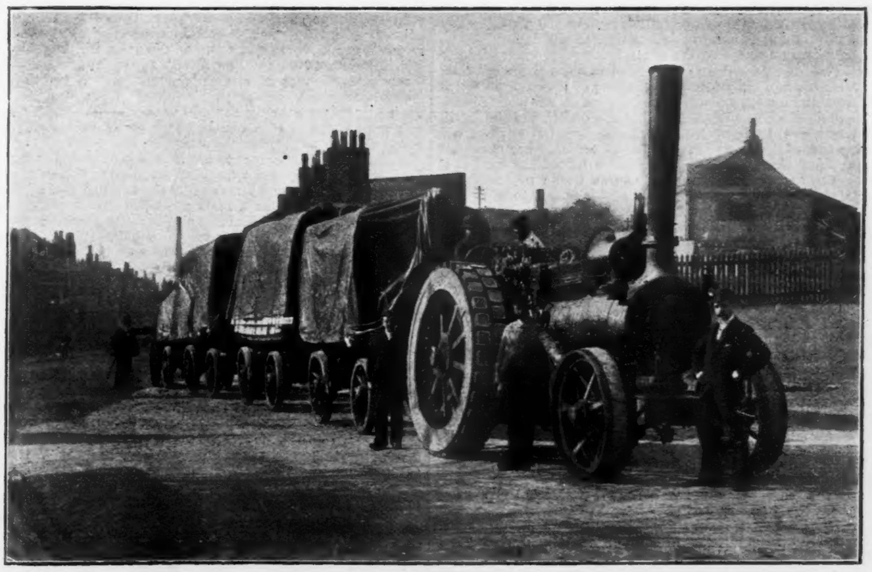
Particular attention is drawn by M. Delamare Debouteville to the gas producers of MM. Buire and Lencauchez as having removed the difficulty which has hitherto stood in the way of the cheap gas for this purpose, namely, the necessity for anthracite coal. They now use the coal of almost any district at about half the cost of anthracite in some places. The gas is, however, very poor, and the Simplex engines referred to have had to be proportioned and arranged with a view to this quality. The bituminous and even some semibituminous coals are not yet, however, considered to be within the province of practical use for this purpose, chiefly because of the difficulty with the tar and of tar extraction. It is considered necessary that efforts should be made to construct gas producers which will utilise not only the suitable coal, which is in lumps or pieces of various sizes, but the fine and powdery coal. This is looked upon as the thing to secure the final success of the gas engine as against any other motor. The use of these coals would no doubt contribute very much to this end, but with these, as with the anthracite, they must be carefully sorted or graded as to sizes of pieces or grains, just as the anthracite coal proprietors and users in the United States have found it necessary to sort anthracite into different sizes for different purposes, and to sell or attempt to use none which is not of grains or pieces of nearly uniform sizes.

## LETTERS TO THE EDITOR.

(*Continued from page* 465)

### TRACTION ENGINES.

SIR,—I have carefully read your remarks about wheels. Their construction is of the utmost importance. It is forty-six years since I first ran by steam on common roads. I have run 100 miles per day by steam on common roads, some of which I believe you have records of in your paper nearly thirty years ago. Nearly the whole of the London Traction Engine Company's engines came into my hands when they gave up thirty years ago, so I can speak with some confidence.



TRACTION ENGINE WITH BOULTON WHEELS

The enclosed photograph may interest your readers. It shows wagons being hauled by an engine with my spring wheels. There are about twenty pairs of my wheels at work daily. Many of them have been at work more than six years every day, and are working to-day. The first pair I made were for Messrs. J. H. Gartside and Co., Wellington Mills, Ashton-under-Lyne, and they were so well pleased that they have had three other pairs for other three engines.

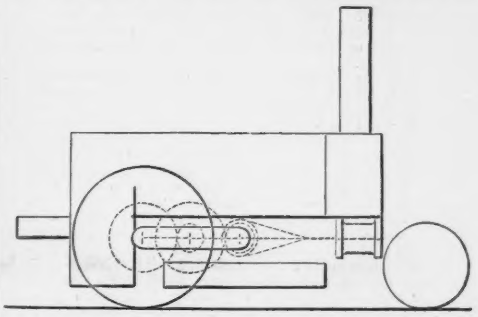
ISAAC WATT BOULTON, Ashton-under-Lyne.

SIR,—I quite agree with you that one "important question is the construction of the wheels." It is well known that the "Highways and Locomotive—Amendment—Act, 1878," requires that the driving-wheels of a locomotive shall be cylindrical and smooth soled or shod with diagonal cross-bars of not less than 3in. in width nor more than ¾in. in thickness, extending the full breadth of the tire, and the space intervening between each such cross-bar shall not exceed 3in. In my opinion this law ought to be amended. If the wheels are smooth soled they slip; if they are shod with diagonal cross-bars they damage the roads. These two propositions require no proof beyond that of experience. You ask "How does wood answer?" I reply, very well indeed. During the past six or seven years it has been my duty to examine and note the difference between the wheels made according to law and Boulton's patent traction engine wheels. With respect to the latter, perhaps I may be allowed to say that the periphery of the wheel is divided into sixty-eight cells or compartments about 6½in. square and 9in. deep. In these cells or compartments hard wood blocks are loosely fitted so that they will move easily about, with the grain of the wood pointing outwards, each block being bound with an iron strap about ¾in. from the end. The blocks are bedded on an india-rubber or other pliable cushion, and are loosely attached to the wheel by bolts let some inches into the wood. The head of the bolt is covered by a wooden plug; the bolt passing through the cushion is secured on the wheel by a nut. As the wheel revolves the weight comes on to three, four, or five of these blocks, as the case may be, the cushion gives way, the bolts are pushed up, and the blocks adapt themselves to the surface of the road. I have watched these wheels at work on scores of occasions, and I have never been able to detect any damage that they have done. Moreover, there is scarcely any vibration. I am certain that they are an immense improvement on the old ones. I have not the slightest interest in the manufacture of these wheels, so I simply sign myself

EXPERTO CREDE.

November 26th.

SIR,—With reference to your remarks on design of traction engines, some fifteen years since I saw in the suburbs of Paris a traction engine which would meet all the objections to the present designs. I send a sketch from memory, which will explain its construction. The engine was on springs; the gearing was carried by two parallel beams attached at one end to the crank-shaft, the other to the axle. There were two cylinders, but no fly-wheel, or possibly a very small one. The tires were of hard wood, the grain



of the wood being set on end as in wood paving. The wheels were smaller both in diameter and face than is usual in English engines. It was evidently intended for road work only and not to travel on soft ground.

Perhaps some of your correspondents in France can give further particulars of what appeared to be a very useful engine.

Farnham, November 24th. JOHN HENRY KNIGHT.

SIR,—I am pleased to see that you are still continuing the discussion upon the traction engine question; but you complain that no practical suggestions have been offered for any alterations in the Highway Acts. In my opinion, one of the most pressing needs of traction engine owners is the prevention of the passing, by small local authorities, of arbitrary bye-laws directed solely against traction engine traffic. The Highway Amendment Act of 1878 partially effected this, but still allows too much latitude. The highway or street committees of county boroughs are small in numbers, and liable to be too much influenced by one or two prejudiced or narrow-minded members, who would, if possible, prevent all traction engines from passing through the borough limits.

Your article is valuable from many points of view. Regarding the improvement in external appearance of the traction engine, provided the motion, gearing, and fly-wheel are hidden, there is no difference whatever between the present type of traction and the road roller. It is a case of the survival of the fittest. The chief reason for the retention of the present form is its general adaptability for either locomotive or for stationary work, for any purpose to which an engine can be put. There would be serious mechanical objections to the adoption of your suggestion of placing the motion beneath the boiler. If I recollect rightly, an engine of this type was exhibited at the Royal Show some years since, with Whittingham's driving gear, but the idea does not appear to have been followed up.

Spark-throwing and a noisy exhaust are being overcome by compounding the cylinders, but the smoke question is as far from a practical solution as ever. Coke or anthracite can be used in steam rollers, as their work is very light in comparison with their power; but either fuel is much too slow in combustion for road engines working with a remunerative load.

In further reply to your correspondent, Mr. Robert Phillips, it is a pleasure to see that he does not include "the little, harmless thrashing engine" in his list of evil-doers, as it is with this class of engine I am chiefly interested. His personal remarks I will let pass for what they are worth. Personalities are out of place in a correspondence of this kind. Mr. Phillips asks why a farmer should be exempt from licence when sending his barley out with his own engine. Why, in the name of common-sense, should he be liable to pay a licence, any more than his neighbour who carts his corn out with his horses? Engine owners require no special privileges. They only ask for equal treatment with other persons using the highways, and while they pay rates and taxes they have a right to demand it. Certificates for drivers is a question which will be settled by Parliament in the near future, and will then include not only traction engine-men, but persons in charge of any kind of steam boiler.

AN AGRICULTURAL ENGINE OWNER.

Norwich, November 26th.

SIR,—The description of a traction engine in your article on page 449 in your last issue is, unfortunately, so very true as to be easily confirmed by most people. At the same time, this kind of thing is not to be mended by such action as is proposed to be taken by the Great Western Railway Co. in its bye-laws, nor yet by any other measure which aims at squashing the traction engine altogether.

There is nothing more certain than that the traction engine in some form or other has come to stay, and it is in not recognising this fact, or trying to blink it, that road authorities and others are continually getting "off the track." They might just as well have tried to stand still when wheel carriages and wagons were first introduced, and claimed that the roads as they then were, were good enough for the ordinary pack-horse and foot traffic, and therefore wheeled abominations should not be allowed to come in and cut the footpaths up. The clock will not stand still any more for surveyors whose idea of keeping up roads is to keep everything objectionable off them, than it will for those drivers of half-broken horses which cannot be got to pass a bicycle without a lot of dancing about, or the owners of bridges which should have been rebuilt long ago.

It is of no use whatever to propose or suggest absurd regulations, which, on the very face of them, have no other aim than that of choking off the traffic altogether. Harassing regulations simply set men's backs up, with the feeling that they are to be cleared out to suit the purpose of some big corporation, or because some surveyors fancy that it will please their "powers that be" to be continually worrying the engine-owner. Unfortunately, the traction engine drivers, and their owners as well, are very often a rough and uncultivated set of men; but it has yet to be shown that there is anything so very seriously wrong with the traction engine and the work it does as to require such a drastic measure as practically snuffing out completely.

Taking engines in their present form, I think it is quite safe to say that the majority of men employed in driving them are not fit for their work in any way; very many of them are ignorant, dirty, and careless beyond measure; absolutely mannerless; and by their own condition, and that in which they quickly get an engine, they raise a feeling of dislike against themselves and their charge long before they even get a chance of making themselves more actively objectionable. As a maker of traction engines it has sometimes gone to my heart to see a fine new engine, upon which we have done our best, and for which the owner has paid hundreds of pounds, handed over to some ignorant clod-poll, whose qualifications as a driver are that he knows there is a hole in one end where the coal goes in, and one at the other where the smoke comes out, and a handle at the top, by pulling which he can start the engine.

Often the same engines will be brought back within six months a perfect wreck, the owner disgusted, and the driver ready for another. I can quite understand, and indeed have often been a witness, that during the period that the wrecking process was going on, the driver had managed to make himself objectionable to a good many people on the road. For this, however, I do not think the design of the engine is so much to blame, and some simple regulations, which ruled the selection of drivers, would put an end to the most of it. On the other hand, I could give scores of instances where traction engines are passing through towns all day without giving any offence whatever; and it was only the other day that I saw an engine, with three loaded trucks, pass through the busiest part of the city of Aberdeen, down to the docks; showing only a very slight vapour of steam from the chimney and no smoke, and not a single horse or individual seemed to take any notice of it, although it was the busiest time of the day.

The simple reason was, that the man who drove it knew his business, and had his engine in good order. The noise of the exhaust, smell of bad oil, and the wholesale splashing of it about, at which Mr. Phillips reasonably enough takes objection, were also conspicuous by their absence. With regard to the question of the condition of roads, and the endeavour to freeze traction engines out under the excuse that they are outside the ordinary requirements of the traffic of the district, this will never be settled until it is understood and agreed that traction engine traffic properly conducted is ordinary to any public road, and is as free to come and go as anything else on wheels. To maintain otherwise is, as I have said, merely trying to stop the clock. The conditions of life and business are continually changing and developing in one direction or another, and it is impossible to allow authorities to stop the development of traffic, simply because some roads which they do not want to repair properly were made to suit other times.

It is not more than forty years since hauling engines first began to work. Yet in the county of Kent, where there is more traction engine traffic than in any other part of the country, one hears infinitely less fuss made about the damage done to roads than in some other districts where engines are far fewer, for the simple reason that the authorities have not tried to stop the clock, but just made up their roads to the traffic. And where will you find better roads? To anyone who understands the outs and ins of the whole subject, this complaint of "extraordinary traffic" seems the paltriest kind of contention, and is so obviously brought forward for a motive that it is impossible to argue seriously against it on its merits.

This is the kind of thing: In a county pretty well known as having about the worst roads in England, the authorities, or their surveyor, consider that the proper way to keep a road is every now and then to put a thick layer of chalk on it, and then cover the latter with broken flints. As long as the weather is dry the only thing that happens is that the flints very quickly grind into powder, and the traffic flattens the crown of the road; but as soon as the rain sets in the chalk and flints grind up into a paste which holds water like clay puddle, and then the condition of things is simply abominable for everything that comes that way. It does not require a traction engine to do this kind of road any harm—the harm has all been done by the authorities, and every ordinarily loaded farmer's wagon or dray that goes over it will cut down into it like cutting into dough.

It is only these roads, and others like them, that are the cause of contention; and the truth about them is that the authorities who make them are even less fitted for their work than are the roads for the ordinary traffic of the district, or indeed any traffic at all. Yet if you speak to any of the powers that be about them, you are met at once by the whole stock of arguments that came out and flourished round at the time the toll-gates were done away with.

With regard to the weight of traction engines being excessive, it seems to me that after all this must be more or less comparative. It is idle to say a traction engine is bad because it is heavy, and an ordinary agricultural wagon is not bad although it is heavy. There should be a standard of weight per unit of breadth of wheel agreed to, irrespective of whether the wheel belongs to a traction engine or anything else. A very common type of agricultural engine used for threshing weighs about 10½ tons. This weight is carried by four wheels, the two hind ones being each 16in. to 18in. wide, and the two front ones 8in. to 9in. wide. Now, assuming that two-thirds of the whole weight comes on the hind wheels, we have 7 tons on, say, 32in. of width of hind wheel, and 3½ tons on 16in. of width of front wheel. Compare this with an ordinary four-wheeled wagon weighing 30 cwt., with 5in. tires, and carrying a load of, say, 3 to 3½ tons. There is practically no difference in weight per unit of width of wheel, and in many cases traction engines have wheels 18in. to 22in. wide, with the object of reducing this weight per unit of width.

There is, of course, the objection of cross plates on the traction engine wheel, and the fact also that the power of the engine is exerted through them on the roads; but this is to be set off by the much larger diameter of the wheels, and the fact that even when the weight per unit of width is the same as in the narrow wagon wheels, the broad wheel has a much better chance on the surface of an ordinary road; and it may be seen any day that, on a decent road, the cross plates of a traction wheel makes no worse mark than the rut of a cart wheel.

With regard to the matter of bridges, the contention that traction engines are too heavy because some bridges are feared to be too weak, will have to go with the "extraordinary traffic" idea; the bridges have probably served their purpose very well, and the sooner they are removed to make room for something stronger the better. As far as engines which are intended to haul wagons along the public roads are concerned, there is no reason why they should not be made much lighter in weight than they usually are at present, beyond the fact that they are practically built to meet the present regulations, which requires a man to walk in front of them.

As, however, you have already in your article dealt more effectively with this point than I can attempt to do, I will say no more about it—except that I would like to point out that there must always be a distinction made between engines which are used solely for threshing purposes, and which go about from farm to farm hauling their threshing tackle, and those engines which are used for road hauling only. Although the latter are usually the heaviest class, they might easily be made the lightest if they were allowed to travel faster with lighter loads; and as they are the ones which come in contact with people who use the roads with horses and carriages, they should be made so as not to give any offence by steam or smoke, or those heartrending, ear-splitting noises which at present very often make life unbearable to any ordinarily educated horse or individual.

With regard to the self-moving threshing engine, I do not see that it is possible to get a satisfactory engine on much less than the present weight, as the conditions are so totally different from hauling a load on a good hard road.

A threshing engine has to take its machine, and probably a straw elevator or a baling machine, to some point among fields, with no road at all, and perhaps a filled-up watercourse or two to cross by the way.

I know a case which occurred not long ago, of an engine on a journey like this, in which, with a pair of 22in. wheels, got so far into the ground at a place where a diverted watercourse had been filled up, that the top of the hind part of the tender sunk to within 5in. of the ordinary surface level of the ground. It may seem paradoxical, but in a case like this a light engine is of no use at all.

The engine in question got out without help, but a light engine would have had to be lifted out. It may perhaps be said that a light engine would probably not have got into the mud so far, and neither would it; but the light engine would never have got into a field at all with its machinery. The standard which all these engines must be built up to is the stress of starting themselves out of a hole with full steam pressure, and very often a good deal more, and nothing but weight will give the required strength. This class of engine also suffers from the prevailing agricultural depression, and generally gets into the condition noticed by you, by being driven by the cheapest, or rather the lowest-priced, labour that can be got to stop on the job. However, as long as farmers grow corn they must have it threshed, and the only thing is to regulate the management of their engines in some reasonable way, without making an already hard life still harder for him. Unfortunately, traction engines are owned by men who are not very well able to express their views or feelings, and are consequently very much at the mercy of the fancies or prejudices of individuals whose only wish is to see him out of the way altogether.

What can one expect from a bench of magistrates who unanimously mulct a traction engine owner in damages for cutting a road up, although it was proved that before the traction engine ever went on the road, at certain seasons of the year a loaded farmer's wagon would sink in up to the axles in those same places, which were said to have been cut up by the traction engine. There surely cannot be any serious difficulty in framing a set of regulations which shall have the effect of keeping the traction engine traffic from being harmful or dangerous, if the matter is only gone about in a reasonable way, and not by one side with the determination to suppress the other side altogether.

Although I am prepared to argue that in many cases the present weights of engines cannot be much reduced, yet I quite recognise the fact that in a great many cases something can be done, and also that there must be a limit somewhere, and I would suggest that this ought to be calculated on the basis of some settled weight per unit of width of driving wheel, something similar to what is aimed at in the present Act, but which is not properly arranged or carried out.

In order to meet the case of heavy ploughing and agricultural engines, and at the same time to prevent road engines being made of excessive weight, I would propose, instead of limiting the weight of any class of engine, to limit the load allowed behind any one engine to 12 tons or 15 tons gross weight, do away with the man in the front, and allow speeds of eight or ten or even twelve miles per hour. There would then be no inducement to build heavy slow-moving engines, and I don't think it would be long before a much better type than the present engine would be seen on the road.

The questions of springs, spring and india-rubber wheels, and, indeed, everything else about the construction of the engine, would soon readjust themselves. There certainly ought also to be further regulations as to the qualifications of drivers, proper covering up of working parts, blowing off of steam and smoke, and observances of certain rules of the road. On the other hand, the present harassing system of licensing ought to be done away with, and wider limits of working hours allowed.

In addition there should also be some regulation requiring efficient brakes to be fitted on both engine and wagons. It is too much, perhaps, to expect that any set of laws would satisfy every person, but I would contend that regulations framed in a reasonable spirit, and based upon those points which I have suggested, would allow traction engine traffic to live and progress without harming any person, place, or thing; and this, I take it, is the aim of all ordinary minded people who are willing to live and let live.

W. C. W. T.

November 26th.

## THEORY OF THE STEAM ENGINE.

SIR,—Before this discussion closes I should like to say a few plain words to strengthen the faith of such of your readers as are too apt to conclude, from such letters as have appeared in your correspondence, that there is something doubtful or uncertain about the accuracy of the modern theory of heat engines as expounded by such men as Rankine and Clausius. It is to this point that I have intended my previous short letters to lead. That Rankine made grave errors in his application of the general theory to concrete examples such as are met with in actual practice, I have repeatedly asserted and demonstrated in articles written for the provincial press, and I think also in your own correspondence columns. This does not, however, affect the accuracy of the laws themselves. It merely evidences the necessity of the practical engineer discriminating between the intrinsic truth of such laws, and their judicious application to the critical examination of the results actually realised or anticipated.

Also it may be remarked that in the case of the steam engine we do not need to take into consideration the theory of thermodynamics in its utmost generality, but may limit our examination to the application of the general laws to engines, in which the working substance is a more or less imperfectly gaseous body in contact or otherwise with the liquid form of that body. Heat is communicated to the body chiefly in general when in its liquid state, and rejected (to use Rankine's expression) when the body is in a more or less attenuated condition. The varying pressure of the working body on a piston, or some mechanical equivalent, is caused by suitable mechanism to result in the conversion of heat into mechanical work.

Now, what Carnot's, Rankine's, and Clausius' investigations teach irrefragably is, primarily, that under such circumstances the maximum fraction of the whole heat expended, which cannot be converted into mechanical work by the pressure of the working substance over the piston, cannot possibly exceed $\frac{T - t}{T}$. The maximum absolute temperature at which heat can be communicated to the substance being T, and the minimum absolute temperature at which heat can be rejected being $t$. It is not open for anyone to attempt to cloud the matter by vague surmises as to air, &c., having essentially different laws of action from steam when employed as a working substance, steam, whether saturated or otherwise, being as much an imperfect gas as air or carbonic anhydride or any substance, so far as we at present know, capable of existing in a gaseous condition.

It is also much beside the question to direct attention to the behaviour of solid bodies not acting cyclically as the working substances, receiving and rejecting heat. Again, a certain class of inventor has endeavoured to unsettle the minds of those who lack time to weigh the matter, or, possibly, have never acquired the mathematical habit of thought necessary. This class of writer and those who follow in his steps seeks to minimise the possible maximum efficiency of the heat engine, and asserts that the fraction $\frac{T - t}{T}$ is not to be taken as a datum of reference for the economy of engines which have hitherto been actually constructed.

From my point of view this is a frivolous contention. It is not a question as to whether the efficiency $\frac{T - t}{T}$ has been or can be realised under the conditions obtaining with the modes of working which have hitherto been found possible. The true question is whether this efficiency can be *exceeded* even theoretically. Practical experience and mathematical investigation alike reply in the negative. In applying the theory to the cases of engines actually realised mechanically in practice, we meet, of course, with the usual difficulties resulting from the attempt to apply conditions consistent with the attainment of maximum efficiency, to imperfect mechanism, which, under the most favourable conceivable circumstances, can only attain a fraction of that efficiency.

Thus, in the case of the steam, gas, or other similar engine, the available heat is not received by the working substance at a definite temperature T, but at varying temperatures, which can only be cognised, in most cases, with impracticable difficulty. Neither, on the other hand, is the unutilised heat, rejected at a single definite temperature $t$. Another class of writer further unsettles the ideas of the uninitiated by disputing the title of Carnot's ideal engine to be treated as specially perfect and reversible. Now I have pointed out above sufficient reason for terming Carnot's engine, in a certain sense, perfect, since its efficiency cannot be exceeded by any heat engine as yet made or suggested. Also it is reversible in the sense that it may be used either to convert heat into mechanical work when the passage of heat takes place from a hotter to a colder body, or *vice versâ*, it may be used to cause the passage of heat from a colder to a hotter body at the expense of mechanical work.

Again, as regards its claim to be treated as the typical "perfect and reversible" heat engine, there should not need much discussion if verbal hair-splitting is avoided. Carnot's engine is that originally conceived by him for the purpose of demonstrating the law of maximum efficiency. Also the simplicity and ready comprehensibility of the conception; all unnecessary adjuncts, such as regenerators, being, as it were, pruned from the engine, do in themselves render it appropriate to treat it as the specially typical perfect and reversible engine. It is perfectly open for anyone that feels so inclined to emphasise the fact that other ideal engines can be conceived of equal efficiency with that generally known as Carnot's. This should not, however, be done in such a manner as to unsettle the minds of untrained thinkers by leading them to suppose that this fact militates against the theory of thermodynamics or the law of maximum efficiency.

HENRY CHERRY.

21, Festing-road, Putney, S.W.,
November 20th.

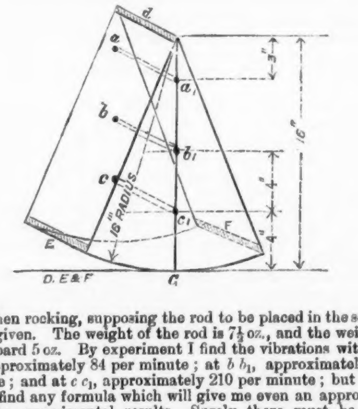
## A PROBLEM IN VIBRATION.

SIR,—Kindly allow me space in your columns to ask a question on a problem, which no doubt some of your readers can solve. The accompanying diagram is an apparatus composed of two pieces of cardboard, joined by two or three light strips of the same material, with a rod passing through both pieces, which can be placed in any of the positions $a\ a_1$, $b\ b_1$, or $c\ c_1$, thus shifting the position of the centre of gravity. For the position $a\ a_1$, the combined centre of gravity for the whole apparatus is 6in. from the apex; for the position $b\ b_1$, the centre of gravity is 8¾in.; and for the position $c\ c_1$, the centre of gravity is 11½in. from the apex. The position of the centre of gravity of the cardboard alone is 5⅝in. from G, when at rest.

The problem is, to find how many vibrations would be made per minute when rocking, supposing the rod to be placed in the several positions given. The weight of the rod is 7½ oz., and the weight of the cardboard 5 oz. By experiment I find the vibrations with rod at $a\ a_1$, approximately 84 per minute; at $b\ b_1$, approximately 130 per minute; and at $c\ c_1$, approximately 210 per minute; but I am unable to find any formula which will give me even an approximation to the experimental results. Surely there must be some mathematical method of determining this. I have had a suggestion that the formula for the time of roll of a ship is attained by a formula that fits this case; but, does not the fact of the metacentric height being constant overthrow this?

McHINERY.

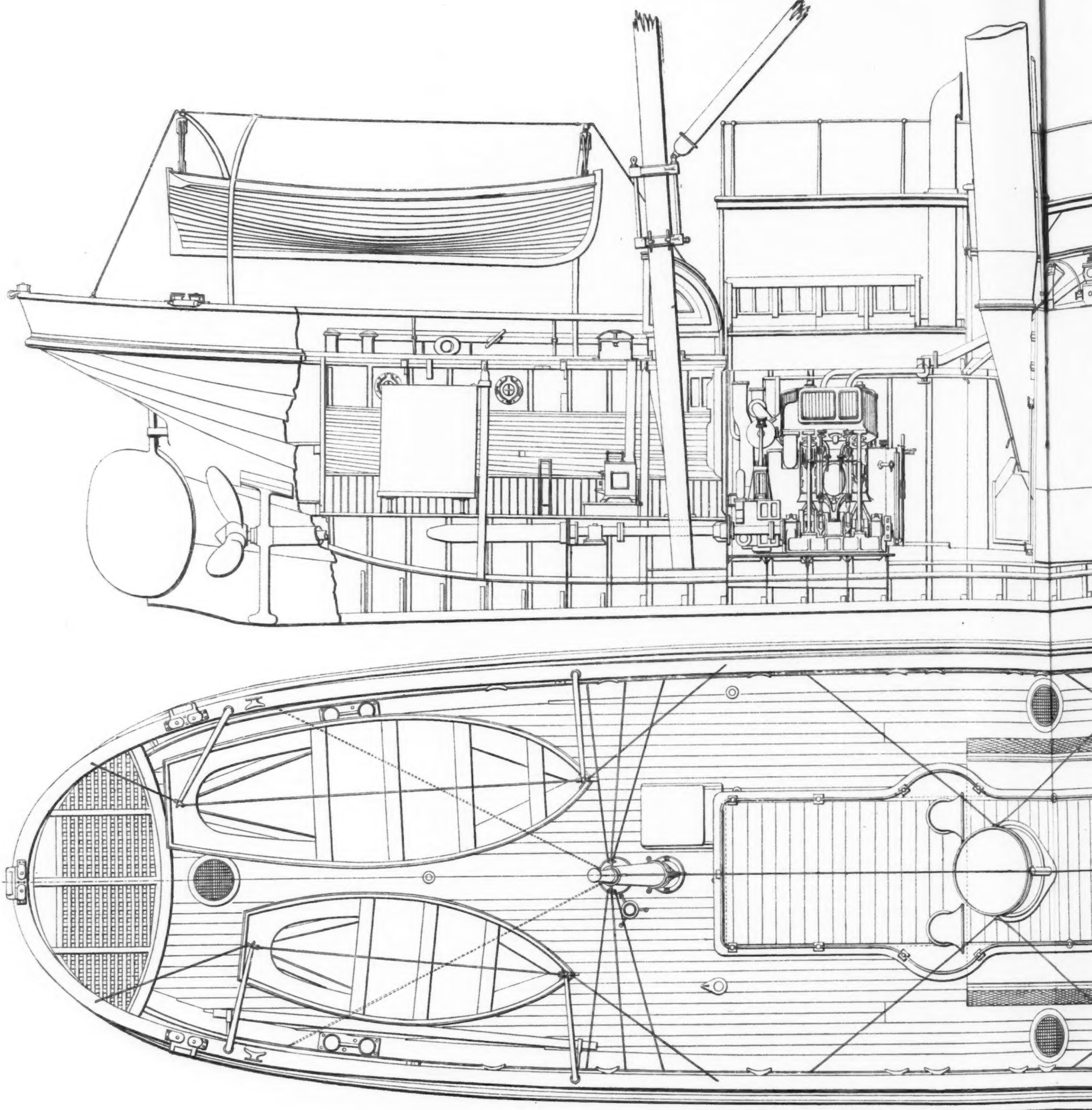
Sunderland, November 28th.



THE first-class battleship Magnificent will be floated out of dock at Chatham on Wednesday, December 19th.

# THE GENERAL SKINNER, SUBMA

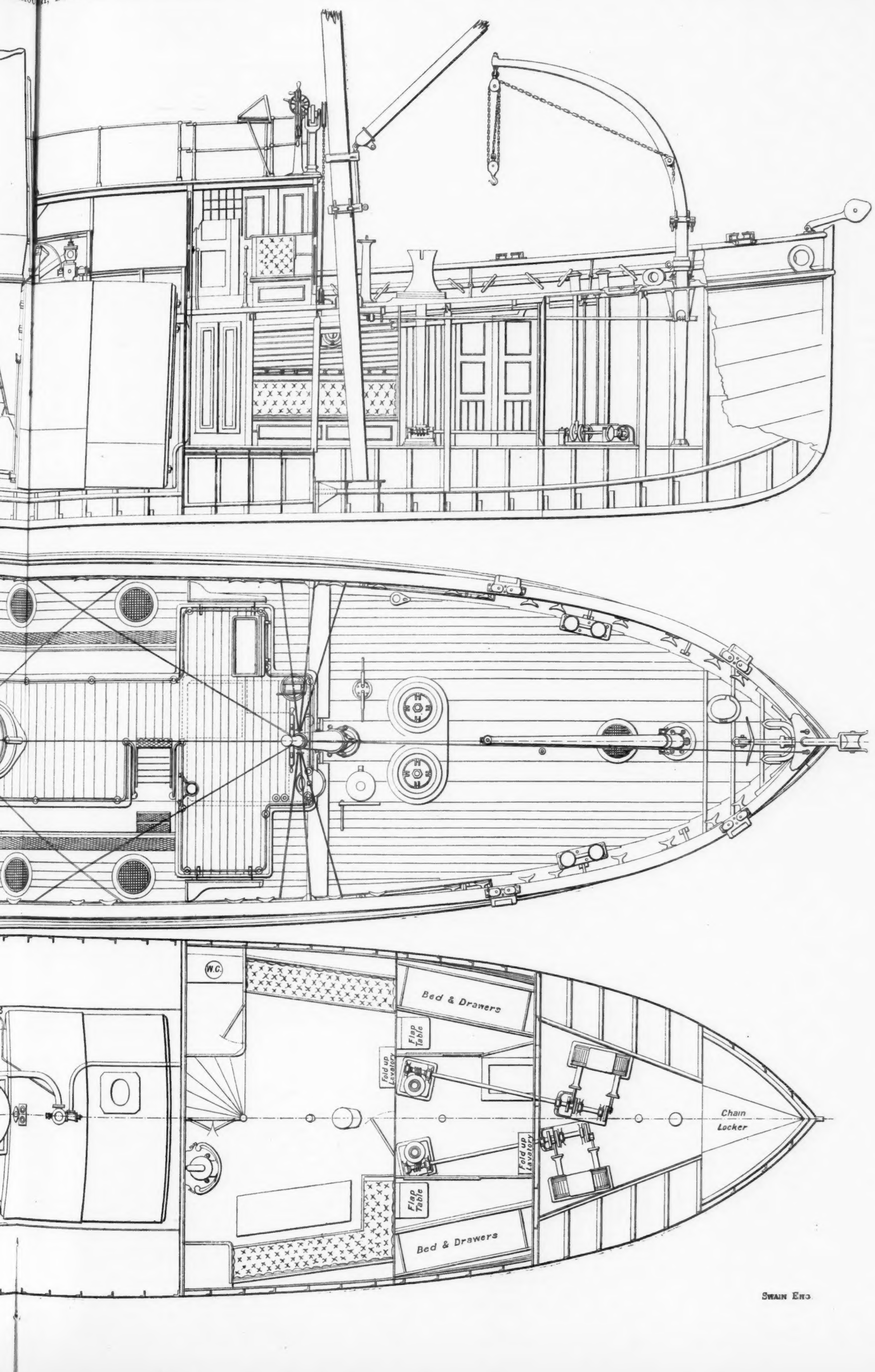
MESSRS. COX AND CO., FALMOUTH, BUIL


Fold up Cot
Fold up Cot
Table
Plate Rack
Cupboard
Fold up Cot
Fold up Cot
Fold up Cot
W.C.

"The Engineer"

# SUBMARINE MINING STEAMER

FALMOUTH, BUILDERS AND ENGINEERS


W.C.
Bed & Drawers
Flap Table
Fold up Lavatory
Chain Locker
Fold up Lavatory
Flap Table
Bed & Drawers

SWAIN ENG

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*⁂ With this week's number is issued as a Supplement a two-page engraving of the General Skinner, Submarine Mining Steamer. Every copy as issued by the Publisher includes a copy of the Supplement, and subscribers are requested to notify the fact should they not receive it.*

## CONTENTS.

The Engineer, November 30th, 1894. PAGE
English and French Quick-fire Armaments .. 459
Wind Pressure .. 459
Harbours and Waterways .. 460
De Rechter's Radial Suspension for Railway Carriages and Tramcars. (Illustrated.) .. 491
Peking .. 462
The Newhall-Cunningham Sheep Shearing Machine. (Illus.) .. 463
The Iron Gates of the Danube .. 463
Letters to the Editor—Locomotives and Trains .. 464
Mine Explosion Relief Fund—Explosions for Mining Purposes—Governing Electric Light Engines—Labour and Luxuries—An Ancient Forging .. 465
320-H.P. Simplex Gas Engine and the Pantin Flour Mill. (Ill.) 466
Letters to the Editor—Traction Engines .. 467
Theory of the Steam Engine—A Problem in Vibration .. 468
Leading Articles—Flameless Explosives .. 469
Locomotives and Trains—Progress with Naval Contracts in Private Yards .. 470
The Utilisation of the Nile—Dynamos and Copper Pipes at Sea .. 471
Literature .. 471
The German Electro-chemical Society .. 472
Elliott's Coal-washing Plant. (Illustrated) .. 472
Wells' Oil Engine. (Illustrated) .. 472
Railway Matters .. 473
Notes and Memoranda .. 473
Miscellanea .. 473
American Engineering News .. 474
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire .. 474
The Sheffield District—The North of England .. 475
Notes from Scotland—Wales and Adjoining Counties—Germany .. 476
American Notes .. 477
Recent Observations on Electricity in Coal Mining .. 477
The Patent Journal .. 477
Selected American Patents .. 478
Two-page Supplement—The General Skinner, Submarine Mining Steamer.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*⁂ In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*⁂ We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*⁂ All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

P. R. (St. Andrews).—*Your solution is not correct. The opposite movement occurs.*

J. A.—*We published the Great Western Railway Company's circular last Friday.*

Messrs. H. and Co.—*Messrs. Elordi and Esteves' report has not been printed in* The Engineer.

M. O.—*You can make any use you please of the printed specifications sold by the Patent-office without communicating with the patentees or anyone else. They are specially published to supply the public with information.*

C. Z. S.—*We have no recollection of the precise question to which your letter refers. We fancy that it originally referred to a statement that but for its weight, which must not be confounded with its mass, an electric cable surrounding the earth would be broken by centrifugal force.*

### AIR PROPELLERS.

(*To the Editor of The Engineer.*)

Sir,—What is the best shape, angle, number and arrangement of blades for a propeller acting on the air, to give the greatest thrust?

November 29th. A. R.

### TAR PAVING MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—I shall be much obliged to any of your readers for information respecting tar paving mixing machinery and sewer trench machinery as used in America.

City Engineer.

November 29th.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*⁂ The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### MEETINGS NEXT WEEK.

The Institution of Civil Engineers. — Tuesday, December 4th, at 8 p.m. Papers: "The Machinery of Warships," by Mr. Albert J. Durston, Engineer-in-Chief of the Navy; "Colliery Surface Works," by Mr. Edw. B. Wain, Assoc. M. Inst. C.E. Friday, November 30th, at 8 p.m. Students' meeting. Paper: "Sub-aqueous Excavation at Newry," by Mr. Charles H. Olley, Stud. Inst C.E. Mr. J. Wolfe Barry, C.B., member of Council, will take the chair.

The Institution of Junior Engineers.—Friday, December 7th, at Westminster Palace Hotel, Victoria-street, at 8 p.m. Paper: "Waterworks and Appliances," by Mr. William Mallock, of the Grand Junction Waterworks, Hampton.

North of England Institute of Mining and Mechanical Engineers.—Saturday, December 8th, at the Wood Memorial Hall, Newcastle-on-Tyne, at 2 p.m. Paper: "The Cost of Electric Transmission of Power," by Alexander Siemens, President of the Institute of Electrical Engineers.

Royal Statistical Society.—Tuesday, December 4th, at the Lecture Theatre of the Museum of Practical Geology, 28, Jermyn-street, S.W., at 4 45 p.m. Paper: "The Eleventh United States Census," by Hon. Robert P. Porter, and an exhibition of the Hollerith electrical counting machine.

Geologists' Association.—Friday, December 7th, at University College, Gower-street, at 8 p.m. Papers: "Note on Megalosaurian Teeth, Discovered by Mr. J. Alstone in the Portlandian of Aylesbury," by A. Smith Woodward, F.Z.S; "On the Geology of the St. Gothard Pass," by H. W. Monckton, F.G.S.

Society of Arts.—Monday, December 3rd, at 8 p.m. Cantor Lectures: "Modern Developments in Explosives," by Prof. Vivian B. Lewes. Wednesday, December 5th, at 8 p.m. Paper: "Fire Protection," by Edwin O. Sachs. Thursday, December 6th, at the Imperial Institute, at 4.30 p.m. Paper: "Roman and British Indian Systems of Government," by Hon. W. Lee-Warner, C.S.I.

### DEATH.

On November 26th, at Ivy Court, Tenterden, Kent, Francis Jellanus Dennys, M.I.C.E., J.P., eldest son of the late Commander Lardner Dennys, R N., aged 66.

# THE ENGINEER.

*NOVEMBER* 30, 1894.

## FLAMELESS EXPLOSIVES.

The recent appearance of a report on flameless explosives from a Committee of the North of England Institute of Mining and Mechanical Engineers revives memories of notes made in The Engineer, May 24th, 1889, page 443, after the appearance of the report of the French Commission on the same subject. It was then demonstrated that powder under any circumstances was unfit for use in firing mines, that nitro-glycerine mixtures were to be regarded with suspicion, and that the only mixtures more or less attaining the standard of safety then and now set forth were certain ammonium nitrate compounds; but it was pointed out that the drawback to such mixtures was that the admixture of their constituents was never absolutely intimate, and explained irregularities then observed in the results obtained with those mixtures. The Commission formulated the following rule, which does not seem to stand in need of much alteration at the present day: "On account of the complexity and uncertainty of the phenomena which may be produced by detonation in the open air, it will always be prudent to avoid firing a shot in mines at those places where the mixture of air and marsh gas is inflammable, even when the explosive employed is one of those considered most safe. The choice of this explosive ought to be regarded as diminishing the danger of explosion considerably, but not as suppressing it absolutely." They also observed that the best effects and the most certain results were obtained when the explosive was completely detonated, which occurred when the explosion was confined; they therefore attached great importance to ramming the charge well into the borehole, and in addition tamping well. Moreover, they regarded as dangerous the use of high explosives in small and more or less confined areas, for under such circumstances the rapid dilution of the products of explosion with air, so essential to safety, might be impossible.

Turning now to our own country, it is known that the restrictions imposed on the use of explosives in mines by the Coal Mines Regulation Act, 1887, rendered imperative the employment of explosives which would not ignite gas or coal dust, and this led to the invention and introduction of several so-called flameless explosives—or, in other words, explosives which ought to detonate at a temperature below the ignition point of an explosive mixture of fire-damp and air, and to yield, when detonated, no combustible products. It was soon found, however, that the flameless explosives placed at the disposal of the miner did not fulfil these conditions; and therefore the inquiry, which originated the subject of the most recent British report, was instituted with the object of clearing away doubts and uncertainties connected with the employment of safety explosives in mines.

We have already, on September 14th, had occasion to mention these investigations, when certain experiments were performed in the presence of some members of the Federated Institution of Mining Engineers, at the works and with the apparatus that are in the report described in detail, with illustrations. Now that more particulars have been made public, it may be well to recall here the appliances used by the committee:—The experimental chamber consisted of a cylindrical tube, 101ft. long by 3ft. in diameter, made of ¼in. Tudhoe wrought iron plates, rivetted with Low Moor iron rivets, constructed in tubular sections, each made of seven plates and bolted together by means of angle-irons riveted on to each end of each section. Glazed sight-holes were arranged at appropriate intervals along one side of the cylinder, whilst the top was furnished with ten vents, 4in. in diameter, 10ft. apart, and fitted with hardwood plugs. One end of the cylinder was closed by a wrought iron plate bolted on to the end angle iron and having in the centre a hole 16in. in diameter, which would be blocked by the cannon in an experiment, whilst 22½ft. from this end a sheet of brown paper, rendered air-tight by varnishing and cut to the required size, being placed against the angle iron and held in position by an iron ring bolted on, acted as a diaphragm to isolate the part of the cylinder used as a combustion chamber for holding the gaseous mixtures from the remaining part of the cylinder, the far end of which was also loosely covered with brown paper before an experiment, to keep out light. The cannon for holding and firing the explosives was a cylindrical steel block —hooped with five steel rings—4ft. 6in. long, and 18in. in diameter at the breech, and for 18½in. from it, the diameter of the remaining length being 15¾in.; the bore was 42¼in. long and 1⅓in. in diameter, and was drilled out of the solid block. The cannon was mounted on a carriage fitted with three pairs of wheels running on rails, and so could be made to approach or recede from the closed end of the cylinder. When experimenting the joint between the cannon and the cylinder was made tight by an india-rubber ring and puddled clay. The necessary pipes and stop-cocks were fixed to connect the combustion chamber with the external air; with a gasometer for delivering a measured quantity of gas into the cylinder, with a Schiele fan, 24in. in diameter, for mixing the air and gas, and operated by a 3-horse power Tangye gas engine, and with a heating arrangement. The combustion chamber was, moreover, provided with a water gauge, and air vent with a stop-cock, and three apertures for abstracting samples of gas. Generally a simple estimation of the oxygen in the mixture by absorption with alkaline ferrous tartrate, and allowing for a small amount of oxygen and carbon dioxide present in the combustible gas employed, supplied sufficient data for calculating within 0·5 per cent. the percentage of explosive gas present.

The operations involved in an experiment were—displacing the existing atmosphere by ordinary air, fixing the brown paper diaphragm, charging and adjusting the cannon, closing the top vents, opening the necessary stop-cocks to admit the desired proportion of gas, and allow a corresponding volume of air to escape through the special vent, closing these stop-cocks and opening those connecting with the fan, mixing, closing all stop-cocks, taking samples and temperatures of mixed gases and firing the shot. If flame effects were to be observed, observers would have been stationed in and taking observations from an adjoining dark-room, the parting brick walls having holes in it corresponding with the glazed ports already referred to, whilst other effects could be recorded in the cylinder room or in the open air. It should be noted that the brown paper would not inflame readily, and that glowing brown paper is not capable of igniting explosive mixtures of gas and air. Of course, samples of the gas could be taken after an explosion, though perhaps the character of the actual atmosphere might be disturbed by inrushes of the external air from the top vents, which would be frequently forced out by the explosion, or from the opening caused by recoil of the cannon or by wind blowing in at the other end.

The explosives used in these experiments were obtained from local collieries, and their relative strengths, tested by the Trauzel method in lead blocks and fired unconfined, were bellite 100, securite 98·13, ammonite 88·73, roburite 80·94, carbonite 41·24, Ardeer powder 26·90; and on this basis the weights employed for shots of each explosive were 1 oz. each bellite and securite, 1⅛ oz. ammonite, 1¼ oz. roburite, 2½ oz. carbonite, 2¾ oz. Ardeer powder—quantities less than those used in a mine. Experiments were made with stemmed and unstemmed shots fired into air, into explosive mixtures of air and coal gas, and of pit gas and air. Bellite unstemmed gave a flame several feet long in air with or without coal gas up to 6 per cent.; with 8 per cent. it caused ignition. With fire-damp 11·6 per cent., and air it frequently gave a flame but caused no ignition. Stemmed it frequently coused ignition with mixtures containing 8 or 10 per cent. of coal-gas, but not with those containing 10 or 11·6 per cent. of fire-damp. Securite behaved in a similar manner to bellite, but in addition, when not stemmed caused ignition of mixture containing 11·6 per cent. of fire-damp. Ammonite behaved somewhat similarly to securite, but gave longer flames. Roburite resembles to some extent bellite, but ignited, when unstemmed, the 6 per cent. coal-gas mixture. Carburite, unstemmed, gave shorter flames than the preceding explosives with air alone, and 4 and 6 per cent. coal-gas mixtures occasionally ignited an 8 per cent. mixture; but neither ignited or scarcely gave a flame in the 11·6 per cent. fire-damp mixture, whilst when stemmed it only occasionally ignited an 8 per cent. coal-gas mixture, and not at all an 11·6 per cent. fire-damp mixture. Ardeer powder, unstemmed, also gave comparatively short flames, but behaved irregularly, sometimes giving a flame, sometimes not, sometimes igniting an 8 or 10 per cent. coal-gas or an 11·6 per cent. marsh-gas mixture, and sometimes not only not igniting but not even giving a flame. Stemmed, it occasionally ignited 8 or 10 per cent. coal-gas mixture, but not at all 10 or 11·6 per cent. fire-damp mixtures. For stemming damp puddled clay rolled into cylinders of 1in. to 3in. were employed; the difference in depth of the stemming did not seem to exert any important influence on the result. Incomplete detonation was observed, both in stemmed and unstemmed cases, and has, of course, given rise to irregularities, but did not render nitrate of ammonium explosives more capable of igniting inflammable gaseous mixtures, as the French Commission reported. With regard to the effect of detonators alone, it has been found that mixtures of both coal-gas and air and fire-damp and air have been ignited by detonators containing 15·4 grains of fulminate of mercury—which, too, is at variance with the result recorded by the French Commission. In the present case, too, the fire-damp seemed more susceptible to the detonator shock than did the coal-gas. No experiments were made with water-cartridges, because the bore in the cannon was not large enough. It is curious that there is generally a perceptible interval after the firing of the shot, before the ignition of the gas takes place. The ignition varied in violence, as might be supposed, according to the position at which it took place in the combustion chamber, being more violent if it started near the cannon than if started near the diaphragm.

That these experiments have been conducted with considerable skill, care, and deliberation, there can be no doubt; and it is therefore of interest to make special note of the conclusions arrived at, which briefly are as follow: All the high explosives on detonation produce evident flame, but they are less liable than blasting powder to ignite inflammable mixtures of air and fire-damp, nevertheless cannot be relied on as ensuring absolute safety, therefore must be regarded as only lessening and not abolishing the risk of explosion. It is consequently essential that similar examinations of the working places, and precautions which are in force in mines where blasting-powder is used, should be rigidly observed when high explosives are employed. If a charge of high explosive has missed fire, and short lengths up to 8in. of stemming have been employed, it may be detonated by another cartridge of the explosive and additional stemming placed in the hole in front of the original stemming. These explosives are found to be defective as regards admixture, variable as regards proportions of the ingredients used in their manufacture, and they alter in character with age. These latter facts are advanced to account in some measure for the irregularity of the results following upon the detonation of these high explosives.

The present investigators do not find tamping or stemming will be absolutely trustworthy for obtaining the best result from the explosive, nor do they comment on the advisability of restricting the quantity of explosive used in a small area to an amount not capable of yielding a volume of gas that would approach that of the surrounding atmosphere. With these two exceptions, we cannot but be struck with the agreement between the results now obtained and those mentioned at the commencement of this article; and while it is without doubt satisfactory to see such confirmation by different investigators in these vital matters, we cannot regard with equal satisfaction the fact that, judging from this most recent report, little or no progress has been made in this direction during the last six years, and that a certain grim uncertainty still surrounds the problem of how to win coal safely and cheaply from fiery mines.

## LOCOMOTIVES AND TRAINS.

THE correspondence which appears in our pages, dealing as it does with many subjects connected with the conduct of railway traffic and the performance of locomotive engines—ancient and modern—would have been yet more interesting than it is had the locomotive superintendent, the traffic manager, or the engine driver taken part in it. Obviously it has flowed from the brains and the pens of more or less shrewd and well-informed amateurs. We use the title in no invidious sense; and we would indeed insist on the fact that the amateur, if only he is careful, may be of use by presenting facts in a new light to professional men. There is no doubt a tendency in all professional men to fall into grooves of thought and practice; and it does them good perhaps to be told from time to time that the world is not quite what it seems to them to be; that other eyes see it not as they do, and that other brains think about it in a different fashion. While, however, we concede so much to the gentlemen who, taking the Northallerton accident for a text, have said so much in our pages in the way of criticism on the management of our great railways, it will not be out of place if we call their attention to certain facts which they have either forgotten for the time, never knew, or of which they underrate the importance. Let us in a word consider some of the questions raised, from the point of view of the traffic manager, the locomotive superintendent, and the engine driver. Certain of our correspondents, it will be remembered, assert, first, that to take a pilot or second engine is a costly mistake. Others complain that the modern locomotive is too big and heavy, and that all that it can accomplish has been done as well, or better, by much smaller and lighter locomotives. Brief as is this statement, it will be seen that it covers portentous issues. Enough to fill a volume might be written on the subject. We may be excused if we leave much unsaid that might be said with advantage.

The traffic manager looks with no special favour on heavy rolling stock; but he has to provide it notwithstanding. It is a result of competition on the one hand, and of the prevailing desire for comfort and even luxury on the other hand. Not twenty-five years ago, passenger coaches on most of our railways were carried on four wheels, and weighed eight to nine tons. They may still be met with on some branch lines. A dozen years ago they were found on the main line of the London and Brighton Railway. They were so low that a moderately tall man could not stand upright in them. They were narrow and cramped and comfortless, but they were very light. The proportion of dead weight to paying load was comparatively small. The northern traffic of the kingdom has, however, been made the principal subject of discussion by our correspondents, and it will be well to confine our attention to it. There are three great railway systems competing for it—the West Coast, the Midland, and the East Coast. The railway companies, some six or seven in number, concerned, have continually outbid each other, until in no other country under the sun is such fast and luxurious means of travel provided. The passenger coaches have increased in weight from eight to seventeen, twenty, twenty-five, and even thirty tons—and this, be it remembered, while the number of passengers per coach has been but little augmented. The dead weight as compared with the live or paying load is enormous. This palatial rolling stock has not been adopted as a matter of choice. The travelling public will have it, and they get it. If the railways were worked by Government the public would enjoy no such benefits, and that is one reason why State railways are a mistake. The traffic managers must not be blamed. They must not be told that they are using stock too heavy, too expensive, too unwieldy. We do not suppose that any traffic manager in the kingdom thinks otherwise in his secret heart. But the public demand corridor trains, dining cars, Pullman drawing-rooms, sleeping berths, &c.—and what the public demands it gets. If our readers see anything wrong in this direction in modern rolling stock they must blame the public.

The locomotive superintendent finds this heavy stock made up into long trains, and he is told that they must be hauled at very high speeds and with the greatest conceivable punctuality. Now, he has long since found out that the work of hauling is a very variable affair. It is one thing on a fine summer's day. It is quite another in a storm of rain and wind. He knows that however well a light engine can perform over a stretch of level road, there is a bank somewhere to be climbed, and the result is that he has to design and build locomotives which, while too powerful for light trains and fine weather, are taxed to the utmost on steep roads in winter. Very naturally he builds a big, powerful engine. To this our correspondents take exception. Because the little London and North-Western engine Waverley hauled a train of 80 tons to Crewe at some 56 miles an hour the whole way during fine summer weather, it seems to be argued that a somewhat similar class of engine ought to be able to conduct the entire passenger traffic of the London and North-Western between Euston and Crewe. It is only necessary to state the matter in this way to show how absurd is this contention. Some of our readers, however, are willing to admit that a more powerful engine is needed to draw modern rolling stock than that which sufficed hitherto, but they object to the extra weight. In a word they contend that the engines are too heavy for their power. We have here an admirable instance of the amateur method of reasoning. A locomotive is constructed to draw trains. Every ounce of weight hauled represents so much fuel; all the weight possible ought therefore to be saved. This reasoning is quite perfect in its way; but the locomotive superintendent knows what the amateur does not, namely, that the cost of fuel is comparatively a small item in working a railway, and that a matter of very much more importance than a little saving in coal is the cost and demurrage of repairs. If we take a modern locomotive with 1000ft. or 1200ft. of heating surface, and compare it with one of the same boiler power built ten years ago, it will be found that the latter is some tons heavier. It will, for example, have a bogie which adds at least three tons. The boiler pressure will be greater, and the boiler much more strongly stayed. The frame plates will be thicker and deeper; the axles larger; the tires 3in. thick instead of 2½in. All the bearings will be larger and wider and longer, and so on. The whole machine will be much heavier and more massive. All this represents some five or six tons difference between the new and the old engine; but the consequence is that the new engine costs next to nothing for repairs for long periods of time. Breakdowns are practically unknown. The engine is always ready when wanted. It will run for years without more repairs than are represented by the turning of the driving and leading wheel tires. Only those who have had experience can realise the difference between a heavy engine and a light engine of the same power as regards repairs; and the curious feature of the matter is, that if we turn to the coal bills it will be found that the modern heavy engine is burning less coal per train mile than its light predecessor. It would involve a considerable digression to explain why. Our readers must be content to accept the statement that, notwithstanding the great augmentation in the weight of rolling stock which has taken place of late years, no tantamount increase has taken place in the consumption of fuel per train mile. This admirable result is due to a number of causes, such as increased boiler pressure and better permanent way—matters which we shall not stop to consider. Thus, then, it will be seen that there is really method in the madness of both the traffic manager and the locomotive superintendent.

What has the engine driver to say on the subject? He at all events has nothing but praise for the big, heavy engine. He knows by experience what it is on a winter's night with a long train to have a locomotive thoroughly up to its work. He knows the heart-breaking, soul-depressing struggle that takes place when he has a locomotive taxed to the very utmost to push along as best he and his fireman can; when he dare not put on an injector unless he is running down hill; when the difference between ruin and comparative success depends on the consummate skill of his fireman and good luck with his coal. Only those who have stood on the foot-plate of a locomotive charged with a big express train on a winter's night can understand what the driver's and fireman's work really is, and the difference to them of the two classes of engine. Concerning the question of pilots, about which so much has been said, we have already written pretty fully in another impression. The evidence given at the close of the inquiry into the Northallerton accident throws a good deal of light into places where it is much wanted. The evidence of the injured driver has at last been taken. It will be remembered that the action of the railway company in giving him a pilot from Darlington to York has been sharply criticised. His explanation goes to the root of the matter. He took a pilot because his Westinghouse air brake compressing engine was out of order, and working badly, "the piston sticking," and also because his engine was steaming badly. As regards the first point, it is obvious that if he had proceeded with his air brake in a condition of doubtful efficiency, he would have incurred a very serious responsibility. For this reason alone he was bound to take a pilot engine, on which the Westinghouse compressing engine was working properly. As to his second statement, we fear that it will be difficult to make its purport intelligible to an outsider, while everyone who has fired or driven a locomotive will understand it at once. The steaming power of a boiler depends on the fire. Now it is the easiest thing imaginable to get a fire either in a locomotive or, for the matter of that in an ironworks, into bad order, and once that occurs things go from bad to worse. Thus, for example, a locomotive starts with a heavy train on a "green" fire. That is to say, there is much coal in the fire-box not yet ignited. Steam is blowing off. It is then a toss up whether the pressure will be lost, or the fire will burn through in the first couple of miles. If the latter, all will go well; if the former, unless it is a stopping train, or there is a long bank to run down, the case is probably hopeless. We have known an express train lose forty minutes in a run of forty miles in this way; and when stopped by signal outside an important junction, the engine was unable to start again, for want of steam, for nearly five minutes. It may be said that in the Northallerton case the driver could have got his fire right between Darlington and York. That would have been impossible. Or that he should have taken his engine off and left another to go on. That avails nothing, as the engine had to go to York in the first place; and he would have disobeyed orders had he not gone on, in the second place.

We have, of course, been unable to do more than glance at the questions raised by our correspondents. We have said enough, perhaps, to let them see that the locomotive has a private as well as a public life, and the private life is quite as much the locomotive superintendent's care as its public life. In a word, the engine has not only to draw trains, but it has to draw them with certainty and punctuality, and with the smallest possible outlay of money and time on repairs. Locomotives have their peculiarities—we had almost said their whims—and these have to be thought of. Any driver of experience who values punctuality will admit that good advice is contained in the words: If you have a sulky engine, take a pilot if you get the chance.

## PROGRESS WITH NAVAL CONTRACTS IN PRIVATE YARDS.

SATISFACTORY, not to say rapid, progress is being made throughout the kingdom with the British warships now under construction by private contract. On the Clyde, where there is a total of no less than 62,000 tons on hand—nearly two-thirds of the whole of the warship tonnage distributed amongst private firms—work, is to say the least, well advanced, although operations have been somewhat delayed by the recent coal strike. At the yard of Messrs. J. and G. Thomson, Clydebank, where Admiralty tonnage to the amount of over 30,000 tons is in hand, the position is one of satisfactory all-round progress. All the three torpedo-boat destroyers entrusted to the firm—the Rocket, the Shark, and the Surley—have been put into the water, the last of the three having been launched on the 10th inst. The Rocket has been handed over to the Government after having undergone preliminary trials during the last week of October. These proved in every way successful, the mean speed attained being 28·25 knots, equal to rather more than 32½ statute miles per hour and 1·25 knots over the contract speed of 27 knots. The Shark is being completed for her trials preliminary to acceptance by the Admiralty. No other firm in the kingdom, it may be stated, has launched three of the destroyers last given out, and none are now likely to outstrip the Clydebank firm in the matter of delivery. On the first-class battleship Jupiter and the first-class cruiser Terrible a fair amount of work has also been accomplished by Messrs. Thomson. Their former experience with the battleship Ramillies, built under the Naval Defence Act of 1889, is no doubt standing them in good stead with the Jupiter; but they are labouring, it is said, under the disadvantage common to all private builders, that the armour-plate contractors usually give a preference to the Royal Dockyards in the supply of material. In the engineering department at Clydebank not only is the work advancing on the machinery and boilers of 22,000-indicated horse power for the Jupiter, and on the engines for the Terrible, but the machinery for the warship Sultan is nearly completed, and will be ready for delivery at Portsmouth by the end of the year.

The Fairfield Company is pushing ahead with the three torpedo-boat destroyers it has on hand—the Handy, Hart, and Hunter—the first named being all but ready for launching. Progress is also being made with the two second-class cruisers, Venus and Diana, of the Talbot type. These, it may be stated, occupy the berths in which the great Cunarders were constructed. The two second-class cruisers under way in the yard of the London and Glasgow Shipbuilding Company, Govan, to be named the Dido and Isis, are progressing apace, and the same is true of the two torpedo-boat destroyers in the hands of the Abercorn Shipbuilding Company, of Paisley. The tonnage all this work represents—62,000 tons—exceeds any previous record as regards Admiralty work on the Clyde at any one time. If the Clyde builders, therefore, have had good reason to be gratified with the favour that was extended to their tenders in the spring, it seems, on the other hand, that the Admiralty have every cause to feel satisfied with the progress made with the Clyde contracts, and with the character of the work as well.

The proportion of Admiralty orders secured by the Naval Construction and Armaments Company, of Barrow, was relatively as noteworthy as the Clyde share, and at the present time the utmost energy is being displayed in the building of the first-class cruiser Powerful, the two second-class cruisers Juno and Doris, and the three torpedo-boat destroyers—Sturgeon, Starfish, and Skate—with all of which this company was entrusted. The order for the Powerful was received last New-Year's day, and the vessel is now well advanced in the plating stage, and a beginning has been made to sheath the hull to a height of about 3ft. above the water-line with teak, preparatory to covering it with copper. The two second-class cruisers are in frame to the protective deck, and the plating has been begun. The first of the three torpedo-boat destroyers, the Sturgeon, has been tried for speed, and the two remaining vessels are about ready for launching. In the engineering and boiler works department the Barrow Company is busy upon the engines for the Majestic, building at Pembroke, and they will be ready to despatch to that yard when the Majestic is launched at the close of the year.

At Messrs. Laird's, of Birkenhead, the Banshee, the first of the three torpedo-boat destroyers ordered at the same time as the others throughout the kingdom, was launched on the 17th inst., and work on the two remaining vessels is proceeding apace. The two recently handed over, the Ferret and Lynx, were part of an order placed prior to the giving out of the last general batch. Messrs. J. and G. Thomson, therefore, in having recently handed over the

Rocket, the first of their lot, and having just launched the Surley, the last of the lot, may be considered to have outstripped the Birkenhead firm in the matter of rapid construction and delivery. On the Mersey, as pointed out in a recent article in our columns, there is an almost complete lack of shipbuilding for the mercantile marine, so that there is little else to stand in the way of the Government work. Owing, doubtless, to this circumstance, Messrs. Laird have been able to make good headway with the first-class battleship Mars—a sister vessel to the Jupiter. A further circumstance connected with the work on this vessel is that she is being built in a dry dock; an immense advantage as regards the facility with which heavy masses can be put on and worked into the structure. The work in other private yards on the Tyne, Wear, Humber, and Thames, consisting chiefly of torpedo-boat destroyers, is, from all that can be gathered, progressing satisfactorily. The Ardent, the first of three destroyers built and building by Messrs. Thornycroft, was recently tried for speed, with the result that she attained 29·182 knots as the mean of two runs, one with and the other against the tide.

Work in the Royal Dockyards themselves is not allowed to languish. At Chatham two first-class battleships, the Magnificent and Victorious, and one second-class cruiser, the Minerva, are well under way; while, according to the terms of the Naval Estimates for 1894-95, an additional battleship of the Jupiter type, to be named Illustrious, will soon be commenced there. The Minerva will be ready for launching this year. For her engines and boilers, which are to be manufactured at Chatham, the naval authorities have allotted £90,770. The Magnificent has now got her barbettes fixed in position, a great portion of her protective deck complete, and she is ready for her armour-plates and engines. Portsmouth has three battleships and one second-class cruiser on hand. The first of these battleships, the Majestic, is advancing so rapidly that there is no longer a doubt that she will be floated before the end of the year, when some 6000 tons will have been built into her in a space of eight months. Pembroke is busy with two more battleships of the first class, the Renown and Hannibal, while Devonport has got on the stocks one second-class cruiser and two sloops.

The total tonnage under construction for the Admiralty is 220,210 tons; 123,640 tons of which are in the Royal yards, and 96,570 tons in private yards. The Royal establishments have probably about as much on hand as they can well overtake at one time; but with the private yards the situation is different. Last year, when the total output came to close on 900,000 tons, it was estimated that our shipbuilding facilities had only been utilised to the extent of two-thirds. This year's estimate promises to be very much to the same effect. When the Government decide, therefore, as they must do soon, to go on with another instalment of their programme, so as further to strengthen our navy, it is but natural that the private builders should expect to receive the same, if not, indeed, a greater proportion of the new contracts.

◆◆◆

### UTILISATION OF THE NILE.

We have in the *Times* of Tuesday the text of the official notification of the proposed modification of the Assouan project, in the shape of a memorandum by Mr. Garstin. In it is recapitulated most of the information and arguments, already in the possession of our readers, as regards the other sites for dams on the Nile below Wadi Halfa. Beyond this he tells us that above Wadi Halfa, that is, south of it, Sir John Fowler's surveys, made in the reign of Khedive Ismail, for a railway projected to Khartoum, show that there is a possible site for a dam and reservoir at the Cataract of Hanneh, or at the Khaibar Gate. The Khaibar Gate is within forty miles of Dongola, and consequently no work would be possible there till the town is taken from the followers of the Mahdi. Another point is brought forward in the argument, which may be taken for what it is worth, and that is, that the emasculated Assouan dam scheme is only a step in a future scheme for the more complete utilisation of the Nile, which will fully serve the whole of the country, because that even if, as is possible, a reservoir be made in the future higher up the river, it will still be imperative to have a second reservoir nearer the point at which the water must be delivered for irrigation. The reason given for this being the waste which would inevitably ensue in the long shallow reaches and sandy side channels of the river on the way down. We confess that this argument and proposal looks like making the best of a bad bargain, and using an after thought as a thing to cover the retreat from the original Philæ proposal. We are glad, of course, to see that Philæ has been preserved for the archæologists, but at what cost remains to be seen. A heavy one, we fear, for it seems that an item in the estimates for the new dam at Assouan is to be an archæological and scientific investigation of the whole of Nubia. This may mean a big order, if the wishes of scientific societies are as stated, to be met in the matter, and it is scarcely fair to include it in the estimate of an irrigation project. We are told to expect this estimate in the spring of 1895; meanwhile it is stated that "the Public Works Department has been directed to put in hand as much of the archæological work as lies within its scope and power during the ensuing winter season. Topographical surveys will be made and plans prepared; the true bearings of the temples will be fixed and the preliminary plans of all sites completed. This portion of the work being done, the Egyptian Goverment will ask the European scientific societies to depute certain of their members to come to Egypt and complete the work."

### DYNAMOS AND COPPER PIPES AT SEA.

The last report of Mr. G. W. Melville, Engineer-in-Chief United States Navy, contains a very singular statement, which, if true, opens up a vista of extremely unpleasant possibilities to shipowners. It has once been said of electricity that "you never know where to have it, and in most cases it has you where you least expect it." Experience in the United States Navy seems to justify this expression of feeling if not of fact. Mr. Melville says: "The rapid destruction of copper piping in several vessels has already caused serious embarassment, and the reason for this deterioration has not yet been determined to an absolute certainty. As it always happens that a copper pipe conveying or surrounded by salt water, as the injection or delivery pipe to a pump, or the coil of a fresh water distiller, is the part attacked, and as the deterioration occurs only in steel ships fitted with dynamos, it is thought the injury may be caused by electrolytic action, since the copper of which the pipes are made is known to be of the very best quality, absolutely free from foreign matter, and therefore not affected by the corrosive action of salt water; in fact, precisely similar pipes, made of the same material, in iron vessels like the Alert or Ranger, which have no dynamos, last almost indefinitely. Steps are being taken to find out the true cause of this rapid destruction and the means by which it may be prevented." Mr. Melville is an extremely careful and competent man, and the more weight attaches to his words. Far-fetched as the theory may seem, we have no doubt that Mr. Melville holds that it has some foundation in fact, or he would not have promulgated it. It is unfortunate, however, that the issue is complicated by the circumstance that the Alert and Ranger are iron vessels. Now it is still a vexed question whether or not steel is more liable to corrosion than iron, and thus it may be said that the steel, and not the dynamo, is to blame. Why and how the dynamo should have anything to do with the matter it is by no means easy to see. As bearing on the same subject it may be worth while to mention that there is, it is said, good reason to believe that iron or steel yachts laid up close to vessels with coppered bottoms are very injuriously affected, the iron or steel corroding rapidly in spite of paint. It is by no means easy to see how the circuit can be completed in such a case, or to imagine that the current can be strong enough to do any mischief.

## LITERATURE.

*Railway Policy in India.* By Horace Bell, M. Inst. C.E., Consulting Engineer for State Railways to the Government of India. London: Rivington, Percival, and Co. 1894.

*Railways in India. Their Economical Construction and Working.* By E. George George, M. Inst. C.E., London: Effingham Wilson. 1894.

His official position gives Mr. Bell many exceptional advantages in dealing with his subject, and although he disclaims any official authority, yet as all his information is culled directly from sectariat records, his writing bears almost the stamp of a State document. Unfortunately, as a penalty for this advantage, his readers are deprived of the benefit of his personal views, and his mouth is closed to all criticism of the Government policy. However, he has produced a most interesting and useful narration of facts connected with the evolution and working of the Indian railway system. He divides his subject into seven chapters, of which the first and fourth have the greater general interest. The one discloses the history of the oscillations of the pendulum of official views on the question of guarantees and finance, the other recounts the story of the battle of the broad—Indian—and narrow—metre—gauges.

In tracing the evolution of the Indian railway system, we learn that as early as the year 1843-44 the first proposal for the construction of a line was advanced by Sir Macdonald Stephenson, and incredible as it may appear, it was at once received with favour by the Honourable Court of Directors, although at the time pressed by serious political anxieties, and sanction was given to the construction of an experimental railway between Calcutta and Allahabad in a despatch to the Government of India, dated May 1845. This and the Great Indian Peninsular were the first two railways started in the country; the gauge adopted was 5½ft., afterwards styled the "Indian or standard gauge." Thus commenced the movement which has given India railway communication extending from Cape Comorin to Afghanistan, and from the Indian Ocean to the Bay of Bengal, measuring 18,042 miles, and costing over £234,000,000 sterling.

From the year 1849, when Lord Dalhousie held the reins of Government, till the close of Lord Lawrence's term of office in 1869, the construction of Indian railways was on the broad, or standard gauge system, chiefly by the agency of guaranteed or assisted companies, and their extension, with the exception of the check caused by the mutiny made steady progress. But about this time the Government awoke to the economic disadvantages of the guarantee system, and constant attempts were made to arrive at a satisfactory settlement in the policy of guarantees and control; but no material change was made till at the close of his tenure of office Lord Lawrence bringing his intimate knowledge of the country to bear on the question, made out an unassailable case against the existing system; and his masterly review on leaving office led to the extension of the scheme for railways entirely and directly by State agency; and to the introduction of the metre gauge as a measure of economy by which the finances of India could be enabled to bear the burden of railway extensions so necessary for the safety and development of the resources of the country. This policy held for ten years, after which, up to date, the construction and management of railway lines have been about equally in the hands of the State and the Companies. At the same time, on most questions of finance, construction, gauge, working, and other matters, there seems to have been no settled railway policy with Government, or definite aim beyond that of protecting the interests of the country and the masses of its population.

Our author has in one of his appendices—C—exemplified the various changes of policy as well as of agencies that have been employed and arrangements that have been made, and gives much interesting and useful information in a tabular form including all the Indian lines.

We cannot in our space follow Mr. Bell into all the intricacies of the question of the gauges, which, as the world knows, was fought out bitterly for years both in England and India; statesmen, engineers, and soldiers ranging themselves on either side, and the policy that was fully and finally discussed in one decade was re-discussed, re-modelled, or even wholly altered in the next. This is the inevitable condition of things in India, with its frequently changing *personnel* of the Home and Indian Governments. Our author shows that as a whole these fluctuations of policy have been distinctly beneficial to the country; and he claims that the introduction of the metre gauge by Lord Mayo was a move in the right direction. Whatever may be the rights of the case, the upshot for the present has been a rational compromise, which even now must be considered as only provisional, for the developments of traffic throughout the country have been unexpected, and as yet no great military movement has afforded the experience which is necessary for the complete settlement of the question.

Our author's chapter on "Rates and Fares" will be read with interest and instruction by many on whose shoulders the cares of railway finance have descended. No better illustration of the paternal solicitude of the Indian Government for the mass of the population can be found than in their anxiety to bring down the railway rates and fares to the lowest paying level, and we see their endeavours from the earliest to keep down the tariff of the guaranteed lines, and when they became owners themselves they laid their measures to reduce and simplify rates and fares, and in the case of the lowest class, this reduction was carried to the extent of limiting the rate to 1½ pie—half a farthing—a mile, with the ultimate intention of reducing it still further, the managers of one of the State lines putting it that their passenger fares must be lowered "sufficiently to enable an ordinary coolie to travel more cheaply by rail than he can travel on foot." In India, as elsewhere, the third class affords the backbone of the coaching receipts; the other class might, as far as profit is concerned, be abolished; indeed, on most lines their removal would be a positive gain, and the author tells of a leading railway manager who stated it would pay him to give every first-class passenger twenty rupees to stay away.

The Government of India is in a position to show a good account for its stewardship, and the small volume under review helps to make this fact clearer; but their case is far from complete. Thousands and thousands of miles of railway still remain to be completed, and there is, as yet, only one mile for every 16,000 of population. A practical example is given us of the value of railway communication for military purposes, and a vivid illustration of the saving of time and money when, during the Afghan Campaign, there was a case in which one train, on a railway which had been rapidly pushed across the desert to the mouth of the Bolan Pass, was found to do in a day of sixteen hours the work which it would have required 2500 camels to do in a fortnight.

We learn from Mr. Bell that were it not for the serious loss by exchange, the Government of India might claim for their railway system unparalleled success as a national investment, for in 1892 the average return on all capital expenditure was 5·43 per cent. This is only the statistical result of the working, for, owing to exchange, the net loss to the State has been about 135½ lakhs of rupees. Had silver remained at par, a magnificient return would have accrued to the Government, for the loss on exchange alone in that year amounted to 153½ lakhs. The sterling interest charges now payable on Indian railways by Government in England are equivalent to a payment of interest at 7·6 per cent. on the total capital raised, if converted into rupees at par.

A clear little map, showing all the railways in India, in distinctive colours, accompanies the letter-press, and appendices, giving details of the standard dimensions to be observed on railways in India, and also a copy of the Indian Railway Act, with a table of contents and a good index, completes the volume.

In a little treatise of less than 100 pages of rather large type, Mr. George aims at compressing a large subject into a very small compass. His first chapter, in fact his whole work, bristles with statistical statement, and he gives his information with almost note-book brevity. Advocating the construction of railways for the political safety of India, he reproaches the British public with its supineness in overlooking such undertakings as a field for investment of capital, and he instances the case of 5136 miles of purely commercial lines constructed by joint stock companies, apparently without guarantee, earning 6·76 per cent. per annum per mile of railway. He makes out roughly a case for investors, and estimates in Chapter II. and Table VII. the cost of 300 miles of a 5½ft. gauge railway, the mode of construction, and working of which he describes farther on. He, however, deplores the unnecessary width of the Indian gauge, and believes that the English gauge of 4ft. 8½in. would have answered all purposes, stating that when the traffic had largely developed the metre guage had been unable to deal with it. His estimate per mile for the line he recommends is 1,08,701 rupees, and he takes the working expenses at 50 per cent. of the gross receipts, which he says, may be safely taken at 120 rupees per mile per week.

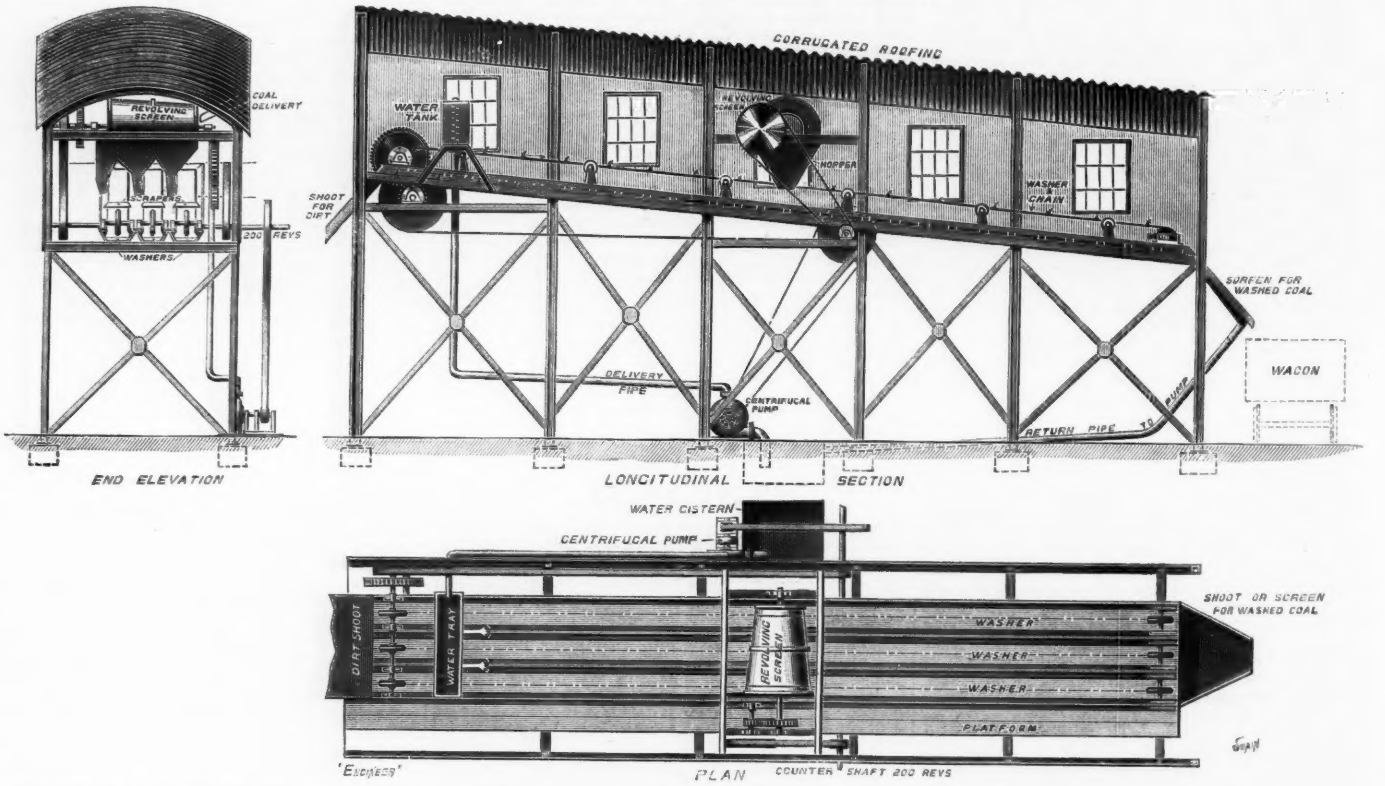
The author's advice on points of survey and construction is sketchy, but, as far as it goes it is good and practical. He is rather hard on the native character, and seems to have little sympathy with that valuable class, the native contractor. Yet at the same time he pronounces against the employment of the agency of large European contractors.

The author's experience seems to have been confined to the plains of India, and this is particularly noticeable in his observations on the founding in Viners and on the construction of earthworks and masonry in the fifth and ninth chapters. We chiefly note that the questions of terminal stations and telegraph communication have been left untouched. The value of the little treatise would have been enhanced by a good index.

**Portrait of Lord Armstrong.**—We have received an excellent reproduction of the latest portrait of Lord Armstrong. *Tyneside*, a new North-country monthly magazine, issues it as a supplement to its first and Christmas number. We congratulate our young contemporary both on the selection of a subject and the excellence of the workmanship. The portrait, we feel sure, will receive its due appreciation from all English engineers.

# ELLIOTT'S COAL WASHING PLANT

THE HARDY PATENT PICK COMPANY, SHEFFIELD, ENGINEERS



## ELLIOTT'S COAL WASHING PLANT.

In recent years, the fact that enormous quantities of small coal have to be disposed of at a very small or nominal price, on account of the large percentage of shale and dirt which is mixed with it, the coal itself being of good and useful quality either as a fuel or for the manufacture of coke, has directed attention to its careful washing and sorting. The usual and most efficient mode of separating the coal from the dirt is by washing. In the manufacture of coke it is essential that the coal should be as pure as possible, so that the ash may not exceed, say, 5 per cent. to 6 per cent. In addition to this, the shale or dirt having no coking qualities, but the reverse, it causes the coke to be unable to support much weight of iron in the furnace, instead of being strong and hard. After washing and grinding, the coke commands a ready sale. In the manufacture of briquettes, also, it is equally necessary to wash and grade the fine coal used or usable for the purpose.

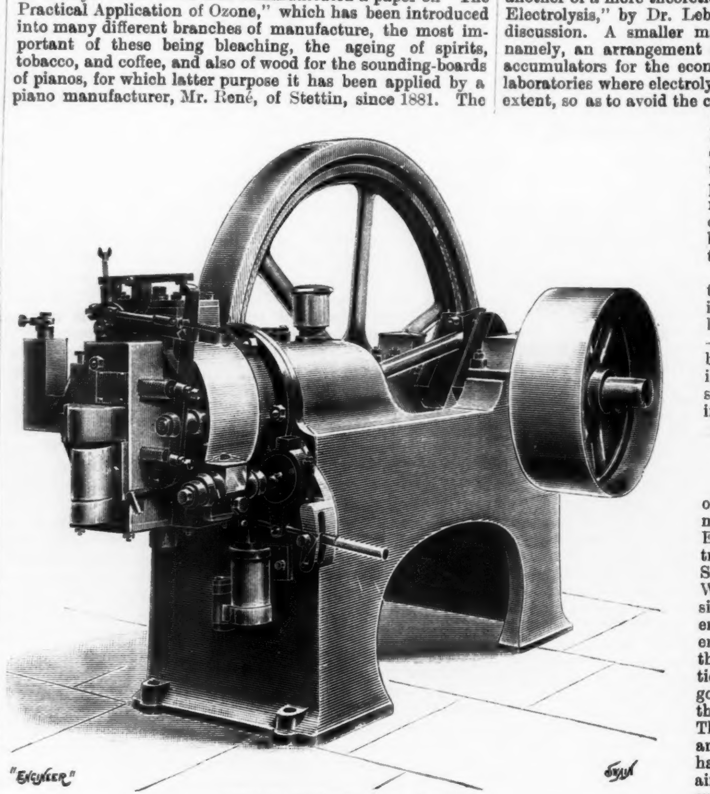
The plant we illustrate has been designed on the lines of the old trough washer. In addition to the difficulty, sometimes, of obtaining the necessary skill and attention, there was in the old troughs the necessity of changing the flow of coal and water into a second trough, while the dirt was being washed off and removed from the first when the stops had become charged with it; for if this was not done at the proper time some of the dirt became mixed with the coal, and the result was not satisfactory. The Elliott washer is automatic in its action.

The washer is constructed with a wrought iron or steel trough about 18in. wide, having sloping sides, being widest apart at the top and narrowest at the bottom. At each end of this trough a sprocket wheel is fixed, on which a chain rides, carrying scrapers. The scrapers form movable stops or dams which are slowly moved by the chain along the trough in the opposite direction to the run of the water. The coal is admitted at the centre of its length, and the water at its highest end or thereabouts, and as it runs to the lowest end it carries with it the coal, and the dirt settles in the scrapers and is conveyed by them against the stream of water and delivered at the opposite end to that at which the coal escapes. The speed of the scrapers and quantity of water is regulated to suit the material washed. As seen in the engraving, the coal is first delivered to a screen, thence the process is automatic.

## THE GERMAN ELECTRO-CHEMICAL SOCIETY.

A new society for the study of electro chemical problems, which was founded at a conference held in Cassel on April 21st, 1894, held its first general meeting at Berlin, on the 5th and 6th of October last, under unusually favourable conditions. Starting with 65 original founders, the number of members had increased to 271 at the time of the meeting, about two-thirds of the whole number being chemists, and the remaining part technical electricians. Among these, thirty members are from non-German countries, including three each from England and the United States. The object of the Society, as defined in the bye-laws, is the development of electro-chemistry in its scientific, technical, and economic aspects, and more particularly by the agency of meetings, a periodical journal, and correspondence with existing chemical and electrical societies. The first instance of the Society's activity, the Report of the First General Meeting, which has been forwarded to us by the council, is of an extremely interesting character, and contains several important communications. Among these we may specially mention a review of the work done by J. W. Ritter, a contemporary of Galvani and Volta, whose discoveries and writings between 1792 and 1808 entitle him, in the opinion of the author of the paper, Professor Ostwald, to be considered as the founder of electro chemistry. He certainly appears to have been the first to perceive that Volta's electro-chemical arrangement of the metals corresponded to the order of their affinity for oxygen. It is sad to think that an experimental philosopher of such high promise should in the later years of his short life have lapsed into mysticism and given himself up to pursuits not very dissimilar to those of the table-turner or spiritualist of later days. Dr. O. Frölich communicated a paper on "The Practical Application of Ozone," which has been introduced into many different branches of manufacture, the most important of these being bleaching, the ageing of spirits, tobacco, and coffee, and also of wood for the sounding-boards of pianos, for which latter purpose it has been applied by a piano manufacturer, Mr. René, of Stettin, since 1881. The wood is exposed to the action of ozonised air in a warm and closed chamber for a period varying from twelve to twenty-four hours, which has the same effect in producing uniform hardness and increased sonority as exposure to the air for several years. In this case the chemical change due to action of ozone on the resins contained in the wood is probably an important factor. The thickening of linseed oil which is effected in linoleum manufactories by allowing it to trickle over strips of gauze for several months, can in like manner be done with ozonised air in a few days. The conversion of crude potato starch into the soluble variety, as well as into dextrine and other gummy substances by ozone, has been effected by the author, and the method is to be introduced practically into a manufactory now in process of construction; but a more interesting application, which, however, is still in the experimental stage, namely, the production of nitric acid from the air, has also been developed by a method which will shortly be published; although, with the present low price of nitrate of soda, it is not likely to become commercially available in the immediate future. Specimens of nitrates made with nitric acid, produced by the direct oxidisation of atmospheric nitrogen, were exhibited at the meeting. The papers which seem to have excited the largest amount of interest were those by Dr. Borchers on "A New Galvanic Element," which we noticed in our issue last week, and another of a more theoretical character on "The Limits of Electrolysis," by Dr. Leblanc, which gave rise to a lively discussion. A smaller matter of some practical interest, namely, an arrangement of copper and zinc batteries and accumulators for the economic production of current in laboratories where electrolytic analysis is used only to a small extent, so as to avoid the cost and trouble of a dynamo, was brought forward by Dr. Heim, of Hanover, and a new form of incandescent lamp, in which alumnium terminals are substituted for platinum, by Dr. W. Bolton. The meeting was well attended, about one-third of the whole of the members being present, which is certainly a good beginning.

The second annual meeting is to be held in May or June, 1895, in some South German city, probably in one of the following three:—Munich, Frankfort, or Heidelberg. The member's contribution is fixed at 5s. entrance fee and 15s. subscription, payable on July 1st in each year.



WELLS' PREMIER OIL ENGINE

## WELLS' OIL ENGINE.

In The Engineer of the 13th of July last we described the manufacture of the Wells' Oil Engine, which ran through the trials of the Royal Agricultural Society at Cambridge in June last. We were not at the time in possession of a perspective view of the engine, but this we are now enabled to give above, which shows the design of the engine. The particulars of the vaporiser and governor were fully described in the impression above referred to. The engine is of the classes four and six of our classification, and has a vaporiser in which oil and air both pass through it as a charge enters the cylinder. The engraving we now publish shows the arrangement which we mentioned, but did not illustrate, which the makers have adopted for working the air-pump by hand, or by the engine when it has started. An excentric is mounted on the side shaft, which runs through the frame of the engine, and by means of a downwardly forked joint engages with the pump lever. As shown, the latter is pivotted by a pin in a slot, and the movement of the excentric operates the lever and the pump. When necessary to work the pump lever by hand, the pin shown towards the handle end is taken out, and the excentric fork joint becomes the pivot upon which the lever works.

Engineering Society, King's College, London.—A general meeting was held on November 23rd, the president in the chair. Mr. Herbert Jackson, F.C.S., read a paper on "Phosphorescence." The author defined phosphoresence and fluorescence, and then proceeded to exhibit the latter by passing a beam of limelight through a solution of fluorescence, the experiment being repeated with the light of sulphur burning in oxygen. An experiment was also shown to illustrate the damping effect of certain colour rays on the vibrations causing phosphorescence.

## RAILWAY MATTERS.

The Council of the Surveyors' Institution have nominated Mr. E. P. Squarey—past president—and Mr. C. Oakley—vice-president—to represent them at the Conference on Light Railways, to be held under the auspices of the Board of Trade on Thursday, the 6th of December.

The desirability of the provision of light railways has been emphatically affirmed by the Staffordshire Chamber of Agriculture. £1500—including land—was the attractively low estimate per mile mentioned by Mr. W. G. Bagnall, the Stafford manufacturer of locomotives and portable railways.

The following is a fair example of the way in which the hours-of-labour malady or craze has attacked some of our military-railway Board of Trade inspectors:—"The hours of duty of the guards of the train are not satisfactory. Donelly commenced work at 9 a.m. to sign off at 11.20 p.m., and though he was off duty for six or seven hours between whiles, the longest interval of rest was only two hours." Poor Donelly, only two hours rest with a few other odd hours during the day. Frightful to think of—a man working seven hours and twenty minutes in one day.

Notice has been given by the parliamentary agents of the London, Walthamstow, and Epping Forest Railway announcing their intention in the next session to ask authority to abandon the line, to release the deposit and to dissolve the company. It will be remembered that the promoters last session had a controversy with the London County Council on the question of workmen's fares, declaring that it would be impossible to raise the capital under the conditions sought to be imposed upon them, but the Bill was eventually passed on a compromise being arrived at between the promoters and the County Council.

Further work is in hand by the railway rolling stock firms. The Oldbury Railway Carriage and Wagon Company, Oldbury Works, near Birmingham, have taken a contract for ten bogie composite carriages for the Government of Western Australia. These carriages, which are to run on two 4-wheel bogies, are 42ft. 2in. long, and are intended for a 3ft. 6in. gauge. They are built on the English principle, with cross compartments for first and second-class passengers. The roofs are double with a clear air space between for ventilation. The outer roof is carried partly down the side of a carriage to form a sunshade, and by an ingenious arrangement is hinged and opens out with the door. The compartments are finished in sycamore, teak, and buffalo hide. The underframe and bogies are made of steel channels and plates, and all the carriages are fitted with the automatic vacuum brake.

In his report to the Board of Trade on the fatal accident which occurred on the 9th instant at a private road level crossing near Chatham station, on the Ashford and Canterbury line of the South-Eastern Railway, when as a one-horse wagon containing twenty-one hop-pickers and children, on the way from Canterbury to a hop garden, was crossing the line at the level crossing of a private road, it was run into, during a thick fog, by the engine of the 4.15 a.m. down goods train from Ashford for Canterbury, and the horse, the driver of the wagon, and six of those riding in it being killed, and nine others being more or less seriously injured, Major-General Hutchinson says the accident must be attributed to the imprudence of the driver of the wagon, which was conveying a party of twenty-one hop-pickers and others from Canterbury to the hop garden. It is almost unnecessary to say that the military-railway inspector craze about the number of working hours is also the burden of the conclusion of this report.

On the Mont Saléve Rock Railway, in Savoy, which is worked by electricity generated by water power, electric heating has been introduced into the carriages. The heating apparatus consists of two resistance boxes, 33in. wide by 12in. high and 7½in. broad, each containing forty-two coils of galvanised iron wire 1½ millimetres thick. These coils are 1in. in diameter, and contain about 20ft., or between 500 and 600 yards in each carriage. The current is taken directly from the rail conductor and passes through the coils, which are coupled in tension. The quantity absorbed is 15 ampères, which at 500 volts represents about 10-horse power. The temperature of the wire is raised to the boiling point of water, and that of the carriage is easily maintained at 60 to 70 deg. Fah., even in the coldest weather. In spite of the large amount of power required, this system of heating is possible on account of the traffic being small in cold weather, only four carriages being usually required, so that 30 or 40-horse power can be spared for the driving current for conversion into heat. The cost of the apparatus is £2 8s. per carriage.

The Lancashire, Derbyshire, and East-Coast Railway Company is applying to Parliament for powers to construct the Sheepbridge Branch and Clay Cross Branch Railways; to abandon certain railways, including the lines authorised under the Newark and Ollerton Act, 1887; and to empower the company to constitute a separate undertaking to take in hand so much of their railway as extends from Chesterfield to Lincoln, the Clown and Langwith Colliery Branches, the Markham and Bolsover Branch deviations, and the Sheepbridge and Clay Cross Branches. The new company will be known as the Lincoln and East-Coast Railway and Dock Company, which will have in hand the completion of the eastern section of the coast to coast railway. The Manchester, Sheffield, and Lincolnshire Railway seek for powers to construct lines in the parishes of Bestwood Park, Bulwell, Nottingham, Basford, Wilford, and Gotham, and for widening the company's railway from Retford to Gainsborough, and from Rampton to Torksey. Other railways are also contemplated in London and in different parts of the Manchester, Sheffield, and Lincolnshire system.

In reporting to the Board of Trade on the double collision which occurred on the 4th September, between Linlithgow and Philpstoun on the North British Railway—when owing to the severance of the train between the first and second wagons in the 12.10 a.m. up goods train from College (Glasgow) to Portobello, the rear portion of the train, consisting of thirty-four wagons and brake-van, was left standing on the up main line between Linlithgow and Philpstoun, at about 4.34 a.m., by the following train, the 12.45 a.m. up goods train from College (Glasgow) to Dundee, consisting of engine, tender, thirty-seven wagons, and brake van, Major Marindin says:—"Considering the nature of the double collision under investigation, it is providential that the results were not far more serious, for the escape of the guard of the 12.10 a.m. up goods train, the rear van of which was completely broken up, could hardly have been expected. The first cause of the collision was, no doubt, the severance of the train between the first and second wagons of the 12.10 a.m. train, and there is no evidence to show exactly where this took place. What may be taken as certain is that the wagon was properly coupled up before it started, and that the coupling was not broken, but in some manner became detached. This is a very unusual occurrence when a train is running on a nearly level line, with no changes of gradient to speak of, unless the train is checked very suddenly, when a coupling may be jerked off. It is easy to imagine that a driver leaving behind a few wagons out of a long train might, on a foggy night, not find it out; it is a different thing when, as in this case, he leaves the whole of a train of thirty-five vehicles, except one wagon, and the driver of the 12.10 a.m. train must be held to have been not sufficiently careful. He and his fireman had, at the time, been on duty for about five and a-half hours, the guard had been on for forty minutes less, and the signalman at Philpstoun for about ten and a-half hours." There is more, we need hardly say, about the working hours, which is the present craze of the Railway-military Department of the Board of Trade.

## NOTES AND MEMORANDA.

Phosphate of lime, obtained in the manufacture of gelatine, and known as precipitated phosphate and used as a manure, is admitted into France free from duty.

Electricity can be used to remedy blow-holes in defective castings by first drilling out the defects and then heating the castings, at the same time introducing scraps of steel, which are melted by the current, making a perfect joint without seam or flaw of any kind.

A high record for rail production was reached in October last by the Edgar Thomson Steel Works, at Braddock, Pa., the output amounting to 35,900 tons. In one twelve-hour turn 1800 tons were turned out, and on the other 1790 tons. The best previous record for production in any one month at this plant was about 33,000 tons.

Nitrate of ammonia can be used for freezing instead of ice and salt by mixing, if a small freezer be used, 7 lb. of nitrate with three quarts of water. The freezer is then rotated, and the cream or water is quickly frozen provided that the material is first cooled down before applying the nitrate. The nitrate can be recovered for further use by evaporating the solution to dryness.

Stage illumination by means of inverted arc lamps fixed so as to throw their beams on to a ceiling—the stage, &c., being illuminated by the reflected and diffused light therefrom, has been found a theoretical but not a practical success by M. Nerz. This is in consequence of a crater deposit, which disturbs the regularity of the arc. *L'Eclairage Electrique* says that the successful adoption of this method would involve the use of purer carbons than are made now-a-days.

Paper from sunflower stalks has recently been produced in the south of England; but as the fibre in the stems is too short to produce a material of fine texture suitable for writing or printing upon, the experiment is not likely to be continued. Some 500 lb. of sunflower stalk produced, by the aid of proper paper-making machinery, about 320 lb. of paper. This was not suitable for other purposes than packing, and to make a good paper it was estimated that the addition of 50 per cent. of rags or similar material would be necessary.

M. Forster, of the Berlin Observatory, has communicated to the *Revue Scientifique* the result of a series of observations carried on simultaneously for twenty months past at Kasan in Russia, Marburg in Germany, and Bethlehem in Pennsylvania, on "The Oscillation of the Axis of Rotation of the Earth." The object was to study the question of the supposed oscillation of the axis of rotation of the earth. From about 10,000 observations it appears that the pole or end of the axis has an oscillation following a spiral traced from west to east. The rate of oscillation is variable; at the present time it is decreasing. It appears, however, that the actual extent of this movement is very small, not exceeding 15 metres.

It appears from the columns of our contemporary, *Die Natur*, that a German chemist has made the discovery of a new compound body, which is said to possess the peculiar quality of solidifying under the action of heat, and to again revert to the liquid state at a temperature below 32 deg. Fah. To this substance the name of crostase has been given, and it is stated to be obtained by mixing equal parts of phenol, camphor, and saporine, with the addition of a smaller proportion of the essence of terebenthine. It is supposed that up to the present time no body possesses this remarkable property of liquefying when cold and solidifying when hot. It is true that certain substances such as albumen, for example, harden when exposed to heat; but once they have attained this condition, they cannot be made to resume the liquid state, although they may be subjected to exceedingly low temperatures.

At the last meeting of the Meteorological Society, Dr. H. B. Guppy read a paper on suggestions as to the methods of determining the influence of springs on the temperature of a river, as illustrated by the Thames and its tributaries. The methods suggested were:—(1) Comparison of the curves of the monthly means of the temperatures of the air and of the water for the river under observation with those of a river beyond the controlling influence of springs. (2) Comparison of the monthly means of the temperature of the river under investigation with that of a river beyond the control of the springs. (3) Comparison of the range of the monthly means of the river temperature with that of the air in the shade. (4) Comparison of the daily range of water temperature at different stations along a river's course. (5) Comparison of sunrise observations made at different stations along a river's course. (6) Comparison of observations made at different stations along a river's course at the hour of maximum temperature. (7) Comparison of the results obtained from a single series of observations made in one day along the whole course of a small tributary like the Wandle, or along the upper course of a larger tributary as the Kennet. (8) Determination of the distance from its sources at which the river begins to freeze.

At the last meeting of the Physical Society, Mr. Womack read a paper on "A Modification of the Ballistic Galvanometer Method of Determining the Electro-magnetic Capacity of a Condenser." The condenser is placed in parallel with one arm, S, of a Wheatstone's bridge arrangement of non-inductive resistances. A balance for steady currents having been obtained, the condenser is placed in circuit, and the throw on depressing the battery key determined. The condenser is then thrown out of circuit, and the proportionality of the arms of the bridge disturbed by changing the value of $S$ to $S + dS$. The steady deflection due to this change is then read. From these two readings and the known values of $S$ and $dS$ the capacity is immediately determined. In practice readings of deflection may be taken with equal positive and negative values of $dS$. To avoid changes of electro-motive force of the battery the author finds it best to use a reversing key in the battery circuit, and to observe the throw on reversing the current instead of on simply breaking it. One advantage of the method is that there is no need to know the galvanometer or battery resistance, and the author points out that it may be of service in the simultaneous determination of the resistance, and of the joint capacity and inductance of a submarine cable or of a telephone or telegraph line.

A simple method of obtaining light of different wave-lengths for use in polarimetric work is described by Landolt in the *Sitzungsberichte*, of the Berlin Academy, No. 38. White light from an Auer's glow-lamp is passed through different absorption cells containing coloured solutions which can be readily procured. Details are given of the preparation of five such cells, by means of which red, yellow, green, light blue, and dark blue light may be obtained. Examined spectroscopically, the light is in each case found to consist of a band, and is not by any means monochromatic; if, however, the rotation be less than 20 deg., or, with one or two of the cells, even if it be considerably greater, the field of the polarimeter remains apparently uniform in tint. The wave-lengths with which the bands may be taken to correspond were determined by using the cells in a set of observations on the rotation of quartz, and comparing the results with those obtained for the rotation of quartz by Broch's method. The wave-lengths were thus ascertained to be not far removed from those of the Fraunhofer lines, C, D, E, F, G. The instrument employed was a Laurent half-shadow polarimeter fitted with a Lippich polariser. A simple method of this kind has, *Nature* says, long been required for the speedy investigation of rotary dispersion. It is also of importance to have a ready means of obtaining light of short wave-length, which if of especial service when determining the rotary power of feebly active substances.

## MISCELLANEA.

It is reported that a landslip has blocked up the Corinth Canal.

At a recent committee meeting of Navy and Dockyard officers at Devonport, it was decided to commence at once laying the foundation for a defence boom as a means of protection for Plymouth, constructed similarly to that recently provided at Chatham for the defence of the Medway.

In the coming session of Parliament application will be made by the Charing-cross and Strand Electricity Supply Corporation for authority to undertake the lighting of the Strand district by electricity; and the County of London and Brush Provincial Company will also seek power to light the districts of St. Mary, Newington, St. Olave, and Battersea.

The official reports continue to show that the rate of increase of the population of London as measured by births is decreasing. In London 2494 births and 1275 deaths were registered last week. Allowing for increase of population, the births were 199 and the deaths 416 below the average numbers in the corresponding weeks of the last ten years.

Experiments were made last week at Cureghem, a suburb of Brussels, with a new rifle, the invention of M. Marga, an officer in the Belgian army. The main feature in the invention is the cartridge, which is so arranged as to contain what are practically two charges. These are fired in succession. The extraordinary muzzle velocity of 3000 foot-seconds was attained. The sole objection to the new weapon seems to lie in the increased cost of and labour of filling the cartridges.

The Secretary of the United States Navy has asked Congress to order three new battleships, each of 10,000 tons, and twelve torpedo boats. This will involve an additional expenditure of £2,800,000. The estimates for the coming year demand £3,560,000 for the ordinary expenses of the navy, and £2,652,080 for the proposed increase, including armament. In addition the Secretary of the Navy recommends that in future no premiums for speeds shall be given to builders.

The Portuguese Government have entered into a contract with Messrs. Yarrow and Co., of Poplar, for the immediate construction of two shallow-draught stern-wheel gunboats, to take part in the Portuguese operations at Lorenzo Marquez. According to the *Times*, the vessels are to be 89ft. in length by 18ft. beam, and will have a draught of 18in. and a speed of ten miles an hour. They will be somewhat similar to the Mosquito and Herald, built by the same firm for the British Government for service on the Zambesi.

On Wednesday the Commission appointed by the Board of Trade under the Thames Conservancy Act, 1894, to inquire as to the improvement of the Thames between Thorney Creek and the Nore Lightship held its first meeting at the offices of the Thames Conservancy. Mr. J. Wolfe Barry, C.B., who presided, said that meeting was a preliminary one for the discussion of future proceedings, and the one desire of the Commissioners was to give everyone concerned the fullest opportunity for offering information. A discussion followed as to the course to be pursued in the inquiry, and the Commission then adjourned till the 18th of December.

The *Weekly Weather Report* of the 17th instant shows that in many districts the rainfall greatly exceeded the mean; over all the southern counties of England the amount was nearly four times as much as the average. The largest amounts recorded at individual stations during the week were 6·25in. at Godmanstone—near Dorchester, 5·51in. at Scilly, 5·13in. at Killarney, and 4·70in. at Falmouth, while 4·60in. fell at Crowborough, Sussex, in six days. The rainfall since the beginning of the year has now exceeded the average in all districts, except the Midland Counties and the West Coast of Scotland. The excess in the South of England and South of Ireland amounts to over 5in.

According to some statistics issued by the German Ironmasters' Association, the total production of pig iron in the Fatherland during September of the present year was 473,000 tons, which exceeds by 62,877 tons the figure for September, 1893. The production of the first nine months of 1894 was 4,088,246 tons, against 3,646,873 tons for the corresponding period of last year, showing an increase of 441,373 tons. The quantity produced during the first eight months of the present year, viz., 3,236,680 tons, is composed of forged pig and spiegeleisen, 1,035,035 tons; Bessemer pig, 222,468 tons; basic pig, 1,473,291 tons; and foundry pig, including castings produced directly from the blast furnace, 599,893 tons.

Experiments as to the visibility and audibility of torpedo boats at night have been made off Newport by the United States torpedo boat Cushing, which had been previously painted with a suitable colour. In the first experiment the Cushing steamed out from shore at night, having a powerful search light from the land directed upon her. At a distance of a thousand yards she became invisible from the shore, although it was light enough on the Cushing herself to read. The second experiment was to determine the distance at which the boat could be detected by her noise. The report says:—"Eight hundred yards is the maximum torpedo range, and a speedy craft would make great progress inside of this before guns could be trained upon her; so it is still questionable whether the search light is much of a safeguard against an attack from torpedo boats."

The Government of Brazil, through its special representative in France, Admiral J. de Proenca, has arranged with the Société des Forges et Chantiers de la Méditerranés at La Seyne, near Toulon, to build for it two ironclad battleships 267ft. 6in. long, 46ft. 11in. broad, and displacing, at a draught of 13ft. 2in., 3162 tons. *The Times* says the designs are by M. Lagane, director of the yard at La Seyne. With natural draught the engines will develope 2650-horse power, and give a speed of 13 knots; with forced draught, they will develope 3400-horse power, and give a speed of 14 knots. Each will have two turrets, and its armament will consist of four 9·4in. breech-loading, four 4·7in. quick-firing, two 5·9in. rifled howitzers or long mortars, two 3in.—12-pounder—quick-firing, four 2·24 in.—6-pounder—quick-firing, two 1·45in.—1-pounder—quick-firing, and two 1in. machine guns, with torpedo ejectors. There will be a thick steel belt, a steel protective deck, and heavy armour on the turrets.

Following a similar action taken by the Dover Harbour Board on Tuesday, the Dover Corporation on Wednesday evening decided unanimously to memorialise the Government to allow convict labour to be employed in escaping and rendering safe the dangerous area of cliff near the convict prison which, it is proposed, shall be closed, although it has cost £108,000 to erect. In drawing attention to the advantage the work would be to the Government as well as to the town, the memorial points out that, if undertaken, it would promote the employment of non-convict labour for several years to the extent of 700 or 800 men, who would be engaged in utilising the *débris* thrown down by the convicts from the cliffs to form a roadway and seawall at the base, where a roadway existed as far as St. Margaret's Bay until it was gradually and completely washed away by the sea. During recent years the encroachment of the sea here has been most serious, and enormous falls of cliff take place very frequently. In reclaiming and protecting the foreshore as proposed, all further erosion of the cliffs would, the memorial declares, be effectually prevented, and the lighthouse and other Government buildings within the area would be rendered safe from a danger which must ultimately threaten their security.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Garbage disposal.*—A commission from New York city is now visiting the various cities in which garbage cremators or other disposal plants are in operation. The Dixon system, at Atlanta, Pa., consists of two reverberatory furnaces, one on top of the other. The flame comes from coal burned in the fire-box. The garbage is dumped into the upper furnace, and, as soon as it dries, it falls through grate bars to the lower one. The fumes, gases, and odours evolved are carried to another furnace under the stack, where an auxiliary fire of coke consumes them. There is said to be no odour, although in the forty tons of stuff burned during twelve hours there are 120 barrels of night-soil, and this carries at least 60 per cent. of water. A dead horse put into the upper chamber had vanished, bones and all, in one hour and ten minutes. The furnaces consume four tons of coal a day. The process is rapid, complete, and perfectly odourless, and the smoke from the stack is slight and has no smell, except that of burning coal. At St. Louis, Mo., the St. Louis Sanitary Company has a ten years' contract for garbage disposal, and operates the Metz system. The wet garbage is placed in receivers, where it drains. It is then put into steam jacketed dryers, where it is constantly stirred for three hours. Transferred to retorts, it is saturated with naphtha, which dissolves all the grease, and this is then distilled off. The residue is ground up fine, placed in packs and sold for fertilising purposes, bringing 8 dols. a ton. The grease, which is odourless, is sold also for 8 dols. a ton to a firm of soap makers. Like all utilisation processes, this has a vile smell, which is complained of by people living five blocks from the works. The people in Detroit protested so strongly against it that the works were moved out of the city. The St. Louis plant is well out of the city limits. The city pays the company 1·80 dols.—or 7s. 6d.—a ton up to 100 tons, and all over that is treated for nothing. The average amount is 180 tons a day. One of the best and most satisfactory systems of cremation is that of the Eagle Company, in which two fires are used, the products of combustion from the garbage passing over the second fire and through a long firebrick chamber, in which these products are completely consumed. This system was employed, with entire success as to efficiency and freedom from odour, at the Chicago Exposition, oil being freely used.

*A bridge of* 4300*ft. span.*—In a recent number of THE ENGINEER was printed a report from a board of prominent bridge engineers in America, showing that a suspension bridge of 3100ft. span is entirely practicable, and is preferable to a cantilever bridge for the crossing of the Hudson river at New York. A report from another board of engineers, also made to the Government, shows that even 4335ft. is possible. This report adopts a steel cable of 6000 wires as the basis of construction for a six track bridge. The strength of such cables is 28,440 tons, giving a working strength of 9480 tons. The diameter would be 21½in., as against 15⅝in. for the Brooklyn bridge. The towers would be 707ft. above the masonry, and weigh 57,172 tons. The total weight of metal in the bridge would be 233,899 tons. After giving in great detail the calculations for this great structure, the board turns its attention to the Hudson river bridge project. It takes up the report of the bridge commission, which fixed the cost of the bridge at 30,743,000 dols., and pointing out that this was a maximum estimate, and that the board expressly stated that it was not to be taken as an absolute estimate, the engineers submit a new estimate considerably reducing the figures. The minimum estimate is given as follows: —Weight of structural steel, 161,507,000 lb. at 4 cents per lb., 6,460,280 dols.; wire work, weight 56,318,000 lb., at 7 cents per lb., 3,942,260 dols.; cost of superstructure, 10,402,540 dols.; of substructure, 11,784,000 dols.; total cost of bridge, 22,186,540 dols. Summing up, the board finds that 23,000,000 dols. is a reasonable estimate for a six track suspension bridge 3200ft. long, and they consider the amount of traffic which such a bridge would accommodate sufficient to warrant the expense of construction. They believe, however, that the bridge should be so constructed that its capacity can be readily increased, and with the suspension system this can be provided for by giving suitable dimensions to the towers and anchorages. The board suggests that competitive designs be invited for such a bridge.

*Fireproof floor construction.*—A very general method of floor construction for office buildings, factories, &c., consist of hollow firebrick blocks laid together between the I-beams or rolled joists of the floor framing, forming a flat arch. The end blocks fit the shape of the floor beams, and the others are of rhomboidal section, except the middle one, which is slightly wedged shaped, forming the keystone. The blocks are supported during construction of the floor by a platform of planks under the floor beams. They are laid in cement; the bottom is roughened so that the ceiling is attached directly to the blocks, and a thin concrete or cement floor is spread over them. The blocks are very light in weight, but very strong, being hollow, with intersecting ribs, and such floors can carry very heavy loads. In the latest form of such floors, the end blocks, or skewbacks, are the full depth of the beams, but the others are shallower and have curved top surfaces, so that the finished arch has actually an arched-shaped top surface, arched ribs in the hollow blocks, and a flat surface for the ceiling. The floor is filled in level with ashes or cement. This arrangement really acts as an arch, while the ordinary flat arch acts merely as a beam. A somewhat different construction is the use of concrete arches, the concrete being filled in an arched centreing and resting on the lower flanges of the beams. Where the spans are considerable, arches of light angle, tee, or H-irons, are placed between the floor beams, about 4ft. apart, and concrete is filled in between them, forming arches whose ends rest upon the floor beam flanges, and whose sides rest upon the arched irons.

## LAUNCHES AND TRIAL TRIPS.

The steam vessel Scotia, which has just been constructed by Mr. James Weatherhead, Eyemouth, for Mr. Richard Irvin, North Shields, went on trial on the Forth on the 22nd inst., and attained a speed of 10 knots. Her engines, which are compound surface-condensing of 200-horse power, have been supplied by Messrs. John Cran and Co., engineers, Leith.

Last week Messrs. Ropner and Son completed and despatched from their Iron Shipbuilding Yard at Stockton-on-Tees the following steamers for their trial trip, viz., the s.s. Harald, the s.s. Glanton, and the s.s. Dovedale. On the 28th instant Messrs. Ropner and Son launched a very finely-modelled steel steamer of the following dimensions, viz.: Length between perpendiculars, 300ft.; breadth, 42s. 6in.; depth moulded to awning, 32ft. 6in. She will have triple-expansion engines by Messrs. Blair and Co., of 1000 indicated horse-power, with two large steel boilers 160 lb. pressure. The steamer has been built to the order of a Newcastle firm, and was named Carlton by Mrs. Pellew.

The s.s. Bainbridge is a fine steel screw steamer, built by Messrs. William Gray and Co. to the order of Messrs. Crosby, Magee, and Co., of West Hartlepool. She has been built to Lloyd's highest class, and is of the following dimensions, viz.:—Length over all, 280ft.; breadth, 27ft.; depth, 19ft. 6in. The engines have been supplied by the Central Marine Engine Works of William Gray and Co., and are of the triple expansion type, working on three cranks. The cylinders are 19in. by 30½in. by 51in. in diameter, and the stroke is 36in. The boilers are of large size, working at 160 lb. per square inch. On her trial trip the engines were driven at 60 revolutions per minute, a speed of over eleven knots being attained without any hitch or trouble with the machinery in any way.

On Tuesday there was launched from the Cleveland Dockyard of Sir Raylton Dixon and Co., Middlesbrough, a very fine steel screw steamer which has been built to the order of Messrs. Lamport and Holt, of Liverpool, for the Liverpool Brazil, and River Plate Steam Navigation Company. This vessel has been specially designed to suit the South American trade, and is exceedingly well fitted in every department. The principal dimensions are: Length, 321ft.; beam, 42ft.; depth moulded, 25ft. 6in.; and she takes Lloyd's highest class, as well as Board of Trade certificate. The machinery will be fitted by the North-Eastern Marine Engineering Company, of Wallsend-on-Tyne, the cylinders being 24in. by 40in. by 64in. by 42in. stroke, with two large double-ended boilers working at 180 lb. pressure. As the vessel was leaving the ways she was named the Homer by Mr. Watt, of Eaglescliffe.

On Wednesday last the new Norwegian steamer Solveig, built by Messrs. C. S. Swan and Hunter, of Wallsend, to the order of Messrs. Christian Michelsen and Co., of Bergen, was taken to sea for her trial trip. Her principal dimensions are: 340ft. length by 44ft. beam by 29ft. 10in. depth to spar deck; to class 100 A1 at Lloyd's, and is the largest steamer by nearly 1000 tons now owned in Norway. The steamer will carry a deadweight cargo of 5500 tons, and a measurement cargo of about 6500 tons on a moderate draught. She is supplied with a full equipment of powerful steam winches and very complete cargo gear. The machinery has been constructed by the North-Eastern Marine Engineering Company, Wallsend, the cylinders 24in., 40in., and 64in. diameter, by 42in. stroke, supplied with steam at 160 lb. pressure by two exceptionally large boilers, which on the trial trip maintained more steam than was required. Whilst the machinery was working at sixty-seven to sixty-eight revolutions a speed of 11¾ knots was attained during the run along the coast, a speed which can only be considered as highly satisfactory both to the owners and the engineers. The shipbuilders were represented on the trial by Mr. Rowland Hodge, and the engineers by Mr. Summers Hunter, whilst the owners' agents in Newcastle, Messrs. Dent and Co., were also on board. During the construction of the vessel she has been superintended by Captain Rodseth, on behalf of the owners, and on the conclusion of the trial trip, which was in every way satisfactory, Captain Rodseth expressed his entire approval of both the vessel and machinery, and afterwards immediately shaped a course for Philadelphia, where the Solveig will take on board 140,000 cases of oil for Japan.

On Tuesday the fine new steel screw steamer Musician, built by Messrs. C. S. Swan and Hunter, to the order of Messrs. T. and J. Harrison, of Liverpool, was tried off the Whitley measured mile. She has been built for their East India and general trade, is 400ft. between perpendiculars long, by 47ft. broad, by 31ft. 6in. depth moulded, and is built on the three-deck grade, of the highest class at Lloyd's, and under their special survey. She has a full poop, with long bridge deck and topgallant forecastle. The cellular double bottom extends the length of the vessel. The winches and derricks are of unusual size and number to suit the owners' particular requirements, and the whole of the cargo gear is of the most complete description, and made especially to Captain Gell's design. The engines are by the Wallsend Slipway and Engineering Co., Wallsend, having cylinders 27in., 44in., and 71in., by 42in. stroke; the boilers are built for a working pressure of 180 lb. on the square inch. After a satisfactory trial a speed of 13·48 knots was obtained, the engines running at 72½ revolutions per minute, and to the satisfaction, in all respects, to the owners' representatives. The steering of this large vessel was particularly marked, the half-circle being performed in three minutes, and she was stopped dead in one and a-half minutes after the order was given to go full speed astern, just as she completed the measured mile, and when running at full speed. The vessel proceeded on her voyage to New Orleans. The construction of the vessel and machinery has been superintended by Mr. C. W. Cadman, Captain W. Gell, and Mr. W. Sargeant, who also represented the owners on the trial trip. The builders were represented by Mr. E. W. De Russett, and the engine builders by Mr. L. Rusden. The vessel is the second of the same dimensions which these builders have constructed for Messrs. T. and J. Harrison.

On Wednesday, November 21st, the s.s. Strathfillam went on her trial trip from Hartlepool. The vessel is a sister ship to the Strathness, Strathnairn, and Strathord, and is the fourth steamer built by Messrs. William Gray and Co., Limited, to the order of Messrs. Burrell and Sons, of Glasgow. She carries 6400 tons dead weight, and is 376ft. 6in. in length, with a breadth of 47ft. and depth of 39ft. 9in. Her engines are supplied by the Central Marine Engine Works, and are of the triple expansion type, having cylinders 27in., 43in. and 72in. in diameter respectively, with a piston stroke of 45in. Steam is supplied by two large single-ended boilers working on the forced draught system, patented by Mr. Howden, of Glasgow, the steam pressure being 170 lb. per square inch. The air fan is in the engine-room, and is driven by a separate vertical engine. The machinery throughout is precisely similar to that supplied to the sister ships previously mentioned, except in respect to the engine-room telegraph, and in this case, as in that of the Strathord, this piece of mechanism is an improved device manufactured by Messrs. Mechan and Sons, of Cranstonhill, Glasgow. This telegraph is combined with the engine, and placed upon it on the centre front column, instead of being a totally independent instrument placed on the bunker or bulkhead. It is called the "Triple Automatic" Engine-room Telegraph, and it derives its name from the fact that it contains three pointers instead of the usual two, the third one being actuated by the reversing gear of the main engines. The action is as follows:—When the order is given from the bridge for the engines to be driven ahead, the bell rings and the pointer points towards the bow of the ship. The engineer then replies by means of a handle or lever which works thwartships in the same manner as an engine starting handle, and this movement brings the second pointer over the first, so that two pointers now point towards the bow of the ship. The engineer then applies steam to his reversing gear, and as this moves to give steam to the engines for going ahead, it also moves the third pointer of the telegraph, so that that also comes to lie over the other two, and thus finally all the three pointers are pointing toward the bow of the ship. One of the main objects of this arrangement is that the engineer can no longer by any possible lapse of attention deceive himself as to which way he is driving the engines.

THE ROYAL MAIL STEAMER NORMAN.—The Union Steamship Company's twin-screw Royal Mail steamer Norman, which left Southampton on the 10th November with the Cape of Good Hope and Natal mails, arrived at the Cape *viâ* Madeira at 5.10 p.m. on the 26th. Passage 15 days 19 hours net steaming time, and average speed 15 9 knots per hour.

THE INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION OF STUDENTS.—The second meeting of the present session was held in the Durham College of Science, Newcastle-on-Tyne, on Wednesday, the 21st inst., the President, Mr. C. A. Harrison, in the chair, when Mr. W. O. E. Meade, M. Inst. C.E., read a paper on the "Irlam Section of the Manchester Ship Canal." The paper began by giving the position of the Irlam section of the Ship Canal, which is not more than five miles long, but where, owing to the number of times the canal crosses the courses of the rivers Mersey and Irwell, the excavation was rendered especially difficult. The strata and methods of excavation were next noticed, the latter being carried out by Ruston and Proctor's steam navvy, Wilson's excavators, and the French and German land dredgers, according to the nature of the ground to be dealt with. After giving the section of the canal, which is 120ft. wide at the bottom, with 26ft. of water, and describing the different methods of protecting the sides by pitching and fascine work, the author went on to describe in detail the locks and sluices at Irlam, and the methods adopted in their construction. The paper concluded with an account of a flood which took place in November, 1890, and by which some three-quarters of a mile of the Irlam section was filled with water, all of which, together with the material brought in by the water, had to be pumped out and excavated again.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE chief event this week is the issuing of the accountants' certificate to the Iron Trade Wages Board of the realised prices of manufactured iron for September and October last. The figure returned is £5 16s. 5d. per ton, against £5 18s. 5d. for last July and August, and £6 3s. this time last year. Thus there is a reduction of 2s. on the bi-monthly period, and 7s. on twelve months back. It has been resolved to reduce all ironworkers' wages by 2½ per cent., making the remuneration of puddlers 7s. 3d. per ton. This is the first reduction in wages that has been made since the end of January last. At that time a drop of equal amount to that now declared took place, and wages, which had previously stood at 7s. 9d. for puddling, came down to 7s. 6d. This change was the result of the accountants having reported a falling-off in the selling prices of iron of 1s. 8d. per ton. Since that date there has been a further fall of altogether 4s. 10d., but the only wages change has been that declared this week.

Concerning the affairs of the Earl of Dudley's Round Oak Ironworks Company, Brierley Hill, to which I referred three weeks ago, it has this week been resolved by the shareholders to wind up under voluntary liquidation, and arrangements will be made under which the works will shortly revert back to their original owner, Lord Dudley, as sole proprietor. The company was formed in 1890, and his lordship holds mortgages and debentures amounting to £100,000. The unsecured creditors are set down at about £10,000, but it is hardly expected that these will receive anything unless Earl Dudley voluntarily concedes a dividend.

Negotiations for the formation of an All-England Association in the Galvanised Iron Trade continue, but the chances of success do not appear to be very rosy. About ten or eleven firms have definitely replied, accepting the association and also the rules as at present drawn up. An equal number have sent replies favourable to the scheme, but suggesting alterations upon various points; and some eight firms have either withheld their approval or have not replied at all. Thus the complete number of twenty-eight or twenty-nine firms engaged in the trade throughout England and Scotland is accounted for. The non-adherents, if their opposition is persisted in, are strong enough numerically to spoil the scheme. With a view to prevent this, a select sub-committee of the organising body has within the past few days been appointed to further negotiate. The sub-committee will seek interviews with the eight non-subscribing producers, solicit their reasons for standing aloof, and if possible induce them to abandon their position of indifference. A further meeting of the organising committee will be held when these firms have been seen.

The Indian order in hand by the Oldbury Company, briefly alluded to a fortnight ago is an extensive one. It is for the Bengal and North Western Railway—metre gauge—and includes 10 composites, 10 intermediate class, 90 third-class, 20 brake vans, and five horse boxes. The order includes the channel steel underframes and ironwork, body steel and ironwork, galvanised roofing, lavatory fittings, metallic fittings, trimmings, glass, &c. The brake vans and horse boxes are four-wheeled, and the composites, intermediates, and third-class are six-wheeled. The composite has entrances from the side and end, and is provided with upper and lower berths, and full lavatory accommodation. The intermediate class is of the English saloon type. The third-class has six compartments, with cross seats. All the carriages have corrugated galvanised roofs, sheet steel panels, and the usual sunshades for the Indian climate. The brake vans and horse boxes are of the customary Indian States type.

The Dudley Chamber of Commerce have forwarded to the Board of Trade the following resolution:—"That it is advisable that the Board of Trade take steps to amend the Chain, Chain-Cables, and Anchor Act, so as to include the proper testing of all rigging, crane, and hoisting-chain for use in British ships or within the United Kingdom; also that the practice which now exists of using false certificates of test, should be dealt with in a stringent manner." Sir B. Hingley, M.P., the chairman of the Staffordshire Iron Trade, is one of the promoters of this reform.

Industrial hygiene is making headway. This week a first meeting has been held in Birmingham of the special committee just appointed by the Home Secretary to conduct a Government inquiry into the condition of all branches of brass manufacture, and also the casting and mixing of gun-metal, bell-metal and kindred amalgamations. Their main duty is to recommend what, if any, special rules should be made under the Factory and Workshops Act, for the protection of the workpeople. The manager to Messrs. Winfield of Birmingham, is one of the members of the committee.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—A despondent tone continues throughout the engineering and iron trades of this district, so far at least as any prospect of improvement in the immediate future is concerned. In the iron market business just drags on at low and unremunerative prices, with very few transactions of any weight put through, and both makers and manufacturers are in most cases short of orders, with the result that there is a tendency to give way upon quoted rates rather than allow business to pass. The steel trade also remains in a depressed condition, and for both raw and manufactured material very low prices are being quoted. The coal trade, judging from the general complaints made by colliery representatives, could scarcely be in a much worse position, and for the season of the year, with pits barely working four days per week, stocks are accumulating, and the tendency of prices is rather in a downward direction than otherwise.

There was about a full average attendance on Tuesday's Manchester Iron Exchange, but both makers and merchants, with few exceptions, reported a continued absence of business of any real moment coming forward, and there was again a more or less general want of firmness in prices, with a good deal of underquoting to get hold of business, and very low sellers here and there for forward delivery. Users of pig iron still go on buying merely from hand to mouth, and where they do enter into anything like forward transactions of any weight, exceptional prices have to be quoted as an inducement. As an illustration of the business of this character which is occasionally put through, I may mention that in Scotch iron a considerable sale for forward delivery has been made during the past week to one of the large users in the district, at prices which are reported to be quite 2s. per ton under current quotations.

Lancashire makers still quote on the basis of about 39s. for forge up to 42s. for foundry, less 2½ per cent., at the works, but they are booking no business of any moment at these figures, and the orders they do secure are chiefly with special customers, where they have exceptionally favourable rates of carriage, as they are altogether out of competition with the much lower priced district brands in this immediate market. Even Lincolnshire and Derbyshire makers, notwithstanding their much lower prices, also report trade as excessively quiet. The full average quoted rates are now about 38s. for forge to 39s. for foundry Lincolnshire, with about 43s. up to 45s. for Derbyshire foundry, net cash delivered Manchester, but these figures are difficult to obtain, and in some cases there are sellers at lower prices. Outside brands offering in this market are rather easier, if anything, good foundry Middlesbrough not averaging more than 43s. 10d. up to 44s. 4d., net cash, delivered equal to Manchester; whilst in Scotch iron, although sellers are asking about 46s. 9d. for Eglinton, for prompt delivery, at the ports, they would in some cases take considerably under this, for forward sales, and for Glengarnock makers are nominally asking about 48s., with merchants offering 47s. net, prompt cash, delivered at the ports, and something between these figures would probably represent the basis on which business might be done.

Manufactured iron makers still report only a very limited weight of orders coming forward, with forges but partially kept going; and although quoted rates are unchanged actual selling prices here and there are rather easier. For inland sales, however, Lancashire bars could scarcely be quoted under £5 6s. 3d. to £5 7s. 6d., delivered Manchester, although £5 5s. has been taken on shipping orders. Staffordshire bars are quoted £5 7s. 6d. to £5 10s. Lancashire and Staffordshire sheets now range from £6 17s. 6d. to £7 2s. 6d., while Lancashire hoops are quoted £5 17s. 6d. for random and £6 2s. 6d. for special cut lengths, delivered Manchester or Liverpool.

Business still comes forward but very slowly in the steel trade, and prices continue low. Ordinary foundry hematites do not average more than 52s. 6d., less 2½; low-class billets, £3 17s. 6d. to £4, and better-class billets quoted £4 7s. 6d. to £4 10s.; ordinary steel bars, £6 to £6 2s. 6d., and boiler-plates, £6 2s. 6d. to £6 5s., delivered in this district.

In the metal market the reduction in prices which has been expected for a week or two back has at length been conceded, but only to the extent of ¼d. per pound upon all descriptions of manufactured goods, and this has brought forward no increased weight of buying. List quotations for delivery, Manchester district, may now be given:—Solid drawn brass boiler tubes, 5¾d.; brass surface condenser tubes, 7¼d.; copper tubes, 7½d.; brazed copper gas and steam tube, 7d.; brazed brass gas tube, 6¼d.; brass wire, 5d.; copper wire, 6d.; rolled brass, 5d.; sheet brass, 6d.; yellow metal condenser plates, 4¾d.; yellow metal bolts, 5½d. per pound, and copper bolts, £57 per ton.

The reports I receive from representatives of the engineering industries throughout the district show no material change in the position generally. Here and there, as I have previously stated, the leading establishments are fairly busy on special work, the stationary engine building trade especially being perhaps in a better position in this respect than other branches. Very few of the machine-tool makers are, however, more than moderately off for work, some of them being decidedly slack. Boiler makers are only very indifferently off for orders, and the same may still be said of locomotive builders, although rather more work has perhaps been coming forward in this branch. Altogether the outlook continues discouraging, new work generally still coming forward but very slowly, and for the most part this is only secured at extremely low-cut prices.

I had an opportunity of inspecting the other day a new design for boiler-shell drilling machines, which Messrs. William Muir and Co., of Manchester, are introducing, the machine I saw in course of construction at the works being the first of the new type that they are building. This machine, which is designed for drilling both the circular seams and the vertical butt strap holes, combines in one upright or head an arrangement of drilling tools for which two or more uprights or heads, or, in fact, two independent machines have hitherto been required to attain the same results. Briefly described, the machine, which is constructed to admit plates 6ft. wide, and boilers from 4ft. up to 9ft. diameter, consists of one upright carrying a rising and falling swivelling cross slide or arm, which can be adjusted either to the vertical position when drilling butt strap holes, or set horizontally when required to drill the circular seams. The spindles are arranged so that they can be set to point to the centre of any diameter of boiler shell, and each drill has its own automatic and quick withdrawing motion, which enables them to be operated together or independently in various positions. When the cross slide is in a vertical position a hole can be drilled 9ft. 9in. above the circular baseplate upon which the boiler shell is chucked. The construction of the machine is such that a varying number of drills can be carried as required, the one which I inspected being arranged to carry five drills, this number being regarded as preferable. The cross-slide or arm is swivelled by worm and wheel, and the driving is effected by means of a two-speed cone, bevel, and mitre-gearing, through the swivel, with spur and worm gearing for the cross-slide or arm. The upright which carries the swivelling cross slide or arm, which is balanced, can be adjusted along a bed for the various dimensions of boiler shells, and when in position is securely bolted to this bed. If desired the machine can be made duplex, with uprights opposite each other, and driven independently, and in the case of large marine boilers these are placed horizontally on adjustable rollers, and not on a table, the cross slide or arm being set vertically for circular seams, and horizontally for butt straps, two or more uprights being placed upon a long bed parallel with the boiler; in these cases the machines are made to deal with boilers up to 18ft. diameter.

We understand that Sir E. Leader Williams, the chief engineer of the Manchester Ship Canal, has accepted the presidency of the Manchester Association of Engineers for the ensuing year, which has been unanimously offered to him by the Executive Committee. Sir E. Leader Williams has for some years been an honorary member of the Association, and was asked about four years ago to accept the position of president; but at that period the heavy work devolving upon him, in connection with the construction of the Ship Canal, occupied so much of his time that he had to decline undertaking any official duties outside those connected with the important work upon which he was engaged. A promise was, however, obtained that he would be disposed to entertain the proposal immediately the canal was completed, and he has now fulfilled his engagement by undertaking the duties of president of the Association for the ensuing year.

An extremely depressed tone continues throughout the coal trade, four days per week being still the full average that pits are working, and notwithstanding this restricted output, supplies of all descriptions of fuel are in excess of requirements. The house-fire coal trade shows no material improvement, owing to the exceptional mildness of the season, and in some cases stocks are accumulating, whilst inferior qualities of fuel for house-fire purposes have here and there given way in price. For the better qualities of Wigan Arley, 10s. 6d. to 11s. represent about the average figures; with Pemberton four-foot and seconds Arley 9s. 6d. to 10s., and common house coals ranging from 7s. to 8s. per ton.

Other descriptions of fuel for iron-making, steam, and general manufacturing purposes continue bad to sell and extremely low in price, steam and forge coals not averaging more than about 6s. 6d., with engine fuel pushed for sale at almost any figure, and the lower qualities especially excessively low in price. Common Lancashire slack at the pit mouth can be readily bought at 3s. to 3s. 6d., with better qualities quoted at 4s. 6d. to 5s., and common slack from outside districts is offering at 1s. 6d. to 2s. per ton at the pit mouth, according to quality.

Only a very limited business is still reported in the shipping trade, with common round coal offering at 8s. to 8s. 3d., and the better qualities quoted at 8s. 9d., delivered at the Garston Docks or the High Level, Liverpool.

*Barrow.*—A quiet business has been done this week in hematite qualities of pig iron, and makers report a very poor inquiry generally, as well on home as on foreign account. The position of the district is adequately expressed in the fact that 1213 tons of pig iron has gone into warrant stocks this week, although only 32 out of 75 furnaces are in blast, an increase equivalent to the production of two furnaces. Stocks now represent 167,440 tons, or an increase of 72,817 tons since the beginning of the year. Prices are easy at 43s. 6d. cash net sellers, and 43s. 5d. buyers. Makers ask 44s. to 45s. for Nos. 1, 2, and 3 Bessemer, net f.o.b., but are doing no business at these figures, except in special sorts.

Iron ore is very quiet in tone, and prices are much about the same. Sales locally are small, and the home demand is quiet, and only small parcels are going away by sea.

Steel makers are rather better off for orders in the rail department. The Barrow Steel Company has booked an order for 5000 tons of heavy rails for the Indian State Railways, but this is not more than ten days' output of one mill. Rail orders generally are very few, and orders are not likely to increase until the spring of next year, when a good colonial and foreign trade is expected. Prices are easy. Steel ship plates are in fair, but not brisk demand. Local makers are sold forward for three months to come, tin-plate bars are in quiet request, and only a small trade is doing in billets and hoops, while wire rods, slabs, and blooms are neglected.

The shipbuilding and engineering trades are especially busy. The recent new orders have given a fillip to trade, which will assume a continuance of activity for a long time to come. The engine shops are very well off for orders. The engines for H.M.S. Majestic are being built at Barrow, and will be ready for delivery by the end of the year, along with the boilers, auxiliary engines, &c.

The coal and coke trades are quieter than ever. Coal is in smaller consumption at late rates. Coke from East Coast furnaces is still at 17s. delivered here.

The shipping trade shows a much quieter tone. The exports of pig iron from West Coast ports during the week amounted to 4070 tons, and of steel 1954 tons, comparing with 7189 tons of pig iron and 2954 tons of steel in the corresponding week of last year, a decrease of 3119 tons of pig iron and 1000 tons of steel. The total shipment this year to date amounted to 319,505 tons of pig iron and 355,205 tons of steel, compared with 252,033 tons of pig iron and 421,336 tons of steel in the corresponding period of last year, an increase of 67,478 tons of pig iron and a decrease of 69,131 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE coal trade still remains in the same languid condition, the pits being very poorly employed for this season of the year. Several collieries, which as a rule are well worked, had to stand idle one or two days last week. The open market is in a weak state, the business done being mainly on contract account. The increased winter demand, which is usually in full operation at this time of the year, has not yet been felt to any extent in this district. This is no doubt on account of the continued mild weather; but during the last few days cold has again set in, and this may give a much-needed stimulus to the house-coal trade. Whilst the demand is far below the average, the output steadily increases. The business in house fuel, which ought at present to be at its height, is in an unsatisfactory condition, the call for this class of fuel being only moderate. The metropolis is still taking a fair average tonnage; but sales are reported as slow, and large stocks are standing on the rails. Most merchants have stocked their coal for the winter season, and therefore do not require to buy as usual. Prices are weak, and have a tendency to further decline. Colliery owners are doing all in their power to try and maintain values; but owing to the Conciliation Board agreement, they can get no further help from the men in the way of reducing the cost of production. Although quotations are unaltered at the pits, a good deal of business is being done at lower rates.

Silkstones are from 9s. 6d. to 11s. per ton; Barnsley house, 8s. 6d. to 9s. 6d. per ton; second qualities from 8s. per ton. During last week a meeting of the South Yorkshire Steam Coalowners' Association was held at Barnsley. As usual, the proceedings were private. It was called for the purpose of considering the condition of the trade. The present demand for steam coal is exceptionally good for this period of the year, and although the closing of the Northern ports has had its effect, the supply sent to Hull and the other Humber ports is still fair. As in household sorts, the railway sidings are reported to be full of stocks of steam coal. Railway companies are at present taking a fair average tonnage on contract account, but there is little trade in other directions. Quotations for this class of fuel are unchanged, with a tendency to weakening values. Barnsley hards realise from 7s. 6d. to 8s. 3d. per ton; other qualities from 6s. 9d. per ton. Gas coal in large request at same prices as last week. Manufacturer's slack is very plentiful, prices being low and weak, and the demand quiet. At some places there are considerable stocks on hand. Pit slack from 3s. per ton; riddled slack 4s. to 5s. 6d. per ton. Smudge and small coal at low rates from 2s. or less. Coke quiet and unaltered.

Coal has been reached at Lord Masham's collieries at Acton Hall, the last 100 yards having been continually through rock. The pit was started to be sunk to the Silkstone seam, which it was hoped to find at a depth of 600 yards, and of nearly 6ft. thickness. At 330 yards the Warren house coal, 5ft. 9¾in. thick, was passed through. At 402 yards the Haigh Moor seam was proved 5ft. 11in. thick, and at 603 yards the Silkstone seam, only 17½in. thick. After this it was decided to test the lower measures, with the result that the Middleton seam was struck at 710 yards, and was also found to be 17½in. thick. It is believed that the Silkstone coal has been struck in the washed-out portion of the seam, and that it will be found on driving out from the shaft to be of the ordinary thickness both east and west.

Iron is rather depressed. Hematites are quoted at:—For West Coast brands 52s.; for North-East Coast 50s.; both delivered in Sheffield. Lincolnshire iron realises 38s., Bessemer billets £5 7s. 6d., bar iron £5 5s.

A good number of orders for railway material have of late been placed in this district, but owing to the productive powers being so large, such new business as has been added to the old hardly suffices to keep the establishments fully employed. In some instances the firms are only working a few days or alternate weeks. It is felt in business circles, however, that the bottom has now been reached, and that we may soon expect a good and steadily-increasing demand. Freights have now improved all round, and this is no doubt one of the reasons upon which the expectation of a revival in railway material is based. An increase in the railway traffic shows that much more material has been and is being made. It will also give a welcome and long looked for help towards the shipbuilding industry. The large firms of the East-end are still busily employed in the production of armour-plates for the Government. They are, however, in want of orders for boiler specialities, shafting, &c., and also require an increase in the building of passenger and merchant ships on which to place these and other productions, Sheffield being but poorly employed on this account.

Reports as to the state of the crucible steel trade are rather perplexing. We gather, however, that while many firms can find work for their hands on old orders, new orders are not coming in very freely. The Government are not placing much on ordnance account. Foreign Powers, on the other hand, are sending considerable requirements for ordnance and rifle parts.

Although the file trade is pretty active, competition remains so keen that prices leave very little margin of profit. There is a brisk request for springs for clocks, bell-sheets, ammunition parts, machine parts, &c. Penholder and pen steel is in fair demand. The wire trade is also active, but the other departments of the lighter steel trade are but poorly engaged.

The silver and electro-plate industries are in an animated condition. Manufacturers express themselves as satisfied with the season trade this year. Some firms are surprised that it has turned out so well, and it is, in fact, well up to the average of previous years. The cutlery trade has also been good. The skilled artisans at present out of employment are only few. The demand has mainly been for case goods, which are sent mostly to the States.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

IN no branch of trade in this district is there any sign of improvement, and the tone of the market generally is very despondent, the opinion being that a hard winter is in store for manufacturers, with irregular work and unprofitable prices. The quietest period of the year has to be passed through, and not before the spring is it considered likely that a change for the better will make its appearance. The prospects of a dull winter cause competition among producers to be very keen, for they are anxious to secure without delay work enough to enable them to keep their mills employed with some approach to regularity, even though they have to accept prices which will leave them with no profit. But they think that if they have to wait they will have to take still lower prices, and may have still greater difficulty in getting orders, for the reports concerning the prospects of all industries concerning iron and steel are very discouraging. Capitalists seem to have no confidence, and keep their money locked up in Consols, banks, and other safe places, even at very low rates of interest, rather than risk it in trade enterprise. Consols accordingly are realising higher prices, while the shares of all companies connected with trade are obtainable at lower prices than were taken a short time ago. The only satisfactory feature in the trade of this district this month is the heavy shipments of pig iron from the Tees. As a rule, November is a time when deliveries by sea are comparatively small—in fact, they are usually almost the poorest in the twelve months—but this year they are likely to be the best of any month in the year.

Taking November of the last six years the average exports have been about 70,000 tons, but this month they considerably exceed that. Up to Wednesday night the quantity was 78,583 tons, as compared with 71,053 tons last month, and 60,977 tons in November last year, all to 28th. There has also been a very large shipment of Cleveland iron from Skinningrove—nearly 8500 tons. Under these circumstances it is expected that stocks of Cleveland pig iron will show a decrease for November—the first decrease since May—but the extent of that decrease cannot well be estimated, as there is no information as to how much of the pig iron shipped has been of hematite quality. It can hardly be doubted that the stocks of hematite pig iron have increased, but as no statistics of the hematite stocks are collected it is impossible to gauge the extent of the hematite pig unsold in makers' hands. It may be expected that the stock will continue to increase during the winter if some reduction in the production is not made, for the prospects of the steel trade at home are very poor, and there must be a considerable falling-off in the shipments on account of the closing of some of the ports to which hematite pig is forwarded rather largely. It would seem to be the best policy to blow out some of the furnaces making hematite iron. A smaller make would enable producers to keep up their prices better, and it would, moreover, probably bring about some reduction in the cost of production, which is now out of proportion with the selling price of the iron. Consumers complain of the prices of coke and ore, but as long as the demand continues for them it is not likely that sellers will bring down their rates. The blowing-out of some of the furnaces would lessen the consumption of materials, and this would have its effect upon prices thereof.

Consumers have been able to buy No. 3 Cleveland G.M.B. pig iron this week for prompt f.o.b. delivery at 35s. 6d., and they are ready to pay that also for deliveries to be made over the first quarter of next year, but they found very few producers ready to sell forward at that rate. They would, however, have had little difficulty in buying at 35s. 9d. forward. Cleveland warrants have been bought, and rather more freely than usual, and 35s. 8d. cash has been paid for them, but Wednesday's close was at 35s. 5½d. cash. The stock of Cleveland pig iron held in Connal's warrant stores on Wednesday night was 90,478 tons, or 1847 tons increase this month. Taking into account the large shipments, and the reported scarcity of No. 3 in makers' hands, a considerable decrease in the stock of the stores might have been expected. Grey forge pig iron could readily be got at 33s. 7½d. Though Mixed Nos. of East Coast hematite pig iron have all the week been quoted at 42s. 9d. per ton, yet buyers have had no difficulty in getting some brands at 42s. 6d. Yet neither ore nor coke is becoming cheaper, and are realising almost as much as they did when hematite pig was 3s. 6d. a ton higher. Cleveland basic iron No. 3 is worth about 37s. 6d., but there is not much being offered for sale.

Trade is very unsatisfactory in the finished iron and steel industries, and the lower prices fail to draw business. Steel plates are 10s. per ton cheaper than they were in September, but shipbuilders are so badly situated that they cannot see their way to order even at the present low range of prices. Both iron and steel ship-plates are at £4 12s. 6d., less 2½ per cent., f.o.t., and iron and steel angles are at £4 10s., less 2½ per cent., f.o.t.

Bar makers feel the depression less than any of the other manufacturers, and they are getting better prices for their goods, while there is no competition with steel with which to contend. The official returns indicate that considerably more has been paid of late for bars than for any other leading description of finished iron. At Thornaby-on-Tees, Mr. Hopper, who has been connected with the late Sir George Elliot's rope works in South Wales, is about to start a steel-wire rope-making establishment, and has secured for the purpose part of the brewery of Messrs. Knights, Stocks, and Co.

The directors of Dorman, Long and Co., Britannia and West Marsh Steel and Ironworks, Middlesbrough, report a profit for the year ending September 30th of £13,707 15s. 0d., but after paying interest on debentures, directors' fees, income tax, &c., they are unable to pay any dividend to the ordinary shareholders. They state that the moulders' strike, which lasted over six months, seriously diminished the demand for finished steel, and materially affected the year's operations. The directors took advantage of the strike to close their works for a time in order to make additions to the plant and appliances of No. 3 mill. They believe that this will enable them to meet the increased competition of the day with better effect. Over £9000 has been spent in thus adding to the plant; they have laid down live roller gear in one of the mills, electric lighting and driving plant in the engineering departments, automatic feeders to gas apparatus, &c.

The statistics of Mr. Waterhouse showing the deliveries of manufactured iron and the net average prices realised for the two months ending October 31st have been presented to the Board of Conciliation. The summary is as follows:—

| Description. | Weight invoiced. | | | | Percentage of total. | Average net selling price per ton. | | |
|---|---|---|---|---|---|---|---|---|
| | Tons. | cwt. | qr. | lb. | | £ | s. | d. |
| Rails .. .. | 728 | 1 | 1 | 7 | 3·02 | 4 | 9 | 0·80 |
| Plates .. .. | 8,726 | 15 | 2 | 19 | 36·16 | 4 | 13 | 11·59 |
| Bars .. .. | 10,940 | 2 | 0 | 2 | 45·33 | 5 | 2 | 11·71 |
| Angles.. .. | 3,735 | 17 | 3 | 22 | 15·49 | 4 | 14 | 7·63 |
| | 24,130 | 16 | 3 | 22 | 100·00 | 4 | 18 | 0·07 |

It is curious to note that, while the values of each description of iron have varied considerably from the previous return, yet the total average is only 0·15d. per ton—three-twentieths of a penny less. The price of iron rails showed an increase of 2s. 7·29d. per ton; that of plates a decrease of 7·92d.; that of bars an increase of 1s. 1·99d.; and that of angles a decrease of 11·14d. The total average is one-half greater than it was in the corresponding period of last year, and is 2s. per ton better than it was at the commencement of the year. The production in September and October was 2500 tons greater than in the previous two months. In accordance with the sliding scale, the wages of finished ironworkers will remain unchanged for December and January. There has been no alteration in them since the end of February.

The shipbuilding industry is much depressed, especially on the Tyne. Comparatively few orders have been received this quarter, and a slack winter is almost certain. Not since 1885 has there been so little work in hand or so many men out of employment. Only a few of the engineering establishments have a fair share of orders, and inquiries are much less numerous than they usually are even at this period of the year. The prospects of better times are not encouraging. The pattern makers in the North of Eggland, after being on strike for eight months for an advance of 3s. 6d. per week in wages, have at length bowed to the inevitable, and abandoned their claim. Those for whom work could be provided resumed operations on Monday, but there are many who still have to remain idle. Many of the moulders also have not been able to get work since their strike ended. Both of these classes of workmen will now see the futility of striking for an advance in a falling market.

Mr. Thomas Bell, the last surviving brother of Sir Lowthian Bell, died in Switzerland a few days ago. In 1850 the deceased became partner in the Walker Ironworks, and was also associated with his brothers, Sir Lowthian and Mr. John, in the ironworks at Wylam, Washington, and Clarence, as well as the Walker Chemical Works. Mr. Thomas Bell managed the Walker Rolling Mills till they were closed, after which he went to Bilbao. He was largely instrumental in bringing into use the salt brine in the Middlesbrough district. When travelling in the neighbourhood of Navey in France he noticed a simple appliance for drawing water from a considerable depth. The idea was utilised and improved upon, and is now generally adopted in the Teesside industry.

The coal trade is becoming duller, and work at the mines is not so regular. This being so, the Durham miners have wisely decided not to press their application for a 15 per cent. advance of wages, but have withdrawn it. They recognise that there is not much chance of securing an advance in a falling market. The establishment of a Conciliation Board for the Durham coal trade is almost accomplished, the rules having been approved by both sides, and for the next two years at least will regulate wages and other questions.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been a rather more firm feeling in the pig iron market, with a moderate business doing. While the turnover of warrants is not very large, prices have hardened somewhat in the last few days. Scotch warrants improved 2s. to 3s. per ton, and Cleveland iron was also a little better, and a steadier feeling likewise pervaded the hematite market. It is considered probable that, as has not infrequently happened in former times, business may improve to some extent towards the close of the year.

The output of pig iron has been steadily increasing, and is now much larger than it was twelve months ago. Stocks had, however, become very light during the strike in makers' yards, and there had been a large decrease in the warrant stores. For this reason an extended output may very likely have little effect upon the market for some time. There are now sixty-seven furnaces in blast —forty-four turning out ordinary iron and twenty-three hematite —compared with forty-five at this time last year.

The following are the current prices of makers' iron:—G.M.B. f.o.b. at Glasgow, No. 1, 43s. 9d.; No. 3, 42s. 2d. per ton; Monkland, No. 1, 45s.; No. 3, 43s.; Carnbroe, No. 1, 45s. 6d.; No. 3, 44s. 6d.; Clyde, No. 1, 50s. 6d.; No. 3, 47s.; Gartsherrie, No. 1, 51s. 6d.; No. 3, 47s. 6d.; Calder, No. 1, 52s.; No. 3, 48s. 6d.; Summerlee, No. 1, 53s.; No. 3, 47s. 6d.; Coltness, No. 1, 55s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 52s.; No. 3, 48s. 6d.; Eglinton, No. 1, 47s. 6d.; No. 3, 45s. 3d.; Dalmellington at Ayr, No. 1, 48s.; No. 3, 46s.; Shotts at Leith, No. 1, 55s. 6d.; No. 3, 50s.

The shipments of pig iron from Scottish ports in the past week amounted to 5103 tons, against 4489 in the corresponding week of last year. There was despatched to Germany 911 tons, Australia 620, Italy 423, Canada 15, India 263, France 20, Holland 155, Belgium 76, Spain 52, China and Japan 350, other countries 110, and coastwise 2108, against 2603 in the same week of 1893.

The finished iron and steel branches are quiet. There is at the same time a slightly improved feeling observable this week. What may come out of it it is impossible to say. The malleable iron department shows a little more activity in various articles, with somewhat steadier prices. There is, however, much room for improvement. The output of steel has been increasing, and is mainly for use in the shipyards.

The exports of manufactured iron and steel, which have declined to very small proportions, now begin to exhibit some expansion. The shipments from Glasgow in the past week embraced locomotives to the value of £28,500; sewing machines, £12,255; other machinery, £18,192; steel goods, £10,923; and miscellaneous iron goods, £37,896.

Messrs. Neilson and Company, of Glasgow, have booked orders for thirty-two locomotive engines, and twelve duplicate boilers for the East Indian Railway Company. The locomotive branch is now very fairly supplied with work.

Some fair orders are reported to have been obtained in the course of the last few days by Clyde shipbuilders and marine engineers. Arrangements are now being made for a large extension of the premises of Messrs. Russell and Company, shipbuilders, Port Glasgow.

The coal market is easier all round. The shipping trade in coals has fallen off considerably, partly owing to unfavourable weather at sea interfering with the sailing of vessels. The shipments of coal from the Scotch ports in the past week amounted to 134,637 tons, being 13,333 less than in the preceding week, and 36,442 below the clearances for the corresponding week of last year. In the home trade there is a fair consumption, but the supplies are now very full, and more than equal to all requirements, so that it is difficult to maintain the prices.

Nothing has come of the attempted agitation by the miners' leaders for an advance of wages. The proposal was obviously inopportune. The great body of the miners are evidently of this opinion, for they have given no active support to the movement sought to be promoted by their leaders.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is more quietness in the steam coal trade than is approved of on 'Change, both at Cardiff and Swansea. Prices at Cardiff kept up tolerably well until mid-week, when the quotations which had been 11s. 3d. to 11s. 6d., subsided down to 11s. 3d., and the demand evidently flagging. While best coals remained with only a slight falling off in firmness, seconds and inferior coals generally, exhibited greater weakness than usual. I give Cardiff quotations as last issued, closing prices, mid-week:—Best steam coal, 11s. 3d.; seconds, 10s. 6d.; dry sorts, 9s. 6d. to 9s. 9d.; best Monmouthshire, 9s. 3d. to 9s. 6d.; best small, 5s. House coal, which is in moderate demand, is selling at Cardiff as follows:—Best households, 10s. 9d. to 11s.; No. 3, Rhondda, 10s., brush, 8s. 3d.; small, 6s. 9d.; No. 2, Rhondda, 8s. 3d.; through, 6s. 3d.; small, 4s. 3d. Pitwood is still scarce, prices:—18s. 6d. to 20s. 6d. Patent fuel, 10s. 6d. to 11s. Coke, furnace, 14s. to 15s.; foundry, 15s. 6d. to 16s.; special foundry, 21s.

The effect of the unsettled condition of the colliers, and the certainty that the sliding scale will come to an end, are already beginning to tell, and that in a ruinous manner, as the colliers, I am sorry to add, will soon know to their cost. I am told upon excellent authority that one coalowner has declined an Admiralty contract of 20,000 tons, simply because he has no faith in the men. In several districts the hauliers are reported to be only waiting their time, and the slightest alleged grievance leads to a stoppage. A colliery manager of great experience, now retired from practical management, remarked lately that he was only too happy to be out of it. "The time is at hand when colliers will be asked as a favour to go down into the workings." A leading manager still at the "helm" coincides with this, adding, "I often have half an hour's discussion at the top of the pit before the men will descend."

One large colliery last week was only at work two days, and another three and a-half days. Colliery gatherings have been held of late for the purpose of arranging about future organisation. The last conference of colliers' representatives was held at Aberdare on Tuesday, Mr. D. Morgan presiding, and Mr. Brace in the vice-chair. At this meeting it was decided that workmen form themselves into an Association for the purpose of organisation; that, beginning with the new year, adults pay one shilling per month, and boys sixpence per month, and that the workmen pay them direct and not through the several colliery offices. With regard to the drawing up of rules, this is to be undertaken by a committee of eleven. It remains to be seen how far this Association will be carried out, with "Mabon," Mr. Abrahams, M.P., taking independent action.

The iron and steel trades remain in a very stagnant condition. Rails are in feeble demand, and tin bar, consequent upon the state of the tin-plate trade and wage discussion, has fallen off considerably. In addition to this large cargoes of pig continue to arrive from Middlesbrough and Harrington, making the situation worse.

The latest news from the tin-plate districts is that there is just a possibility of workmen coming to terms with the employers, and making such concessions as will enable the works to be carried on. Meetings have been held without coming to a final decision, and the last was adjourned until next week, when it is to be hoped that a common-sense conclusion will be arrived at. I am glad to hear that at one or two works the men have agreed to concede a reduction. At a few work this week is practically nil, and though the old quotations remain, they are simply nominal. It was stated on 'Change, Swansea, this week that orders offered were on such a basis as to leave a serious loss to makers, and that many leading tin-plate manufacturers regard the alternative of closing, for a time at least, as the better course.

Swansea quotations this week are as follows:—Pig iron market perceptibly weaker. Glasgow warrants, 42s. 6d. cash buyers; Middlesbrough No. 3, 35s. 5d. prompt; hematite, 43s. 5d; Welsh bars, £5 2s. 6d.; sheet iron, £6 to £6 10s.; sheet steel, £6 5s. to £6 10s.; steel rails, £3 15s. to £3 17s. 6d., heavy sections; light, £4 7s. 6d. to £4 10s. Bessemer steel: Tin-plate bars, £4; Siemens best, £4 to £4 2s. 6d. Tin-plates: Bessemer steel cokes, 10s.; Siemens, 10s. 3d. to 10s. 6d.; ternes, 28 by 20, 20s. to 24s.; best charcoal, 11s. 6d. to 12s. 6d.; wasters, 6d. to 1s. less. Block tin is now quoted at £62 12s. 6d. to £62 15s.; patent fuel, 10s. to 11s. Iron ores: Tafna, 11s.; Rubio, 11s. 3d. to 12s. Coke, from 12s.; furnace and best foundry, from 17s. 6d.; pitwood, 20s.; anthracite, 12s. to 12s. 6d., best vein; ordinary, 8s. 9d. to 9s. 6d.; small rubbly cokes, 4s. 6d.

The dockising of the river Avon is again to the front at Bristol. This week at a meeting of the Bristol Dock Board a member proposed rescinding the resolution of July last against carrying out the dockisation of the river Avon. The chairman pointed out that it was practicable for any member to propose a new scheme, for port improvements, including dockising, and the member, Mr. Deridder, withdrew his motion, so as to retain liberty of action.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

BUSINESS in the different branches of the iron and steel trade has been remarkably quiet all through last week; very few contracts are being secured, and the situation of makers and manufacturers is, in some instances, getting worse instead of better

In Silesia the condition of the iron and allied trades is exactly the same as before; pig iron meets with poor request, and manufactured iron is, generally, also but weakly called for. Quotations are as low and unpaying as ever. The prolongations of the Silesian Rolling Mill Convention till end of 1895 has not had the desired stiffening influence on prices; on the contrary, makers have come to the conclusion that unless they offer their articles at prices below those of the Belgian and German firms, they are not likely to get any orders at all, and so the works willingly agree to pretty large concessions. In hoops and in some special sorts of structural iron, a comparatively fair business has been transacted upon the week. There is nothing new or specially interesting to note concerning the state of the iron business in Austria-Hungary. For the present producers and consumers report themselves pretty well satisfied with quotations and demand, the majority of the works maintaining a regular activity. Quotations are, as a rule, firm, although for large orders makers do not hesitate to accept prices which are considerably below list rates. Inland works actually have to fight for orders, as the Rhenish-Westphalian firms continue to throw large quantities of iron on the Bohemian, Galician, and Hungarian market; at a recent tendering for railway requirements, a Rhenish-Westphalian works, underquoting the inland makers, got the contract.

Demand and employment on the French iron market continue irregular. In the Haute-Marne districts iron business slowly tends towards improvement, while in Paris quotations show considerable weakness. The works of the Department Nord all complain of a scarcity of new orders and a consequent increase in stocks, which compels them to considerably restrict their output.

Belgian iron industry begins to be slowly influenced by the advancing winter and the closing of the Baltic ports, which always causes a decrease in consumption. Foreign trade, especially that to the East, has been very dull lately; nevertheless, statistic figures for the first nine months of present year are, on the whole, rather favourable. Total export of finished iron, for instance, shows an increase of 39,000 t., against 1893. In steel manufactured goods import, on the other hand, has increased by 30,000 t. Export in pig iron shows a decrease of 5000 t.; in iron ore 176,504 t. were exported, against 123,423 t. in the year before. At a recent tendering for 15,000 t. steel rails for the State Railways, Belgian works succeeded in securing the contract at 119·90f. p.t., Krupp Essen offering at 123f. p.t., while most of the foreign works asked 125f. p.t. On the Belgian coal market only a quiet business has been done for some time past, the demand for house coal being flat, The cold weather which has now set in cannot, however, fail to cause a general increase in demand, and a stiffening tendency in quotations will follow. Engine classes of fuel are firm, especially in the Liège district, while from Hainault the reports are rather unfavourable, some of the leading coalowners of the centre, Mons and Charleroi district, having proposed to stop on Monday and to reduce wages 5 to 7 p. c. Regarding the Belgian business in coal during the first nine months of the year, import in coal is stated to have been 1,003,653 t. this year, against 951,907 t. in the preceding year, of which 448,790 t. came from Germany, against 410,907 t. in 1893. Import in coke was 240,615 t., of which 232,994 t. fell to Germany, 50 t. to England, 6844 t. to France, and 727 t. to the Low Countries; in 1893, 183,694 t. were imported, of which no less than 178,580 t. came from Germany. Export in coal shows a decrease of 160,000 t., or 5 p.c., against last year, 3,209,611 t. only being shipped against 3,370,835 t. in 1893; Germany bought 163,680 t., against 169,195 t.; while to France 2,535,480 t. were exported, against 2,672,531 t. in 1893, which is equal to a decrease of 137,000 t. Total export in coke amounted to 651,152 t., against 682,053 t. in previous year; to Germany 118,008 t. were sent, against 107,950 t. in 1893. Export to France and Luxumburg shows a considerable falling off. According to statements published by the Minister of Public Work, output of the Belgian collieries was, in 1893, 19,410,519 t., worth 181,405,900f., which shows, compared to the preceding year, a decrease of 172,654 t. in quantity, and in value a decrease of 19,883,100f. The number of men employed was 116,861 in 1893, being 1717 less than in the year before. The number of women employed has decreased by 1519. Wages paid amounted to 103,648,600f., so that average pay was 3·06f. per day; yearly wages being 887f. Actually, however, 871f. per cent. only were given after the usual deductions, against 957f. that were paid in 1892, which shows a decrease of 74·10 per cent. on the annual wages, and 7 per cent. on daily wages.

The unfavourable condition of the Rhenish-Westphalian iron industry continues. Considering the extremely small demand that is coming forward for all descriptions of iron, it is rather astonishing that prices have remained comparatively firm. Spiegeleisen, 10 to 12 p.c. grade; notes M. 52 p.t.; Rhenish-Westphalian forge pig No. 1, M. 46 to 47 p.t.; No. 3, M. 40 p.t.; Siegerland quality, M. 44 p.t. Hematite is being offered at M. 63 p.t.; foundry pig, No. 1, costs M. 63; No. 3, M. 54 p.t.; basic stands at M. 45 p.t. German Bessemer fetches M. 50 to 51 p.t. For Luxemburg forge pig 48f. p.t. is still the price officially quoted. The situation of the malleable iron market is even more unfavourable than that of the pig iron trade. Quotations have been reduced to such a degree that some of the larger mills were obliged to limit their working hours and to dismiss a number o their men.

The scarcity of fresh orders is particularly felt at the steel works and construction shops, one works having given notice to about 500 men. The tube foundries, which had hitherto been well engaged, also begin to complain, prices being fluctuating and far from paying.

Latest list quotations, per ton at works, are as follows:—Good merchant bars, M. 100 to 105; rivet iron, M. 125; angles, M. 110 to 115; girders, M. 90 to 93; hoops, M. 108 to 113; billets in basic and Bessemer, M. 73 to 77; heavy plates for boiler-making purposes, M. 140 to 145; tank do., M. 130 to 135; steel plates, M. 120 to 125; tank do., M. 110 to 115; sheets, M. 140. Siegen thin sheets, M. 125. Iron wire rods, common quality, M. 115 to 120; wire nails, M. 115 to 120; rivets, M. 145 to 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 110 to 120; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230.

The total production of pig iron in Germany, including Luxemburg, was, for month of October, 1894, 490,934 t., of which 133,035 t. were forge pig and spiegeleisen, 32,508 t. Bessemer, 241,181 t. basic, and 84,210 t. foundry pig. Production in October, 1893, amounted to 437,183 t. in September, 1894, it was 473,070 t. From January 1st to October 31st, 1894, 4,579,180 t. were produced, against 4,084,056 t. for the same period the year before.

I regret to record the death of Herr Hendschel, of Kassel, owner of the well-known locomotive and machine shops. Herr Hendschel, who was only fifty seven years of age, died of inflammation of the lungs.

BORDEAUX EXHIBITION.—A meeting of the committee which has been appointed by the Council of the London Chamber of Commerce to further the success of this Exhibition was held at the office of that Institution on the 21st inst., under the presidency of Sir Albert K. Rollit, LL.D., M.P. Those present included Sir Walter Gilbey, Sir Bernhard Samuelson, M.P., Sir Charles M. Kennedy, Messrs. Henry V. Trapp, Paul Albert, R. W. Fithian, Ernest Clarke, E. Burney Young, and others. It was reported to the committee that the executive of the Bordeaux Exhibition did not propose allocating space for international sections, but that if any desire were expressed for the formation of a British section, proper accommodation might be provided in a separate annexe. Sir Bernhard Samuelson suggested that the committee agreed that it would probably be more satisfactory to adhere to the intentions of the Bordeaux Executive in classifying the goods of all nations according to groups. The Secretary of the Chamber of Commerce is, by direction of the committee, communicating with the Bordeaux executive as to the appointment of a British committee in Bordeaux who will protect the interest of British exhibitors. All applications for space must be lodged not later than the end of December. The Secretary of the London Chamber of Commerce at Botolph House, Eastcheap, E.C., will give particulars.

THE IMPERIAL INSTITUTE.—The greatest Photographic Exhibition which this country will have ever seen has been planned by the Executive Council of the Imperial Institute, to be held at South Kensington in the summer of 1895. The Exhibition will include seven divisions, namely:—(1) Artistic photography. (2) Historical photography. (3) Photography in its application to industries. (4) The application of photography to sciences, including chromatics, optics, stereoscopy, photomicrography, spectroscopy, meteorology, magnetism, astronomy, automatic recording apparatus, and so on. (5) Applications of photography to educational purposes. (6) Miscellaneous applications of photography, including engineering, architecture, archæology, military and naval purposes, legal purposes, surveying, cartography, and chronography. (7) Photography as an industry, including the apparatus used in photography, the stages of the manufacture of lenses, the making of brass fittings and cameras, shown in actual operation; the preparation of dry plates, the coating by sensitive media, printing processes, reproduction of pictures, and the production of portraits by daylight and artificial light. The Governor-General of India, the Governor-General of the Dominion of Canada, and the Governors of the various Colonies, have been requested to invite Indian and Colonial manufacturers to exhibit.

JUBILEE OF AN EMINENT SHIPBUILDING FIRM.—The present is the jubilee year in the history of the well-known firm of William Denny and Brothers, Leven Shipyard, Dumbarton, and the event is about to be fittingly celebrated in that busy little port. The workmen and officials in the Leven yard, backed up by the townspeople generally, are bestirring themselves to mark in some tangible way their sense of the importance of the occasion, and their goodwill towards, and admiration of, Dr. Peter Denny, the head of the concern and one of its founders. A further interesting fact is that next year Dr. and Mrs. Denny—the latter of whom is as great and admired a figure in the social and domestic life of Dumbarton as that of the doctor himself in industrial and commercial circles—will celebrate their golden wedding. Having this in view, as well as the jubilee of the firm, various proposals are being canvassed as to a fitting and lasting memorial of the double event. While the firm under its present designation has only been in existence fifty years, that period, of course, does not represent the length of time during which the name of Denny has figured prominently in the annals of shipbuilding on the Clyde. It has been closely and honourably allied with the industry almost since the beginning of the present century, the business having about that time been founded by William Denny the elder, father of the present Dr. Denny. From his unpretending yard, on a site on the opposite side of the Leven from the present large works, were launched, amongst other large vessels, the Marjory and Rob Roy, both of which took a notable part in the early development of steam navigation. Dying in 1833, William Denny left behind him seven sons, all trained in shipbuilding, three of whom, William, Alexander, and Peter, obtained joint possession of the family yard, and launched into iron shipbuilding under the designation of William Denny and Brothers. In 1843 they removed to the present site, and were soon in the thick of work for the most enterprising of the early steam shipping companies. About eight years after removal to the Leven shipyard, Mr. Peter Denny, through the decease of his brothers, found himself sole partner of the firm. In 1851 he, with others, established the distinct engineering business of Denny and Co., the managing partner in which for many years has been Mr. Walter Brock. In 1868 Mr. Peter Denny assumed as partner in the shipbuilding yard Mr. William Denny, his eldest son, whose untimely death at Buenos Ayres in March, 1887, is still acutely lamented. At the present time the company partnership consists of, besides Dr. Denny, Messrs. Walter Brock, Peter Denny, jun., John Denny, Archibald Denny, and John Ward. The firm have built during the past fifty years close on 450 vessels, large and small, aggregating some 550,000 tons, and comprising steamers—sailing ships have been all along out of their line—of all kinds, from capacious deadweight carriers and powerful mail and screw passenger steamers to swift channel paddle steamers and light-draught river boats, shipped abroad in pieces.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, November 22nd.

The manufacturing interests have yet shown very little signs of recovery from the depression induced by the economic measures agitated by the present administration. Prices in iron and steel continue low. Steel billets are 15·50 dols. at Pittsburgh; 18 dols. at Philadelphia; bridge iron 1·15 dols. upwards at mill; tank steel, 1·10 dols. in large orders; steel rails, 24 dols. A difference of 8 dols. and over between billets and rails is not considered one that can be maintained as soon as one or two elements of competition assert themselves. Much new work is in sight, but it cannot be pushed at present. The rolling mills are running to about 65 per cent. of capacity. The commercial situation has not improved. The action of the Government in borrowing money when its own people are willing to support it is unfavourably considered. Coal production is steadily increasing. Shop work is more abundant than for a year. An improving demand will probably spring up about midwinter for machinery and equipments of all kinds for spring use.

## RECENT OBSERVATIONS ON ELECTRICITY IN COAL-MINING.*

By Elmer A. Sperry.

In this paper the author briefly summarises the advances that have been made in the United States during the present year, some under his personal supervision or observation, in the application of electricity to coal-mining.

Improvements in electric haulage have been largely in the direction of giving increased flexibility to the wheel-base, and rendering the same more complete. To obtain perfect adhesion on a mine track, which, from many causes, becomes very uneven, the wheel-base should be entirely flexible, dividing up the total weight of the locomotive so as to distribute an equal amount upon each driver contact. This was at first only partially accomplished by a spring over the journal housing from a rigid frame. It has latterly been found that a system of links and rockers somewhat similar to those used in the latest construction of heavy freight locomotives in America is the best arrangement for electric haulage cars in mines. The mechanically coupled driver has been found to be far superior in tractive effect, the tendency of one driver to slip being checked by all the others instead of by its fellow only, as is the case where separately driven axles are employed. For average conditions the locomotive is, in the author's opinion, the best system of haulage. Where heavy grades in mines exist against the loads, say, from 5 per cent. upwards, and in many other instances, and endless or a tail-rope haulage may be found preferable to electric haulage; but either of these older systems may in most cases be electrically driven with great saving over compressed air or steam.

The author gives the following rule for determining the proper rail section where electric locomotives are used in coal mining: Divide the weight of the locomotive resting on the drivers in tons by the number of drivers; for dry entries, multiply the number so obtained by 12½, and for wet entries by 15; this gives the number of pounds per yard of rail that should be employed for the best effect.

Amongst the latest improvements in electric long-wall coal cutters is a specially low type for thin seams, involving the use of a much more powerful motor than has heretofore been applied to this class of machinery, the capacity for power having been increased 75 per cent. This has necessitated a heavier and stronger cutting mechanism, and steel gearing throughout. Trouble from moisture in and about the electrical part of the machine has almost totally disappeared. The method of holding the knives or cutters has been improved, necessitating a new form of cutter. The width of the machine has been kept under 24in., allowing the props to be used in close proximity to the face, and rollers have been provided upon the machine for passing the rails from the rear to the front of it, after the machine has travelled along the rails. Other improvements are noted, among which is the new removable truck which has been devised for running the machine upon the mine track when changing it to the point of starting in with the cut.

Very little advance has been made in the past year in breast machines, which have many weak points.

The pick machine has recently undergone considerable change in detail, strengthening of the main structure, &c. It strikes a heavier and more effective blow than the same class of machine operated by compressed air; and the author is of opinion that it will be found to fulfil the requirements and to be of general service in and about a mine, among sulphur balls and in hard ground, and under conditions in which other machines cannot be employed.

Improvements in dynamos during the present year have been in matters of smaller detail, tending to increase the output per given weight of machine and rendering it more durable and stable. A special mine-type of dynamo is preferable to the ordinary type in having fewer delicate parts, and being in general less liable to derangement, and designed for specially hard service through any number of hours per day.

**New Swindon Junior Engineering Society.**—A large number of the members of this society attended a meeting at the Mechanics' Institute, New Swindon, on Saturday, the 24th inst., to hear a paper on "Liquid Fuel, with reference to Holden's system," by Mr. J. H. B. Jenkins, F.C.S., of the Stratford Works. Passing from an account of the origin of liquid fuel systems in Great Britain, Mr. Jenkins described Crow's system, which consisted of the evaporisation of the oil in pipes acting as retorts in furnaces. with the aid of a very large diagram of the famous G.E.R. locomotive Petroleo, and sectional drawings of the special injectors, Mr. Jenkins was able clearly to define the principles of Holden's liquid fuel system, carefully tracing out the arrangement of pipes and, in fact, every detail.

---

* "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

14*th November*, 1894.

22,033. Securing Corks in Bottles, G. Gibbons' London.
22,034. Coke Manufacturing Apparatus, H. Schon, London.
22,035. Printing Press, W. A. Kelsey, London.
22,036. Artificial Fuel, W. H. Biggs and R. R. Greenhow, London.
22,037. Pneumatic Tires, H. H. Lake.—(*E. S. Frazier, United States.*)
22,038. Carding Engines, G. E. Fauquet, London.
22,039. Torpedo Net, S. O. Cowper-Coles, London.
22,040. New Combination Switch, D. F. Adamson, London.

15*th November*, 1894.

22,041. Balancing Movable Vehicles, J. T. Shipman, Doncaster.
22,042. Screw Cork Stoppers, A. Bullard, Newport Pagnell.
22,043. Electrical Heating of Metals, W. Holland, jun., Birmingham.
22,044 Heating Metallic Lengths, W. Holland, jun., Birmingham.
22,045. Oil Lamps, J. T. Paul and J. Paul, Glasgow.
22,046. Arc Lamps, F. M. Lewis, Leeds.
22,047. Shaft Bearings, M. Jefferson, W. M. L. Lishman, and J. Clapham, Halifax.
22,048. Signalling on Railways, J. Marriott and J. Martin, Birmingham.
22,049. Attachment for Bells, A. Nicholas, Birmingham.
22,050. Exhausting Steam and Gases, R. Cooke, Hounslow.
22,051. Eye Glasses, T. Wilson, Birmingham.
22,052. Paper Bobbins, J. Whitley and J. E. Shackleton, Bradford.
22,053. Coating Plates with Tin, T. J. Rickard, Newport.
22,054. Ventilating Ships, H. B. and J. S. Watson, Newcastle-on-Tyne.
22 055. Inflating Tires, W. and J. Ellis, and T. Spurr, Hull.
22,056. Chimney Smoke Cure, G. Lear and J. Davison, Birkenhead.
22,057. Fenders, J. Fletcher, Birmingham.
22,058. Gas Motor Engines, A R. Bellamy, Manchester.
22,059. Warming Churches, H. Brook, H. Watson, and J. Hardcastle, Huddersfield.
22,060. Transmitting Orders, W. Chadburn, Liverpool.
22 061. Extraction of Gold, J. C. Quinn and R. McDougall, Lancashire.
22,062. Fastenings for Leggings, C. J. Allen, Birmingham.
22,063. Lavatory Wash-basins, C. Heyworth, Manchester.
22,064. Combing Machine Brushes, W. Terry and E. Hopwood, Bradford.
22,065. Securing Handles to Cutlery, G. H. Askham, Sheffield.
22,066. Compound Armour Plates, T. Hampton, Sheffield.
22,067. Casting Compound Ingots, T. Hampton, Sheffield.
22,068. Table Cutlery, W. A. Pashley and J. Merrill, Sheffield.
22,069. Lifter for Photographic Plates, F. Iles, Birmingham.
22,070. Treating Metallic Salts, J. Hargreaves and T. Bird, Lancashire.
22,071. Ornamenting Flower-pots, J. J. Slack, Derby.
22,072. Venetian Blinds, &c., J. S. Kain, Birmingham.
22,073. Construction of Tiles, G. A. Marsden, Longport.
22,074. Water-waste Preventing Cisterns, J. Hodge, Manchester.
22 075. Pneumatic Wheel and Tire, F. Haisman, London.
22,076. Construction of Envelopes, S. Reid, Newcastle-on-Tyne.
22,077. Windows, W. Nicol, Glasgow.
22,078. Ventilators, W. Nicol, Glasgow.
22,079. Portable Stand for Safety Bicycle, J. Small, Bristol.
22,080. Composition for Steam Boilers, H. Watson and J. Baird, Glasgow.
22 081. Cycle Gear, D. K. C. Russell, Glasgow.
22,082. Hoops of Pneumatic Tires, H. Weatherill, Manchester.
22,083. Paper Boxes, E. Bluhme, Berlin.
22,084. Coal Raiser, D. Williams, Barnsley.
22,085. Envelopes, W. Brotherton and R. Wilson, Auckland.
22,086. Destructor Furnaces, W. P. Abell, British Guiana.
22,087. Stand for Holding Fruit, G. Johnson, Stockport.
22,088. Adjustment of Cycle Saddles, W. Brown, London.
22,089. Revolving Music Cabinets, A. P. Chatterson, London.
22,090. Adhesive Postage Stamps, W. Wilson, London.
22,091. Apparatus for Feeding Animals, H. R. J. Denton, London.
22,092. Communication of Automatic Messages, C. E. Campbell, London.
22,093. Labels, S. H. Crocker, London.
22,094. Apparatus to Supplement Levers, F. Nowell, London.
22,095. Apparatus for Healthful Exercise, M. A. Chreiman, London.
22,096. Tackle Blocks, H. V. Hartz, London.
22,097. Stable Fittings, A. Browne, London.
22,098. Machinery for Pressing Fabrics, W. B. Leachman, London.
22,099. Pulls for Blinds, &c, R. G. L. Burn, London.
22,100. Damp-proof Paints, A. J. Boult.—(*G. Philipps, Belgium.*)
22,101. Shaping the Mouths of Jars, G. Houghton and A. Shaw, Liverpool.
22,102. Road Vehicles, J. Clulow and H. E. Orton, London.
22,103. Producing Fish-meal, G. Bergman, Manchester.
22,104. Boot Edge-setting Machines, H. Hyde, London.
22,105. Photographic Enlargements, J. Gage, Liverpool.
22,106. Propulsion of Cycles, A. F. Sguazzardi, London.
22,107. Attaching Brace Ends, G. H. Kew, Manchester.
22,108. Shaping the Mouths of Jars, G. Houghton, Liverpool.
22,109. Bed-clothes Holders, G. H. Hollidge, London.
22,110. Lamp Chimneys, L. Delmer, London.
22,111. Lamp Chimneys, L. Delmer, London.
22,112. Thermo-pneumatic Fire-alarm, L. J. Tirard, London.
22,113. Children's Mail Carts, &c., F. Brittain, London.
22,114. Road Sweeping Machines, H. J. Noonan, London.
22,115. Starch for Laundry Purposes, A. Harrison, London.
22,116. Milling Machines, R. Haddan.—(*The Cincinnati Milling Machine Company, United States.*)
22,117. Collapsible Chairs and Seats, H. Hardy, London.
22,118. Tiles, S. W. Dean, London.
22,119. Connecting Tram Rails Electrically, F. F. Robinson, London.
22,120. Manufacture of Conducting Wire, G. Höper, London.
22,121. Signals for Railway Trains, G. E. L. Elliot, London.
22,122. Bicycles, J. T. Clarke, Harrow.
22,123. Sewing-machines, B. Willcox.—(*H. Springmann, Germany.*)
22,124. Tobacco Pipes, C. Fouracre and H. Moore, London.
22,125. Musical Instrument, G. F. Restall and G. Walker, London.
22,126. Oil Heating-stoves, &c., J. Ristelhueber, London.
22,127. Forks for Bicycles, E. P. Verdot, London.
22,128. Opening, &c., Gates, S. O. Cowper-Coles, London.
22,129. Cash Receptacles, F. R. Garfield, London.
22,130. Sole-rounding Machines, L. E. Ericson, London.
22,131. Postal Envelopes, W. Scheidt, London.
22,132. Apparatus for Stage Performances, J. Selbini, London.
22,133. Economic Envelope, A. Migotti and E. Mizrahi, London.
22,134. Propulsion of Boats, A. G. New and A. J. Mayne, London.
22,135. Friction-gear for Machines, W. Lancaster, London.
22,136. Lamps for Railway Signalling Purposes, J. P. O'Donnell, Westminster.

16*th November*, 1894.

22,137. Household Furniture, &c., D. Sinclair, High Barnet
22,138. Keeping Cigars in Condition, L. Sinclair, London.
22,139. Umbrella Water Catcher, L. Wookey, London.
22,140. Wheel Spoke Adjuster, J. B. Bromley, Birmingham.
22,141. Construction of Warp Beams, R. L. Hattersley, Bradford.
22,142. Flexible Tires of Bicycles, J. H. P. Montford, Longport.
22,143. Rolling Mill Platform, W. Davies and T. Williams, Stockton-on-Tees.
22,144. Corks, G. A. Shaw and Kay Bros., Stockport.
22,145. Valves for Beer-engine Taps, T. Heath, London.
22,146. A Wheel Tire, W. Pilling. Bolton.
22,147. Drilling Brackets of Cycles, A. Herbert, Coventry.
22,148. Tin Openers, L. Seager, Kent.
22,149. Stone Sawing Machinery, G. Anderson, Dundee.
22,150. Golf Clubs, R. Ramsbottom, Manchester.
22,151. Cycle Driving Gear, G. Barker, Liverpool.
22,152. Sash Windows, D. Arnot, Glasgow.
22,153. Utilising Waste Heat, T. Sykes, Huddersfield.
22,154. Toast Crisper and Tea Kettle, A. E. Spurrier, Birmingham.
22,155. Combing Machine, J. C. Walker, Bradford.
22,156. Double-lift Jacquards, T. Dracup, Bradford.
22,157. Electrical Switches, W. McGeoch, jun., Birmingham.
22,158. Wheels of Cycles, B. Peebles, Birmingham.
22,159. Cycle Saddles, J. Harrington and T. Middlemore, London.
22,160. Automatic Safety Lamp, W. and J. Turner, Rochdale.
22,161. The Human Arrow, J. Zedora, London.
22,162. Manufacture of Tips for Horse Shoes, W. Donnerstag and G. Leisegang. Glasgow.
22,163. Measuring Liquids, G. M. Nyström and A. C. Lembke, Manchester.
22,164. Smoking Tobacco, J. F. Fletcher and L. F. Sharp, Manchester.
22,165. Driving Gear for Cycles, C. B. Lawson, Glasgow.
22,166. Warming Public Buildings, E. N. Beszent, Liverpool.
22,167. Dress Fastenings, M. Kaiserblüth and H. Lazarus, Manchester.
22,168. Shafts for Mail-carts, S. Rivett and C. Campbell, Manchester.
22,169. Flattening Wire Meshes, A. E. Wale, Birmingham.
22,170. Briquette Fuel, A. E. Tavernier and W. L. Malcolmson, London.
22,171. Tooth Brushes, A. W. Prautch.—(*E. Hamilton, India.*)
22,172. Chain Guards for Cycles, A. E. Smart, Birmingham.
22,173. Setting Retorts in their Beds, T. Mobberley, Birmingham.
22,174. Dye-wood Extractor, H. S. Wilkinson, London.
22,175. Seats of Omnibuses, &c., W. H. Leeder, London.
22,176. Knife and Pencil Holder, N. Vincent, Guildford.
22,177. Mills for Crushing Malt, A. G. Southby, London.
22,178. Fresh-air Inlets, E. B. A. Barnett, London.
22,179. Postal Wrapper, T. H. Lewis, London.
22,180. Smoke Channels in Tobacco Pipes, F. Knights, London.
22,181. Magazine Stoves, G. Reinhardt, London.
21,182. Non-filling Bottles, H. I. Leith, London.
22,183. Preparing Gas Lamp Material, E. G. Gearing, London.
22,184. Apparatus for Making Gas, C. W. Pinkney, London.
22,185. Ships' Logs, A. J. Cooper and E. E. Wigzell, London.
22,186. Fastening-up, &c., Paper Boxes, W. Love, London.
22,187. Means for Weaving Figured Fabrics, D. Scott, London.
22,188. Bearings, F. W. Kitto and W. Haworth, London.
22,189. Developing Film or Plate Holder, F. Davis, London.
22,190. Casein Compounds, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
22,191. Solid Silver Compound, O. Imray.—(*The Farbwerke vormals Meister, Lucius, and Brüning, Germany.*)
22,192. Electric Exploders, Siemens Brothers and Co. and A. S. Schloemer, London.
22,193. Steam Engines, E. Hopkinson, London.
22,194. Bar Clasp, E. M. Bourke, London.
22,195. Coating Iron, The Cowper-Coles Galvanising Syndicate and S. O. Cowper-Coles, London.
22,196. Stirrup Leather Suspenders, G. Biebuyck, London.
22,197. Recording Telegraphic Apparatus, A. Damaskinos, London.
22,198. Shirts, Shirt-fronts, Collars, and Cuffs, C. E. Revill, London.
22,199. Anti-friction Bodies, M. Wagner.—(*C. F. Beyer, Germany.*)
22,200. Check Tills, H. M. Geiger, London.
22,201. Walking Sticks and Umbrellas, C. Kröger, London.
22,202. Hauling Blocks, T. Ryland, Liverpool.
22,203. Connecting Joints, S. W. R. Pashley and C. H. Barlow, London.
22,204. Velocipedes, G. E. P. de Lobel, London.
22,205. Soap Tablet, J. Wigglesworth and C. H. Simpson, London.
22,206. Machinery for Stacking Coal, J. Woodward, Manchester.
22,207. Ammonia Manufacture, H. H. Lake.—(*C. Pieper and C. Fellner, Germany.*)
22,208. Armoured Hose, J. E. Howard, London.
22,209. Butter Drying Apparatus, T. Bradford, London.
22,210. Churning Apparatus, T. Bradford, London.
22,211. Binocular Glasses, W. H. Harvey, London.
22,212. Pneumatic Tires for Cycles Wheels, L. Pic, London.

17*th November*, 1894.

22,213. Grit-making Food for Poultry, G. Heeley, Sheffield.
22,214. Pins, S. W. Pedley, London.
22 215. Cycle Dress and Chain Guards, J. B. Brooks, Birmingham.
22,216. Wire Measuring Gauges, G. W. Lowcock, Manchester.
22,217. Gas Meters, W. Alexander and W. E. Thompson, Birkenhead.
22,218 Voting Screen, R. H. Barratt and G. Hibberd, Slough.
22,219. Hanging Pictures, E. Hanisch and C. Adamy, London.
22,220. Bowling Hoops, T. H. Collingbourne and W. Turrell, Coventry.
22,221. Bleaching Yarns, J. Clapham, W. W. L. Eishman, and M. Jefferson, Halifax.
22.222. Railway Signals, J. A. Walshaw and J. H. Sutcliffe, Yorkshire.
22,223. Attaching Air Pumps to Cycles, E. Lycett, London.
22,224. Tire, R. J. Tippett, Bristol.
22,225. Cycle Brakes, W. Rebbla, Leeds.
22,226. Stop Motion of Looms, A. Owens and E. Thorne, Barnsley.
22 227. Taps, C. Taylor and I. Taylor, Manchester.
22,228. Type Frames and Galleys, J. Macfarlane, Glasgow.
22,229. Sheet Metal Boxes, A. Graham and J. Kay, Glasgow.
22,230. Preventing Purses Falling from the Hand, J. Johnston, Glasgow.
22,231. Atmospheric Gas Burners, T. Fletcher, W. Russell, and Fletcher, Russell, and Co., Ld., Manchester.
22,232. Telepathic, &c., Messages, C. E. Campbell, London.
22,233. An Improved Case for Pins, G. Lewis, Redditch.
22,234. Fire-proof Curtain for Theatres J. C. Merryweather, London.
22,235. Horse Hoes, T. W. Mayos, Ross.
22,236. Plug for Tobacco Pipes, A. R. Forbes, London.
22,237. Swivel Padded Brace, J. Robertson, London.
22,338. Mounting Cannon, J. Eastwick and I. Timmis, London.
22,239. Shut-off Cocks, W. E. Heys.—(*Schaffer and Budenberg, Germany.*)
22,240. Coupling for Flexible Tubes, F. G. Smith, Newcastle-on-Tyne.
22 241. Saddles, W. Brampton, Birmingham.
22,242. Fender Curbs, F. H. Young, T. H. Lawton, and G. J. Duval, Birmingham.
22,243. Signalling in Foggy Weather, E. Piper, London.
22,244. Ornaments, &c., W. M. and P. G. Burnham, London.
22,245. Ornaments, &c., W. M. and P. G. Burnham, London.
22,246. Apparatus for Propelling Vessels, W. S. Simpson, London.
22,247. Gear Cases or Guards for Cycles, T. H. Hill, London.
22,248. Bottles and Jars, A. J. Boult.—(*L. Bouncu, Belgium.*)
22,249. Operating Fluids in Motors, A. Kolbe, Liverpool.
22,250. Relieving Frictional Surfaces, A. Kolbe, Liverpool.
22,251. Crystalline Salts, J. J. Crosfield and G. S. Johnson, Liverpool.
22,252. Cleaning Grains and Seeds, J. Higginbottom, Liverpool.
22,253. Babies' Napkins, K. P. Sumby and H. P. Williams, Liverpool.
22,254. Gloves, E. A. Angel, London.
22,255. Bedsteads, H. J. Ford, London.
22,256. Modified Bagatelle Boards, W. M. Jones, London.
22,257. Lids of Culinary Vessels, J. Whatmore, London.
22,258. Stable Fittings in Case of Fire, C. Smith, London.
22,259. Cycles, W. S. Woodmancy, London.
22,260. Size, R. H. Evans, London.
22,261. Pneumatic Tires, T. S. Paynter, London.
22,262. Ascertaining Acidity of Liquids, J. Benson, London.
22,263. Paper Making Machinery, &c., E. Crégut, London.
22,264. Disinfectors for Sinks, &c., F. Lettuce, London.
22,265. Flexible Tubing, W. H. K. Bowley, London.
22,266. Register Stoves, J. Lusty and R. Strang, Cheltenham.
22,267. Umbrellas and the like, C. R. Hammerstein, London.
22,268. Amalgamating Apparatus, S. L. Priestone, London.
22,269. Cocks or Taps and Valves, G. Fowler, London.
22,270. Pure Grape Spirit and Whisky, P. L. F. E. Vignier, London.
22,271. Toy, F. Cashmore, London.
22,272. Valves for Steam Control, J. E. L. Ogden, London.
22,273. Dyestuffs, S. Pitt.—(*L. Casella and Co., Germany.*)
22,274. Carding or Combing Cotton, J. Thornton, London.
22,275. Speed Mechanism for Cycles, N. Mardary, London.
22,276. Thickening Colours, W. W. Horn.—(*W. Maybury, United States.*)
22,277. Window Sash and Apparatus, C. J. Cooze, London.
22,278. Cycles for Military Purposes, F. Western, London.
22,279. Refrigerating Apparatus, M. Audriffen, London.

19*th November*, 1894.

22,280. Heel-tip for Boots and Shoes, J. L. West, Croydon.
22,281. Stop Valves, J. Morton, Leeds.
22,282. Music Recorders for Pianos, J. L. Cantelo, Liverpool.
22,283. Sliding Doors and Partitions, G. Napier, Altrincham.
22,284. Ring Space in Gloves, W. Neagle, Sandymount.
22,285. Cool Smoker, A. L. Thompson, Bishop Auckland.
22 286. Valves, &c., E. P. Brook and B. Corfield, Halifax.
22,287. Railway Signalling, J. Wilson, Glasgow.
22,288. Saddles, A C. McKean, Manchester.
22,289. Racks for Drying Bottles, B. P. Wigan, Manchester.
22,290. Securing Rims on Wheels, C. R. Earthy, Manchester.
22,291. Wheels of Road Vehicles, C. R. Earthy, Manchester.
22,292. Fog-signalling Apparatus, T. Hathaway, Sheffield.
22,293. Transmitting Orders on Ships, W. Chadburn, Liverpool.
22,294. Saddle Clips for Velocipedes, J. J. H. Sturmey, Leicester.
22,295. Cycle Foot-rests, J. Hazlewood, Birmingham.
22,296. Steering Mechanism for Torpedoes, L. Obry, Manchester.
22,297. Windows, A. Barr, Glasgow.

22,298. Castors for Bedsteads, S. I. Whitfield, Birmingham.
22,299. Making Cycle Handles, W. Fogg, Dukinfield.
22,300. Inflator Carrier for Cycles, F. G. Heath, Redditch.
22,301. The Hydrodynamic, M. McCrimmon and A. McLean, Ardrossan.
22,302. Chairs for Electric Tramways, J. Wilkinson, Blackpool.
22,303. Arc Lamps, V. H. Coates, Belfast.
22,304. Rigid Pince-nez, G. Paxton and W. Curry, London.
22,305. Wagon Tarpaulin, &c., A. and W. Purvis, Glasgow.
22,306. Detachable Sconce for Lamp, W. W. Hare, London.
22,307. Metal Ends of Neckties, D. Cutler, Birmingham.
22,308. Bricks for Fireproof Buildings, C. G. Picking, London.
22,309. Production of Printing Blocks, C. Crabbe, London.
22,310. Thimbles, S. H. James, London.
22,311. Railway-signalling Appliance, H. L. Peters, Surrey.
22,312. Lifting Plates from Ovens, G. Henshall, S. Thompson, R. Crabtree, and F. Nuttall, London.
22,313. Railway Carriage, &c., Doors, R. Dakin, London.
22,314. Cigar-ash Trays, J. Fitton, Manchester.
22,315. Window-sash Fasteners, J. C. Craine, Manchester.
22,316. Method of Evaporating Brine, R. Pearson, London.
22,317. Cranks and Pedals of Cycles, G. P. Mills, London.
22,318. Cream Separators, P. Withers.—(*A. Helzel, Italy.*)
22,319. Screw-nuts, J. L. Wiles, London.
22,320. New Game, J. C. Willis, London.
22,321. Tools, &c., E. Roberts and C. W. Whitham, London.
22,322. Pneumatic Tires for Vehicles, J. Litherland, London.
22,323. Producing Spiral Mouldings, W. Osment, London.
22,324. Locks and Keys, J. K. Oldfield, London.
22,325. Fuses for Electric Light Wire, R. G. Tyler, London.
22,326. Frames of Bicycles and Tricycles, R. J. White, London.
22,327. Covering for Street Manholes, W. Denton, London.
22,328. Cycles, C. Tarling, London.
22,329. Washing and Cleansing Grain, E. A. Weinhold, London.
22,330. Fire-lighter, F. Schusterbauer, London.
22,331. Velocipedes, H. C. Field and A. W. Storey, London.
22,332. Curative and Nourishing Emulsion, T. Jardine, London.
22,333. Perforating Patterns in Leather, T. Lewis, London.
22,334. Brakes, A. J. Boult.—(*Fahrendeller Hutte-Winterberg and Jüres, Germany.*)
22,335. Manufacture of Boots, C. H. and F. J. Dale, London.
22,336. Fastening Neckties, W. P. Thompson.—(*W. Bohnhoff, Germany.*)
22,337. Inkstands, J. W. Young, London.
22,338. Wrenches, W. E. Pugsley, London.
22,339. Construction of Washing Machines, A. J. Askew, London.
22,340. Multipolar Dynamos, G. L. Addenbrooke, London.
22,341. Exposing Tea or Coffee to the Air, S. C. Davidson, London.
22,342. Steam Generators, T. L. and T. J. Sturtevant, London.
22,343. Miner's Lamp, C. Dahlmann, London.
22,344. Funnels, H. I. Keiner, London.
22,345. Ratchet Brace, P. R. J. Willis.—(*A. Taylor, United States.*)
22,346. Chiming Clocks, P. R. J. Willis.—(*T. Sargant, Canada.*)
22,347. Roller-grinding Machines, G. Eckhardt, London.
22,348. Flushing Cisterns, R. B. Evered and N. Coleman, London.
22,349. Steam or other Fluid Engines, W. H. Scott, London.
22,350. Ventilators, R. Lofthouse, London.
22,351. Bicycles, &c., R. Haddan.—(*F. Thouin*, ——.)
22,352. Fire-escape, C. Rajot, London.
22,353. Flange Packings, J. P. Gauthier, N. Henriot, and A. Jourdanet, London.
22,354. Strap Buckles, C. Rohte, London.
22,355. Saddle Covers for Bicycles, W. L. Loveridge, London.
22,356. Spirit Stoves, H. H. Leigh.—(*E. Garnier, France.*)
22,357. Kilns for Drying Bricks, &c., J. Craven, London.
22,358. Playing Stringed Instruments, E. Dansaert, London.
22,359. Wheels for Velocipedes, &c., A. Mortera, London.
22,360. Gear Cases for Velocipedes, P. Hunaeus, London.
22,361. Pickling, W. S. Rawson and Woodhouse and Rawson United, Ld., London.
22,362. Railway Signalling, A. Richard and N. Gray, London.
22,363. Oxidised Lead Process, A. Gutensohn, London.
22,364. Weighbridges and Machinery, A. Aeffcke, London.
22,365. Watch Dials, T. C. Hailey and P. C. Hamilton, London.
22,366. Textile Fabrics, E. Esser and P. Scheider, London.
22,367. Binder for Music and other Sheets, H. Hill, London.
22,368. Tile, G. Czerwonky, London.

*20th November*, 1894.

22,369. Paint Pots and the like, C. R. Gorringe, London.
22,370. Paint and other Brushes, C. R. Gorringe, London.
22,371. Signal Apparatus for Railways, J. A. F. Hall, Brentford.
22,372. Bobbins and Carriages, E. Whitworth, Nottingham.
22,373. Knitting Machinery, &c., G. F. Sturgess, Leicester.
22,374. Miners' Safety Cage, J. Knox, Durham.
22,375. Rain Protectors for Vehicles, A. Eckford, Leith.
22,376. Disinfecting, P. E. Singer and J. Enright, London.
22,377. Winding Thread, A. G. Brooks.—(*J. W. Foster, United States.*)
22,378. Rotary Engine for Locomotives, G. Bewick, London.
22,379. Tobacco Pipe, J. McLaren, Dersingham.
22,380. Reducing Breakage of Coal, S. Tate, Newcastle-on-Tyne.
22,381. Ball-bearing Axles for Vehicles, G. Strong, Dublin.
22,382. Tobacco Pipes, F. O. Ferguson, Ilfracombe.
22,383. Bookmarks, J. Scott, Manchester.
22,384. Construction of Knitted Gloves, W. Simmonite, Sheffield.
22,385. Flushing Cisterns, T. and W. C. M. Curtis, Dublin.
22,386. Cigarette, F. A. Ware, Cardiff.
22,387. Watch and other Protectors, W. Light, Birmingham.
22,388. Wire Fabrics, W. Waterhouse and T. W. Blantern, Birmingham.
22,389. Joint Rings for Pipe Joints, J. Kirkman, Chorley.
22,390. Machine for Soaking Bottles, J. G. Binnington, Hull.
22,391. Transmitting Orders on Board Ship, W. Chadburn, Liverpool.
22,392. Toy Engines, E. W. Banner, Southport.
22,393. Angler Combination Outfit, H. P. Turner, London.
22,394. Electric Liquid Level Indicator, W. Blenheim, Egham.
22,395. Tea and Dinner Trays, H. T. Simpson, London.
22,396. Brake for Pneumatic Tires, T. Mabbutt, Birmingham.
22,397. Fastening, E. H. Griffiths, Birmingham.
22,398. Protecting Boots and Shoes, E. Carr, Leicester.
22,399. Combustion of Hydrocarbons, F. G. Treharne, Llanishen.
22,400. Hat Blocks, J. Vaughan, London.
22,401. Measuring Textile Fabrics, W. H. Hacking, Manchester.
22,402. Spinning Machinery, W. G. H. Peltzer-Teacher, Manchester.
22,403. Steam Engines, J. Weir and J. G. Latta, Glasgow.
22,404. Self-acting Mules, S. and J. Whitaker, Burnley.
22,405. Tobacco Pipe, C. Makin, Halifax.
22,406. Transmitting Motion, S. Hey.—(*The Bouve, Crawford, and Co. Corporation, United States.*)
22,407. Wheels for Pneumatic Tires, C. E. Bell, F. W. Killingbeck and H. L. Parkinson, Manchester.
22,408. Fastening Doors of Vehicles, T. Taylor, Manchester.
22,409. Windows of the Doors of Vehicles, T. Taylor, Manchester.
22,410. Relieving the Pressure on Gas Retorts, T. Settle, London.
22,411. Rotary Washing Machines, A. J. Instone, Aldershot.
22,412. Combination Shirt and Scarf Stand, R. McDaniel, Liverpool.
22,413. Printing Invisible Drawings, W. P. Thompson.—(*O. Klauss, Germany.*)
22,414. Improvements in Organs, R. Hope Jones, Liverpool.
22,415. Composition of Metals, P. Inch, Liverpool.
22,416. Producing Mixed Coloured Silk Yarn, R. J. Maclean, Halifax.
22,417. Altering the Shape of Foreparts of Lasts A. Eley, Stafford.
22,418. Shut-off Connector for Taps, A. M. Coleman, Gosport.
22,419. Baths, R. Drury, Smethwick.
22,420. Copy Book for Teaching Writing, E. L. de Grave, London.
22,421. Self-opening Door, A. J. Stannah, London.
22,422. Handles for Handle-bars of Cycles, C. Stotesbury and W. M. White, London.
22,423. Additional Seat to Double Perambulators, C. Myers, London.
22,424. Protective Appliance for Knives, C. H. Hilton, London.
22,425. Velocipedes and Vehicles, C. Stephenson, London.
22,426. Stencil Printing, B. J. B. Mills.—(*A. B. Dick, United States.*)
22,427. Water Bars for Casements, W. Youlten, London.
22,428. Type-setting, W. H. Beck.—(*L. K. Johnson and A. A. Low, United States.*)
22,429. Roughing Shoes, The Mail Horseshoe Syndicate, Ld., C. J. Jutson, and F. A. Poupard, London.
22,430. Curling or Frizzing the Hair, J. Smith, London.
22,431. Measuring Apparatus, F. N. Connet and W. W. Jackson, London.
22,432. Increasing Circulation of Water, T. Wigley, London.
22,433. Oil Stoves, J. Harper and Co., and C. Retallack, London.
22,434. Couplings, J. S. Heaton, J. M. Scobee, and J. S. Dale, London.
22,435. Printing Presses, W. H. Golding, London.
22,436. Guards, &c., W. Bryden and H. Stansfield, London.
22,437. Herbal Solutions and Sauces, J. H. Payne, London.
22,438. Coin Balance and Tester, J. Wedderburn, London.
22,439. Insect Traps, E. D. Coates, London.
22,440. Lasting Machines, H. H. Lake.—(*C. H. Kelley, United States.*)
22,441. Cutting Veneer, H. H. Lake.—(*The International Woodworking Machine Company, United States.*)
22,442. Tubes, W. Wilkinson, London.
22,443. Handles for Velocipedes, &c., V. T. Facer, London.
22,444. Rims and Detachable Tires, A. G. Bicknell, London.
22,445. Saddles for Velocipedes, &c., J. A. Lamplugh, London.
22,446. Constructing Hollow Glassware, H. Guinard, London.
22,447. Steam Engines, E. E. Wigzell, London.
22,448. Pile Wire Retainers for Looms, H. Hardwick, London.
22,449. Compressed Blocks or Briquettes, M. Thury, London.
22,450. Sewing Machine Threader, P. Bralley, London.
22,451. Glass Fasteners, W. Wilson and H. Weeden, London.
22,452. Coke Ovens, H. A. Allport and A. Crossley, London.
22,453. Insulated Electric Conductors, J. Robinson, London.
22,454. Dye Stuffs, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
22,455. Moquette Fabrics, P. A. Newton.—(*W. B. Smith, United States.*)
22,456. Hydraulic Balances, G. Andrews, London.
22,457. Prepayment Gas Meters, A. G. Sutherland, J. G. Stidder, and J. F. Everett, London.
22,458. Electrically Propelled Carriages, F. King, London.
22,459. Manufacturing Paper Tubes, P. V. M. Blache, London.
22,460. Electrically Propelled Vehicles, F. King, London.
22,461. Oil Lamps, J. H. Lee and J. C. C. Read, London.
22,462. Hydraulic Air-compressors, H. H. Lake.—(*J. H. Champ, United States.*)
22,463. Brakes for Bicycles, C. Guédon and C. A. Morieux, London.
22,464. Buoyancy Motors, H. H. Lake.—(*G. Bacci, Italy.*)
22,465. Electrical Switches, W. T. Burbey, London.
22,466. Fasteners for Labels, R. Oxborrow, London.
22,467. Tobacco Pipe, F. G. Talbot, London.
22,468. Enemas, A. H. V. Schildknecht, London.
22,469. Fountain Penholder, F. S. Cocker, London.
22,470. Piano Music-rest, W. H. Goodrich, London.
22,471. Cycles, L. Cottereau, London.
22,472. Apparatus for Analysing Gases, E. Natanson, London.
22,473. Kaleidoscope, R. H. Barkett, London.
22,474. Driving-chains, C. Kenyon and H. K. Morley, Stockport.
22,475. Table-knife, E. Peters, Berlin.

*21st November*, 1894.

22,476. Ball-bearing Billiard, &c., Cue, A. Kahn, London.
22,477. Cigarette Making Machine, G. H. Stechmann, London.
22,478. Method of Ornamenting and Figuring, T. Moore, Bristol.
22,479. Manufacture of Umbrella Rings, T. Hopwood, Birmingham.
22,480. Shedding Mechanism of Looms, J. Ward, Halifax.
22,481. Boxes for Blacking Substances, J. Stevenson, Halifax.
22,482. Horseshoe Studs, C. E. Roberts, W. T. Kirkman, and H. Doughty, Liverpool.
22,483. Railway Signalling, W. Kershaw, Leeds.
22,484. Bank Cheque Books, A. D. Ottewell and J. Coles, Derby.
22,485. Wheel Guards for Washing Machines, T. Dickinson, Accrington.
22,486. Telephone Renters' Book, S. Buckthought, Manchester.
22,487. Additions to Pneumatic Wheel Circumferences, F. Noake, Birmingham.
22,488. Seat Fittings for Dog Carts, E. Crudington, Birmingham.
22,489. Order Transmitting Apparatus, W. Chadburn, Liverpool.
22,490. Frames for Making Balls of Yarn, H. Lord, Bradford.
22,491. Hydro-extractors, J. Laidlaw, Glasgow.
22,492. Penholders, Pencils, &c., F. W. Timmins, Derby.
22,493. Golf Clubs, O. Stark, Glasgow.
22,494. Disinfecting Powders, F. M. Spence, Manchester.
22,495. Lead Pipes or Tubes for Water, S. Barwise, Derby.
22,496. Washing and Wringing Machines, E. Taylor, Blackburn.
22,497. Fog Signalling Apparatus, J. Crawford, Bishop Auckland.
22,498. Alarm Signals for Railway Carriages, W. E. Bryan, Lyndhurst.
22,499. Raising and Lowering Lamps, R. H. Best, London.
22,500. Gas Engines, D. Clerk and F. W. Lanchester, London.
22,501. Reservoirs, F. S. Rippingille, London.
22,502. Packings for Piston-rods, &c., C. J. McEwen, Liverpool.
22,503. Pens, F. H. Batters, Liverpool.
22,504. Deodorising Hydrocarbon Oils, S. Banner, Liverpool.
22,505. Protectors for Pencils, E. O. Puddephatt, New Brompton.
22,506. Mop, A. T. Chamberlain and R. I. Spencer, London.
22,507. Casements, J. E. Williams, Bristol.
22,508. Boot and Shoe Machinery, J. H. H. Allsop, Bristol.
22,509. Flushing Tanks, E. T. Howard, Bristol.
22,510. Cooking Ranges, J. E. Gibson and A. Balloch, Glasgow.
22,511. Conversion of Sulpho-cyanides, G. T. Beilby, Slateford.
22,512. Combs, C. Lang and M. Plato, London.
22,513. Printing Calico, C. A. Burghardt and H. Meller, Manchester.
22,514. Metallic Alloy for Cutlery, A. J. Hobson, Manchester.
22,515. Detachable Nest Boxes, H. J. F. Rose, Eaton Bray.
22,516. Table, E. Porter, Whitstable.
22,517. Commutator Brushes for Dynamos, W. Begg, Glasgow.
22,518. Spinning Fibrous Substances, W. S. Bancroft, Halifax.
22,519. Grindstone Apparatus, H. A. Mitchell, G. A. Garfitt, and C. Garfitt, Barnsley.
22,520. Combination Walking-stick, E. Brauen, Manchester.
22,521. Gas-lighters, A. Orling, Manchester.
22,522. Lamp Stoves for Cooking, H. V. Rippingille, Birmingham.
22,523. Gear for Transmitting Power, H. B. Trotter, London.
22,524. Apparatus for Drying Clay, J. H. Bowden, London.

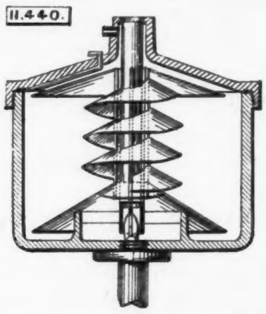
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**11,440.** Centrifugal Cream-separator, *A. Malmros, Stockholm, Sweden.—Filed February* 3rd, 1894.

*Claim.*—In a centrifugal separator, the combination with a revoluble drum, of a feed tube provided at its lower end with a discharge opening, a series of ribs on said tube, a screw-worm supported by said ribs and having a diameter less than that of the interior of the drum, the inner edge of the worm being somewhat removed from the tube whereby vertical passages are formed, a vertical extension of the drum formed upon the bottom of the same, a hood carried by the ribs and arranged above the upper edge of said extension, and a second hood also carried by the ribs and arranged above the upper end of the worm, the drum being provided with discharge openings for the skim-milk and the cream, arranged as described.

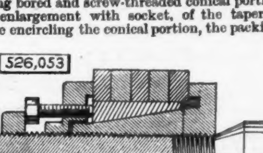
11.440.



**526,053.** Cup-head or Piston-packing, *J. F. Pruden, Oakdale Station, Pa.—Filed March* 15th, 1894.

*Claim.*—The combination with the body portion having bored and screw-threaded conical portion, boss and enlargement with socket, of the tapered split sleeve encircling the conical portion, the packing rings around the sleeve, the cap-piece with threaded extension, and socket, the threaded piston rod, the adjusting screws passed through the cap-piece and bearing upon the sleeve, and the nut on the end of the piston rod and bearing upon the ends of said screws, all substantially as specified.

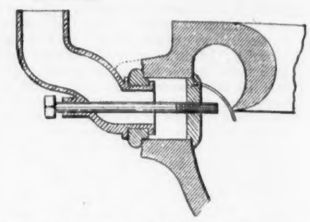
526,053



**526,089.** Coupling for Water-closets, *J. H. Savill, Philadelphia, Pa.—Filed May 7th*, 1894.

*Claim.*—(1) The herein described coupling, comprising a nut or bearing having a spring adapted to engage the flushing rim of a bowl or hopper so as to hold the nut or bearing in position in the bowl, or hopper, a pipe section and connection between the pipe section and the nut or bearing, substantially as specified. (2) The herein described coupling comprising a nut or bearing having a spring adapted to engage the flushing rim of a bowl or hopper, so as to hold the nut or bearing in position in the bowl or hopper, a pipe section, a cushion carried by the pipe section and adapted to bear against the bowl or hopper, and a threaded bolt connecting the pipe section and the nut or bearing, substantially as specified.

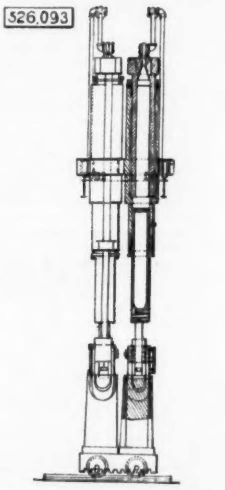
526,089



**526,093.** Ingot Extractor, *H. Aiken, Pittsburg, Pa.—Filed February 17th*, 1894.

*Claim.*—(1) In an ingot-extracting apparatus, a cylinder having two oppositely projecting plungers, one for lifting the mould, and the other for holding down the ingot, and a common water inlet between said plungers, substantially as described. (2) In ingot-extracting apparatus, the combination of a mould-lifting plunger and a down-holding plunger, both being single acting, the down-holding plunger being of less area than the lifting plunger, said down-holding portion having a portion situate in the path of motion of a portion of the lifting plunger, whereby it is engaged during the rise of the latter and is lifted thereby, substantially as described.

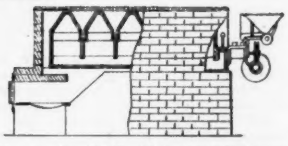
526,093



**526,116.** Process of Making Nitric Acid, *M. Prentice, Stowmarket, England.—Filed October 10th*, 1893.

*Claim.*—The described continuous process for the production of nitric acid, consisting in mixing nitrate of soda and sulphuric acid, dissolving by heat the former in the latter, passing the liquid successively through a series of compartments, subjecting the same in the last to a higher temperature than in the ones preceding, and collecting separately and condensing the vapours produced in the different compartments, as set forth.

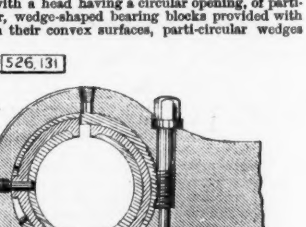
526,116



**526,131.** Adjustable Bearing for Journals, *L. Hollingworth, Chicago, Ill.—Filed May 2nd*, 1893.

*Claim.*—(1) The combination, with head provided with a circular aperture, of parti-circular, wedged-shaped bearing blocks, parti-circular wedges interposed between the walls of the aperture and the outer surface of the bearing blocks, and means for securing relative adjustment between the wedges and bearing blocks, substantially as described. (2) The combination, with a head having a circular opening, of parti-circular, wedge-shaped bearing blocks provided with lugs on their convex surfaces, parti-circular wedges provided with slots for said lugs and interposed between the bearing blocks and the walls of the opening, radial pins entering the lugs and also entering the head and means for adjusting the wedges. (3) The combination, with a head having a circular opening, of parti-circular, wedge-shaped bearing blocks, parti-circular wedges interposed between the bearing blocks and the walls of the opening, a rack on one of said wedges and a worm mounted in the head and engaged with said rack, whereby the bearing blocks and wedges may be adjusted relatively to each other.

526,131



Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided for our breakfast and supper a delicately flavoured beverage which may save us many heavy doctors' bills."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled, "James Epps and Co, Homœopathic Chemists, London.'

## SOUTH WALES RAILWAY AND DOCK BILLS.

South Wales will present a large batch of Railway and Dock Bills at Westminster in the coming session, and if they are not all as important as those of last year, two at least possess a highly contentious character. These are the Barry and Bute proposals, one relating to a new railway, and the other authorising alterations which involve large financial questions in the arrangements between the Bute Company and the railways delivering cargo at Cardiff Docks. The project of the Barry Company consists of six short lines, which together would carry the Barry Railway in a north-easterly direction across Glamorganshire, and over the Monmouthshire border; giving it access to large collieries and an undeveloped coalfield at present served by the Taff Vale and Rhymney Railway; and ending in a junction with the London and North-Western and Midland systems, whereby it would gain direct communication with the North, obtain enormously increased facilities for attracting traffic to Barry Docks, and make Barry itself a more valuable distributing centre. Under the name of the East Glamorganshire Railway the proposal was submitted to the Parliamentary Committee last session as an independent line with a separate directorate; but it was an open secret that the Barry directors were its authors and promoters. It was stubbornly opposed, and after a severe contest was defeated. It is the same scheme, with but slight modifications, that is now revived, and this time it is brought forward as a Barry Bill, and as a step to the natural expansion of the Barry Railway, though to be worked as a separate undertaking. Power is sought to make agreements with the London and North-Western, the Midland, the Great Western, the Rhymney, the Brecon and Merthyr, and the Cambrian companies "with respect to the construction, working, use, management, and maintenance, by any or either of the contracting companies, of the intended railways or any part or parts thereof; the supply of rolling or working stock and machinery, and of officers and servants for the purposes of the traffic of such railways," &c. The London and North-Western Company is supposed to regard the proposed line with sympathetic interest, and it is believed that the Midland is disposed to welcome every means of strengthening its position in the Bristol Channel ports. But as the Barry extension must necessarily tap a large and productive area hitherto reserved to the Taff Vale and Rhymney companies, the Bill will be as stoutly contested as before. As traffic diverted from these lines to the Barry Railway would also be diverted from Cardiff Docks, the Bute Docks Company and other representatives of Cardiff interests are expected to reinforce the opposition. The Barry Company is to work the Vale of Glamorgan Railway, now in course of construction, which extends westward from Barry Docks, through a fertile agricultural district, to the borders of a promising coalfield, as yet only partially developed. In a Vale of Glamorgan Bill, the Barry Company proposes to make deviations in the authorised lines, to extend the period for the compulsory purchase of lands, to acquire additional lands in Penmark and Porthkerry, and to secure the use of the approach roads to the Bridgend station of the Great Western Railway.

Section 23 of the Barry Act of 1888 has been the subject of much costly litigation between the Taff Vale and Barry companies. The dispute arose on the rates charged by the Taff Vale for carrying coal from the collieries on its line to the points of junction with the Barry Railway. The Act limits the toll to the lowest sum the Taff Vale charges anywhere for the "like traffic." The Taff construed this to mean that it might charge Barry on the basis of its rate to the Bute Docks; whereas Barry contended that the lowest sum for the "like traffic" should be based on the rates to Penarth Dock, a greater distance by three miles. The Court of Appeal decided in favour of Barry, and the importance of the judgment will be seen when it is stated that the difference affects three and a-half million tons per annum. But Section 23 covers more than the point as to the lowest rate. It provided that if the Taff Vale at any time refused facilities in collecting Barry traffic at the collieries and carrying it to the Barry Junctions at Havod and Treforest, the Barry Company would be entitled to exercise running powers over the Taff and fetch its traffic for itself. Moreover, the Taff Vale has a branch line running through Penarth to Cadoxton-Barry, originally designed for mineral as well as passenger traffic. Section 23 requires the Taff Vale to abstain from using the Cadoxton branch for mineral traffic; or otherwise the Barry would claim the right of running powers over the Taff Railway above the Havod and Treforest Junctions. This explanation of a complicated situation was necessary to an intelligible statement of the new Bill of the Taff Vale Company. Its main purpose is to amend or alter the agreements embodied in section 23 of the Barry Act of 1888 and a confirmatory section in the Barry Act of this year. The financial issue fought in the Court of Appeal is likely to be carried to the House of Lords; but on the other questions the Taff Vale will ask Parliament to undo what Parliament did six years ago. The Barry Company meanwhile is so little disposed to find fault with Section 23, that it proposes to include it in the Glamorganshire Railway Bill, so as to secure the collection of traffic on the railways specified, and its transfer to Barry over the proposed new line. The other powers sought in the Taff Vale Bill are unimportant, except the proposal for an embankment at Penarth Dock in order to reclaim a portion of the foreshore near the dock entrance, which, so peculiarly are the dock and basin placed, is the only available land for extension of the works.

The Bute Dock Bill concerns itself largely with questions of internal arrangements; but they are arrangements which touch so many interests, financial and otherwise, that the contest promises to be unusually keen and exciting. When the new Bute Dock was before the Committee last session the promoters asked to be relieved of the duty of sorting and carrying to the ships' side traffic which was brought to the dock by the local railways. The railway companies, as things stood, were under obligations to carry traffic gratuitously over the Bute sidings to the staithes or tips, and a similar obligation was placed upon the Taff Vale, Rhymney, and Great Western in connection with the new dock then authorised. Now the Bute Company seeks to repeal the sections of Acts enabling the railway companies to use the Bute line and sidings, with a view to obtaining payment or some other consideration in lieu of rent for the sidings and lines in question. No sooner, however, had the Parliamentary notice been published than a counterblast appeared under the joint names of the Great Western, London and North-Western, Taff Vale, and Rhymney Railways. They gave notice of an application to Parliament for a "Bute Docks Amendment Act" to repeal the clauses or covenants requiring them "to convey traffic of any description over any railways or sidings of the Bute Docks Company, and to relieve the said railway companies, or some of them, from any obligation to convey such traffic or to provide accommodation or render services in connection therewith, except upon terms to be agreed upon between the said companies respectively, and the Bute Docks Company, or to be prescribed or determined by or under the provisions of the intended Act." They ask also to have conferred upon them "all such powers of running over and using the said railways and sidings, and of demanding and reserving tolls, rates, and charges, and to make such other provision with reference thereto as may be found necessary or expedient, and as may be prescribed or provided for by the intended Act." Thus the Bute Dock Company is directly challenged by a combination of railway companies which contends, as indeed the Taff Vale and Rhymney contended last session, that the services imposed upon them by Bute Dock Acts and subsidiary covenants are so onerous and burdensome that they are compelled to ask Parliament for relief.

The Bute Docks Company incidentally proposes to make an easterly extension of the intended sea wall south of the site of the new dock, to reclaim the foreshore thus embanked, and to purchase by compulsion any lands or works required for the purpose of the undertaking. More time is asked for the construction of the sea walls and embankments already authorised. Lord Bute seeks authority to extend his lease to the company to 250 years, or any other period which may be defined. More important in some respects is the application for power to create further capital, and consolidate or convert the existing stock. It is understood that one of the reasons inclining Lord Bute so favourably to receive the overtures of the promoters of the Harbour Trust was his desire to relieve himself of some of the burden of his vast estate. At present the public holding in the company's property, which Mr. Hedley has valued at £4,700,000, is the 4 per cent. debenture stock, of which £800,000 has been issued. The belief is that if the capital is increased, a block of similar debentures will be offered to the public, probably to an equal amount, which would cover the estimated cost of constructing and equipping the new dock. In that case the Bute Dock Company would be following the example of Barry, which is building its dock extension on £4 per cent. Preference stock, while its capital is earning 10 per cent. on the other parts of the property.

Among other railway Bills, the Rhymney Company proposes to construct a new railway in the parishes of Gelligaer and Llanvabon, to acquire more land near Cardiff Station, and to divide the ordinary stock into preferred and deferred, the former to bear 4 per cent. The Rhondda and Swansea Bay asks for powers to construct short railways at Swansea, Neath, and Briton Ferry, and to compel its old antagonist, the Great Western, to complete and fit with signals certain junctions of that company's line with the railways and sidings of the Swansea Harbour Trust, over which the Rhondda Company has obtained running powers for passenger traffic. The Great Western Railway proposes to construct a new line from the bridge over the Rumney river, a few miles east of Cardiff, which will diverge into two branches running on either side of the Roath Dock, while the main line is to be widened for a distance of eight miles between Cardiff and Newport, in order to facilitate the transport of Monmouthshire coal to Cardiff Docks. Further westward the Great Western Company intends building a new station at Carmarthen and abolishing Carmarthen Junction, all main line trains running through the town. The North Pembrokeshire and Fishguard Railway seeks power to extend its line to Carmarthen, and efforts are being locally made to induce the companies concerned to agree to construct a central station at Carmarthen for the joint use of the Great Western, the London and North-Western, and the North Pembrokeshire.

## THE MANCHESTER THIRLMERE WATER-WORKS.

### No. III.

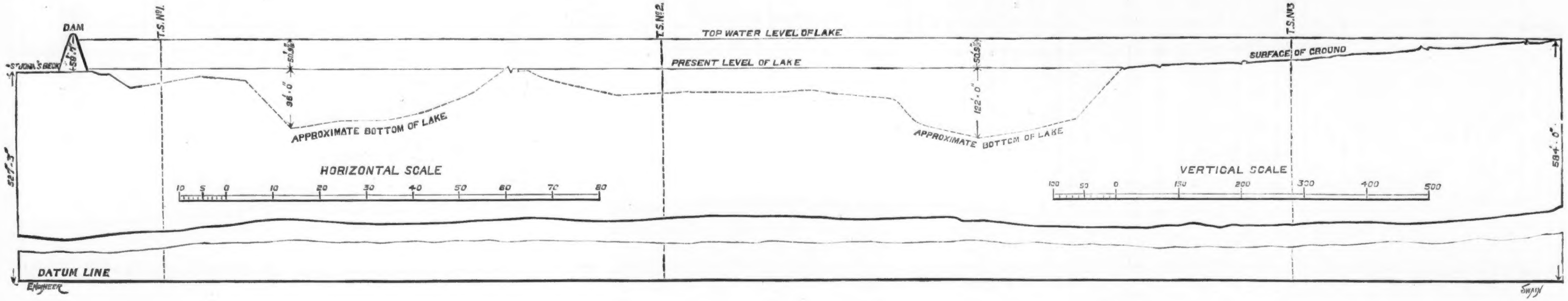
Of the £3,425,000 authorised to be raised for the construction of the works at Thirlmere and the conveyance of water to Manchester, between £2,500,000 and £3,000,000 has been spent in obtaining the first instalment of 10,000,000 gallons a day.

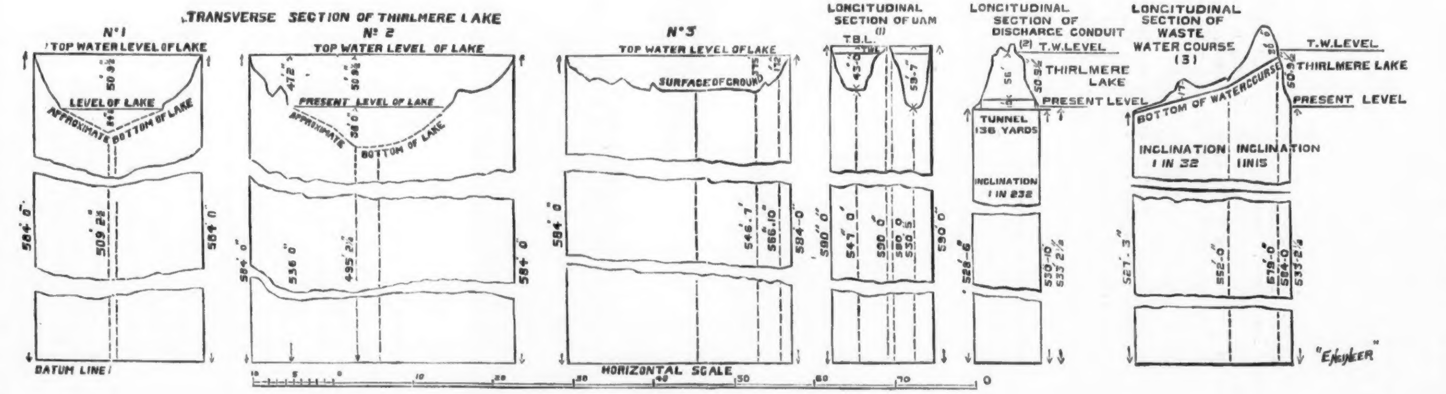
MANCHESTER WATER SUPPLY WORKS—THIRLMERE FROM THE NORTH

Although the acquisition of much of the land before the Act was obtained had simplified matters, still there were many difficulties to be overcome before Manchester was in possession of the authority necessary to enable the work to be carried out. Many costly arbitrations had to be undertaken. What we believe will prove to be the last one is now before Mr. Oakley as umpire, who has to decide on the claim made by the trustees of Lord Lonsdale for payment on account of the stone excavated in making tunnels through the land of which he is Lord of the Manor. This stone was used by the Corporation for making concrete, but their contention is that as the district abounds in this particular stone, it is of no more intrinsic value than an abundance of marl or sand would be in any other place. The most peculiar arbitration was that undertaken to obtain possession of the Countess of Ossalinsky's property, which consisted of about 850 acres. The rental from this was a little over £500 a year, and the Corporation valued it at from £20,000 to £25 000—thus, we should have thought, taking a very liberal view of the value, present and prospective, including a handsome "solatium" for compulsory sale. The values given by those who acted for the Countess ranged from £70,000 to £100,000, extra value being included in consequence, as it was stated, of the land being adapted to waterworks purposes. The award was received with astonishment, amounting as it did to nearly £70,000, and led to an alteration in the law by which the appointment of umpires, when corporations and parties with whom they are dealing cannot agree, has been put upon the same footing as in the case of railway companies under the Land Clauses Act, and the appointment of the umpire is now removed from the authorities of the district and vested in the Board of Trade. A decision was also obtained from the Courts laying down as law that arbitrators are not to value land with reference to the particular purpose for which it is required, especially when Parliament had given powers for the acquisition of the property compulsorily.

The aqueduct which conveys the water from Thirlmere to Manchester is $95\frac{3}{4}$ miles long, and is constructed as follows:—45 miles of cast iron pipes; 37 miles of cut and cover; and $13\frac{3}{4}$ miles of tunnel. We give, p. 492, longitudinal sections of upwards of 27 miles, comprising the most interesting portions of the aqueduct. Commencing at the lake we show 11 miles, including the longest tunnel, which passes under Dunmail Raise, and is 5186 yards long, the greatest depth below the surface being 265ft. It also includes the tunnel under Nab's Scar, which towers above the aqueduct to a height of 660ft.; the tunnel under Skellgill Wood and the Syphon crossing the valley down which flows the Troutbeck—names all of which are familiar to those who have visited the Lake District. On the south side of the Troutbeck Valley there is another tunnel under Moor-How 3040 yards long. There are other tunnels in this district amounting to upwards of 8 miles in the first 14 miles of aqueduct. Several of these tunnels were not driven straight. The long

## THE MANCHESTER THIRLMERE WATER SUPPLY WORKS—SECTIONS OF THIRLMERE





one through Dunmail Raise had two angles, and, therefore required very careful setting out; the junctions, however, were successfully accomplished. Troutbeck was to have been passed in a syphon, but the impetuous stream resented the indignity, and demanded as much consideration as the Lune or the Ribble. Its indignation was shown by repeatedly washing out the pipes laid under its bed, and in the end the engineer had to submit and build a bridge to carry the aqueduct over the Beck.

At 18½ miles we reach the first long length of syphon extending from 18½ miles to 21¾ miles. This is necessary to carry the water across the river Sprint and several other streams, as well as under the London and North-Western Railway Company's main line. The aqueduct is continued by works as above mentioned across country.

We have illustrated two other lengths, viz., the crossing of the river Lune by a syphon extending from 40 miles to 42¾ miles. The level of the aqueduct at this point is 460ft. 10in. above datum, and falls to 42ft.—a drop of 428ft. 10in. This is the greatest drop on the whole line from Thirlmere to Manchester. The inclination through these pipes is 22·6in. per mile. The inclination given through the tunnels and culverts is uniformly 20in. per mile. The pipes are carried over the river Lune by a bridge of three spans at a height of 20ft. above ordinary water level. The rivers Wye and Calder are crossed by syphons. The Ribble is crossed on a bridge. The syphon across the valley extends from 60 m. 4 f. 7 ch. to 69 m. 7 f. 8 ch.—a length of nearly 9½ miles, the fall being 22·8in. per mile. A section of this is given.

The dimensions of the aqueduct through the tunnels and culverts which were constructed in open cutting are 7ft. 1in. wide by 7ft. 9in. high. Through the larger tunnels the height is reduced to 7ft., the width, where side walls were not considered necessary, being increased from 7ft. 1in. to 8ft. 6in.

The floors throughout are of concrete, the side walls of brick or of concrete, and the arches are in some lengths semicircular, in others segments of circles are employed, a rise of 2ft. 6in. being usually given to the latter. For the 13 miles nearest Manchester the aqueduct passes through a colliery district, and is formed of pipes 36in. in diameter, the inclination having been made quicker along this portion. The fall throughout the entire aqueduct is 178ft. from the ordinary level of Lake Thirlmere to the top water level of the service reservoir at Prestwich, a suburb of Manchester on its northern side. The normal fall in the wide aqueduct is 20in. per mile, and through the various lengths of pipes 24in. per mile.

The pipes are of cast iron, 40in. diameter for the greater length, and varying in thickness from 1in. where under slight pressure, to 1⅝in. at the Ribble crossing, where there is a pressure due to upwards of 400ft.; while at the Lune crossing the pressure is due to about 425ft. of head, and the thickness of pipe increased to 1¾in., which is the greatest thickness used. For a short length in the Lake District the pipes have been laid 48in. in diameter, to convey 14,000,000 gallons per diem, so as to avoid disturbing the surface so frequently as elsewhere, three lines of these pipes being sufficient to convey the 50,000 gallons per diem. The ordinary length of pipes is 12ft. Where laid under streams, they are bedded in concrete, and also at the foot of steep slopes. Where the aqueduct crosses the Leeds and Liverpool Canal it is bedded in concrete for the whole width of the canal. Wherever the pipes are above ground-level they are carried on piers and covered by an earth embankment.

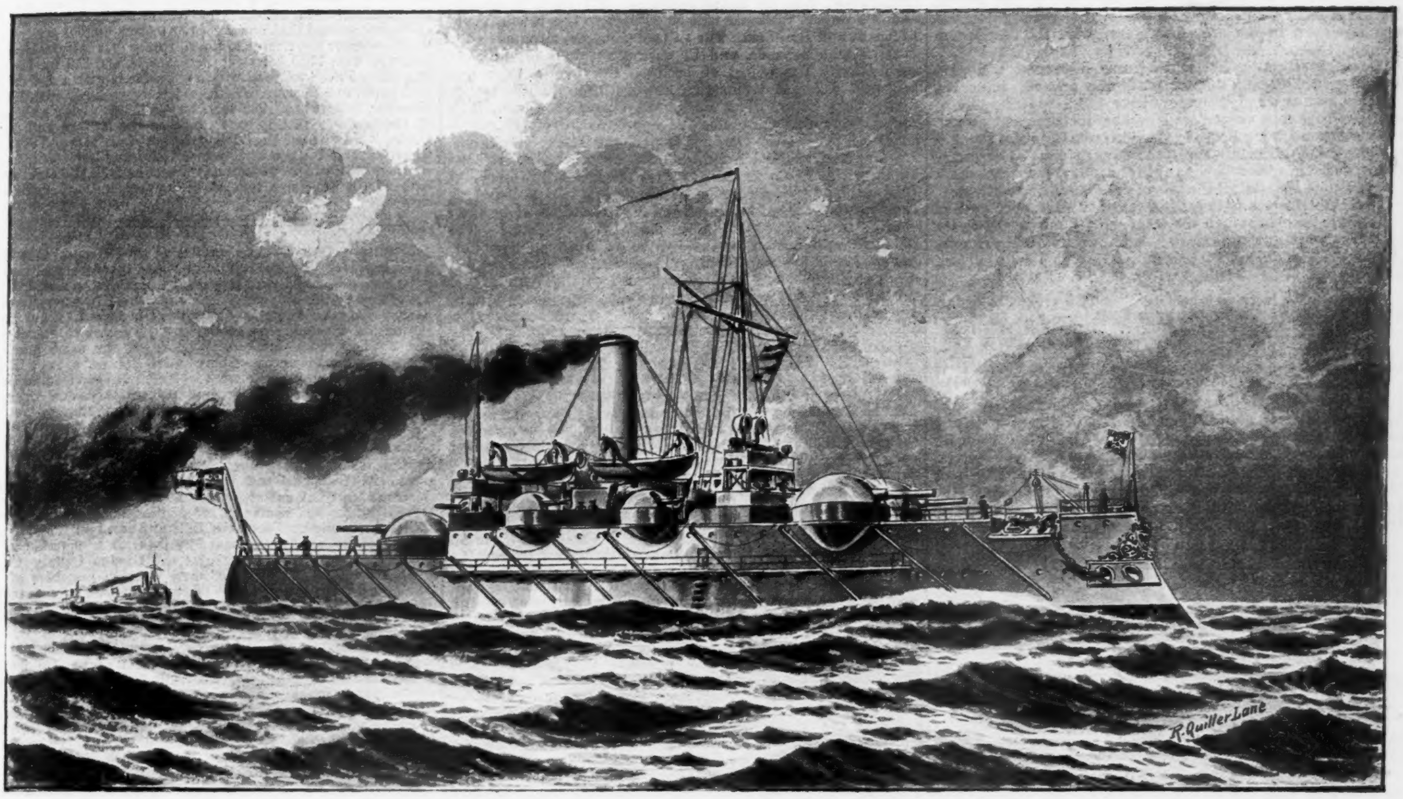
We give an illustration of Thirlmere taken from the north end of the lake near the foot of Raven's Crag. The pass of Dunmail Raise is seen at the extreme south, and the lofty range of hills culminating in Helvellyn on the east. By comparing this with the enlarged plan of the lake published in our issue of the 2nd of November last, the alterations that will be made in the appearance by raising the water 50ft. can be approximately gauged. The farmhouse at Armboth on the west side will be at the edge of the water, and the original coach road from Keswick to Windermere on the east side will be submerged. To provide for the loss of this road, a new road has been made, not only on the east but also on the west side, so that there is now a wide and excellent drive on both sides of the lake. The cost of making these roads was borne by the Corporation of Manchester, and added considerably to the expense incurred by them.

*To be continued.*)

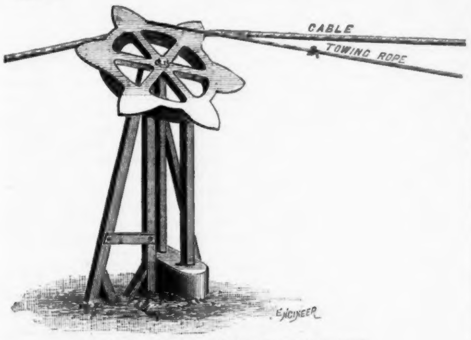
## CABLE HAULAGE ON CANALS.

The system of haulage by means of cables worked by machinery has long been considered in France as one of the most promising expedients for securing the greatest economy and efficiency in the towing of boats on canals. The simplicity of the idea naturally appealed to inventors, who seemed to think that there was little question as to the possibility of its being carried out successfully. A great deal of attention was consequently given to this principle of canal traction, and several experimental installations were carried out with a view of testing some of the systems then introduced. In 1884, M. Rigoni laid down an installation on the St. Martin Canal, and it was then seen that the idea was not so simple as it appeared. The cable worked very irregularly, and was constantly being pulled out of the pulleys, so that it was speedily abandoned. The same fate awaited the installation laid down by M. Oriolle on the St. Quentin Canal. The difficulty of preventing the escape of the cable from the pulleys offered plenty of scope for the ingenuity of engineers, and some of the most likely contrivances failed to act properly when put into practice. As events have since proved, this drawback would have been easily remedied if the cable could be made to run in a perfectly straight line, but in most installations there is scarcely a hundred yards of cable in which the direction has not to be changed by pulleys. The inequalities in the ground, the locks, the tunnels, and the curves in the canal, necessitate a great many pulleys of various shapes and sizes, and these at first offered a serious impediment to the passage of the tow rope attached to the cable. MM. Rigoni and Oriolle employed in their installations ordinary pulleys with smooth grooves, from which the cable was pulled away by the oblique strain of the boat. When at length this was overcome a still greater difficulty presented itself in the awkwardness of turning corners by means of the cable. In the horizontal pulleys changing the direction of the cable away from the canal, and in the vertical pulleys carrying the cable either over or under, the towing rope can pass easily without obstruction; but in many cases the cable takes an inward direction, with the result that it has to pass around the outer edge of the pulley. It was evident, therefore, that the horizontal pulley carrying the cable away from the canal would have to be suppressed, and some other system devised whereby the towing rope would continue to follow the cable without interruption. This difficulty has been overcome by M. Maurice Levy, Inspector-general of the Ponts et Chausées, who has just prepared a voluminous report upon his system. M. Levy induced the Government to authorise a trial of his system in 1888, when he laid down an installation upon the Marne, the Saint Maur and Saint Maurice Canals, a distance of 5200 metres. This installation presented nearly all the difficulties that could be met with in such an undertaking, so that if successful there could be no question as to its efficiency for the general purposes of canal traction. The installation was laid down in four sections—one starting about 150 metres above the Joinville Bridge and finishing at the Saint Maur Tunnel; another passing underneath the tunnel; a third working between the tunnel and the Gravelle Lock; and a fourth between the Gravelle Lock and the Charenton Lock. The cost of the whole installation was 150,000f., or 25,000f. per kilom. At first, operations were restricted to the line from the Saint Maur Tunnel to the Gravelle Lock, and this work was completed in four months. The engineering and Government officials were so far satisfied with this line that permission was given to complete it over the three other sections. This extension was a particularly awkward undertaking from the fact that it had to serve the port of Charenton, which has a length of 250 metres, had to pass underneath a tunnel 600 metres in length, had to go through the Gravelle lock, to which entrance is made extremely difficult on account of a bridge and a sharp curve, and had to cross a branch of the canal of St. Maur by a

# THE SIEGFRIED, GERMAN IMPERIAL NAVY



single span of 121 metres, to say nothing of the numerous curves that had to be met along the route. The installation comprises an endless cable that starts from the Gravelle lock, and after following on one side of the canal, crosses at Charenton and returns on the other side. A second endless cable makes a similar circuit from the Gravelle lock to the river Marne by way of the Joinville tunnel. Special attention has been given to facilitating the attachment of the towing rope to the cable, and this is effected by means of short lengths of rope that hang from the cable at regular intervals, and provided with an ingenious clutch. The boatman can attach his tow rope to the clutch in a few seconds without leaving the boat, and by merely pulling a lever the boat is loosened in a moment. The principal feature in this system is the ingenious method that has been adopted to prevent the cable slipping from the pulleys. This is done by constructing the pulleys, where necessary, with a serrated flange, so that the towing rope will enter one of the notches, and will leave it at the other side when the pulley has made a partial revolution. While plenty of freedom is thus left for the towing rope to pass over the pulley, the flange will prevent the cable from being pulled away. This principle has been developed to a singular extent at the curves, where the cable has to pass outside the support.



CANAL ROPE TOWING STANDARD

The horizontal pulleys which at first gave so much difficulty have been replaced by oblique pulleys. In this new system the upper face is star-shaped, the flange bearing four or six prolongations that are made almost semi-circular in form, so as to facilitate the entrance and release of the cable. These oblique pulleys have a diameter inside the groove of two metres. Of course, in the position in which the pulley is placed the cable exerts a constant strain upon the flange, but the star-like projections are made sufficiently large to preclude the possibility of the cable escaping. The motive power for this installation is supplied by a horizontal engine placed at the Gravelle Lock. On each side of the engine-house are three pulleys for operating the two circuits, the one working as far as the river Marne, and the other to Charenton. Two of the pulleys are built in solid masonry, and the larger one receives its power direct from the engine. The second pulley serves merely to keep the cable in its place upon the driving pulley. A third pulley works upon a running frame, and acts as a tension-wheel for the cable. In such an extensive installation the cable has naturally a tendency to be always slackening, and when this takes place the sliding pulley, around which the cable is wound, is drawn away from the driving pulley so that the cable may be tightened. The rate of speed imparted to the cable is one metre per second, but it is stated that this is too fast for the boatmen, who have asked that the speed should be reduced. This system of M. Maurice has put beyond question the possibility of hauling boats upon canals by means of mechanical cable traction, but this possibility will avail nothing if it is not found to be at the same time efficient and economical. So far, it cannot be said that M. Levy's system has met with the success that was at one time looked upon as being assured.

It is the general opinion of engineers that nothing could be more satisfactory if the cable could be worked in a perfectly straight line, but where the cable has to be turned in different directions by pulleys of all shapes and sizes, and sometimes placed two and three together, the friction must necessarily result in an enormous waste of power, to say nothing of the wear and tear of the cable. The installation upon the Saint Maur and Saint Maurice Canals has never passed much beyond the experimental stage, and the work which it has done has certainly not justified the cost of the installation. It is believed that the system can only be economical upon canals with a heavy traffic. With a traffic of a million tons a year the cable traction could be employed with great advantage, and from this point the economy would increase in proportion to the augmentation of traffic, until an economy of 50 per cent. could be effected upon the present cost of working, with a traffic of from three to four million tons. As there are many canals in the north of France fulfilling these conditions, the system is at the present moment being experimented with in view of its further extension, and it is likely that an installation will be laid down shortly on the canals in the Loire. The Government of Holland is also carrying out experiments upon the Aisne Canal adjoining the Marne, where the first section has already been laid down in the Billy Tunnel. Similar experiments have been carried out for some time past by the German Government upon the canal from the Oder to the Spree, and the results are being looked forward to with great interest. Though the system has not so far been an unqualified success from an economical point of view, it is the opinion of engineers in France that it has a great future before it, and that it will be used extensively upon canals carrying a heavy traffic.

## THE SIEGFRIED, GERMAN IMPERIAL NAVY.

We illustrate above the Siegfried, a recent addition to the German Imperial Navy, the first—completed—of eight of a type, of which, unfortunately, we have no counterpart in our Royal Navy; although as long ago as March, 1893, Lord Charles Beresford, in his "Programme for proposed increase of British Fleet," strongly recommended such a class of ship to watch the torpedo stations of an enemy, and destroy his boats, &c.

The Siegfried is like the other vessels of her class, 240ft. long, and has a displacement of something like 3500 tons. She is provided with a belt of steel armour at the water line the entire length of the ship the belt being 7ft. 6in. deep and 9·4in. thick. Her armament consists of three 9·4in. Krupp guns, in barbettes, two forward and one aft, the barbettes being protected by 8in. steel armour; and six 3·4in. quick-firing guns, by the same maker. She is also provided with four torpedo tubes, two being submerged.

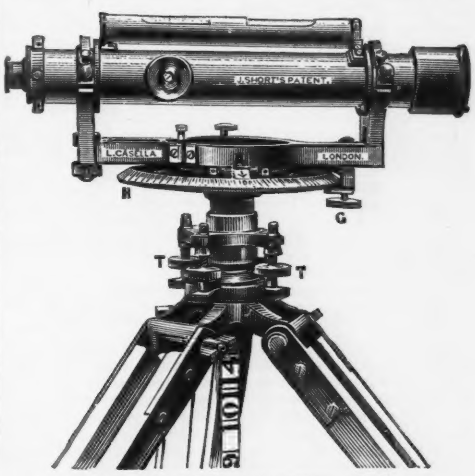
Her speed is between fifteen and sixteen knots, and she has a complete electric light installation, besides being warmed throughout by hot-water pipes.

The names of the other ships are Odin, Beowulf, Frittijof, Hagen, Heindal, Hildebrand, and one "T," still unlaunched, and building at Kiel.

## THE GRADIENT TELEMETER LEVEL.

We have lately had the opportunity of examining a new form of surveying instrument invented by Mr. J. Short, which promises to be of great service by economising time and labour in the preparation of detailed surveys for engineering works, without in any way impairing the accuracy of these indispensable but laborious operations, when compared with the methods in current use.

This instrument, which has been named by the inventor the gradient telemeter level, is constructed for the purpose of determining linear distances, gradients, and differences of level by a single observation, without the use of chain or tape, for measurement on the ground. As will be seen from the illustration, it resembles an ordinary dumpy or Y level, with the addition of a divided horizontal plate or limb H, turning upon an axis, which is exterior to that of the cross-bar carrying the Y's of the telescope. This outer axis, however, is not parallel to the inner one, but both have different centres inclined to each other, so that it is only when the instrument is set with the index G clamped to the zero point of the scale on the limb and levelled upon the outer centre, that the line of sight lies in the horizontal plane. If, now, the clamp screw be released and the outer limb moved by hand so as to bring another part of the scale under the index, the visual plane will, by the canting of the axis, be inclined or depressed by an amount corresponding to the obliquity of the two axes in that position, and which is expressed by the reading on the scale in terms of the gradient, although any other system of division may be used if desired. The limiting obliquity of the two axes of course depends upon the construction of the individual instrument; in the one that we have examined it was, we believe, 1 in 12, or about 11 degrees of arc. When used in taking gradients the level reading is taken upon the staff in the ordinary way, the height of the centre of the objective of the telescope above the ground at the station being read upon a tape hung below the tripod stand. The telescope is then unclamped, and the line of sight is lowered—on a falling gradient—until the staff reading is made to correspond with the height of the instrument, when the index will stand at the point of the scale giving the gradient required, apart from any consideration of distance between the points, whether long or short. The method of observation on a rising gradient is similar, except that the telescope must be reversed in the Y's so as to bring the object glass end next to the clamp screw G. The difference, whether rise or fall, is learned by noting the word "rise" or "fall" engraved on the eye-piece end of the stage carrying the Y's.



SHORT'S GRADIENT TELEMETER LEVEL

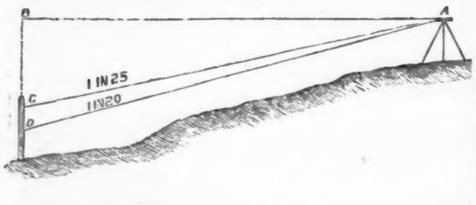
As the level line is only required in the preliminary setting up of the instrument, gradients may be determined by it when the vertical interval between two stations is as much as 90ft. or 100ft., or when the instrument is between two stations, differences up to 200ft. may be determined in a few minutes with an ordinary 14ft. levelling staff, when a pair of readings upon it can be obtained with the telescope at two known degrees of inclination. An example of this class of application is shown in the annexed figure, with the description given by the author.

"Method of getting horizontal linear distances, and also levels up to 90ft. and 100ft. on sloping ground, when the levelling staff is wholly below or above the horizontal line of sight, without moving the staff or the instrument. When the instrument is levelled, and the horizontal line of sight A B is above the top of the 14ft. staff, proceed as follows:—Loosen the clamp and move the telescope until the index reaches gradient 100, and sight the staff; if the line of sight is still above the staff, move the telescope and index farther until the upper part of the staff is visible through the telescope. Suppose the index is then near gradient 28, move it again until it cuts exactly gradient 25, then take the staff reading at that gradient. Suppose this to be 13·86ft.,

Then move the index on to gradient 20 and again read the staff; let this reading be 8·45ft. and take their difference thus .. .. .. .. .. Gradient 25 = 13·86
Gradient 20 = 8 45

Difference between 1 in 25 (4 per cent) and 1 in 20 (5 per cent) = 1 per cent. or 1 in 100 .. .. .. .. .. .. .. .. = 5·41

Eliminate the decimal point, and the horizontal linear distance A B, as in above illustration, is 541ft., without any calculation being necessary for hypothenusal difference or for other reduction. For facilitating this class of work a series of pairs of gradients are engraved on the limb, any pair of which will give by the difference of their readings the horizontal distances in this manner—the choice of gradients being determined by the nature of the ground."



The instrument has been tried by engineers engaged on railways and other public works both in this country and abroad, and has everywhere met with a most favourable reception. Mr. Beckett, of the Manchester Ship Canal; Mr. Cooper, Borough Engineer, of Edinburgh; Mr. Binnie, of the London County Council; and Mr. Weightmann, Consulting Engineer for Railways in Madras, among others, having expressed their sense of its novelty and value. As an example of the class of work done by it the figures contained in the following trial will be of interest:—

*An Abstract from the Report of the Trial of J. Short's Patent Gradient-Telemeter Level by the Royal Engineer Committee, at Chatham, in the Spring of* 1892.

| No. of Station. | Gradients used. | Chained Distance. | Error by Grad. Ter. Level. | | Remarks. |
|---|---|---|---|---|---|
| | | | Minus. | Plus. | |
| | | Feet. | Feet. | Feet. | |
| I. Back | 17 and 34 | 115·50 | 0·75 | | |
| Forward | Level and 25 | 288·42 | | 0·33 | |
| II. Back | Level and 50 | 289·25 | | 0·25 | |
| Forward | Level and 60 | *— | — | — | *This was a bad reading due to smoke obscuring the staff.<br>A. O. Green, Major, R.E. |
| III. Back | Level and 20 | 362·34 | | 0·36 | |
| Forward | 20 and 30 | 278·52 | 0·12 | | |
| IV. Back | 20 and 30 | 435·60 | nil | nil | |
| Forward | Level and 20 | 119·46 | | 0·14 | |
| Distance by Chain .. .. = | | 1839·09 | 0·87 | 1·08 | |
| ,, by Gra. Tel. Level = | | 1839·20 | | 0·87 | |
| Difference .. .. .. .. = | | 21 | | 0·21 feet = 2½in. about. | |

Result.—In the "traverse" or distance measured above with the Gradient-Telemeter Level of over 613 yards, the error or difference compared to the land chain measurement was only about 2½in.; this means that in one mile of ground measured with this instrument the difference would be less than 8in. And distances can be got with all this accuracy across water, or rough and broken ground, where the land chain cannot be used at all. (Signed) A. O. Green, Major R E.

The construction of the instrument has been confided to Mr. L. Casella, of 147, Holborn Bars.

## NEW WATER SCHEMES FOR YORKSHIRE.

The remarkable dry summer of last year seems to have taught Corporations a lesson in respect to their water supplies. No fewer than three separate applications to Parliament for water rights have been made in respect to one of the chief moorland streams by three important Yorkshire boroughs. The Barnsley Corporation, who have capital works on the moors at Ingbirchworth, and an old water supply unused, are promoting a Bill to Parliament to construct a reservoir at Midhope by throwing an embankment across the valley of Hagg Brook, about eleven chains from Hagg Bridge, which crosses the valley, and provides a road from Upper Midhope to Midhope Stones. A number of important tributaries to the Little Don, including Hagg Brook, Edge Clyfe Brook, and Thickwood Brook, are to be impounded. The proposed line of pipes is to pass through the township of Wartley, for the most part the property of Lord Wharncliffe, to a service tank which is proposed to be constructed. Leaving Wartley the line of pipes passes through some part of Tankersley, famous for large ironworks and collieries, belonging to Messrs. Newton, Chambers, and Co.; through some portion of the township of Wartley, Darfield Marshes, and on to Barnsley, terminating near Sheffield-road, in the borough. The Corporation seek for power to extend considerably the limits within which they are authorised to supply water. The proposed route would give a supply to many places where the natural springs have become dry, owing to the working of the coal measures. Mr. J. H. Hawksley is engineer to the scheme, which is estimated to cost £170,000. The Dewsbury and Heckmondwike Water Board, which already have extensive reservoirs and works at Dunford Bridge, on the same moors, have given notice to promote a Bill in Parliament to construct a reservoir on the Porter or Little Don River, which is collected in the first instance in a swampy tract in the neighbourhood of Lady Cross, a flat extent of moorland property belonging to Sir L. Pilkington, of Chevet Hall. The proposed reservoir is to be formed from east to west by an embankment, 203 yards in length, and the entire reservoir will be situate in the townships of Langsett and Bradfield. The two schemes are situated in the same neighbourhoods, and in valleys within a few miles of each other. The object of both schemes is to take and impound different tributaries flowing into the Porter or Little Don River. The Rotheram Corporation are, it is stated, promoting a Bill for the appropriation of the watersheds of the Little Don River and the Hagg, Thickwood, Hardin, and Mickleden Brooks, and all other streams flowing into the Little Don. The fact of three such important Bills being promoted relating to streams and tributaries which supply important works, mills, and manufactories along their course, is certain to lead to powerful opposition. The Sheffield mill owners are said to be up in arms. The Parliamentary expenses attending the Barnsley scheme are put down at £10,000, and in a report issued to the Water Committee it is admitted that considerable opposition may be expected.

## MR. WILLIAM ALLAN ON THE NAVY.

Mr. William Allan, M.P., addressing his constituents at Gateshead on Tuesday night, alluded especially to the Navy, and said he was no alarmist, but Great Britain was the most helpless nation on the face of the earth, because she was the only nation dependent upon other countries for a food supply. No other nation was situated so hardly or so dangerously as the British nation in this respect. Blockade France, America, Germany, or Russia, and those countries could live by themselves. Blockade English ports, and there were not six weeks' provisions with which to feed the people. The lesson to be derived from this was, that we of all nations must command the sea. Our position demanded that we should have such a fleet of well-manned ships that, come what might, we could guarantee to working men and women that they should get their provisions as cheaply as they could to-day. We were building the finest ships in the world, but the black spot was that we had no docks to put them in. The dock accommodation at Devonport and Portsmouth was not sufficient for the purpose of docking damaged vessels, especially the powerful cruisers now building. Round all the other coasts of England and Ireland there were no docks, although there were splendid places on the Irish coast where docks could be built. In the event of a naval battle in the Mediterranean there was not a single dock at Gibraltar for them to go to, and they would have to work their way to Malta, where there were two or three badly-equipped docks, or else steam several days to Devonport, without much chance of reaching either place. We had no docks at the Cape or in the East Indies. If the French ruled Madagascar, he ventured to say that within two or three years they would have there an arsenal and docks, which would check the growth of the British Empire in the south of Africa. How were the ships upon which we spent millions manned in the engine-room? On the Revenge, built at Jarrow, there were eighty-six engines, and these had to be looked after by seventeen mechanics, and the same proportion of engineers was maintained throughout the Navy. There were no reserves of engineers, no reserves of engine-room artificers, and no reserve of stokers. Engineers and engine-room artificers could not be induced to join the Navy. The Navy was in this condition because the Board of Admiralty was antiquated. The First Lord of the Admiralty knew nothing about engines or ships, neither did the Secretary of the Admiralty, who was a country squire. The Civil Lord of the Admiralty was a lawyer and was equally ignorant of the wants of the Navy. He accused both Liberal and Conservative Governments of neglecting their duty in this matter. The Board of Admiralty consisted of seamen not at all in sympathy with science. These men thought only of the fighting element in our fleets and overlooked the vital importance of the engine-room. There should be an equal representation of engineers and captains on the Board. He did not intend that this question should be lost sight of. What he had told them was the truth, and went to show that the neglect of our first line of defence was calculated to leave England helpless.

## MANCHESTER SHIP CANAL.

As we have aways contended, the growth of traffic between the new port of Manchester and the rest of the maritime world must of necessity be slow, and in the outset very difficult.

Still, in spite of the keenest competition and the most bitter opposition, the shipping trade is gradually gravitating towards Cottonopolis direct, and not through Liverpool as heretofore; and the last few weeks have seen quite a forward movement in more than one quarter. Under the guidance of the present traffic manager—Mr. J. K. Bythell—himself an old East India merchant, a contract has been arranged by the Ship Canal Company and the Bombay Native Piece Goods Association, securing all shipments during the next two years "*via* Ship Canal."

In this connection it has been announced that the new steamship Empress—2900 tons—will sail from Salford for Bombay on the 10th January next; and she will be followed by the steamship Castleventry ten days later, thus inaugurating a regular succession of sailings every tenth day, which will be augmented from time to time as required. Another important item in the annals of the city is the securing of direct consignments of raw cotton to be distributed at once from Salford Docks, and not through the agency of the Liverpool Cotton Exchange. Last week the first of these cargoes of this year's American cotton crop reached the Mersey *en route* for Manchester, and quite an exciting scene followed on their arrival in the estuary. The Darlington from Galveston, U.S.A., with 7083 bales, entered the Mersey on the morning tide of the 21st ult., and dropped anchor in the Sloyne. Shortly afterwards, her rival, the Delano, 2968 tons, from New Orleans, with 7000 bales for Manchester, crossed the bar and at once proceeded to enter the canal at Eastham about 9 a.m., although it was then 3½ hours after high water.

The skipper of the Darlington finding himself thus overhauled, weighed anchor and tried to follow the Delano into the canal; but in his excitement and haste, ran on to a sandbank and remained grounded in the river till the next tide. Meanwhile the Delano, after passing the Customs officer at Eastham, left at 10 o'clock the same morning for Manchester assisted by one tug. The Lockmaster at Eastham telephoned at once that the Delano was underway for Latchford—the half-way house of the canal, and head of the tidal portion—that he was just about to pass the s.s. Dalton—Lamport and Holt line—down to the tidal pond on her way out to sea.

In the ordinary course the two vessels would thus pass each other near Runcorn; but, seeing that the Runcorn bend is one of the sharpest in the whole line of work, and that these two vessels were both of large tonnage, it was arranged between the two officials that the outward bound Dalton should lie up at Old Quay above Runcorn and await the passing of the Delano. With these instructions therefore the Dalton steamed away from Latchford Locks, but, safely under way, the pilot and skipper seem to have put their heads together and arranged, that come what might, they would quietly steam down stream and past the Delano "bend or no bend."

After all that has been said, and is still being repeated by those hostile to the canal, as to its being impossible for two vessels to pass each other, it is interesting and instructive to find that these two ships—the Dalton, 315ft. by 34ft. beam, and the Delano, 320ft. by 41ft. beam, not only met, but passed under steam on one of the sharpest curves of the canal, and did so without the least trouble or mishap. This afforded a direct contradiction of the recent remarks of a well-known opponent of the canal.

We understand that one Egyptian cotton crop is coming direct to Manchester also; the s.s. Royal Prince left Alexandria on the 15th ult. with 2910 bales for Manchester, and 843 for Liverpool. The Sailor Prince followed within a few hours with a full cargo for both ports, and the Swedish Prince left a week ago with 1500 odd bales for Salford, and 960 for Liverpool. As giving a slight idea of the business already being done at the Salford and Pomona Docks, it may be mentioned that the list of arrivals and departures which appeared in the local press of one day last week, included eighteen vessels in the canal, and thirteen arrivals and eight sailings, without counting five tugs, three hoppers, and twenty-five cargo barges.

Liverpool Trade.—At a meeting of the Liverpool City Council on Wednesday, Sir W. B. Forwood said the Liverpool trade was not growing as rapidly as they had a right to expect, but it was not caused by the Ship Canal. It was caused by the railway companies, who were strangling the trade of Liverpool. They charged 8s. per ton for conveying goods from Liverpool to Manchester—about thirty miles—while they conveyed the same goods from London to Southampton—ninety miles—for 6s. a ton; that was the reason the grain trade went to Hull. No good would be done until Liverpool took the matter into its own hands and constructed its own line between Liverpool and the Midland towns.

The New London Building Act.—The London Building Act, which has recently been passed, and which comes into operation on the 1st of January next, has a number of provisions with respect to the height and curtilage around buildings, as well as other matters that are of great sanitary importance. The Sanitary Institute has arranged for a discussion to be held at the sessional meeting on December 12th at 8 p.m., on "The Sanitary Aspects of the Act," to be opened by Dr. G. B. Longstaff, chairman of the Building Act Committee of the London County Council, when other members of the County Council, members of local boards and vestries, and those officers who will be concerned in carrying out the provisions of the Act, are expected to take part in the discussion.

Royal Institution.—A general monthly meeting of the members of the Royal Institution was held on the 3rd inst., Sir James Crichton-Browne presiding. The following lecture arrangements have been announced:—Professor J. A. Fleming, F.R.S., six lectures—adapted to a juvenile auditory—on "The Work of an Electric Current." Professor Charles Stewart, twelve lectures on "The Internal Framework of Plants and Animals." Mr. William Samuel Lilly, four lectures on "The English Humourists of the Nineteenth Century." Mr. L. Fletcher, F.R.S., three lectures on "Meteorites." Dr. S. Rawson Gardiner, three lectures on "Three Periods of Seventeenth Century History: (1) The Monarchy; (2) the Commonwealth; (3) the Restoration." Dr. E. B. Tylor, F.R.S., two lectures on "Animism." Mr. Lewis F. Day, three lectures on "Stained Glass Windows and Painted Glass from the point of view of Art and Craftmanship." Dr. A. C. Mackenzie, three lectures on "Hänsel and Gretel," an opera by E. Humperdinck—with musical illustrations. The Right Hon. Lord Rayleigh, six lectures. The Friday evening meetings will commence on January 18th, when Professor Dewar will deliver a discourse on "Phosphorescence and Photographic Action at the Temperature of Boiling Liquid Air." Succeeding discourses will probably be given by Sir Colin Scott-Moncrieff, Mr. Henry Irving, Dr. G. Sims Woodhead, Mr. Clinton T. Dent, Professor A Schuster, Professor A. W. Rücker, Professor Roberts-Austen, Professor H. E. Armstrong, the Right Hon. Lord Rayleigh, and other gentlemen.

The Conference on Light Railways.—On the invitation of the Board of Trade, the following bodies were represented at the Conference on Light Railways, which took place yesterday. London County Council: Rev. Fleming Williams, Mr. Bruce, Mr. Beachcroft. Association of Chambers of Commerce: Sir Albert Rollit, M.P., Sir Bernhard Samuelson, M.P., Sir Alfred Hickman, M.P., Mr. F. Corbett. Central and Associated Chambers of Agriculture: Mr. Channing, M.P., Mr. Jeffreys, M.P., Mr. R. H. Rew. London Chamber of Commerce: Sir Edward Carbutt, Mr. E. Garcke. Railway Companies Association: Lord Claud Hamilton, Mr. J. C. Bolton, Mr. W. L. Jackson, M.P. Institute of Civil Engineers: Sir Benjamin Baker, Sir Douglas Fox. Association of Municipal Corporations: Mr. Alderman Brownswood, Mr. Harcourt Clare, Mr. G. C. Kent. Association of County Councils: Sir John Hibbert, M.P., Lord Thring, Lord Edmond Fitzmaurice, Mr. Henry Hobhouse, M.P. Scottish Chamber of Agriculture: Mr. Alexander Cross, M.P. Surveyors' Institution: Mr. E. P. Squarey, Mr. C. Oakley. Tramways Institute of Great Britain and Ireland: Mr. Carruthers Wain. Mansion House Association on Railway and Canal Traffic: Sir James Whitehead, Mr. Tomlinson, M.P. Institution of Electrical Engineers: Mr. Alexander Siemens, Major-General Webber. Royal Agricultural Society of England: Earl Cathcart, Mr. W. Frankish, Mr. Ernest Clarke. National Traction-Engine Owners' and Users' Association: Mr. R. W. Eddison. British Dairy Farmers' Association. In addition, certain gentlemen having expert knowledge of the subject matter will attend the Conference, among whom are the following:—Duke of Sutherland, Lord Farrer, Lord Kelvin, Sir Juland Danvers, Sir Alexander Rendel, Mr. W. M. Acworth, and Sir Richard Sankey.

New South Wales Railways and Tramways.—The following is from the report of railway commissioners for the quarter ending September, 1894. It shows some considerable improvements and lessened percentage of expenditure, but there have been also less receipts in its tramways. The report is signed by Mr. G. M. Eddy and others:—

| Railways. | | 1893. | 1894. | Quarter ending Sept 30th, 1893. | Quarter ending Sept. 30th, 1894. |
|---|---|---|---|---|---|
| Miles open | | | | 2,390 | 2,501¼ |
| Revenue | Passenger | £233,626 | £231,011 | £684,916 | £667,892 |
| | Merchandise | £451,290 | £436,881 | | |
| Expenditure | | | | £421,926 | £371,840 |
| Train miles run | | | | 1,800,931 | 1,821,247 |
| Earnings per train mile | | | | 7s. 7¼d. | 7s. 4d. |
| Expenditure per train mile | | | | 4s. 8¼d. | 4s. 1d. |
| Percentage—Expenditure to earnings | | | | 61·60 | 55 67 |
| Number of passengers | | | | 4,747,616 | 4,685,517 |
| Tonnage of goods traffic | | | | 816,544 | 1,006,876 |
| Tonnage of live stock traffic | | | | 39,679 | 41,521 |

| Tramways. | Quarter ending Sept 30th, 1893. | Quarter ending Sept. 30th, 1894. |
|---|---|---|
| Miles open | 53½ | 61 |
| Revenue from all sources | £68,516 | £63,206 |
| Expenditure | £59,825 | £53,928 |
| Train miles run | 498,278 | 562,982 |
| Earnings per train mile | 2s. 9d. | 2s 3d. |
| Expenditure per train mile | 2s 4¾d. | 1s. 11d. |
| Percentage—Expenditure to earnings | 87·31 | 85·32 |
| Number of fares collected | 16,104,518 | 14,941,860 |

Although considerable expenditure has been incurred and debited to working expenses, in renewing the permanent way, and other works, the total expenses for the quarter show the satisfactory decrease of £50,086. The percentage of the expenditure shows a decrease of about 6 per cent. from the cost of working for the corresponding period of 1893.

## RAILWAY MATTERS.

The South-Indian Railway are rapidly fitting the whole of their rolling stock with the vacuum brake.

The linking-up of the metre-gauge railways in Northern India and on the Madras-Ennore line is to be commenced at once.

An extra rail has been laid throughout most of the Oregonian Railway system—narrow gauge—thus rendering it available for trains of the usual standard gauge.

There are nearly [illegible] hundred miles of street railway lines within the city boundary of Los Angeles, California, worked principally by cables and electricity, and carrying about 12,000,000 passengers per annum.

Two railways in Turkestan are under consideration. One of these lines, as we have before stated, is from Samarkand to Ardisham, with a branch to Tashkend. Both lines would penetrate a cotton producing country 1500ft. to 2500ft. above the sea in the valleys. The Russians think they might get a large part of their cotton supply thence.

The Portuguese Government have sanctioned a railway in their West Africa possession, Benguela, from Lobito Bay, a little north of Benguela, about 190 miles to Chaconda, in the interior. Another charter has been granted for a line from Mossamedes, a coast town some 180 miles south of Benguela, up the Bero River to the foothills of the Chella plateau.

The new line under construction between Exeter and Chagford will be about twenty-six miles long, and, with one exception—that of a tunnel—presents no engineering difficulties. The estimated cost is £240,000, or about £14,000 per mile. The Great Western Railway has entered into a contract for working the new line, and a connection will be formed with the Exeter Canal.

According to the British Consul at San Francisco, a new transcontinental railway to that place is in contemplation. It is said that the San Francisco and Atlantic will form a junction with the Atlantic and Pacific Railway in either King's or Los Angeles County, California. The contracts for the construction of 300 miles of the line south from San Francisco have been let.

The cable electric railway to a peak of the Tierra Madra Mountains, overlooking Los Angeles, being constructed by the Passadena and Mount Wilson Railway, is completed to Echo Mountain, 3500ft. above the sea. The second section is 3000ft. long, and makes a direct ascent of 1300ft. The third section extending the line to a peak 6700ft. above the sea will now be constructed.

It is stated in the report of the Greek Ministry of Public Works that there are 568 miles of railway in operation in that country, exclusive of 204 miles under construction, and 214 more chartered. Of these 272 miles are of standard gauge, 104 of metre gauge, 80 of 30in., and 11 of 24in. gauge. All the lines which are actually in operation are of metre gauge, with the exception of 55 miles of standard gauge.

In the new Central Railway station at Lisbon, the tracks are provided with turntables operated by hydraulic capstans, one capstan serving four tables. Each turntable has six stanchions placed at equal distances apart around its circumference. The rope from the capstan is passed around the table as far as necessary and hooked to a stanchion and the other end given several turns on the capstan. When the latter is set in motion, and the strain comes on the rope, it is drawn against the stanchions, and the table rotated as far as necessary, even to a complete revolution.

A serious breakdown occurred on Sunday morning last on the Great Western main line. A heavily laden mineral train was proceeding towards Wolverhampton when a tire of a wheel of one of the front wagons broke. The wagon left the rails, as did also all the other wagons on the train. The permanent way and the rolling stock were considerably damaged, and the wagons and their contents were strewn about the up and down lines, but without any person being injured. Both lines were blocked for several hours. Since iron tires were disused accidents of this kind have been seldom.

In its new "class P" locomotives the Pennsylvania Company has tried a new method of fastening piston-rods into crossheads. An American contemporary says:—"The end of the piston-rod is turned down, but a collar is left on the very end of it. Over the part thus turned down a nut made in halves is fitted. The crosshead is tapped out for this nut and the latter screwed home until it locks the collar of the rod against the bottom of the bore of the crosshead. The nut is provided with a flange outside of the crosshead through which a pointed set screw is fitted, and this when forced against the face of the crosshead prevents any movement of the nut."

Portable railways are used on a number of farms in France, and the French *Journal of Practical Agriculture* states that there is likely to be an important extension of the system. It is pointed out that by these lines crops can be moved much more rapidly than by ordinary cartage; that the power required is much less; that asses or mules can thus do work for which horses or oxen would be required, or a steam motor can be employed; and that these lines can be laid through lands over which it would be too expensive to build roads. Steel instead of iron rails are recommended. A complete plant for about 1660ft. of line, six cars, crossings, switches, &c., can, it is claimed, be built for £80 to £100. Portable railways are also exclusively used in the construction of public works and on large contracting undertakings.

A large number of gentlemen, representing the Southampton Harbour Board, the South-Western Railway Company, and the shipping interests of the port, were conveyed by special steamer to the Solent yesterday, to inspect the four new gas buoys which have been placed in the Solent, for its safe navigation at any time during the night. There are four gas buoys, one at East Lepe, one at West Brambles, one at East Brambles, and the fourth at Netley Shoal. The light can be easily distinguishable for two and a-half miles. Each buoy is charged to last six weeks. The new buoys are on the system of the Pintsch's Lighting Company and will now give a perfectly safe passage from the Needles to Southampton Docks at any state of tide or weather, and they are looked upon by mariners as the greatest improvement ever effected so far as the navigation of the Solent is concerned.

The Travnik-Bugojno of the Lasva-Arrano, a length of 25½ miles, has been completed and opened for traffic. Although the preliminary surveys, plans and estimates for the continuation of this line to the Bosnian frontier at Arrano, and thence across Dalmatia to Spalabo have been made, nothing has been definitely settled as to it. The branch line from Dolnji Vakuf to Jaïce, 21⅛ miles in length, is nearly completed, but will not be opened to public traffic before next spring. The total length of railways in Bosnia and Herzegovina is 494 miles, comprising lines of the ordinary European gauge:—Banjabuka-Doberlin, 70¼ miles; Austrian Brod-Bosnian Brod, 2¼ miles. Narrow gauge lines of 2ft. 5$\frac{9}{16}$in.:—Brod Serajevo, 166⅔ miles; Tarajevo-Metkavic, 110 miles; Lasva-Bugojno, 44¼ miles; Dabaj-Timin Han, 41½ miles; Usora Valley, 29½ miles; Dolnji Vakuf Jaïce, 21⅛ miles; Vagasca-Cerljanovic, 12¾ miles; Ilidze-Bath Ilidze, ¾ miles. The Vagasca-Cerljanovic and Usara Valley lines have been constructed by private companies for the transport of minerals and timber, and there is not any regular service of trains or passenger traffic over them. A magnificent carriage road has been completed between Banjabuka and Jaïce, so constructed that to make it a railway there is nothing required but to lay the rails.

## NOTES AND MEMORANDA.

In Brussels cabinet makers work from 14 to 18 hours per day, street car employés 17, and masons 13 hours per day.

According to a recent determination of Professor Richarz, the smallest possible quantity of electricity is such that 430 multiplied by a million cubed will give the number of atoms contained in a coulomb.

We understand that Sir Howard Grubb has made plans for a 10ft. reflector telescope, weighing nearly 100 tons, to cost about £30,000. It is proposed in mounting the mirror to float it in an enormous tank of water, 60ft. in diameter and 100ft. high, in order to eliminate the friction of motion.

Over seventy miles of hydraulic mains are laid in London, the working pressure being 750lb. per square inch, the power being available day and night. The number of machines worked from the Power Company in 1884, ten years ago, was 59; the number now is 2220.

The export of flour from the Hungarian mills through the port of Fiume during the first ten months of the current year, January 1st to October 31st, amounted to 57,614 tons. About 75 per cent. of the total was for ports in Great Britain; London, Liverpool, Glasgow, Hull, and Leith taking 42,000 tons.

According to a recent German patent, benzine can be rendered unfit for use in a lamp, while it remains equally good for use in a benzine motor, by mixing from 1½ per cent. to 3 per cent. of linseed oil varnish with it. The varnish collects in the fore chamber of the motor, while the vapour of the benzine goes on and does the work.

Cryostase is the name conferred by a German chemist—Natur—upon a newly-discovered body possessing the unusual property of being liquid at a temperature below the freezing point, and solidifying under the influence of heat—in which respect it is absolutely unique. This body may be obtained by mixing together equal parts of phenol, camphor, and saponin, to which is added a slightly smaller quantity of oil of turpentine.

In a new process for colouring leather by electrical action, the hide is stretched upon a metallic table and covered, except at the edges, with the colouring liquid. *Electricity*, of New York, says that a difference of potential is established between the liquid and the metallic table. The effect of the electric current is to cause the pores of the skin to open, whereby the colouring is enabled to penetrate deeply into its tissue.

The results of carefully-kept records of the input and output of accumulators in constant use at the Clichy sector in Paris are given in *l'Industrie Electrique*. The battery consists of two sets of 250 cells each; the total weight of plates in a cell is 330 lb., the normal output 250 ampères, and the corresponding capacity 2000 ampère-hours; the necessary increase in voltage for charging being obtained by means of a separate dynamo. A table is given containing the monthly charges and discharges in watt-hours and the efficiency for each month, the mean of which is 69 per cent.

At a recent meeting of the Sugar Planters' Association in New Orleans, a paper was read accompanied by samples of sugar demonstrating the possibility of sugar refinement by electricity. The samples sent had been treated by being boiled through a bag; boiled down in open pan; no purging, no boneblack, and no molasses left. He claimed the cost could be materially reduced. By the elimination of all nitrogenous substances from melted sugar by electricity and aluminium he was able, he said, to polarise 99 per cent. and crystallise the entire syrup. People are likely, however, to be shy of electric sugar refining.

Mr. P. L. Gray, of the Mason Science College, Birmingham, recently made experiments with a view to determine the lowest temperatures at which bodies heated could be made visible in the dark. The experiments were conducted with bright and lamp-blacked platinum strips, and gave the following results:—During the morning hours, when the eye is least sensitive to radiation of low frequency, the minimum temperature of visibility of a solid is about 470 deg. C.; at night-time this temperature is reduced to 410 deg. C., and after resting the eye for some time in complete darkness, the temperature may be still further reduced to 370 deg.

Dr. Lunge, of Zurich, the well-known authority on coal tar and ammonia, observes the viscosity of tar in a very simple manner. He uses a glass vessel like an areometer, with a cylindrical bulb below and a narrow tube above, graduated to show specific gravities. He takes a watch in one hand, and the instrument in the other, and at an exact minute he drops the latter into the tar; he then counts the exact number of seconds taken by it to fall to the 1250 mark; this observation, with the aid of tables, enables the viscosity to be readily ascertained. Care must be taken that all observations are made at the same temperature. Dr. Lunge gives an account of this instrument and its use in the *Zeitschrift fur Angewandte Chemie*, August 1st, 1894.

A new method for rapidly removing iron parts shrunk on hot, like a crank on a shaft, has been communicated by M. Raffard to the Bulletin Technologique of the French Société des Anciens Eleves des Ecoles Nationales d'Arts et Metiers. An endeavour had been made to take off the outer hoop of a Laval turbine by heating it with a gas blowpipe; but the heat was communicated too quickly throughout the whole mass to give a sufficient difference of expansion in the hoop alone, so as to loosen it, and there appeared no alternative but to cut it. In such a case, M. Raffard recommends that molten lead be run round the part to be detached—a method he applied with success in 1860 at the Soho Foundry, Melbourne, in removing a crank that had been shrunk on a shaft 8in. in diameter.

From the latest returns compiled by "Lloyd's Register of Shipping," it appears that, excluding warships, there were 327 vessels of 653,331 tons gross under construction in the United Kingdom at the close of the quarter ended September 30th, 1894. The present returns are less than those of the previous quarter by about 65,000 tons. The reduction occurs both in steam and sailing tonnage, but is much greater proportionately in the latter. In fact the returns of sailing tonnage under construction are now less than at any time since 1879. It is noticeable, moreover, that the total tonnage which has been commenced during the quarter is unusually low. The actual figures will be seen on reference to Table 3. Last quarter these figures were exceeded by 83 per cent. In particular, attention may be drawn to the fact that the sailing tonnage commenced amounted only to 2320 tons, as compared with 22,960 tons commenced last quarter, and 91,250 tons commenced in the last quarter of 1891.

According to recent reports from Washington, the United States Navy Department has just completed a test of aluminium as a material for ships' boats, with the object of determining its adaptability to naval uses. The utility on board ship of this material is much decreased by its susceptibility to the corrosive action of salt water. Accordingly, two sheets, 1-16th of an inch thick, were immersed for three months at the Norfolk Navy Yard. One was of pure metal, and the other slightly alloyed with nickel. The pure plate was thickly covered with barnacles throughout the surface, and was more or less pitted by the action of salt water. The alloyed plate was incrusted with smaller barnacles, and was badly corroded, being perforated and eaten away over much of its exposed surface. This plate was as injuriously affected as a combination of iron and copper would have been with the same exposure. The claim that barnacles would not adhere to the metal was not substantiated in the smallest degree; consequently, aluminium cannot be recommended for use in salt water.

## MISCELLANEA.

The sugar industry in India appears to be prospering. There are in course of construction three large sugar refineries—one in Bengal, another in the Bombay Presidency, and the third at Cawnpore.

The Sultan of Turkey has conferred upon Mr. Joseph Ruston the order of the Osmanié, in recognition of the merits of machinery supplied by Ruston, Proctor, and Co., to the Imperial farms and agricultural schools.

Jaffa, having become the seaboard terminus of the Jaff-Jerusalem Railway, is now contemplating the construction of a port, with a tramway to the railway station. The Turkish Minister of Public Works has the matter in hand.

Two more torpedo boat destroyers were launched last week, the Boxer and the Contest. The former, built by Messrs. J. I. Thornycroft and Co., is 200ft. long, the latter, by Messrs. Laird Bros., being 208ft. long. Both are of 19ft. beam.

We hear that Messrs. Fleming and Ferguson, Phœnix Works, Paisley, have secured an order for three of their "Clyde" water-tube boilers and set of their two-crank triple-expansion engines to indicate 500-horse power, for the New Gordon Diamond Mining Company, Kimberley.

We have received a sample of asbestos covering for water and other pipes from the Bell's Asbestos Company, which consists of asbestos cloth wound round the pipe to a considerable thickness, and kept in place by a varnished cloth cover, and held by a series of easily applied light metal hoops and fastenings.

The improvement of Colchester Harbour is to be undertaken at an early date. The *Miller* says Mr. Wheeler, M. Inst. C.E., who has been consulted by the Corporation, has drafted a comprehensive scheme for widening and deepening the river Colne. The present facilities are very inadequate, and unless something is done, trade is not unlikely to desert the port.

The Admiralty have ordered that vent sealing tubes with ball—both electric and percussion—are, when the existing stock is exhausted, to be superseded by vent sealing tubes without ball, and to be used in conjunction with cordite primers in breech-loading guns of 8in. calibre and upwards. The cordite primers are for the purpose of clearing the vent of fouling and conveying the flash from the tube to the charge, and they are to be inserted in the vent before entering the tube.

The Portuguese Government have entered into a contract with Messrs. Yarrow and Company, of Poplar, for the immediate construction of two shallow draught stern-wheel gunboats, to take part in the Portuguese operations at Lourenco Marques. The vessels are to be 89ft. in length by 18ft. beam, and will have a draught of 18in., and a speed of ten miles an hour. They will be somewhat similar to the Mosquito and Herald, built by the same firm for the British Government for service on the Zambesi.

The recent bold torpedo-boat attack upon Port Arthur was led by the Kotaka, constructed by Messrs. Yarrow and Co., in the year 1886, for the Japanese Government. She is of nearly the same dimensions as the destroyers of the Hornet class now building for the Admiralty, being 170ft. in length by 20ft. beam, propelled by twin-screws, and having a speed of nineteen knots. The distinctive feature in her design is that the machinery compartment is completely armour-plated with 1in. steel plates, so as to protect this portion of the vessel, the rest of the hull being subdivided into a very large number of small water-tight compartments. It is a remarkable fact that the Japanese Government was the first to adopt seagoing torpedo boats, and the Kotaka is probably the only armoured torpedo boat afloat.

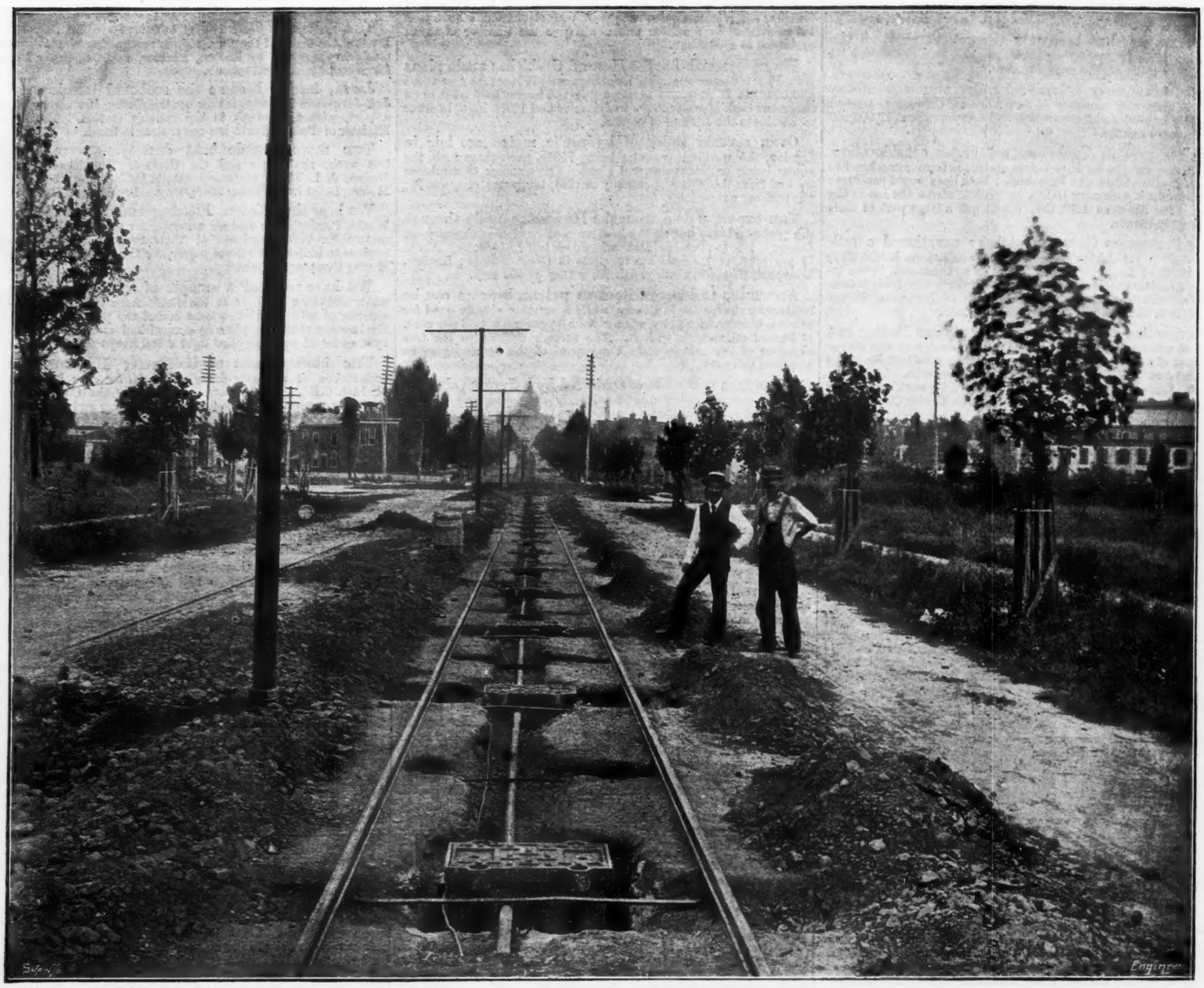
A meeting of the cement trade was held at the London Chamber of Commerce on Friday last for the purpose of receiving and adopting, or otherwise, certain recommendations of the Special Committee which has been appointed to investigate and report upon the extent of the practice of admixtures with Portland cement, and as to the justifiability thereof. The trade, with only one dissentient, adopted the recommendation of the committee, that it was advisable that all manufacturers of Portland cement, who have used any outside material or materials in the manufacture of that article, should at once discontinue the practice. The use, however, of not more than two per cent. of gypsum, as practised by the German manufacturers for the purpose of regulating the setting of the cement, is considered optional.

At the recent annual dinner of the Leeds Association of Engineers, Mr. E. Windsor Richards said he had just returned from America, and he was quite sure they could not wonder that there should be depression in trade there, because the power of production was enormous. We were a Free Trade country, but the Americans were worse off, although they were a Protected country. Ten years ago, at Messrs. Bolckow's, they rolled 4000 tons of rails per week, and that was considered a great thing; but at Messrs. Carnegie's alone they turned out 8000 tons of rails per week, and these rails were entirely manipulated by machinery. If America had only Free Trade, he was perfectly sure she would rob England of a great deal of trade. What he feared America would do was that she would have such an amount of Protection that she would sell to China at very cheap rates in the same way that continental makers did, and so they in England would be greater sufferers still.

The report to the Board of Trade upon the working of the Boiler Explosions Act during the twelve months ended June 30th last shows that 104 cases of explosion—the largest number dealt with since the Act of 1882 came into force—were inquired into within the period under review. Though the explosions were so abnormally numerous, the loss of life caused by them was below the annual average. Altogether 24 persons were killed and 54 injured. Formal inquiries were held in 23 cases—those in which were *prima facie* evidence of any neglect. In the majority of these the owners of the boilers were ordered to pay costs ranging in amount from £5 to £60. In only one case formally investigated was an explosion attributed to an unavoidable accident; in three cases only was it found that no one was to blame. Many of the explosions with regard to which preliminary inquiries were held were of a trivial nature. The report dwells upon precautions during severe frost. Boilers should be fitted with means for preventing undue pressure; in the absence of such fitting the temperature of the water in the boiler or connections should not be allowed to fal to freezing point.

On Friday last the time expired for the deposit of plans and books of reference relating to schemes which it is intended to promote in the coming session. There were deposited fifty plans of railway schemes, three tramways, and forty miscellaneous; 65 provisional orders relating principally to gas and water undertakings, and 31 relating to electric lighting; a total of 189, as compared with 196 deposited last year. Among those relating to the metropolis were the London, Walthamstow, and Epping Forest Railway, Uxbridge and Rickmansworth Railway, London, Deptford, and Greenwich Tramways, Chelsea Waterworks, Lambeth Waterworks, London County Council Tower Bridge southern approach, to which the principle of betterment is sought to be applied, the Vauxhall Bridge rebuilding, and the General Powers Bill. The eight Bills of the County Council for the acquisition of the water companies did not require to have plans deposited in respect of them, as no new works are contemplated. Other schemes were the Strand Improvement, Southend-on-Sea Corporation, Eastbourne Improvement, London, Deptford, and Greenwich Tramways, London United Tramways, Mid-Kent Water, Twickenham Local Board, and electric lighting schemes for Battersea, St. Olave, St. George, the Strand, Walthamstow, and St. Mary, Newington.

# CLOSED CONDUIT ELECTRICAL TRAMWAY, WASHINGTON, U.S.A.



## A CLOSED CONDUIT SYSTEM FOR ELECTRICAL TRAMWAYS.

An entirely new system of electrical tramcar propulsion is now successfully operating in daily service upon a branch of the Eckington and Soldiers' Home Tramway, about one mile in length, situated upon North Capitol-street, Washington, D.C., which fully complies with the three main requirements of an electric tramway, viz., minimum first cost of construction, maximum economy in working, both of power and maintenance, and absolute safety to both passengers and the general public. The car is of the ordinary description, working upon electric lines, except that in lieu of a trolly stand upon the roof, it has suspended from the under-side of its framing, as shown in Fig. 1, two iron bars, the same length as the car, hung upon light springs, and adjustable by means of screws, known as the energizing and collecting bars respectively. Beneath one of the seats of the car is a small storage battery consisting of six cells, which is arranged to discharge a low potential current at a pressure of about eight volts, and is connected by means of suitable wiring to the energizing bar.

In the centre of the line are placed, at intervals of about 15ft. apart, hermetically sealed cast iron boxes, upon the lids of which, properly insulated, are two raised surfaces, as shown in Fig. 2, known as the energizing and collecting plates respectively, corresponding with the bars suspended from the car, which slide lightly upon them. Securely attached to the underside of the lids of the cast iron boxes are a series of simple electro-magnets, as shown in Figs. 3 and 4, each wound with a fine copper wire, one end of which is connected to the energizing plate. The free poles of the magnet hang down vertically, and work in connection with an armature attached to a bridge piece, upon which are two carbon faces, directly above each of which is a corresponding carbon face fixed to the slate bed of the magnet. One of the fixed carbon faces is directly connected to the main cable, which conveys the 500-volt current from the generators at the power house—and runs in an iron pipe through all the boxes, as shown in Fig. 5 above—and the other carbon face to the collecting plate upon the box lid.

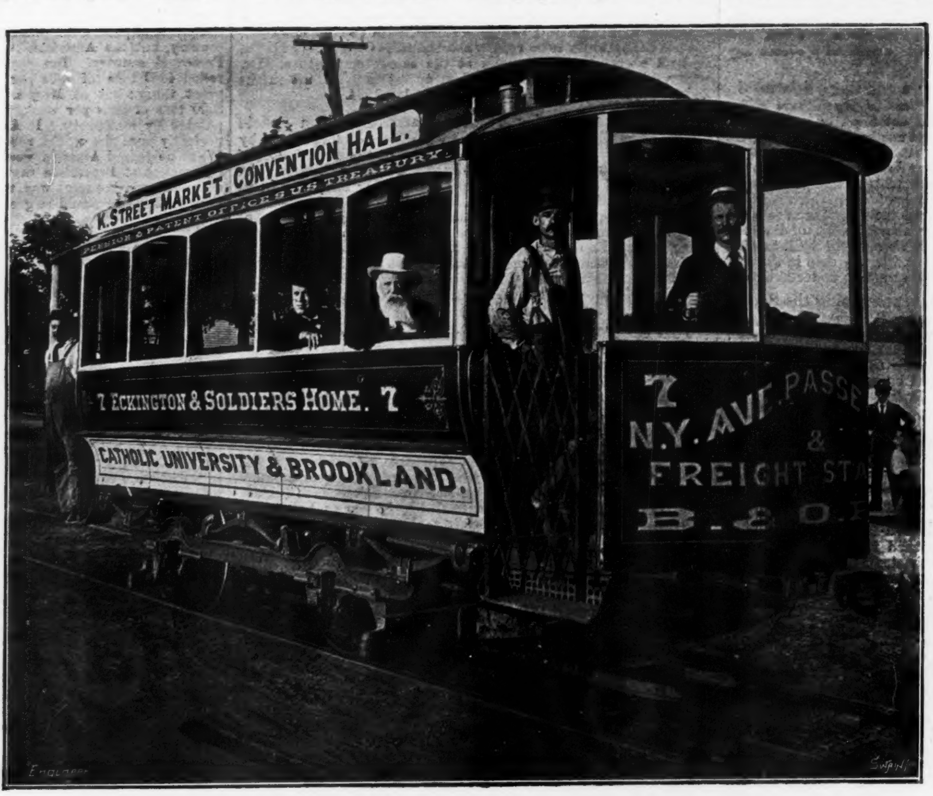

K. STREET MARKET. CONVENTION HALL.
PENSION & PATENT OFFICES U.S. TREASURY.
7 ECKINGTON & SOLDIERS HOME. 7
CATHOLIC UNIVERSITY & BROOKLAND.
7
N.Y. AVE. PASSE
&
FREIGHT STA
B. & O.

Fig. 1. SHOWING ENERGISING AND COLLECTING BARS

The operation of the car then becomes as follows:—The battery discharges its low pressure current along the energizing bar through the corresponding plate upon the box lid to the electro-magnet, which, upon becoming energized, instantly attracts the armature and bridge piece, thus bringing all four carbon faces into close contact, and completing the circuit which allows the current to flow from the main cable up through the collecting plate to its corresponding bar upon the car, whence it is admitted to the motors in the usual manner.

The above description applies only to single lines. Where there is a double line the arrangement is somewhat modified, and in the new roads now under construction upon this system another novel feature has been introduced in the shape of a metallic return, which is effected by simply adding a third or return circuit bar to the car, and connecting a third contact plate upon the street with a cable which, laid in the same trench together with the main cable, returns the current after doing its work to the generators at the power house. In double lines the construction is as follows:—The cast iron boxes, at the same distance apart as before described, are placed between the lines, or, in railway parlance, in the six-foot, and the electro-magnets working the up and down roads placed in the same box. The collecting, energizing, and return contact plates are then set in the centre of each line, in the same manner as illustrated for a single line, with the exception that they are set upon blocks of either terra-cotta or granite, as may be preferred by the local authorities, instead of on the cast iron box lid, as shown. All the connections are made in a suitably designed cast iron water-tight dish underneath the blocks, and taken to the cast iron box in the six-foot in an iron pipe. The advantages of this arrangement are manifold, not only reducing the cost of construction, but enabling the whole system to be installed with little or no interruption to the traffic on the road.

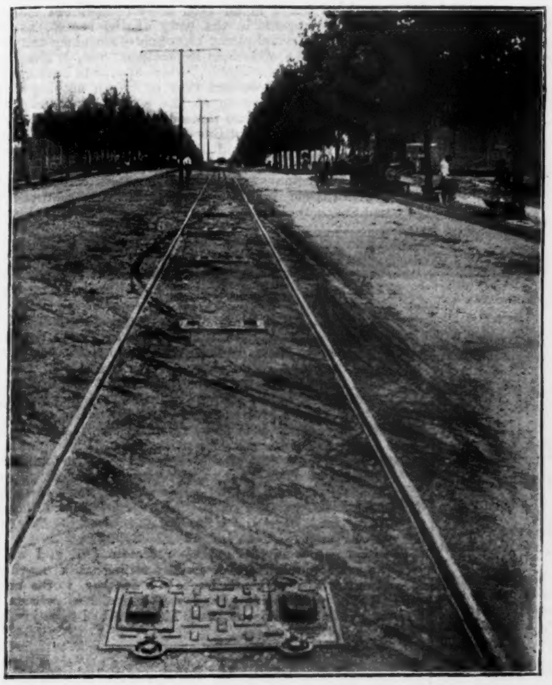


Fig. 6—STREET UNDER WORKING CONDITIONS

The American engineer correspondent, to whom we are indebted for these particulars, states that he has had ample opportunities of thoroughly examining the work, and of travelling upon the cars under all sorts of conditions, and he thinks that this system must take preference over any other electrical underground system at present on the market in his country. The difference between the length of the collecting bars and the centres of the boxes insures that good contact shall have been made with the forward plate before the rear one is left, and as proof of this, even when travelling at a considerably greater rate of speed than the city authorities allow, a steady and unflickering light is maintained in the lamps of the car, which draw their electric current from the same source as the motors. The action of the electro-magnets is instantaneous, both in picking up the current as the car approaches and of dropping it again as it leaves. To obtain current or shock from any contact plate is impossible, as should any part of the electro-magnetic switch fail, it simply leaves the plates dead, and the car has to drift by its own momentum to the next box. So simple, however, is the construction of these switches or electro-magnets, with the total absence of anything in the shape of a mechanical movement, that during the three months that the current has been on the existing road nothing in the shape of trouble has been experienced so far, which, considering that this is the first road installed upon this principle, speaks volumes. From tests applied by the Wheatstone bridge and tangent galvanometer, after flooding certain of the boxes with water with the car keeping the switches closed, the leakage was found to be less than one-half of 1 per cent. of the power required per car.

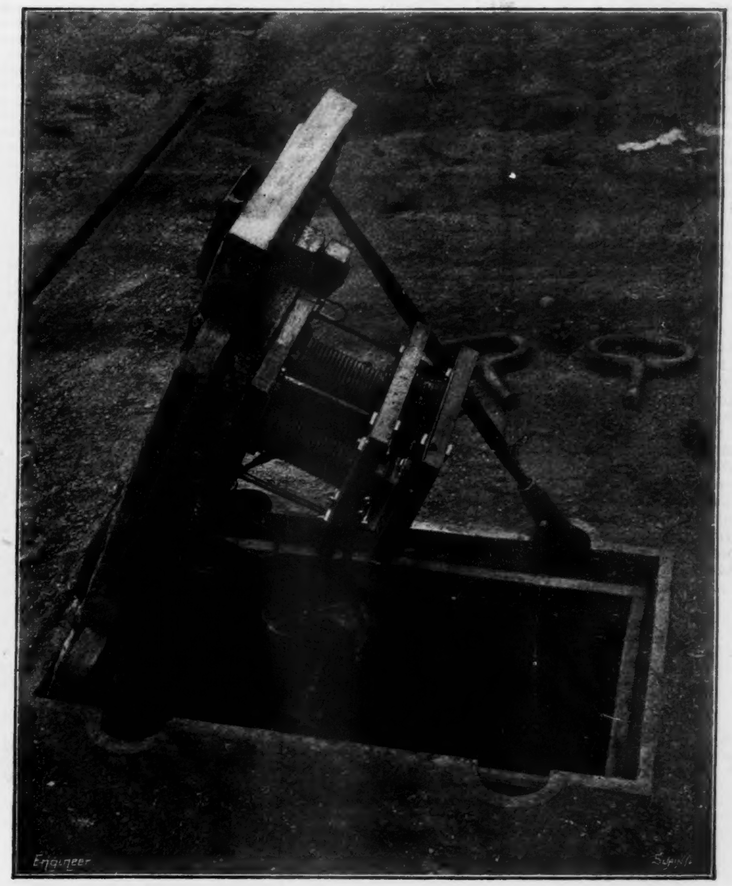


Fig. 3—MAGNET BOX OPEN

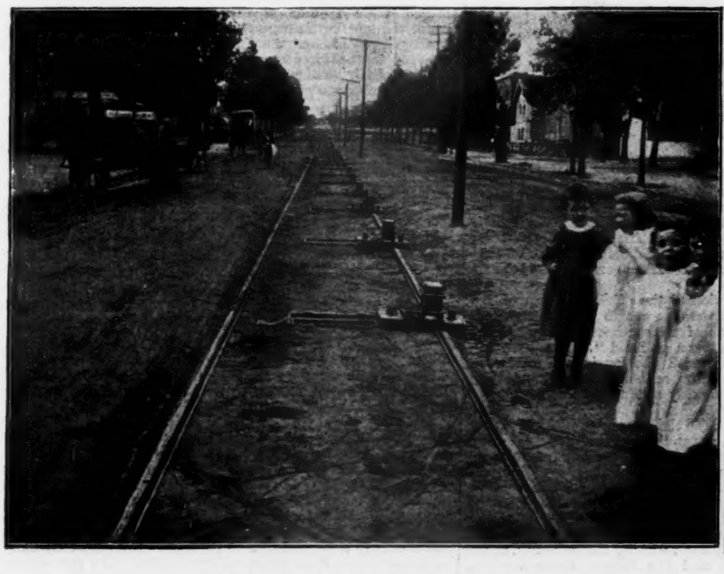


Fig. 4—MAGNET BOXES OPEN

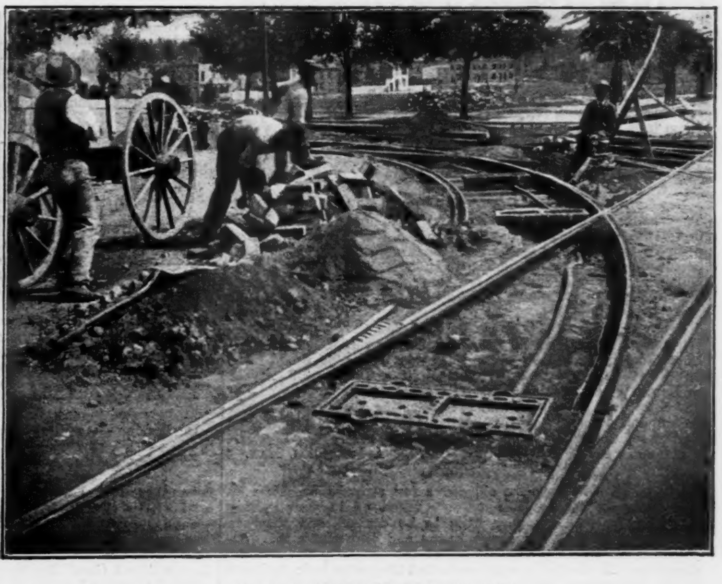


Fig. 7—ARRANGEMENT ON CURVES

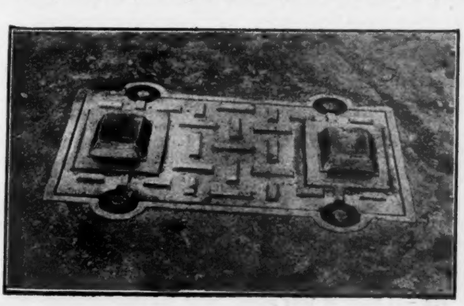


Fig. 2—MAGNET BOX

During snowstorms the lines will have to be kept clear of snow in the usual manner, and when frost after rain is expected a car will be kept in operation to keep the contact plates clear of ice. The contact plates stand only about three-quarters of an inch above the pavement and offer little or no obstruction to vehicular traffic. The cost of installing this system is, we are told by our correspondent, trifling compared with the elaborate preparations required for an open conduit, being only about £7000 per mile of double line, including the metallic return, and all the cables, feeders, and conduit for same, and the system is obviously superior for cities to any overhead line, however cheap. It is unnecessary, however, to admit that experience in the working of the system, especially in respect of the collector bars, is required.

No doubt many of our readers may wish to obtain further information concerning a system which has apparently much to recommend it. We must refer them to the Electro-Magnetic Traction Company, Corcoran-building, Washington, or to Mr. E. W. Creecy, at the same address.

## 900 I.H.P. COMPOUND FIXED ENGINE.

THE engine illustrated on p. 488 is a fine specimen of modern engineering, and has been manufactured by the well-known engine makers, Messrs. Robey and Co., Limited, of the Globe Works, Lincoln. As will be seen, the cylinders are placed side by side, with the fly-wheel in the centre, this method having many advantages. The diameter of the high-pressure cylinder is 24in., low-pressure 40in., and stroke 48in.; and with a steam pressure of 100 lb. per square inch the engine will, when condensing, give off 900 indicated horse-power. A condenser, of the injection type, worked by an extension of the low-pressure piston-rod through a rocking lever, is placed at the rear of the low-pressure cylinder, and at a lower level; the air pumps are single-acting, two in number, each 23½in. diameter. The main shaft is exceedingly massive, being 15½in. diameter in the centre, the main bearings being 12in. diameter by 24in. long, thus giving ample bearing surface.

The power is transmitted by means of a fly-wheel, 18ft. diameter, grooved for fourteen ropes, 1¾in. diameter, and the rim is built up of ten segments, the latter being carried by ten arms, which are fastened in the central boss by double cottars. The main feature, however, in this engine is the trip valve gear, which is Richardson and Rowland's patent, and works with a smoothness and precision which leaves nothing to be desired. The inlet valves on the high-pressure cylinder are of the double-beat type, and are actuated by trip levers, which again receive their motion from a cross shaft driven from the main shaft of the engine by cut gearing. The trippers which lift the valve are coupled to the governor, which by means of a simple motion adjusts the cut-off from zero to ¾, by sliding the tripper into longer or shorter communication with the tripping lever. This arrangement has been found in numerous examples to be most effective, and controls the speed of the engine within less than one per cent. on ordinary variations in load. The exhaust valves are underneath the cylinders, and have large openings with a very small movement, thus giving a free exhaust, and draining the cylinders effectually. A large receiver is situated between the two cylinders, into which the high-pressure exhausts; here it is re-heated by means of a live steam coil, and enters the low-pressure cylinder at a slightly enhanced pressure.

The economy of steam consumption in this type of engine has been proved to be very considerable, and with the engine illustrated the consumption has been brought to the lowest practicable point. As a proof of the accurate balancing of all parts, the engine was erected on a temporary foundation of timber and moulding boxes, at a height of 10ft. from the ground level, and on this slight foundation, run at the full speed of 75 revolutions per minute, with scarcely any perceptible vibration. The engine is for driving a large mill in Russia, and has been specially designed to render transport easier, the girder bed being made in two halves, and bolted securely together, and a foot placed in the centre, whereby absolute rigidity is obtained. The fly-wheel has been turned dead true, a result seldom obtained with equal accuracy with so large a wheel. We have seen the engine run at all speeds, from the lowest possible, up, as we have said, to 75 revolutions, and with greatest steadiness. Above 75 revolutions the admission valves do not open at all, as the governor was set at the time of our visit. The cylinders are lagged with blue steel, instead of the objectionable wood still retained by many makers, largely, we understand, because of the difficulty met with in obtaining in this country suitable lagging steel.

The workmanship of the engine is unusually fine. It is not an affair of polish and bright work, but of real accuracy of adjustment and lining out. Right angles *are* right angles, bearing surfaces are in contact all over, and so on. In short, the workmanship will compare most favourably with that of the best continental makers, and will maintain the reputation of English builders of stationary engines abroad.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### LOCOMOTIVES AND TRAINS.

SIR,—I—and I have no doubt many of your readers—have read with much interest and pleasure your very practical article on page 470, last week. The article, I consider, is just now of the very greatest use, as it throws much light on the long recent discussion in your columns, and gives some idea of the difficulties that a driver has always to contend with. Because there happened to be two engines upon a train when it came into collision, some of your readers seem to rave against the use of a pilot engine. What had the pilot engine to do with this collision? If there had been no pilot engine it would have been the train driver who would have been killed, not the pilot man. What do railway companies keep pilot engines for, always in steam, if they are not to be used in case of necessity?

From the tone of many of the letters on this matter which have appeared in your columns I should say the writers are amateurs, who have perhaps never travelled on the footplate of an express engine. I should like to ask these gentlemen a few plain questions. The driver of the up express was a man living at York; but the engine he had was 1622, which belongs to Newcastle, and only runs north to Edinburgh. Does not that seem strange; does it not point to the conclusion that the driver had not his usual regular engine? The writers of letters to your paper have not told us that the driver had previously had to leave his usual engine at Newcastle.

Why was 1622 so "sulky" on this occasion? Perhaps she did not approve of being sent to York, perhaps she did not like to be taken from her usual driver, perhaps the driver did not know her little "fads" and "whims." Anyhow, time was lost to Darlington, and there was only about 80 lb. of steam in the boiler. With such a low and falling pressure the air brake was always likely to give trouble by not releasing quickly.

Now, what will our amateur writers say should have been done? They blame the driver for taking a "pilot," but what was he to do? His engine had to go to York, so had he. There was every prospect that if helped over the temporary difficulty the train engine would soon be all right again and get steam. Then, as you point out in your able article, it would never have done for the driver to start with such a low pressure of air—that, in fact, he had no efficient brake power.

Let me, in short, tell your amateur readers that by taking the Darlington pilot engine the driver did just the very thing he should have done, and if he had taken any other course he would have been very properly seriously blamed, if not taken off express driving. If instead of blaming pilot engines your correspondents had considered why it was that the self-acting fog signal did not go off and warn the drivers of the express, they would have written something of very great interest to

December 3rd. A PRACTICAL MAN.

SIR,—I should like to be allowed a few remarks on this very interesting discussion. The attitude taken up in your leading articles seem to leave very little to be desired, and they are evidently written by a man who knows and appreciates the difficulties of the problem. The reason of the similarity of the Caledonian and North British engines is that they were both designed by Mr. Drummond, who was locomotive superintendent of, first, the North British, and then, until a few years back, of the Caledonian.

In all probability the fact that the characters of the rival roads between Edinburgh and Carlisle are not very dissimilar, furnishes another reason for similar designs being adhered to. The difference between, say, the Great Northern and the Midland lines is a point frequently overlooked, but it would account for much in the way of difference in design in the engines used by each company. The critics of modern express engines appear to overlook the fact that the duty of these is not simply to keep time under ordinary circumstances, but to keep it, aye, and make up time, under the most adverse conditions, if such be at all possible.

Most of your correspondents state or imply that the cause of our Scotch express trains being frequently late is due to the inefficiency of the modern express engine, and blame it accordingly. Now, in my opinion, the chief reason must be put down to another cause altogether. It is simply the fact that the stipulated stopping time is so often exceeded at—taking the West Coast as an example—important stations like Crewe, Preston, and Carlisle. Some of this may be due to making up trains, which is unavoidable. Further, I am of opinion that this delay is largely due to luggage, which is the cause of endless confusion.

The railway companies should absolutely limit each passenger on their fastest expresses to 30 lb. of luggage. Several advantages would accrue to the travelling public—which outweigh in my estimation any objections—if this system were properly carried out. Some of them are these: The express trains would keep better time, thus to some extent rendering travelling safer; no responsibility or anxiety about luggage; a great diminution in tipping. At first luggage could be sent by what are called fast trains, and an amount equivalent to 100 lb. per head carried free; over this to be paid for, and the Company allowed to make a small charge for collection and delivery. In this way the public would merely have the slight disadvantage of waiting a few hours for luggage.

Very soon the railway companies would arrange fast luggage trains, and what is now a terrific nuisance all round would cease. A further advantage would be that much less luggage would be lost, while the railway officials would find an immense saving in worry. Let anyone look at, say, Perth Station, or Waverley Station, Edinburgh, any day in August, and they will appreciate the luggage trouble. This is not, perhaps, engineering, but the subject appeals to a a much wider circle, and I strongly believe, if some system of the kind were adopted, we should hear much less of the alleged inability of modern express engines to do their work.

As a trial of the plan indicated, let the North-Western alter their 10 a.m. train from Euston and corresponding down trains into corridor luncheon expresses, allow only the very little luggage mentioned, cut their twenty minutes' stop at Preston down to five, and run into Edinburgh at 6.15 and Euston 6.30. The other companies would follow at once. R. C. DOWIE.

Manchester, December 6th.

SIR,—After all we have had rather a storm in a teacup over the engines in the Northallerton smash as it turns out, as I guessed from the photograph that it was the big one which was helping the small one, which had an injured brake pump, and could not make steam enough. I think your article sums up the whole matter very well—the main point being that if you want to haul heavy trains punctually in every kind of weather, you must have large enough engines. That these large engines save fuel, repairs, and expenses generally, has been proved to demonstration in America long ago, and is being proved here now. When Mr. D. Drummond went from the N.B.R. to the Caledonian, and replaced their old small express engine by his famous type—which is now the standard on most lines—the saving on locomotive expenses ran to five figures in several half years.

"Permanent Way's" letter on November 23rd is very interesting, and he most happily describes what is the most wonderful daily run in the world, viz , on the Caledonian, the day express from Aberdeen, running at 54·1 miles per hour, Symington to Carlisle, with well over 200 tons on, this being done with one of Mr. Drummond's famous type of engine.

Is he correct, however, when he says a W.C.J.S. dining car weighs 33½ tons, which is just the same as a M.S.J.S one, which looks much heavier? Worsdell's engines weigh 94 tons, but Greater Britains only about 80 tons. Mr. Head is surely wrong when he makes the Empire State Express cars weigh only 30 tons; they must be 50 tons, I think. As to the question of the increase of speed and weight of trains, I look upon 1888 as the date to be kept in mind as that from which speed and weight of trains and size of locomotives began to grow. The ideal locomotive for the future is one such as Mr. Drummond had in view, I think, with 8ft. coupled drivers, the drawback being the necessity for outside cylinders.

Mr. Edward J. M. Davies, in replying to my three propositions as to the brakes on the Northallerton train, clearly shows that, had this train been made up of eight-wheeled or twelve-wheeled stock, and therefore braked on every wheel, it could be stopped at sixty miles an hour in 116ft. less than if made up, as it was, of antiquated two-thirds braked six-wheelers, or in 168ft. less if the bogie wheels on the engine had been braked in addition. Comment is needless. Mr. Bowles under-estimated the weight of this train—empty—by thirteen or fourteen tons from the first. Will nothing persuade him to come forth, and tell us where his "McDonnell engine weighing 39 tons, with pick-up tender weighing 15 tons," is or was to be found? I see the word in his letter of October 19th is "Macdonnel." NORMAN MACDONALD.

SIR,—Although I do not care about taking part in any correspondence, I think it only fair to name two other lines besides the Great Northern, on which the use of pilot engines—except in the rare case of light engines getting about from one place to another—is forbidden. The lines I refer to are the London, Brighton, and South Coast, and the South Eastern, which are both noted for the heavy loads run. Although I can make a good guess, I should like to know which company Mr. W. B. Thompson means as the one which has had more experience with 19in. cylinder engines than any other in the kingdom, and shall be glad if he will name it. E. R.

London December 3rd.

### ENGLISH AND AMERICAN LOCOMOTIVES IN SOUTH AMERICA.

SIR,—In my former letter, in your issue of the 16th inst., I indicated the views I have heard expressed by experienced commercial and locomotive men as to the tone and mode of advertising the Elordi and Esteves' report on the above subject. Time did not then permit, however, of my going into details in support of that opinion. I therefore now purpose proceeding to examine the grounds for this indictment.

I have already said that, in view of the official position of the authors, a judicial treatment of the case was to have been reasonably expected. Moreover, some of the sentiments in the report itself—for example, that it was taken in hand "to enlighten the President," and "in compliance with the President's mandate"—ought to have weighed with the authors, as one would have thought, in making them scrupulously careful to hold the scale of justice evenly between the parties.

In pursuing this subject I make no claim to any special knowledge bearing on this particular case, beyond what is to be derived from a somewhat careful examination of the report, added to some study of this branch of engineering in the time available to me from other kindred avocations, and supplemented by such information as is open to anyone who has happened to be over the ground and used his eyes with ordinary intelligence, in examining and comparing the general features and details of the rolling stock used on the two lines of railway dealt with by the authors, *i.e.*, the Buenos Ayres Great Southern and the Buenos Ayres Western, which for brevity I shall hereafter call the Great Southern and the Western respectively.

I may further premise by saying that long connection with the district, coupled with an active interest in its mechanical industries, as well as in its general commercial prosperity, gives the subject a special interest to me, for I feel that anything injuriously affecting the trade of the district is a matter of concern to one and all belonging to it. In these times of commercial depression in the district, with the cotton industry apparently on the wane and, along with it, the machine shops dependent on it much reduced in output, it is of unusual concern to us, and one cannot therefore regard with indifference the publication of even a Provincial Government report, and however unknown to the world at large the accredited authors of it may be, which report—if based on any substantial foundation of fact—would justify the transference of the locomotive industry from its old centres at home to other countries and other hands, as far at all events as foreign orders are concerned. The attack, in this instance, is directed against an individual firm; but if allowed to go unchallenged and unexposed, the same tactics will not improbably be directed—on other occasions—against other makers in this country.

Without further preface, however, I will proceed to the charge. In doing so I will take, in the first place, in support of it, what I may term the organic or structural features of the report, as distinct from its technical treatment of the subject. Now, what strikes one forcibly in this connection is, that while the opening sentences are framed in guarded and impersonal terms, as though the merits of the case alone occupied the minds of the authors—the term "builders" being used in conjunction with the equally impersonal phrase, "all the rolling stock of the Southern Railway was manufactured in England"—yet later on, when the mind of the reader may be thought to have been "seized"—to use a legal phrase—of the doctrine of the authors as to the worthlessness—worse than worthlessness—of the English locomotive, the name and address of "the maker" of the said "masses of iron" are inserted, not once, but again and again in each of the paragraphs relating to the several classes of engines coming successively under Messrs. Elordi and Esteves' condemnation, and the first disguise of "impersonal treatment" then vanishes into thin air.

But the authors have have not been content, as an examination of their report reveals, with giving the names and address of the makers of the discredited English locomotives; on the contrary they further judge it consistent with the avowedly judicial nature of their task to insert in an even more conspicuous manner, if possible—for it appears in the body of the report, as well as parenthetically in several places elsewhere—the name and address of the makers of the American locomotives, viz , "The Baldwin Locomotive Works, Philadelphia," which appear to have had such a fascination for the authors that they could see nothing worse to say in criticism thereof, even at the end of their long "comparative study"—as they are pleased to term it—than to "except a few details" from the running chorus of praise with which they felt constrained to commend the Baldwin locomotives to the favourable notice of "the President."

It is this insertion of individual names in a report avowedly dealing with the general question of the fitness, or otherwise, for the Great Southern Railway of the rolling stock which the railway company had thought fit, in the interests of its shareholders, to order during a succession of years, not experimentally, but after ample experience, on the advice of its consulting engineers, and in respect of which it is impossible to see what the names of the makers had to do with the question, coupled with the mixing up in the question—as we have seen—of the name of the makers of the American locomotives used on another line altogether, which affords ample grounds, as I think your readers will perceive, for the opinion pretty generally arrived at, namely, that the matter of the report, taken in conjunction with the manner of its circulation, gave it the character, pure and simple, of a trade circular. But let me note another point which, I think, supplies an additional clue to that I have just suggested in explanation of the general drift of the report. It is to be found in the following sentences taken from one of its concluding paragraphs. I have put in italics the more significant part of the sentence. It is as follows:—

"We think that the foregoing report is sufficiently specific to enlighten the President, and to justify us in asking him to decree that *no company be allowed in future to import in this country their locomotives without first presenting and submitting their plans to the approbation of this department.*"

In connection with this notable recommendation, I will quote just two extracts relative to American rolling stock, leaving these several extracts in their relation to one another, to the unbiassed reflection of your readers, and will henceforth pass on to the technical parts of the document. The extracts I have just alluded to are the following:—

"The American locomotives owned by the Western Railway, which were acquired, when this road was the property of the State, by the engineers, Messrs. M. Tedin and L. Rapelli, are ten for rapid trains, eight for freight trains, and twelve for switching, and were built at the Baldwin Locomotive Works, of Philadelphia, in 1889. The same works built in 1884 thirty locomotives for mixed trains, for the railway of this province."

"The construction of these sixty locomotives, notwithstanding its simplicity, is first-class, except in a few small details, which by no means affect their good conditions for service. The thirty locomotives for mixed trains have withstood very severe tests during the period when the railway had not the number necessary for its service, as, notwithstanding the excessive amount of work imposed upon them, the results have been very satisfactory and economical."

In contrast with this laudatory language, I place the following:—"It may be concluded from all the data furnished in this report that the Southern Railway locomotives are but *iron masses*, entirely injurious to the roads and interests of the company."

With the increase of salaries which would doubtless accrue to the officials of the department, whoever they might be, in consideration of the new duties suggested to be assigned to them, I have nothing directly to do. But in view of the preconceived opinion conveyed in the foregoing significant sentences, what chance, it may be asked, would the poor, discredited English locomotive have in running the gauntlet of "this department" in the Province of Argentine?

The question whether "all the data furnished in this report" does, or does not, justify the damnatory conclusions arrived at by Messrs. Elordi and Esteves regarding English locomotives, is the next branch of the subject calling for treatment; but as it will occupy more space than would be reasonable to enroach on in a single issue, I must reserve it for another occasion, supposing, in view of what I have given above, it may not seem to your readers as a mere "killing of the slain," and therefore, in your opinion, a needless enroachment on your space. VERITAS,

Manchester, November 27th.

### SIMPLEX GAS ENGINES AND THE PANTIN FLOUR MILLS.

SIR,—In these days of progress your description of what is being done in France is exceedingly interesting, as it again points to the inevitable in the near future—a revolution of the power-producing industry, or, in other words, the more direct conversion of power from heat without the intervention of a fluid and the consequent loss of latent heat.

Taking a general view of your description of the 320 indicated horse-power engine and producer plant at the Pantin Flour Mills, it appears that there is yet a wide field for inventors, and vast improvements are yet capable. If I correctly understand the engine. it is of the Otto cycle, *i.e.*, a possible impulse every second revolution; the products of combustion are only partially expelled, and the shocks are in large engines abnormally heavy; the relative values of the indicated horse-power and the brake horse-power are low; the strength of the engine framing, &c., have to be proportionate to excessive violent strains. The gas apparatus is not all that can be desired, as it is only equal to the conversion of certain classes of fuel into gas, and those classes do not adapt themselves to the requirements of this country, where the coal is of a rich bituminous nature.

What is wanted here is a producer that will deal with the small but rich bituminous coal of the North of England, worth about 5s. to 10s. per ton, and an engine approaching far more nearly to the steam engine than the Otto type of gas engine described.

Appreciating, as I do, the strides being made in France in this industry, and which should stimulate Englishmen to emulate, I must say that in my opinion there is a wide field before engineers, and I shall be much surprised if, in a short time, a far more simple and efficient construction of engine is not brought out, and a gas-working apparatus which will convert our refuse bituminous-coal into useful gas. The prospect is a large one—three-quarters of a pound of coal per actual horse-power per hour against an average of three or four pounds, or even more in the ordinary commercial steam engine.

I trust that your excellent notice will be the means of waking up Englishmen to the fact that the steam engine is virtually doomed, and that they will not be behind other nations in the production of its successor. PROGRESS.

December 5th.

### TRACTION ENGINES.

SIR,—In reply to your leader under the above heading—which appears to me to be a true version, and a correct summing up of the question at issue—I beg to offer the following suggestions for discussion, as something that might be utilised as a guide in framing new regulations for the use of steam on highways.

Every traction engine to have a licence. The municipal authorities for boroughs, and the district council board for rural districts, to be the bodies appointed to issue such licences, but to have no power to make special bye-laws for their own districts. The hackney carriage example might be followed, that is, upon certain appointed days, all the engines in a town or district would have to appear before a committee for inspection, in order to ascertain if they were in a fit state of repair, &c., to work upon the highways, and fulfilled the conditions required by Act of Parliament. This would be a good thing for many owners, as it would compel them to have a fettle up once a year, instead of allowing their engines to knock to pieces as at present.

Licences to be divided into several classes. (1) Say £2 per annum for purely agricultural engines, this to qualify them for pulling their own threshing, ploughing, sawing, and other tackle about, and allow the engines to be used for hauling farm produce and manures—for hire—for six months in the year, say from beginning of March to end of August, this would find them employment during the summer, when there is little or no threshing, and encourage hauling when parish roads were in the best condition to stand it. Engines in this class not to exceed ten tons in weight, in working order, excepting existing ploughing engines. Road rollers used for hauling road metal in summer to come in this class. Class 2—say £5—for road locomotives or hauling engines, not exceeding ten tons in weight in working order. Class 3—say £10—for similar engines between ten and twelve tons weight, and £2 a ton extra for every ton above 12 tons.

When a second-hand engine is sold the licence should go with it and qualify it until the next licensing day of the district into which it is going. A provisional licence to be obtained at any time for a new engine—without inspection—which will qualify it until the next licensing day. Makers to be allowed to deliver engines and bring them to their works without a licence. The licensing committees to have power to decide the maximum speed an engine is to run at, and whether it is necessary to have a flagman or person walking in front. Any of the above licences to qualify an engine for running upon any highway in the country.

Agricultural engines paying the £2 licence, maximum speed four miles per hour. Road locomotives over ten tons in weight—working order—and the existing noisy objectionable engines that we have heard so much about lately—no matter what their weight—maximum speed four miles per hour.

Modern high-class engines, not over ten tons in weight—working order—mounted upon springs, provided with a powerful brake acting upon both main road wheels, with a sensitive and trustworthy steering gear, all working parts to be properly cased in, and making only a minimum amount of noise, and in charge of thoroughly experienced men, to be allowed to run at a speed of six miles per hour in daylight upon country roads, but must reduce to four miles per hour through town and village streets. Wagons for these engines to be on springs. For this latter class of engine no flagman or person walking in front to be required. But upon any driver of a vehicle or person on horseback holding up the hand, the engine must be stopped, and the steersman get down and lead the animal past. Agricultural engines—£2 class—if fulfilling the required conditions, may do without a flagman. Engines which make a noise, &c., and have not working parts cased in, and are not up to modern requirements, to have a man walking in front as at present. A flagman's occupation is most dangerous, and it is quite a common form of accident for one to be run over and killed—he gets so accustomed to the rattle of the engine behind that it is upon him before he is aware of it.

Drivers of engines over the £2 licence must take out a licence (say, 2s. 6d.) showing that he is a qualified man and of good character. Steersmen of engines running at six miles per hour might have a similar licence. For certain breaches of the Act of Parliament the driver to be fined as well as the owner, and in some cases instead. This would ensure them being more careful. If any restrictions are to be made in working hours—which I think unnecessary—it should be uniform throughout the country. The time when a traction engine is most objectionable is upon a country road on a dark night, when our old "ram-shackle" friend, which you so graphically describe, is not a lovely thing to meet, especially if you are driving a horse with any metal in him at all, and you cannot see the stone heaps and gutters on the roadside. Although it is against progress to prohibit, it is not unreasonable to discourage engines running about after dark up to midnight; therefore, one doing so should have four men with it—one a considerable distance in front with a good light, and another one behind the engine, both to be provided with a whistle, and stop the engine upon the approach of a trap, &c. Both men to assist in leading the animal past. Engine, of course, to carry good lights, and proceed only at a slow speed.

All main and turnpike roads and bridges to be "up to traction engine weight," which shall be considered ordinary traffic—except in case of excessive weight, such as a very large boiler—and no owner be liable for any damage done to the surface of such road or drains or bridges, providing he is within the Act of Parliament. He should of course be liable for breaking curbstones, knocking down walls, posts, &c. Parish and bye roads can hardly be expected to come up to this standard. New engines between eight and ten tons—working order—to have main road wheels not under 16in. in width. Engines between ten and fourteen tons to have wheels 18in. wide. Wagons to have 1in. width in wheel for every ton gross loads, except large boiler wagons, &c. Until something better is introduced, I am afraid we shall have to stick to the cross strip for ordinary work, but believe that with lighter loads and increased speeds, some useful work is possible with a smooth shod wheel; this should be encouraged, as it would roll the roads. A wheel with wood blocks or shoes has been introduced, it is useful for very heavy loads upon paved streets in towns, but is much too heavy for ordinary work on macadamised roads. You invite discussion upon "what is the least offensive form that a common road locomotive available for heavy haulage can take?"

The best engine is undoubtedly one neat and compact in design, and which pulls a good load at a fair speed with little damage to the roads. Its working parts should be few in number, and properly cased in, should work without noise, and be most economical in consumption of fuel and water. I should therefore recommend a single crank compound engine about 10 tons weight, upon 18in. wheels, geared in the fast speed up to six miles per hour. The gear wheels should be few in number, and great care taken that the teeth are of the proper shape and carefully pitched, in order to run quietly. The sliding pinions should be cast together and work between bearings, and slide along a square-shaped on the shaft, instead of along feather keys, which are constantly getting loose and cause a considerable amount of clatter. The engine should be mounted upon a simple arrangement of springs, and all castings requiring strength should be made of steel in order to keep down weight. It should have a sensitive rack steerage instead of chains, which are liable to break, and might cause a serious accident at top speed. The steerage to be on the left side, so that the steersman can run close to the causeway in going through towns, &c. A powerful screw brake should be provided acting upon both main road wheels. Proper places should be made for securely holding all loose things, such as spuds, firing tools, spanners, oil cans, kettle, &c., they being responsible for a lot of clatter; the spud box on the front axle, which has recently become so fashionable, being a great producer of unnecessary sound. The above engine would be better adapted for ordinary every-day traction work than for shifting successive weights, such as large boilers.

Leeds, December 5th. J. H. M.

---

Sir,—Your article and the correspondence on traction engines is doubtless very opportune, as some steps should be taken to ameliorate the laws relating to them when working on common roads, as I am of opinion that with less restrictions they would materially assist depressed agriculture, and at the same time be the indirect means of producing better country roads. As to the wear and tear of the roads, it must be remembered that this traffic is not extraneous; it must pass over the roads, but probably in smaller units of weight. Then the question, viz., given the same weight drawn by horses, would they not do more damage My experience is they will. But another condition presents itself. Given a road with the crust probably quite sufficient to withstand the ordinary horse units of weight, say, two tons on each pair of wheels passing over it, but it breaks up under a ten-ton engine and four tons on each pair of wagon wheels, although of extra width. Can this road be considered in proper order? The local surveyor says yes; but if we give the question further consideration it may not be so plain. The whole matter becomes a financial question. A road well metalled, shaped, and drained, will improve with the use of an engine with properly designed wheels running over it, as the new metal is consolidated, and the increased expenditure for material becomes a paying investment, inasmuch as the road has a much longer proportional life. To emphasise this view, several County Councils have now their own road rollers, vans, and water-carts to accomplish this; and as mentioned by your correspondent, "J. E. S.," the roads of Kent are the best in England, and there are more engines in use on them than any other county, at the same time there is more money laid out on their consolidation.

Mr. Phillips' views as to licences—which should be charged as a registration only—inspection, damage to roads, are to the point; but what is to be the basis of the distinction between a good and bad engine? The following points suggest themselves, namely:—No engine for common haulage to exceed 12 tons in weight when fully loaded, the wheel base in diameter and contact with the road to be fixed at a given deflection. The thickness of the cross bars also to be stated, together with the total width of engine. A spring engine to minimise the force of impact is no doubt desirable both for the benefit of the roads as well as the owner, but hitherto they have not been all that has been desired; wood blocked wheels have also been tried. As to general design, to alter the general form of the present best types would doubtless be difficult, as the locomotive type of boiler is the fundamental shape to build on; but special attention is required to abate the noise from the exhaust, having due regard to the amount of induced draught required to maintain the steam boiler pressure.

Compound traction engines with two cranks do not find favour with users or drivers, single crank engines being much preferred, and the ratio of expansion being so often altered according to the requirements of the engine to the inequalities of the roads, the theoretical value of compounding disappears at once. Engines with their working gear underneath have been tried also, but a stop on a dead centre will sometimes occur at starting, hence disfavour. A large diameter of single cylinder driven well linked up, giving a good range of expansion, cheaper in first cost, with fewer working parts, is what experience has taught me to be the better engine. At the same time higher boiler pressure and piston valves are also desirable.

As to drivers, it is one of the most important considerations how to teach them. A good driver is an exceptional individual. A man may be a good mechanic and know how to handle a fixed engine well, but fails when on the foot-plate of a traction engine. I have known first-class locomotive men precisely the same. A good nerve, reliance on his engine to answer his hand, are essential. He must see no fear. Directly he sets his engine in motion he has to look where he is going, and a good driver when in difficult travelling prefers to steer himself. Having had personal experience on locomotive foot-plates also, I can safely say that a traction engine driver to cope with all emergencies, such as getting out of holes at side of roads, loading and hauling timber from woods, frosted roads, keeping down sparking, &c., must be almost born to it, and his examiner must also be of the same type.

Broad-street House, November 27th. T. E. Gakee.

---

Sir,—As one who is interested in traction engines, I am pleased to see that there is to be an effort made to remove some of the restrictions which at present press so heavily on the makers and users of these valuable machines. As an employé in a firm where large numbers of high-class traction engines are turned out annually, I consider it to be the duty of everyone who gets his crust, directly or indirectly, by the manufacture or use of these engines, to put his shoulder to the wheel and use his best endeavours to remove the absurd laws which prevent the extension of this important industry. Workmen as well as masters should therefore sink their political difference, and combine to bring some pressure on the gentlemen who represent them in Parliament, and who are, therefore, to some extent responsible for the existence of a law which should be abolished without delay.

The workmen especially should approach their members of Parliament with a view of removing some, if not all the unreasonable statutes which hamper their production, for should they succeed, they would also benefit a large number of their fellow workmen who are engaged in other industries and manufactures, seeing that cheap carriage of material and produce is so essential to good trade. I am sure the men will do their share if the matter be carefully brought to their notice. At present I consider that comparatively few of those interested know anything of the subject. I therefore beg to suggest that the leaders of the movement should by printed circular, or other means, do their best to lay the matter before their employers and all others who may be likely to help the cause.

Having had my say regarding the law relating to traction engines, I will be glad if you will grant me the space to say a word or two *re* the engines in question. After over twenty years' practical experience with traction engines of various types, working under various conditions, and having some knowledge of what is being done abroad in the way of steam hauling on common roads, I have come to the conclusion that at the present time the best traction engines in the world are made in this country, engines which leave little to be desired where heavy loads require to be moved over common roads at slow speeds, at the same time leaving the engine available for use as a stationary engine when not in use as a locomotive.

In the meantime, when the law is altered, as it should be, to allow of speeds of eight, ten, and twelve miles per hour for road locomotives, the traction engine makers of this country will rise to the occasion, and introduce engines far different in design to the present heavy, slow engines. And while I admit that the present gear-driven engines will hold their own for slow traffic, I venture to predict that the modern high-speed road locomotive of the near future will be chain-driven, mounted on laminated springs, and fitted with sufficient brake power for any and all emergencies. With regard to your suggestion as to placing the motion beneath the boiler in traction engines, I am inclined to think that so long as the present type of boiler remains in use, so long will the motion be mounted in its present position. Should, however, the water-tube boiler come into general use—a not unlikely thing—it may be found convenient to place the motion in the position suggested.

Much has been said and written regarding certificates of efficiency, &c., of the men employed to take charge of traction engines. I think the case might be met by compelling every man when in charge of an engine on the public highway to wear a numbered badge, such badge to be registered, and the holder to be liable to lose his badge for wilful neglect on his part. Of course some recommendation would be necessary to obtain such badge.

Leeds, December 3rd. Pitch Chain.

---

Sir,—In following the discussion that is at present being carried on in your valuable columns, I think that "W. C. W. T." is right in saying that it is the men in charge of the engine that are objectionable. Nine out of ten traction engine drivers are an ignorant, uncouth, dirty set of men, and have the machine under their charge in a filthy state, motion covered with oil and coke dust, and as "W. C. W. T." said, they know there is a hole one end to put coke in and a hole the other end for smoke to come out. But I think it would be a puzzle for some of these so-called drivers to tell how the smoke got to the other end, and if spoken to on any subject a grunt is the answer. With regard to your article on page 449, November 23rd issue, where you recommend undertype motion, I think it would be a detriment to a great many owners who use their traction engine for stationary work, such as travelling showmen that have their engine to haul the caravans, and when their plant is pitched, to drive a dynamo; also farmers who use the engine for threshing and steam ploughing, although I think the side frames to hide the motion would be a very great improvement. F. J. M.

December 4th.

---

Sir,—Enclosed I beg to hand you a cutting from the *Devizes and Wiltshire Gazette*, which I think will prove interesting to some of your correspondents on "Traction Engines":—

> "On Wednesday morning, the steam roller belonging to Mr. Tilke, of Melksham, which is engaged in road work by the Rural Sanitary Authority, was crossing the bridge over the brook near to Black Dog station when the bridge gave way, and the roller sank into the brook. The driver fortunately realised his dangerous position, and escaped by jumping off the engine. It is supposed that the accident is due to the recent heavy floods having undermined the bridge. Fortunately only one portion of the structure has given way, and by the aid of substantial planks light vehicles are still able to pass over in safety, although heavy traffic is stopped. The engine lies embedded in the brook with roller upwards, and there will be considerable difficulty in extricating it from its present position. Large numbers of people went out on Wednesday from Calne to see it."

The bridge is on the London—Bath main road, and is guarded by the "usual" notices. It is a stone bridge, but seems to be too small for the volume of water. The engine was one of Robey's, and weighs 13 tons. Its position might be described as lying at an angle of 45 deg., with roller on the road and fire-box in the brook. It was hauled out on Friday afternoon by means of a traction engine—such as "W. C. W. T." described in last week's number—and three shear legs. I should like to know whether such accidents are common. R. J. H. B.

December 4th.

## LABOUR AND LUXURIES.

Sir,—The letter of your correspondent, "J. C. S.," no doubt raises a very interesting question, but it has nothing whatever to do with me or any statement I have made. A sovereign is spent on an air gun, and it will do as much good so spent, I say, as if it was spent on cartridges, or buttons, or moral treatises. That is to say, it will enable the maker of air guns to procure in exchange for it food and raiment, or it may be beer, or a concertina, or shoes for his children. But the sovereign has nothing whatever to do with the air gun. The misuse of that is a point of ethics about which the sovereign knows nothing. It is really curious, and not at all uninteresting to read the various letters which have been written on this subject; not one of your correspondents has advanced a single argument or stated a single fact which controverts the proposition I have advanced. The utmost they can say is that I have overlooked the ethical part of the question. But that is precisely my intention. I hold, with Lord Farrar, that economics are one thing, ethics another.

As regards the "time element" a strange misconception seems to exist. What I have meant to convey is simply that, no matter how gold is spent, in the long run the result will be the same in the community at large. But I freely admit that as regards the individual, it may be a matter of great importance to him on what the sovereign is spent, while it is of no consequence to the individual who receives it. For example, a shoemaker needs leather in his week's work. He spends a sovereign on beer instead of on leather. In doing this he is directly benefitting the publican, and through him the brewer, the hop merchant, and the barley grower. If he had spent it on leather he would have benefitted the men of Bermondsey, and he would also have benefitted himself, his wife, and his children in the long run. The economic work of the sovereign has been performed equally well in either case; and the sovereign, it may be shown, will ultimately return to the shoe maker. But for the time being he is worse off by spending the money on beer than on leather. That is what I mean by the time element. But your readers will not fail to see that after all this is dragging in the ethical element, and the sovereign must not be held to have done its work any less satisfactorily as regards the community in one case than the other. The mistake made by your readers is that they are always dealing with men while they should think only of gold. No matter how the sovereign is spent it must be spent at the expense of one section or another of the community. Y. X.

December 3rd, 1894.

---

Sir,—If "Y. X." had previously condescended to quotation, we might have got on better. Being wholly agreed as to Lord Farrar's excellent statements, let us apply them to our case. "Ethics is a science of art and duty teaching men what they ought to do." Therefore, if a labourer says he ought not to be discharged he is talking ethics, and his fallacy, if any, is not economic. "Economic science treats of the manner in which wealth is produced and distributed." Why, then, does "Y. X." say that in political economy it matters nothing how gold—which I suppose he allows is part of wealth—is got or expended? "It is within the province of political economy to say that weak and lazy people are likely to starve, but to add, serve them right, is a question for ethics." Similarly, I was talking strict economics when I said that robbery and murder tend to diminish wealth, but the moral state of the criminal which "Y. X." discusses is a question of ethics. Two familiar aphorisms well illustrate the last passage of the quotation. The first ethical, "an honest man is the noblest work of God." The second strictly economic, "honesty is the best policy." But surely "Y. X." has been driving at something very different from the mere distinction—distinction, mind, not opposition, between ethics and economics. It is my turn to quote, and does not this more or less describe his view? "They seemed to have persuaded themselves that the most important thing for our nation was that not one sou should ever leave France; that so long as this was so, the kind and the amount of taxation, the rate of wages, the greater or less perfection of industrial arts, were things of complete indifference, provided always that one Frenchman gained what another Frenchman lost." The writer is Mollier, financier to the first Napoleon, and he is acknowledging his debt to Adam Smith whose writings had delivered him from the foolishness of his predecessors, which he thus describes. W. A. S. B.

London, December 1st.

## SHEEP SHEARING MACHINE.

Sir,—Will you allow me to point out that in your very lucid description of my sheep shearing machine, you have made a small error in attributing to me the original patent for swinging bevel gears? Such gears were made and used many years ago. My claim is only for the combination of them with swivelling sockets, so arranged as to allow a universal movement. John M. Newall.

London, December 4th.

(*For continuation of Letters see page* 494)

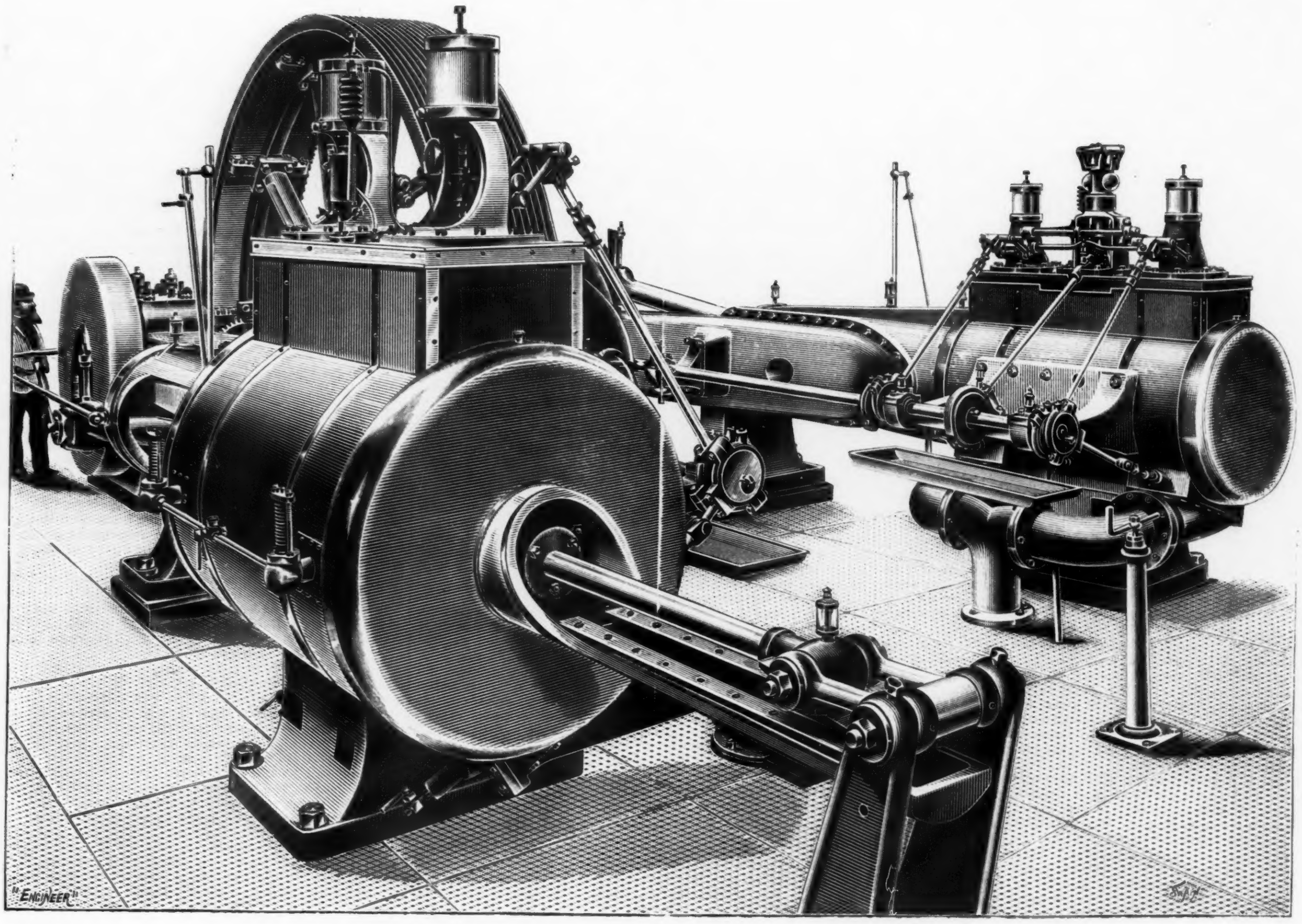
---

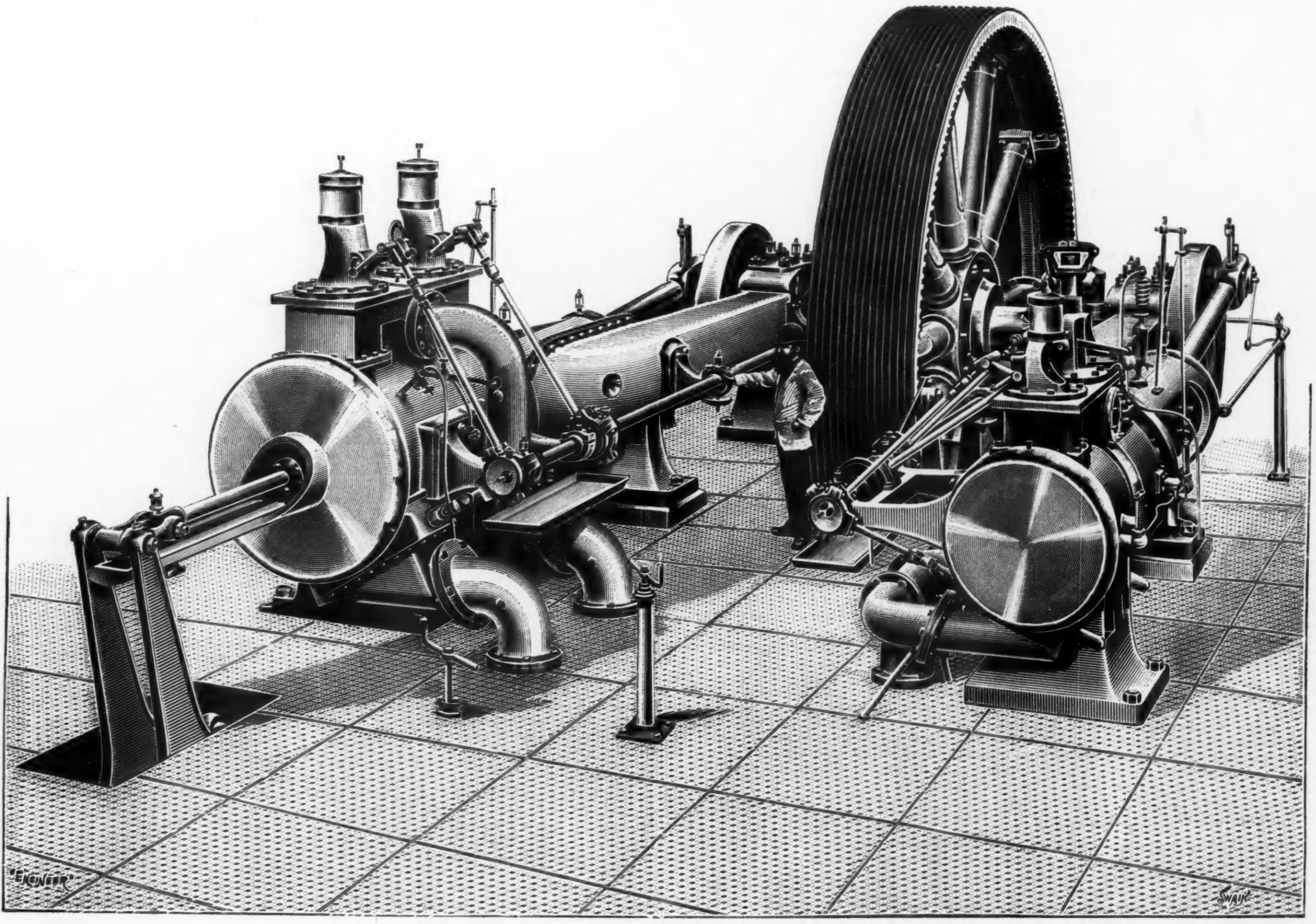
The Electric Lighting Companies and Transformer Chambers.—An inquiry is to be held at the Board of Trade on the 13th inst. into the subject of transformer chambers. The London County Council and other local authorities in the metropolis have objected to the chambers being placed in the public streets, contending that they are a serious obstruction in the roadway and may possibly interfere with the laying of gas, water, and other pipes in the future; and further, that they are a grave public danger. They have therefore urged the Board of Trade to compel electric lighting companies to place their transformer chambers on private property. On the other hand, those connected with the electric lighting industry contend that there is no danger to the public in placing the chambers in the streets, and that they can be so constructed as not to form any serious obstacle to the future use of the streets for other necessary purposes.

# NINE HUNDRED HORSE-POWER COMPOUND ENGINE

MESSRS. ROBEY AND CO., LINCOLN, ENGINEERS

(*For description see page* 85)




"ENGINEER"
SWAIN

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*The Publisher of* The Engineer *begs leave to announce that on next Friday, December* 14*th, will be published a* Special Number *of* The Engineer.

*This number will possess many features of unusual interest.*

*With it will be published* Two Supplements: *one a* Four-page Engraving *of a* Six-coupled Bogie Goods Engine *on the Highland Railway, the* Most Powerful Locomotive Engine *in Great Britain; the second a* Tracing *to the scale of three-quarters of an inch to the foot, giving a section and plan of this Engine.*

*A profusely-illustrated description of* Messrs. Sharp, Stewart, and Co.'s Locomotive Building Works, Glasgow, *with its tools and machinery, will also be found in the same issue.*

*A* Complete Set of Engravings *from photographs of the* Armoured Cruiser "Blanco Encalada," *will supply information of a kind which has never before been published.*

*Yet another feature of interest will be a* Set of Drawings *made by our special artist in the* Engine-room *of the new* Peninsular and Oriental Steamship "Caledonia."

The Engineer *for December* 14*th will also contain numerous articles on important and interesting topics.*

*This Special Number will take the place of the ordinary issue of December* 14*th, and to prevent disappointment, advertisements should reach the Office not later than Tuesday morning next, December* 11*th.*

*The price of the Number will be* 6d., *as usual (post free,* 6½d., *to any part of the United Kingdom).*

*Foreign Edition (on thin paper)* 11d. *post free to any destination outside the United Kingdom.*

## CONTENTS.

The Engineer, December 7th, 1894.

PAGE
South Wales Railway and Dock Bills .. .. .. .. .. .. .. 479
The Manchester Thirlmere Waterworks. No. 3. (Illustrated.) . 479
Cable Haulage on Canals. (Illustrated ) .. .. .. .. 480
The Siegfried, German Imperial Navy (Illustrated ) .. .. .. 481
The Gradient Telemeter Level. (Illustrated ) .. .. .. .. .. 481
New Water Schemes for Yorkshire.. .. .. .. .. .. .. .. 482
Manchester Ship Canal .. .. .. .. .. .. .. .. .. .. .. 482
Railway Matters—Notes and Memoranda—Miscellanea .. .. 483
A Closed Conduit for Electrical Tramways. (Illustrated ) .. 484
900 I.H.P. Compound Fixed Engine (Illustrated ) .. .. .. .. 485
Letters to the Editor—Locomotives and Trains—English and American Locomotives in South America—Simplex Gas Engines and the Pantin Flour Mills—Traction Engines .. .. .. .. 486
Traction Engines—Labour and Luxuries—Sheep Shearing Machine 487
Leading Articles—Legislation on the London Water Question—The Machinery of Warships .. .. .. .. .. .. .. .. 489
Measuring Water in Steam—Instability of French Battleships—New Clyde River Boats—The Northern Chemical Crisis.. .. .. .. 490
The Year's Scottish Shipbuilding.. .. .. .. .. .. .. .. 491
Literature—Books Received .. .. .. .. .. .. .. .. .. 491
Foreign Ship Canals. (Illustrated ) .. .. .. .. .. .. .. 492
South African Railways.. .. .. .. .. .. .. .. .. .. 493
In Parliament, Session 1895 .. .. .. .. .. .. .. .. 494
Letters to the Editor—The Theory of the Steam Engine—Thrust Bearing for Marine Engines—The Flying Machine—Boilers and Boiler Explosions .. .. .. .. .. .. .. .. .. 494
Mine Explosion Relief Funds—American Woodworking Machinery and English Manufacturing Interests—A Problem in Vibration—L.C.C. Contractors *v.* L.C.C. Works Department: A Challenge—The Kinetic Theory of Gases: Time Occupied by an Impact 495
The Progress of Naval Contracts .. .. .. .. .. .. .. .. 496
The Various Types of Basic Open-hearth Steel Furnaces.. .. 496
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire.. .. .. .. .. .. .. .. .. .. 496
The Sheffield District—The North of England .. .. .. .. 497
Notes from Scotland—Wales and Adjoining Counties—Germany .. 498
American Notes .. .. .. .. .. .. .. .. .. .. .. .. 498
Launches and Trial Trips .. .. .. .. .. .. .. .. .. .. 498
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. 499
Selected American Patents .. .. .. .. .. .. .. .. .. 500

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

A. J. C.—*We can only advise you to consult the numerous books on the subjects concerned in water supply in the library of the Institution of Civil Engineers.*

Permanent Way.—*Your letter is full of errors. You are quite mistaken as to the action of locomotive superintendents, as to their knowledge, and as to their work*

J. R. H. (Newcastle-on-Tyne)—*Probably the course you mention would constitute an infringement. Everything depends on the construction of the specification and its claims. A reply will be sent you by post.*

H. V. (Birmingham).—"*Le Genie Civile.*" *Paris*: 6, *Rue de la Chaussée d'Antin.* "*Les Annales Industrielles*" *Paris*: 52, *Rue Lafayette. You will find names of books by reference to the librarian in the Birmingham Library.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price* 2s. 6d. *each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, December 11th, at 8 p.m. Paper: "Colliery Surface Works," by Mr. Edw. B. Wain, Assoc. M. Inst. C.E. Friday, December 14th, at 8 p.m. Paper: "Some Experiments on the Heat Losses to the Cylinder Walls of a Steam Engine," by Mr. S. Henry Barraclough, B.E., Stud. Inst. C.E., and Mr. Lionel S. Marks, B.Sc. Mr. Bryan Donkin, M. Inst. C.E., will take the chair.

The Institution of Electrical Engineers.—Thursday, December 13th, at 7 p.m. Council meeting. Annual general meeting at 8 p.m. Annual report of the Council and election of Council and officers for the year 1895. Papers: Electrical Steep Grade Traction in Europe," by C. S. du Riche Preller, M.A., Ph.D., member; "Notes on Electric Tramways in the United States and Canada," by H. D. Wilkinson, member; "Electric Traction, with special reference to the Installation of Elevated Conductors," by R. W. Blackwell, foreign member, and Philip Dawson, associate.

Institute of Marine Engineers.—Monday, December 10th, at 8 p.m. Paper: "Wrecks and Salvage Operations," by Mr. T. W. Wailes, member.

The Sanitary Institute.—Wednesday, December 12th, at 8 p.m. Paper: "The Sanitary Aspects of the London Building Act, 1894," by George Blundell Longstaff, M.A., M.D., Oxon., F.R.C.P.

Society of Arts.—Monday, December 10th, at 8 p.m. Cantor Lectures: "Modern Developments in Explosives," by Prof. Vivian B. Lewes. Wednesday, December 12th, at 8 p.m. Paper: "Manufacture of Salt," by Thomas Ward.

## DEATH.

On the 4th inst. at Stanhope House, Park-road, Wandsworth, William Joseph Brown, aged 59 years, managing director and secretary of James Simpson and Company, engineers, London, with whom he has been associated over forty years.

# THE ENGINEER.

*DECEMBER* 7, 1894.

## LEGISLATION ON THE LONDON WATER QUESTION.

The great scheme by which the London County Council are to bring into the metropolis a new supply of water, from Wales or elsewhere, is not yet matured, and the project stands over until after the next session. But in the meantime the Council are to bring eight Bills into Parliament, comprehending the purchase of the eight metropolitan water companies. The transaction is called a "transfer," to be effected by means of an agreement, or, failing that, by the process of arbitration. As the only agreement tolerated by the County Council must be expected to correspond very closely to the terms laid down for the arbitration, it is not in any degree likely that the Companies, or any one of them, will come to an understanding with the Council on the subject. The conditions under which the arbitration is to take place are of such a nature that it is difficult to see how they can possibly receive the approval of Parliament, much less the consent of the Companies. The arbitrators are to be appointed by the Council, the Company, and the Board of Trade respectively, and this may be fair enough, but in arriving at what is called the value of the several undertakings, the arbitrators are to have regard to a variety of matters, some of a very contingent and speculative character, but all of such a nature as to reduce the amount to be paid for the acquisition of the property. Deductions are to be carried out right and left, and it is specified that "no allowance" shall be made in respect of any assumed future increase of the rateable value of buildings in the district of each company, other than an increase due to alterations or additions involving increased supply of water. Nor is any allowance to be made in respect of any past increase in rateable value, except for a similar reason. The conditions to be imposed on the arbitrators are many and various, and though some may be just, the aggregate presents so formidable an appearance that the water companies are certain to offer the most determined opposition to the passage of the Bills. It might even be supposed that the County Council calculate on this, and have no desire to purchase the undertakings. It may suit the policy of the Council by-and-bye to plead that the Companies refused to come to terms, and that there is no alternative but to introduce an independent supply. Or it may be the other way, and that the threat of a huge project, to make its appearance a year later on, is designed as a menace to force the Companies into a surrender of their undertakings on a greatly reduced valuation. The Council may not adhere to all the terms laid down in their statutory notice, and if the Bills contain such terms these may be partially abandoned. But of such moderation there are no indications at present, although there is a party in the Council who disagree with the Bills.

While the intentions of the County Council with respect to the water supply of London are invested with a considerable amount of uncertainty, the water companies are moving in a manner which leaves no room for doubt. The East London, the Southwark and Vauxhall, and the Middlesex Companies each obtained power in the past session for the raising of new capital and the enlargement of their works. The Lambeth and the Chelsea Companies are now coming forward with Bills for a similar purpose. The need for action appears very conspicuously in the case of the East London. Their proposed extension was strenuously opposed in two sessions by the County Council, and even by the Government. Now that the East London Bill has been carried, and the works are about to be commenced, the County Council turn round and accuse the Company of having, at the present time, a deficient supply. For this the Company are less to blame than the Council, though in reality a falling-off in the rainfall has precipitated the crisis. All will be right in due time, unless the Council succeed in getting possession of the works, when it is difficult to say what will happen. It is rather curious that a scheme emanates from the City authorities which goes rather ahead of the County Council. The Commissioners of Sewers have an artesian well, by means of which they are able to supply water to their artisans' dwellings in Petticoat-square. They have now given notice of a Bill by which they propose to establish baths and washhouses, and to supply these, as well as "buildings," with water, heat, and electricity. Their supply of water will doubtless come from the well, and it will be interesting to know, when the time arrives, how far this supply is to extend. Of course, none of it can be sold, and at present the Commissioners have no power to break up the streets for the purpose of laying water mains. The scheme is an interesting one, but, if the Bill proves to be designed for aggressive purposes, it will infallibly encounter the decided opposition of the New River Company. The County Council claim that no water company in London has the power to exclude any other company or body from introducing a competing supply. This is one of the questions which their eight transfer Bills propose shall be taken into consideration by the arbitrators. In fact, if the arbitrators take into consideration all the points laid down for them, it would seem as if their labours would be of an unusually protracted nature.

A statement prepared by the Corporation shows that in 1606 that body obtained an Act of Parliament, which empowered the mayor, commonalty, and citizens of London, and their successors, at any time, to open a trench for the purpose of bringing a fresh stream of running water to the north parts of the city, from Chadwell and Amwell, in the county of Herts. But "instead of undertaking the work, and reaping the benefits therefrom, on their own responsibility, the Corporation deputed the enterprise, after a lapse of three years, to Hugh Myddleton, citizen and goldsmith." The enterprise resulted in the ruin of the unfortunate goldsmith; but a Royal Charter was granted, by which Sir Hugh Myddleton and his co-adventurers were incorporated as the New River Company. The history of this undertaking shows how the municipal authority drew back from an enterprise which threatened to be costly and troublesome, and how London owed its first set of waterworks to private energy. The Corporation might have held the New River supply, whereas now, through the medium of the Commissioners of Sewers, they seek, if possible, to compete with it, and the County Council desire to buy it up at the cheapest possible rate. Many other enterprises in London are passing through a similar experience. When they were struggling concerns, reaping little or no profit, they were left to fight their own battle. But now they can pay a dividend, it is proposed that they shall be "municipalised," which means that a local authority shall step in to appropriate private profits. Under these circumstances, there is danger that local authorities will be left to undertake initiatory work, and private capital will stand aloof. How the world is to get on under such conditions, another generation may declare.

## THE MACHINERY OF WARSHIPS.

The excellent paper read by Mr. Durston before the Institution of Civil Engineers on the 20th of November, supplies more information of a kind concerning marine engines than any other written since Mr. Marshall's standard paper, read at the Newcastle meeting of the Institution of Mechanical Engineers several years ago. We have already published the only abstract of Mr. Durston's paper allowable under the rule of the Institution; but that abstract gives but a scant and inadequate notion of the great mass of information collected by Mr. Durston into tabular form. Although, as we have said, we are in great measure debarred from dealing with the paper in any comprehensive way, there are certain facts and statements which may be reproduced here without any breach of faith. These we take at haphazard as they suggest themselves.

One of the first is, that a very considerable number of ships in the British Navy are still running with compound engines, and it is interesting to compare one of these with more recent vessels. All the "Admirals" have compound engines, their average horse-power on natural draught is 8277, under forced draught 11,271. The average weight of the machinery is 1209 tons, the boiler representing 667·6 tons of this weight. With natural draught we have 6·8-horse power, and with forced draught 9·8 indicated horse-power per ton. The indicated power per foot of grate is 10·4 and 14·2, and the heating surface per horse-power is 2·4 square feet by 1·8 square inch. These figures deserve particular attention. We may note further that there is a very great similarity of dimensions, &c., among all the "Admirals." They have vertical 3-cylinder compound engines with twin-screws running about 100 revolutions per minute at full power. Stroke, 3ft. 9in.; piston-speed, 750ft. per minute. The engines of the Collingwood make 95 revolutions per minute; 3ft. 6in. stroke; piston-speed, 665ft. per minute. Their boilers are of the single-ended return-tube type, twelve in number, with three furnaces in each. The load on the safety valves is 90 lb. per square inch. The Anson has eight four-furnace boilers carrying 100 lb. pressure; the boilers are placed in four compartments, arranged back to back against a middle-line bulkhead. The ratio of the cylinders is about one to four. Unfortunately Mr. Durston in no place states the consumption per indicated horse-power per hour of any of these ships. We believe, however, that we shall not be far from the truth if we give it as 2½ lb. for natural draught, and 3 lb. for forced draught. This, of course, is understood to include auxiliary machinery, such as fan engines, steering gear, electric lighting, &c. We may now compare these figures with those relating to the machinery of more recent vessels, such, for instance, as the Empress of India, one of eight, all alike, first-class battleships, with vertical 3-cylinder triple-expansion twin-screw engines, designed to run at 108 revolutions per minute at full power, 13,000 indicated horse-power. Stroke, 4ft. 3in.; piston-speed, 918ft. per minute. The valve gear and propellers—except in Royal Sovereign—are arranged to work at a maximum effort of 11,000 indicated horse-power in order to obtain more economical results at ordinary rate of working. The boilers are of the single-ended return-tube type, eight in number, in four compartments arranged back to back against a middle-line division. Each boiler has four furnaces with two, three, or four combustion chambers. The load on the safety valves is 155 lb. per square inch.

Here we have the most modern engines to compare with those eight or ten years old. The Empress of India indicated, with natural draught, 9508-horse power; with forced draught, 11,625-horse power. The total weight of machinery and boiler is 1149 tons, of which the boilers represent 581 tons. The indicated horse-power per ton is 8·2 and 10·1. The heating surface per indicated horse-power is 2·1 square feet and 1·7 square feet. Before going further, it may be well to say that the boilers named above give, with natural draught, 16·3, and with forced draught 20-horse power per ton. In the Admiral class they give 12·4 and 16·9-horse power to the ton, on the average. The Anson has, however, given 13·5 and 20·5 indicated horse-power per ton. It will be seen, then, that the net gain due to the use of higher pressures and higher expansion engines, as regards the boilers, is about 8-horse power per ton at forced draught, and about 4-horse power per ton at natural draught, or not far from 20 per cent. This is very well worth having. But when we turn to the machinery complete, we find that while the Empress of India has 8·2 and 10·1 indicated horse-power per ton, the Howe has 6·6 and 11·8 indicated horse-power, while the Anson has 7·2 and 10·9 indicated horse-power. Thus, at forced draught both these ships beat the Empress of India, and the Howe, indeed, beat the Royal Sovereign, which indicated 13,363-horse power—to the great detriment of her boilers, be it added. It would seem, therefore, that there is really very little to choose between the triple and the compound engines on the score of weight as a whole. So far as can be gathered, indeed, the facts seem to show that in the Navy the principal benefit conferred by the use of triple-expansion engines is a saving in coal. We learn from Mr. Durston that the Royal Sovereign, on a passage from Plymouth to Gibraltar, maintained 8180 indicated horse-power for seventy-two hours, the coal consumed being 1·84 lb. per indicated horse-power per hour. The Royal Arthur, on a passage from Callao to Coquimbo, maintained 8821 indicated horse-power for seventy-two hours, with a coal consumption of 1·85 lb. per indicated horse-power per hour. The Sans Pareil, on a passage from Malta to Volo, developed 7051 indicated horse-power for fifty hours, with a coal consumption of 2·23 lb. per indicated horse-power per hour. The Sirius, on a passage, maintained 4555 indicated horse-power for sixty-four hours, with a coal consumption of 2·03 lb. per indicated horse-power per hour. The Pallas, on a passage, developed 3620 indicated horse-power for seventy-three hours. The Royal Arthur is a first-class cruiser, 10,517 indicated horse-power; the Sirius is a second-class cruiser; the Sans Pareil is a first-class battleship. These all have triple-expansion engines.

The question arises whether, considering the conditions under which the engines of ships of war are worked, it is worth while to use triple-expansion. It is perfectly well understood that, unless engines of the kind are worked at just the right power, they are wasteful of fuel. This is the reason why the valve gear has been so set that, with the exception of the Royal Sovereign, the maximum forced draught power cannot be got. Mr. Durston, in speaking of the Mersey and Severn second-class cruisers, with compound engines, points out that the ratio of the cylinders—one to 2·8 or 2·9—is not sufficient in one sense, the size of the low-pressure cylinders being too small for full power, but at the reduced powers developed on ordinary service a fair ratio of expansion can be used, and there is a certain amount of weight saved—an important item. It appears to be worth considering whether the principle might not be pushed a little further. Unfortunately we have not sufficient information as to cruising coal consumption to be able to speak with certainty, but it is fair to ask whether an adequate return all round has been got for the triple-expansion system, as compared with the compound. Furthermore, saving in space and weight being of such vital importance, might it not be worth while to inquire into the merits of Mr. Asplin's system, as fitted to Messrs. Leyland's ships with, we understand, very great success. Mr. Asplin simply omits the intermediate cylinder in a triple-expansion engine. In other words, he builds a compound engine with cylinders in the ratio of about 8 to 1. It is evident that if the system will answer in other ways, its adoption would save a great deal of space and weight in an engine-room.

Concerning the vexed question of forced draught and leaky boilers, we find Mr. Durston stating in effect that the difficulties have been overcome partly by the use of ferrules, partly by the use of pure water. But, we may add that, effectual as these may be, they are as nothing compared with the reduction of air pressure to a maximum of 1in. of water. That is the principal reason why forced draught is successfully used in the mercantile marine. The experiments with Martin's induced draught have resulted on the whole satisfactorily. Mr. Durston tells us that it does not ensure immunity from leakage, but that it gives a cool stokehold, saves fuel, and is so satisfactory in other ways, that the system is to be fitted in one of the new first-class battleships now being built, and also in a gunboat. Mr. Martin certainly deserves the measure of success he has achieved. Probably the result obtained in the battleship will be even better than Mr. Durston anticipates.

### MEASURING WATER IN STEAM.

Any of our readers who have made themselves acquainted with Professor Unwin's paper on "Priming," which appeared in our issues for Sept. 7th, Aug. 21st and 28th, can scarcely have failed to arrive at the conclusion that no accurate method of ascertaining the percentage of water in steam as it leaves a boiler exists, at all events in a shape available for ordinary use by engineers. This is extremely unsatisfactory. It is highly important that dry clean steam should be supplied to engines; and ignorance concerning the quantity of unevaporated water that leaves a boiler through the steam-pipe vitiates experiments intended to determine economic efficiency. Rightly or wrongly it has come to be understood that all boilers supply more or less wet steam—the percentage varying between about three for very good and fourteen for very bad boilers; if the latter percentage is exceeded the boiler is said to prime. If it is not exceeded, then it is said that the steam is more or less wet. Recent inquiries appear, however, to have resulted in proving that all these figures are in excess of the fact, and that most boilers are giving off dry saturated steam, and that under comparatively trying conditions. On the other hand, it is known that the engines using this steam are more or less drowned, and that from the high-pressure cylinder especially it is difficult to get a diagram which does not show the presence of volumes of water. The very natural conclusion arrived at is that the calorimeter or the salt test is entirely wrong, and give erroneous conclusions. That is pretty much what Professor Unwin's paper concedes.

In the United States a great deal of attention has been given to the subject, and it seems to be taken for granted that the Barrus calorimeter is, when *properly used*, fairly accurate. The words which we have italicised have an application beyond the Barrus calorimeter. In the difficulty of using any form of calorimeter properly, must, we think, be sought the principal cause of the unsatisfactory and untrustworthy results that are so often obtained.

The first and paramount difficulty lies in getting the sample of steam. If it is drawn from the centre of the steam pipe, it is objected that the water is really to be found on the sides and bottom of the pipe, and so escapes the calorimeter. We have ourselves seen a stop cock opened on the side of a steam pipe, the stem of the cock projecting well into the pipe. The steam coming out through the cock was apparently dry, yet further on a separator was removing water in considerable quantities from the same steam pipe. If, on the other hand, the steam is taken from the bottom or sides of the pipe close to the metal, it is urged that the sample drawn off will be much wetter than the average. It is not easy to satisfy both parties. Again, it is very well known that wire-drawing steam dries it. Consequently, if the sample is withdrawn through a small orifice, it is certain to be drier than the average. As regards the salt test, that may be regarded as entirely untrustworthy, because it is by no means certain that the water found in the steam must carry salt with it.

If it were known with any accuracy why steam is wet, the difficulty of testing it would be diminished; but nothing is certainly known on the subject. There is, of course, very good reason to believe that quantities of water are thrown up into the steam space by the up-rush of the steam bubbles breaking through the surface; but then the water ought to fall back by its gravity in any quiet part of the boiler. But this bubble action does not cover the whole ground. If any of our readers will boil clean water in a clean earthenware pipkin, they will see that there is continually flung up from the surface, what may not inaptly be termed "water dust," a multitude of excessively small spheres of water. They do not seem to have anything to do with bubbles. Indeed, they may be seen to rise before ebullition begins, and they are apparently projected upwards with considerable violence. We are not aware that this phenomena, which is very interesting, has ever attracted the attention of any physicists. It seems to be the result of some surface action of repulsion in the heated liquid. Now if the water dust does not find its way back but remains suspended in the steam, it may very well represent a considerable percentage of water, while it is by no means clear that it would carry any salt with it. But further, we may ask if it is quite certain that steam once made shall always remain steam while in the boiler? There are many reasons why it should not. Thus, although the pressure in a boiler is practically the same throughout, the temperature certainly cannot be. Not only does the feed-water come in at a lower heat than at which evaporation is taking place, but the boiling water is hotter in some places than in others. But steam is to the last degree sensitive to change in temperature, and it seems to be quite possible that steam produced in one part of a boiler may be condensed in another; the extremely fine mist resulting remaining in suspension in the steam, and being carried away with it to the engine. This action could not in any way be detected by salt.

In 1888 Mr. J. E. Denton, of Hoboken, read a very interesting paper on "The Identification of Dry Steam" before the American Institution of Mechanical Engineers. He carefully investigated—by the aid of photography, among other expedients—the appearance of steam jets. The conclusion at which he arrived is that dry steam, if allowed to flow into the atmosphere through an orifice under such conditions that it attains its maximum velocity at about the instant of exit into the air, is invisible for a very short distance from the orifice. The slightest obstruction to its outflow created by throttling, superheats the steam, and less than five degrees produces a considerable increase in the length of the invisible portion of the jet. The jet is similarly sensitive, in a reverse way, to the presence of moisture, as little as 1 per cent. causing distinct whiteness in the jet over that portion which would have been blue had no moisture been present. Mr. Denton holds that, with proper precaution, the tub calorimeter gives the most accurate results. But he adds that if a stop-cock be fitted on the steam pipe, and the jet is transparent close to the orifice, or even a greyish white colour, the steam may be assumed to be so nearly dry that no portable tub apparatus will detect the true percentage of moisture present. In all cases he advises that the pet cock should be fixed on the boiler; if put on the pipe it may give deceptive results, due to condensation in the pipe. In using the tub, the weight of condensing water ought not to be more than thirteen times the weight of steam condensed, and the range of temperature not less than 85 deg.

On the whole, when considerable quantities of steam are dealt with, and adequate appliances are available, nothing, in our opinion, can be more trustworthy than this well-known system of blowing a given weight of steam into a tank or tub. The precautions to be observed are, after all, not very troublesome. The end of the tube opening into the cold water tub ought to be fitted with a spring-loaded valve, so that the water may not be blown out of the tub, as commonly happens. The tub should be carefully felted to prevent loss of heat, and should hold a good deal of water—certainly not less than twenty gallons. A special thermometer with long range ought to be used, and the whole experiment should, in a word, be carried out on a scale sufficiently large to reduce the importance of small errors to a minimum. Whether our readers do or do not agree with us in these suggestions, they will have to admit that no perfectly trustworthy system of measuring the dryness of steam is now available to settle disputed questions as to the merits and demerits of boilers. And this is such an unsatisfactory position of affairs that the whole subject should be carefully and fully discussed with a view to setting it on a better footing.

◆

### INSTABILITY OF FRENCH BATTLESHIPS.

A few months ago a great deal of criticism was passed in France upon the behaviour of the battleship Magenta, which gave alarming signs of instability, and necessitated some costly alterations before the vessel could be considered at all seaworthy. Nothing definite was ever made public as to the causes of the Magenta's instability, or as to the nature of the improvements that had to be carried out. Official prudence inclines rather to minimise any such untoward occurrences, so that the public may not be unduly alarmed at the increased expenditure. In any event, it might have been thought that the experience would have served as a lesson to French designers in the future. So far is this from being the case that the very same defects have become noticeable in the battleship Brennus, which recently left the Lorient Arsenal for her official trials at Brest. While on the voyage the vessel behaved in a very alarming manner, and, according to the official explanation, this was due to the exceptionally bad weather and the heavy seas. During the trials the vessel listed over to such an extent that it was feared she would turn turtle. The water came rushing in at the port side, and for a moment there was a panic on board. The men were then mustered on the starboard side, and the vessel righted herself. It is stated in the official communications that the unsatisfactory results of the trials have been much exaggerated, and that no proof has been afforded of the instability of the Brennus. The vessel, it is said, listed over eight degrees, which was quite sufficient to let the water in at the open port holes. Had these been shut there would have been no cause for the sensational rumours now afloat. This explanation is hardly likely to satisfy the critics in view of the fact that the official authorities have considered it necessary to carry out extensive alterations which will involve an expenditure of something like £16,000. It is stated that the defects are caused by the overloading of the deck with constructions that had not been provided for in the specification, and that consequently the responsibility rests with the authorities at the Lorient Arsenal. Whether or not there is any truth in this statement, it is certain that it has been found advisable to remove one of the armoured masts and reduce the others, so that there would seem to be something more in the defects than the additions made to the upper structure by the arsenal authorities upon their own responsibility. The alterations to be made will occupy a twelvemonth, so that instead of the Brennus joining the Mediterranean squadron on the 1st of January next, she will not be ready until the beginning of 1896.

### NEW CLYDE RIVER BOATS.

On the Clyde, next summer, apart from yacht racing, the appetite for nautical sensations is likely to be fully whetted. During November no fewer than four contracts for fast river passenger steamers have been placed with rival Clyde builders. The most important order is that for a new vessel for the Caledonian Steam Packet Company, entrusted to Messrs. J. and G. Thomson, Clyde Bank. The guaranteed measured mile trial speed of this vessel is said to be eighteen and a-quarter knots, which might not be considered abnormal were it not for the stiff conditions with which its attainment is said to be hedged round. These are concered with boiler power, air pressure in the stokehold, &c., and a number of Clyde builders are declared to be of opinion that this new steamer is a stiff nut to crack. Another of the orders is for a steamer for the North British Railway Company, which Messrs. Barclay, Curle, and Co., will build and engine, and which owners and builders alike intend shall be a "flyer." A third order is for a first-class paddle saloon steamer, to be built for Mr. John Williamson, for service between Glasgow and the Kyles of Bute. Messrs. Russell and Co., Greenock, will build the hull, and Messrs. Rankin and Blackmore, Greenock, will supply engines of a specially economical type. The fourth order is for a Bristol Channel boat, secured by Messrs. Hutson and Son, Kelvinghaugh Engine Works, who will engine her, the hull being built at Alloa by Messrs. H. McIntyre and Co. She will be a repeat of the Westward Ho, completed by Messrs. Hutson and Son last year for the same service. In the case of the new vessel, the owners have publicly stated she is to be one of the handsomest and fastest river steamers afloat.

### THE NORTHERN CHEMICAL CRISIS.

In the north-east the chemical manufacture is evidently approaching a crisis. The notices to terminate the employment of some thousands of persons employed in the manufacture are running their course; and whilst the beginning of the idleness antedates only a little the usual year-end holidays, it is now officially stated that the resumption of work will depend on the acceptance by the workmen of certain reductions in wages. It is, we believe, the fact that three or four years ago the trade was comparatively brisk, and advances in the rate of pay were made, in some instances voluntarily, and in others in response to claims on the employers by the men. Since that time the price of many of the products of the factories has gone down considerably—the fall in soda crystals being about 40 per cent., with a declining tendency still; and the employers naturally wish to reduce the cost of production in some degree. It is now becoming apparent that the competition between the two methods of manufacture—that by the old Leblanc process, and that by the newer ammonia process—are beginning, in the present dull condition of the general manufacturing industries, to make certain kinds of chemicals so plentiful that low prices are needful to enable them to be sold. America, it was thought, would greatly increase her orders when the tariff unsettlement was removed; but although this has to some extent been the case, the recovery is an incomplete one, partly because of the intense depression in the trade of the United States, and partly because of the constant endeavour to enlarge her own producing facilities. On the European Continent, too, the production of alkali is being enlarged, so that our manufacturers find that it is imperative to reduce the cost of production if they are to retain some of the markets they have been wont to supply, and to make any profit out of their produce. On Tyneside the production is exclusively by the old Leblanc process, and it finds very keenly the critical state of the trade, as may be readily seen when it is added that the number of the alkali works in operation there is now only about a third of what it was a few years ago, though probably the production of the operative works has been increased. Thus the issue of the choice that has been put before the workmen in the northern chemical trade is one that will be looked forward to by all who are interested in the alkali manufacture, and in its English birthplace.

### THE YEAR'S SCOTTISH SHIPBUILDING.

Eleven months of 1894 having now passed, an accurate estimate may be made of the output of new shipping in Scotland for the whole twelve months. During the eleven months, tonnage to the extent of 325,000 tons has been sent off the stocks, and from observations taken as to the vessels still in the yards and nearing the launching stage, the year's output may safely be set down at 345,000 or 346,000 tons. This result is an advance on last year's output by about 65,000 tons, but forms exactly an average figure for the past five years. Of the total, the Clyde alone is to be credited with 315,000 tons, leaving a small proportion indeed to the credit of the Forth, the Tay, and other Scottish centres.

## LITERATURE.

*The Electric Current.* By R. Mullineux Walmsley, D. Sc. (London), F.R.S.E., &c. Cassell and Co., London, Paris, and Melbourne. 1894.

*Electric Lighting and Power Distribution.* By W. Perren Maycock, M.I E.E. Whittaker and Co., London. 1894.

*Electric Light Installations.* By Sir David Salomons, Bart., M.A. Vol. III. Whittaker and Co., London. 1894.

We recently had occasion to review a book—"Electricity in the Service of Man," Cassell and Co.—edited and partially rewritten by Dr. Walmsley. The present work strongly resembles the former, but we suppose that the author has felt less hampered when writing a work of his own than when dealing with that of another. The work extends to 754 pages, and the subject is treated as far as possible without the aid of mathematics, the object being to enable the lay reader to understand as much as possible of the modern uses of electricity. The author's position as Professor of Applied Physics and Electrical Engineering at the Heriot-Watt College, Edinburgh, and his earlier experience as principal of the Sind Arts College, Bombay University, have undoubtedly given him valuable experience in this branch of education. The book is well illustrated with 379 figures.

After a brief but carefully written historical sketch of the growth of the science, the author proceeds to describe the methods available for the production of the electric current. The subject of primary batteries is treated with sufficient fulness for the lay reader, and the book is not burdened with descriptions of numbers of obsolete types of cells. The subject of magnetisation is dealt with, and the curves obtained by Professor Ewing are explained. The author acknowledges his indebtedness also to Professor S. P. Thompson. In the description of the thermopile the small commercial efficiency of this class of apparatus is pointed out. Taking the Gulcher thermopile, which was exhibited at the Frankfort Exhibition, as about the most efficient yet produced, he shows that the same quantity of gas, if used in a gas engine and employed to drive a dynamo, would produce about 18½ times the electrical energy produced by the thermopile.

Very considerable space is devoted to descriptions of measuring instruments. Telegraphy is then touched upon, and the subject of the transmission of power and the public supply of the electric current treated. It is of course out of the question, in the space occupied, to treat such a large subject in detail; but the author has produced a work which should assist the general public to comprehend more clearly the principal facts of the science of electricity. If journalists occupied upon the daily papers were to read such books, it might result in more lucid paragraphs dealing with electrical matters.

Mr. Perren Maycock states that, in his work as a teacher under the City and Guilds of London Institute, he knew of no really reliable elementary work which he could recommend to beginners in his classes, and therefore has tried to supply the want. The work originally appeared in three parts, the present volume consisting of the three parts bound in one as a second edition. The author is indebted to Mr. James Swinburne for the revision of proofs and valuable suggestions. The book is written with a view to the syllabus of the City and Guilds ordinary grade examination, and at the end of each chapter there are numerous problems, to be worked by the student. It is intended for use in classes, and there is a savour of the payment-on-results system, which is perhaps difficult to avoid. When a teacher is obliged to rely upon a certain percentage of passes—for pecuniary profit—he cannot afford to illustrate his subject by showing the gradual life history of the various apparatus he describes, but is driven by the ever-present syllabus to sacrifice everything which does not appear calculated to lead to "marks." The book, however, is carefully written and well printed; but some of the illustrations are rather crude sketches.

As the book was originally published in three separate parts, with a table of contents in each, three tables will now be found at different points in the volume. It would seem preferable to collect these at the front, as the work is paged continuously throughout.

The third part of Sir David Salomons' book is now before us. The first two volumes have already received notice, on p. 409, Nov. 9th, 1894. The present volume deals with the application of electricity. In the first chapter the author gives a needful caution to persons desirous of using the electric light, and suggests that a consulting engineer should be called in just as an architect is applied to if a building is required. The far too common practice appears to be to obtain tenders from contractors, and then to find that such tenders cannot be compared with one another, and finally to call in an independent engineer to revise such tenders, or to leave the work entirely in the hands of the contractor. The author points out that the alternate current is far more dangerous than the direct current. For example, he states that there can be no doubt that "an alternate current of 100 volts suitably applied to the human body may prove a death current, whereas a direct current of 600 volts does no harm at all." The susceptibility of different individuals, however, varies greatly, for a person with a naturally dry skin may handle with impunity terminals of an alternate current circuit, which another with a naturally moist skin could not touch without experiencing a shock.

The author distinctly favours paper insulation for conductors as likely to prevent decentralisation of the core, which is liable to occur with rubber insulation if the conductor becomes hot through carrying too large a current. But he states that at present no opinion can be formed as to the lasting character of the paper. With a view to avoiding the evil effects upon the eyesight of clear glass lamp bulbs, the author advises the use of ground glass bulbs only, and we quite agree with the view that a diffused light is best, and that the use of lamps or lights of any kind with shades which cause an intense illumination to be thrown upon any object, while the eyes themselves are in the shade, is a mistake, as it causes unnatural strain upon the iris. The chapter upon testing for insulation is exceedingly clear, and we do not doubt that it is advisable for all persons using the electric light to cause periodical tests to be made as to the state of the wiring, and in this way fires caused by leakage would be avoided.

The book is a valuable addition to the literature of the subject; the author has had so much practical experience that his advice is perfectly sound. In the chapter upon alternate currents he passes beyond the usual bounds of the practical application of the science, and suggests the view that life itself may be a phase of electrical energy; but he is careful to point out that what is said must not be regarded as necessarily his personal views upon the subject, nor must the argument be considered from a religious or irreligious standpoint. Should the existence of life be at any future period proved to be an electric phenomenon, all questions as to whether revealed religion is true or not would in no way be affected.

*Practical Electrical Engineering. A complete Treatise on the Construction and the Management of Electrical Apparatus as used in electric lighting and electric transmission of power.* By various writers. Edited by C. H. W. Biggs, M.I.E E. London: Biggs and Co. Vols. I. and II. 1894.

The first of these volumes contains chapters on general electrical principles and the conductive and inductive circuits and the magnetic circuit, and on electrographics, in all of which the hand of the editor is traceable. Other chapters are on the central station and on foundations considered with reference to the class of machinery used in electric supply works. These are followed by a long section on boilers and boiler fittings, which, though elaborate and painstaking, does not quite meet the requirements of electrical engineers, as it is, on the one hand, too much on the elements of construction, and, on the other, too much merely descriptive of fittings, unnecessary space being given to such things as engravings of donkey pumps. It is also a question whether textbook matters do not take up rather more space than is necessary in the chapter on heat, and, although in itself satisfactory, it is like the chapters on the steam engine, so much of the nature of that which every engineer prefers to look for in the special text and reference books, that it seems somewhat out of place in a work which one would expect would more especially contain those things mechanical, electrical, and critical, which concern the practical engineer in connection with the application of mechanical and electrical engineering knowledge already obtained, in the generation, measurement, and sale of electricity. Our impression as to the requirements, and the promise which is implied in the title, lead us to remark that no chapters in a work of this kind can take the place of the existing standard books on heat for the steam engine and steam boilers, nor are such chapters implied. When, however, we have passed these chapters and reach those on electrical measurement, on switchboards and switches, and on electric light mains, we find what must be looked upon as legitimate and useful parts of the book.

In the second volume we have a valuable addition to the existing literature of practical electrical engineering. The first part deals in fourteen chapters, occupying ninety-seven pages, with the theory and construction of dynamos, alternators, and transformers, and will be recognised as an able treatise on these subjects, and one which will be constantly referred to by the learner as well as by those engaged in these branches of electrical engineering. This part is followed by six chapters, occupying seventy-eight pages, on secondary batteries, and as these contain not only a general description of the construction and electro-chemistry of these batteries, but a useful chapter on the employment of secondary batteries in central stations, they form a valuable part of the work, for although secondary batteries have never achieved all that was expected of them, they form an important portion of the plant in many installations. The design of conductors for distribution, including distributing mains and the various questions concerned in the design and proportions of net works of mains and feeders, occupy the next chapters and 66 pages, and these are followed by chapters on one of the most interesting of electrical subjects, namely, electric transmission, occupying 122 pages. Electric transmission of power and distribution, traction data, energy consumed, and load diagram, form the subjects of the second of this section, and their treatment will be recognised, when taken with the questions dealt with in the third chapter, as of practical value. It may perhaps be noted that there is a little inconsistency in the two following paragraphs found in pages 252 and 257. Speaking of the energy consumed on electrical tramways, the writer says, "therefore it may be safely assumed that a motor which is capable of propelling the car on any road will also be powerful enough to start it in every part of the line, provided that the magnet coils are joined in series with the armature, and provided also that the supply of current from the generator accords with the requirements of the motor." "If we calculate from the accepted coefficients of resistance to traction on common tram rails, we find that an ordinary tramcar will require but 3 to 4-horse power when once in motion. But it is the setting of a vehicle in motion from a state of rest which demands the greatest amount of energy; and the electric motors which were built in the early days were soon knocked to pieces by the enormous strain put upon them at starting." And further on we read:—"The maximum current used was 70 ampères at starting; on the curve or grade it rose to as much as 120 ampères. The average current consumed was 22·6 ampères." Other remarks, which we need not quote, prove that in practice the motor power which would be sufficient to propel a car six miles an hour, will not be sufficient for the other requirements of tramcar operation. Some very good engravings are given of the underground conductors and permanent way of some electrical street tramways at work, and of others which had been under trial; and the parts on traction by overhead conductors is interesting. With reference to the papers by Mr. H. D. Wilkinson, now under discussion at the Institute of Electrical Engineers, the particulars given of the generating stations, road curves, and cost of electric traction in America and elsewhere, form a valuable part of the book. Chapters on incandescent lamps and arc lamps, their construction, consumption, arrangement, and cost, complete the volume.

## *BOOKS RECEIVED.*

*Annual Report of the Board of Regents of the Smithsonian Institution.* Showing the operations, expenditures, and condition of the Institution to July, 1893. Washington: Government Printing Office. 1894. — A valuable collection of papers on scientific subjects, some of which have appeared in other places in this country, with illustrations.

*The Mechanism of Weaving.* By T. W. Fox. Price 7s. 6d. London; Macmillan and Co. 1894.—This is an octavo book of 472 pages. Fairly well illustrated, and supplied with a good index, it has been written in the cause of technical education, and to give the workman of the present day, say a weaver, some information concerning the construction of looms in general, and the principles of their action. The illustrations given were prepared from machines now in the Municipal Technical School, Manchester.

*Thirteenth Annual Report of the United States Geological Survey to the Secretary of the Interior*, 1891-92. By J. W. Powell, Director. In Three Parts. Part I., Report of the Director. Part II., Geology. Part III., Irrigation. Washington Government Printing Office. 1893. These handsome volumes contain papers on hydrography and irrigation on the American Continent, and an elaborate description of the canal system in India, which cannot fail to be of interest to all engineers engaged in this class of work. The illustrations are excellent and abundant.

*Proceedings of the Incorporated Association of Municipal and County Engineers.* Vol. xx. 1893-94. Edited by Thomas Cole, Assoc. M. Inst. C.E. London: E. and F. N. Spon. 1894.—We have in this work a series of papers on subjects interesting to county and municipal engineers. There is neither index nor contents. The papers deal with such matters as breaking up Macadam, wood paving, electric lighting, water and sewage works. The discussions were carried on by those qualified by their position and attainments to speak with authority.

*Proceedings of the Twenty-seventh Annual Convention, American Institute of Architects, held at Chicago July 31st and August 1st.* 1893. Published by the Board of Directors, A.I.A. Alfred Stone, editor. Chicago: Inland Press-office. 1893.—Contains papers on the construction of the buildings of the late Exhibition at Chicago, the transport and power and electrical plant there; accoustics in building, architectural style in the United States, ethics in architecture, recent plumbing practice, use of colour in architectural design, foundations of high buildings, fire-proof construction, architectural engineering, library buildings, and on other subjects.

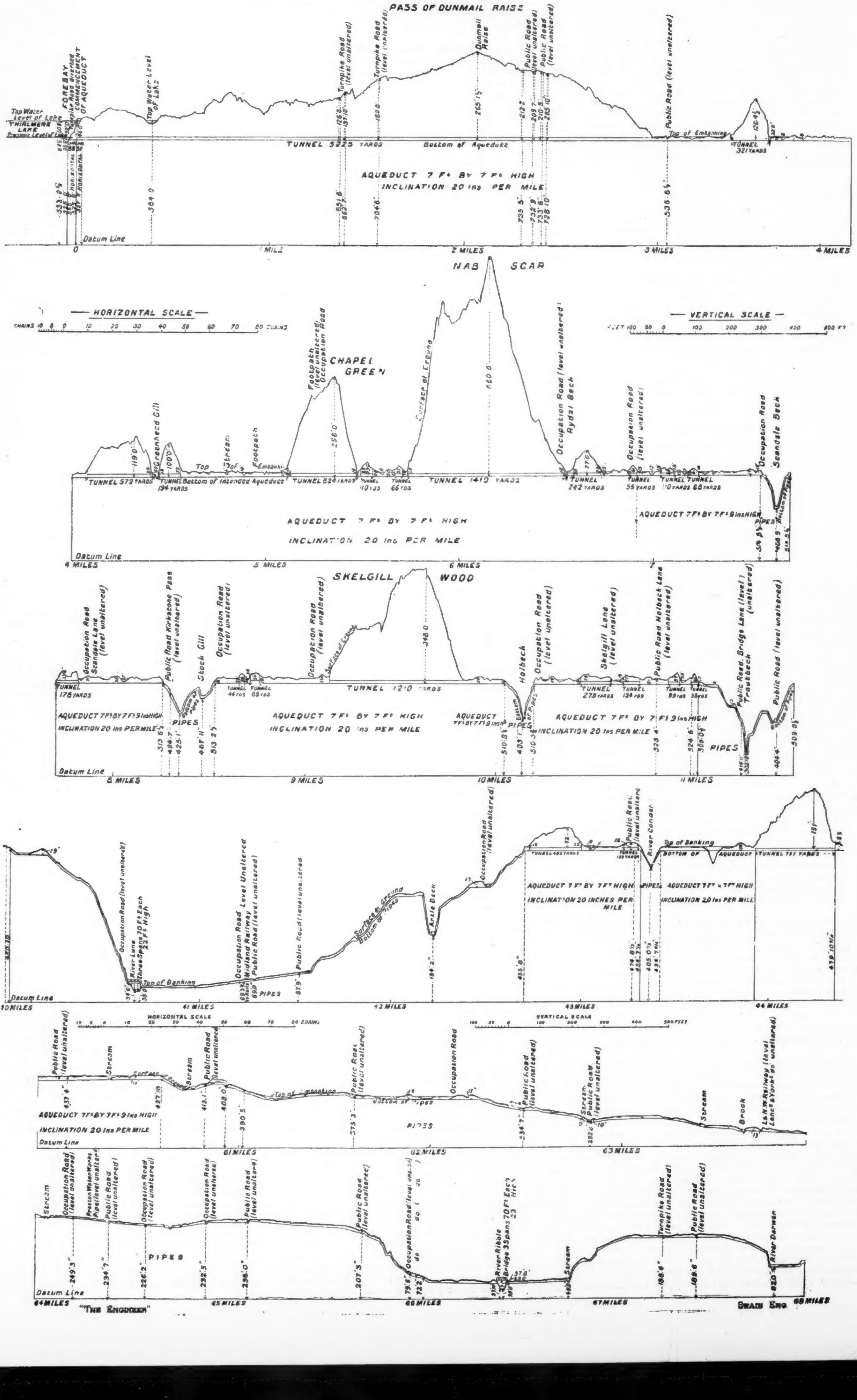
*The Thumb Ready Reckoner. Containing calculations from one sixteenth of a penny to nineteen shillings and ninepence, &c.* Price 1s. London: Henry Frowde. 1895.—This tiny volume contains 640 pages, measures only 2⅛ by 1⅞ inches, and weighs less than an ounce. The figures are all clear and distinct, type having been specially cast. The interest tables give the percentages most generally required; and, with the discount tables, show in a compact form calculations which have to be made daily in every counting-house. The metric system is fully described; together with comparative tables of English and French weights and measures, showing at a glance the value of inches in centimetres, pounds in kilogrammes, &c.; the values of foreign money, and a postal guide are also added. A little case for the book would be useful.

*The Student's Cotton Spinning.* By Joseph Nasmyth. Manchester: Of the Author, 61, Barton-arcade; and of John Heywood, Manchester and London.—This is the second edition of a book which has removed a want previously existing. The chapters are on the evolution of cotton spinning and the distribution and varieties of cotton; mixing, opening, and scutching; carding, combing, and drawing; mule and ring spinning; manufacture of thread; waste spinning; and the construction of mills. The book thus covers a wide range not covered by the author's book on "Modern Cotton-spinning Machinery," but it may be questioned whether the part concerning steam engines is either looked for or the information wanted, or, if wanted, not much provided by books on steam engines and not on spinning. The book is a valuable one even if nothing is allowed for this part of it, and it conveys to the student clear ideas on the many complicated processes it explains.

# THE MANCHESTER THIRLMERE WATER SUPPLY WORKS

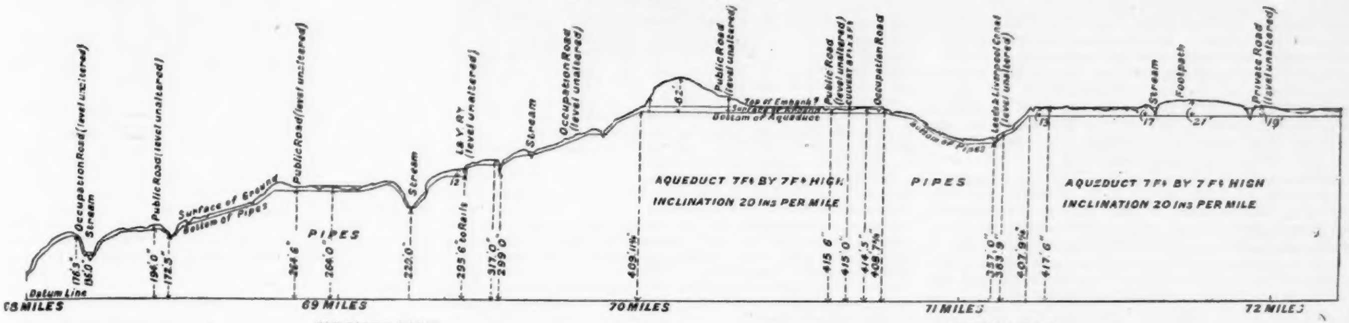
SECTIONS ON LINE OF AQUEDUCT

(*For description see page* 479)


PASS OF DUNMAIL RAISE
Top Water Level of Lake
THIRLMERE LAKE
Present Level of Lake
FOREBAY
COMMENCEMENT OF AQUEDUCT
Top Water Level of Lake
Turnpike Road (level unaltered)
Turnpike Road (level unaltered)
Dunmail Raise
Public Road (level unaltered)
Public Road (level unaltered)
Public Road (level unaltered)
TUNNEL 5225 YARDS
Bottom of Aqueduct
Top of Embanking
TUNNEL 321 YARDS
AQUEDUCT 7 FT BY 7 FT HIGH
INCLINATION 20 Ins PER MILE
Datum Line
0
1 MILE
2 MILES
3 MILES
4 MILES
NAB SCAR
HORIZONTAL SCALE
CHAINS 10 5 0 10 20 30 40 50 60 70 80 CHAINS
VERTICAL SCALE
FEET 100 50 0 100 200 300 400 500 FT
CHAPEL GREEN
Footpath (level unaltered)
Occupation Road
Surface of Ground
Greenhead Gill
Stream
Footpath
Occupation Road (level unaltered)
Rydal Beck
Occupation Road (level unaltered)
Occupation Road
Scandale Beck
TUNNEL 572 YARDS
TUNNEL 194 YARDS
Bottom of Intended Aqueduct
TUNNEL 524 YARDS
TUNNEL 110 YDS
TUNNEL 66 YDS
TUNNEL 1419 YARDS
TUNNEL 242 YARDS
TUNNEL 55 YARDS
TUNNEL 110 YARDS
TUNNEL 68 YARDS
AQUEDUCT 7 FT BY 7 FT HIGH
INCLINATION 20 Ins PER MILE
AQUEDUCT 7FT BY 7FT 9 Ins HIGH
PIPES
Datum Line
4 MILES
5 MILES
6 MILES
7
SKELGILL WOOD
Occupation Road Scandale Lane (level unaltered)
Public Road Kirkstone Pass (level unaltered)
Stock Gill
Occupation Road (level unaltered)
Occupation Road (level unaltered)
Holbeck
Occupation Road (level unaltered)
Skelgill Lane (level unaltered)
Public Road Holbeck Lane (level unaltered)
Public Road Bridge Lane (level) (unaltered)
Troutbeck
Public Road (level unaltered)
TUNNEL 176 YARDS
TUNNEL 44 YDS
TUNNEL 88 YDS
TUNNEL 1210 YARDS
TUNNEL 275 YARDS
TUNNEL 138 YDS
TUNNEL 99 YDS
TUNNEL 55 YDS
AQUEDUCT 7FT BY 7FT 9 Ins HIGH
INCLINATION 20 Ins PER MILE
PIPES
AQUEDUCT 7 FT BY 7 FT HIGH
INCLINATION 20 Ins PER MILE
AQUEDUCT 7FT BY 7FT 9 Ins HIGH
AQUEDUCT 7 FT BY 7 FT 9 Ins HIGH
INCLINATION 20 Ins PER MILE
PIPES
Datum Line
8 MILES
9 MILES
10 MILES
11 MILES
Occupation Road (level unaltered)
River Lune Three Spans 70 Ft Each 122 Ft High
Top of Banking
Occupation Road Level Unaltered
Midland Railway
Public Road (level unaltered)
PIPES
Public Road (level unaltered)
Surface of Ground
Bottom of Pipes
Artle Beck
Occupation Road (level unaltered)
TUNNEL 482 YARDS
Public Road (level unaltered)
River Conder
Top of Banking
BOTTOM OF AQUEDUCT
TUNNEL 737 YARDS
AQUEDUCT 7 FT BY 7 FT HIGH
INCLINATION 20 INCHES PER MILE
PIPES
AQUEDUCT 7 FT BY 7 FT HIGH
INCLINATION 20 Ins PER MILE
Datum Line
40 MILES
41 MILES
42 MILES
43 MILES
44 MILES
HORIZONTAL SCALE
VERTICAL SCALE
Public Road (level unaltered)
Stream
Surface of Ground
Stream
Public Road (level unaltered)
Top of Embanking
Public Road (level unaltered)
Bottom of Pipes
Occupation Road
Public Road (level unaltered)
Stream
Public Road (level unaltered)
Stream
Brook
L. & N.W. Railway (level unaltered)
Lanc. & Yorks. do (unaltered)
AQUEDUCT 7FT BY 7FT 9 Ins HIGH
INCLINATION 20 Ins PER MILE
PIPES
Datum Line
61 MILES
62 MILES
63 MILES
Stream
Occupation Road (level unaltered)
Preston Water Works Pipe (level unaltered)
Public Road (level unaltered)
Occupation Road (level unaltered)
Occupation Road (level unaltered)
Public Road (level unaltered)
Public Road (level unaltered)
Occupation Road (level unaltered)
do do
River Ribble Bridge 3 Spans 70 Ft Each 23 High
Stream
Turnpike Road (level unaltered)
Public Road (level unaltered)
River Darwen
PIPES
Datum Line
64 MILES
65 MILES
66 MILES
67 MILES
68 MILES
"The Engineer"
Swain Eng

# THE MANCHESTER THIRLMERE WATER SUPPLY AQUEDUCT

(*For description see page* 479)

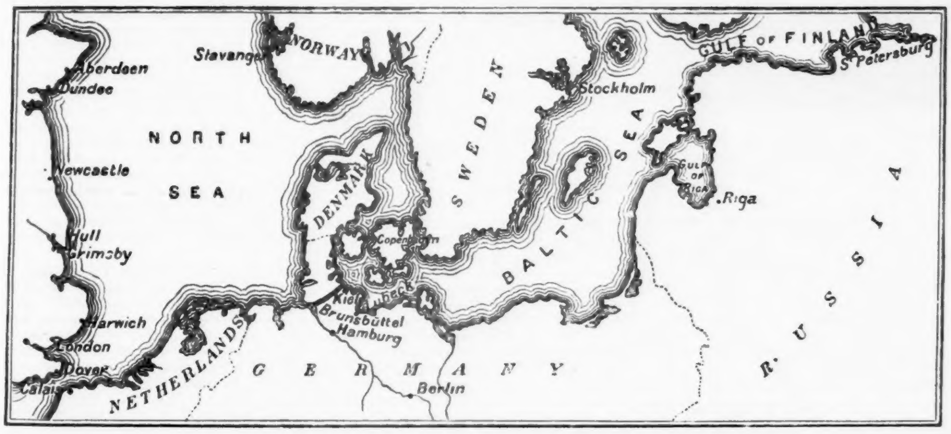


## FOREIGN SHIP CANALS.

The present seems to be the era of canals and shipways. No sooner was the Manchester Canal undertaken than other schemes for securing similar advantages came up for discussion and promotion. Some comparison of these may be of interest. Two of these later schemes, which are now approaching completion, viz., the Baltic and North Sea Canal and the Chicago Canal—of the latter of these we recently gave a short account, and of the former we published an account in The Engineer, vol. lxxvi., p. 326—are works of great importance and magnitude, and present features of general interest to the profession. The annexed table gives the leading features of these three canals, and also of the Suez, so that a comparison may readily be drawn without trouble:—

| Name of canal. | Length in miles. | Depth in feet. | Bottom width in feet. | Surface width in feet. | Passing places. | Number of fixed bridges over canal. | Headway for masts under ditto. | Number of swing bridges over canal. | Years in construction. | Cubic yards of excavation in all materials. | Cost of scheme in pounds sterling. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manchester .. | 35½ | 26 | 120 | 172 (average) | None | 7 | 75 | 9 | 6 | 53½ million | £15,000,000 |
| Baltic.. .. .. | 62 | 30 | 86 | 217 | 7 | 2 | 140 | 4 | 7 | 69 million | £8,000,000 [estimated |
| Chicago .. .. | 29 | 23 to 26 | 160 to 200 | 162 to 300 | None | — | — | — | Not finished | 36 million | Not finished. |
| Suez .. .. .. | 100 | 26 | 72 | 150 to 300 | 18 | None | — | — | 10 | 80 million | £20,000,000 |

*The Baltic Canal.*—The accompanying map will show at a glance the position and object of the Baltic scheme, and indicates at once the great facilities which the canal will offer to all vessels trading with Baltic ports. At present the natural and only entrance to this sea is by the canal Skagerack, and through the sinuous channels dividing the East Coast of Denmark from the neighbouring shores of Sweden. When we consider the dangers of this passage, and the enormous amount of shipping passing and re-passing every year, in addition to the list of vessels which are annually lost in and about the Sound, we do not wonder that at length an alternative route is being provided at the entire cost of the State. In 1877 the amount of shipping entering and leaving the Baltic was returned at 10¼ million tons, and by 1889 this great trade had increased to over 16½ million tons, and is still growing. Every year two hundred shipping disasters on an average are reported from these seas, and in 50 per cent. of the cases the ship becomes a total wreck, the crew most frequently perishing along with the vessel. The first attempt at an improved channel was made by the townfolk of Lübeck early in the fourteenth century, by cutting a short canal to connect them direct by water with the city of Hamburg. Other and more important schemes were from time to time proposed, but most of them came to nothing for reasons of a political and somewhat selfish nature. But when the provinces of Schleswig-Holstein became a part of the consolidated German Empire, Herr Dahlstroen, the engineer of Hamburg, saw that there was some hope of carrying some such project to a successful issue. In 1878 he first prepared a tentative scheme, and in eight years' time all opponents, both commercial, political, and military or strategic, had been convinced of the true value of the scheme. It is said that Von Moltke was for a long time opposed to the idea, but afterwards came to see that it had without doubt special advantages to offer in case of a prolonged naval struggle. After the plans had passed with the Reichstag and the Prussian Diet the money was raised as a State loan, and the work of construction officially commenced on June 3rd, 1887, by the late Emperor William I.—just five months before the cutting of the first sod of the Manchester Canal. Eight years was the estimated time for construction, and this, it is said, will not be exceeded, but whether the original estimate of 156 millions of marks is also "within the mark" we are not told. The canal, as we have said, is sixty-two miles long, and runs by easy bends in a north-easterly direction from Brunsbüttel on the Elbe to Holtenau, near Kiel. At each of these places entrance locks, 500ft. by 83ft., with a depth of 32ft. 6in. on the sill, have been constructed, but it is not expected that they will be called into use except on rare occasions, possibly at Holtenau, and for a short time between tides at Brunsbüttel. The engineer's scheme is that there shall be a constant flow from east to west, out of the practically tideless Baltic into the Elbe. In this way the canal itself will be kept sweet and fresh, and the steady flow, it is expected, will help to scour the channel of the Elbe, which in some places is shallow and tends to silt. The construction of the work has not been a matter of serious difficulty at any stage, the entire mass of excavation being in sand or clay, no rock being met with from end to end. Perhaps the greatest trouble to be overcome was the cutting of the channel through the Meckelmoor—a swamp or morass a few miles west of Rendsburg. However, by tipping sand from other parts of the work into the bog, the unstable material was placed under pressure and "spewed" out. The canal was afterwards cut through the comparatively dry sand which had deposited in place on the clay substratum. The normal surface width of the canal is 217ft., with a bottom width of 87ft.; but at the seven special passing places or "lay-byes" the width at surface is increased to 330ft. from side to side.



MAP OF SEAS CONNECTED BY NORTH SEA AND BALTIC CANAL

*The Chicago Canal.*—Referring shortly by way of comparison to this latest American work, we find a most curious state of things existing. The Chicago river was and is little better than an open sewer, taking all the town drainage, and discharging it into Lake Michigan or into the valley of the Mississippi as the local rainfall chanced to cause the river flow to tend. For some years past, however, the discharge of any sewage into the lake has been forbidden by the "powers that be," so the river has been given an artificial current back to the Mississippi water-shed by means of pumping at the Chicago City end. With a view to improve on this state of things, and to afford relief from flooding, the river is now being diverted, and a new drainage canal cut from Chicago to Lockport, a distance of twenty-nine miles. This is, however, only a part of the entire scheme, for it is contemplated to carry the works down the valley a further seven miles to Lake Joliet, making a total distance of thirty-six miles from Chicago. It is interesting to note that whereas in the case of the Manchester Canal one of the great arguments used by the opponents of the scheme before Parliament, was the fact of there being sewage in the river water. At Chicago the promoters are actually proposing that their "open sewer" shall be used as a navigable channel for vessels up to 22ft. draught. We dealt fully with the various aspects of this work in The Engineer, of 28th September, 1894, and only hope that no serious epidemic will result from this bold venture if ever it becomes an accomplished fact. Some critics, however, say they cannot imagine a more complete "cholera trap" than this is likely to prove during the hot months of an American summer.

## SOUTH AFRICAN RAILWAYS.

The British Consul at Beira has made a further report on the railway from Beira to Mashonaland, considering one necessary, as since the former report a wet season has passed, improvements have been made in the rolling stock, and the extension to Chimoio is well under weigh. Starting from Beira at 8 a.m., Fontesvilla was reached at 4 p.m. The railway workshops there contained a circular saw, various boring and cutting machines, and a turning lathe. About six men were at work fitting up a new locomotive and repairing others. There is a fairly large siding here, the rails running to the goods station at the river bank. Landing is effected when necessary by a six-ton steam crane. Shunting is mostly done by natives, of whom there is a staff of about fifty for station service. The passenger station, like most of the buildings at Fontesvilla, is of wood and corrugated iron. The railway ground is enclosed by a fence of barbed wire. There are two trains each day, one leaving at 7 a.m. and the other a few hours later. The early one, by which passengers usually travel, reaches the terminus about 6 p.m. The journey is performed in three stages of forty, twenty-five, and ten miles each, this method of running being rendered necessary by the unsuitability of the rolling stock. The heavy engines are not on bogies, and cannot with safety go round the sharp curves on the upper part of the line, and the smaller engines cannot take heavy loads up the inclines. The train, on starting from Fontesvilla, consisted of four goods and one passenger truck, but by the time it reached the terminus only one goods truck was left. After forty miles, even with a small engine, the train went very slowly round the many curves. Passengers are carried in a truck fitted with garden seats, and protected from sparks and the weather by a light wooden roof without sides. The line is very well laid and maintained, the trucks running smoothly even when going at twenty miles an hour on the level. Surface men are stationed at every seven miles to keep the permanent way in good order. At seventy-five miles is the camp, 1000ft. above the sea level, the headquarters of the men working on the extension. Almost immediately after the cuttings and embankments begin, and continue for about three miles, the extreme depth of the former being 40ft., and the extreme height of the latter 60ft. The soil is mostly hard gravel, and very little blasting has been required. The longest embankment is about 1000ft. long, and contains 17,000 cubic yards of material. The heavy work has to be finished and ready for the rails by the end of the month of August. Plate-laying was going on beyond, and had reached to eighty-two miles. A temporary line passing round the heavy work had been laid over a short, steep hill. Material for the plate-laying has to be carried on men's shoulders about 500 yards up-hill, that part of the temporary line being too steep for trucks. From the top of the hill trollies run of themselves towards the extension. A locomotive employed in carrying material was dragged up the hill by 200 natives. The contractor's principal office, connected by telegraph with Fontesvilla, is at seventy-seven miles. There are telegraph stations at forty and sixty-two miles. The supply of water along the line has been a serious affair. As a rule, it is pumped from wells over 60ft. deep into iron tanks at the side of the line. Wood fuel is largely used for the locomotives, being readily obtainable close to the line except along the first ten miles. The timber on alternate blocks along the line belongs to the railway company. In a few places the trees are large enough to have a commercial value, which the railway company intends to test by exporting some specimens. Between Fontesvilla and the terminus there are two wooden bridges carrying the line across the Crocodile and Mutachiri rivers, also several cuttings and embankments, but none of any size. The first run of the train driven by a traction engine to pass through that portion of the line going through the tsetse fly country was a comparative failure, no proper arrangements having been made for a water supply along the line which runs along the top of a ridge, and all water having to be carried to the engine in buckets, sometimes for a distance of 400 yards. Some days the run made did not exceed five miles. The second run was also a failure, and during the first month only thirty runs were performed, instead of 150, as was hoped for. The water difficulty still exists, though to a much smaller extent; but the contractors have great trouble with their engine drivers, who are not steady. Transport to Chimoio by wagons and native carriers was going on more rapidly than from Chimoio forward. The rates are: From seventy-five miles terminus to Chimoio, wagons, £12 10s.; traction engine, £12 per ton; natives per load of 50 lb. to 75 lb., 9s.: Chimoio to Salisbury: Wagons, £15 per ton. When the railway is open to Chimoio it is expected that the rate from Biera will be reduced from £32 10s. to £20 per ton. Very little serious damage was done to the line by the rains of 1893-4. For the line the work was most suitable. The only defects are—Insufficiency and unsuitability of the rolling stock; laying of the first part at the level of the surrounding plain, which in the wet season is flooded to a depth of 2ft. or 3ft., and the extreme steepness of some of the embankments, from which the jar of the passing train causes earth and stone to fall down. The first is being remedied, the second has not any result until the rains, and the third, it is said, will cease when the grass has grown on the banks.

## IN PARLIAMENT, SESSION 1895.

AMONG the notices already put forward is an application by the Great Eastern Railway for general powers, including the construction of a new railway and wharf or quay in the Isle of Ely, along the north-west bank of the River Nene, the old course of which is to be dredged. The company also petitions for powers to purchase additional lands in the counties of Middlesex, Essex, Suffolk, Cambridge, and the Isle of Ely, and for an extension of time for the completion of the works authorised by its Act of 1890. Under the title of Lynton and Barnstaple Railway, a Bill will be introduced for the incorporation of a company, together with the clauses necessary for entering into agreements with the London and South-Western and the Great Western Railways. Clause 2 contains a special provision, which is to authorise the construction and maintenance of the railway hereinbefore described, or any part of it, on any gauge not being less than a 2ft. gauge, and not of greater width than 4ft. 8½in., and as far as may be necessary, to exempt the company and the railway from the provisions of the "Act for regulating the gauge of railways," and to amend or repeal the Act. A Bill is also sought for by the Wrexham and Ellesmere Railway for a new line in Salop, and an extension of their loop line to Oswestry. The Fishguard and Rosslare Railways and Harbours Company ask for powers to build, work, and use steam and other vessels, and to raise further capital. The Brymbo Water, the British Gas Light—Staffordshire Potteries—and the Chesterfield Gas and Water Board are also in the list of proposed applications.

A Provisional Order is solicited for the construction of a new pier, 230 yards in length, and harbour at Minehead; and the Pontypool Electric Lighting, Notting Hill, Winchester Corporation, New Windsor Corporation, Alderley Edge, near Chester, and Swindon New Town, are all petitioning under the Electric Lighting Acts for similar Orders. The Barnstable Gas Company has likewise scheduled an application to the Board of Trade.

The recent addition of over a hundred notices for Private Bills and Provisional Orders for next session must have had an inspiring effect upon the parties concerned in the promotion of engineering projects and utilitarian schemes demanding legislative enactments. More than a third of this number are promoted by existing railway companies, as is usual, many of which require extension of powers, extension of time, and extension of capital. Among these we observe it is proposed to make a light railway—Stroud and Painswich—to be constructed and worked as such.

In London, the Metropolitan District ask for time to complete the Acton Junction line, and the City and South London desires to make an additional approach to its station at King William-street. The Great Northern and City petition for extension of time to purchase lands and complete works. In respect of projected works closely concerning the metropolis, other than railways, the London County Council has no rival. The Tower Bridge, Southern approach, is again to be brought forward, and a Bill is put forward for a new bridge over the Thames at Vauxhall. Besides asking for general powers to enable it to widen some of the London streets, the London County Council seeks separate Bills for widening the Strand and Carting-lane, and to allow them to work some of the tramways. Eight of our waterworks are to be transferred to the same authority, not to mention some minor absorptions.

Under the title of the Westminster Parliament-street Improvement, an extension of time is petitioned for, in order to allow of the compulsory purchase of lands between Great George-street and Charles-street, and between Parliament-street and Delahay-street. Powers are asked by the Manchester Ship Canal Company to alter the position of its pontoons, jetties, and workshops; and we notice the reappearance of the Dover Undercliff Reclamation, which proposes the construction of an embankment from Dover to the bay of Saint Margaret.

Among the Provisional Orders, which are increased by over a score, those applying to electric lighting far exceed all the others. There are a few relating to water supply, and one or two for the construction of piers and other marine works. In the metropolis, the Strand District and the Battersea Electric Lighting Co.'s are to the front, while in the provinces we find included in the same category towns of the size and importance of Southampton, Salisbury, Llandudno, Luton, Bath, Devonport, Margate, and others of similar calibre.

## LETTERS TO THE EDITOR.

(*Continued from page* 4o7)

### THE THEORY OF THE STEAM ENGINE.

SIR,—Mr. Cherry's proposition may be put into the following shape. The three angles of a triangle are equal to two right angles. Therefore no heat engine can have a higher efficiency than that denoted by the fraction $\frac{T-t}{T}$.

The assertion that what is known as Carnot's theorem can prove of the smallest utility to inventors or designers of hot air, steam, or gas engines, is flatly untrue. Mr. Cherry ought to know perfectly well that it is untrue. I have already shown that the fraction of the heat supplied utilised in the cylinder of a good steam engine may be double that which, according to Carnot's theorem, it ought to be. Why does not Mr. Cherry attack that statement and show wherein the error lies?

I will go further, and challenge Mr. Cherry to prove that Carnot's engine is that which will give a maximum return in work for heat expended. The so-called "proof" is most unsatisfactory. Here it is as given by Maxwell:—"Carnot's principle, then, is that the efficiency of a reversible engine is the greatest that can be obtained with a given range of temperature. For suppose a certain engine M has a greater efficiency between the temperatures S and T than a reversible engine N, then if we connect the two engines, so that M by its action drives N in the reverse direction, at each stroke of the compound engine N will take from the cold body B the heat *h*, and by the expenditure of work W give to the hot body A the heat H. The engine M will receive the heat H, and by hypothesis will do more work while transforming it to B than is required to drive the engine N. Hence, at every stroke there will be an excess of useful work done by the combined engine. We must not suppose, however, that this is a violation of the principle of the conservation of energy, for if M does more work than N would do, it converts more heat into work in every stroke, and therefore M returns to the cold body a smaller quantity of heat than N takes from it; hence, the legitimate conclusion from the hypothesis is, that the combined engine will, by its unaided action, convert the heat of the cold body B into mechanical work, and that this process may go on till all the heat in the system is converted into work. This is manifestly *contrary to experience*, and therefore we must admit that no engine can have an efficiency greater than that of a reversible engine working within the same temperatures."

It will be seen that the whole point of the "proof" hangs on the words which I have put in italics. Ther eply is simply that no one has any experience on the subject, and that there is no valid reason whatever why the whole of the heat in a system should not be turned into work, as well as any part of it. Indeed, it is quite possible to conceive of a condition in which every portion of the heat contained in a gas would be turned into work. The so-called proof is not in any way a proof. I can remember when the argument used to stop at the words "combined engine"—not in Maxwell's treatise, be it observed—and then we were told that the action supposed would be contrary to the conservation of energy. Maxwell combats this notion very properly, and is driven to "contrary to experience," which is, of course not in any way a mathematical proof of an assumed mathematical law. Need I tell Mr. Cherry that a host of the first mathematicians, such as Tait, Hirn, &c., have disputed at various times and in various ways the soundness of Clausius' conclusions?

But not to unduly prolong this letter I will ask Mr. Cherry to state definitely, plainly, and without any quibble, mathematical or otherwise:—(1) In what way Carnot's theorem is to be applied to a modern heat engine, gas, oil, steam, or hot air? (2) How Carnot's theorem is to be used to prevent an engineer from making an invention, and wasting money in designing and making any particular kind of heat engine? (3) Why it is that for a given range of temperature, steam in a good engine utilises about twice as large a fraction of the heat expended as ought by Carnot's theorem to be utilised?

No doubt his reply will be that Carnot's theorem refers to a mathematical abstraction. That being so, will he kindly state, if he can, what is the use of reproducing it in text-books on thermodynamics as though it was a thing of "very great value," a "most important principle," and so on? and lastly, is it not true that I have assessed at its full value to engineers, which is equivalent to that of a treatise on the ice caps of Mars?

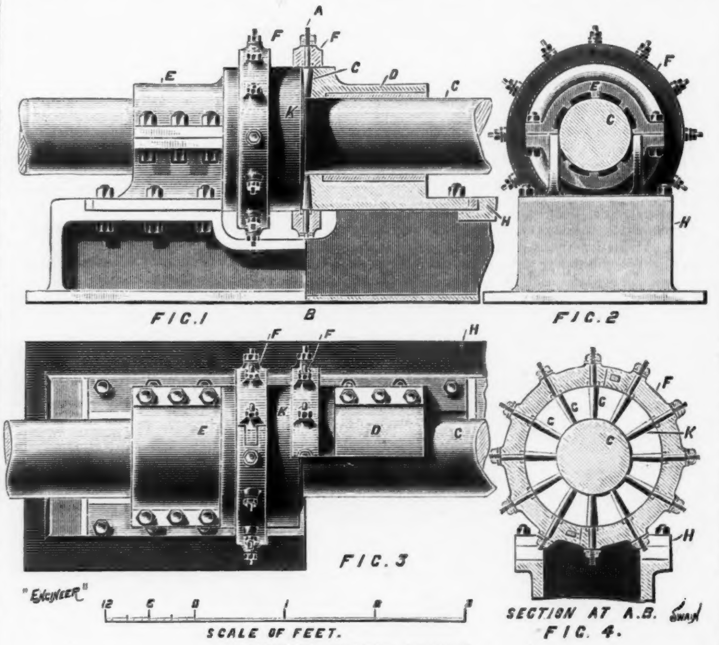
Is it too much to hope that before this discussion closes, Mr. Cherry will write one more of his oracular letters, and state plainly the case for Carnot's theorem I *should* like to see it.

December 3rd. MAURICE CROSS.

### THRUST BEARING FOR MARINE ENGINES.

SIR,—The enclosed drawing represents Pether's anti-friction thrust block to reduce the load on the engines. The principle consists in taking the thrust on a series of conical rollers carried in a ring surrounding the thrust collar on the shaft, each of which rollers revolves as the shaft rotates. The rollers are confined to a circular path by means of shoulders bearing against gun-metal bushes in the ring. This ring is also free to revolve, and thus, by the combined action of the two rotating surfaces, the load is distributed, and the speed on the thrust surfaces reduced to half that of the shaft. Tests have been made on the same thrust collar under equal loads with a model, with the result that the side having the conical rollers takes half the torsional strain to revolve as against the same thrust fitted and working against a fixed thrust box of the ordinary pattern. Referring to drawing, Fig. 1: C, shaft; D, thrust bearing in section; E, thrust bearing, outside view; F, ring retaining rollers; G, rollers taking thrust; H, foundation of thrust block; K, thrust collar. Fig. 2: C, shaft in section; E, thrust bearing; F, ring retaining rollers; H. foundation. Fig. 3: C, shaft; D, thrust bearing in section; E, thrust bearing outside view; F, ring retaining rollers; H, foundation plate; G, thrust collar. Fig. 4: C, shaft in section; F, ring retaining rollers; G G G, conical rollers; H, foundation in section; K, thrust collar. W. R. PETHER.

London, November 24th.



PETHER'S THRUST BEARING

### THE FLYING MACHINE.

SIR,—Referring to the letter on the "Flying Machine" signed "B.," which appeared in your last impression, it seems to me that the analogy of the kite is pushed much too far in dealing with a free machine, such as Mr. Maxim's would be when once clear of the rails. It is a fact well known to balloonists that when once they are up the air appears to be quite stationary relatively to them. The effect of a change in the direction of the wind in such a case is simply to make the balloon or flying machine move bodily in that direction, and there is no sideway tilting force whatever unless the body of the machine is held. This is practically the case of the kite. Just as a ship if moored broadside against a strong tide would assume a list, but if free would merely be carried bodily along on an even keel.

The time when an aërial navigator would have to be careful would be just when alighting or rising, which he should always do head to wind, as many large birds are in the habit of doing. The great disadvantage of only having a horizontal driving screw is that a level track is required to start the machine. If flying machines are to be of practical use, as I firmly believe will be the case in a very few years, they should be able to come down in any fairly level place, such as a field. This would seem to point to the use of propellers on vertical shafts, as "B." remarks, or better still, to propellers on shafts which are capable of being rotated through a right angle. At starting the shafts could be made vertical, and as the machine rose they could be gradually lowered until sufficient translational speed had been attained for the aëroplanes to take the entire weight. The whole of the power on board would then be employed in driving the machine horizontally, and this would be the minimum speed admissible to secure the maximum efficiency of the propelling apparatus. These screws on adjustable shafts would have the advantage that only one set of engines would be needed. For, if as "B." suggests, fixed auxiliary lifting screws were used, all the weight of engines necessary to drive them would be useless when once the machine was properly under weigh. This speed of maximum efficiency, if I may so term it, would probably be something over 100 miles an hour.

A far more difficult problem to tackle is the question of fore and aft stability. Any alteration of the centre of gravity, such as a man walking from one end of the machine to the other, would tend to make it either swoop or soar. A bird when he finds his centre of gravity shifted rights himself instantaneouely, and by instinct, with his tail. And it is the tail of the artificial bird which is the crucial point of the whole thing. We must either have an exceedingly practised and quick steersman, who must never let his attention wander for a moment, or better still some delicate form of mechanism, which will, on the slightest tendency of the machine to swoop or soar, immediately raise or lower the tail till equilibrium is again restored. Mr. Maxim seems to have solved the problem of mechanical flight in so far as it relates to the ability of his machine to lift its own weight, but in its present state what is to become of it when once it is up, Mr. Maxim and Providence will have to settle between them. CONTEST.

Birkenhead, November 27th.

### BOILERS AND BOILER EXPLOSIONS.

SIR,—The illustration you published in last week's issue of THE ENGINEER is by no means a solitary instance of the most woeful ignorance of some people as to their moral and legal responsibility concerning the use of steam power. I once heard of a case where the fire-box shell of an old and badly cared-for portable was roped round in two places, and wedges driven in between the plates and the ropes. This was, I suppose, considered quite a clever idea on the owner's part to keep the plates together, where the proper means seemed likely to fail. I also had a case under my own personal notice where a boiler was knowingly worked with a portion of the front plate no thicker than a sheet of paper, and when I finally prevailed on the owner to have it stopped, a hammer was driven clean through the plate by a comparatively light blow. This boiler was a Lancashire, 9ft. in diameter by 24ft. long, and was working at 60 lb. pressure. The only reply of the owner when informed of its dangerous state was, that "all he hoped was that it would hold out for a few weeks longer," and the boiler was deliberately worked in this condition for several weeks in a factory employing about 200 hands, which in my opinion was as decidedly a criminal action as that of a man who places a sleeper in front of a railway train to see if the wheel guards will throw it off.

Now, part of what I am about to say has been brought up times without number in different ways, and therefore possesses no claim to originality, but it will take no harm from a fresh thrust on the world, and that fact must stand as my apology for again bringing it up. I allude to some system of compulsory inspection. Engineers themselves, and others who are careful in a similar way, are apt, we know, to keep their plant in good order without any external pressure of any kind, simply because they realise of their own accord the economic importance of keeping that same plant in first-class—and consequently safe—repair. But it is when the first-class—to use an expression—user has considered it more beneficial to himself to part with a boiler that the real danger begins, and then a step further than inspection might well prove useful. I mean some system of compulsory registration, for as a boiler passes from hand to hand each vendor in turn expatiates on its merits to effect its sale, and thus in time all chance of obtaining any trustworthy information concerning it disappears. I would venture to say that if every boiler in the United Kingdom were inspected next week, there would be found at work hundreds that no sane engineer would ever put anywhere but on the scrap heap; and if users of boilers were to notify all particulars of changes, repairs, and general incidents that have taken place in connection with such plant, the result would be surprising, especially those reports from the agricultural districts.

The trouble is unfortunately not a lessening, but rather a growing one, for as a boiler increases in age and defects and decreases in price, so it proportionately comes more and more within the reach of persons with little or no previous experience, and who are in many ways less able to undertake the growing responsibility of its care.

What I would suggest, therefore, for older and wiser engineers to consider, is some system that would embrace the following essential points:—(1) Compulsory annual inspection by duly qualified inspectors, or carried out by firms capable of assuming the responsibility of such work, several of which are already existing. (2) Compulsory registration, to include (*a*) makers' name and date of manufacture; (*b*) past history of the boiler; (*c*) nature of past repairs, renewals, &c.; (*d*) fittings, description and condition of; (*e*) present use and pressure employed; (*f*) a yearly report, showing details of all repairs and matters of consequence connected with the boiler during the year.

It is very evident that it is neither conducive to the good of the users themselves, nor the trades or public generally, that old wasteful "tanks" should be working at pressures varying from 10 lb. to 30lb. per square inch, to the imminent danger of life and property; and it is, moreover, manifestly ridiculous and unjust that, while a firm may be indicted by a factory inspector for so small a matter as leaving a flywheel unguarded, yet others—say, for instance, a farmer, who may use an old portable in close proximity to the village street—are unmolested in the use of plant that is a far and away more dangerous matter where life is concerned.

That the difficulty would not be so very great is proved by the fact that some firms are able to register with more or less success the whereabout of their own goods. For instance, I believe the Pulsometer Engineering Company is able to refer anyone to almost any of the 14,000 of their pumps in use, and this firm will make a stipulation that place and use of a pump must be supplied before they will execute an order.

If a private firm can do this with even a small measure of success, surely it is an easy matter for an official register to be kept by making it illegal to work a boiler that is not duly entered and approved of. Of course for a few years there will be entries of a doubtful character, and many boilers of which full particulars cannot possibly be obtained, but in time as the old stagers become useless and drop out, this would correct itself, and whatever objection there may be to such a scheme there is no doubt in my mind that it would be a very desirable improvement on the present state of affairs, and it appears to be only by some such system that any embargo can be put on wilfully careless neglect.

WILLIAM F. RICHMOND.

1, Martello-terrace, Strand, Bray,
Co. Wicklow, November 4th.

Sir,—Being subscribers to your paper, we beg to report the explosion of a Cornish boiler in this village, particulars of which might be of interest. The boiler in question was used for supplying steam to drive the engine of a flour mill situated within one minute's walk from this station.

The back end plate was blown outwards, and twisted outwards like two curl papers, and lies at some distance behind the remains of the boiler-house, apparently demolishing the brick shaft in its path. The boiler itself, of which the shell and front plate are quite intact, was forced through the front of the boiler-house, across a roadway, through a brick wall and up a garden slope of considerable gradient, striking the side of a brick dwelling-house with considerable force. The tube has collapsed from end to end.

From a casual inspection we have been unable to form any firm opinion of the cause of the explosion; the engine driver tells us he had about 40 lb. pressure of steam and plenty of water in his guage glass; and, as far as we can see, all the damaged plates are of ample thickness, and the lead plug is not melted out.

SQUIER AND HINNELL,

Stanford-le-Hope, Essex, December 1st, 1894.

### MINE EXPLOSION RELIEF FUNDS.

Sir,—A correspondent, signing himself "William Brace," presumes to correct your statements in reference to the terms on which the distribution is being made of the funds subscribed for the sufferers by the Albion Colliery disaster. Your correspondent is singularly ill-informed as regards the facts, or he is guilty of serious misrepresentation. The circumstances which brought the South Wales and Monmouthshire Provident Fund into question may be set forth succinctly—but not, I am afraid, very briefly.

When the explosion took place it was estimated that a sum of between £60,000 and £70,000 would be required to succour and sustain the 135 widows and 350 children bereft of their breadwinners. You were right in saying that the Provident Society, to which the Albion colliers were contributors, had a reserve fund of £144,614. But the society had on its books—as standing obligations—the names of 750 widows and 1500 children, the sufferers from former mining disasters, of which the victims were also subscribers to the Provident Fund. If I remember rightly, you pointed out that besides the £15,000 and odd disbursed last year to widows and orphans on the books, the society had to provide for 20,000 cases of disablement, which created a casualty pension list for the time being of £21,558 per annum.

It was obviously impossible that the society, or any society constituted on similarly loose basis, could meet, out of its own resources, the sudden and exceptional drain. That, Sir, was the point which was addressed to the public in every one of the appeals I have seen. It was said in connection with the Mansion House subscription, and so with the local collections, that the moneys would be directed to the central fund, except in such cases as those in which the subscribers specifically desired that their gifts should pass directly to the widows and orphans in the Albion Colliery village.

Mr. Brace's contention would appear to be that the whole of the amount derived from public benevolence should be devoted to the benefit—an extra benefit—of the widows and orphans. I take it upon myself to say that if Mr. Brace's view had been carried out, and the Provident Society had meanwhile been required to go on paying the stipulated allowances to the widows and children, the Provident Society would have been bankrupt in a year, its resources exhausted, and all its beneficiaries—its 750 widows and 1500 children, and its 20,000 pensioners on account of mining casualties—left to find relief at other doors, and in many cases at the doors of the poorhouse.

What has been done is to constitute a Trust, in close alliance, no doubt, with the Provident Society's Executive, which will be responsible for all the sums that made up the public contribution. The Trust will reinforce the funds of the Provident Society, and avail itself of that society's machinery for the sake of economy in administration. But the society, by arrangement with the Trust, will use the public moneys, so far as may be, to give an addition to the stipulated allowances of the widows and orphans of the unfortunate Albion men. In your kindly way you described this arrangement as a compromise. I, Sir, would have preferred to say that it was a concession. Whatever this transaction may be called, it is based on the Llanerch agreement, and how far the provisions of that agreement confirm or disprove Mr. Brace's allegations, your readers may judge for themselves from an abstract taken from the only daily newspaper in South Wales which has ventured to suggest that the funds of the bountiful public have been diverted to channels for which they were not intended.

The Llanerch arrangement gives the childless widow from the Trust Fund 2s. per week, in addition to the prescribed 5s. per week she should receive from the Provident Fund. A widow with six children receives for herself 5s. 6d. per week—the 5s. coming from the society—and 2s. 6d. per week for each of her children, making a total of £1 0s. 6d. A widow with two children will receive by the arrangement 5s. per week from the society, supplemented by 2s. from the auxiliary Trust, and 1s. 6d. per week for each child. It is not much, truly, but then, as you very cogently pointed out, if a larger allowance is to be made sure of by the widows and orphans in these sad emergencies, the provident societies must be entirely remodelled and placed upon the foundation of actuarial calculations and a larger individual subscription.

AN ALBION RELIEF FUND SUBSCRIBER.

Cardiff, December 3rd.

### AMERICAN WOOD-WORKING MACHINERY AND ENGLISH MANUFACTURING INTERESTS.

Sir,—The mighty advance in wood-working machinery in the United States has evoked surprise everywhere. In America the idea is to make everything of wood without hand-labour, automatically where possible. This desire has been so successful that it is a rare exception a factory is found employing hand-work. Every known description of wood-work out of every kind of wood is made entirely by machinery. Many of these machines are veritable wonders, performing their work with a readiness and an accuracy that excites the most profound attention. Some of the English experts say of them, that they are the best examples of ingenuity ever produced, but of a lighter construction than the English make; but one must bear in mind that American iron when cast into form is very much tougher, and hence does not require so much of it to give their machines strength and solidity. This is hardly true of English iron, and in consequence thereof their machines contain a great deal more weight in iron, and consequently look more massive, but by experience it is proved conclusively that the later improved American machines are just as strong and just as capable in durability as those made by the English makers.

Progressive English manufacturers, and there are a few of them, are gradually awakening up to the fact that if they want to hold their own in the commerce of the world, they will be compelled through necessity to employ the later and far more economical methods to produce their manufactures. To do this they will have to turn to the Americans, much as it may be against their inclination.

American furniture made entirely with machinery is now getting foot-hold in England, and attracts the admiration of English buyers, not only for the beautiful designs and finish, but for superb construction, and lastly at a moderate price. Other articles of wood for domestic, vehicle, agricultural, building uses, &c., are fast creeping in, to the disadvantage of the English manufacturer. Indeed, wherein the American manufacturers succeeds it is only through the use of machinery, and therefore the Englishman, in order to protect himself from encroachment, must adopt the American idea by using American machinery, for is it not a fact that the Englishman is behind the times in the getting up of "up to date" wood working machinery? If this statement is not correct show us the fallacy of it. Machinery saves time and labour, consequently money.

J. T. B.

Cincinati, November 22, 1894.

### A PROBLEM IN VIBRATION.

Sir,—In offering the following formula for calculating the rate of vibration of "McHinery's" apparatus, I may remark that it is merely a modification of the well-known formula

$$\text{Time of vibration} = \pi \times \sqrt{\frac{\text{moment of inertia} \times \text{angular displacement.}}{\text{righting moment.}}}$$

Which applies to a body vibrating about a fixed axis, and subject to the condition that the righting moment varies directly with the angular displacement from a position of rest. For such cases the fundamental formula is exact, and the rate of vibration is independent of the amplitude of the swing.

In the present case these conditions are not fulfilled, for first, the apparatus does not oscillate about a fixed axis—with the result that the moment of inertia is greater as the inclination increases; second, the righting moment varies with the line of the angle of inclination instead of directly with the angle.

But, like a common pendulum, the apparatus approximates to the ideal case more and more as the amplitude of the swing is reduced, and therefore the formula may be expected to give fairly correct results under such conditions. It will be seen that the moment of inertia is split up into two parts, one due to the mass of the cardboard and the other to the mass of the rod. The latter is easily calculated, as it may be taken without appreciable error to have a radius of gyration measured to its geometrical centre, but the moment of inertia of the cardboard—which will be the same for all positions of the rod—is best deduced from experiment.* The formula for time of vibration in seconds is:—

$$T = \pi \times \sqrt{\frac{M R^2 + m r^2}{W d}}$$

where M is the mass of the cardboard, or weight in pounds divided by 32·2; and R is its radius of gyration in feet; *m* is the mass of the rod; and *r* is its radius of gyration. W is the weight of the apparatus in pounds; *d* is the distance of its centre of gravity from the vertex in feet. Note, both R and *r* are measured from the base. For number of vibrations per minute the formula may be written,

$$N = \sqrt{\frac{365\ W d}{M R^2 + m r^2}}$$

I find that, in order to make the result of this formula agree with McHinery's last experiment, I must give the cardboard a moment of inertia—reckoning in the above units—of ·0044, corresponding to a radius of gyration of 8in. The vibrations per minute in the three cases given then come out 81, 138, and 209, against experiment 84, 130, and 210. But considering the nature of the apparatus, one could hardly expect much better.

December 1st. A. N. SOMERSCALES.

### L.C.C. CONTRACTORS *v.* L.C.C. WORKS DEPARTMENT.—A CHALLENGE.

Sir,—We have to-day written the chairman of the London County Council as per copy below. The matter being of great importance to the ratepayers of London, we shall feel obliged if you will publish same.

REED, BLIGHT, AND Co., Ld.,
per JOHN REED, Managing Director.

London, November 28th.

[COPY.]

Albany-buildings, 47, Victoria-street,
Westminster, S.W., November 28th, 1894.

Sir John Hutton,
Chairman of the London County Council,
Spring-gardens, London, S.W.

Sir,—Our attention has been drawn to some remarks made by Mr. John Burns at a special meeting of the London County Council on Thursday last. Mr. Burns is reported to have said that although the estimates of the Works Department of the L.C.C. had been exceeded in many instances, the Council had the satisfaction of knowing that the works executed by their Works Department were of a better quality than the works executed by the contractors under the old conditions.

The excess of the estimates we do not propose to discuss, but we consider Mr. Burns' statement as to the quality of the work not only misleading to the ratepayers of London, but absolutely devoid of foundation, and calculated to damage ourselves and other contractors. We challenge proof of this statement, and would suggest that a committee of experts be at once appointed by the Council to verify it in fairness to the contractors and ratepayers of London.

We give as specimens of the works executed by us the following:—The Private Lunatic Asylum at Claybury, Dynamo House and Electric Light Station at Claybury, foundations for the Artisans Dwellings at Yabsley-street, Poplar, and the Artisans' Dwellings known as Beachcroft-buildings, Brook-street, Limehouse, E.

If in the opinion of the suggested committee of experts, these works are not equal in quality of material and workmanship to works of a similar nature executed by the Works Department of the L.C.C, we are willing to hand over £50 to any hospital you may name.

We presume that—if you adopt our suggestion—the report of the said committee will be published, and as we consider the matter of great public interest, we are sending a copy of this letter to the Press.

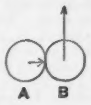
We are, Sir,
Your obedient servants,
(signed) REED, BLIGHT, and Co., Ld.,
per John Reed, Managing Director.

### THE KINETIC THEORY OF GASES: TIME OCCUPIED BY AN IMPACT.

Sir,—I was much gratified by the flattering reference to my last letter on this subject contained in your interesting article on "The Uncertainties of Science." I must, however, disclaim any intention of throwing discredit on the kinetic theory. My letter was simply written to show that "enormous velocities"—or anything approaching to them—were physically impossible in real permanent gases, and that consequently the theory required modification in that respect; and I briefly indicated at the end of the letter the nature of the modification which appeared to me to meet the difficulty, viz., "dissociation." I hope at some future time to discuss this suggested modification at a little greater length, but must refrain from doing so at present as the subject of my present letter—viz., the time of an impact—will occupy as much space as I have the conscience to ask for.

In considering the probable time of impact of molecules of real gases, which may, and probably do possess a vibratory motion, and not a motion of translation only, the time of direct impact may reasonably be supposed to depend upon the time of a vibration, which may be constant for all amplitudes. Under such conditions the time of direct impact will be the same for all velocities, the amplitude of the vibration only varying with the energy of the impact. But in the mathematical conception of a gas composed of smooth elastic non-vibrating spheres, the time of a direct impact, as will be shown hereafter, will vary inversely with the velocity of impact. To prevent misconception, I may mention that throughout this letter the word "molecule" is intended to apply to real gases, and not to include in its meaning non-vibrating smooth elastic spheres.

Although a direct impact between molecules may always occupy the same time, it does not follow that a glancing impact will do so. For suppose two molecules A and B of the same gas to be in the act of colliding, their paths being at right angles to each other as shown in the figure. In this case if a collision was an absolutely instantaneous phenomenon, A would be brought to rest, and B would move on with the combined energy of the two before impact. But if the time of direct impact is a constant definite quantity, *i.e.*, if the time of compression and restitution is always the same, then B's velocity may be so great that it will have moved beyond the influence of A before the completion of the above-named action. Under these conditions the force of restitution may not have had time to come into action at all, and even the compressive action of the impact may be reduced, until it almost vanishes, by giving a sufficiently great velocity to B. For the compression must be gradual in its action on an elastic body, it cannot act with full force at first contact like St. Venan's bars. From these considerations it follows, that the effect of a collision between two molecules depends (1) on the time of compression and restitution; (2) on the direction of the velocities of the molecules at impact, and (3) on the relative velocities of the molecules.



It has been assumed that for molecules of the same gas, the time of compression and restitution is always the same; but it would not be right to assume that in different gases the times were equal. For example, it is not difficult to show that the duration of direct impact between oxygen molecules must be four times as great as the time of impact between molecules of hydrogen. This follows from the fact that while the mean velocity of hydrogen is only four times as great as that of oxygen, the molecules of the latter gas are sixteen times the mass of the former. And since the mean pressure is the same in the two cases, it must act four times as long on an oxygen as on a hydrogen molecule. Hence it is easily seen that, when a direct collision occurs between a molecule of oxygen and one of hydrogen, they will separate before the former molecule is fully compressed.

We will now pass on to find the time of direct impact between two non-vibrating elastic spheres, or what comes to the same thing, the time of impact between a sphere and a fixed plane. Let $\bar{u}$ be the velocity of mean square of a great number of elastic spheres, resolved in a direction to one of the containing planes $l^2$. Let $p$ equal the pressure on that plane due to the impact of any single sphere impinging against it with the above velocity. Let $m$ equal the mass and $d$ the diameter of each sphere, and $n$ the number of spheres in contact with the plane at any instant. Also let $t$ equal half the time of a direct impact and $\rho$ the density of the medium. Now let $l^2$, the area of the plane, be taken so great that the number of spheres in contact with it at any instant is equal to the number in unit volume. Then $l^2 d = 1$ or $l^2 = \frac{1}{d}$.

Now the mean pressure of a sphere, during impact, on the plane impinging with the above velocity is given by the equation

$$p = \frac{m \bar{u}}{t\ l^2}.$$

Hence the pressure of $n$ spheres will be,

$$n p = \frac{n m \bar{u}}{t\ l^2}.$$

But as $n$ is the number of spheres in unit volume $n m = \rho$ the density; and as before seen $l^2 = \frac{1}{d}$. Substituting these values in the above equation and remembering that $2t$ is the time of impact = T, suppose, we get

$$T = \frac{2 \rho \bar{u} d}{n p} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Let P equal the pressure on unit surface of the plane, then $n p = P \times l^2 = \frac{P}{d}$. Hence

$$T = \frac{2 \rho \bar{u} d^2}{P} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If in (2) we substitute the value usually given for P—viz., $\frac{1}{3} \rho \bar{v}^2$; where $\bar{v}^2$ is the mean square of the velocity without regard to direction, and is equal to $3 \bar{u}^2$ it becomes

$$T = \frac{2 d^2}{\bar{u}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

This expression gives the time of an impact for a velocity $\bar{u}$ and for spheres of diameter $d$. The form of the expression shows that the time varies directly with the diameter, and inversely with the velocity of direct impact. The first inference we have drawn agrees with the result obtained in the first part of this letter for the difference in time of impact occupied by molecules of different gases, and the latter might perhaps have been arrived at by ordinary dynamical reasoning. When T become indefinitely small, vanishes, in fact, $\bar{u}$ becomes infinitely great, and when $\bar{u}$ vanishes T becomes infinitely great, which latter result is obvious without any mathematical reasoning.

If Dr. Watson is correct in considering that the mathematical conception of a collision is that of an absolutely instantaneous phenomenon—"Kinetic Theory of Gases," note to page 1—then it would appear from the above equation that all the velocities would be infinite,* and the Maxwellian distribution of velocities would have no meaning. If on the other hand the time of impact varies, as it must, then when the velocity of impact between two spheres is exceedingly slow, their impact may occupy an appreciable time compared with the average time of free path. So that in this case the probabilities of the collision between them being completed before impact with a third commenced would be very small indeed. This seems somewhat antagonistic to Dr. Watson's proof of the Maxwellian distribution—"Kinetic Theory," note to page 1—but it must be conceded that the probability of an impact between two spheres with very low velocities may, according to the conditions of the problem, be very slight indeed, but it seems to me that these conditions require to be definitely laid down.

In the proof given for equation (3), the value of the pressure on unit surface in terms of the mean square velocity is given as $P = \frac{1}{3} \rho \bar{v}^2$. In giving this value a concession is made to the present accepted opinion; but I have given ample reasons in former letters to show that the correct value of P is $\frac{1}{6} \rho \bar{v}^2$, and with this latter value equation (3) becomes

$$T = \frac{4 d^2}{\bar{u}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

As the value of P in terms of $\bar{v}$ and $\rho$ is of great importance in the kinetic theory—so important indeed that with the value $\frac{1}{6} \rho \bar{v}^2$ I was able to show in a former letter—May 4th, 1894, page 370—that the ratio of specific heat could be directly found from it, for permanent gases, when the density and pressure at a given temperature is known. I should like to give a further short proof of the correctness of the above expression.

Suppose a stream of inelastic particles to impinge directly against a plane, then the pressure against the plane will be in proportion to the density of the stream and to the square of the velocity. Now suppose a stream of elastic particles to be reflected backward and forwards between two planes, my contention is that the pressure will still be in proportion to the density and not to

---

* If the number of vibrations of the cardboard when unloaded is observed and found to be, let us say, 140 per minute,

$$\text{the moment of inertia} = \frac{365\ W d}{N^2}$$

$$\text{,,} \quad \text{,,} \quad = \frac{365 \times {\cdot}312 \times {\cdot}865}{140 \times 140}$$

$$\text{,,} \quad \text{,,} \quad = {\cdot}005.$$

Or, if a position is found for the rod, which does not alter the rate of vibration, then the distance from that position to the base, is the radius of gyration of the cardboard alone.

* Comparatively few of the velocities might be zero.

half the density of the stream. For consider a single particle, it of course can exercise no pressure on the plane until impact, it is then compressed by its own inertia, and it is only when this compression is completed that the centre of gravity of the particle is brought to rest. The force of restitution then comes into play, and the centre of gravity of the particle commences its journey in the opposite direction; but the particle will remain in contact with the plane, and press against it until it has regained its normal shape. Thus each particle will in turn press against the plane at either end at the end of one journey and the beginning of the next. Consequently the pressure on either plane is proportional to the density and not to half the density. This proves the proposition, but a more vigorous proof was given in my letter of April 13th last, and further developed and amended in my letter of July 27th.

Lord Kelvin estimates the diameter of a molecule as between $\frac{1}{50000000}$ and $\frac{1}{10000000000}$ of a centimetre. Taking the first of these values, the time of direct impact of elastic spheres impinging with velocities of 180,000 cm. would be $0{\cdot}44 \times 10^{-19}$ seconds; the second value would make the time of impact $0{\cdot}11 \times 10^{-23}$ for the same velocity. These times are calculated from equation 3; if equation 4 is employed, these times must be multiplied by two. The distance that a free sphere would move in the time of an impact can be obtained from the formula $s = \frac{2\,d^2\,v}{u}$ or $s = \frac{4\,d^2\,v}{u}$, according as to whether it is derived from equation 3 or 4, $s$ being the distance, and $v$ the velocity of the sphere. And if $v = u$, the expressions become respectively $s = 2\,d^2$ and $s = 4\,d^2$. Thus, it is at once seen that in a glancing impact, as in the figure, if both the spheres are moving with the above velocity, B would not move through an appreciable distance during the impact. The above remarks apply only to imaginary elastic spheres, and not to molecules of real gases. C. E. Basevi.

8, Norfolk-square, W., November 28th.

### THE PROGRESS OF NAVAL CONTRACTS.

Sir,—We notice in your issue of 30th ult. an interesting article on the Progress of Naval Contracts in private yards, but the facts do not bear out the statement that the Clyde builders have outstripped our firm in the matter of rapid construction and delivery. The order for the Banshee, Contest, and Dragon was placed with us in the middle of February last, and the first was launched on the 17th ultimo, the second on the 1st inst., and the third is to be launched on the 15th inst., the hull and fittings being as far advanced as they can be until the machinery is put on board.

The principal parts of the machinery have been placed in the Banshee, and she will be ready for steam at moorings in about a fortnight, and for preliminary trials under weigh in a few weeks after. The respective machinery for the other boats is also ready to go on board.

The orders for the Destroyers building on the Clyde were, we believe, placed during November, 1893—about three months earlier than our boats, and although the progress made with them is excellent, it will be found that merely the preliminary trials have been made, and that some time must elapse before the official trials are completed, and the boats ready for delivery. The battleship Mars progresses rapidly, and the weight of material worked into the hull and passed over scale is 3420 tons in 155 days from the laying of the keel. No doubt building in a dry dock gives us an important advantage and facility for building such a ship.

Birkenhead, December 4th. Laird Bros.

## THE VARIOUS TYPES OF BASIC OPEN HEARTH STEEL FURNACES.

The following is a report of the discussion which took place at the meeting of the Cleveland Institution of Engineers at Middlesbrough, on Mr. Bernard Dawson's paper on "The Various Types of Basic Open Hearth Steel Furnaces."

In opening the discussion, the President said that Mr. Dawson had given a great deal of time and attention to the subject, and appeared to have got people in all parts of the world to give him the latest information. The President then read communications from Mr. E. H. Saniter, Wigan; Mr. William Hawdon, ex-President; and Mr. Thomas Turner, Stoke-on-Trent.

Mr. Hawdon in his remarks said the question raised by Mr. Dawson of making steel by the Siemens basic furnace as opposed to the acid was a most important one to the Cleveland district, and would be solved by the matter of cost. He gave figures to show the small progress that had been made in basic steel manufacturing. The statistics were as under :—

| | 1880. Tons. | | 1893. Tons. |
|---|---|---|---|
| Ore raised in the United Kingdom .. .. .. .. | 18,026,000 | .. | 11,203,000 |
| Ore raised in Cleveland .. .. .. .. .. .. .. | 6,441,000 | .. | 4,625,000 |
| Percentage of imported ore in total consumption. | 12·74 | .. | 26·6 |
| Ore imported .. .. .. .. .. .. .. .. .. .. | 2,634,000 | .. | 4,065,000 |
| Cleveland iron made .. .. .. .. .. .. .. .. | 1,991,000 | .. | 1,388 000 |
| Hematite, &c., made in North of England .. .. | 519,000 | .. | 1,336,000 |
| Bessemer hematite steel ingots, United Kingdom | 1,042,000 | .. | 1,493,000 |
| Bessemer hematite steel ingots, North-East Coast | 144,000 | .. | 373,700 |
| Bessemer basic steel, United Kingdom .. .. .. | 10,000 | .. | 262 362 |
| Open-hearth steel, United Kingdom .. .. .. | 251,000 | .. | 1,456 323 |
| Open-hearth steel, North-East Coast .. .. .. | 3,200 | .. | 482.120 |
| Basic steel, United Kingdom .. .. .. .. .. | *nil* | .. | 78,645 |

The figures showed that on the north-east coast the quantity of steel ingots made in 1893 was :—Bessemer hematite, 373,700 tons; open-hearth hematite, 482,120 tons; Bessemer basic, about 160,000 tons; and Siemens basic, none; total, 1,015,820 tons. In other words, only 15·70 per cent. was basic. The loss to this country, and the Cleveland district in particular, by this importation of foreign ore was very great. If native ore were used there would be gain in the employment of men engaged in (1) the locomotives and railways in conveying the ores from the mines to the furnaces; (2) in building locomotives, wagons, &c., making rails, &c.; (3) raising coal for locomotives. On the other hand, when importing ores, men were employed (1) on the ships carrying the ore; (2) raising coal for these ships; (3) in building the ships and engines, rolling the plates, &c.; (4) in loading and unloading the vessels. Of course with native ore more men would be engaged at the local mines. The balance of gain would doubtless be in favour of native ore, but it was not so much so as appeared at first sight. That there was an advantage in the Bessemer basic process was certain, and it was to be hoped that the experiments going on with the Siemens basic might prove equally satisfactory.

Mr. Thomas Turner's communication stated that he had lately seen plants which had been designed by Mr. Dawson which had done excellent work. Ironmasters located among phosphoric ores were strongly urged to adopt the basic open-hearth process and utilise those ores. That for Cleveland was a wise recommendation. There was no difficulty in making basic open-hearth steel uniform and of a reliable quality. Its cost in Cleveland should be much less than acid steel, and for the industries in the North of England it was admirably adapted. Pig iron with phosphorus up to 4 per cent. could readily be worked provided silicon and other elements were kept right. In his own practice he had used pig with that percentage of phosphorus for a long period, and had got excellent results in work and excellent qualities of steel regularly. Working such pig produced very large slags worth 6s. to 7s. per ton of steel, and with that as an asset in calculation of cost, the process was worth the attention of northern ironmasters. The life of a furnace bottom largely depended on the skill in running. He had had dolomite furnace bottoms which had lasted over two years, turned out 798 charges and 10,500 tons of steel before renewing. Undoubtedly the basic process, with Saniter's desulphuriser and Darby's recarburiser, was the right thing for the North of England.

Mr. W. H. Penton (Dorman, Long, and Co., Britannia and West Marsh Iron and Steel Works, Middlesbrough) said they had for the past few weeks been getting steel successfully from Cleveland white iron, and they could make good reliable steel from it. The furnaces they employed were those they used for the acid process, but the bottom was made of dolomite.

Mr. C. J. Bagley (Moor Steel Works, Stockton) remarked that with regard to furnaces of large capacity, Mr. Dawson held that though they be economical in labour the large quantity of slag made was an objection. At the Moor they had 40-ton furnaces, and got thirty-five tons out regularly, and had no trouble. Large furnaces had an advantage in first cost. From six 40-ton furnaces they could get a much larger output for the same outlay as ten 20-ton furnaces. Less scrap and runners were produced. He had recently been working some of the steel made by Mr. Penton from Cleveland white iron, and found it very satisfactory; it stood more severe tests for thin plates than they had been able to get with their own acid steel. The quality was very regular. It had been made from ordinary white pig, treated by the Saniter process, and worked on a basic hearth. He thought the Lash furnace would be advantageous, seeing that they could tap off the slag from time to time.

Mr. Richard Howson (Middlesbrough) asked if the slag from the basic slag was saleable for agricultural purposes.

Mr. Penton said it was. He was not at liberty to state what they got for it, but it was enough almost to pay for the basic materials.

Mr. Jeremiah Head (Middlesbrough) considered that the paper had been given at a singularly opportune moment for the great steel makers of the North. Their trade was not in a happy condition at present, and they were on the outlook for anything that could improve their position. There was no doubt that the competition of Belgium and Germany, who had adopted the basic open-hearth process to a much larger extent than ourselves, was very seriously felt at present. It was curious that the North of England, with such large supplies of phosphoric ores, should be making steel by the acid process at all, with ores from foreign countries. In this basic process lay the most hopeful way of bringing back prosperity to the steel trade. In the United States, where he had lately been, they were progressing much in this direction. He had come in contact with the manager of the melting department at Carnegie's works at Pittsburgh, who said that four years ago all their furnaces at Homestead Works were acid lined; now they were basic. They usually got 25 tons of ingot per furnace, and they had hardly any difficulty in dealing with them. The local iron there was of a pretty high quality, and containing little phosphorus. They divided the pig into Bessemer hematite containing ·1 per cent. or less of phosphorus, and anything having more was non-Bessemer, and sold at a considerably lower price. Their policy was to buy the iron that contained a little more than 1 per cent., and use it in the basic-lined furnace. The cost of the process was 2s. 6d. more than the Bessemer, but the cheaper pig used more than made up for this. This basic steel was made into plates for the United States Navy and various shipyards. In Alabama the cheapest pig iron in the world was produced; it was 6s. or 7s. a ton cheaper than Cleveland pig. It was chiefly used for foundry purposes, and as they could sell all they could produce for that purpose, it had not been tried yet for steel making.

Mr. F. H. Marshall asked the difference between magnesite and dolomite.

Mr. C. H. Ridsdale, North-Eastern Steel Works, Middlesbrough, referring to the regret so often expressed that so little steel should be made entirely from Cleveland stone, said that was not owing to mechanical difficulties, but because of purely commercial reasons, by which every process should be judged. Even in the earlier period of the basic process the use of a large proportion of tap cinder indicated clearly that it was generally considered that from the stone to the ingot all mine pig was not commercially the most economical. That had been more than ever the case since the slag acquired a material value on account of its phosphoric acid as a manurial agent, and it was quite understood that that was an important factor in favour of which they were enabled to use the present quantity of stone. Whenever it ceased to pay to use tap, and they were thrown entirely on to the use of Cleveland stone as the source of the pig, it would be more than ever necessary to make the most of the available phosphoric acid which it contained, and in that respect—the production of a phosphoric slag of considerable manurial value—it seemed that the basic process would be placed at a disadvantage as compared with the Bessemer, on account of the necessarily greater dilution of the phosphoric acid, thus giving a greater weight of useless bodies to deal with per ton of slag. This was due partly from the fact that a large proportion of the oxygen needed was supplied in the form of ore, which though introducing a good deal of iron, also introduced objectionable impurities. Then the sandage from the pig and sand from the roof of the furnace were introduced, which would not be in the Bessemer. All these impurities in turn required extra time, which, as it also was impure, introduced in turn inert bodies. For a charge of 20 tons pig and four tons scrap, there would as a minimum in that way be introduced, together with the time necessary, about 40 cwt. of impurities more than would be the case if the same iron was converted into steel by the Bessemer process. That, on the smallest total quantity of slag that could be made, would reduce the phosphoric acid to only about 9½ per cent., as compared with 12¾ per cent., which could be obtained from the same pig by the Bessemer process. Respecting the space taken up by the slag, the specific gravity was 3·45 to 3 5, and of the ingot metal 7·85 to 7 9., the slag being two and a-quarter times the volume of the same weight of metal. These were cold, and difference when molten would be still more marked, because of the frothing of the slag. Another interesting question was as to whether white or ordinary Cleveland forge pig would be used. White pig, if a large demand for it arose, could not be made at a much lower rate than forge. It was a question whether they could produce white Cleveland containing not over 6 per cent. successfully.

Mr. J. E. Stead said it was a pertinent question to ask what the price of Cleveland white iron would be if a really good market could be found for it. He could state that basic slag from open-hearth furnaces was very remarkable, and he was continually analysing slag sold at a very good price. The phosphorus was not as great in quantity in the slag from the open-hearth basic as it was from the Bessemer basic furnaces, but the difference was not great—15 per cent. in the former, against 18 per cent. in the latter. But while they had a smaller percentage of phosphorus with the open-hearth basic slag, they got a larger quantity of slag. With respect to the Lash furnace, he thought that it would be very convenient to have the furnace on rollers, because when a large quantity of slag accumulated on the top of the metal a portion of that slag might be run off, and the process of purifying the steel would be facilitated. Then from one charge in the furnace they could get different qualities of steel, for they could run portions off at different times, and if the steel they got at any time did not suit them they could put it back into the furnace. The whole or part of the charge of a furnace could be run out just as the operator liked. Referring to the Saniter process, Mr. Dawson evidently spoke in his paper of the ladle process and not the steel. Mr. Saniter had two processes—one in which he purified the pig iron from sulphur in the ladle, and in the other he added chloride of calcium to the open-hearth furnace.

Mr. Bernard Dawson in replying, said very large furnaces had been in use—some of 40 tons and some of 70 or 80 tons, and he heard the Americans were intending to put up one of 150 tons. It was all very well working large acid furnaces, but it was different with basic furnaces, and it was better to deal with smaller masses. He could state that basic open-hearth slag was very reliable, and some steel makers had told him that the only profits they made were those they got from their slag. He knew that some of the Staffordshire firms had sold their make of slag for years to come. Much was being sent for manurial purposes to Germany from King's Lynn or other East Coast ports.

Mr. Charles Wood interpolated the remark that this basic slag manure was chiefly used by beet-root growers. The Lash tilting furnaces was ingenious; it had been used for basic steel-making. With respect to white pig iron, he did not think the supply was large, because makers did their best to avoid producing it. He did not think they would care to produce that quality continuously, say, for six months. If he were an ironmaster he would not like his furnaces to produce either mottled or white for so long; he was afraid they would not be on at the six months' end. The speaker said he had been asked to state the difference between magnesite and dolomite; but he was not prepared to do that, as there was much diversity of opinion on the subject, and there had been most fierce discussions thereupon in the German technical societies and journals. Referring to the Batho furnace, he said the great first cost was an objection, and there were comparatively few in existence. The space they took up was also against their adoption generally, and many stuck to the old Siemens type. The figures that had been given in the discussion were very useful. It was all very well importing foreign ore when this country was at peace; but the matter would assume another complexion if anything occurred to hinder our imports, and then more attention would be paid to the basic open-hearth process.

A vote of thanks was passed to Mr. Dawson for his paper.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

Considerable comment has been aroused this week in trade circles by a statement as to the condition of trade, made during the past few days by Sir Alfred Hickman, M.P., who declares that neither at the Spring Vale Furnaces nor at the steel works is a penny of profit being made. The same state of things applies to his Staffordshire colliery. He is producing nearly one-third of the total pig iron in the district, and it is declared that unless an advance in price occurs, the present condition of absolute absence of profit must continue. The outlook for trade for next year, under these circumstances, is certainly not a very bright one.

"Conditions which determine the Choice of a Steam Engine" was the title of a paper read on Saturday before the South Staffordshire Institute of Iron and Steel Managers, by Mr. John W. Hall. With engines running fairly successfully in daily practice at speeds ranging from 30 to 300 revolutions per minute, using steam varying in pressure from 20 lb. to 200 lb. per square inch, in one, two, three, or more cylinders, either condensing or non-condensing, and consuming, say, from 15 lb. of coal per horse-power per hour to one-tenth of this quantity, there is certainly a very large range of types from which to select—without mentioning such exceptional instances as the Parsons turbomotor, which runs ordinarily at about 12,000 revolutions per minute, and has been run successfully at 18,000; or the Laval steam turbine, which runs at 30,000; the Davey motor, using steam below atmospheric pressure, or the Perkins engine, employing it at 400 or more pounds per square inch above that pressure. The author gave an interesting enumeration of the various factors which go to decide the choice, and succeeded well in his attempt to assign to each its relative importance. He incidentally expressed the opinion that probably the day is very near at hand when regenerative gas furnaces will be generally used for puddling and reheating. In the discussion the weakness of many of the engines existing in the ironworks of Staffordshire was pointed out, and therefore the difficulty of practising economy by using high steam pressures. The lecturer suggested, as to one such case, that another cylinder of small size should be added, and that the steam should then be transferred from that to the existing cylinder. The strain upon the latter under the circumstances would not be much more than at present. At the same time he admitted that there was a good deal of difficulty in altering old engines.

The work of the South Staffordshire Mines Drainage Commissioners during the past month has proceeded steadily and satisfactorily. The rainfall has been 3 34in., which is again above the average. At the same time the quantity of water to be dealt with was less than in the previous month by 1380 tons per day. A pleasing instance of quick repairs in the case of an engine breakdown was afforded during the month, when the bottom rod in No. 1 plunger lift at the New Moat engine broke through the timber without any previous warning. The fracture took place close to the joint, and is attributed to the alternate action of compression and tension acting on the decayed timber. The accident occurred at an awkward time — for it happened on a Sunday night. No time was lost, however, in carrying out the emergency orders, and by the use of telephone, horses, and several messengers, the repairing staff and men for starting the auxiliary Gospel Oak engine were soon on the ground, and steam was put through the cylinders of this auxiliary within six hours of the mishap, which beats previous records by five hours. A new rod was fixed to the Moat engine and all repairs completed within fifty hours of the accident, without injury occurring to any mine in the deep.

The proofs of all kinds of barrels at the Birmingham Proof House have been :—1893, 335,271; 1892, 379,086; 1891, 361,631. This shows a decrease of 43,815 in the number passing the Proof House last year, as compared with the year previous. Not a single accident has occurred in any department during 1893. The superannuation pension scheme is still working satisfactorily. The balance-sheet for 1893 shows that the assets of the Proof House Guardians at the close of the year were estimated at £28,073, as against £28,227 in the previous year. The English gun trade continues to experience severe competition, caused by cheaper foreign labour abroad, and by protective duties upon the English goods when entering foreign markets. The stamping of foreign-made arms with the English proof marks, though conferring a guarantee of safety in use, yet operates further in conferring an imaginary English origin upon foreign goods, and this still somewhat affects home-manufactured arms in competition with them.

That machinery used in the process of gas-making is dearer than it used to be is one of the arguments being employed just now by the Gas Committee of the Birmingham Corporation to protect themselves against further demands for cheap gas. The public are, however, well satisfied with a reduction of 3d. decided upon this week, which brings the price down to 2s. 3d. or 2s. 7d., according to the scale of consumption. Birmingham is now lower than seventeen large towns.

Messrs. Kynoch and Co., of Birmingham, the well-known ammunition makers, have fixed on a site for a new cordite factory in the neighbourhood of Arklow, county Wicklow, Ireland.

The officials of the Birmingham Association of Mechanical Engineers have been appointed for the coming year. At the Association's annual meeting on Saturday, the president, Mr. E. Hazel, was unanimously re-elected. The vice-president, Mr. J. Mills; the treasurer, Mr. J. F. Crockatt; the committee, Messrs. W. Bacon, J. Burns, J. Cox, and A. W. Hayes; the auditor, Mr. J. R. Meiklejohn; and the secretary, Mr. L. O'Brien, were also re-elected.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The general position throughout the iron trade of this district continues one of dragging on through the remainder of the year, with a vague sort of anticipation of some possible improvement next spring. In the meantime the tendency of price is to get still lower, and any business that is to be secured is competed for at exceedingly low figures. With regard to the engineering industries the position continues about stationary; it does not get worse, but there is still an absence of any real improvement, and with few exceptions establishments are not only indifferently off for work, but see no present prospect of becoming busier.

The Manchester iron market on Tuesday was fairly well attended, but extreme slackness of demand was again the report all through, and except that outside brands of pig iron were firm at recent quotations, a weak tone prevailed generally as regards prices. Users of raw material continue to buy only in the smallest hand-to-mouth quantities, or where they do enter into transactions beyond this, some excessively low quotation has in most cases been the inducement. Lancashire pig iron makers who still quote nominally on the basis of about 39s. for forge to 42s. for foundry, less 2½ per cent., delivered Manchester, are practically out of this market in face of the much lower figures at which Lincolnshire can be bought, and they are only booking occasional small orders with special customers. Lincolnshire iron continues to ease down, especially as regards forge qualities, for which there is only the most limited inquiry owing to the depressed condition of the finished iron trade.

During the past week sales have been made at prices equal to about 37s. 6d. net cash, delivered Manchester, which is about 6d. under the minimum quotation of a week ago, and this price would not only now be readily taken by most makers, but there are even lower quotations in the market from merchants. Foundry qualities are fairly steady, Lincolnshire averaging about 39s. to 39s. 6d., with Derbyshire still quoted about 43s. up to 45s. net cash, delivered equal to Manchester. Middlesbrough iron, if anything, shows rather more firmness; low class ordinary brands might still be bought at 43s. 10d. net cash, delivered Manchester, but for anything like good brands 3d. to 6d. above this is quoted. For Scotch iron prices remain about 46s. 6d. to 47s. for Eglinton, and 47s. 6d. to 48s. for Glengarnock net prompt cash delivered at the Lancashire ports.

In the manufactured iron trade there is still only a very limited weight of new business coming forward, and forges are either on short time or only about two-thirds the plant is kept running. Prices gradually tend downwards, Lancashire bars being now readily obtainable at £5 5s., not only for shipment but for inland sales; North Staffordshire bars have also been quoted at £5 5s. for shipment, and only in exceptional cases average more than £5 7s. 6d. for inland sale. For Lancashire and Staffordshire sheets, £6 17s. 6d. to £7 2s. 6d. represent about the full prices for delivery here, and the Lancashire hoopmakers—at a meeting on Tuesday—decided to reduce their list rates 2s. 6d. per ton, quotations now being £5 15s. for random and £6 for special cut lengths, delivered Manchester or Liverpool. This reduction has been made not with the expectation that it will lead to any greatly increased business, but is based more upon the lower prices at which pig iron is now obtainable, and the slight reduction which has been effected in wages.

The steel trade continues extremely quiet, with little or nothing doing to really test prices. Ordinary foundry hematites nominally average about 52s., less 2½; low-class billets are readily obtainable at £3 17s. 6d. to £4, with better-class billets quoted at £4 7s. 6d. to £4 10s.; steel bars, £6 to £6 2s. 6d.; and boiler plates £6 2s. 6d. to £6 5s. delivered in the Manchester district.

In the metal market business continues very slow, with no further quotable change on list rates for manufactured goods.

I understand that one of the best-known Lancashire engineers who visited Belgium with the Iron and Steel Institute a few months back, and was then very much impressed with the development of electricity, not only for lighting, but for motive purposes, is at present making a special tour on the Continent for the purpose of further investigating electrical appliances and developments, with the view of extending the new branch of business he has recently opened out for the manufacture of electrical motors; and I may add that at his works near Manchester he has recently put up one of the most powerful and perfectly-equipped electrically driven cranes that has so far been erected in this country.

Quite a new design of gas engine, specially constructed for electric lighting work, is being introduced by Messrs. Crossley Brothers, of Openshaw, and they have at present in hand one of these new motors which they are building for the Altrincham Central Electrical Supply Station. This is a four-cylinder engine, specially designed for absolutely steady driving, and receives two impulses for every revolution. The firm are also introducing a new one horse-power nominal gas engine, the arrangement of which is similar to that of their present half horse-power engines with middle crank. In their oil engines Messrs. Crossley have introduced several important modifications and improvements since the earlier types were designed, and a considerable extension of their works has been necessary to find accommodation for this comparatively new branch of their trade. These oil engines are now made up to 14-horse power nominal, and at present Messrs. Crossley have in hand an order for two oil engines, with air-compressors combined, which are intended to work the fog signal machinery at Rattray Head, and I may add that this order, which came from the Commissioners of Northern Lighthouses, was placed with Messrs. Crossley as the result of a protracted trial of similar engines at the Pladda Lighthouse.

In connection with my recent visit to the works of Messrs. Muir and Co., referred to last week, there were one or two other interesting specialities in the way of engineering which in my previous notes I had not space to deal with. Amongst these I noticed a new countershaft arrangement which had just been fitted to one of their lathes for driving by friction with double friction pads, and ball thrust bearings, and adjustable tension spring. This, I was informed, had given very good results, and allowed the operator to get any speed or feed desired within the capacity of his machine, and was readily controlled by means of a cord at the rear. They had also just put down a new automatic bevel-wheel planing machine, of American type, which planes both ways, and had, I was informed, given great satisfaction. In their lathes, Messrs. Muir are also making a speciality of double-geared headstocks, so that they can be arranged to work single speed, or single geared, or double gear, and they had just completed for one of their special milling machines a cutter 24in. long and 5in. diameter, for milling through cranks and large marine engineering work and forgings.

The coal trade continues extremely depressed, with pits not only working short time, many of them only three to four days per week, but supplies excessive and prices barely maintained, one of the leading firms in the Manchester district having been compelled with the commencement of the month to modify their list rates both for round coal and engine fuel to meet the keen competition from other quarters. Generally, however, quotations remained unchanged, and with some increased activity in the house-fire trade, here and there attempts are being made to slightly harden up the better qualities, but with scarcely any success.

Common round coals still meet with but a very slow sale for iron-making, steam, and general manufacturing purposes, and engine classes of fuel, although, perhaps, not quite so excessive a drug as they have been recently, are still plentiful, with the result that surplus supplies are pushed upon the market at extremely low figures. At the pit mouth best Wigan Arley coals average 10s. 6d. to 11s.; Pemberton four-foot and seconds Arley, 9s. 6d. to 10s.; common house coals, 7s. up to 8s.; steam and forge coals, 6s. 6d. to 7s.; and slack from 3s. and 3s. 6d. for common to 4s. 6d. and 5s. for better qualities, with special lots of slack from outside districts offering at 1s. 6d. to 2s. per ton at the pit mouth.

In the shipping trade there is still only a very limited business doing, with steam coal delivered at the Garston Docks or the High Level, Liverpool, ranging from 8s. for inferior sorts to 8s. 6d. and 8s. 9d. for better qualities.

*Barrow.*—The hematite market is lifeless and unchanged. Orders for pig iron are quiet, and neither on home or on foreign account is much business being done. Bessemer qualities are being less sold on local account, and in forge and foundry iron very little is being done. Stocks during the week have increased 2192 tons, and now stands at 169,632 tons, being an increase since the beginning of the year of 75,009 tons. Prices are easy at 44s. to 45s. per ton, net, f.o.b., for Nos. 1, 2, and 3, and warrant iron is quoted at 43s. 4½d., net cash, sellers, and 43s. 3½d. buyers. Thirty-two furnaces are in blast, compared with thirty-three in the corresponding week of last year.

Iron ore is still greatly depressed, and orders are only few, most of them being confined to the small wants of smelters in the immediate district. Prices are unchanged.

Steel makers are, generally speaking, short of orders. The contract booked last week for 5000 tons of light rails for the Indian State Railways does not represent much work for a mill capable of turning out nearly 1000 tons a day. Other orders are scarce. Prices are steady at £3 10s. for heavy sections.

No new contracts are noted for ship plates, but the mills are busy on old orders, and will remain so well into March. In the meantime new orders are expected. Steel castings of heavy weights are in big demand. Hoops and billets are quiet in tone, and blooms, slabs, and wire rods are neglected.

Shipbuilders and engineers are very busy now on the Admiralty and general orders in hand, and a brisk winter and an active spring may be expected. No new orders are now in the market.

Coal and coke are quiet, and sales are few. Coke is still dear at 17s. per ton, delivered here from East coke ovens. Steam and shipping coal in poor request.

Shipping steel shows signs of marked depression. The exports of pig iron during the past week from West Coast ports reached 7240 tons, compared with 6809 tons in the corresponding week of last year, an increase of 431 tons. The exports of steel last week were 8562 tons, compared with 12,623 tons in the corresponding week of last year, a decrease of 4061 tons. The aggregate shipments to date this year represent 326,745 tons of pig iron and 363,767 tons of steel, compared with 258,842 and 436,959 tons in the corresponding period of last year, an increase of 671,903 tons of pig iron and a decrease of 73,192 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

SINCE my last letter more seasonable weather has prevailed in this district. Most of the fog has left us, and this has had its influence upon the house coal trade. This business has shown a decided improvement during the week. Many of the thick seam collieries, however, are making only four days. The metropolis is not taking such a large demand as was anticipated, and nothing but a protracted spell of cold weather will bring the demand up to the average. It was thought that during the winter the United States market would do a much larger trade than it has done before, but this expectation has been disappointed. The productive capacity of the district is now greater than ever. Prices are very weak, and had it not been for the agreement with the men on the wages questions, remuneration would have further declined. At some collieries the men are demanding concessions in their wages, and have even threatened to strike. The owners have replied that they might set the pits down if they chose, that there was no trade, and they could afford to stand for a time. Quotations are about the same as when last reported. Silkstone coal is at 9s. to 10s. 6d. per ton, Barnsley softs 8s. 6d. to 9s. 6d., Flockton makes from 8s. to 9s., and secondary qualities from 7s. to 7s. 9d.

The steam fuel trade is only moderate for the season. The Humber ports are taking a fairly good quantity, and the railway companies maintain a steady demand mainly on contract account. The requirements for the home market are, however, only fair, and prices are weak. Barnsley hards are from 7s. 6d. to 8s. 3d. per ton; Parkgate and other qualities from 6s. 9d. to 7s. 3d. per ton. The North-Eastern Railway Company is at present seeking tenders for the supply of locomotive fuel, owing to the languid condition of which keen competition is looked for. It will be at least a fortnight before the arrangements are completed.

Gas coal is reported to be in increased request, and most contracts are now completed, or nearly so. Prices range from 7s. to 8s. per ton, and supplies are plentiful at these rates. Slack and smudge are in the same depressed state. Although the output has of late been somewhat restricted, prices do not improve. Unriddled slack fetches from 3s., and riddled 5s. per ton, in quantities. Smudge can be easily obtained at 2s. to 2s. 3d. per ton. The coke trade is in a good condition, and business holds up well. The bulk is used for smelting purposes, and prices vary from 9s. 6d. to 11s. per ton.

Many complaints are heard both in the light and heavy industries. It is certainly true that in some directions full time is not being worked, and the weight of business, except in several specialities for which there is an abnormal demand, is not equal to what was anticipated. Inquiry, however, discloses the fact that there is not, generally speaking, so much ground to grumble, although it is the case that new orders are being placed very slowly, and the expectations of improvement, which were noted at the beginning of the year, have not yet been realised. It is now almost impossible for there to be any real revival of business this year, but there are anticipations of a very good year's working to begin with the New Year. Railway material is now being manufactured in fair quantities, and the armour plate factories are fully employed on Government account. The depression in the iron market is partly attributable to the keen competition of northern firms for orders usually placed in the Sheffield district. Makers of rails, girders, &c., finding the call for these productions to be very light, have turned to Bessemer billets, which are now at quotations leaving a very narrow margin of profit. Hematites are at 50s. to 52s. per ton, delivered in Sheffield. Lincolnshire iron, 38s.; Bessemer billets, £5 7s. 6d.; bar iron, £5 5s. to £5 15s. at makers' works.

In the lighter industries business in files has been satisfactory in regard to output, which will no doubt be in excess of that of last year. Owing mainly to the keen and extraordinary competition, profits have been cut down to a lower margin than Sheffield firms have been accustomed to. Machine-made files are now being very freely used, and being turned out in large quantities in this district.

Ivory goods have been in good request for the home markets during the last few weeks, but manufacturers of these high classes of articles have had no orders from abroad worth mentioning, foreign demands having mainly been for common pearl goods, and xylonite haftings. Dealers in ivory complain bitterly that the public buy xylonite under the impression that it is ivory, and suggest that all articles made of the inferior hafting material should be marked as such.

The "boom" in the cutlery and silver plate trades, which has been reported during the last few weeks, now appears to have fallen off in many cases. There were, of course, the usual orders for Christmas and New Year, but these having been mainly completed most firms are anything but busy, more especially in the cutlery department. One section of the cutlery trade—spring-knife department—is employing its men upon full time, mainly on account of orders from America. These houses, which are supplying the United States with butchers' knives, are profiting most by the reform of the tariff, the new duties treating this class of cutlery more favourably than any other. The commercial outlook throughout the greater part of the United States is becoming brighter every week, and Sheffield may count upon still further advancing her trade with the States early in the New Year. Some very good orders have lately been received in this city from the Argentine Republic for butchers' knives, forks, and spoons. On several occasions reference has been made to the increase in the use of sterling silver goods over those of silver plate, &c., owing principally to the cheapness of silver. Not many, perhaps, are aware of the enormous extent of that increase. In spite of the fact that this tendency has been conspicuous for several years, the head of a firm, which practically monopolises the whole of the rolling for local silversmiths, states that the quantity of silver rolled during the months of October and November show an increase to the amount of one-third as compared with the corresponding period of last year. Nor is there any appreciable difference in the amount of German silver and Britannia metal, although several firms roll and cast their own metal. The conclusion come to is that the whole industry of silver and electro-plate manufacture is rapidly increasing. While few reports are heard of firms giving up this important branch, many are published of houses adding it to their cutlery business. The cheapness of silver does not seem to have had, as was anticipated, any effect upon the manufacture of electro-plated goods. Fairly well-to-do people now purchase sterling silver appointments for their tables, instead of, as before, the best electro-plate, the difference in price being so small, and yet the production of plated goods has not decreased, but increased. Owing to the cheapness of plated goods, many homes are now being furnished with these beautiful goods for the first time.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

AN unsatisfactory report cannot but be given with respect to the trade of this district. Little business is being done in any branch, and now that the winter season has practically commenced, any important improvement is not likely to be experienced until people begin to buy for spring deliveries. Certainly the prospects of business for the next two months are not comforting, but makers and merchants generally are sanguine that a revival of trade will follow in the spring. At present manufacturers have to be content if they realise the bare cost of production for their goods, but many cannot even do that, and profits to even the most favourably situated firms are almost out of the question. Though prospects for the winter are bad, yet the opinion is that prices will not be further reduced to any material extent, but if they are it will be necessary to blow out some of the furnaces. That would be a good thing even now, especially in the hematite pig iron trade, where, it is said, the output exceeds the requirements even more largely than is the case in connection with Cleveland pig iron, but the exact extent of the over-production cannot be ascertained, as no statistics relative to the stocks of hematite or basic iron are collected. The extent of the over-production in Cleveland pig iron is known; it has been 37,737 tons this year. Only in three out of the eleven months of the year has there been reported a decrease in stocks, viz., in February, March, and April, the aggregate decrease being 28,207 tons. Just over the period when a reduction of stock might have been counted upon, when what is generally the briskest part of the navigation season, there were decreases. In January the increase was 8676 tons; in May, 11,000 tons; in June, 9178; in July, 9745; in August, 13,298; in September, 5476 tons; in October, 4689; and in November, 3697 tons. It certainly is very depressing to find that in November with such large shipments—91,257 tons—there should have been any increase in stocks. Most people looked for a decrease, and if with such exports it has been found impossible to avoid an increase, what chance is there during the next three months of preventing an increase when the exports will naturally be considerably less. Stocks will be even more rapidly augmented than they have been without some steps are taken to reduce the production. It would seem very desirable that this should be done in the case of hematite iron, and it would be better for the makers and the trade generally if such a course were taken, for with a reduced production there would be some chance of arresting the fall in prices, while the lessened consumption would bring about easier prices for materials. At present the position is, that the selling price of the produce is declining, while the cost of materials is not being reduced at all. There are fourteen furnaces more in operation in the North of England than there were at this time last year, but clearly there are too many at work, in face of the winter time- and when during the last seven months, extending over the best period of the year, stocks have been increased over 56,000 tons in Cleveland pig alone.

The returns of the Cleveland Ironmasters' Association for November have proved less satisfactory than had been looked for, because people, forming their estimates on the excellent shipments that were being reported, expected to see some decrease in stocks, instead of which there was an increase of 3697 tons. The exports of hematite pig iron were little in excess of the October figures—14,210 tons, against 13,525 tons, whereas the total shipments were 11,004 tons more than in October. This reveals an unsatisfactory feature, viz., that the inland consumption of Cleveland pig iron has declined, which means greater depression in the finished iron and foundry industries; and no doubt this is so, for some of the ironmasters report that they have had instructions to keep back deliveries of some of the iron which should have been sent inland last month in accordance with contracts made. The statistics show that ninety-five furnaces were at work last month, of which fifty-one were making ordinary Cleveland iron, and forty-four hematite, &c., these figures being the same as those reported for October. Two furnaces were reported to be in course of erection at Skinningrove. These are the first that have been erected in Cleveland during the last twenty years, and only one or two have been built in the whole of the North of England; but during that interval at least twenty-four have been demolished. The production of pig iron last month was 123,658 tons of Cleveland iron—2970 tons decrease on October—and 130,194 tons of hematite, basic, and spiegel iron—5487 tons decrease; total, 253,852 tons—decrease, 8457 tons. The decrease is accounted for by there being a day less in November than in the previous month. The total amount of Cleveland pig iron in stock at November 30th was 200,571 tons—3697 tons increase. Makers had 98,678 tons unsold—2289 tons decrease; makers' stores held 3680 tons—1054 tons increase; the North-Eastern Railway Company's stores, 7000 tons—increase, 2350 tons, and Connal's stores, 91,213 tons—increase, 2582 tons. No particulars are given of the stocks of hematite iron, but Messrs. Connal and Co. say they had 76,210 tons of hematite iron in their warrant stores, or an increase during the month of 5553 tons.

The pig iron shipments from Middlesbrough reached 91,257 tons in November, the heaviest this year, 11,004 tons more than in October, and 21,269 tons more than in November last year. From the Tees the following are the quantities of the iron and steel shipped in the months named :—

| | Pig iron. | Manufactured iron. | Steel. | Total. |
|---|---|---|---|---|
| | Tons. | Tons. | Tons. | Tons. |
| November, 1894 | 91,257 | 12,877 | 22,581 | 127,085 |
| October, 1894 | 80,253 | 11,953 | 28,539 | 120,745 |
| November, 1893 | 69,988 | 12,486 | 15,054 | 97,538 |

To India 15,196 tons of iron and steel were shipped last month; to Scotland, 40,029 tons, nearly all pig iron; to Germany, 10,976 tons; to Holland, 6101 tons; to Italy, 4765 tons, all pig iron; to Belgium, 1948 tons, all pig iron; to Denmark, 5992 tons; to Russia, 3414 tons.

Quotations for Cleveland pig iron are well maintained, but for hematite iron they are easier than they were last week, thus making the situation more difficult for the latter, as they cannot get any relief in the cost of production, Rubio ore being firmly maintained at 12s. 1½d. per ton delivered in the Tees; and coke is fully 12s. 3d. per ton at the furnaces in the Middlesbrough district, prices which have ruled for a considerable time, during which hematite iron has been falling in value. The prompt f.o.b. delivery price of No. 3 Cleveland pig is 35s. 6d., and some has been sold at that for delivery over the first quarter of next year; but beyond that makers will not sell, as they expect higher prices to rule when the exports begin to increase. The warrant market has been stronger on the whole, and for the last fortnight there has been very little change from 35s. 6d. cash. No. 4 Cleveland foundry pig iron has been sold at 34s. 7½d., and grey forge at 33s. 7½d., but most makers ask 1½d. more. Hematite pig-iron prices are extremely weak, and mixed numbers can be secured at 42s. 6d., as the position is so unsatisfactory and the prospects of the steel trade unfavourable.

The manufactured iron and steel trades are dull, and producers do not speak hopefully of the likelihood of regular work during the winter. It is very few firms that can keep their establishments in full operation now, and the same may be said of ironfounders, engineers, shipbuilders, &c. At some of the shipyards not half the berths are occupied, but they appear to be better situated on the Tees than on the Tyne and Wear. Sir Raylton Dixon and Co., at Middlesbrough, have orders for eight large steamers, but there are two yards on the river entirely closed. Some of the patternmakers are complaining because they have not been set to work since their strike terminated, and want to make out that the employers have not carried out the arrangement made when the dispute was terminated. The masters, however, cannot create work for the men directly they choose to abandon their struggle. Trade is worse than it was when the strike commenced last April, and the work has not accumulated, or masters have got their patterns made out of the district. Some of the moulders whose strike ended in September have never been able to find work since.

The directors of the Weardale Lead Company report that the produce of their mines considerably increased during the last financial year, and the average price of lead was £9 9s. 7d. per ton delivered at Parkhead, or 13s. 3d. per ton less than in the previous year, when the values were exceptionally low. The quantity of ore raised was 4971 tons, of ore dressed 4827 tons, and of ore smelted 4738 tons, the yield being 3315½ tons of pig lead.

The season of the year is favourable to the house and gas coal trades, but decidedly unfavourable to the steam coal trade, which has its harvest time during the shipping season, as so large a proportion of the steam coal raised is exported. On this account the price of steam coal has dropped rapidly during the last few weeks, so that best is obtainable at 9s. per ton, f.o.b., or 2s. less than was being realised a short time ago, and small has dropped from 5s. to 3s. 9d. per ton. Locomotive coal is cheaper, and it is expected that the extensive contract of the North-Eastern Railway for next half-year's supplies will be taken at 6d. to 9d. less than the contracts that are now running. About 8s. 6d. per ton is what is now generally quoted for locomotive coal.

Mr. Charles V. Craster, of Middlesbrough, has invented a railway fog signalling apparatus which, he claims, would make it impossible for an engine-driver to run his train past when the signal is standing at danger during a fog. It would dispense with fogmen, fog signals, and detonators.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has shown a little more animation on several days this week, increased quantities of warrants changing hands. Business has been done in Scotch warrants from 42s. 5½d. to 42s. 7d. cash. Cleveland warrants have been quiet at 35s. 5d. and 35s. 5½d. The business in hematite iron has been very limited in the warrant market. Cumberland hematite is quoted 43s. 5d. and Middlesbrough 42s. 2½d. cash.

The amount of the pig iron output is practically the same as a week ago, but two furnaces have been changed from hematite to ordinary iron. There are now 25 furnaces making hematite and 42 ordinary, the total of 67 comparing with 15 at this time last year, when the output was temporarily much reduced by a strike of miners. The stocks of pig iron in Glasgow warrant stores show a reduction for the week of about 500 tons.

The values of makers' special brands are fairly well maintained:—G.M.B. f.o.b. at Glasgow, No. 1, is quoted 44s. per ton; No. 3, 42s.; Monkland, No. 1, 45s.; No. 3, 42s.; Carnbroe, No. 1, 45s. 6d.; No. 3, 44s.; Clyde, No. 1, 50s. 6d.; No. 3, 47s. 6d.; Gartsherrie, No. 1. 52s.; No. 3, 47s. 6d.; Calder, No. 1, 52s.; No. 3, 48s.; Summerlee, No. 1, 53s.; No. 3, 48s.; Coltness, No. 1, 55s.; No. 3, 51s.; Glengarnock at Ardrossan, No. 1, 50s.; No. 3, 47s. 6d.; Eglinton, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Dalmellington at Ayr, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 54s.; No. 3, 50s. 6d.

The demand for pig iron for shipment is fair considering the season. The quantity cleared at the various ports during the past week reached 5926 tons, compared with 3642 in the corresponding week of last year. There was despatched to China and Japan 587 tons, Italy 572, Australia 460, India 241, Germany 219, Russia 50, Holland 385, Belgium 80, Spain 72, other countries 140, and coastwise 3120, against 1945 in the same week of 1893.

The manufactured iron and steel branches continue quiet but steady. There is a fair business doing in both iron and steel, about former prices. The exports in the past week of these articles are comparatively light, embracing sewing machines worth £5449, other machinery £4872, steel goods £3490, and miscellaneous iron goods £15,798.

The coal trade has become somewhat firmer since last report. The weather has taken a colder turn, increasing the household demand, and the shipments are larger. These facts have a favour-effect upon the market. The larger shipments are the result, to some extent, of sailings that had been delayed owing to unfavourable weather. The total quantity of coals cleared at the various Scotch ports was 163,568 tons, compared with 85,805 tons in the corresponding week.

No success whatever has attended the request of the miners for an increase of wages. This is not surprising, looking at the general state of trade, and taking into account the fact that the leaders of the men were divided in opinion as to the expediency of making such a demand at this particular time.

In the course of November there were launched from the Clyde shipyards ten vessels, with a total tonnage of 18,332, compared with 16 vessels and 20,600 tons in November, 1893. The output of the past 11 months amounts to 305,331 tons, against 264,462 in the corresponding period of last year.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE result of the last audit of the Coalowners' Sliding Scale Association is the declaration of another reduction of 1½ per cent. This was published on Saturday last, and was received with a good deal of unconcern, the colliers having quite made up their minds that the falling off in the coal trade would lead to a reduction, and a larger one was no doubt expected. The change from stormy to fine seasonable weather has been attended with a good deal of activity at Cardiff, Newport, and Swansea. The coal tonnage despatched from Cardiff alone was close upon 300,000 tons. It was the subject of comment on 'Change this week that this heavy shipment did not necessarily imply a brightening up of trade, as it was principally clearing off accumulations caused by the late storms; still there is no doubt a firmer tone begins to characterise the coal trade, and between now and the Christmas season it is very likely that there will be a good deal of business. Prices mid-week, both of best and seconds, showed a tendency to advance, and were better by 3d. a ton than Saturday's prices.

Current prices on 'Change, Cardiff, mid-week, were 11s. to 11s. 6d. best; seconds, 10s. 3d. to 10s. 6d.; dry sorts, 9s. 3d. to 9s. 6d.; best Monmouthshire, 10s. 3d. to 10s. 6d.; small, 4s. 9d. to 5s. 3d. A more satisfactory condition still begins to characterise the house coal trade, and the last report was "very firm, with a steady demand." Best households at Cardiff now command 10s. 9d. to 11s.; No 3 Rhondda, 10s.; brush, 8s. 3d. to 8s. 6d.; small, 6s. 6d. to 6s. 9d.; No. 2 Rhondda, 8s. 3d. to 8s. 6d.; small, 4s. 3d. to 4s. 6d.

Coke continues firm, with no alteration in price; patent fuel, 10s. 6d. to 11s. Pitwood still commands higher than usual figures; but this is exceptional, and with the arrival of cargoes will soon right itself. I inquired of a large importer whether any benefit had accrued from the advance of prices to £1, and even 25s., and was assured not; "stocks were low." Swansea price this week is 19s. to 20s. into truck, cash thirty days. Swansea's shipment of anthracite coal last week was marked, one vessel clearing for San Francisco with 3400 tons, and 900 tons bunkers. Swansea harbour trade in all respects was good last week, showing an excess of 18,000 tons over the preceding week. In coal there was a distinct improvement; in patent fuel the shipment was 6130 tons.

The tin-plate question is still the prominent one, maintaining its position in front even of the sad loss of Lord Swansea, who was the industrial chief of the district, and by whose mental energy and remarkable activity so many branches of labour were retained in full swing. Swansea owes much to him in the coal development alone, one great track being worked under sea. Lord Swansea was buried this week with great demonstration and regret, but it is satisfactory to learn that the various establishments will be continued.

I am glad to see, too, that the Beaufort tin-plate works, Morriston, which lost its owner in Mr. D. Davies, lately, are in good able hands. Mid-week it was announced that a settlement had been brought about at the South Wales Works, Llanelly, the men accepting a reduction of 10 per cent. So far there is not any indication of united action, and some works in the Swansea and Briton Ferry districts are under notice. It was announced this week that Llwydarth tin-plate works, Maesteg, would be closed at the end of the month. It is not improbable but that various notices now out may be recalled if the men imitate the wise course taken by those of the workmen of Mr. Rogers and Mr. Bond, Llanelly.

As regards bulk there is still a good deal doing in tin-plate, and America, Liverpool, and Bristol have been during last week the destination of a large quantity of make. The total shipment of tin-plates last week was 95,330 boxes, while the quantity received from works only totalled 72,673 boxes. Stocks now stand at 253,362 boxes.

Conversing this week with a leading tin-plate manufacturer, I remarked on the quantity of tin bar that was being sent into various Welsh ports from the North, and was assured that, notwithstanding this, the Welsh steel works, and pre-eminently those of Cyfarthfa, held the palm for superiority of tin bar. The Northern works are putting in bar, he said, at 4s. per ton under the price of some of the Welsh makers, but their bar is made by the basic process, and though good enough for common plate is not for the best. Speaking to him about the situation, he said a good deal of the present condition of trade is brought about by buyers having, in view of the American tariff passing, over-bought themselves. He had no no doubt this would right itself. and Wales would be secure of a good trade in tin-plate for years. American rivalry was not going to do much yet. Such is the substance of his views, and if wage agitation can be allayed a turn for the better may be expected.

Swansea imported 636 tons of pig and 360 tons of tin bars last week.

The iron and steel trades, which are generally dull at the end of the year, show no improvement, and prices remain at their old and low points. On 'Change, Swansea, this week, Glasgow pig warrants were quoted at 42s. 6½d. Other quotations were as follows:—Middlesbrough, No. 3, 35s. 5½d., prompt. Welsh bars, £5 2s. 6d. Steel rails, heavy, £3 15s. to £3 17s. 6d.; light section, £4 7s. 6d. to £4 10s., f.o.t. Sleepers, angles, channels, &c, according to section and specification. Steel was £6 to £6 10s. Steel sheets, £6 5s. to £6 10s. Bessemer steel bars, £4; Siemens, £4 to £4 2s. 6d.

Block tin is again receding; prices, £61 15s. to £61 17s. 6d. Tin-plate quotations remain in the old groove:—Bessemer steel cokes, 10s.; Siemens, 10s. 3d. to 10s. 6d.; ternes, per double box, 28 by 20 C., 20s. to 24s.; best charcoal, 11s. 6d. to 12s. 6d.; wasters, 6d. to 1s. less than primes.

Swansea quotation for iron ore is—Tafna, 11s.; Rubio, 11s. 3d. to 12s. An investigating contemporary has discovered that Wales is now getting its supplies of iron ore from the quarter which once supplied the Romans with its best steel. Stocks of ore are now well up for the winter season, but should they fail, the hematites of the Forest of Dean may command more attention than they do at present.

A new line of steamers has been put on between Cardiff and the South Coast ports of Southampton, Plymouth, and Bristol. Four have already been placed, and it is expected others will follow, and a large coasting traffic be developed. "Dock people" at Cardiff were interested this week by the visit of the Norwegian barquentine Reform, built on novel lines. She is a four-master, but when the wind is insufficient, can be propelled by means of petroleum. The ship is provided with two tanks, sufficient for the voyage, but has no funnel, and to the ordinary eye would seem to have no other motive power than her sails.

General Hutchinson, acting under instructions from the Board of Trade, made a special inspection of the tramway extension at Newport, Mon., this week before it was opened for general traffic. The new lines run through High-street, over Newport Bridge, Clarence-place, Chepstow-road, and Church-road, and indicate, in a marked manner, the improvement and prosperity of the port. The Government inspector, who was accompanied by the Parliamentary Committee and others, expressed himself as very pleased with the thoroughly satisfactory character of the work, and this week a start will be made with traffic.

A rumour has been current during the last few days to the effect that Sir W. T. Lewis was about retiring from official life. This I have not been able to substantiate, Sir William being absent either in Scotland or on the Continent, but I do not place much faith in it. This week another rumour was discussed gravely at the Bute Docks, "That Sir William's eldest son would take the active duties of the position at the Bute Docks, Sir William retaining the superintendence." About this, seeing the enormous strain, mental and physical, upon the representative of Lord Bute, there is certainly a likelihood.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE iron and steel trades over here continue in a most unsatisfactory condition. Fresh orders are only with difficulty obtainable, very few inquiries being generally made for winter deliveries, and a slackening off in activity is consequently reported from various establishments. With regard to the Silesian iron business the best that can be said is that in most departments a fairly regular employment has been maintained, but the prices quoted are not paying. Negotiations concerning the forming of a Central German Rolling Mill Convention have led to no result, and makers are more than ever inclined to agree to reductions. Breslau dealers have found it expedient to lower the price for bars from M. 125 on M. 120 p.t.; heavy plates have been reduced from M. 140 on M. 135 p.t., thin sheets remaining firm on M. 145 p.t.

Iron trade in Austria-Hungary is in entirely the same position as during former weeks. There is a quiet, in some instances insufficient demand coming forward for all descriptions of iron, and as foreign competition is very keen at the present moment and likely to remain so for some time to come, makers and manufacturers naturally feel rather uncomfortable. Pig iron continues scarce, and producers are therefore not very anxious to sell at the low prices which competition forces them to accept. At a late tendering, Styrian forge pig, No. 1, was sold at 58·70fl. p.t.; Hungarian forge pig being offered at 45 30 p.t.

The rolling mills have been hitherto well employed, especially those producing bars and plates, while the steel works and construction shops begin to be rather hard up for new work.

In France the iron business continues to slowly improve, the majority of the iron and steel works being satisfactorily engaged, but there are also some firms which had to restrict operations on account of a general lack of fresh orders. Up to date, prices have been with firmness maintained, and the tone of confidence which has been formerly noticed still prevails in the leading branches of industry. Recently a pretty large supply of bolts and nuts has been ordered at 305f. p.t. free Algiers.

In Belgium a quiet sort of business is still done on the iron market. Pig iron continues steadily inquired for, and prices have been on the whole tolerably well maintained. A rise in quotations for iron is generally expected to take place in the new year, which is the more likely because coke is sure to advance. Luxemburg foundry pig is at present paid with 48f. p.t.; forge pig, 47f. p.t. All sorts of plates meet with a lively request, and are better paid for than most articles of manufactured iron; the basis price of 132·50f. p.t. for iron plates, and 142·50f. p.t. for steel plates, being firmly maintained. Export in iron and steel continues depressed, which is due in some measure to the wars and troubles in the East. Just now negotiations are being carried on with Japan concerning the supply of railway requirements for narrow track railways.

The reports of the Rhenish-Westphalian ironmasters show no change in the position of the various industries since last week, except that the number of unemployed has increased in some instances. Pig iron is flat and the general lack of orders has brought about an extreme weakness in quotations, so that list prices can scarcely be considered more than nominal. The demand for finished iron also remains exceedingly quiet, and the transactions noted during the past week are of small account. Business on foreign account has been *nil*, and a great number of men have been thrown out of employment lately. Bars have been reported in fair request on home account, but nothing is gained at the present quotations, and makers do not care to book orders for forward delivery, as they firmly expect a rise in quotations before long. In girders and hoops a moderate business is done; plates and sheets have also been very quiet upon the week, quotations, of course, remaining extremely low. The wire mills are, as a rule, but poorly employed; here and there a small order has been booked, which will help to keep the mills slowly going. The construction shops and iron foundries are in a poor condition; at the locomotive shops a regular activity is reported.

Concerning the total shipments of coal from the ports of the Rhein and Ruhr—Hochfeld, Duisburg, Ruhrort—statistics show that in 1893 4,917,063 t. were shipped, out of 5,125,071 t. which came to the ports. Of the last-named quantity 1,116.997 t. fall to Duisburg, 893,971 t. to Hochfeld, and 3,114,103 t. to Ruhrort. As total production of the 169 collieries in the Rhenish-Westphalian district amounted to 38,613,146 t., it appears that one-eighth of total output has been shipped from the above-named ports.

Value of French import, during the first ten months of present year, is stated to have been 3,436,450.000f., against 3,121,980,000f. for the same period in the year 1893. Value of export, on the other hand, was 2,620,051,000f. only, against 2,666,272,000f. for the first ten months in previons year.

## AMERICAN NOTES.

NEW YORK, Nov. 28th, 1894.

REPORTS by wire from all large interior commercial centres show a steady volume of business is being transacted, and that stocks of material and merchandise are low. The opinion is entertained in commercial and manufacturing circles that the hesitating policy of consumers will disappear early next year; and that, under a more liberal provision of requirements, a slight improvement in selling prices will result. Steel mills are generally on full time. Iron rolling mills are not so crowded. Structural and plate mills will have large winter contracts placed in January. Railway companies are now ready to order increased rolling stock. General machinery is in somewhat better demand. The anthracite coal output is one million tons per week. Connelsville coke output last week, 105,720 tons. The industrial condition is slowly improving.

## LAUNCHES AND TRIAL TRIPS.

On the 27th ult. the s.s. Newlyn was sent to sea from the Tyne on her trial trip and afterwards proceeded on her first voyage to Constantinople. The vessel was built to the order of Messrs. J. J. and C. M. Forster for the Newcastle Steam Shipping Company by Messrs. C. S. Swan and Hunter, Wallsend, and engined by the Wallsend Slipway and Engineering Company. Wallsend. The Newlyn is 322ft. in length, 41ft. beam, and 23ft. 1½in. moulded depth; to carry 4400 tons deadweight. She is built on the improved awning deck type, classed 100 A1 at Lloyd's and built under special survey. The engines are 23in., 38in., and 61in. by 39in. stroke. The Newlyn is the fourth steamer built for Messrs. J. J. and C. M. Forster by Messrs. C. S. Swan and Hunter.

There was also launched last week, from the yard of Messrs. Swan and Hunter, a screw steamer built to the order of Mr. H. W. Dillon, of London, for the Dowgate Steamship Company, Limited, to augment their line of steamers, this being the second vessel built for this company by Messrs. C. S. Swan and Hunter. Length of the vessel, 336ft. over all; extreme breadth, 41ft.; depth, moulded, 27ft. 1½in. She is built on the improved spar deck grade, with poop, long bridge house amidships, and topgallant forecastle, cellular double bottom throughout, and all modern appliances for rapid loading and discharging of cargo. The vessel will be classed 100 A1 at Lloyd's, built under special survey. The engines are by the North-Eastern Marine Engineering Company, Limited, with cylinders 23in., 38in., and 61in. by 39in. stroke. On leaving the ways the steamer was named the Dowgate by Miss Willis, of Whitby.

Last week Messrs. Harland and Wolff launched a large twin-screw steamer, named the Oropesa, from the south end of the Queen's Island. The new vessel is built for the Pacific Steam Navigation Company, and intended to run in that company's line of mail steamers between Liverpool and the eastern and western ports of South America. She is 420ft. in length, and 48ft. 6in. in breadth, and has a gross tonnage of about 5370. On the main deck the first-class saloon is located, which will extend the full width of the vessel, and state-room accommodation for ninety first-class passengers. There is a second-class saloon of the same width, and state-rooms for ninety-four second-class passengers. Accommodation will be provided for 440 third-class passengers, a few of whom will be placed in rooms on the main deck forward, and the remainder on the lower deck. The Oropesa will be fitted with electric light and refrigerating machinery, and will have large spaces as promenades. Two sets of triple expansion engines, each of about 1800 indicated horse-power, have been constructed by Messrs. Harland and Wolff, the propellers being of manganese bronze. Mr. Hugh Brown was present at the launch on behalf of the owners.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—A general meeting was held on Friday, November 30th, Mr. E. Wilson in the chair. Mr. Cobb read a paper on "Electrical Transmission of Power." The author dealt chiefly with the different systems of distribution, and several specimens of cables and conductors were shown.

THE BIRMINGHAM ASSOCIATION OF MECHANICAL ENGINEERS.—At the annual meeting of the above Association held on Saturday last, the election of officers for the ensuing year was taken after the ordinary business had been disposed of, and resulted as follows:—Mr. E. Hazel, the retiring president, was unanimously re-elected for a second term, as was also Mr. J. Mills, vice-president. Mr. J. F. Crockatt was re-elected treasurer, and the following gentlemen were elected as members of committee:—Messrs. W. Bacon, J. Burns, J. Cox, A. W. Hayes; auditor, Mr. J. R. Meeklejohn; and the secretary, Mr. L. O'Brien, was also re-elected. The remainder of the evening was devoted to social intercourse and music.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*21st November*, 1894.

22,525. Device for Dispensers' Use, A. O. Haslewood, London.
22,526. Buttonhole Finishing Machines, F. Lee, Godalming.
22,527. Mode of Advertising on Vehicles, J. A. Taylor, London.
22,528. Look-out Apparatus for Ships, H. W. Ferris, London.
22,529. Combination Water-closets, S. H. Rowley, London.
22,530. Diamond Crossings of Railways, R. Crichton, London.
22,531. Resistances for Electric Circuits, M. H. Smith, London.
22,532. Roof Oil Lamps, The Lamp Manufacturing Company and W. H. I. Welch, London.
22,533. Colouring Matter, O. Imray.—(*W. J. Matheson and Co., United States*)
22,534. Brakes for Carriage Wheels, E. J. Byrne, London.
22,535. Checking the Speed of Trains, A. Marshall, London.
22,536. Educational Puzzle or Toy, M. Fulton, London.
22,537. Spring Roller Window Fittings, I. Pedley, jun., London.
22,538. Railway Sleepers, A. Marcet.—(*R. de Saussure, United States.*)
22,539. Cycles, A. I. Gravier, London.
22,540. Wheels, C. Jackson and H. H. Mulliner, Birmingham.
22,541. Cycle Brakes, J. M. Rimington and T. Shepherd, London.
22,542. Washing and Rinsing Machine, J. P. Malaviale, London.
22,543. Devices for Locking Corves in Cages, F. Pelzer, London.
22,544. Pipes and Cigarette Tubes, A. H. S. Campbell, London.
22,545. Toy and Game, A. Tuck and W. H. Ellam, London.
22,546. Removing Lime from Skins and Hides, J. Hauff, London.
22,547. Accumulator Electrodes, A. E. H. Honrichs, London.
22,548. Faucet, P. R. J. Willis.—(*F. H. Burrill, M. B. Stearns, and F. C. Ring, United States.*)
22,549. Closing Doors, P. R. J. Willis.—(*G. Rischmuller, United States.*)
22,550. Railway Signalling Apparatus, F. Nicholson, London.
22,551. Producing Flower Casts in Wax, N. F. Layard, London.
22,552. Developing Photographic Plates, E. Poulenc, London.
22,553. Fruit Stoning Machine, H. Schwartzkopf and A. Schnabel, London.
22,554. Hearses, J. Monday, London.
22,555. Sweetmeats, P. R. Franke and G. C. F. Roediger, London.
22,556. Seats for Shop Assistants, &c., J. Mallett, London.
22,557. Corset Busks, J. Ritchie, London.
22,558. Cock Construction, T. Brogan, London.
22,559. Fire Escape, H. A. Taylor, London.
22,560. Cycle Brake, R. Powell and H. C. Powell, London.
22,561. Preventing Boiler Incrustration, A. J. Boult.—(*A. Nieske, Germany.*)
22,562. Bread and Cake Knife, C. F. Smith, London.
22,563. Polishing Wire, L. Bündgens and J. Bündgens, London.
22,564. Locks, A. J. Boult.—(*A. Hampel, Germany.*)
22,565. Gas Stoves, F. Lönholdt, London.
22,566. Manufacture of Paper Pulp, A. Grandjean, London.
22,567. Matchbox Filling Machine, A. Schuster, London.
22,568. Purification of Saccharine Syrups, G. Gin, London.

*22nd November*, 1894.

22,569. Manufacture of Alkali Sulphides, B. Peitzsch, London.
22,570. Scissors, Shears, and the like, G. E. Challis, London.
22,571. Triple Expanding Tire for Cycles, A. Hill, Liverpool.
22,572. Pencil Sharpener and Holder, H. Pipe, London.
22,573. Spoons, H. J. Cooper and W. Pearce, Birmingham.
22,574. Knife Cleaning Machine, J. Davies and J. Anderson, London.
22,575. Elastic Tires for Vehicles, M. Smith, Manchester.
22,576. Fog-signalling Apparatus, H. G. Roberts, Hyde.
22,577. Pen Holders, J. Sutton, Liverpool.
22,578. Method of Cleaning Teeth, C. Millington, Yorkshire.
22,579. Manufacture of Balls, T. M. Cockroft, Manchester.
22,580. Band or Rope Pulleys, A. Trafford, Birmingham.
22,581. Cash Registering Apparatus, W. Rockliffe, Newcastle-on-Tyne.
22,582. Files for Letters and Invoices, J. G. Wood, Stockport.
22,583. Lamps, J. T. M. Hircock, J. T. B. Bennett, and J. Cohen, London.
22,584. Hat Making Apparatus, W. H. Blackwell, Stockport.
22,585. Pudding Making Machinery, E. Turner and J. Bell, Liverpool.
22,586. Cycle Lamp, R. L. Philpot and J. Murray, Coventry.
22,587. Steam Traps, E. Nightingale, Manchester.
22,588. Cycle Steering Lock, C. T. Lunt, W. Wakefield, and W. J. Mountford, Birmingham.
22,589. Rocking Washing Machine, F. J. Hembes, Berlin.
22,590. Letter Boxes, W. U. Morton and C. McCallum, Glasgow.
22,591. Cycles, H. W. D. Ingham, Birmingham.
22,592. Hot Air Motors and Apparatus, J. Murrie, Glasgow.
22,593. Packing Box for Plush, W. P. Thompson.—(*R. Thyssen, Germany*)
22,594. Printing Machines, C. and J. R. Oldham, Manchester.
22,595. Softening Vegetable Fibres, W. P. Thompson.—(*J. F. Kerr, United States.*)
22,596. Cameras, J. E. Thornton and E. Pickard, Manchester.
22,597. A Flying Apparatus, E. J. W. P. Birnbaum, London.
22,598. Machine for Cutting Wooden Blocks, A. Gogl, Glasgow.
22,599. Propulsion of Cycles, W. J. Collins and W. W. White, Glasgow.
22,600. Covered Vehicles, R. T. Huston, Belfast.
22,601. Transmitting Power for Cycles, J. Gutgeman, Birmingham.
22,602. Pneumatic Cycle Hub, W. M. Taylor and A. J. Sanderson, London.
22,603. Colouring Matters, J. Y. Johnson.—(*The Badische Anilin and Soda Fabrik, Germany.*)
22,604. Cartridges, T. Andrews, London.
22,605. Ironing Machines, T. H. Harris and H. C. Capel, London.
22,606. Pocket Closer and Protector, E. W. Stevens, London.
22,607. Bottle Stopper, F. W. Golby.—(*K. Kiefer, United States*)
22,608. Cycles, F. X. Bartl, London.
22,609. Tripod Stand, J. A. Prestwich, London.
22,610. Portiere Rods, G. Mackie and S. Hill, London.
22,611. Stoppers for Bottles and Jars, A. Boisselier, London.
22,612. Pin Cushion and Laundry List, J. White, London.
22,613. Decomposing Salt Solutions, J. C. Richardson, London.
22,614. Twine Holders, S. Moore and J. C. Elliott, London.
22,615. Gas Illuminating Apparatus, L. Denayrouze, London.
28,616. Mail Carts or Perambulators, H. B. Murdoch, London.
22,617. Pharmaceutical Compounds, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
22,618. Fire-arms, J. Purdey and W. Nobbs, London.
22,619. Means for Holding Glass, &c., F. B. Rendle, London.
22,620. Machine for Reeling Paper, J. Hyde, jun., London.
22,621. Soldering Glass, N. E. Cooke and C. R. Soar, London.
22,622. Cleansing Compound, A. Edmonds, London.
22,623. Drains, C. Smith, London.
22,624. Desiccating Liquids, &c., A. G. Southby, London.
22,625. Essence, J. B. Bouyoud and A. Velluet, London.
22,626. Velocipedes, T. Whitworth, London.
22,627. Lathing, E. F. Stimson, London.
22,628. New Motor, A. F. Windel, London.
22,629. Cycles, J. Faure, London.
22,630. Window Fastenings, G. F. Williamson, London.
22,631. Soldering Stoves, L. Oliven, London.
22,632. Door Fastenings, H. H. Lake.—(*J. Stuttgardter, Germany.*)
22,633. Paving-stone, J. Leuba, London.
22,634. Leather-disintegrating Machines, C. F. Wurmbach, London.
22,635. Knives, C. Giles, London.
22,636. Fashion Plates, &c., R. and L. A. Kann, London.
22,637. Electric Uterine Batteries, C. E. Hebard, London.
22,638. Boots and Shoes, F. Piggott, London.
22,639. Fastenings, C. F. Slater, London.
22,640. Lamp Brackets for Velocipedes, C. F. Sanderson, London.
22,641. Wrench for Pipes, C. Chevillard and A. A. Girard, London.

*23rd November*, 1894.

22,642. Securing Milk Cans, E. Broekhuijsen and E. Grahame, London.
22,643. Metal Plug for Tobacco Pipes, W. H. Pike, Liverpool.
22,644. Saving Incandescent Light Mantles, J. Love, Barking.
22,645. Filter Presses, J. Hill, Stoke-on-Trent.
22,646. Umbrellas, J. H. Lord, Rochdale.
22,647. Match Attachment to a Cigar, W. Squires and W. Pickard, Leeds.
22,648. Watch-carrier for Cycles, J. A. Beard, Birmingham.
22,649. Fluid-pressure Reducing Valves, J. Menzies, Glasgow.
22,650. Perforating Letters on Paper, M. S. Stevenson, Glasgow.
22,651. Restoring Vulcanised Rubber, J. Thomas, Manchester.
22,652. Corrugated Plates for Bridges, S. Strickland, Derby.
22,653. Step Ladder, W. H. Lee, Accrington.
22,654. Device for Drawing Corks, T. Pickin, Manchester.
22,655. Curling or Frizzing Hair, J. Barnes, Birmingham.
22,656. Reversible Ladies' Saddle, J. Kidman, London.
22,657. Alloy for Cartridge Cases, G. Hookham, London.
22,658. Automatic Gas-burner, W. H. Wallis, Southampton.
22,659. Chess-boards, W. A. Murray and J. A. Porterfield-Rynd, Dublin.
22,660. Method of Opening Parcels, W. G. Birkinshaw, Derby.
22,661. Combined Knife and Fork, W. H. Barwell, Sheffield.
22,662. Warming Infants' Food, S. J. Elliott, Southport.
22,663. Dolly-tubs, J. H. Gold and G. J. Bowcock, Southport.
22,664. Inflator Clip for Cycles, M. Lintine, Birmingham.
22,665. Sash Fastener, J. Whitehead and A. G. Herbert, Birmingham.
22,666. Finishing Boots and Shoes, G. Waters, Birmingham.
22,667. Roasting, &c., Appliance, J. Gaskell, Liverpool.
22,668. Pin Trays, J. F. Nowell, Bradford.
22,669. Doors for Railway Carriages, T. Batty, Bradford.
22,670. Fixing Handles to Broom-heads, A. Stather, Huddersfield.
22,671. Record Bar for Pistols, W. R. Barnes, jun., Worcester.
22,672. Liquifying Oil in Casks, D. Hinchliffe, Bradford.
22,673. Velocipedes, J. and H. J. Brookes and P. L. Renouf, Smethwick.
22,674. Flushing Cisterns for Closets, R. Deam, Manchester.
22,675. Paint Brushes and Tins, D. D. Macpherson, Manchester.
22,676. Locks for Carriage Doors, W. Rocca, Manchester.
22,677. Bicycle Stand, J. Ling, Birmingham.
22,678. Apparatus for Cotton Scutchers, H. A. Corrigan, Manchester.
22,679. Fastening Pneumatic Tire Covers, W. Robertson, Manchester.
22,680. Mail-carts and Bassinettes, W. S. Dove, Glasgow.
22,681. Washing Boards, J. W. Turner and J. A. Drummond, Glasgow.
22,682. Speed Motion for Mules, G. Peel and A. Yates, Manchester.
22,683. Combination Garment, H. Volkmer, Manchester.
22,684. Speed Gear for Cycles, H. G. Cadywould, Great Yarmouth.
22,685. Weighting Tackle for Beams, E. A. Bloom and S. Machin, Nottingham.
22,686. Road Vehicles, E. D. Brewer, London.
22,687. Cycling Costume, L. A. Diamant, London.
22,688. Chimney or Ventilator Top, J. Cordner, London.
22,689. Self-acting Window-fastener, F. de L. Banting, London.
22,690. Taps, Cocks, and Valves, A. J. Hathaway, London.
22,691. Fire-lighter, R. J. Cogan and E. J. Hollamby, London.
22,692. Raising the Temperature of Liquids, A. E. Noakes, Catford.
22,693. Making Croquet Balls, A. J. Altman, London.
22,694. Bicycle Support, J. Marston and J. Whitaker, London.
22,695. Cigar Boxes, S. and P. Cohen and L. Weenen, London.
22,696. Railway-signalling Apparatus, G. A. Wildsmith and J. Scaife, London.
22,697. Putting Fire-bars in Boilers, G. P. Craig, London.
22,698. Appliance for Spreading Gum, K. Schall, London.
22,699. Water Sprinklers to Protect Buildings, R. A. Taylor, Glasgow.
22,700. Accumulators, A. Lesquoy, London.
22,701. Cutters for Paste, &c., J. G. Lochlein, London.
22,702. Expanding Plug for Drain Pipes, T. Crapper, London.
22,703. Appliance for Driving Nails, J. Bonn, London.
22,704. Optical Lanterns, W. D. Askew, London.
22,705. Screw Nuts, B. Thompson, London.
22,706. Cycles, B. Thompson, London.
22,707. Automatic Nail Puller, J. E. McMurray, Illinois, U.S.A.
22,708. Boots for Horses, F. H. Wood, London.
22,709. Children's Carriage Handles, S. T. Fawcett, D. Simpson, and J. J. Simpson, London.
22,710. Producing Soap Bubbles, J. R. von Schmädel, London.
22,711. Fasteners for Flimsy Walls, C. N. Russell, London.
22,712. Lamps, T. H. Ambrose, London.
22,713. Tobacco Pipes, G. Vaudin, London.
22,714. Frog for Railway Crossings, J. C. Shipman, London.
22,715. Gloves and Pads for Cricket, A. Pullman, London.
22,716. Mounting the Saddle of Cycles, A. Mayhew, London.
22,717. Bicycles, A. Mayhew, London.
22,718. Electric Motors, A. J. Boult.—(*E. Depoux, France.*)
22,719. Revolving Fire-arms, J. F. and H. W. Latham, London.
22,720. Compound of Beef Extract, W. Robertson, London.
22,721. A New Pilot Gas Jet Burner, T. Alexander, London.
22,722. Spring Hook for Ties, Müller and Hörman, London.
22,723. Puzzle, G. E. Rennie, London.
22,724. Lead Pencil Cases, Perry and Co., Ltd., and W. Wiley, Birmingham.
22,725. Copper Fungicide, G. F. Strawson, London.
22,726. Crystallose, J. Y. Johnson.—(*F. von H. Nachfolger, Germany*)
22,727. Thrashing Machines, J. Marshall, London.
22,728. Rope Grips for Haulage, J. H. Craven, London.
22,729. Compasses, A. W. Horsbrugh and J. H. Lee, London.
22,730. Washing Board, G. C. Marks and F. W. Thomas, London.
22,731. Steam Boiler Tubes, R. W., T. S., and W. H. Lewis, London.
22,732. Collars for Horses, &c., E. H. Ludlow, London.
22,733. Steel Tubes, C. Faulkner, F. H. Lloyd, W. E. Lloyd, and W. H. Lloyd, London.
22,734. Brakes for Vehicles, J. and F. Netsch, London.
22,735. Attaching Gloves together, S. H. Crocker, London.
22,736. Bicycles, W. J. Midleton, London.
22,737. Artificial Bristles for Brushes, S. Crosse, London.
22,738. Wire-spring Mattresses, A. H. Gale, London.
22,739. Metal Bedsteads, A. H. Gale, London.
22,740. Soldering Aluminium, L. Oliven, London.
22,741. Mixing Taps, H. C. Willmott and H. Sumerling, London.
22,742. Manufacture of Carpets, F. A. Bonton, London.
22,743. Dyes, L. G. Williams and A. Turner, London.
22,744. Lamps, S. Falk and H. C. Webb, London.
22,745. Alarms for Steam Boilers, G. F. Redfern.—(*A. C. Southwell, Corsica*)
22,746. Bells for Velocipedes, C. Lohmann.—(*H. Wessner, Germany.*)
22,747. Reaping Machines, J. Hornsby and J. Innocent, London.
22,748. Solid Metal Bars, &c., A. F. E. Dupont, London.
22,749. Protecting Ships from Torpedoes, G. H. Jones, London.

*20th November*, 1894.

22,750. Raising Metal Lids from Tins, E. H. Durnford, Kent.
22,751. Attaching Pneumatic Tires to Cycles, J. Moore, Hull.
22,752. Photographic Pictures, L. A. Marion, H. Giubout, G. Bishop, F. Bishop, and J. P. Kirk, London.
22,753. Safety Automatic Carving Fork, H. T. King, Norwich.
22,754. Lamp Stoves, H. V. Rippingille, Birmingham.
22,755. Trays for Gas Stoves, H. V. Rippingille, Birmingham.
22,756. Fertilisers, T. Twynam and F. T. Barnett, Surrey.
22,757. Pneumatic Tire, H. Jackson, Stockport.
22,758. Jacquards, W. Birks, W. J. Watson, and J. Taylor, Nottingham.
22,759. Pneumatic Tires, H. Smith, Nottingham.
22,760. Waiters' Trays, Tables, &c., C. E. Corbitt, London.
22,761. Machine for Open Embroidery, W. Bowden, Manchester.
22,762. Pipes for Smoking Tobacco, J. Walker, Birmingham.
22,763. Adjusting Seats in Vehicles, W. E. Rippon, Huddersfield.
22,764. Star Maps, G. Castleden, Framlingham.
22,765. Toe Clip for Cycle Pedals, J. McN. Rimington and T. Shepherd, Newcastle-on-Tyne.
22,766. Lamp Brackets for Velocipedes, J. McN. Rimington and T. Shepherd, Newcastle-on-Tyne.
22,767. Stoves for Cooking, J. Edmonson, Newcastle-on-Tyne.
22,768. A New Indoor Game, G. P. Blagdon, Birmingham.
22,769. A String Raiser, E. A. Davis and A. B. Willway, Bristol.
22,770. Electrically Illuminated Timepiece, G. Ashford, Newport.
22,771. Boots for Golfing, L. S. Stroyan, Derby.
22,772. Socket in Earthenware Pipes, J. J. Green and W. Oates, Halifax.
22,773. Forming Joints in Earthenware Pipes, J. J. Green and W. Oates, Halifax.
22,774. Joining Earthenware Pipes, J. J. Green and W. Oates, Halifax.
22,775. Earthenware Access Pipe, J. J. Green and W. Oates, Halifax.
22,776. Hammer for Pianofortes, J. Jones, Essex.
22,777. Polishing Mops, J. E. and H. E. Hartley, Birmingham.
22,778. Steam Generators, W. R. Austin, Stockton-on-Tees.
22,779. Phonographs, J. Oulton, Bradford.
22,780. Harness Buckles, E. Kipling and C. W. Walker, Bradford.
22,781. Exposing Chamber for Production of Lantern Slides, W. Tylar, Birmingham.
22,782. Solid Pattern Metal Dark Slides, W. Tylar, Birmingham.
22,783. Attachment for Photographic Shutters, W. Tylar, Birmingham.
22,784. Spark Arrester, W. P. Thompson.—(*A. Beeri, Germany.*)
22,785. Waterproofing of Textile Fabrics, J. B. and J. S. Fearnley, Manchester.
22,786. Driving Gears of Bicycles, &c., E. F. Carter, Birmingham.
22,787. Carriage Axles and Axle Brushes, J. Grice, Birmingham.
22,788. Metallic Diamond Clip-all, J. Aspinall, J. S. Baron, and F. G. Gunhouse, Blackburn.
22,789. Roller Racks for Blinds, F. Barker and S. Bott, London.
22,790. Locking Nuts upon Bolts, L. Lindley, Nottingham.
22,791. Cavity Sow-box for Sizing Machines, J. Gregson, Lancashire.
22,792. Manufacture of Handkerchiefs, R. W. Gribbon, Belfast.
22,793. Concrete and Composite Buildings, W. Orr, Glasgow.
22,794. Filing and Finishing Work, S. Hunter, London.
22,795. Playing Bowed Musical Instruments, J. Cocking, Sheffield.
22,796. Stoves, G. Woolliscroft and H. Garland, Cheshire.
22,797. Utilising Bosh Dirt, W. J. Langham, Birmingham.
22,798. Loom Shuttle Guards, J. Scaife, London.
22,799. Looms for Making Ladder Tapes, S. Butterworth, Manchester.
22,800. Valve Gear, J. Cockrane and W. Cameron, Barrhead, N.B.
22,801. Chains for Gearing, C. J. Chubb and R. H. Seaton, London.
22,802. Automatic Electrical Wonder, W. F. White, London.
22,803. Warming Beds, F. Taylor, London.
22,804. Training or Supporting Device, G. A. Bentley, London.
22,805. Preventing the Extraction of a Watch from the Pocket, C. Smallman, London.
22,806. Straining Device for Coffee Jugs, C. D. Sutton, London.
22,807. Combined Cash Till and Writing Desk, A. Barnett, London.
22,808. Vehicles for Advertising Purposes, A. M. Marsden, London.
22,809. Advertising on Hoardings, A. M. Marsden, London.
22,810. Mud Guards for Velocipedes, J. Fletcher, London.
22,811. Capes for Cyclists, J. Fletcher, London.
22,812. Type-writers, C. J. Wollaston, London.
22,813. Adjusting Device for Wind Motors, H. O. Plump, London.
22,814. Protector for Dress, &c., Pockets, A. Grove, London.
22,815. Ventilators and Construction of Greenhouses, T. Griffen, London.
22,816. Flushing Cisterns, W. H. Bailey, London.
22,817. Manufacture of Horseshoe Nails, E. Perkins, London.
22,818. Fastening Appliances for Belting, S. C. Davidson, London.
22,819. Lock and Block Electric Apparatus, E. Tyer, London.
22,820. Railway Fog Signal Apparatus, F. A. Rodewald, London.
22,821. Conduits for Electrical Conductors, J. Tatham, London.
22,822. Counting Apparatus, H. Heilbronner and M. Stein, London.
22,823. Velocipede Bells, J. M. Rimington and T. Shepherd, London.
22,824. Short-circuiting Device, F. N. Denison, London.
22,825. Bows for Violins, O. Möesner, London.
22,826. Treatment of Solutions of Zinc Chloride, J. Brock, A. E. Wareing, and F. Hurter, London.
22,827. Treatment of Solutions of Zinc Chloride, J. Brock, A. E. Wareing, and F. Hurter, London.
22,828. Utilisation of Zinc Blende, J. Brock, A. E. Wareing, and F. Hurter, London
22,829. Breaking Steel Rails, T. W. Ward and H. W. Lash, London.
22,830. Coin-freed Apparatus, R. T. and J. G. Glover, London.
22,831. Table for Use of Artists, B. Littler, London.
22,832. Door Slides, W. C. Tanner, London.
22,833. Determining Position of Vessels at Sea, D. J. Jenkins and S. Carey, London.
22,834. Vitrified Material, La Société Anonyme des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny et Cirey, London.
22,835. Type-writing Machines, T. H. Stackhouse, London.
22,836. Adapting Fire-arms for use with Miniature Ammunition, J. F. Latnam and J. T. Musgrave, London.
22,837. Mean Pressure Indicator, A. H. Allen, London.
22,838. Advertising, A. Lucien, London.
22,839. Attaching Address Cards to Barrels, F. G. Thorne, London.
22,840. Supporting Bicycles, &c., R. W. Smith, Birmingham.
22,841. Parts of Velocipede Frames, R. W. Smith, Birmingham.
22,842. Automatic Circuit Breakers, J. Lorwa and P. Feys, London.

*26th November*, 1894.

22,843. Teapot and Slop Basin, F. W. Bentall, London.
22,844. Concentrating Sulphuric Acid, I. Levinstein, Manchester.
22,845. Power Sheep-shears, W. H. and T. Burman, Birmingham.
22,846. Spring Bedstead Frames, C. P. Robins, Birmingham.
22,847. Jacks Employed in Lasting Boots, J. M., J., A. J. and S. A. Gimson, Leicester.
22,848. Cigar-holder Plug, J. Nicholl and T. G. Dickinson, Halifax.
22,849. Stockings, H. Gregory and F. Smith, Manchester.
22,850. Adjustable Cross-bar, J. F. Braidwood, London.
22,851. Construction of Pneumatic Tires, A. Maltby, London.
22,852. Hand Starting Gear for Gas Engines, T. H. Armstrong, Northumberland.
22,853. Utilising Acid Sulphates, J. W. Walker, Glasgow.
22,854. Tea Making, W. G. M. Ivy and The Princess Company, London.
22,855. Automatic Locking-arrangement, B. Mack, London.
22,856. Varying Electrical Currents, H. C. Haycraft, London.
22,857. Application to Cops, J. Finlayson, jun., London.
22,858. New Ornamentation for Gloves, J. Hall, Leek.
22,859. Ratchet for Window-blind Cord, J. C. Pickard, Burnley.
22,860. Broach for Holding Tickets, J. F. R. Wood, London.
22,861. Hanging Window Sashes, J. G. Crowe and G. J. Cording, London.
22,862. Manufacturing Nitric Acid, W. Garroway, Glasgow.
22,863. Recovery of Coal Dust, D. Young, Glasgow.
22,864. Sieve for Cleansing Milk, R. Badger, Clitheroe.
22,865. Ventilated Lamp Reflector, W. O. Rogers, London.
22,866. Regulating Lever-action, F. E. Morriss, Norfolk.
22,867. Fusible Plug, S. O. Pearson, Manchester.
22,868. Cycle Stands, G. Lund, Bradford.
22,869. Chestnut Roaster, T. H. Douthat, Hounslow.
22,870. Tires for Cycles, J., J. Cutlan and R. Hochfeld, London.
22,871. Manufacture of Scroll Irons, J. Brockhouse, Birmingham.
22,872. Artificial Spinning Baits, R. F. Juckes, Wales.

22,873. Removing Grains from Mash Tuns, H. H. Hawkins, Manchester.
22,874. Fog-signal Apparatus, B. Buckley, Manchester.
22,875. An Inflated Sole, G. Fox, York.
22,876. Inhaler, J. G. Hewson, Manchester.
22,877. Rain Boots or Leggings, E. A. Bailey, Liverpool.
22,878. Metallic Packing, J. Inglis and J. Herdman, Leith.
22,879. Stone Saw, G. Rushworth and J. Rushworth, London.
22,880. Electric Arc Lamp, R. M. Trille, Jersey.
22,881. Brace, E. Price and E. W. Almond, London.
22 882. Brace, E. Price and E. W. Almond, London.
22,883 Measures, G. Binswanger and E. Stanley, London.
22,884. A Revolving Mast and Sail, E. B. Walker, Dorset.
22,885. Fire-doors, J. H. P. Kickhefel, London.
22 886. Attaching Uppers to Boots, T. Herbert, London.
22 887. Utilising the Flow of Tides, F. H. Kitchin, London.
22,888. Sliding Bolts for Doors, &c., J. Wharfe, London.
22,889. Lead Pipe Junctions, T., J. W., and J. H. Claughton, London.
22,890. Manipulating Electric Boxes, A. Taylor, London.
22,891. Starting Handle for Engines, A. P. Turner, Peterborough.
2,892. Boots and Shoes for Cycling, W. Gamage, London.
22,893. Gloves, F. Heafield, London.
22,894. Guns, J. Robertson, London.
22.895. Photographic Cameras, D. H. Houston, London.
22,896. Photographic Cameras, D. H. Houston, London.
22,897. Grain Separators, P. R. J. Willis.—(*H. Bailey and W. L. Gilson, United States.*)
22,898. Mortice Locks for Doors, G. J. A. Richardson, London.
22,899. Mortice Locks for Doors, G. J. A. Richardson, London.
22,900. Cauterising Apparatus, R. T. A. O'Callaghan, London.
22,901. Feed-water Heaters, R. Klostermann, London.
22,902. Making Bismuthoxyiodide-gallate, F. Lüdy, London.
22 903. Composite Sheet Metal, J. J. Atkinson, London.
22,904. Colouring Matters, J. Imray.—(*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, France.*)
22,905. Vulcanisation of Caoutchouc Articles, C. E. Bergeon, London.
22,906. Machines for Cutting Rock, B. J. Atterbury, London.
22,907 Gun Boat for Coast Defence, A. Coke, London.
22 908. Water-closets, E. Chatelain, London.
22 909. Cycle Brakes, J. A. Goodby and W. Capewell, London.
22 910. Lifts, T. Mullock, London.
22,911. Letter-cards, J. E. Browne, London.
22,912. Making Cycles, A. Kriéger and R. Blondeau, London.
22.913. Displaying Advertisements, R. Haddan.—(*The Firm of G. Stollwerck, Germany*)
22,914. Fast Yellow Dyestuffs, S. Pitt.—(*L. Cassella and Co., Germany.*)
22 915. Apparatus for Stopping Ribbed Tubes, W. Boaz, London.
22,916. Mounting Grindstones, A. Clare, London.
22.917. Treatment of Ammonia, J. Brock, A. E. Wareing, and F. Hurter, London.
22,918. Electrically-heated Iron, T. B. Grant, London.
22,919. Electrically-driven Hydro-extractor, T. B. Grant, London.
22,920. An Improved Trap for Animals, G. Gibbons, London.
22,921. Trimming Type, The Linotype Company, Ld., and C. Holliwell, London.
22 922. Constructing Elastic Tires, C. H. Michelsen, London.
22,923. Advertising, M. M. Dessau, London.
22,924. Fasteners for Dresses, &c., M. Rollin, London.
22,925. Fire-proof Walls and Partitions, B. R. Ikin, London.
22,926 Packing Textile Fabrics, H. Wollheim, London.
22,927. Domestic Stoves and Ranges, J. S. Hainsworth, London.
22,928. Making Sheet-metal Cramps, H. Wollheim, London.
22,929. Artificial Ivory, E. Weihers and R. Crosse, London.

*27th November*, 1894.

22,930. Charging Pistols with Shot, B. R. Banks, Croydon.
22,931. Wrench, J. F. Whiteside, Clitheroe.
22,932. Pillow Holder and Bolster, A. L. B. McNair, Weston-super-Mare.
22,933. Check System, J. B. Edmondson and T. Lewis, Dublin.
22,934. Pneumatic Shields for Wounds, A. Cole, Dublin.
22,935. Driving Gear for Cycles, W. Ferrier, Dundee.
22,936. Steam Generator and Furnace, W. S. Bancroft, Halifax.
22 937. Securing Rail Chairs, J. J. Hayman, H. W. Pearson, and H K. Cripps, Bristol.
22 938. Heels, A. G. Brookes.—(*J. W. Brookes, United States.*)
22,939 Controlling Supply and Yarn, A. G. Brookes.—(*W. F. Draper, United States.*)
22,940. Effecting Changes of Speeds, A. G. Brookes.—(*H. H. Cummings, United States.*)
22.941. Seat-wheel and Heel Iron, J. D. Webber, Derby.
22,942. Vertical Combination Fret Cutter, J. Davis, Bradford-on-Avon.
22,943. Spinning and Twisting Yarn, W. Golding, Manchester.
22,944. Cycles, T. Pickin, Manchester.
22,945. Valves, T. Pickin, Manchester.
22,946. Gas Engines, D. Clark and F. W. Lanchester, London.
22,947. Flotation of Battleships, R. J. Plunkett, Bristol.
22,948. Lock-nuts for Bolts and Screws, L. Lindley, Nottingham.
22,949. Measuring Fluid Pressures, W. H. Watkinson, Glasgow.
22,950. Kiln, J. C. Bailey, Longport.
22,951. Printing Machines, W. H. and A. P. Dawson and J. Stott, Bradford.
22,952. Development of Photographs, A. G. Adamson, Glasgow.
22,953. Dials for Watches, J. Hawley and J. Bradley, Birmingham.
22,954. Apparatus for Cleaning Drain Traps, G. Hardie, Glasgow.
22,955. Tool-holders, T. Wallace, Barrow-in-Furness.
22,956. Umbrella Handles, B. R. Simmons and H. E. Venour, Birmingham.
22.957. Paper Bags, J. Handford, Manchester.
22,958. Rotary Engine, F. Kadlcik, F. Juppa, and J. Juppa, Glasgow.
22,959. Boilers, J. J. Bohner, Manchester.
22,960. Impromptu Class-rooms, G. Allinson and Sons, Sheffield.
22,961. Liquid for Polishing Metals, T. Blake, London.
22,962. Water-cocks, A. B. and A. C. Simmons, London.
22,963. Protecting the Joints of Windows, E. O. Read, London.
22,964. Fire-escapes, C. E. Hoefling, London.
22,965. Electric Welding, W. P. Thompson.—(*C. L. Coffin, United States.*)
22,966. Paint Compounds, W. P. Thompson.—(*W. Griscom, jun., United States*)
22,967. Winding Machines, T. Guest, T. Brookes, and M. Walsh, Manchester.
22,968. Treating Hides for Leather, W. R. Earp, Liverpool.
22,969. Treatment of Rhea Fibre, R. J. Rastrick, Hants.
22 970. Attaching Cycle Mudguards, W. and G. E. Clarke, London.
22 971. Shuttle Guards, Hartley and Ainsworth, Ld., and H. Hartley, Manchester.
22,972. Cycle Mud Shield or Protector, C. E. Vining, London.
22,973. Storage Batteries, C. S. W. Brown, London.
22 674 Door Stop and Burglar Alarm, J. W. Jones, London.
22 975. Banjo Rest Suspender, J. T. Moore, London.
22 976. Cycles, J. Mason, London.
22 977. Cranks, A. J. Boult.—(*H. Farjas, France*)
22,978. Irons for Pressing Clothes, J. W. Blackshaw, London.
22,979. Hooks and Eyes, A. Picken, London.
22,980. Fire Escapes, G. Leete and A. Young, London.
22 981. Cardboard Box Stapling Box, A. Greifenhagen, London.
22,982. Choked Drain Indicator, E. A. S. Fawcett, London.
22,983. Gas Stove and Gas Fire Burners, G. E. Wright, London.
22,984. Ceiling Brackets, J. Whitby, W. W. Slate, and J. Whitby, London.
22,985. Electric Lamp Ray Diffuser, E. Oldenbourg, London.
22,986. Portable Electric Batteries, C. J. Hubbell, London.
22,987. Furnaces of Steam Boilers, R. H. Dames, London.
22,988. Wrapping Apparatus, W. L. Wise.—(*J. P. Henderson, United States*)
22,989. Apparatus for Curing Round Shoulders, E. Wall, London.
22,990. Exhibiting Cycloramic Views, T. W. Barber, London.
22,991. Ball Valves for Cisterns, &c , J. F. Rubbins, London.
22,992. Spirit Burner for Heating Purposes, E. Lent, London.
22,993. Governing Engines, G. L. Addenbrooke.—(*R. Macdonald, Australia.*)
22,994. Correcting Manuscript Documents, M. Bartholomew, London.
22,995. Steam Boiler, A. Abrassart and P. J. Lecomte, London.
22,996. Non-explosive Reservoir for Oil, J. Bouhon, Hamburg.
22,997. Swimming Learning Apparatus, E. Edwards.—(*R. Scheller, Germany.*)
22,998. Shirt, J. Grant, London.
22 999. Furnaces, H. H. Lake.—(*E. D. Meier, United States*)
23,000. Screw Pumps, E. M. Fox.—(*W. E. Quimby, United States.*)
23,001. Water-carts, A. Riener, London.
23,002. Heating Railway Vehicles, E. H. Gold, London.
23,003. Steam Boiler and other Furnaces, B. W. May, London.
23,004. Musical Chart, H. H. Lake.—(*R. W. Lyle, United States*)
23,005. Churns, L. Sturges, London.
23,006. Process for Extraction of Gold, L. C. Daumas, London.
23,007. High-power Explosives, H. H. Lake.—(*C. S. Randall, United States.*)
23,008. Screw Propellers, J. B. Jones and J. Branson, London.
23,009. Slide Valves, E. L. Sauer and A. Coleman, London.
23,010. Lamps, S. Chandler, jun., and J. Chandler, London.
23 011. Attachments for Sinks, Drains, &c., H. Howse, London.
23,012. Electric Signalling Systems, H. E. Walter, London.
23,013. Sewing Machines, J. Morrison, London.
23,014. Presser-foot for Sewing Machines, J. Morrison, London.
23,015. Dressers for Lady Cyclists, N. A. Aubertin and A. Lebas, London.
23,016. Factory Chimneys, &c., A. H. E. Gribbohm, London.
23,017. Sleeping and Drawing-room Cars, L. F. Ruth, London.
23 018. Boring Machines, C. Cristadoro, London.
23,019. Devices for Carding Machines, A. Borios, London.
23,020. Crushing Minerals, J. C. Fell.—(*W. Hinrichs, United States.*)
23 021. Engraving Machines, C. C. Bruckner, London.
23,022. Sleep-giving, &c., Sound, P. E. Fahlberg, London.
23,023. Extinguishers for Lamps, E. Rippingille and W. Brandon, London.
23,024. Diagrams for Tacheometers, G. Gillman, London.
23,025. Can-opener, J. Bien, London.
23.026. Window Fastener, W. Shelley, London.
23,027. Locking Devices, F. J. J. Gibbons, London.
23.028. Gas and Vapour Engines, M. H. Robinson, London.
23,029. Time, &c., Indicating Device, W. Wood, London.
23 030. Elastic Handle for Velocipedes, H. J. Haddan.—(*Marcus and Co., Germany.*)
23,031. Carbonating Liquids, H. J. Haddan.—(*The Ferry Manufacturing Company, United States*)
23,032. Carbonating Liquids, H. J. Haddan.—(*The Ferry Manufacturing Company, United States.*)
23,033. Stool, E. Bolens, London.
23,034. Cyclists' Wallets, G. E. Campbell, London.
23,035. Corsets, W. Kleinwächter, London.
23,036. Rulers, H. Furmidge, London.
23,037. Cover for Culinary Purposes, S. L. Jones, London.
23,038. Box and Call Board for Hotels, J. P. Moore, London.
23,039. Elastic Stockings and Anklets, J. Lorac, London.
23,040. Windows and Cheval Glasses, R. Lanham, London.
23,041. Feeding Heaters with Water, W. Schmidt, London.
23,042. Embroidering Machines, P. Schiersand, London.
23,043. Propellers, E. Davis, London.
23,044. Draught-excluders, W. C. Tanner, London.
23,045. Pipe Cleaners, H. M. Hodges, London.
23,046. Sectional Roller for Blinds, E. T. Headech, Ashford.

*28th November*, 1894.

23,047. Stop and other Valve-chests, R. Semple, Bellshill.
26,048. Broom-fastener, W. Clode and J. Smith, Birmingham.
23,949. Steam Pumps, M. and A. Shanks and R. W. Morrice, Pollakshaws.
23,050. Metal Sheets, C. Pegram, Birmingham.
23,051. Firegrates and Stoves, E. Hallam, Derby.
23,052. Screens for Process Engraving, A. W. K. Bryan. Manchester.
23,053. Flue for Incubators, C. W. Siviter, Birmingham.
23,054. Dry Soap, H. Heaton, Bradford.
23,055. Steam Generators, C. Christmas, Birmingham.
23,056. Weaving of Textile Webbings, H. T. Ollard, Birmingham.
23,057. Candle Holder, W. Horabin, Crewe.
23 058. Harness, J. L. Bradshaw, Southport.
23,059. Device for Mixing Grain, J. L. Bradshaw, Southport.

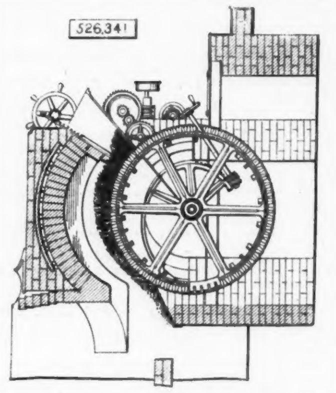
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**526,341.** Mechanical Stoker, *T. R. Butman, Chicago, Ill.—Filed January 5th*, 1894.

*Claim.*—(1) In a furnace the herein-described rotary drum-shaped grate having the end heads and the periphery formed of grate bars, said end heads having gearing and the drive shaft parallel with the grate and having the gear-wheels engaging said gearing of the heads, and means to rotate said shaft, substantially as described. (2) In a furnace, the combination with the rotary grate, of the combustion chamber above the same, having the curved arch dropped at the receiving and discharging ends, substantially as set forth, so as to contract the combustion chamber at its front and rear ends for the purpose mentioned. (3) In a furnace, the combination of a rotary grate, the combustion chamber above the same having the curved arch, the feed hopper at the front end of said chamber, and the rear discharge end of the chamber in a lower plane than the front receiving end. substantially as set forth. (4) A furnace having the rotary grate and the movable ashpan located within the grate beneath the upper surface thereof, and controlling the distribution of air through said upper surface.

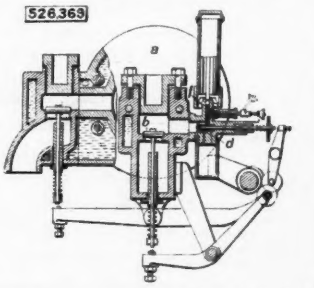
526,341



**526,369.** Gas, Oil, or Similar Motor Engine, *H. H. Andrew and A. R. Bellamy, Reddish, near Stockport, England.—Filed March* 13th, 1894.

*Claim* – (1) In combination in a gas or motor engine, the ignition tube *h*, the ignition valve, the snifting valve *k* arranged in proximity to and in communication with the ignition tube and opening at or about the same time as the ignition valve for the purpose of allowing the contents of the ignition tube to escape into the atmosphere, and a disengaging device adapted to open the snifting valve, and allow it to be closed automatically, substantially as described. (2) In a gas or oil motor engine the combination of the snifting *k* having a pivoted tumbler catch *m*; the ignition tube *h*, the ignition valve and spindle kicker plate *n* and washer *l* on the spindle of the ignition valve, all arranged and operating substantially as described and as shown.

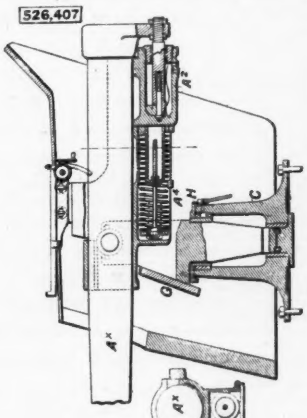
526,369



**526,407.** Quick-firing-gun Mount, *A. Noble and R. T. Brankston, England.—Filed May* 14th 1894.

*Claim.*—(1) The combination of a gun, its cradle, with trunnions supported in bearings carried by a fork at the upper end of a vertical pivot, a pedestal for the vertical pivot to rest in, a shield carried from this pivot by yielding stays and shielding a space around the front and sides of the pivot, a spring box for running out the gun carried on the under side of the cradle and open on the under side, so that the springs may be taken out and removed rearward and sights carried by an upward extension of one side of the cradle at a level above the front portion of the shield substantially as described. (2) The combination of a gun A* cradle A with its trunnions supported in bearings on a vertical spindle B, the pedestal C for vertical spindle to rest in the movable ball bearing C* at the bottom of the pedestal—recoil cylinder $A^2$ and spring box $A^3$ on under side of cradle containing a spring $A^4$ for running out the gun and open at bottom to admit of the springs being readily removed—a worm wheel H attached by friction to the pedestal—a flat shield G fixed across the front of the vertical pivot to protect the spring-box and the worm wheel, and a shield D carried from the pivot by yielding stays F to protect the space around the front and sides of the pedestal.

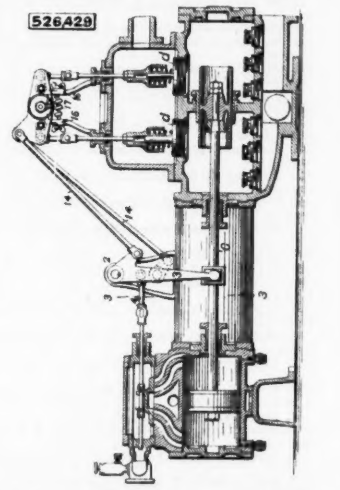
526,407



**526,429.** Valve Gear for Pumps, *C. C. Worthington, Irvington, N Y—Filed March 28th*, 1890.

*Claim.*—(1) The combination with the plunger of a direct-acting steam pump, of a valve located upon the force side of the plunger, and means substantially as described for positively closing the valve to remove the pressure of the force main from in front of the plunger as it reaches the end of its stroke. substantially as described. (2) The combination with valves *d*, of rods 10 having heads engaging said valves, oscillating lever 13, and yielding connections between said rods and lever, rock shaft 2 actuated by a moving part of the pump, and connecting-rod 14 between said shaft and lever, substantially as described. (3) The combination with the valves *d*, of rods 10 having heads engaging said valves, oscillating lever 13, bell crank levers 16 fulcrumed on said oscillating lever and connected to the rods 10, spring 17 connecting said bell crank levers, rock shaft 2 actuated by a moving part of the pump, and connecting rod 14 between said shaft and lever 13, substantially as described. (4) The combination with the valves *d*, of rods 10 having heads engaging said valves, oscillating lever 13, bell crank levers 16 fulcrumed on said oscillating lever, and connected to the rods 10, spring 17 and stops 30, rock shaft 2 actuated by a moving part of the pump, and connecting-rod 14 between said shaft and lever 13, substantially as described. (5) The combination with the piston-rods C, rock shafts 2, levers 3, and connecting-rods 4 for operating the steam valves of a duplex pump from opposite sides, of devices for closing the water valves and connecting rods 14, connecting said devices with the rock shafts 2 actuated from their own side of the pump, substantially as described. (6) The combination with the piston-rods C, rock shafts 2, levers 3 and connecting-rods 4 for operating the steam valves of a duplex pump from opposite sides, of water valves *d*, rods 10 having heads engaging said valves, oscillating levers 13 carrying said rods, and connecting-rods 14 between said levers and the rock shafts 2 actuated from their own side of the pump, substantially as described. (7) The combination with the piston-rods C, rock shafts 2, levers 3 and connecting-rods 4 for operating the steam valves of a duplex pump from opposite sides, of water valves *d*, rods 10 having heads engaging the valves, oscillating levers 13, bell crank levers 16 fulcrumed on said oscillating levers and connected to said rods 10, and spring 17, substantially as described.

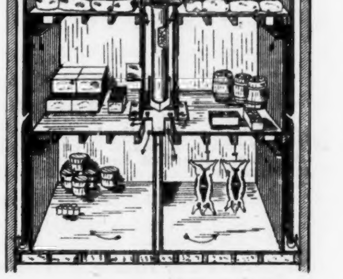
526,429



**525,695.** Cold Storage Building, *A. I. Dexter, Wauwatosa, Wis.—Filed October 23rd*, 1893.

*Claim.*—(1) In a refrigerator or cold storage building, the combination of an ice storage room; one or more produce storage rooms located below said ice storage room; downward cold air flues communicating from said ice storage room to said produce rooms; and heat intercepting flues communicating first downward and then upward from the upper parts of said produce storage rooms to said ice storage room, substantially as and for the purpose set forth. (2) The combination in a refrigerator or cold storage building of two or more produce storage rooms; a chemical refrigerator; cold air distributing flues communicating between said chemical refrigerator and said produce storage rooms; an ice storage room located above said chemical refrigerator and warm air flues, communicating from the upper part of said produce storage rooms, first downward and then upward to the upper part of said ice storage room, all substantially as and for the purpose specified.

525,695



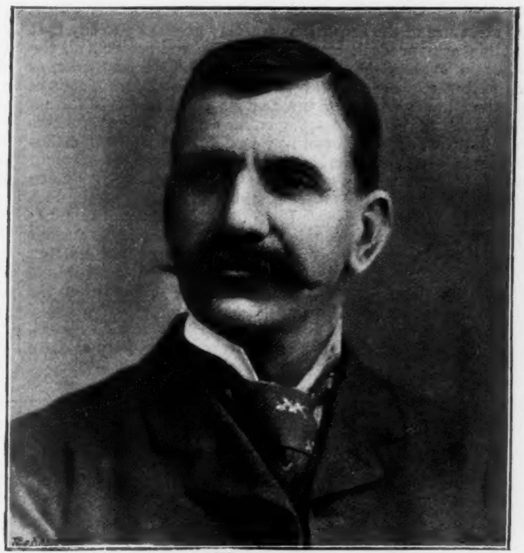
Throat Irritation and Cough.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d.; tins, 1s. 1½d., labelled, "James Epps and Co., Homœopathic Chemists, London."

## THE CHILIAN CRUISER BLANCO ENCALADA.

THE new Chilian cruiser Blanco Encalada, which has lately been completed at the Elswick shipyard of Messrs. Sir W. G. Armstrong, Mitchell, and Co., of Newcastle-on-Tyne, may be regarded as the latest development of the fast protected cruiser type of war vessel, and is the outcome of an experience in the design and construction of ships of this class extending over their whole history. To illustrate the growth of the protected cruiser, it is necessary to go some way back to the Comus class in the British navy, and to the Tsukushi Kan and Yung Wei built for the Japanese and Chinese Governments respectively, in 1881, at the Walker shipyard of Messrs. Armstrong. These two vessels had their coal bunkers disposed so as to afford protection to the machinery, in conjunction with slight steel protection to the engines and magazines, and in this respect they resembled the Comus class built about three years before, but they had a speed of nearly 16½ knots, against 13 in the Comus, were heavily armed, and carried a good coal supply.

From these vessels it was a great step to the Esmeralda, which was also built at Walker shipyard in 1882-3 for the Chilian Government, from the designs of Mr. George Rendel. The Esmeralda and the English cruisers of the Leander class, built about the same time, were the earliest cruisers ever fitted with a curved steel protective deck extending throughout the whole of their length. This system of protection has since been adopted so generally by our own and other Governments, not only in all the lighter and faster cruising war vessels, but in the latest and largest cruisers, such as the Edgar class, the Blake and Blenheim of 9000 tons, and now in the Powerful and Terrible of 14,200 tons displacement, and also—in conjunction with a deep armour belt—in the new armour-clads of the Majestic class. So that, whatever may be said—and there is much—in favour of outside armour protection as opposed to inside curved armour decks, the latter system, which has been adopted by the Elswick firm in all their cruisers, from the Esmeralda to the Blanco Encalada, cannot at any rate be said to have lost favour with most of our greatest authorities on naval architecture.

We append a table (p. 503) giving the principal features of some of the many cruisers designed and constructed at Elswick, in chronological order; and this table will show that Messrs. Armstrong have always more than kept on a level with all competitors in producing cruisers with powerful armaments and good protection, and in the matter of high speed they have generally led the way. To revert for a moment to the Esmeralda and the Leander class; the former had a curved steel deck of 1in. compared to 1½in. in the Leander, and she had two 10in. and six 6in. guns against the Leander's ten 6in., so that in protection the Leander, which it must be borne in mind was much the larger ship, was superior, in armament about equal, but in speed the Esmeralda went far ahead of any cruiser of the time, making 18·3 knots against 17 in the English ship. The dimensions of the two ships were as follows:—Leander, length 300ft., breadth, 46ft.; mean draught, 19ft.; displacement, 4300 tons. The Esmeralda was 270ft. long, 42ft. beam, 18½ft. draught, and 2950 tons displacement.



P. Watts

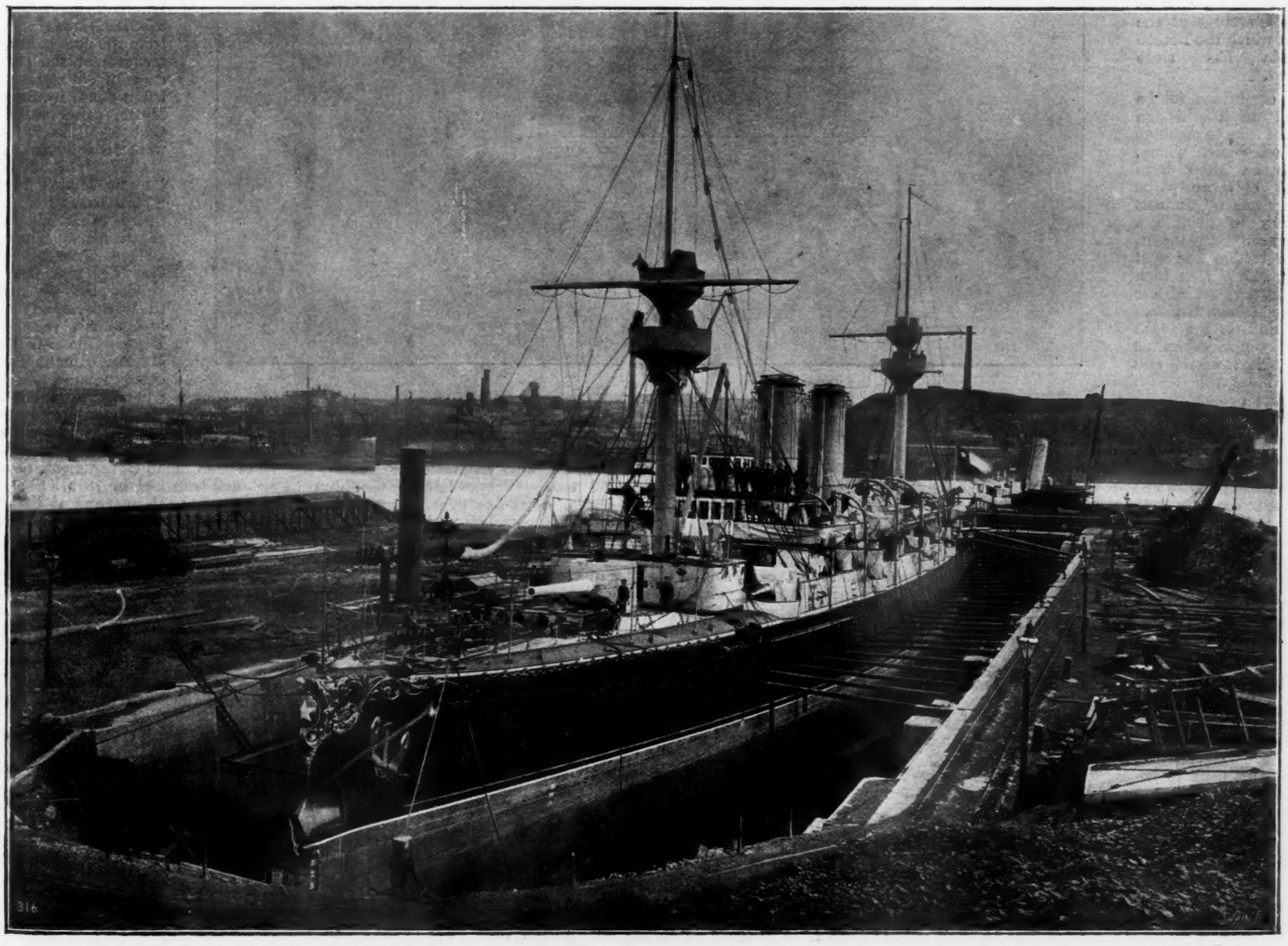


Fig. 1—THE BLANCO ENCALADA LYING IN DOCK

So successful was the Esmeralda that the Giovanni Bausan was built to the order of the Italian Government shortly after, on practically the same lines, and was succeeded by the Naniwa Kan and Takachiho Kan for the Japanese Government. These vessels were an advance upon the Esmeralda, both as regards size, protection, and speed, and were not unlike the Mersey class built for the British Navy during the same year, 1885. The Naniwa had nearly the same armament as the Esmeralda, whereas the Mersey carried two 15-ton and ten 6in. guns. In protection she was the equal of the Mersey, both ships having a curved steel deck from 2in. to 3in. in thickness; but in speed the Naniwa was superior with 18¾ knots against the Mersey's 18. The Naniwa and Takachiho were designed by Mr. W. H. White upon his joining the Elswick firm, as were also the Panther and Leopard, two small cruisers of 18½ knots speed, built at Elswick for the Austrian Government, and the Dogali for the Italian Government, which had a displacement of 2050 tons and a speed of 19½ knots.

From Mr. White's designs also, were built the two Chinese cruisers Chih Yuen and Ching Yuen, one of which is reported to have been sunk in the recent battle off the Yalu. These two Chinese vessels were an advance on their predecessors more in the direction of good defensive qualities than in speed, as they were provided with a complete armour deck 2in. thick on the horizontal, and 4in. on the sloping portions, and they carried an armament of three 8in. and two 6in., and 24 smaller quick-firing and machine guns, on a displacement of 2300 tons and a length of 250ft. Their speed was 18·5 knots.

In 1887 the small cruiser Elizabeta was launched for the Roumanian Government; she was similar in type, though rather smaller than the Blanche of our navy.

In the same year, Messrs. Thomson, of Glasgow, launched the Spanish cruiser Reina Regente. She is a very powerfully armed, well protected cruiser, carrying four 24 cm. guns, six 12 cm., and eight quick-firing, and having a deck 3in. on the flats and 4¾in. on the slopes; and at that time she was the fastest cruiser afloat, with a speed of 20¾ knots; but Messrs. Armstrong were not far behind, and in the following year the Italian cruiser Piémonté was launched at their yard. This vessel was designed by Mr. Philip Watts, who succeeded Mr. W. H. White as director of Elswick shipyard, when the latter was appointed Director of Naval Construction at the Admiralty.

Mr. Watts read a paper upon the cruiser "Piémonté," before the Institution of Naval Architects in 1889, a full account of which was given in our issue of April 26th for that year. It will, however, be interesting here to recapitulate a few particulars of this remarkable vessel, and place them side by side with the Medea class, which were built for our Navy about the same time. The Piémonté was a vessel of 2500 tons displacement, her length was 300ft., breadth 38ft., and mean draught 15ft. She carried an armament of six 6in. quick-firing guns, and six 4·7in. quick-firers and ten 6-pounders, besides smaller machine guns, and was thus remarkable as being the first war vessel armed with the new 6in. and 4·7in. quick-firing guns introduced by Elswick, and which have since formed at any rate part of the armament in almost every British war ship. Her protection consisted of a complete steel deck 1in. on the flats and 3in. on the sloping sides, and her speed with natural draught was 20½ knots, and with forced draught 22 8 knots. The Medeas were vessels of 2800 tons, 265ft. long, 41ft. broad, and 16¼ft. draught; they carried six 6in. guns, nine 6-pounders, and other small guns; they have protective decks 1in. thick on the flats and 2in. thick on the slopes, and steam at 19 knots. So that in the Piémonté was a vessel of rather less disl pacement than the Medea, with much more powerful armament, better protection, and much greater speed than her contemporary in our Navy.

The Piémonté was the forerunner of other fast cruisers designed by Mr. Watts and constructed at Elswick; but the performances of such vessels as the 25 de Mayo and the 9 de Julio, built for the Argentine Government, and the Japanese cruiser Yoshino, which made over 23 knots on her trial, and lately gave such a good account of herself in the sea fight off the Korea, are so fresh in the minds of our readers that we will only refer them to the list of vessels built at Elswick which we give, and where particulars of their leading features will be found. It is only necessary to remark here that, with the exception of the United States commerce destroyers Columbia and Minneapolis, which are much larger vessels of 7400 tons displacement, the three last-named Elswick cruisers, 25 de Mayo, 9 de Julio, and Yoshino, all surpass any similar vessels in the world in speed, and have since their departure from England given great satisfaction to the several countries to which they belong. We will, therefore, pass on at once to an account of the design and construction of the latest warship completed at Elswick, the Chilian cruiser Blanco Encalada.

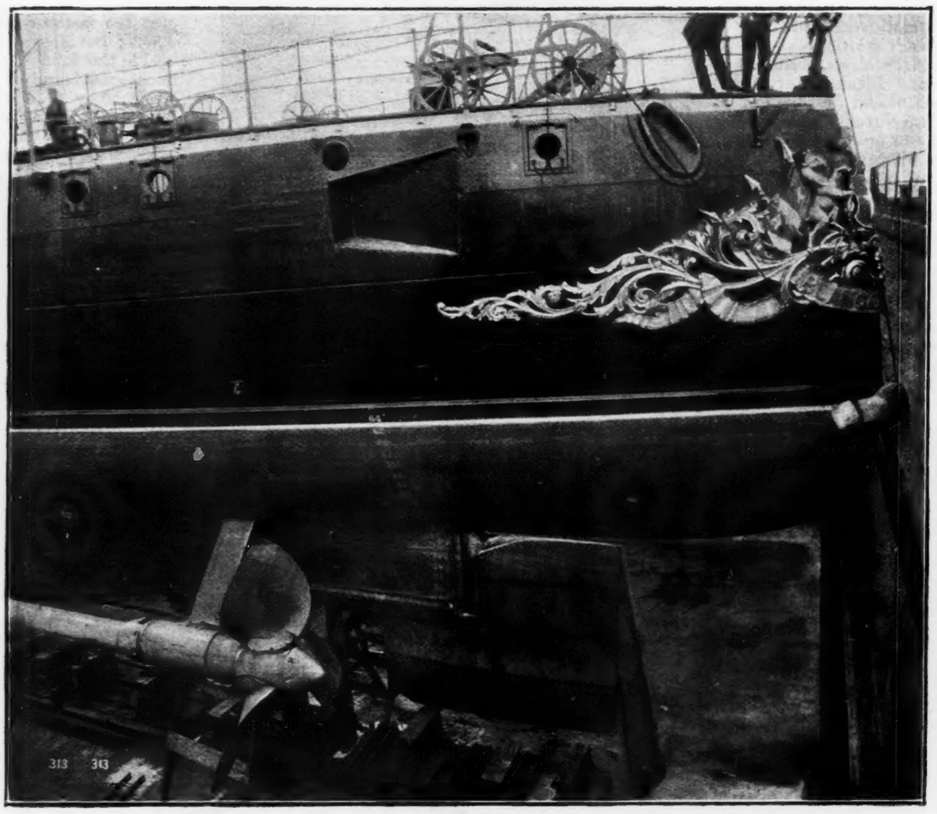


Fig. 2—STERN OF BLANCO ENCALADA IN DOCK

It must have been largely owing to the success of the various vessels described above, that the Chilian Commission appointed to obtain designs and tenders from various firms in Europe for a fast first-class cruiser, decided to accept the design submitted by the Elswick firm; this, and the fact that Sir Edward Reed was a member and technical adviser of the Commission, and that out of all the designs submitted to him by many of the best known shipbuilders in England and abroad, the tender of Messrs. Armstrong for a vessel designed by their naval architect, Mr. Watts, was finally accepted, was in itself a guarantee of the success which the Blanco Encalada has since achieved.

The conditions to be fulfilled in the design were not easy to combine in one war vessel, which, as has so often been pointed out, must be a compromise. It was necessary to provide a very powerful armament, good protection and coal supply, and a very high speed in a vessel of less than 5000 tons displacement, and on a draught of water not exceeding 18½ft. The vessel also had to be sheathed with wood and copper, which was no doubt a most valuable quality in a cruising ship for a State of South America, where docks of sufficient size to take large ships are exceedingly scarce; but which also meant more weight to be provided for in the design, and increased draught. However, the great experience gained at Elswick in vessels of the cruiser class enabled them to overcome all these difficulties, and to combine the various points asked for in a vessel of the following dimensions:—

| | Feet. |
|---|---|
| Length between perpendiculars ... ... ... | 370 |
| Breadth extreme ... ... ... ... ... ... | 46·6 |
| Draught of water forward ... ... ... ... | 17·6 |
| ,, ,, aft ... ... ... ... ... ... ... | 19·6 |
| ,, ,, mean ... ... ... ... ... ... | 18·6 |
| Displacement in tons... ... ... ... ... ... ... | 4500 |

The speed aimed at was 22½ knots, with forced draught in the stokeholds, and 20½ knots was the guaranteed speed with natural draught, both of which were exceeded on the trials, the latter by more than a knot.

The armament to be carried was two 8in. guns, ten 6in. guns, quick-firing; twelve 3-pounder Hotchkiss, ten 1-pounder Hotchkiss, and five torpedo tubes. This was an abnormally heavy armament for a cruiser of such small displacement, and if, for the two 8in. guns, two 9·2in. were substituted, the armament of the Blanco would be equal to that of H.M. first-class cruisers Blenheim and Blake, vessels of just twice her displacement.

The amount of coal to be carried on the normal mean draught of 18½ft. was 350 tons; but her bunkers, which are disposed so as to augment as much as possible her defensive qualities, are capable of holding over 900 tons of coal; and she could steam carrying this full supply at a very slightly reduced speed. With her bunkers full to start with, she could steam at a rate of 21½ knots, her full speed natural draught, for eighty-four hours and cover 1800 knots, whilst at 12 knots she could steam for twenty-eight days and traverse 8000 knots.

Her protection consists of a complete steel deck extending from stem to stern, having a thickness of 1¾in. on the horizontal portion, which is 18in. above the load water-line, and the sloping portions at the side are from 3in. to 4in. in thickness, and are carried to a depth of 4ft. 3in. below the load water-line. At the ends of the ship this deck slopes downwards, ending below water at each extremity, furnishing aft admirable protection to the steering gear and rudder head, and forward being brought down to the ram casting and securely fastened to it, greatly adding to the strength of the ram, and tending to distribute the shock of ramming over the whole of this heavy deck, and thus throughout the entire structure of the ship. It is scarcely necessary to say that this armour deck completely covers and protects all the main engines, boilers, magazines, and steering gear, as well as other spaces devoted to stores, &c., at the ends of the ship. Wherever the armour deck is cut to form a hatch or other necessary opening, armour bars or shutters are provided, which can be closed down in action; coffer-dams are also worked round all openings to a height of at least 4ft. above the water, greatly reducing the chance of water getting below, if the deck ever became flooded. In action the commander has the shelter of a conning tower built of steel armour 6in. in thickness, from which an armoured tube conveys the rods from the steering wheel situated in the conning tower, telegraphs, &c., to a position of safety below the protective deck. The guns are all protected by heavy shields, 3in. thick, in the case of the 8in. and 6in. guns. What was promised in the design has been fully realised in the ship, and for her size she is without doubt one of the most formidable cruisers afloat. The English cruisers of the Astrea class, which are also sheathed ships, have a displacement of 4360 tons, 140 tons less than the Blanco, and carry two 6in. quick-fire guns, and eight 4·7in. quick-fire guns, and eight 6-pounders, and smaller guns, and four torpedo discharging tubes. They steam at 19¾ knots, and are protected by a deck 1in. and 2in. in thickness, so that the Blanco has greatly superior armament and protection, and can steam three knots faster. The Blanco Encalada was commenced on September 30th, 1892, when the first keel plates were laid. Her framing is a combination of the transverse and longitudinal systems, and in general construction and scantlings she resembles vessels of similar type and size in her Majesty's service.

She is built with a cellular double-bottom extending throughout the space occupied by the engines and boilers, and carried on to the ends in the form of magazine and other flats. The double bottom is divided into numerous water-tight compartments, which can be utilised for water ballast, or as reserve feed tanks; and the longitudinal bulkheads to the side coal bunkers carry the inner bottom right up to the protective deck, so that with the coal bunkers above this deck, which extend over about half the length of the ship amidships, she can be said to have a double side over her whole main portion from the keel to a height of 6ft. above water. This and the subdivision of the vessel throughout into a very large number of water-tight compartments by means of transverse and longitudinal bulkheads, greatly minimises the chance of her being sunk in action. All the bulkheads below the protective deck are, where it is absolutely necessary to have communication, fitted with water-tight doors which can be closed from the main deck, and have automatic means of indicating whether they are open or shut.

In determining the lines on the model the utmost care and skill had to be exercised to obtain the best results at high speeds, and the noticeable absence of wave and eddy-making during the whole course of her trials at sea was a subject of wonder to all on board, and proved that the lines adopted left little, if anything, to be desired. Some idea of the form of the lines may be gathered from the illustration we give of her lying in dock, Fig. 1.

The powerful ram alluded to above is a great feature of the Blanco, projecting 8ft. beyond the point where the stem cuts the water-line and with its spur about 9ft. below the surface. It is made of a strong casting of phosphor bronze, as are also the stern post casting and the struts for supporting the ends of the twin propeller shafts. The rudder, which is shown in the picture of the stern of the ship in dock (Fig. 2), was, as may be seen, of a form rather unusual in such large vessels. It was first adopted at Elswick in the cruiser 9 de Julio, and proved so satisfactory that it was subsequently fitted to the Yoshino, and also to the Blanco Encalada. It is hung upon a short but very strong stern post, which is its axis, and projects below this and also in front, so that it is really a balanced rudder. The great advantage claimed for this form of rudder is that it enables a large portion of the so-called dead wood to be cut away, thus greatly reducing the lateral resistance of the vessel to turning. The admirable manœuvring qualities displayed at sea by all the Elswick cruisers have fully justified the adoption of the arrangement.

The outside plating of the Blanco was completed in June, 1893, and then the sheathing with wood was begun. This is a work that requires immense care; the danger of metallic connection, and consequent galvanic action, between the steel of the hull and the copper sheets which are finally nailed on the wood, having always to be borne in mind and guarded against. The wood used is the best teak, of a minimum thickness of 3¼in., and this is fastened to the shell with bolts of naval brass. In the region of the stem thicker plates of naval brass are substituted for the copper, where the chafe of the anchor is likely to cause great wear and tear.

The Blanco was launched on September 9th, 1893, less than a year from the date of her commencement, the performance of christening her being done by Signorita Matte, daughter of the Chilian Minister. There were also present, Senor Matte, Sir E. J. Reed, Captain Munoz Hirtado, Sir Andrew Noble, and many other ladies and gentlemen. The new Blanco Encalada glided smoothly into the Tyne amidst the cheers from the large company assembled to see the launch. We say the new Blanco Encalada, for it was decided to name this latest addition to the Chilian Navy after an old armour-clad, which, it will be remembered, was torpedoed and sunk off Caldera in the civil war in 1891. The old Blanco was, at the request of the Chilian Government, designed by Sir Edward Reed, and launched in 1875. She was a sister ship of the Almirante Cochrane, and at that time was regarded as a great advance in armour-clad construction. She had an armour belt 9in. thick, and carried six 12½-ton guns, manufactured at Elswick. She took a prominent part in the engagement of Oct. 8th, 1879, when as flagship of the Chilian squadron, she encountered the Peruvian Huascar, and which, after about an hour's fighting, was disabled by the fire of the Blanco and the Almirante Cochrane. The Blanco was sent to be repaired at Elswick shipyard in 1886. No more fitting name could therefore be found for the new Chilian ship, which was also built under the supervision of Sir Edward Reed.

After the launch the work of getting on board the machinery supplied by the well-known firm of Messrs. Humphrys, Tennant and Co., of Deptford, was quickly proceeded with. We shall describe the machinery more fully later, but it may be well to mention here that it was similar to that supplied by Messrs. Humphrys for the cruisers 25 de Mayo and 9 de Julio, which proved in every way so satisfactory. The Blanco was completed for sea with all machinery, guns, boats, and fittings on board, by July, 1894, or twenty-two months after the date of her commencement.

In a previous issue we gave an account of the gunnery trials of the Blanco Encalada, but it will not be out of place here to give a few more particulars of the armament. All the 8in. and 6in. guns are of 40 calibres length and of the latest Elswick pattern. The 8in. guns are mounted one forward on the upper deck and one aft. The after 8in. gun is shown in illustration Fig. 3, with some of the Chilian crew who came to Elswick to take the vessel away. The carriage in the front of the photograph is for mounting a 1-pounder gun for shore service.

# THE CHILIAN CRUISER BLANCO ENCALADA

MESSRS. SIR W. G. ARMSTRONG, MITCHELL, AND CO., NEWCASTLE-ON-TYNE, BUILDERS

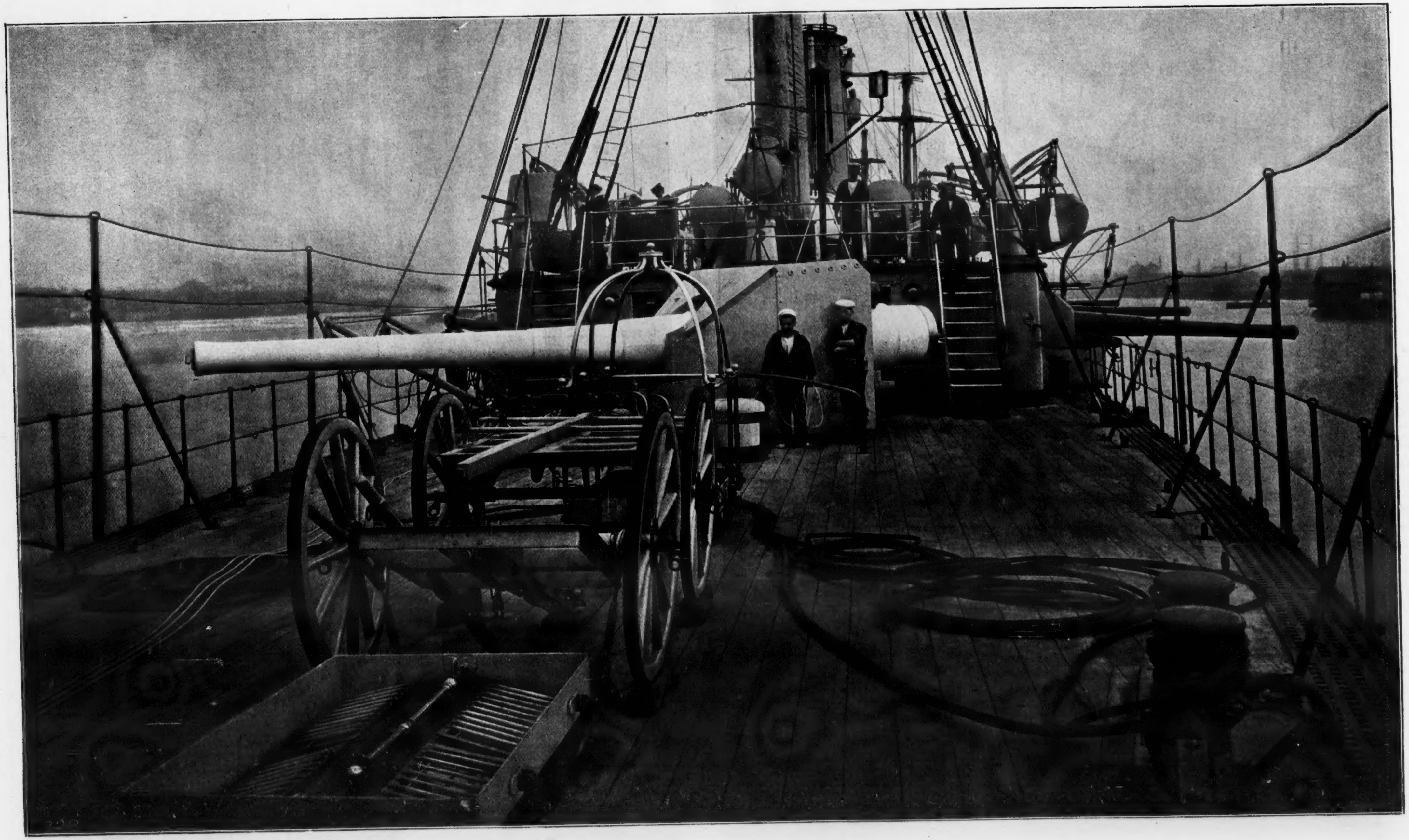


Fig 3—UPPER DECK AFT, WITH EIGHT-INCH GUN

# THE CHILIAN CRUISER BLANCO ENCALADA

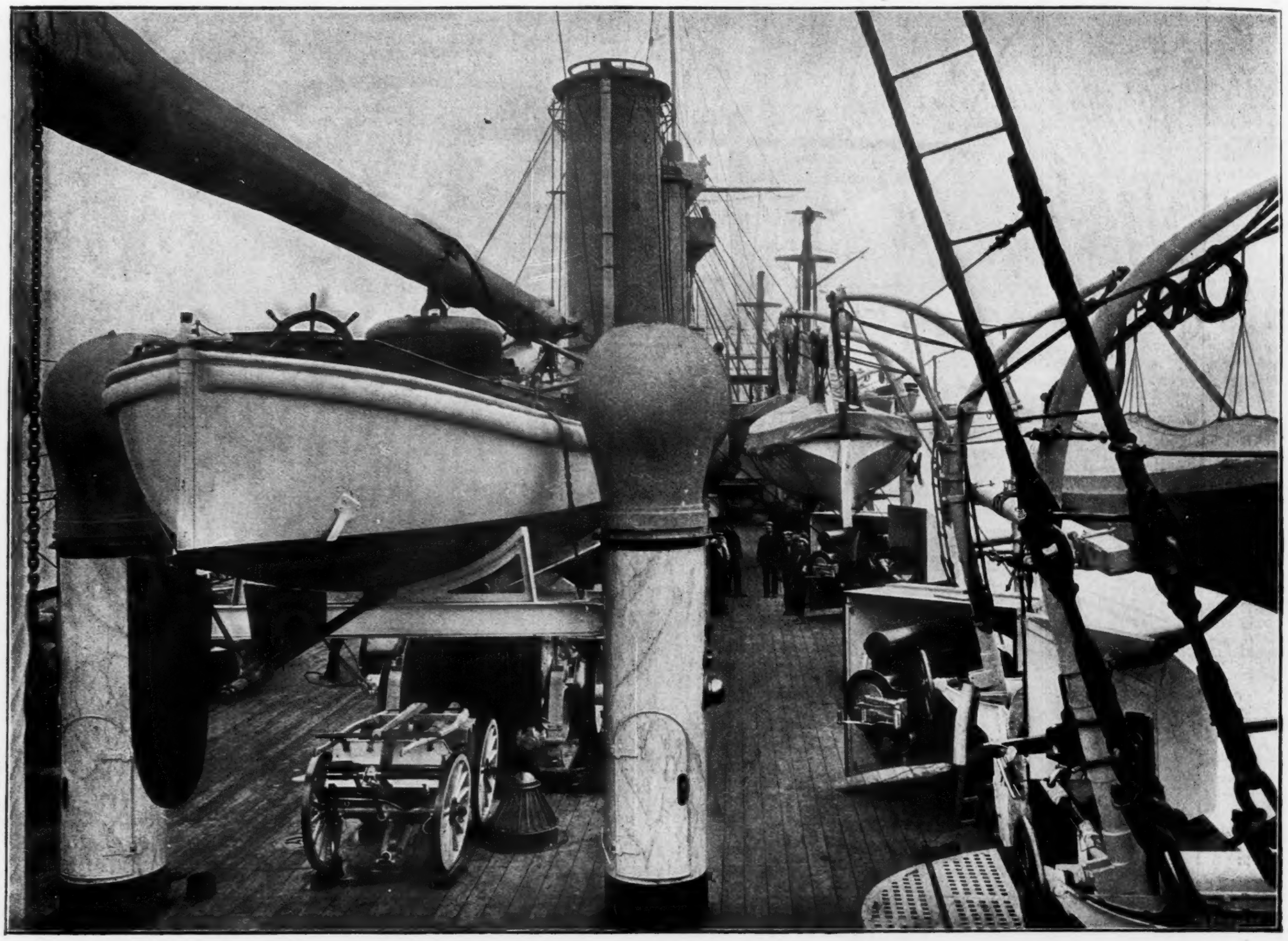


Fig. 4—UPPER DECK LOOKING FORWARD, SHOWING TORPEDO BOAT

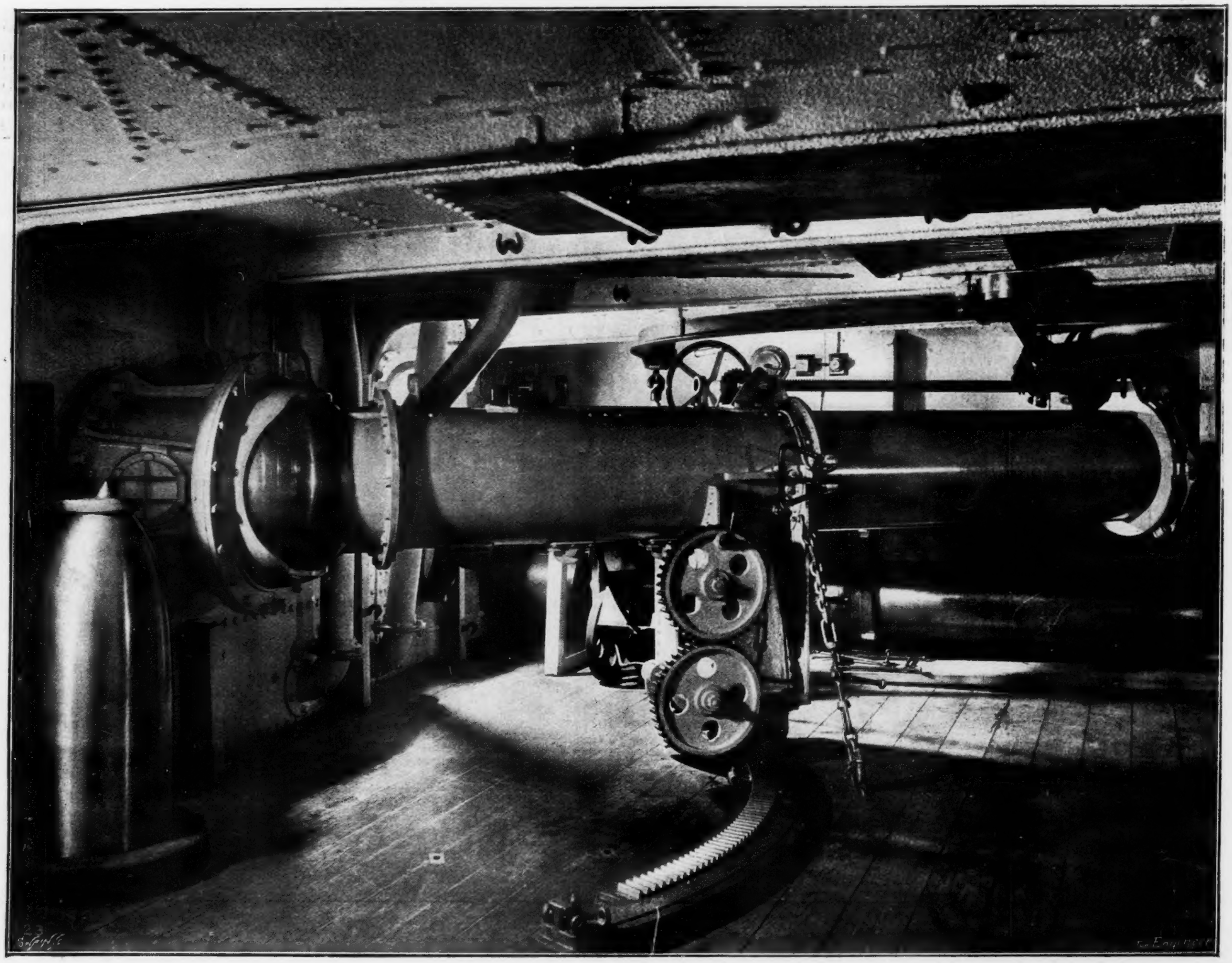
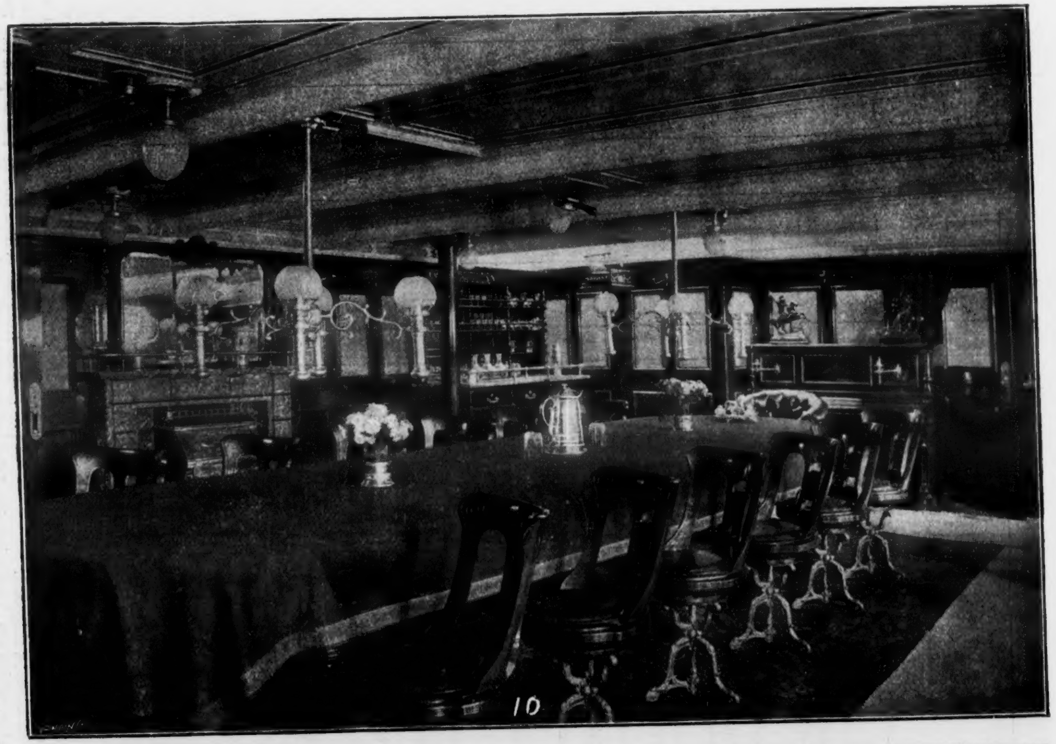
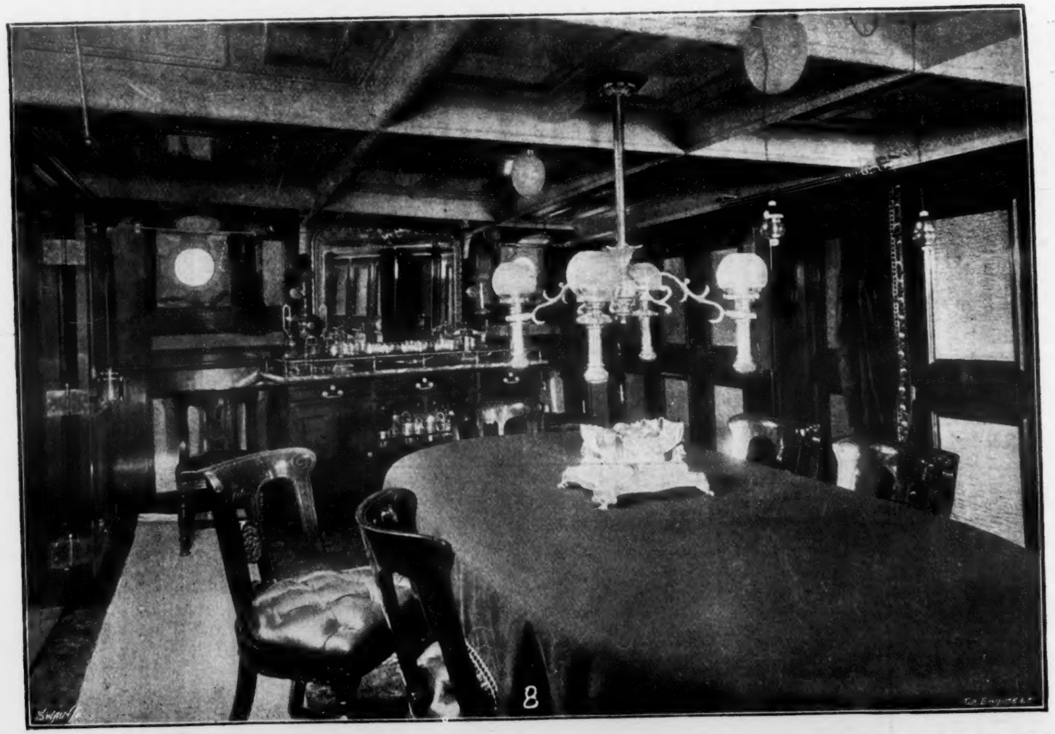
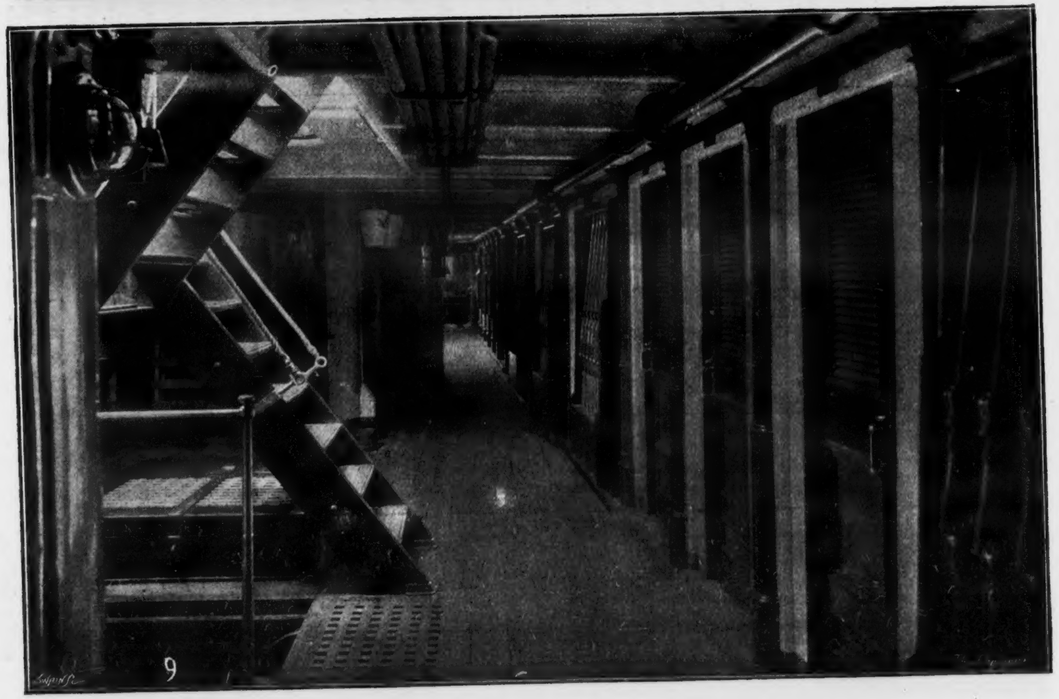


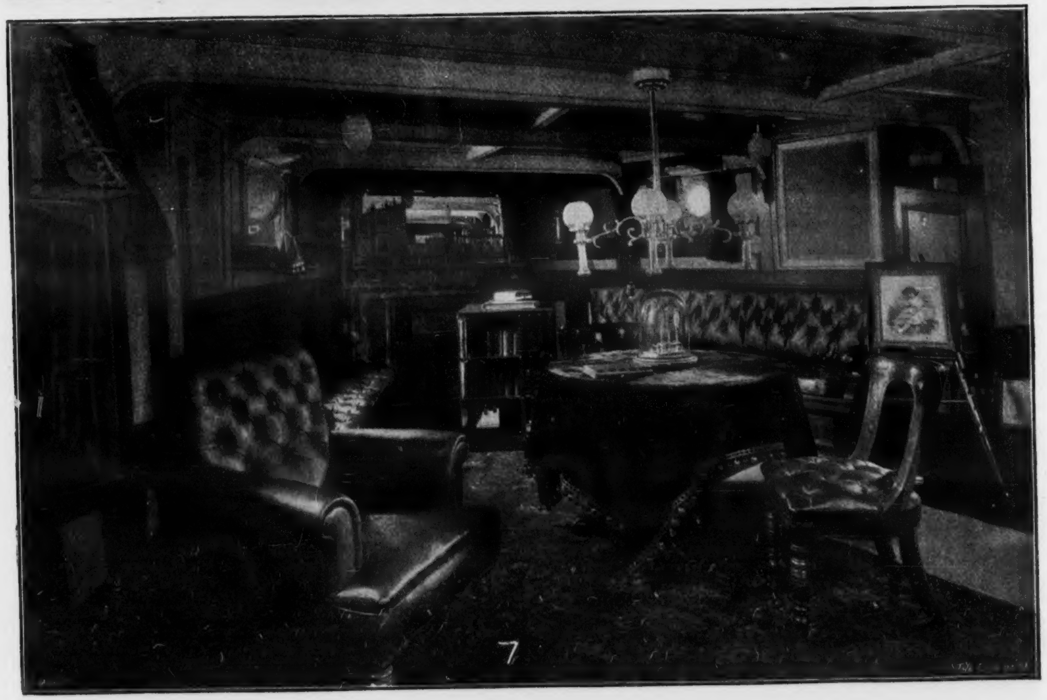
Fig. 5—BROADSIDE TORPEDO ROOM

# OFFICERS QUARTERS, CHILIAN CRUISER BLANCO ENCALADA


10


8


9


7

The ten 6in. guns are mounted in sponsons on the upper deck, two capable of firing right ahead and two right astern, so that one 8in. and two 6in. can be directed right ahead or astern, and two 8in. and five 6in. can fire through an arc of at least 100 degrees on either beam, not counting the 3-pounder and 1-pounder Hotchkiss guns. Owing to the simple and handy breech mechanism of the 8in. guns, and the admirable arrangements for bringing the powder from the magazines to the guns, the 8in. as well as the 6in. may fairly claim to be called quick-firing, seeing that during the gunnery trials four rounds were fired from one of the 8in. in just over one minute, a hitherto unequalled performance in a gun of this size. The 8in. guns can penetrate 18in., and the 6in. guns 15·6in. of steel. The 3-pounder guns are placed, eight on the bulwarks and four between decks, two forward and two aft. The 1-pounders are six of them in the military tops, and four on the shelters.

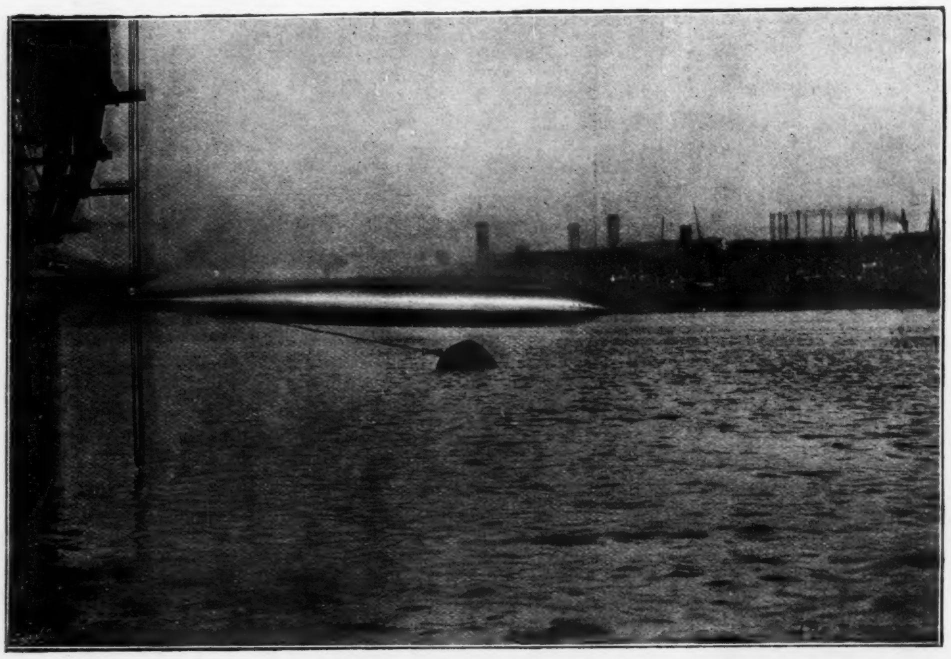


Fig. 6—TORPEDO BEING FIRED FROM BROADSIDE TUBE

PARTICULARS OF ELSWICK CRUISERS

| Name. | Nationality. | Class. | Length. | | Beam. | | Draught | | Displacement in tons. | Material of hull. | Protective material. | Armament. | Torpedo tubes. | I.H.P. natural draught. | I.H.P. forced draught. | Speed in knots. | | Coal. | | Date of launch. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ft. | in. | Ft. | in. | Ft. | in. | Tons | | | | | | | Natural draught | Forced draught | Normal. | Full supply. | |
| ... ... | Japanese | Unarmoured cruiser | 210 | 0 | 32 | 0 | 15 | 0 | 1380 | Steel. | | 2 25-ton B.L. in turrets<br>4 12 cm. guns<br>4 Hotchkiss<br>2 9-pounder | — | 2887 | — | 16·5 | — | 250 | 300 | 1881 |
| aeralda ... ... | Chilian | Protected cruiser | 270 | 0 | 42 | 0 | 18 | 6 | 2950 | ,, | Protective deck 1in. to ½in. | 2 10in. 25-ton B.L. guns<br>6 6in. 4-ton ,, ,,<br>2 6-pounder Q.F. guns<br>5 37 mm. Hotchkiss<br>2 Gardner | — | 6083 | — | 18·3 | — | 400 | 600 | 1883 |
| Giovanni Bausan ... | Italian | Protected cruiser | 280 | 0 | 42 | 0 | 18 | 6 | 3050 | ,, | Protective deck 1½in.<br>Conning tower 2in. | 2 10in. 25-ton B.L. guns<br>6 15 cm. 4-ton ,, ,,<br>2 6-pounder Q F. guns<br>4 Hotchkiss guns<br>4 Nordenfelts | 3 | 6555 | — | 17·9 | — | 400 | 600 | 1884 |
| Naniwa ...<br>Takochiho ... | Japanese | Protected cruiser | 300 | 0 | 46 | 0 | 18 | 6 | 3700 | ,, | Protective deck: slopes 3in. flats, 2in.<br>Glacis plates 3in.<br>Conning tower 1½in. | 2 10in. B.L. guns<br>6 6in. ,, ,,<br>2 6-pounder B.L. guns<br>10 1in. Nordenfelts<br>4 Gatlings | 4 | 7120 | — | 18·77 | — | 350 | 800 | 1885 |
| Panther ... ...<br>Leopard ... ... | Austrian | Torpedo cruiser | 224 | 0 | 34 | 0 | 14 | 0 | 1540 | ,, | Conning tower 1½in. | 2 12 cm. guns<br>10 47 mm. Hotchkiss | 4 | 4627 | 5940 | 17·64 | 18·4 | 200 | 300 | 1885 |
| Dogali ... ... ... | Italian | Protected cruiser | 250 | 0 | 37 | 0 | 14 | 6 | 2050 | ,, | Protective deck: slopes 2in. flats 1in.<br>Conning tower 2in. | 6 6in. B.L. guns<br>9 6-pounder Q.F. Hotchkiss<br>6 Gatlings | 4 | 5012 | 7179 | 17·7 | 19·66 | 160 | 480 | 1885 |
| Chih Yuen ...<br>Ching Yuen ... | Chinese | Protected cruiser | 250 | 0 | 38 | 0 | 15 | 0 | 2300 | ,, | Protective deck: slopes 4in. flats 2in.<br>Conning tower 3in. | 3 8in. B.L. guns<br>2 6in. B.L. guns<br>8 6-pounder B.L. guns<br>2 3-pounder B.L. guns<br>6 Gatling guns | 4 | 2733 | 6892 | 15·26 | 18·5 | 200 | 520 | 1886 |
| Elizabeta ... ... | Roumanian | Protected cruiser | 222 | 0 | 38 | 0 | 15 | 0 | 2500 | ,, | Protective deck: slopes 3½in. flats 1¾in. | 4 15 cm. guns<br>4 57 mm. Q.F. guns<br>2 37 mm. Q.F. guns<br>2 Nordenfelts | 4 | 4295 | 4714 | 18·05 | 18·30 | 80 | 320 | 1887 |
| Piemonte ... ... | Italian | Protected cruiser | 300 | 0 | 38 | 0 | 15 | 0 | 2500 | ,, | Protected deck: slopes 3in. flats 1in.<br>Conning tower 3in. | 6 6in. Q.F. guns<br>10 6-pounder Hotchkiss<br>6 45-pounder 12 cm. Q.F<br>6 1-pounder Q.F.<br>4 10 mm. Maxim | 3 | 7100 | 12,980 | 20·45 | 22·3 | 200 | 600 | 1888 |
| 25 de Mayo ... ... | Argentina | Protected cruiser | 330 | 0 | 43 | 0 | 16 | 0 | 3180 | ,, | Protected deck: slopes 4½in. flats 1¾in.<br>Conning tower 4in. | 2 8in. B.L.<br>8 12 cm. B.L.<br>12 3-pounder B.L.<br>12 1-pounder B.L. | 3 | 8750 | 14,150 | 21¼ | 22½ | 300 | 680 | 1890 |
| 9 de Julio ... ... | Argentina | Protected cruiser | 350 | 0 | 44 | 0 | 16 | 6 | 3500 | — | Protected deck: slopes 4½ to 3½in flats 1¾in. | 4 6in. Q.F. guns<br>8 4·7in. Q.F. guns<br>14 3-pounder Q.F. guns<br>12 1-pounder Q.F. guns | 5 | 10,000 | 14,500 | 22·04 | 22·74 | 350 | 750 | 1891 |
| Republica ... ... | Brazilian | Protected cruiser | 210 | 0 | 35 | 0 | 12 | 9 | 1300 | ,, | Protected deck: slopes 2in. flats 1in.<br>Conning tower 3in. | 6 12 cm. Q.F. guns<br>4 6-pounder Q.F. guns<br>6 Machine guns | 4 | 2600 | 3800 | 16·0 | 17·5 | 100 | 170 | 1892 |
| Yoshino ... ... ... | Japanese | Protected cruiser | 360 | 0 | 46 | 6 | 17 | 0 | 4180 | ,, | Protected deck, slopes 1¾ to 4½in. flats 1¾in.<br>Conning tower 4in. | 4 6in. Q.F. guns<br>8 4·7in. Q F. guns<br>22 3-pounder Q F. guns | 5 | 10,320 | 15,700 | 21·6 | 23·0 | 350 | 1000 | 1892 |
| Blanco Encalada ... | Chilian | Protected cruiser | 370 | 0 | 46 | 6 | 18 | 6 | 4420 | ,, | Protective deck: slopes 3 to to 4in. flats 1¾in.<br>Conning tower 6in. | 2 8in. B.L. guns<br>10 6in. Q.F. guns<br>12 3-pounder Q.F. guns<br>10 1-pounder Q.F. guns<br>2 0·45 Gatlings | 5 | 11,000 | 14,500 | 21·7 | 22·78 | 350 | 900 | 1893 |

Fig. 4 of the upper deck looking forward shows the breeches of some of the 6in. guns on the starboard side, and also a field carriage for a 1-pounder. It also gives a very good stern view of a second-class torpedo boat, and the derrick for lifting it. This boat, which is an unusually large and heavy one for a cruiser of the Blanco's displacement, was supplied by Messrs. White, of Cowes. A 14in. torpedo tube was fitted on board at Elswick, and provision is made for mounting a 3-pounder gun on board; in front of the field carriage is seen the steam winch, supplied by Messrs. Clarke, Chapman, and Co., of Gateshead, for working the derrick which lifts the torpedo boat; this derrick has an outreach of 48ft., and is capable of lifting 25 tons. The whole of the gear was thoroughly tested in position before the torpedo boat was itself lifted. All the other boats, including a steam launch with a speed of 8½ knots, were made at Elswick shipyard.

The five torpedo tubes, which are for discharging 18in. torpedoes, are all situated above water in three torpedo rooms; one being a fixed tube firing right forward through the stern; and four training through an angle of 60 deg., firing two on each broadside, and placed in two torpedo rooms on the lower deck before and abaft the machinery spaces. We give an illustration—Fig. 5—of one of these broadside torpedo rooms, which shows the tube and mechanism for training. On the left is a torpedo head stowed in position ready for use, and at the back is a torpedo body; and the overhead rail for transporting the torpedoes is also seen. Owing to the great length of the tubes necessary for firing these large 18in. torpedoes, they are made with a joint and hinge a little abaft the middle of each tube, to facilitate training and loading. The tubes fitted, are of the new Elswick design, and are arranged to use cordite as the impulsive agent. A series of experiments with this new arrangement have given most satisfactory results, and have proved that the velocities obtained with cordite impulse are even more uniform than those when compressed air is used. By an ingenious contrivance the pressure can be very carefully regulated, and it is found that the high velocity of over 50ft. per second is obtained with a pressure of 35 lb. in the tube; a great advantage, particularly in a bow discharge. The cordite is burned in a chamber formed in the door of the torpedo tube, and it is so arranged that it cannot be fired unless the door is properly secured, a point which has hardly received sufficient attention in the service tubes. The whole contrivance is exceedingly simple, and can be worked by any blue jacket, and there is nothing to get out of order. Other great advantages in the use of cordite are that there is no smoke or noise, air accumulators, pipes, and valves are all done away with, and there is practically no fouling of the tube. At the gunnery trials torpedoes were fired from each of the broadside tubes. Illustration Fig. 6 shows a torpedo being discharged from one of the Blanco's broadside tubes while she was lying in the Tyne off Elswick; this picture is from an instantaneous photograph taken by the photographer to the Elswick Works.

It is scarcely necessary to say that in a war vessel like the Blanco the steering apparatus is a most important feature. She is fitted with an arrangement specially designed and made at Elswick, and which has worked very well in other cruisers of similar type. Owing to the fineness of the lines aft, and to the fact that the steering gear had to be kept entirely under the protective deck, which is here brought below the load water-line, the space available for the rudder crosshead was very limited, and only just over 4ft. in width; and the rods connecting the crosshead to the tiller had to be very long, measuring 24ft., before sufficient space was found for the movement of the tiller. These rods have to pass through a water-tight bulkhead, and to allow for the lateral motion of the rods, specially designed stuffing-boxes had to be fitted which could slide on the bulkhead as the rods moved nearer or farther from the centre line of the ship in the process of steering. The tiller is fitted with a modified form of the Rapson slide, and is worked by a chain passing over two sheaves, one at each side of the ship, and round a sprocket wheel situated below, and turned directly by the steam steering engine. This engine was supplied by Messrs. Bow, McLachlan, and Co., of Paisley, and is of sufficient power to move the tiller from hard over on one side to hard over on the other—through an angle of 38 deg. each way—in thirty seconds when the ship is going at full speed. Arrangements are made, in case of emergency, for rapidly substituting hand gear for the steam gear, and *vice versâ*. The hand steering wheel is under the after shelter on the upper deck, and there are wheels in connection with the steam gear on the forward bridge, in the conning tower, and in a compartment forward in a safe position below the protective deck.

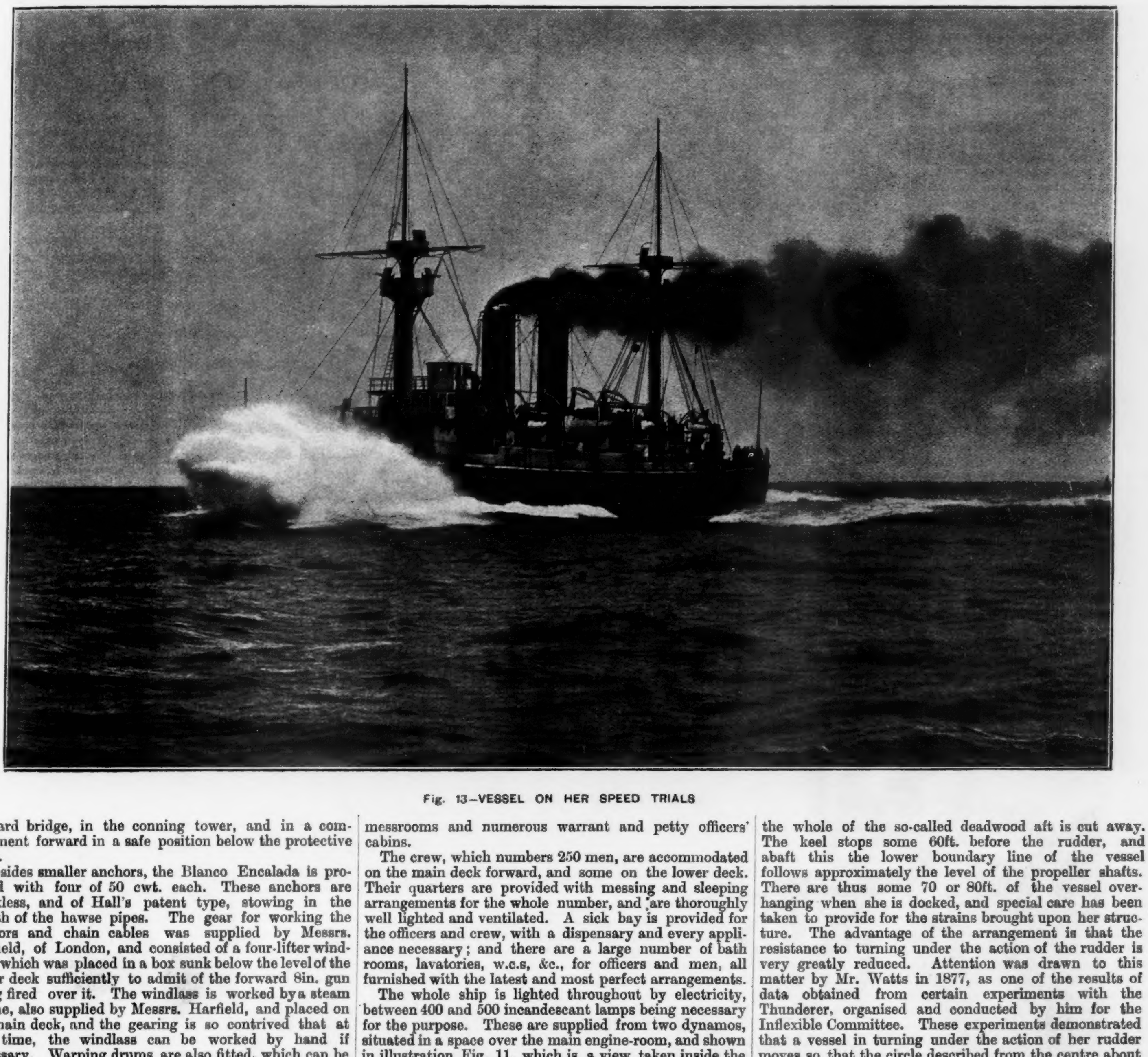


Fig. 13—VESSEL ON HER SPEED TRIALS

Besides smaller anchors, the Blanco Encalada is provided with four of 50 cwt. each. These anchors are stockless, and of Hall's patent type, stowing in the mouth of the hawse pipes. The gear for working the anchors and chain cables was supplied by Messrs. Harfield, of London, and consisted of a four-lifter windlass, which was placed in a box sunk below the level of the upper deck sufficiently to admit of the forward 8in. gun being fired over it. The windlass is worked by a steam engine, also supplied by Messrs. Harfield, and placed on the main deck, and the gearing is so contrived that at any time, the windlass can be worked by hand if necessary. Warping drums are also fitted, which can be worked with the windlass or independently. An auxiliary boiler is fitted on board for the purpose of supplying steam to the auxiliary engines, winches, &c., when there is no steam up in the main boilers. This boiler is of the vertical type, and is placed in a separate compartment on the lower deck.

The officers' quarters are arranged aft under the upper deck. The captain has a saloon, a dining-room, and two sleeping cabins. His saloon, of which we give an illustration—Fig. 7—is at the extreme after end of the vessel, and has a most comfortable, not to say luxurious, appearance. It is panelled throughout with Hungarian ash panels set in rosewood frames, between handsome carved teak pilasters. The ceiling is white, with wood mouldings on all the beams. The chairs and couches are upholstered in dark red morocco. Numerous sidelights in addition to a skylight make it always a light and cheerful room. The captain's dining-room—illustration Fig. 8—immediately joins his saloon, and is fitted up in the same style. Accommodation is provided in it for dining ten persons comfortably, and there is a pantry close at hand. His two bedrooms adjoin the other apartments, and are large and nicely-fitted rooms, with a bathroom and lavatory in communication with each. Forward of the captain's quarters are the other officers' cabins situated on both sides of the vessel. Illustration Fig. 9 is a view looking along the main deck aft, with the bulkhead and doors to officers' cabins, and a main hatchway coming down from the upper deck and leading below. This bulkhead is panelled with teak pilasters, and the doors have jalousies above and oak panels below. The rifles, as seen in the photo, are fitted in racks in between the cabin doors. The officers' cabins, which are amply large, are painted white and have handsome mahogany fittings, and are provided with every convenience, such as wash basins, tables, wardrobes, &c., and are well lighted. The ward room—seown in Fig. 10—is placed just aft of the engine hatch, on the starboard side, and is a very fine room, about 30ft. long by 24ft. wide. The large table seen in the photo accommodates fourteen people, and two other smaller tables, not shown, would seat about eight or ten more. The walls are panelled with maple, in teak framing, and the ceiling is white with mouldings on the beams. There are twenty-four officers' cabins, besides the midshipmen's and engineers' messrooms and numerous warrant and petty officers' cabins.

The crew, which numbers 250 men, are accommodated on the main deck forward, and some on the lower deck. Their quarters are provided with messing and sleeping arrangements for the whole number, and are thoroughly well lighted and ventilated. A sick bay is provided for the officers and crew, with a dispensary and every appliance necessary; and there are a large number of bath rooms, lavatories, w.c.s, &c., for officers and men, all furnished with the latest and most perfect arrangements.

The whole ship is lighted throughout by electricity, between 400 and 500 incandescant lamps being necessary for the purpose. These are supplied from two dynamos, situated in a space over the main engine-room, and shown in illustration Fig. 11, which is a view taken inside the main engine hatch. The dynamos were made by Messrs. Scott and Mountain, of Newcastle-on-Tyne, and besides lighting all the small incandescant lamps, they supply the current for the three search-lights which are placed, two on the forward bridge, and one on the after shelter, and are each of 20,000-candle power. The masthead and side lights are fitted to use oil or electric lights, and oil lamps are provided in the engine-room and stokehold, in addition to the electric light.

The engineer's workshop which we illustrate—Fig. 12—is situated in a convenient position on the lower deck forward, and is fitted up with a screw-cutting lathe, planing, and punching machines, grindstones, &c.

The ventilation of all compartments above the protective deck is obtained by natural means; but artificial ventilation is required for some of the compartments below, and fans are provided for the purpose: wherever an aperture occurs in a bulkhead to admit of ventilation between two adjacent water-tight compartments below the protective deck, automatic stop valves are fitted to prevent the flow of water in case one of the compartments becomes filled. The pumping arrangements and fire service are most complete, and besides the main steam pumps there are two 7in. Downton's hand pumps and two 5½in. Downton's. Altogether more than 2000 tons of water could be pumped out of the ship in an hour.

Two strong steel masts are provided, each carrying two military tops, which carry 1-pounder and machine guns. The main mast also supports the large derrick for hoisting in and out the 60ft. torpedo boat. A light fore-and-aft rig is provided, and on the foremast is a yard for signalling purposes.

We gave an account of the Blanco's speed trials in our issue of June 15th for this year. But this account would not be complete without a few particulars of her performances. With forced draught her engines developed 14,500-horse power, and the mean of several runs on the measured mile course off the Tyne, with and against the tide, was 22·78 knots, while, with natural draught, she steamed at 21·75 knots, with about 11,000-horse power. Her good manœuvring powers were displayed during the course of the trials, when she made a complete circle at full speed in three and three-quarter minutes, the diameter being 405 yards.

In the Blanco Encalada, as already explained, the whole of the so-called deadwood aft is cut away. The keel stops some 60ft. before the rudder, and abaft this the lower boundary line of the vessel follows approximately the level of the propeller shafts. There are thus some 70 or 80ft. of the vessel overhanging when she is docked, and special care has been taken to provide for the strains brought upon her structure. The advantage of the arrangement is that the resistance to turning under the action of the rudder is very greatly reduced. Attention was drawn to this matter by Mr. Watts in 1877, as one of the results of data obtained from certain experiments with the Thunderer, organised and conducted by him for the Inflexible Committee. These experiments demonstrated that a vessel in turning under the action of her rudder moves so that the circle described from the centre about which she turns, to touch her middle line, touches her middle line at a point considerably on the fore side of her centre of gravity, and it thus follows that the streams of water cross the after part of the ship at a greater angle than any other part, and in a direction so as to resist the turning, and the less the resistance opposed to these streams by the form of the ship, the smaller will be the circle in which the vessel will turn. As the result of this the after deadwood in the Conqueror and Polyphemus were cut way to a considerable extent for the purpose of reducing the resistance to turning.

Her behaviour amongst waves was remarkably steady, which was probably due in some measure to the bilge keels with which she is fitted. We give an illustration—Fig. 13—of her running at a high speed during the steam trials. There was a considerable sea at the time, and when going head to wind, every now and then a shower of spray was thrown up from her stem, and it was at such a moment that the instantaneous photo we give was taken. For a general broadside view of the Blanco we must refer to the full-page supplement we published with our issue of September 7th, 1894, which was from a photograph taken during the gunnery trials.

The Blanco finally left the Tyne on October 9th, 1894, under the command of Captain Munoz Hirtado, who was at Elswick during nearly the whole time occupied in the construction and fitting-out of the vessel, which he in conjunction with Mr. Forbes, also a member of the Chilian Commission, personally supervised, and throughout rendered great assistance to the officials, and won the esteem of all with whom he came in contact.

Of the ships in the list we give on page 506, of fast

# THE CHILIAN CRUISER BLANCO ENCALADA

MESSRS. SIR W. G. ARMSTRONG, MITCHELL, AND COMPANY, NEWCASTLE-ON-TYNE, BUILDERS

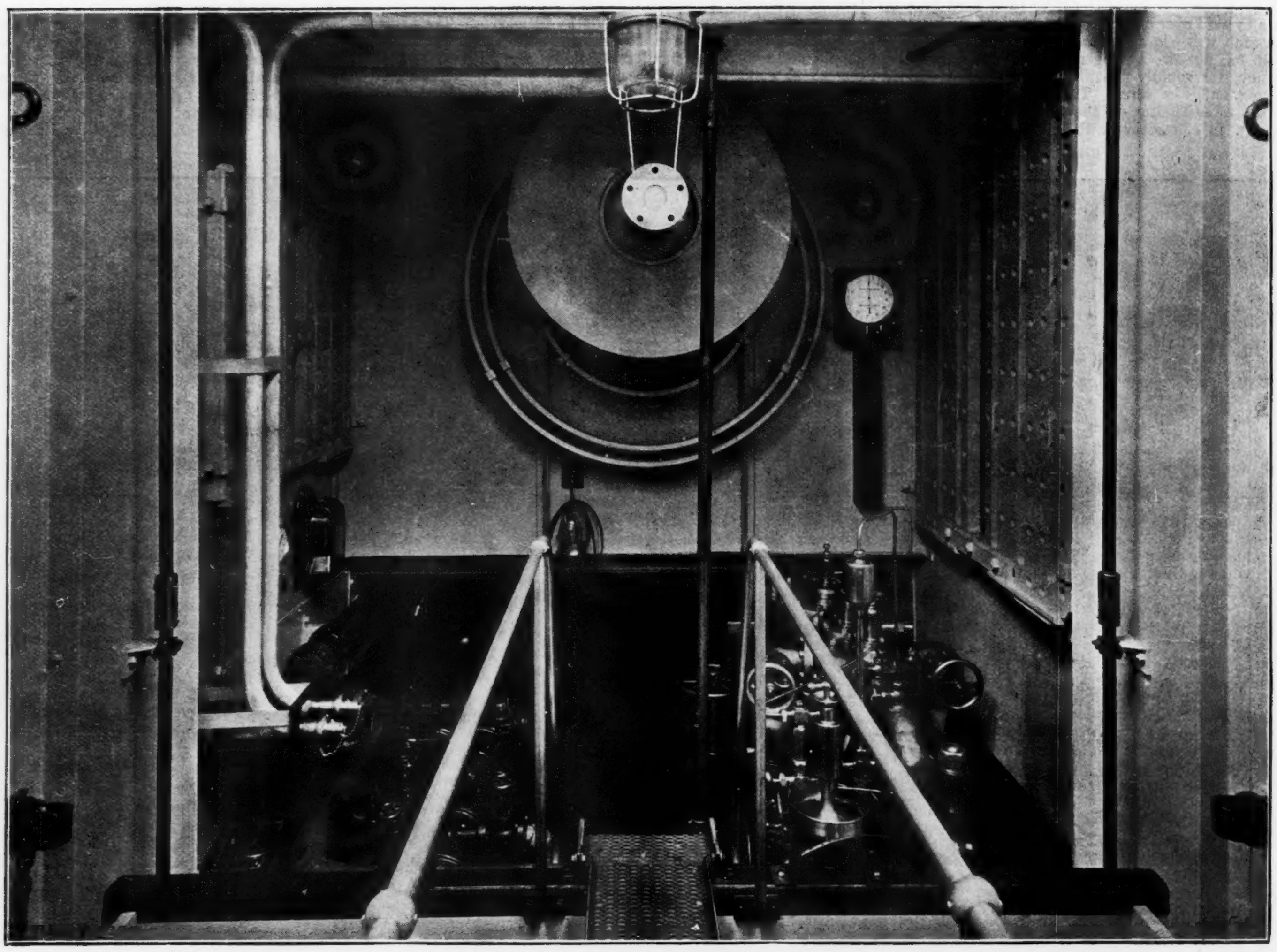


Fig. 11—VIEW INSIDE ENGINE-ROOM HATCH

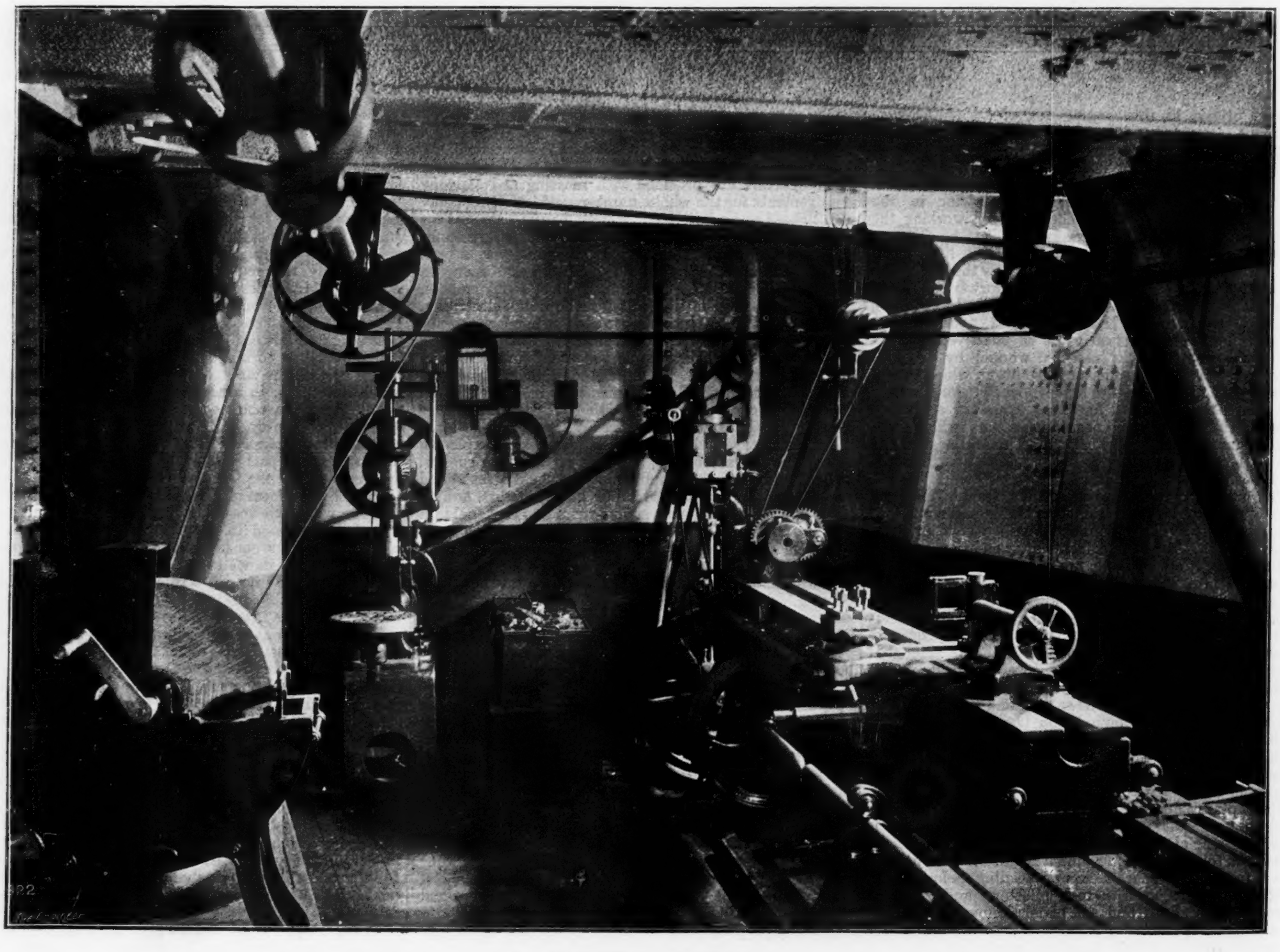


Fig. 12—ENGINEERS' WORKSHOP

Elswick built cruisers, five took part in the recent battle of Yalu; namely, the Naniwa, Takachiho, and Yoshino, on the Japanese side, and the Ching Yuen, and Chih Yuen on the Chinese side. In addition to these, there were other Elswick vessels, including the Tschao Yong and Yang Wai, in the engagement; but these have not been included in our table as they were not remarkable for their speed. It is difficult, with the somewhat meagre and unreliable information we have at present of the battle, to draw any very certain conclusions regarding the respective merits of the different types of vessels engaged. Taken as a whole, the Chinese fleet was distinctly superior in protection, and was armed with heavier guns; but the Japanese were faster than their rivals, and had more modern quick-firing guns; and it is pretty clear that the Japanese gained a great advantage at the very outset of the engagement, which enabled them, from the superior average speed of their ships, to out-manœuvre and circle round their slower opponents; this may partly have been due to the better tactics which were doubtless displayed by the Japanese commanders, but the evolutions performed would have been impossible without the fast cruisers which formed the most important part of the Japanese squadron.

This feature of the battle would have been even more fully emphasised had the Japanese been possessed of a few more cruisers like the Yoshino, which has a speed four knots in excess of any of the other vessels engaged. Another very noticeable point in the account of the battle is that no damage is spoken of to any of the engines, magazines, or steering gear in vessels of either side, showing that the curved protective deck, which on the Japanese side was the only form of armoured protection on any of the vessels except the Tschiyoda, was sufficient to defend the ship's vitals against the enemy's projectiles, which in this case ranged from the smaller quick-firing up to the 30½ cm. shells thrown by the guns of the Chinese armour-clads. Though the protective decks did such good service, showing that this system of defence is satisfactory for light fast cruisers, which cannot carry the weight of an armour belt on a small displacement, at the same time the impossibility of cruisers coping with armour-clads in battle was pretty clearly shown; for if the accounts we hear are to be believed, the armour belts of the Chinese battleships completely withstood all the fire directed against them, which at the same time made havoc of the superstructures and unarmoured portions.

One effect of the rain of shot and shell—which, as far as we know, has never been anticipated to such an extent as this engagement showed to be the case—was the setting on fire of nearly all the ships engaged. The Japanese seem to have been more successful in extinguishing the flames than the Chinese, who were probably not so well versed in fire drill; and the latter lost two ships, the Tschao Yong and Yang Wai, from this cause. This seems to point to the fact that the use of any inflammable material should be avoided as much as possible in the construction of war ships; with this small exception, the battle of Yalu seems to show that our naval architects have been working in the right direction, and that the fast cruisers of the Elswick type are most essential in a sea fight for quick manœuvring, but that armour-clads are absolutely necessary as the first line of defence.

On page 501 we give a portrait of Mr. Watts, the designer of the Blanco Encalada, and other fast Elswick cruisers. Mr. Watts was apprenticed in 1860 at the Royal Dockyard, Portsmouth, undergoing the superior course of instruction under Mr. Craddock, the master shipwright. From 1866 to 1870 he passed through the Royal School of Naval Architecture and Marine Engineering. On leaving this he received the appointment of draughtsman of Portsmouth Dockyard; but was shortly afterwards sent to Jarrow as an Admiralty inspector, in connection with the building of the Swiftsure and Triumph at Messrs. Palmer's yard. At the close of 1872 he was placed on the staff at the Admiralty, and was associated for several years with the late Mr. William Froude in experimental investigations on the forms of ships. While at the Admiralty Mr. Watts occupied several positions, and latterly that of constructor at Chatham Dockyard. He left the Government service in 1885, under an arrangement between Lord Armstrong and Lord George Hamilton, by which Mr. White left Elswick and took up the position of Director of Naval Construction at the Admiralty, and Mr. Watts took the position vacated by Mr. White at Elswick.

## "EIGHTY-FOUR MILES AN HOUR."

By CHARLES ROUS-MARTEN.

To most people it must seem strange that the question, "How fast can a locomotive run?" which has so often been asked—in the columns of THE ENGINEER and elsewhere—for many years past, still remains without an authoritative answer. It might have appeared certain that systematic and persistent attempts would be made to solve such an interesting problem. But the truth is, that, however interesting on scientific grounds, the problem does not possess much practical value. Locomotives have for nearly half-a-century proved themselves able to fulfil all practical requirements in respect of mere velocity. During the last twenty-five years the problem has been to run the greatest possible load for long distances over all gradients at a high sustained speed, not to run a light load at extreme speeds for a few miles on favourable grades. British railways are purely practical undertakings for commercial purposes, and there has been nothing to be gained by testing a question mainly academic in its nature.

The question, "How fast do trains run?" is almost daily receiving replies—of a kind. Responses come in rich abundance from the irresponsible amateur railway passenger. Readers are treated to an abundance of fabulous and virtually impossible locomotive feats, many given apparently in good faith, but manifestly based on some error of observation or record. As a recent instance may be mentioned the case of that American engine No. 999, which with the "Exhibition Flyer," was stated to have run a mile in thirty-two seconds, or at the rate of about 112 miles an hour. The same engine on that train was twice timed privately for me by two railway experts independently, both capable and trustworthy men well versed in engineering matters, and their results, obtained when the engine was presumably doing its best, fell short of these wild figures by about one-third! In another case a very eminent American engineer absolutely vouched for the alleged fact that one of his engines had attained 82·5 miles an hour on a level road with a heavy train; but when in reply to an expressed doubt he published his own recorded figures, these showed the maximum speed to have been only 67 miles an hour, while in one instance his figures represented the train as passing a second station half-a-minute before the one previous! When even trained observers fall into these errors, it is not surprising that amateur "speed cranks" tumble into the maddest whirlpools of blundering. It is by no means easy to time a fast train accurately. Mile posts are missed, or other posts are mistaken for them; watches are read off incorrectly in the extreme haste which is necessitated; three-quarters are taken as a mile, and so on, *ad infinitum.* For continuous accuracy at least two stop watches or chronographs are essential, and in many cases three are needed to give a continuous checked record.

Gross carelessness, too, is commonly displayed in relation to those speed records which are offered as genuine. Results are quoted as obtained by taking the time-table distances between stations as precise, instead of being as they usually are only roughly approximate, and straying often by fully a quarter-mile or more from strict exactness. Times are taken only to the even minute, fractions and seconds being ignored. As a consequence we get results which, to every competent observer, are self-evidently absurd, but which nevertheless are readily accepted by the world in general, and by the newspaper world in particular, as unquestionable scientific truths. In some cases it is impossible to explain the statements made on any theory of misconception, and the unpleasant conclusion is inevitable that the figures are utterly fictitious.

In the course of my extended examination of the railways of Great Britain, nine years ago, I paid particular attention to this question of maximum-speed possibilities, and carefully recorded the work done by every important express and fast train then running, making several tests of each train. The general results of those observations have often been referred to in the columns of THE ENGINEER. Briefly, I found that while speeds of 70 to 74 miles an hour were commonly attained on certain falling gradients, 75 miles an hour was only occasionally reached, and very seldom even slightly exceeded. The highest velocity that I noted in ordinary express work was about 76·3 miles an hour. Once or twice in special cases this maximum was slightly passed, but it is needless on the present occasion to enter into details of past performances, as the best of these are entirely eclipsed in my more recent experience.

During the past eighteen months I have made at intervals a very large number of observations on the English railways, through the courtesy of the respective authorities, with a view mainly to a comparison between the locomotive work of the present day and that of nine or ten years ago. I have devoted much special attention to this question of speed maxima, and have obtained some very interesting results. My timings have been done either with three chronographs, or with two chronographs and a watch. My plan has been to use two chronographs for successive miles or quarter-miles while the highest speed was being run, the third, or the watch, being employed as a check, to take the longer distances, of so many miles, or from station to station, the records being subsequently collated and compared, almost invariably with the result of agreement within one or two tenths of a second.

My earliest experiments on this occasion were made on the London and North-Western Railway, with Mr. F. W. Webb's famous engine Greater Britain. The results have been published in THE ENGINEER. It will be remembered that Greater Britain in two instances easily attained a speed of 78·2 miles an hour, and was manifestly capable of considerably exceeding that rate, but that this was precluded by the fact that the train was already in advance of time, so that "easing off" became imperative. There was no opportunity of ascertaining the engine's full capabilities in the way of speed, but I have no reason to doubt her ability to equal anything which has been done by any other engine now running.

It was not long before this maximum of 78·2 miles was surpassed. Testing the 7.15 a.m., 9.45 a.m., and 4.15 p.m. down trains on the Great Northern line, I soon obtained unquestionable instances of speeds ranging from 79·1 to 79·5 miles an hour, and similarly on the up expresses of that railway, due at King's Cross respectively at 10.40 a.m. (Mondays only), 6.15 p.m., and 9.20 p.m. The engines were both classes of "singles"—the 8ft. 1in. with outside cylinders, and the 7ft. 7in. with inside cylinders. The loads ranged from six to ten coaches; the gradients were 1 in 200 to 1 in 150 falling. Like speeds were attained by a Midland 7ft. 4in. single, with a load of twelve coaches, during a descent of 1 in 132 to 1 in 120, and by a North-Eastern single compound, with a heavy train of sixteen coaches, down an incline of 1 in100.

The first clear case of 80 miles an hour was recorded by me on the Great Northern line with an 8ft. single down the Abbott's Ripton bank of 1 in 200 for five miles. This was on the last mile at the foot of the incline, the two previous miles having been done at 76·5 and 78·2 respectively. That was promptly rivalled by a 7ft. 7in. single, and by other "eight-footers," both on the down line near Arlesey, and on the up line near Essendine. But for a while I did not meet with any instances on other lines. When these did come they went still farther, and in its turn the Great Northern was for a while distanced in the race.

Most people would be inclined to expect, reasoning *à priori,* that if a speed of 80 miles an hour could be beaten, it would be by a large-wheeled "single" engine. Certainly I should have anticipated this, judging from my former experiences. But such was not the case. To begin with, the Great Northern maximum was equalled by two 6ft. 6in. coupled London and North-Western engines of the Precedent class. Going down the incline which extends from Shap Summit to Carlisle, with a train of seventeen coaches, these two engines attained a speed of exactly 80 miles an hour for three miles just before slackening for Carlisle, each successive mile being run in just 45 seconds. At Carlisle, two of the 6ft. 6in. coupled Caledonian engines — Carbrook class—took on the train. After some very remarkable performances, which I may deal with under another heading, one of these engines, with the seven Edinburgh coaches, going down the Cobbinshaw bank of 1 in 100, managed to do a mile in 44·4 seconds, equal to 81·1 miles an hour. On the return journey the same engine and load got up to 80 miles an hour down 1 in 200 near Gretna. But this was eclipsed by the London and North-Western, between Carlisle and Preston. Some time having been lost by a signal stop, the Shap bank of 1 in 75 and 1 in 147 was descended by the two 6ft. 6in. coupled Precedent engines, with sixteen coaches, at an exceptionally rapid pace. After passing the thirty-seventh mile-post—reckoned from Lancaster—half a mile from the summit, the successive miles were run in 56, 49, 45, and 44 seconds, the next being slightly slower, approaching Tebay Junction. The speed did not rise again until Grayrigg had been passed, but it then again attained the same rate as before, of a mile in 44 seconds, equal to 81·8 miles an hour, which was maintained for several miles down the gradient of 1 in 125. The entire journey from Carlisle to Preston, and thence to Euston, was in many respects remarkable as a locomotive feat, but a description of it would not come within the scope of my present subject, and I must leave it for another occasion. The fact, however, is in itself notable that fully six miles of the distance were run at a speed of 81·8 miles an hour, and this by engines with 6ft. 6in. coupled wheels, not by the more popular large-wheeled "singles."

So long did this rate of velocity remain my highest record, that it began to appear as if this really was the maximum possible with engines of existing types. That London and North-Western maximum was quickly rivalled by engines on several other lines, and I obtained a large number of records of 81·8 miles an hour. The Midland was the first to reach the same point. A 7ft. 4in. single on the 10.35 a.m. down Edinburgh express, and another on the 1.30 p.m. dining-car Scotch train, each touched the "magic eighty," the former approaching Bedford, the latter approaching Nottingham—gradients 1 in 200 down. Then a 7ft. 6in. single on the 5.40 p.m. down, near Bedford, attained 81·8, and a 7ft. 4in. on the up Glasgow express—due St. Pancras at 7.25 p.m.—performed the same feat with a load of ten coaches at no fewer than three points in the run from Leicester to London, viz., descending respectively the banks past Isham, Sharnbrook, and St. Albans, ranging from 1 in 177 to 1 in 100. A like engine did identical work on the up dining-car express on the same lengths of the line, and several instances occurred with various trains between Ampthill and Bedford. All these were with "single" engines of either the 7ft. 4in. or the 7ft. 6in. class. But in one case a 7ft. coupled engine of the 1750 class, with the 2 p.m. down train, succeeded in reaching 81·8 miles an hour with a load of nine coaches, down 1 in 200. The Great Northern soon followed suit, and both the 8ft. and the 7ft. 7in. classes of engines proved that they too could manage 81·8 miles an hour, with loads of eight to ten vehicles, down the long descending gradient which extends from Stoke Box past Tallington.

Nor were other coupled engines than those of the London and North-Western and Great Northern lines behindhand in this respect. On the London and South-Western one of Mr. Adams' new 6ft. 7in. coupled engines of the 557 class, having 19in. by 26in. cylinders, and 175 lb. steam pressure, ran at 81·8 miles an hour for two miles down the incline of 1 in 80 between Okehampton and Yeoford. The run between those stations—14½ miles—is timed to be done in 16 minutes, or at the rate of 54·3 miles an hour. In this instance it was accomplished in 14 minutes 14 seconds, although part of the distance is an ascending grade of 1 in 80. On the Caledonian Railway the Edinburgh Exhibition engine Carbrook twice ran a mile in 44 seconds down a bank of 1 in 100 with a train of seven coaches. It is noteworthy in this connection that the speed at which the American engines, which were said to have run 102 and 112 miles an hour respectively, were actually timed by careful and unbiassed English observers, was in each case the same as that recorded by me with these English engines, viz., 81·8 miles an hour. But it is only fair to add that each observer expressly informed me that in his judgment his respective engine was not doing its utmost at the time, and could, if "pushed," have attained a slightly higher velocity. I note this simply as an expression of personal opinion, but subsequent experiences have tended materially to support the conclusion arrived at. I may add also that capable and trustworthy information has been furnished to me of the same maximum having been reached by the Caledonian 7ft. single, No. 123, by a Lancashire and Yorkshire 7ft. 3in. coupled—Mr. Aspinall's—by a 7ft. compound on the London and North-Western, and by one of Mr. Adams' 7ft. 1in. coupled on the London and South-Western.

On one occasion I made a special effort to exceed that apparently fixed limit of speed. Travelling on one of the newest of Mr. P. Stirling's splendid 8ft. 1in. single express engines, we attained 80 miles an hour down the gradient of 1 in 200 near Little Bytham. In reply to my question, the engine driver, a very intelligent man, said that in his opinion the engine was doing "about her best." He gave however, a little more steam experimentally, when the speed rose to 81·8. But a second addition of steam was followed by a drop to 78·2, apparently due to back pressure. The line then became more level and no increase could be obtained. It is my impression, in view of later occurrences, that had the first additional steam been given at an earlier and steeper portion of the incline, the maximum of 81·8 might have been passed. However, this was not done, the driver's knowledge and practical experience of the obstructive effect of back-pressure when too much steam is admitted to the cylinders, having led him to err on the side of excessive caution. Hence, this remains my maximum so far with the 8ft. 1in. engines.

It may be interesting at this stage to set forth in tabular form a list of the various classes of engines with which I recorded a speed of a mile in 44 seconds, or 81·8 miles an hour:—

| Railway. | Locomotive superintendent or designer. | Dimensions of cylinders. | Dia. of driving wheels | Single or coupled. | Steam pressure. |
|---|---|---|---|---|---|
| | | in. in. | ft. in. | | lbs. |
| †L. & N.-W. | F. W. Webb | 17 × 24 | 6 6 | Coupled | 150 |
| *Gt. Nor. .. | P. Stirling | 18½ × 28 | 8 1 | Single | 160 |
| † „ .. | „ | 18⅞ × 26 | 7 7 | „ | 160 |
| Midland .. | S. W. Johnson | 18½ × 26 | 7 6 | „ | 160 |
| „ .. | „ | 18 × 26 | 7 4 | „ | 160 |
| „ .. | „ | 18 × 26 | 7 0 | Coupled | 160 |
| *L. & S.-W. | W. Adams | 19 × 26 | 6 7 | „ | 175 |
| Caledonian | D. Drummond | 18 × 26 | 6 6 | „ | 150 |

* Outside cylinders; all others are inside. † Radial leading axles; all others have leading bogies.

In all these cases there was remarkable steadiness of running and freedom from oscillation; in fact, as I had noticed in my experiments of nine years previously, the steadiness of running was often superior at the highest velocities to that experienced at a slower rate of travelling. The impression conveyed was that, in respect of stability on the road, this improved as the speed augmented. It is needless to say that this applies solely to roads suitable for speed—well and substantially laid, with heavy rails and plentiful sleepers, and free from sharp curves and facing points. On such lines there would be no danger in running at the speeds fabulously reported of some American engines, could these be actually attained in practice.

The first instance of a higher speed being attained than a mile in 44 seconds, for which I can absolutely vouch, occurred somewhat unexpectedly to me, and, I suspect, unconsciously so far as the engine-drivers were concerned. The 3 p.m. Leeds fast express from St. Pancras left with two engines, both 7ft. 6in. singles—one a return pilot "going home"—the load being only eight coaches. Now, as either of the engines could probably have kept time with double that load, it is obvious that there was a large margin of locomotive power available. The train was much hindered at first by a strong side wind, and a loss of fully two minutes was caused by a signal check at Elstree Tunnel. The drivers evidently considered that they must "push ahead" to make up lost time, and after Toddington summit—33¾ miles—was passed, and the sixteen-mile descent to Bedford entered upon—the side wind by this time being lost—the speed rose in a very remarkable way.

By the time Flitwick was reached the speed had risen to 76·5 miles an hour; approaching Ampthill it was 77·1. Then followed the sudden drop in speed which I have invariably noticed near Ampthill and through the tunnel. On emerging from the tunnel the rate was only 70·6, but it then steadily and rapidly rose. Speeds of 75·0, 76·6, 77·4, 78·2, 79·1, 80·0, 81·1, and 81·8 were successively shown by the two chronographs, the last being reached at the forty-fifth mile-post. But the speed still continued to rise, and at the forty-sixth post had attained the rate of 83·7 miles an hour, at which it continued for two miles, each being done in 43 seconds. Steam was shut off at 48 miles, and the velocity gradually fell until Bedford was passed at the usual reduction to 10 miles an hour. The third chronograph showed that a distance of 9½ miles, up to the time of shutting off steam, was run in 7 min. 13·4 sec., or at the average rate of 78·9 miles an hour, including the falling-off to 70 miles an hour, and the gradual recovery after Ampthill. During the fastest part of the running I obtained two doubtful timings of a quarter-mile in 10·7 seconds, which would give a slightly higher rate, but owing to the intervention of trains passing in opposite directions, I cannot positively vouch for these, and therefore do not put them forward on this occasion. The fact, however, remains that a speed of 83·7 was unquestionably and indisputably maintained for two successive miles on a falling gradient of 1 in 200.

There was no wind at the time, and the rails were in excellent order, while the train was composed of mostly uniform rolling stock, and, being of moderate length, had no "tail" to "wag." Nothing could exceed the smoothness of the travelling. There was no appreciable oscillation whatever, and the whole train seemed to glide along as if on ice or on oiled runners. The passengers did not appear at all conscious of travelling at exceptional speed, and no remark was made. On other occasions when going at 55 to 60 miles an hour down steep gradients and round sharp curves, I have heard many exclamations at the "fearful speed," which, in fact, was doubtless less safe relatively than was this 83 miles an hour on so eminently favourable a length of line. It may be worth while to add that the complete run from Kentish Town to Kettering—70½ miles—was done in 76 minutes 29 seconds, including a loss of three minutes by two bad signal checks—near Elstree Tunnel and Irchester respectively—thus leaving the net time 73 minutes 29 seconds.

Curiously enough the same week furnished a second instance of the same exceptional speed being run by an engine of the same class on the same line. This was on the 10 a.m. Glasgow express with nine coaches in showery weather, with light head wind during part of the distance, not, however, on the length where the best speed was achieved. There was a Pullman car in the train, which tended to improve the steadiness in running.

On this occasion the remarkable run of 12 miles—36th to 48th mile-post—in 9 minutes 14 seconds was made by the engine, including the customary diminution of speed near Ampthill. Unfortunately, owing to the intervention of trains on the up or relief line, several intermediate posts could not be taken on the best part of this interesting run, but several successive quarter-miles were run in 10·7 seconds each, equal to a speed of 84·1 miles per hour.

Such performances having been accomplished by the Midland single-wheel engines, there seemed no valid reason why the Great Northern engines, with practically identical dimensions and power, should not be able to show equal speed records, so I made a number of experimental trips with the object of determining this point. It did not long remain in doubt. One of these inside-cylinder engines, with 7ft. 7in. single driving wheels, got up to 82·5 miles an hour descending the bank of 1 in 150 and 1 in 200 which extends from near Nostell toward Doncaster. Three successive runs with an engine of this class, which has larger cylinders than the others—18⅞in. diameter—gave some interesting results. The first was somewhat impeded by side wind, nevertheless a speed of 81·1 miles per hour was reached; the load was seven coaches, weighing approximately 100 tons. In the second trial the load was the same, but the weather was more favourable and higher figures resulted. After passing Corby at 70·6 miles an hour, the speed rapidly increased to 73·5, 75·0, 76·6, 78·2, 80·0, 81·8, 82·4, 83·7, and finally 84·1 miles an hour, several successive quarter-miles being covered in 10·7 seconds apiece, and two miles consecutively in 42·8 seconds each. The third trial had the advantages of perfectly calm, fine weather and a load lighter by one coach, but the results were in most respects identical. Again a speed of 84·1 was reached and maintained for two miles. This maximum was, however, attained somewhat more quickly with the lighter than with the heavier load, and the speed diminished rather more slowly as the falling gradient merged into a level road. But the difference was very small, only 3 seconds gained between Stoke Summit and Bytham, and 2 seconds gained between Essendine and Tallington. The time for the 3 miles 52 chains from Bytham to Essendine was in each case the same, and the quickest by 5 seconds ever recorded by me, viz., 2 minutes 39 seconds, equal to an average rate of 82·6 miles an hour. As in the other cases quoted, there was in these instances entire and remarkable steadiness alike on the footplate and in the train, for I tested both, travelling on the footplate in one case, and in the rear coach in the other. Even the most nervous passenger, who writes indignant but silly and ignorant complaints about "dangerous" and "alarming" speeds, could not have discovered the slightest grievance in the swift but utterly smooth running of these Great Northern and Midland trains that proved the feasibleness of travelling with complete safety at the rate of 84 miles an hour.

### SPEED TABLES.

*Midland Railway.*

| Distance. | Stations | Engines, two 7ft. 6in. singles, and 8 coaches. | Engine, 7ft. 6in. single, and 9 coaches. |
|---|---|---|---|
| — | St. Pancras | dep. 3 0 22 | dep. 10 1 2 |
| 1¾ | Kentish Town | arr. 3 37<br>dep. 6 29 | pass 4 32 |
| 2½ | Haverstock Hill | pass 7 14 | „ 5 42 |
| 3½ | Finchley-road | „ 9 7 | „ 7 25 |
| 4 | West End | „ 9 42 | „ 8 9 |
| 5¼ | Child's Hill | „ 11 22 | „ 9 45 |
| 7 | Hendon | „ 13 17 | „ 11 43 |
| 9½ | Mill Hill | „ 15 23 | „ 14 25 |
| | [Elstree Tunnel] | „ * 19 20 | „ — |
| 12½ | Elstree | „ 20 12 | „ 18 28 |
| 15¼ | Radlett | „ 23 23 | „ 21 10 |
| 20 | St. Albans | „ 28 10 | „ 26 10 |
| 24¾ | Harpenden | „ 33 36 | „ 31 22 |
| 27¼ | Chiltern Green | „ 36 8 | „ 33 59 |
| 30¼ | Luton | „ 38 59 | „ 36 52 |
| 32¾ | Leagrave | „ 41 34 | „ 39 30 |
| 37¼ | Harlington | „ 45 51 | „ 43 37 |
| 40¼ | Flitwick | „ 48 11 | „ 45 56 |
| 41¾ | Ampthill | „ 49 21 | „ † 47 9 |
| 49¾ | Bedford | „ ‡ 56 17 | „ ‡ 54 47 |
| 53 | Oakley | „ 4 0 50 | „ 59 24 |
| 56¾ | Sharnbrook | „ 4 58 | „ 11 3 28 |
| 59¾ | Summit | „ 9 0 | „ 7 50 |
| 62¾ | Irchester | „ 12 12 | „ 11 0 |
| 65¼ | Wellingborough | „ § 14 50 | „ ‖ 13 6 |
| 68¼ | Finedon | „ 18 47 | „ 17 1 |
| 69½ | Isham | „ 19 58 | „ 18 34 |
| 72¼ | Kettering | arr. **22 58 | „ 21 48 |
| 75¾ | Rushton | — | „ 26 28 |
| 78¼ | Desborough | — | „ 29 48 |
| 83¼ | Market Harboro' | — | „ 34 37 |
| 86½ | East Langton | — | „ 38 25 |
| 89 | Kibworth | — | „ 41 33 |
| 91½ | Glen | — | „ 44 35 |
| 95½ | Wigston | — | „ ¶ 48 18 |
| 99¼ | Leicester | — | ††arr. 11 53 4 |

* Slackened by signal to 10 miles an hour.
‡ Slack to 10 miles an hour.
§ Slack by signal to 15 miles an hour.
** Total time lost by signal = 3 minutes.
† Slackened twice by signal at 48¼ and 49¼ mile-posts to 10 miles an hour.
‖ Slack between Wellingborough and Finedon to 10 miles an hour for relaying.
¶ Slackened at Wigston Junction by signal to 15 miles an hour.
†† Total time lost by signals = 5 minutes.

*Great Northern Railway.*

| Distance in miles and chains from King's Cross. m. ch. | Station or signal box. | Engine, 7ft. 7in. single, and 7 coaches. | Engine, 7ft 7in single, and 6 coaches. |
|---|---|---|---|
| 105 28 | Grantham | dep. 4 20 3 | dep. 4 18 32 |
| 101 79½ | Great Pinton | pass 26 11 | pass 24 31 |
| 100 0 | Stoke Box | „ 28 48 | „ 27 1 |
| 97 6 | Corby | „ 31 50 | „ 30 1 |
| 92 16 | Little Bytham | „ 35 50 | „ 34 0 |
| 88 44 | Essendine | „ 38 29 | „ 36 39 |
| 84 57 | Tallington | „ 41 26 | „ 39 44 |
| 78 46½ | Walton | „ 46 49 | „ 45 8 |
| 76 20 | Peterborough* | „ 49 14 | „ 47 29 |
| 72 46½ | Yaxley | „ 54 38 | „ 52 47 |
| 69 19 | Holme | „ 57 52 | „ 55 48 |
| 63 34½ | Abbott's Ripton | „ 5 4 12 | „ 5 1 40 |
| 58 65 | Huntingdon | „ 8 55 | „ 6 9 |
| 55 67¾ | Offord | „ 11 34 | „ 8 33 |
| 51 50 | St. Neots | „ 16 0 | „ 12 39 |
| 47 35½ | Tempsford | „ 20 26 | „ 16 38 |
| — | Near Everton Box | — | arr. † 17 32<br>dep. 19 40 |
| 44 7 | Sandy | pass 24 10 | pass 24 24 |
| 41 6 | Biggleswade | „ 27 47 | arr. † 27 39<br>dep. 28 29 |
| — | Near Langford Box | — | arr. † 32 0<br>dep. 33 48 |
| 37 5¾ | Arlesey | pass 32 42 | pass 35 30 |
| 35 50 | Three Counties | „ 34 14 | „ 37 8 |
| 31 76 | Hitchin | „ 38 50 | „ 41 26 |
| 28 46¼ | Stevenage | „ 43 22 | „ 45 31 |
| 25 7¼ | Knebworth | „ 47 28 | „ 49 26 |
| 21 75¾ | Welwyn | „ 50 52 | „ 52 39 |
| 17 57 | Hatfield | „ 54 51 | „ 56 20 |
| 12 62¼ | Potters Bar | „ 6 0 17 | „ 6 1 29 |
| 10 50½ | Hadley Wood | „ 2 32 | „ 3 25 |
| 9 16 | Barnet | „ 3 10 | „ 4 42 |
| 8 35½ | Oakleigh Park | „ 4 34 | „ 5 25 |
| 6 30 | Southgate | „ 6 13 | „ 7 0 |
| 4 79 | Wood Green | „ 7 26 | „ 8 8 |
| 4 5¼ | Hornsey | „ 8 10 | „ 8 51 |
| 3 34 | Harringay | „ 8 41 | „ 9 22 |
| 2 42¾ | Finsbury Park | „ 9 31 | „ 10 6 |
| — | King's Cross | arr. 6 13 0 | arr. 6 13 35 |

NOTE.—Distances are from official tables. * Slack to ten miles an hour. † Signal stop.

The leading dimensions of the engines which attained 84·1 miles an hour may be summarised as follows:—

| Railway. | Class. | Cylinders. | Diameter driving wheel. | Mean pressure. | Bogie or rad'l axle |
|---|---|---|---|---|---|
| Midland ... | Single | 18½ × 26 | 7ft. 6in. | 160 lb. | Bogie |
| Gt. Northern | Single | 18⅞ × 26 | 7ft. 7in. | 160 lb. | Radial |

It will be noticed the former of these two Great Northern runs gives the excellent performance of 105⅓ miles, from Grantham to King's Cross, in 1 hour 52 minutes 57 seconds, and the latter the still better work of the same distance in 1 hour 55 minutes 3 seconds, with three intermediate signal stops, absorbing 4 minutes 46 seconds, bringing down the actual travelling time to 1 hour 50 minutes 17 seconds, while the further loss by three extra stoppings and startings was fully 6 minutes, making the virtual net time 1 hour 44 minutes 17 seconds.

In the annexed speed tables we give the "logs" of the respective trains' running.

The question will naturally suggest itself whether the engine was really doing its utmost when this speed of 84·1 miles an hour was attained. My own opinion is that the limit of the engine's capacity in the way of actual speed was, if not reached, yet very closely approached. The driver, who, as in the other case referred to, was a very intelligent and capable man, was of opinion that by giving the engine a little more steam it might have been possible to reduce the time per mile by a second or nearly so, provided he received special authority to press the engine to her utmost capacity. It seemed to me, however, that she was already taking as much steam as she could profitably utilise, and that to give more would have been simply to invite obstruction by back-pressure, as in other experiences. As it was, the engine had just sufficient load to enable her to put out her full-power and utilise the steam to the best advantage. At the same time I freely admit that her driver ought to be best acquainted with his engine's idiosyncrasies, and that he may be right in his view, although I gather that so far it is based solely upon theory, as the higher speed does not appear to have been hitherto authentically recorded.

It may be worth while to remark that all the engines which have exceeded the maxima recorded by me nine years ago have increased steam pressure, viz., 150, 160, or 175 lb., as against 140 lb. or less. That is the one salient difference between then and now. Cylinder diameters are larger in some cases but not in all, or even in the majority of instances, and my almost invariable experience on the present occasion has been, that while the speed maximum is higher than it was nine years ago, it is attained more gradually than then, a fact which probably points to more careful and economical development of the engines' powers on the part of their drivers, who avoid prematurely forcing or hurrying them up to their highest velocity. I suspect also that a freer exhaust may now be provided, in some cases, at any rate, thus reducing back-pressure.

It is not intended at all to convey the idea that other engines and other railways are unable to equal the performances above set forth. On the contrary, I see no reason whatever to doubt that some of the engines on most of the leading English lines are fully capable of performing equally fast work. But I am simply recording what came under my own personal notice, and hitherto I have never yet attained a speed of 80 miles an hour on any British standard-gauge railway excepting those specified in these notes. The present prevalent policy on most of the British lines seems to be rather to make fast average time by "forcing the pace" uphill, even at the cost of additional consumption of fuel, than to utilise the force of gravitation on moderate descending gradients by running at the highest speeds downhill. This, of course, is purely a question of policy, the discussion of which does not come within the sphere of the present article. But the results of my investigations go conclusively to show that no valid argument against this utilisation of a valuable force exists on the score of danger or unsteadiness, and that no additional risk or discomfort is incurred by descending moderate gradients on well-laid and fairly straight roads at speeds of 75 to 84 miles an hour.

Some of the engines of the classes referred to in this article have been illustrated in THE ENGINEER, December 16th, 1892; September 20th, 1889; December 23rd 1887; April 21st, 1892.

## THE ATLAS WORKS, GLASGOW.

Although we have already illustrated and described more than one of the leading locomotive works in the kingdom, this description of the Atlas Works of Messrs. Sharp, Stewart, and Co., is exceptional in the sense that it is the first establishment which has, since its commencement, been conducted entirely by private capital. To engineers the name requires no introduction, on account of its close connection with locomotive engine progress; and even to those of our readers who are not exactly engineers—if that title should possess any exact meaning in the minds of any of them—we feel that an explanation would be superfluous on account of the widespread circulation of the firm's name-plates. At the same time we here give a brief history which may interest some of an archæological turn of mind. The firm was originally styled Sharp, Roberts, and Co.—that is to say, Thomas Sharp and Richard Roberts entered into partnership in 1828 for the purpose of manufacturing cotton-spinning machinery; their works being situated in Falkner-st., Manchester. They pursued this branch of industry for some time, taking out patents for improvements in spinning machinery, Roberts' self-acting mule meeting with extraordinary success. They also went in for card-making and block-printing machinery, though no large development was attained in these last two branches. It was just about this time—that is, between 1830 and 1840—that the demand for machine tools sprung up, and the genius of Roberts, aided by the enterprise of the Brothers Sharp, soon found means of extending this manufacture both at home and abroad. The machines for planing, slotting, wheel-teeth cutting, punching and shearing, and the numerous lathes invented and adopted by Roberts secured for the firm the high reputation which it still retains.

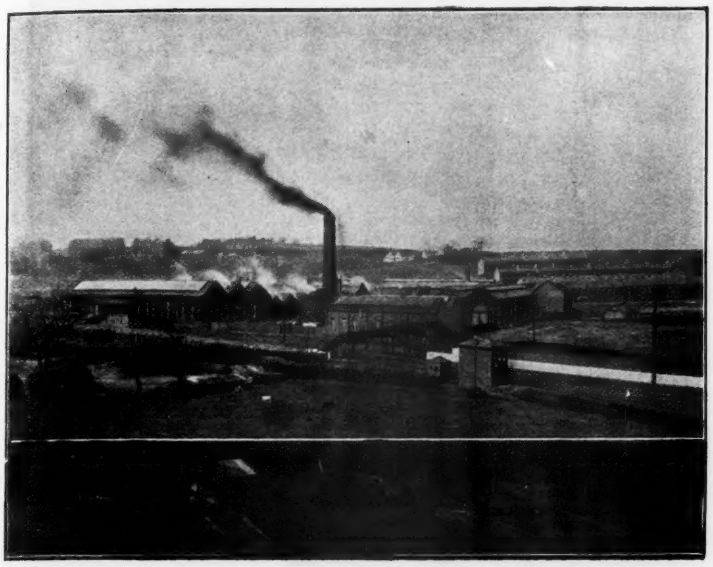


Fig. 3—MESSRS. SHARP, STEWART, AND CO.'S WORKS FROM THE SOUTH

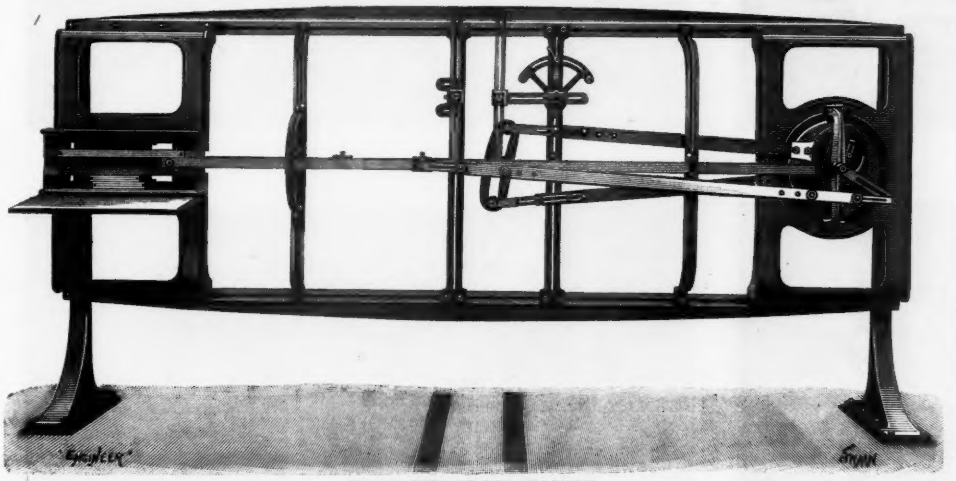


Fig. 6—SETTING-OFF MACHINE

It was in 1834 that the building of locomotive engines was commenced, the first four productions being of the bell-crank and lever type, all exactly alike. No. 1 was an experimental engine with 11in. cylinders and 16in. stroke; diameter of boiler 3ft., and diameter of driving wheel 5ft., and ran on the Liverpool and Manchester Railway. Nos. 2, 3, and 4—the Hibernia, Manchester, and Britannia—were supplied to the Dublin and Kingstown Railway. The Hibernia is shown in Fig. 1, side by side with the engine which is now doing the duty which her predecessor did sixty years ago—the two forming a striking contrast between past and present.

The modern tank engine, Fig. 2, was supplied to the Dublin, Wicklow, and Wexford Railway in 1893 by Sharp, Stewart, and Co., and has 5ft. 3in. wheels with 18in. cylinders, with 2ft. 2in. stroke. The heating surface is 1226½ square feet, total weight 55¼in. tons, and tank capacity 1200 gallons.

To return to our history. In 1842 Thomas Sharp, the senior partner, died, and in the following year Roberts retired from the firm, continuing business alone at Falkner-street, the other partners taking their business to the Atlas Works. The firm was also reconstructed by the admission of Mr. John Robinson, who had been a pupil of the old firm, and he, with Mr. John Sharp and Mr. Thomas B. Sharp, continued the business under the style of Sharp, Bros., and Co. Under their management the manufacture of locomotives became a leading feature, accompanied by that of machine tools, while the cotton and textile machinery was given up. It was not till 1852 that Mr. C. P. Stewart's name appeared. This gentleman, who had been a pupil of the celebrated marine engineers, Seward and Co., succeeded Mr. John Sharp, the senior partner, then retiring. The business continued to prosper, and shortly afterwards Mr. T. B. Sharp retired as well, to be succeeded in his turn by Mr. Stephen Robinson.

It was then that the manufacture and exploitation of Giffard's injector became an important adjunct to the business. This arose from the observance by Mr. Stewart of one of these appliances at work in a steamboat in the Mediterranean, the utility of which was so apparent that he made arrangements with M. Giffard for the manufacture and sale of his invention, which practically revolutionised locomotive boiler feeding.

In 1863, in accordance with the Limited Liability Act just passed, the partnership was converted into a limited company, the three partners remaining in the business as managing directors, C. P. Stewart as chairman, and John Robinson as vice-chairman. Mr. Stewart died in 1882, Mr. John Robinson succeeding to the chair, the business still being carried on at the Atlas Works, Manchester. Owing to the expiration of the lease of these premises, negotiations were opened in 1887 for the acquiring of premises and plant in Glasgow, which had been till then known as the Clyde Locomotive Works, the works, in fact, with which we now have to deal under an altered name. The antecedents of the Clyde Works were briefly as follows:—They were founded by Mr. W. Montgomerie Neilson—formerly principal partner in Neilson and Co.'s Hyde Park Works, Glasgow—in conjunction with other gentlemen. The company was incorporated in March, 1884, and commenced operations in 1885, and their orders came chiefly from the Highland Railway Company, one of eight express engines built for this line being exhibited at the Edinburgh Exhibition in 1886.

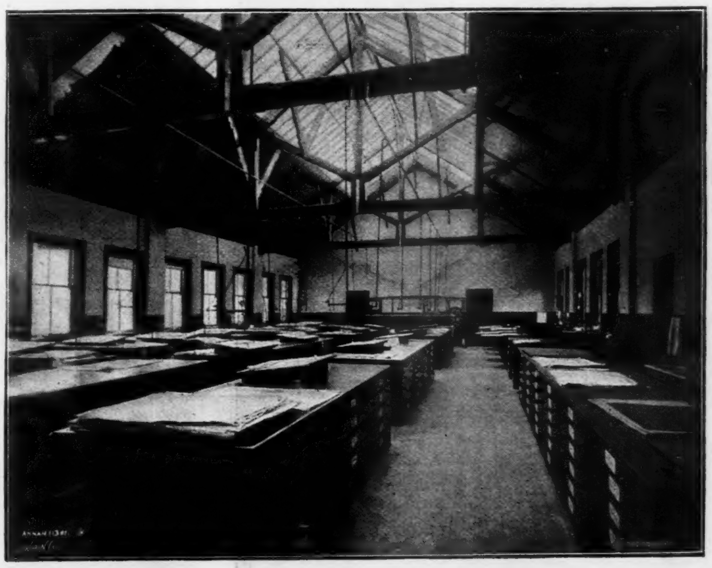


Fig. 5—DRAWING-OFFICE

The amalgamation with the Clyde Locomotive Company was completed, and the new works were started in January, 1888; Mr. John Robinson remaining chairman, and a board of directors being chosen to represent both the English and Scotch capital of the concern.

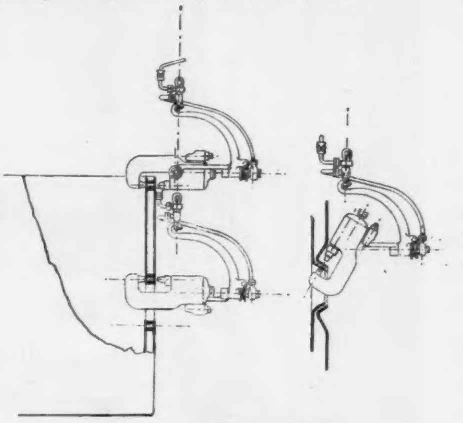


Fig. 9—FIRE-DOOR RIVETER

Springburn, where the Atlas Works now are, lies north-east of Glasgow, and can be reached from that city in fifteen minutes by the North British local trains, although it is actually within the municipal boundaries.

Fig. 3 is a general view of the works, reproduced from a photograph taken some while back, before the present offices were built—which are a great improvement—but otherwise than this the photograph is accurate. We give a plan of the premises in Fig. 4.

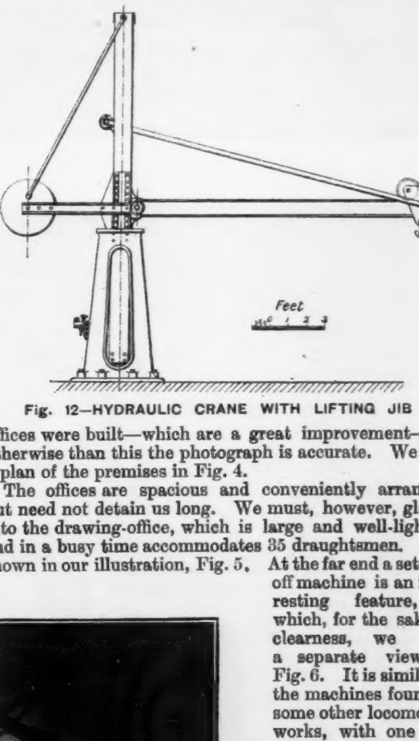
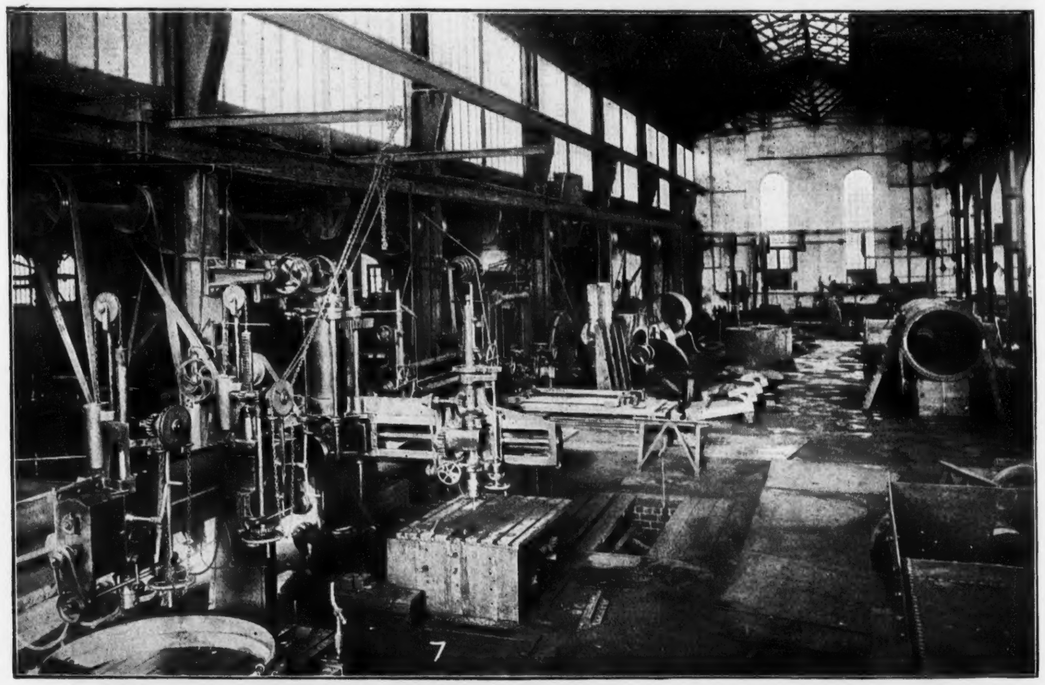


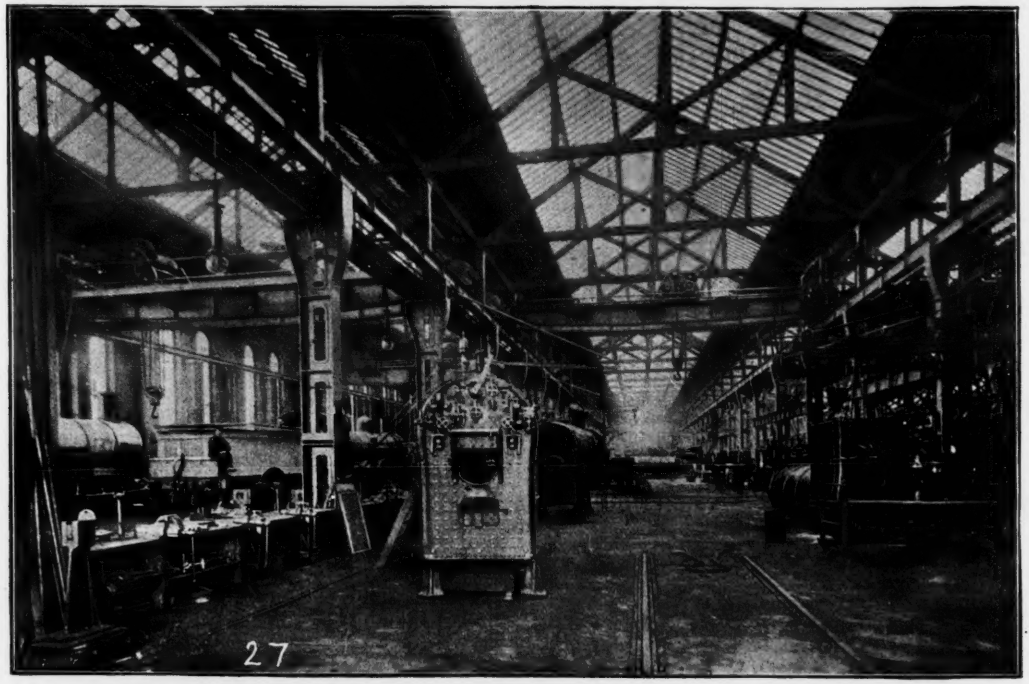
Fig. 12—HYDRAULIC CRANE WITH LIFTING JIB

The offices are spacious and conveniently arranged, but need not detain us long. We must, however, glance into the drawing-office, which is large and well-lighted, and in a busy time accommodates 35 draughtsmen. It is shown in our illustration, Fig. 5. At the far end a setting-off machine is an interesting feature, of which, for the sake of clearness, we give a separate view in Fig. 6. It is similar to the machines found in some other locomotive works, with one exception, that being the manner in which the excentric pulleys are placed on the shaft. In all cases which we have hitherto met with these pulleys are together side by side, as they are on the finished engine. The trouble with this arrangement has always been, when dealing with the outer excentric, the necessity of using a square to read off the figures on the graduated disc. Here we have the disc graduated on both sides, and the angles of both excentrics can be read with equal accuracy.

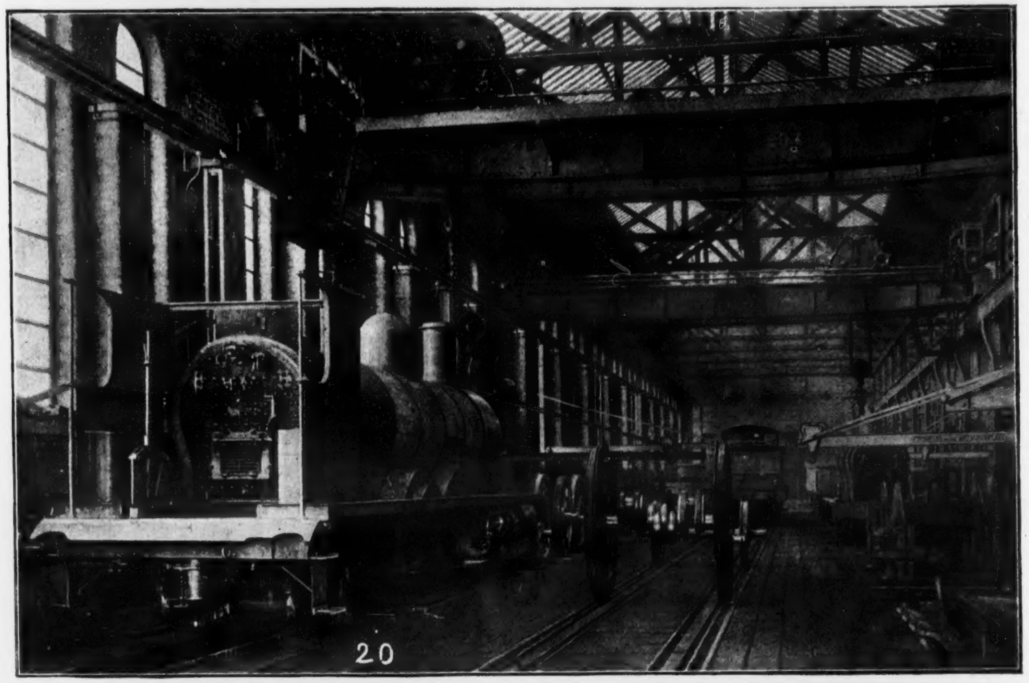
A room adjoining is a separate tracing department, where there is nothing particularly attractive — excepting, of course, the lady trecers employed therein. They appear to do the work as

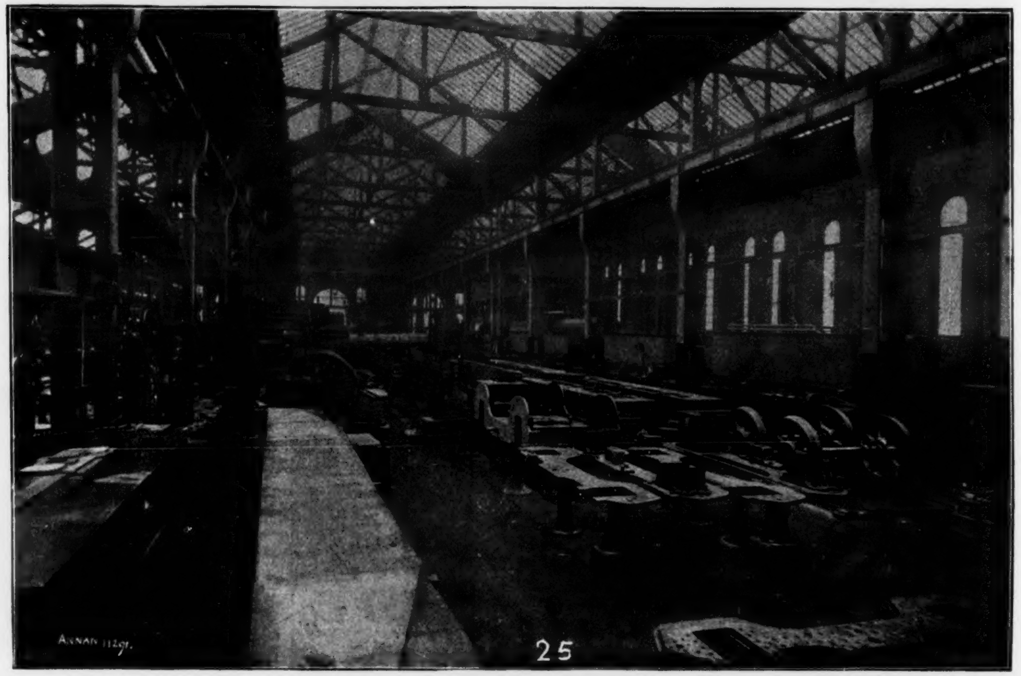
# VIEWS IN MESSRS. SHARP, STEWART, AND CO.'S WORKS


7


27

Figs. 7 and 27—BOILER SHOP AND BOILER MOUNTING SHOP

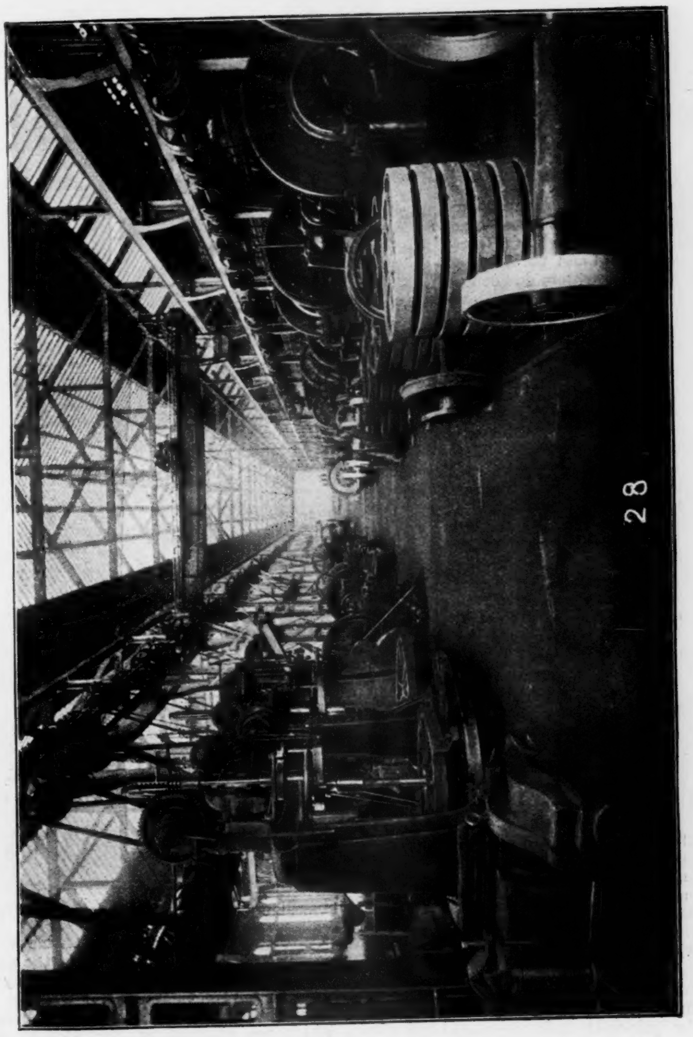

20

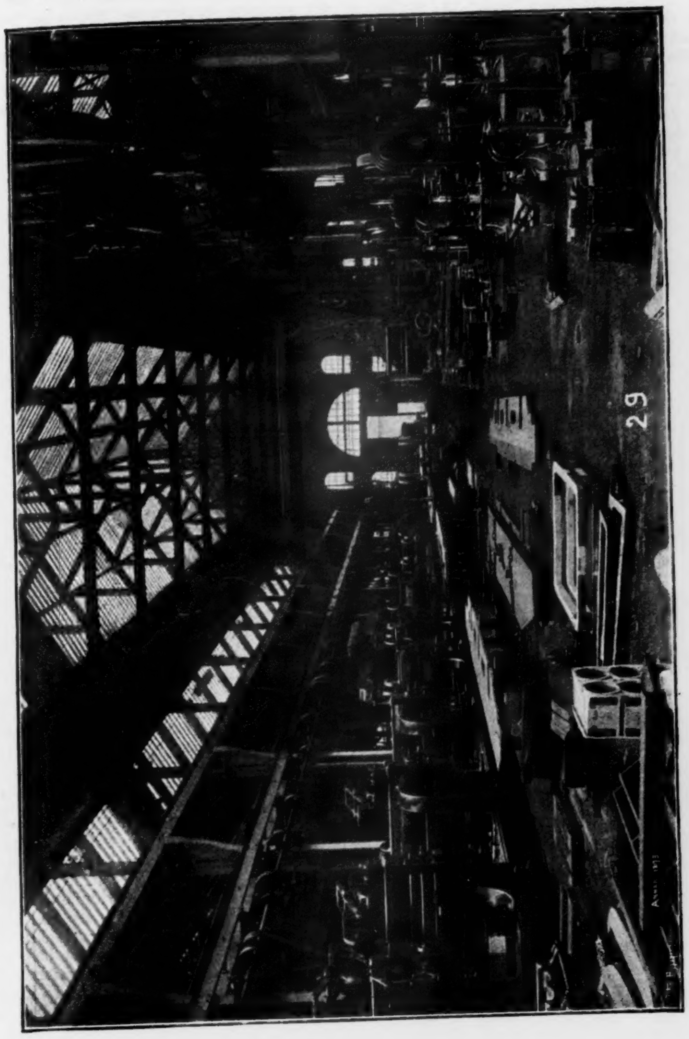


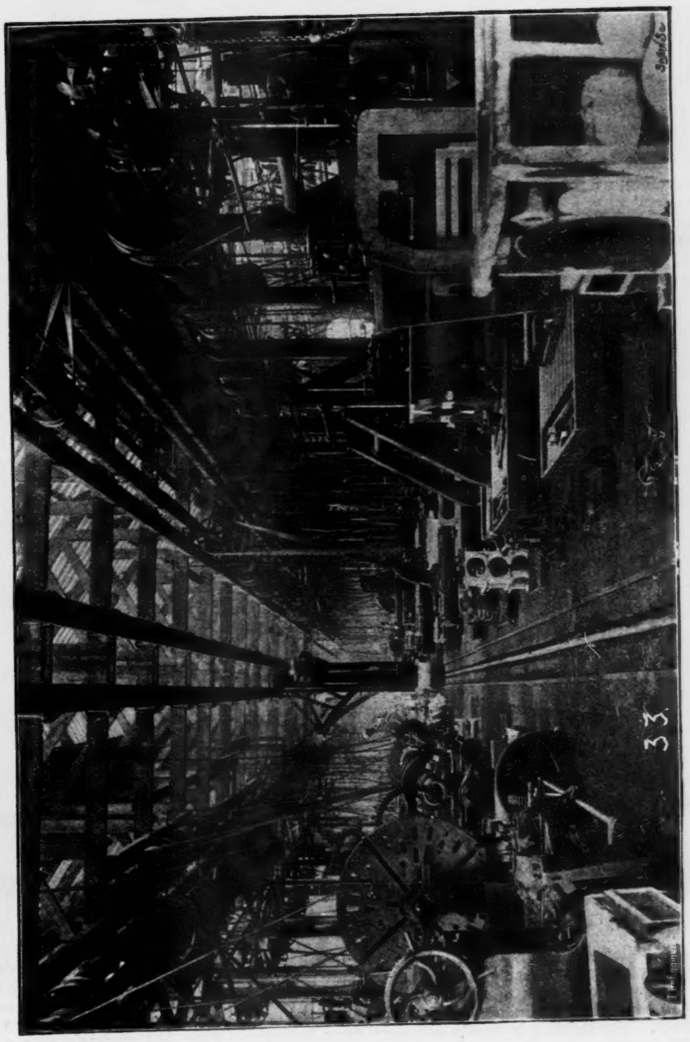
25

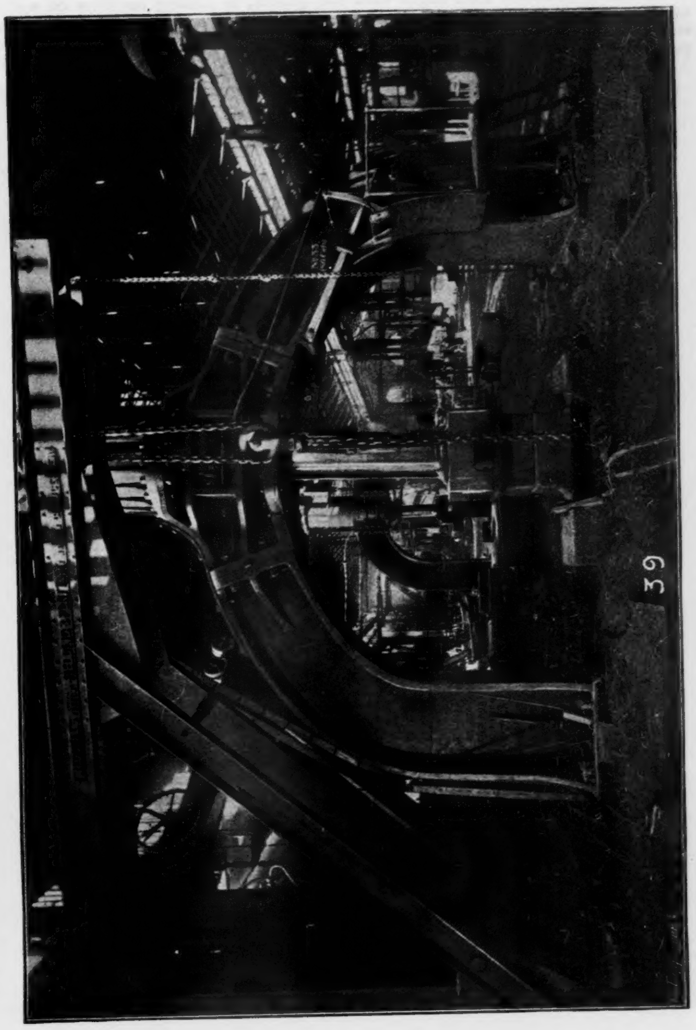
Figs. 20 and 25—ERECTING SHOP AND FRAME SHOP

## VIEWS IN MESSRS. SHARP, STEWART, AND CO.'S WORKS





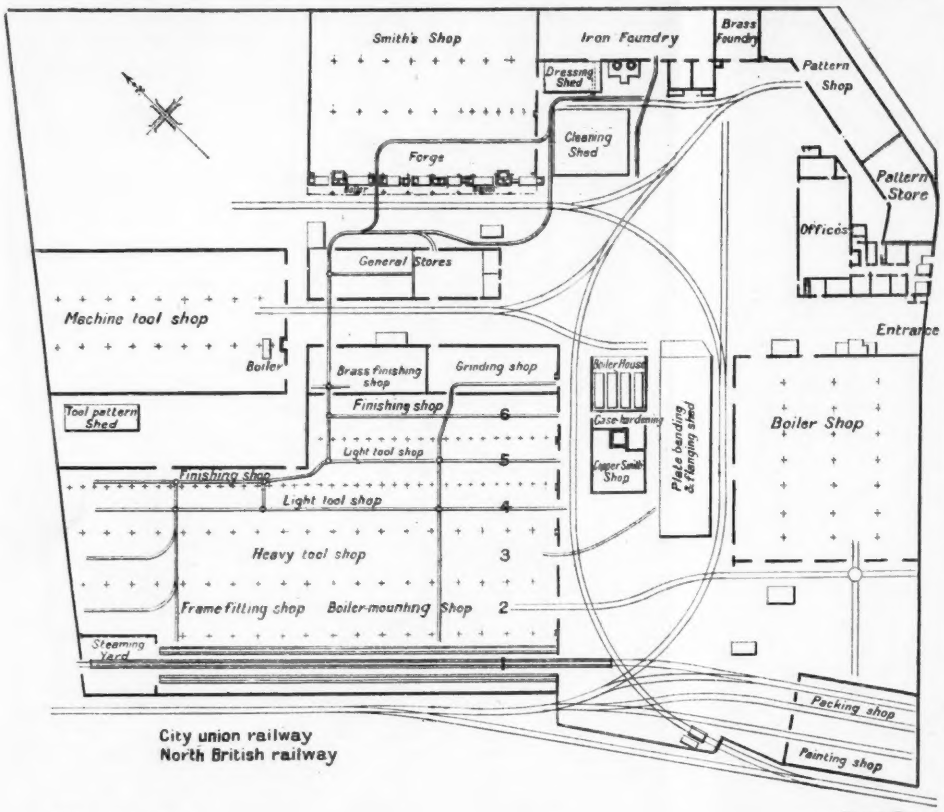




Figs. 28 and 33—WHEEL SHOP AND LIGHT TOOL SHOP

Figs. 29 and 39 HEAVY TOOL SHOP AND SMITHY well, if not better than their *confrères* of the sterner sex.

We cannot do better than begin with the boilers, as any attempt to follow the growth of a locomotive, taking each phase in its manufacture in a definite order, must prove futile—simply because there is, so to speak, no common starting point. A locomotive is not like a sausage. Were we dealing with a sausage factory, we should feel no doubt about our starting point. But here there is unfortunately no pig. In the following description, therefore, we must imagine ourselves to be acting as our readers' cicerone, taking the features of interest in the order in which they would be presented to a visitor making a personal tour of inspection.


Smith's Shop
Iron Foundry
Brass Foundry
Pattern Shop
Dressing Shed
Cleaning Shed
Forge
Pattern Store
Offices
General Stores
Entrance
Machine tool shop
Boiler
Brass finishing shop
Grinding shop
Boiler House
Case-hardening
Copper Smith Shop
Plate bending & flanging shed
Boiler Shop
Tool pattern Shed
Finishing shop
6
Light tool shop
5
Finishing shop
Light tool shop
4
Heavy tool shop
3
Frame fitting shop
Boiler-mounting Shop
2
Steaming Yard
Packing shop
Painting shop
City union railway
North British railway

"The Engineer" Swain Eng

Fig. 4—PLAN OF MESSRS. SHARP, STEWART, AND CO.'S PREMISES

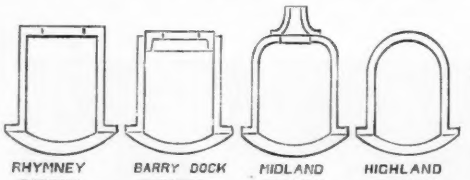

RHYMNEY RAILWAY
BARRY DOCK RAILWAY
MIDLAND RAILWAY
HIGHLAND RAILWAY

Fig. 13

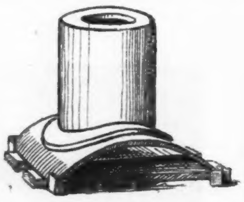


Fig. 5

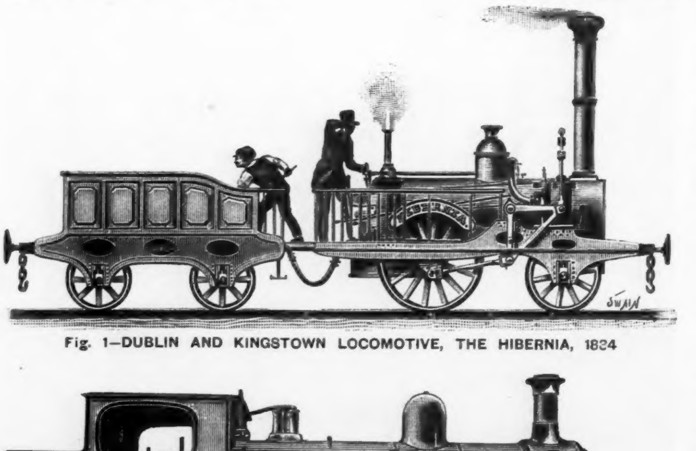


Fig. 1—DUBLIN AND KINGSTOWN LOCOMOTIVE, THE HIBERNIA, 1824

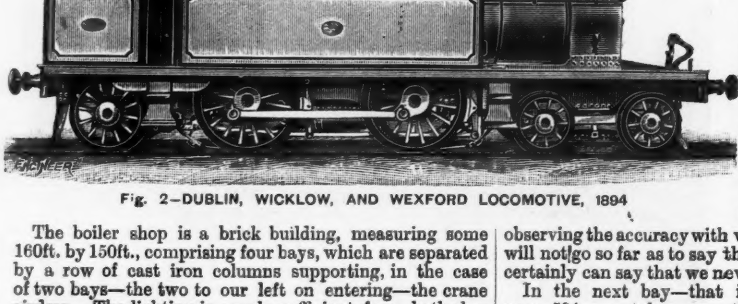


Fig. 2—DUBLIN, WICKLOW, AND WEXFORD LOCOMOTIVE, 1894

The boiler shop is a brick building, measuring some 160ft. by 150ft., comprising four bays, which are separated by a row of cast iron columns supporting, in the case of two bays—the two to our left on entering—the crane girders. The lighting is amply sufficient from both skylights and side windows, as will be seen from Fig. 7 on page 504. There are two overhead travelling cranes by Craven Brothers, the largest of which is capable of lifting ten tons on a 33ft. span—both rope driven. In addition to these there are the necessary jibs over the hydraulic riveters, the largest of which, with a 14ft. rake, is in the east corner, and lifts seven tons to a height of 22ft. All the motions of this crane, which is shown in Fig. 8, namely, lifting, slewing, and racking in are effected hydraulically, the valves being placed on the riveter, so that one man can control both riveter and crane. It is made on Tweddell's system by Fielding and Platt, as is all the hydraulic machinery throughout the works, including, besides the riveting tools and their accessories a great number of cranes. The various riveters, both fixed and portable, we shall deal with in due course.

A hanging portable hydraulic riveter with very small gap, for use on furnace doors, claims attention on the score of its special suitability to the work in question. It can, by reason of its freedom to revolve on a gudgeon, rivet the Webb angular flanged rings as well as the ordinary. The gap is necessarily very small, in order that the machine may be admitted through the firedoor ring, as in Fig. 9.

The accumulator supplying all the hydraulic appliances throughout the establishment is situated just outside this shop. It has a 15ft. stroke, and is fitted with automatic stopping and starting gear.

The general erection of boilers is carried on in this first bay. Passing down it among boiler barrels, fireboxes, tanks, parts of tenders, &c., we have an opportunity of admiring the character of the workmanship, and noting that the edges of all plates are planed in accordance with the best locomotive practice; also of observing the accuracy with which the drilling is done. We will not go so far as to say that a drift is not used, but we certainly can say that we never saw this tool in requisition.

In the next bay—that in which our photograph on page 504 was taken—are the principal tools, some of which are worthy of mention. On our left is one of Buckton's angle iron shears, and further up the bay is a double-headed drilling machine—prominent on the foreground of the picture—by Craven, which is used for drilling fire-boxes, and a good deal of general work. The cross slide will admit work 9ft. 6in. wide, the spindle being adjustable 8ft. 3in. apart, taking 4ft. 9in. from floor line to the bottom of the spindles. There are two of these machines in use. Further up there is just visible in the picture a pair of rolls, about which we must again have something to say.

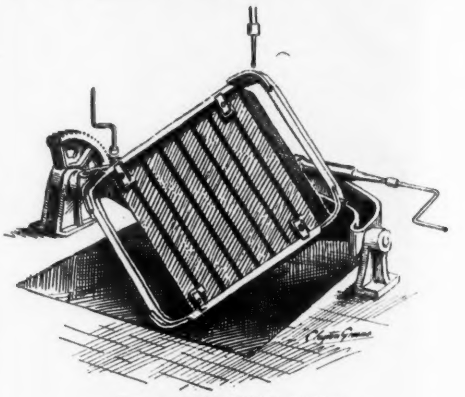


Fig. 13—TURNABOUT TABLE

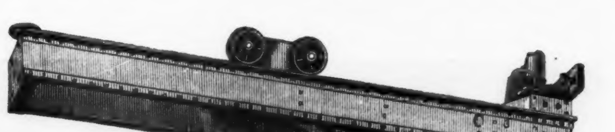


Fig. 8—HYDRAULIC CRANE ON TWEDDELL'S SYSTEM

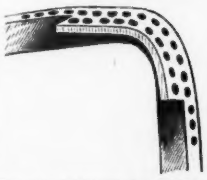


Fig. 14—CORNER OF FOUNDATION RING

They have been designed by Messrs. Sharp, Stewart, specially for cylindrical work, and there is a special arrangement for removing one of the bearings of the top roll to allow of the withdrawal of the plates when they have become cylindrical. This is clearly shown in Fig. 10. The rolls are arranged pyramidically, and take plates up to an inch in thickness and 9ft. in width. The two lower rolls, which are 11in. in diameter, are geared together and driven by spur-wheels, the top roll, 13½in. in diameter, being free and adjustable vertically. A clutch is provided to raise or lower one end alone, for conical rolling, the steps and bearings of the top roll having balls and sockets to allow of this movement. For cylindrical work one of the top roll bearings can be slid, by means of a hand-screw, on to a swinging frame, leaving the end of the roll unsupported. This frame, in order that it may be got clear of the roll plate when being withdrawn, is pivoted in such a way as to enable it to be turned temporarily into a horizontal position, the weight of the top roll being taken in the meantime by the adjustable carrier at the right-hand end.

Near is a useful boiler-drilling machine by Kendall and Gent, which we illustrate in Fig. 11. In these machines four drills can be advanced or withdrawn simultaneously through precisely the same distance no matter at what angles their spindles may be set, the rate of advance being at a suitable speed for drilling, while the return of all the drills is almost instantaneous; the two drills pointing truly to the centre of the boiler, having adjustment for varying their distance apart to suit the different diameters of shells and varying pitches of rivets. The drilling spindle has at the opposite end to the drill a square-threaded screw cut upon it, and upon this is mounted a circular nut. If the nut were revolved at the same speed as the spindle, no advance of the drill would be made. If, however, the number of revolutions of the nut be diminished by differential gearing, the drill can be advanced at any determined a speed. On the spindle is mounted also a sleeve with sliding key, which latter acts as driver of the gearing for the nut when the drill is advancing. The connection between the sleeve and the first driving pinion is so formed by a spring catch that it will drive the revolving nut when the spindle is running in one direction only. Hence, when the direction of rotation of the drill spindles is reversed the nuts remain at rest, and the spindles are withdrawn at a speed due to the full pitch of the screw. When the machine is in action, the uprights are rigidly bolted to the longitudinal bed carrying the table; and vertical slides on the face of each upright allow of the saddles being simultaneously raised and lowered by power, for different heights of rings or when drilling the butt seams. Each drilling saddle carries two heads, the spindles of which can be adjusted to any angle by right and left-hand screws, so as to point to the centre of a boiler of any diameter; and the centres can be adjusted apart to distances varying from 2in. to 5in., pitches below 2in. being drilled alternately. This is certainly an interesting machine, and especially noticeable for its rapidity; the best results being obtained by running the drills at as high a speed as 215 revolutions per minute, and advancing at the rate of $1\frac{7}{16}$in. per minute in $\frac{13}{16}$in. holes, four holes being drilled at the same time. With $\frac{15}{16}$in. holes the machine is capable of drilling $1\frac{7}{32}$in. per minute, the drills running at the rate of 185 revolutions per minute. The machine will take shells from 2ft. 6in. to 5ft. in diameter, and rings made from plates up to 7ft. wide.

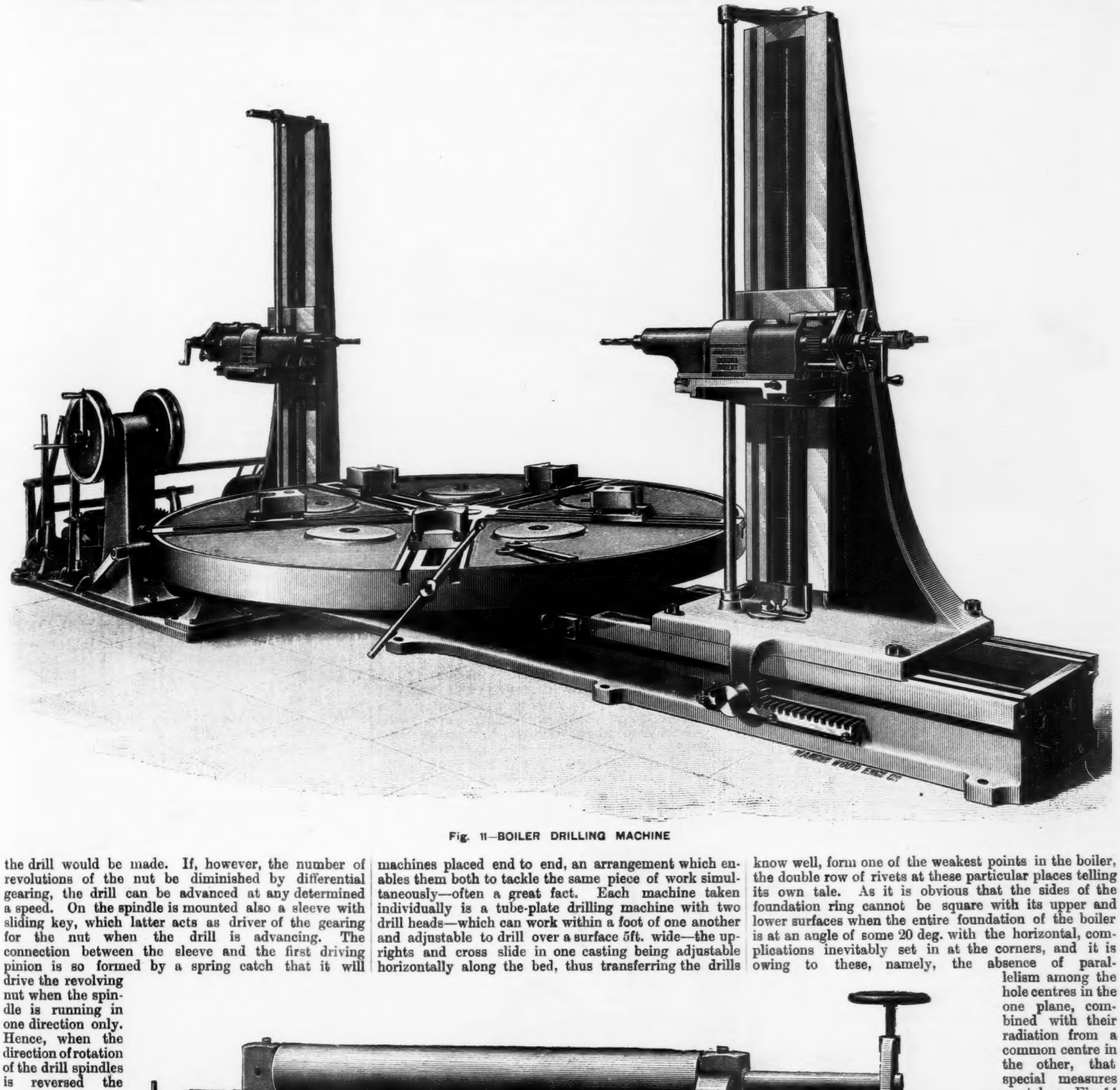


Fig. 11—BOILER DRILLING MACHINE

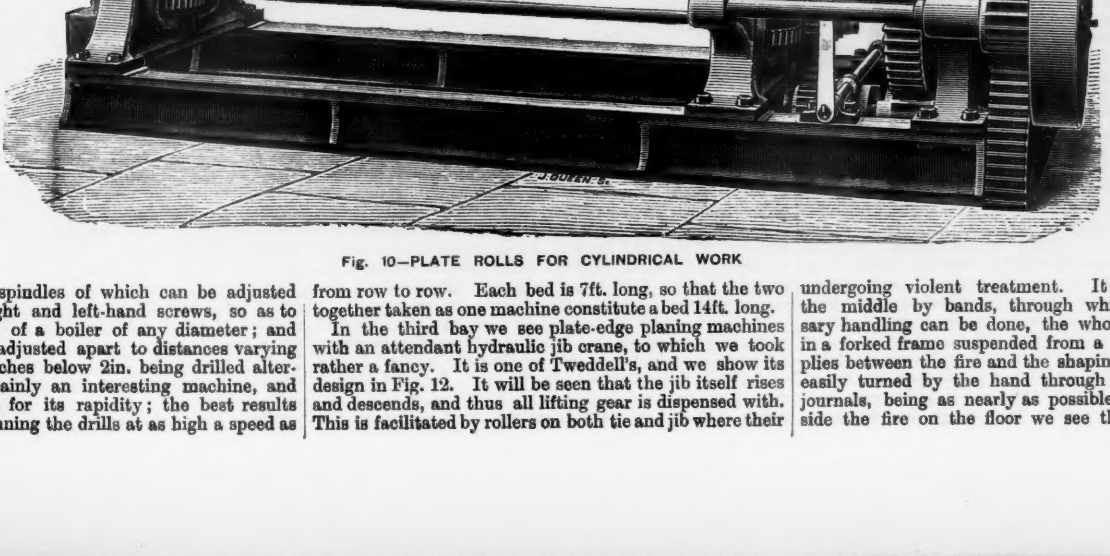
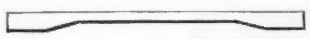


Fig. 10—PLATE ROLLS FOR CYLINDRICAL WORK

We have now come to the end—the far end according to Fig. 7—of this bay, and here we find what appears at first sight a heavy machine, but in reality consists of two machines placed end to end, an arrangement which enables them both to tackle the same piece of work simultaneously—often a great fact. Each machine taken individually is a tube-plate drilling machine with two drill heads—which can work within a foot of one another and adjustable to drill over a surface 5ft. wide—the uprights and cross slide in one casting being adjustable horizontally along the bed, thus transferring the drills from row to row. Each bed is 7ft. long, so that the two together taken as one machine constitute a bed 14ft. long.

In the third bay we see plate-edge planing machines with an attendant hydraulic jib crane, to which we took rather a fancy. It is one of Tweddell's, and we show its design in Fig. 12. It will be seen that the jib itself rises and descends, and thus all lifting gear is dispensed with. This is facilitated by rollers on both tie and jib where their stresses come on to the crane post. The vertical columns serve as guides for the cylinder, which is placed between them and forms part of the crane post. Further on are several more drilling machines—one having a turnabout table of a type which we do not remember having met with before. It is shown in the sketch, Fig. 13, with a foundation ring clamped to it for the purpose of drilling the rivet holes, which become a little troublesome at the corners owing to the nature of the ring. Fig. 14 shows one of the corners, which, as all locomotive engineers know well, form one of the weakest points in the boiler, the double row of rivets at these particular places telling its own tale. As it is obvious that the sides of the foundation ring cannot be square with its upper and lower surfaces when the entire foundation of the boiler is at an angle of some 20 deg. with the horizontal, complications inevitably set in at the corners, and it is owing to these, namely, the absence of parallelism among the hole centres in the one plane, combined with their radiation from a common centre in the other, that special measures are taken. Fig. 14 pretty well explains itself, the only thing which is hidden being the worm and wormwheel immediately at the back of the table, which turns the table proper in a plane at right angles to the plane of rotation of the carrying frame. This machine was made by Fairbairn, Naylor, and Co.

The remaining bay is the boiler smithy. We are attracted by a glowing dome undergoing violent treatment. It is gripped about the middle by bands, through which all the necessary handling can be done, the whole being journalled in a forked frame suspended from a jib overhead, which plies between the fire and the shaping block. It can be easily turned by the hand through extensions of the journals, being as nearly as possible balanced. Alongside the fire on the floor we see the set-plate, which represents for the time being the boiler shell. It is made fast to the ground, as shown in sketch, Fig. 15, and the set of the dome flange is being continually tried thereon. Those which we saw treated were for the Rhymney Railway locomotives, without the usual angle iron at the crown, the dome being flanged instead. This is rather a difficult piece of work, the actual flange being thicker than the dome plate in view of its having to carry studs. The thicker flanges are obtained in this case by utilising special "thick-edged" plates rolled by some of the best Yorkshire houses, their section being shaped as shown in cut. The plate is first welded into a cylinder, and the flange then formed by bending the plate inwards all round. There are a good many domes lying about, presenting various forms which are shown in Fig. 16, and is an instance showing how much superior a class of ability is needed in the employés of a firm conducting general locomotive work, and prepared to make locomotives to any design or pattern than is needed in a railway company's works, where the standard patterns are rarely departed from.



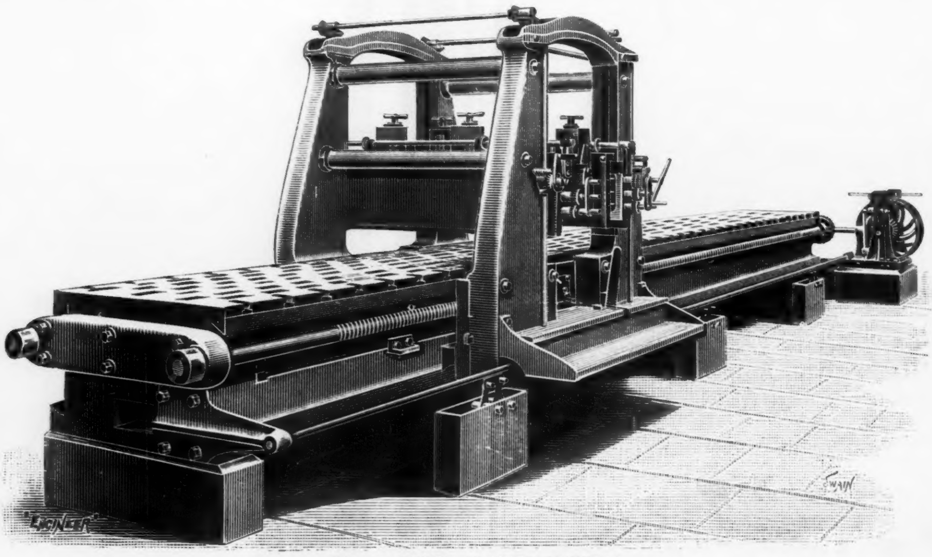


Fig. 31—FRAME PLANING MACHINE

The plate bending shed presents no very novel feature. The hydraulic plant, that is the flanging press, is of the usual type; also the "flangers." We will not, therefore, weary our readers with a description of methods of such universal adoption, but will here confine ourselves to an illustration of the quick way in which light splasher boxes are turned out, such as are fitted inside tenders, whose opposite wheels are closer together than are the opposite sides of the tank. It is the usual employment of male and female dies, as shown in Fig. 19. The finished article is shown below. Furnace fronts and tube-plates, &c., are flanged in the same machine, which is an ordinary Tweddell flanging press.

We now enter the extensive department in which the locomotive assumes definite shape, where all its parts at some period of their transformation receive treatment, and out of which the engine steams a living thing, ready for its trial run, complete in every sense but that of its final adornment of paint. This building consists of six bays, four of which approach 400ft. in length, the total width of all six being about 280ft. It comprises, as will be seen from the plan erecting, boiler mounting, frame, and heavy and light tool shops, which we shall proceed to deal with in the order just given. Fig. 20 gives a perspective view of the erecting shop as we enter it. Overhead are two travelling cranes, by Craven, of 30 tons capacity, driven by rope gearing. We may here briefly allude to the peculiarities of the crane-driving arrangement, which serves for the adjacent two bays as well as that in which we now stand. A two-cylinder wall engine, with cylinders 9½in. in diameter by 18in. stroke, is coupled direct to a countershaft running transversely across the three gables, from which the ropes of five cranes, capable of lifting in all 95 tons, take their motion.

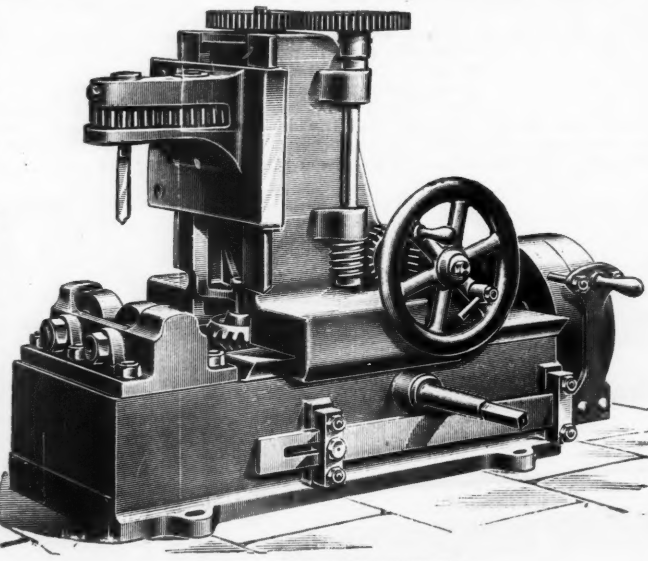
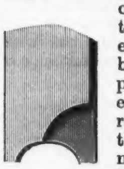


Fig. 30—TIRE DRILLING MACHINE

The driving ropes run 2000ft. per minute and pass from the countershaft partly round three grooved pulleys, on the crane headstock, from which the three motions necessary to the crane are taken. Besides these, hydraulic jib-cranes, situated at intervals along both sides of the shop, are very convenient; these are on the same principle as that of the rod type which we saw in the boiler shop, that is, with regard to the raising and lowering of the jib. We might now find ample pretext for devoting many pages to a treatise on the arts and mysteries of locomotive-erecting. But, to do this, two things are wanting, namely, space and something new to say. Even were the first secured, we could not guarantee the second, seeing that we have quite recently published an exhaustive series of articles on "The Construction of the Modern Locomotive." At Sharp Stewart's, ordinary practice is not departed from to any extent. We shall, therefore, confine ourselves in the main to describing what the place is like—leaving wider questions to articles of a different nature. At the vices, where the men are chiefly engaged in fitting and finishing axle-boxes, we were shown a special tender axle-box, which has been adopted by Mr. Jones for the Highland tenders, and which we endeavour to elucidate in Fig. 21. The object sought in this device is the quick withdrawal of the brass, only the removal of the front cover being required besides the usual lifting of the box. When the weight is thus taken off the brass, it remains behind on the axle, and with it the wrought iron block or distance piece, which lies on the top of the brass. This wrought iron block is slightly recessed into the top of the box itself, and so can only be withdrawn when the brass has fallen. The brass can then be lifted clear of the collar of the axle and taken out.

It is noticeable that the old horn-block is being superseded in the case of the Midland and Great Northern Joint engines by cast iron guides, with chilled cheeks, shown by A A in Fig. 22, the axle-box being case-hardened. We understand that the Midland Co. is alone in adopting this. Where the horn block is used, it is now almost invariably of cast steel. The appearance of these frames sets us thinking of the past—reminding us of the picture of the Sharp, Roberts' frame, which we reproduce in Fig. 23, to be seen in the earliest works on the locomotive. The form was originally designed to dispense with the use of long axle-box guides, which were necessary for the carrying wheels when the frame had no curvature—the frame in a sense accommodating itself to the axles. The design was considered then, so the books say, to unite strength with elegance, which latter qualification the other frames, such as Stevenson's and Bury's, were supposed to lack. This modern frame is obviously a survival of the old design. Another peculiarity which we noticed in these Midland and Great Northern Joint engines lies in their boiler lagging. The Midland Co. employ silicate cotton for this purpose exclusively.

We must pause a moment to look at a portable tool which appears more than usually convenient; this is a key-grooving machine, which we illustrate in Fig. 24. As might be at first surmised, the disc here does not revolve on a fixed centre. The crank-pin, therefore, does not rotate, but simply vibrates on the fixed centre at the other end of the link, which centre is mounted on an excrescence on the bed of the machine. It is obvious, therefore, that if the disc is caused to rotate its centre must reciprocate; consequently, the entire sliding headstock on which this disc is journalled reciprocates, the length of the travel being variable by means of the slot on the disc. The disc receives its motion from the pulley-shaft through elliptical gearing, to ensure uniformity in speed of transverse, all being contained inside the head. The driving pulley in the shop shafting is, of course, wide enough to allow the belt to traverse with the reciprocation of the tool head. The cutting is on the principle of the slot-drilling machine. The nature of the tool employed is shown in the accompanying cut.



If we now pass through the line of columns at our right hand, we enter the next bay, which is divided into two departments—viz., frame shop, where we now stand, and the boiler-mounting shop, which is at the far end. In the former—see Fig. 25—are seen engine, tender, and bogie frames, receiving such fittings as axle-box guides and brasses, stays, &c., this being their half-way house, so to speak, between the machines and the erecting shop. Among the tools here is a portable hydraulic riveter, which is most useful for light work in connection with the frames. We see it riveting the angle-irons on to cross-stretcher plates for both engine and tender, and small gussets, such as B B in Fig. 22, which represents the back end of one of the Midland and Great Northern Joint frames as we saw it in the erecting shop.

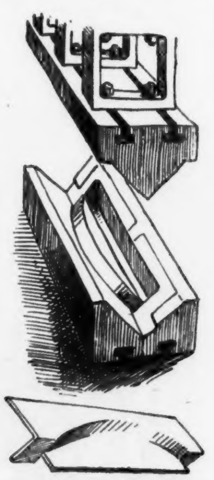


Fig. 19—Splasher Box Mould and Finished Article

A row of six of the firm's jib vertical drilling machines are evidently taking the overflow work from the frame-drilling machines in the next bay, which they do perfectly well, besides being useful for all sorts of heterogeneous work.

Passing up among the frames we once more find ourselves in boiler-land. Besides the addition of their mountings, the boilers here receive their fire-box stays, with the assistance of hanging portable rimer and tap rotators, of which we give a small sketch, Fig. 26. They can be seen in our view of the boiler-mounting shop, Fig. 27, where they are at work on one of the Midland and Great Northern Joint locomotives. This tool is doing the work at a great rate, and can be transferred from hole to hole with the utmost ease, a balance weight keeping the driving rope in tension under all conditions of working.

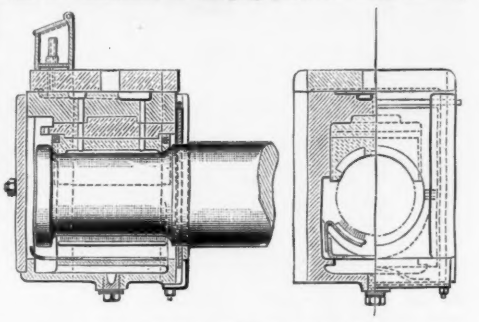


Fig. 21—SPECIAL TENDER AXLE-BOXES

We can now turn to what is perhaps the most interesting part of the works, namely, the heavy tool shop. It is so on account of the variety of machines which it contains and their special features.

The shop consists of the entire length of Bay No. 3, and, like the last, includes two departments, namely, that for general heavy work and the wheel department. We shall commence with the latter, it being the nearest. Figs. 28 and 29 are two views of the shop. In Fig. 28 we are looking up the shop, that is to the north-west—see plan—and in Fig. 29 to the south east. Proceeding upwards, therefore, the vertical wheel-boring machine on our left—see Fig. 28—first engages our attention. As can be seen from Fig. 28 this machine has two tables, one for driving wheels, the other for carrying wheels. The wheels, when bored, are transferred to the hydraulic wheel presses alongside. These cannot be seen in Fig. 28, being right in the left-hand corner. The lathes here seem to be mostly by Shanks and Whitworth. On the right are three large wheel lathes, about which we do not remember seeing any unusual features We observed, however, that the firm no longer turn their crank axles themselves, but buy them finished. Many makers of crank axle forgings have plant for turning them now. It is purely a question of convenience. Further up on the left is a milling machine, originally designed by Craven Bros., for milling crank bosses, with an ordinary milling cutter, 4in. diameter, having coarse-pitched teeth; but in consequence of the growing disuse

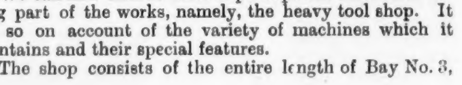


Fig. 23—OLD SHARP-ROBERTS' FRAME

of wrought iron wheels, the machine has lost much of its importance, the cast steel wheels not requiring any treatment in this respect. The machine is, nevertheless, still found useful, particularly for circular work, the table being adjustable in order that boss work of any kind can be placed central with the circular motion; there being also compound self-acting slides to mill in a straight line, which are, of course, useful in rounding-off connecting or coupling-rod heads. Crossing the bogie railway we come to two tire-drilling machines on the right, the firm's own make. We illustrate one of these in Fig. 30. This machine is drilling holes 1in. in diameter and 3in. deep in the tires of wheels from the inside of the rim, the drilling head being carried on vertical vees in a headstock capable of horizontal adjustment. Opposite to this machine is a quartering lathe by Whitworth for boring crank-pin bosses at right angles to one another—or in other words, at quarter centres—also for turning crank pins. The machine is enabled to bore conically by means of a short boring bar carrying an inclined slide, along which the tool is fed by means of a pair of bevel wheels, the adjustable spindles of the machine having self-acting feeds for boring, turning, or screwing. It is a heavily-built machine, and will take wheels up to 8ft. in diameter, on axles over 8ft. long, with crank throws as long as 2ft. 2in. Two wheel-slotting machines—Webb's patent, which can just be seen under a pile of crank-axles—have fallen into almost entire disuse, owing to the cast steel wheel centres not requiring this treatment.

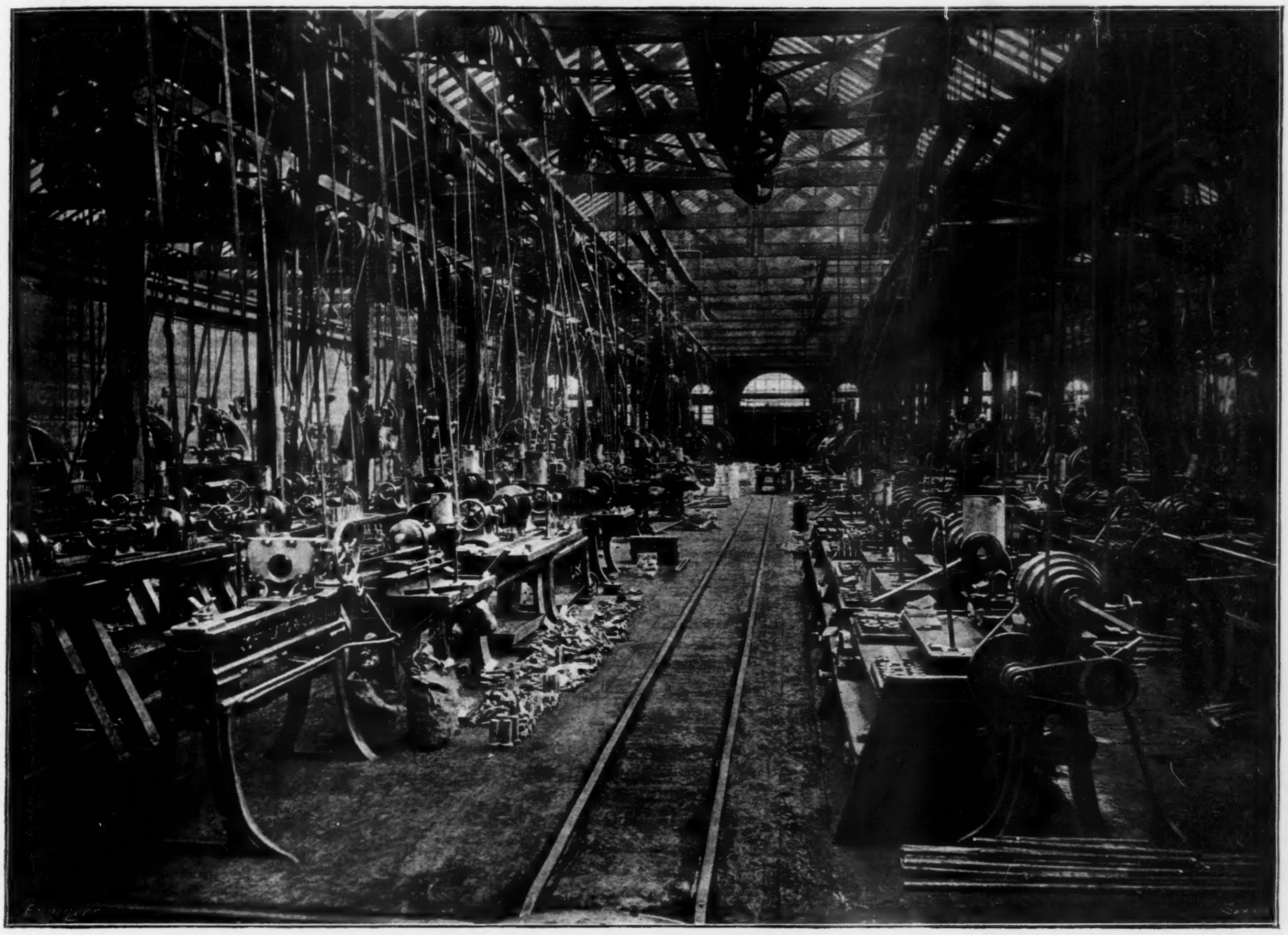


Fig. 37—LIGHT TOOL SHOP, BAY NO. 5

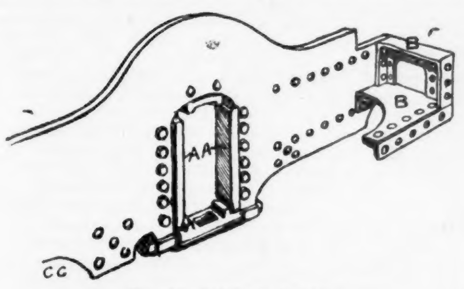


Fig. 22—EMBRYO FRAME

With respect to crank pins, it is noticeable that there is some difference of opinion with regard to the method of securing them to the wheels. For instance, we observe that the Joint Midland engines have pins of uniform diameter where they pass through the wheel, with a shoulder, while the Highland engines have the usual conical pins. The Midland Railway Co. is the only company we know of in this country which prefers parallel sides on crank-pin seatings. They are forced in by hydraulic pressure and riveted over. Another lathe here, by Whitworth, is turning the bosses of wheels, for which purpose it has a special gap, admitting wheels up to 8ft. 4in. diameter. The wheel to be bossed is placed on a mandrel which revolves in bearings, the lathe centres taking the end thrust occasioned by the tool in cutting, the mandrel being driven from the face-plate by a carrier. There are four rests, which are all under control from whichever side of the lathe the workman chooses.

Now we come to the large machines specially designed for dealing with frames. The first of these is on our right, and is a frame-drilling machine by Shepherd, Hill, and Co., having three drilling heads, tackling sometimes over six frames at once, one above the other. The table measures 36ft. by 5ft. Opposite to this machine is a duplex frame-planing machine by Craven, a splendid tool, shown in Fig. 31. It will plane work 30ft. long by 5ft. wide, admitting 2ft. under the cross slide. The frame, consisting of four standards, is actuated by two screws, one at each side of the bed, geared together by mitre-wheels, each pair of standards carrying a cross slide with self-acting tool boxes for vertical, horizontal, and angular cuts, each of which boxes may carry several tools. When the standards are travelling one set of tools is raised from the work, the other set coming into play on the reversal of the direction of travel. Both time and space are thus saved, the former by uninterrupted cutting, and the latter by the avoidance of a table traversing a distance double its length. The entire machine weighs thirty-three tons. Opposite is a huge machine, which we do not illustrate, for the excellent reason that we have already done so in a previous issue. It is a frame-slotting machine by Craven, and will be found fully illustrated and described in our issue of November 23rd last. It is also discernible in the view of this end of Bay No. 3, given in Fig. 29 on P. Its bed is 36ft. long, admitting work 5ft. in width. The stroke of the tool head is adjustable to 15in.

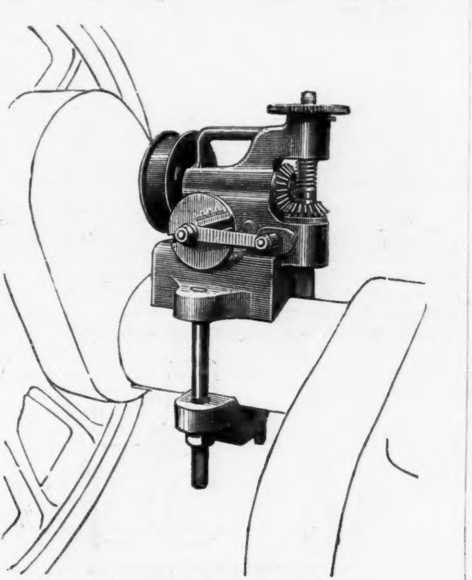


Fig. 24—PORTABLE KEYWAY CUTTER

On the left-hand—opposite Craven's slotter—is a number of small drilling machines, some of the firm's own make, others by Harvey, of Glasgow; also a brake lathe by Hetherington, Manchester. Further down on the right are four planing machines, including a special machine by Craven, designed to plane both ends of connecting or coupling rods simultaneously, suited also to slide bars, axle-boxes, or any motion work where there is repetition. Its difference from ordinary machines lies in the fact that the table travels in both directions at the same speed, there being two pairs of standards, and therefore two cross slides. The table has adjustable stops for various strokes, and takes work up to 10ft. in length and 4ft. in width, admitting 2ft. under the cross slides.

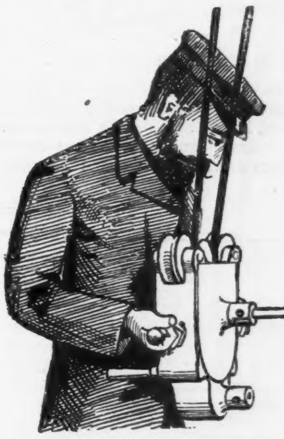


Fig 26—RIMING AND TAPPING TOOL

The three other planing machines here are all by Sharp, Stewart, and Co., and have the diagonal worm shaft for driving the table, which is perhaps the chief characteristic of their machines. This is made clear by the diagram—Fig. 32—the object being a straight thrust from the surface of the worm-teeth in the direction of the resistance. The worm gears into a machine-cut rack, and is running constantly in an oil well. We ought not to pass these planing machines by without an allusion to the firm's patent feed motion—Robinson and Oldfield's patent. It has more than one feature to recommend it, and should therefore be known. We must here, having due regard for the patent obtained for this device, confine ourselves to stating that there is a cam enclosed in a box which is caused to turn at the end of the return stroke so as to put on the feed then, the travel of the table necessary to do this being no larger than that demanded by the ordinary feed motion, and there is no drag of the tool over the work during the feeding.

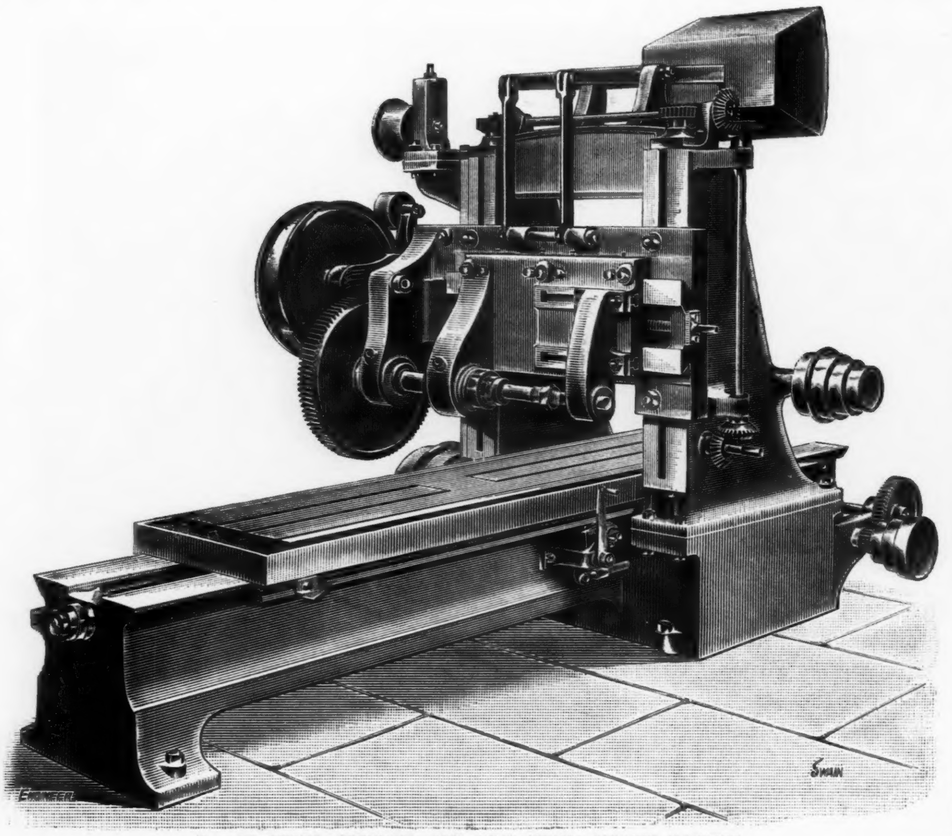


Fig. 35—SHARP, STEWART, AND CO.'S HEAVY MILLING MACHINE

Passing by a cluster of machines of various kinds, we cross over into Bay No. 4, and shape a south-easterly course. This is the light tool shop, as shown in Fig. 33. It must be understood that this photograph is taken looking in the opposite direction to that in which we are now moving; therefore what is seen in the foreground we shall not deal with—till we get there. The travelling crane, which runs on one rail the complete length of the shop, is by Craven. We give a sketch of it in Fig. 34. The crane is guided at the top by two light rolled steel girders carried by brackets attached to the roof principals. The bottom carriage and crane are carried by two double-flanged travelling wheels. The jib can swing right round. All the motions for lifting, lowering, and traversing are derived from an endless rope running the length of the shop, which, guided by the jockey wheels at the top, drives a vertical shaft down the centre post. This shaft has a pulley near the top, which drives by an open and cross belting the lifting gear, and another pulley near the bottom which drives the travelling wheels in the same way. These are all under the control of the crane man by hand wheels. This crane will lift five tons. The plant here consists, firstly, of three cold saws by Butterfield, and several most useful grinding tools. One of these, by Craven Brothers, is especially worthy of mention. When we saw it it was at work on case-hardened driving-wheel axle-box cheeks, but is useful for flat surfaces of any kind, such as slide bars, slide valves, &c. Its feature consists in the transverse reciprocation of the wheel while the work is passing, and as the stroke of the table and transverse stroke of the wheel do not synchronise, it follows that as the work proceeds the wheel engages with the entire surface to be treated in both longitudinal and transverse senses, the resultant path of the tool over the work being semicircular.

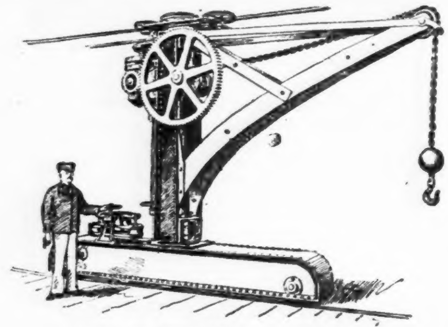


Fig. 34—TRAVELLING JIB CRANE

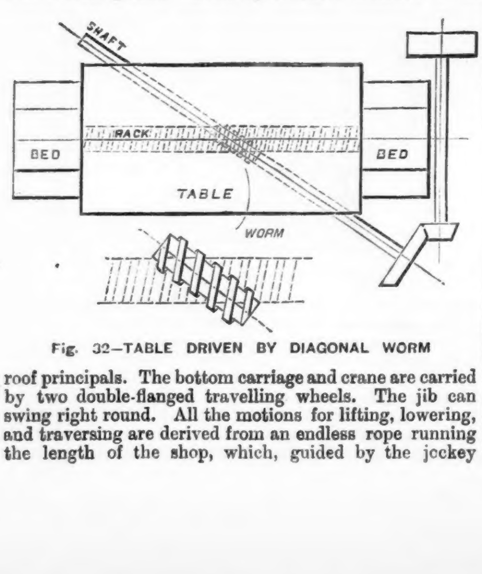


Fig. 32—TABLE DRIVEN BY DIAGONAL WORM

These driving-wheel axle-boxes are ground also on their inner sides, and are expeditiously done, two at a time on a reciprocating table, two emery wheels engaging alternately, one with the lower the other with the upper portions of their respective axle-boxes. At the end of each stroke a stop engages with a cam, which throws the belt over and reverses the motion in the ordinary way.

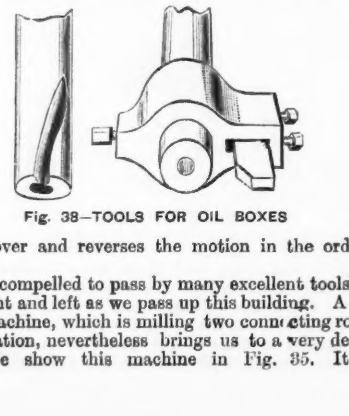


Fig. 38—TOOLS FOR OIL BOXES

We are compelled to pass by many excellent tools both to our right and left as we pass up this building. A large milling machine, which is milling two connecting rods at one operation, nevertheless brings us to a very decided stop. We show this machine in Fig. 35. It has been specially designed for forged steel work, and is therefore of a massive character. Some idea of its size may be conveyed by the fact that it admits work as wide as 3ft. milling a length of 10ft., and taking cutters up to 1ft. in diameter, and the extreme distance from top of table to centre of spindle is 2ft. 8in. The spindle is 5¼in. in diameter at front end, and has a removable outer bearing necessary for taking out the cutter, mandrils, &c. The table is driven by a screw, and has automatic knocking-off motion at any part of its stroke. A pump is attached, which throws lubricant on the cutter—an indispensable item. This is another machine which is "home-made" only, of course, in the literal sense of the phrase.

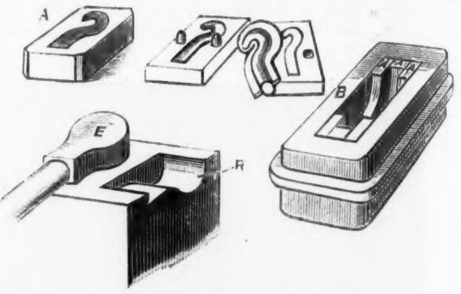


Fig. 40—MOULDS AND DIE BLOCK

Opposite is an axle lathe by Thos. Shanks and Co., Johnstone, fitted with breast slides at the front of the bed, on which are fitted the saddles which carry the slide rest. This enables the turning tools to completely traverse the shortest journal without obstruction. The centres do not overhang the loose headstock, and are very sturdy to resist the pressure of the cut. One of the loose headstocks, as in many axle lathes, is balanced, and can be swung out of the way, thus facilitating the withdrawal of the axle. The bed of this machine is 12ft. long and admits axles up to 8ft. long, the centres being 13in. above the bed. We were told that this machine will easily turn the two wheel-seats, two journals, and the two collars of an ordinary axle in nine hours.

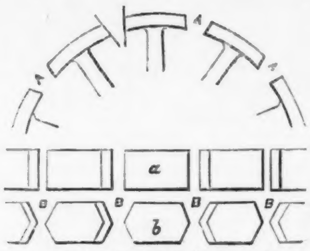


Fig. 41—WROUGHT IRON WHEEL FORGING

Beyond are a number of planing machines of various shapes and sizes, some by Hulse; another duplex planing machine, by Craven, similar to that already spoken of in the heavy tool shop; an axle-box planing machine, by Shanks, which is well worth mention on the score of its convenience. It carries eight tool slides, or four on each of two cross slides, which are supported by common standards. It is a squat-looking affair, only admitting 1ft. 6in. below the slide, and has, generally, regular bull-dog qualities. The table, which measures 10ft. by 4ft. 6in., is driven by a screw of large diameter and can plane twenty-four axle-boxes at once, *i.e.*, four rows of three boxes at each end. Each tool slide is self-acting and independent—horizontally and vertically.

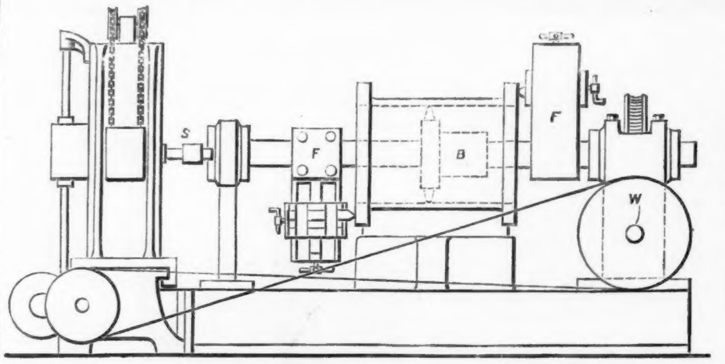


Fig. 36—CYLINDER BORING AND FACING MACHINE

A collection of horizontal boring machines give us an idea of the amount of work in hand, showing as they do the large number of cylinders undergoing a refining process, so to speak. One of these machines which is facing both ends of a cylinder at once, having already bored it, we illustrate in Fig. 36, as we consider it a most useful combination. It is by Craven Brothers, and has a boring bar 7in. diameter centred 2ft. from the table. The bar carries three tool heads, two F F being facing arms. The boring head B carries three tools. There is, besides, a boring spindle adjustable vertically and horizontally in a cast-iron standard, which is used for boring valve spindle holes or drilling ends of cylinders when cast in one with the barrel. The bar is driven by worm gearing at W.

The second light tool shop—of which we give a view from the north-west end, Fig. 37, p. 517—contains a collection of small machines of the stud lathe, and nut-facing order; also some brass-milling and nut-tapping machines by the ubiquitous Craven Brothers—what might be termed the *profanum vulgus* of machine tools. Two double spindle vertical drilling machines, bolted back to back on the shop columns, each consisting of a slide carrying two headstocks with a table below, are doing some interesting work on connecting and coupling rods, both ends of which are being drilled at the same time, a template bar being always used, which is a great safeguard against mistakes. This template is nothing much to look at—consisting merely of a wrought iron bar of something like 2in. by 3in. section—through which holes are carefully drilled to fit the drilling spindles at various distances apart. One bar will do for quite a number of different rods, and ensures great exactness when a large number of rods are centred alike. But what interested us most in connection with these machines, which are by G. and A. Harvey, Glasgow, was the method of drilling out oil cups in the heads of coupling or connecting rods. The drill used is of a special annular form, shown in Fig. 38. The hollow in the centre allows material to remain and form the feeding tube of the oil cup.

It will be seen that here again a difference of opinion is evident with regard to the shape of these oil-boxes, not so much with regard to the question of fitting a separate box as to the way in which the box, which is forged solid with the rod, should be finished.

Some rods, for instance, have a square box milled out, the cover being a separate piece, which is amalgamated with the sides by careful fitting and riveting over — others have the corners rounded off merely. Fig. 38 shows the form of tool employed for doing so. It is amusing, *en passant*, to watch the manipulation of the larger of the two quadruple tapping machines before alluded to. The hand levers which are fitted are clearly something more than their name suggests. They are levers of the second order, and in tapping nuts of, say, 1in. or 1¼in. it is vanity to suppose that this lever is to be used as a hand lever; far from it, it must be a body lever if that tap is to get started. So the operator thinks at all events, for he throws himself prone on to the handle feet off the ground, and there balances himself until the tap is started.

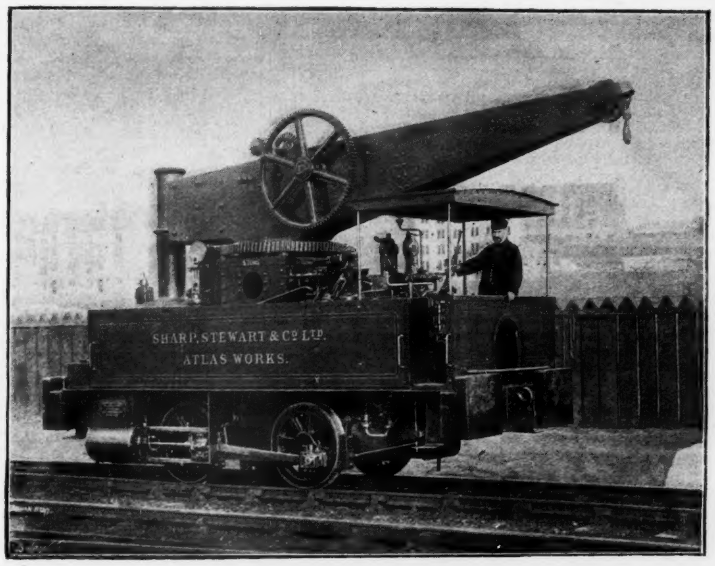


Fig. 44—WORKS' CRANE LOCOMOTIVE

We will not detain our visitor in the grinding or brass-finishing shops, nor in the store, where one merely sees the usual plant, but pass straight into the smithy, where we are immediately struck by its extent and the number of steam hammers it contains. The number of fires cannot be under forty-five, exclusive of the large furnaces which are eleven in number in a row on the south-west side of the shop, the largest measuring 12ft. by 7ft. As in all well-conducted establishments, the waste products from the large furnaces are utilised to supply steam for the hammers. Two locomotive boilers are used for this purpose fixed over the furnaces.

The hammers are by various makers, the largest, shown in Fig. 39 with quite a vista of hammers behind it, being by the late firm of Glen and Ross—now R. G. Ross and Son — Glasgow, and weighs four tons. This hammer is made under patents which Mr. W. Rigby, of Parkhead Forge, Glasgow, took out in 1854. They apply more particularly to the stuffing-box and frame than to the valve. Only one hammer was made by Mr. Rigby himself, who transferred the whole of his rights to Messrs. Glen and Ross, and probably made a very good thing out of it. These hammers have a peculiar feature which Mr. Ross added in the shape of an equilibrium piston valve, which effected quite a revolution in the mode of operation, as previously the cumbrous valve gear employed had been sluggish.

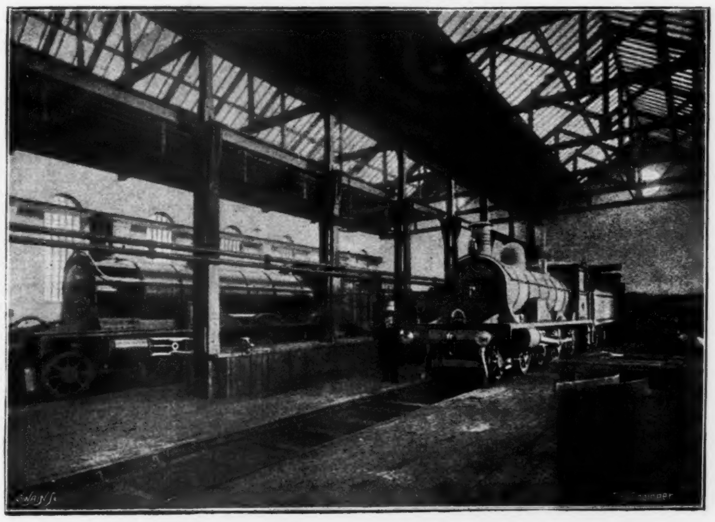


Fig. 45—PAINT SHOP

The principle of this valve is to take the steam from the lower side of the piston, after it has raised the hammer, and to utilise it on the upper side. Later a valve was added, whereby full pressure of steam could be admitted on the upper side of the piston, thus adding to rapidity of action and force of blow. The cylinder of this hammer is 29in. in diameter, with a fall or stroke of 5ft. The total height is 20ft. and the span 13ft. We had an opportunity of seeing this hammer doing some violent work on coupling cranks. Blocks of metal built up by the double faggoting process are brought under the hammer and driven into a recess, the shape of the web, in a cast iron block, reinforced by wrought iron bands, and is thus moulded into the required form. The overflow metal, or "fin," can be got rid of by forcing the metal out of the recess by means of wedges applied below, inserting another pattern-piece, dropping the metal into it with the "fin" resting on its upper surface, and placing a dummy crank web above the red hot crank web, which when struck by the tup drives the web through before it, and the "fin" takes a lasting farewell. In the same operation the metal is forced out to leave the pin and axle seatings, and the web is in about five minutes turned out a complete forging, the whole being done in one heat. This mould system is applied wherever possible, and is exceedingly quick, being of course especially valuable where a large number of forgings, identically alike, are required.

Take drag-hooks, as an example: these are, to begin with, forged into something very faintly resembling a hook, and quickly driven through a cast-iron pattern, something like A in Fig. 40. Then each is ready for the moulds B B in Fig. 40, from which it emerges, as shown, with the "fin" only remaining to be treated, which is quickly removed in the same manner as that mentioned in speaking of coupling cranks. We were shown an immense variety of these moulds, all displaying much ingenuity in their design. We cannot, however, afford space for more than one type. This is that shown in Fig. 40, which is used for the smaller sheaves of excentric pulleys, which are in most cases of wrought iron. The box B serves for many different sizes—by changing the pieces A, A, A, whose sides form the walls of the mould—the box B simply holding them together. This we think most ingenious—and commendable to all to whom a saving of time and labour is an object.

All hangers, brackets, details of motion work, &c., anything with a head of any shape are forged on the principle shown in Fig. 40, which is of course largely used, but we give this one illustration of it, as it is quite possible that some of our readers may not know of it. We are not writing solely for locomotive *savants*. E is to be an ordinary double eye. By alternately turning it over first on its face and then on its side in the recess R, while the tup comes down between every turn; the head is finished quickly and absolutely accurately. There can be no mistake about it. This principle can be carried out to any extent, a fact which Messrs. Sharp, Stewart, and Co. certainly recognise.

With regard to the steam hammers, we may here state that there are seven hammers by Glen and Ross of 4 tons, 2 tons, 12½ cwt., 6 cwt., and two of 5 cwt., and a horizontal double-ended "veeing" hammer. This last we should weep over, as it is now nothing more than a monument to the memory of wrought-iron wheels. It is useful now and then, but its glory has departed. To those who are not moved by this spectacle, we would point out that the process of "veeing" was, a few years ago, universally adopted for welding the rims of locomotive and other wheels after the arms had been welded at the centre. Fig. 41 shows what we mean, the spaces A, A, A, denoting where the V-pieces are to go. But we must here inform the reader that the term "veeing" did not arise from the fact that the pieces inserted at B, B, B, were shaped as V in the elevation, but because the older method was to fit in dovetailed pieces, as in *b*, below, the origin of the "vee" arising from the spaces B, B, B, being the shape of that letter.

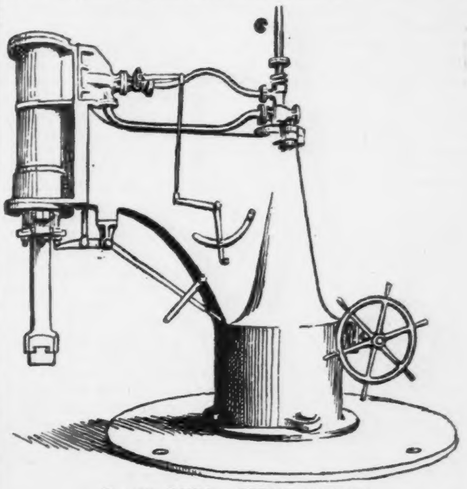


Fig. 42—RADIAL STEAM HAMMER

There are five hammers, by Harvey, Glasgow, of weights weighing between 12 cwt. and 5 cwt., two of Massey's varying 30 cwt. and 20 cwt., and a radial hammer, by Davis and Primrose. This is another relic of the past. Fig. 42 shows what it is like. The cylinder is mounted on a radial arm, which is free to revolve round a central post, the turning movement being controlled by a large star wheel. A most useful hammer this has been in its day. Its peculiarity lies in its capability of dealing with five or six anvils placed round it at once. Thus for the "scarfing" and "dabbing in" processes in wrought iron wheel work, the forging can be quickly transferred from die to die, the hammer following it, the hot forging being laid on each die in succession, thus undergoing a transformation. Usually a spoke can be completed as in Fig. 43 in one heat. But of course, for general die work, a good deal depends on the nature of the forging and the number of dies it has to pass through. Since, however, cast steel wheels have come so much into vogue, the radial properties of this hammer are rarely required.

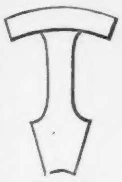


Fig. 43

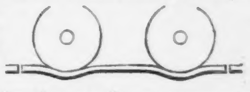
The iron and brass foundries are well equipped, but need not keep us. Readers can guess pretty well what they are like. All power is supplied by vertical wall engines, by J. Copeland and Co., Glasgow, placed outside the buildings, steam being generated by four boilers, by Messrs. Penman and Co., Glasgow.

These engines by Copeland formed subject for discussion in D. Kinnear Clark's work on the steam engine, as perhaps some of our readers know. Their peculiarity consists in their direct connection to the lines of shafting—the lengths of which vary from 180ft. to 80ft.

The crank shafts, and therefore the shafting, are 13¼ft. above the ground—the frame being rectangular, carrying the cylinder at the lower end. The shaft passes through the wall unconnected with any wall box. The cylinder is 16in. in diameter by 20in. stroke. The frame plate is bedded on oak and fastened to the wall with ten 1½in. bolts and cast iron wall plates of T section.

Fig. 44 shows a fussy individual, whose functions are of a most indispensable kind. As can be seen from the plan—Fig. 4—there are few places into which he cannot poke his nose, so to speak. He does hauling and shunting duties, and fetching and carrying of all kinds; a sort of works orderly. Messrs. A. Barclay and Son, Kilmarnock, supplied this engine. A fitting wind-up of the locomotive department is in the paint shop—Fig. 45—where two imposing Highland engines are being decently clad before being sent forth to cold and mountainous regions—and very beautiful clothing it is. This little picture—Fig. 45—perhaps will give the reader a better idea, at first glance, of the size of these engines than perhaps even our four-page supplement conveys.

The works are also intersected by a bogie tramway system. The turntables used in connection with these are of a sweetly simple description. Their charm lies in their ability to take the bogie without being adjusted to suit the lines. This is because they themselves have no lines or grooves—the wheels of the bogie simply falling into the corrugation as in the accompanying sectional diagram. One of these tables can be seen in the foreground of the light tool shop, Fig. 37.



The photographs we reproduce in connection with this article, were taken expressly for us by Messrs. T. R. Annan and Sons, of Sauchiehall-street, Glasgow.

We much regret that want of space compels us to hold over a number of illustrations of locomotives, representing Messrs. Sharp, Stewart, and Co.'s work both in the past and in the present. These, with an account of the machine tool department, which is also crowded out, we hope to deal with in a subsequent issue. We must here, however, take the opportunity of thanking all those who so kindly afforded our representative every facility, particularly Mr. J. F. Robinson, managing director, and Mr. John Sharp, jun., whose assistance we have highly valued.

## THE NIAGARA HALL ICE RINK.

Few of the most attractive of modern entertainments on the large scale, including the large theatres, would possess that attractiveness without the energising aid of the engineer. In some cases it would almost seem a degradation of the art of the engineer to employ it on such trivial or frivolous matters, but perhaps it is not more so than with the highest of the older arts, whose greatest aims are entertainment, more or less intelligent. At Paris there was the great tower of nearly a thousand feet in height, with lifts which taxed the ingenuity of the mechanician, there were the electrically illuminated fountains, the great wheel at Chicago, and others on which engineering skill and much energy and money were spent, and with one object, namely, to amuse and to make profitable employment for iron, steel, and brains, from the money people are willing to spend in being entertained by something which is not their work.

At Westminster the Niagara panorama has given way to a great rink, which will soon be completed, and provide a sheet of hard ice of about 112ft. in diameter, providing room for several hundred skaters at one time. The system upon which the rink is being constructed and equipped, namely, Uensold's, is a new one, and comprises several novel features. Hitherto the several ice rinks which have been made, including that which is so popular in Paris, have been constructed with concrete or other rigid floors for the ice sheet; in one of the first it was a cast iron tank floor. These floors are both rigid and costly, and the sheet of ice is costly to maintain, because of the heat conducted to it by these floors. The new floor is of wood plank laid upon iron joists, not too close together, and forming the roof or ceiling of a cold storage place below. Considerable flexibility in the floor is thus obtained, which is felt by those on the ice it supports, and as the ice sheet will be only about 5in. in thickness, it will in considerable degree behave like a sheet of natural ice. The boards are laid so as to be free to expand and contract, the joints being caulked and filled. The whole floor is covered with pipes of 2in. diameter and ⅛in. thick, arranged so that part or all may receive a full or partial supply of brine from the main, which is about 12in. in diameter. A total of about 30,000ft. of piping is now on the floor. The brine is cooled by three small size De La Vergne ammonia refrigerators, made by Messrs. Louis Sterne and Co., each capable of making 12 tons of ice per day, and when the ice is once formed one of these machines will generally be sufficient to maintain its low temperature and to provide for re-making the surface. The three refrigerators will be required to make the first ice sheet, and as the formation of this sheet will involve the making of about 260 tons of ice, the operation will take several days. Once the sheet is formed, about eight tons will have to be re-made per day to counteract the losses by wear and evaporation.

The refrigerators will be supplied with steam from two locomotive boilers by Messrs. Davey, Paxman, and Co., each capable of supplying 75 indicated horse-power to the engines of the refrigerators. The remainder of the refrigerator plant will be employed in maintaining the low temperature of a cold store of 60,000 cubic feet capacity below the rink and for making ice, the plant being capable of employment as may be most required either for the cold store, the rink, or for ice-making, or for all of these together.

The Niagara building was handed over to the builders for the modifications on the 24th of October, and it is expected that the formal opening of the rink will take place on the 5th of January next. There was a great quantity of material in the centre of the hall, which, as well as the material filling the space required for the cold store, had to be moved, and the progress has been so rapid that the whole of this has been done and the rink floor completed. The arrangements for heating the promenade of 14ft. in width which surrounds the rink, are also nearly completed. This promenade is separated from the rink by a strong iron rail about 3ft. high capped with wood, and from this hangs a blanket all round just touching the ice. Within this blanket the temperature will vary from 32 deg. near the ice to something more than that a little distance above, but outside this blanket in the promenade the temperature will be maintained at about 60 deg. There is also an upper promenade above that already mentioned. Messrs. Bramwell and Harris, MM. Inst. C.E., are the engineers for the whole of the works. The architectural work has been carried out from the designs of Messrs. Carslake and Mortimer. The rink is the property of the Niagara Hall Company, of which Mr. Hwfa Williams is chairman, the capital being only £42,500. The system of construction is similar to that of the Munich Rink, constructed by Mr. Uensold, but with several important improvements in details, and the experience with this has determined its adoption here.

---

The Preservation of the Propeller Shafts of Steamers: A Successful Invention. — It is now about two years since the first of the propeller shafts fitted with the arrangement devised by Mr. Mudd, of Hartlepool, for preventing their destruction by galvanic action and corrosion were sent to sea, and they are now rapidly coming in for examination. We are able to say that the device has so far proved entirely and absolutely successful in every respect, the shafts on examination having no trace whatever of galvanic action or corrosion, nor of the defects and decay that formerly so extensively resulted from these causes. As instances, we may mention the s.s. Guernsey, whose shaft has been running at sea for eighteen months since it was fitted with the preserver. This vessel had her tail shaft drawn at a dry dock in the Tyne recently, and the preserver pulled loose from its attachment to the shaft, when it was found not only that the shaft had been entirely preserved, but that the rubber sleeve itself had taken no harm and was capable of being cemented down again for a further period at sea. The s.s. Zanzibar, whose shaft was drawn at a dry dock in Cardiff, the manager of which writes saying he found it in perfect order, the sleeve having adhered splendidly to the shaft and retained its elasticity, forming a really good preservative, no corrosion whatever having taken place. The s.s. Elmville, which has during the present week been dry-docked at West Hartlepool, had her tail shaft drawn and examined after having been twenty months at sea, when exactly the same result was found. That is to say, the sleeve itself was in perfectly flexible and good condition, and when turned back from its attachment to the shaft, the shaft and the ends of the brass liners were found in the same perfect condition in which they left the lathe when new, having taken no harm whatever during the twenty months' work. The shaft was re-cemented and the preserver put down in its place again for continued use at sea. The best qualities of rubber retain their natural elasticity indefinitely when kept immersed in water and free from light and air, and these conditions are fairly satisfactorily fulfilled in the inside of a stern tube, so that the very conditions that were previously destructive to the tail shafts themselves are now those that are relied upon in this apparatus to keep the covering material in good condition.

---

# LETTERS TO THE EDITOR.

*(We do not hold ourselves responsible for the opinions of our correspondents.)*

### GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—To understand something which is new, not only by a mechanical detail, but also by its manner of action, it is necessary to have clearly in mind in what manner the usual electric regulations act. In Fig. 1, D is the dynamo, A B and C D are the mains. Connections from one main to the other by means of incandescent lamps, *a b c d*, or any other apparatus R are shunts, and the current in each of these connections is a shunt current, while the current from C through D to A is the main current. Now, if we wish that each lamp—for instance, *c*—should glow with the same brilliancy irrespective of the number of other lamps switched on, then we ought to have a constant voltage between the mains A B and C D. That, of course, implies that the mains are sufficiently large, so that the loss of voltage from A to B or C to D may be neglected. In a distribution at constant voltage, as is generally the case with glow-lamps, we must therefore distinguish the main current, or the current in the dynamo, which is essentially variable according to the number of lamps switched on from a shunt current which is or at least ought to be constant. Now in similitude to what is done with other regulators—for temperature, for speed, &c.—the electric regulator, such as Richardson's, for instance, is inserted there where the current ought to remain constant, thus in this case as a shunt, at R, Fig. 1, for instance. The regulator will now tend to maintain a constant current in R, and thus a constant voltage betwen A B and C D.

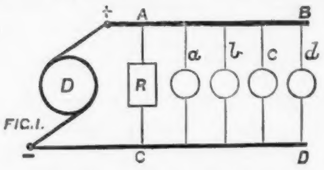


FIG. 1.

If the electric regulator R is inserted in the main current, Fig. 2, then it will evidently act so as to maintain a constant main current.

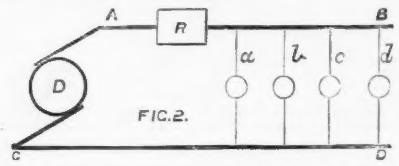


FIG. 2.

Suppose we have exactly the current which is wanted when only one lamp *a* is switched on. Now, if a second similar lamp *c* be added, then, as by the action of the regulator R, we have then again the same main current, we will have in each lamp only half that current. With three lamps each lamp will have only one-third the current we had originally in *a*. This arrangement of the regulator would be therefore entirely unsuitable for our purpose.

However, when we have arc lamps in series, Fig. 3, then we must insert the regulator R in the main current. This arrangement allows some lamps *c* and *d*, for instance, to be taken out of the circuit and then—of course when the circuit is closed again—the remaining lamps, *a c e*, will burn as before.

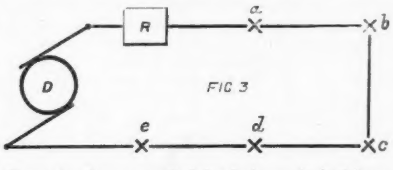


FIG. 3

The principle of the action of the electric regulator now in use—and which is, as said, the same as in regulators for temperature, speed, &c.—seems so natural and the only one possible, that the manner how the regulator must be connected to the circuit is often not, or not clearly, indicated. So, for instance, in the letter of Mr. F. Kadveitsch, on page 446 of your issue of November 23rd. We read there:—"The resistance of the main current (*sic*) is increased; consequently the voltage rises. The solenoid, being intercalated in the current, draws the iron core downwards." Though not decidedly said, it is obvious that the solenoid must be intercalated as a shunt, for when the voltage rises then the shunt current will increase, and thus draw the iron core downwards against the force of the spring, while the main current decreases when lamps are switched off.

We may therefore take it as settled that for a distribution at constant voltage the electric regulator must be inserted in a shunt, as in Fig. 1.

I may further state that any electric regulator should have, or at least should as nearly as possible approach to the following general properties: The movable part—and here I mean that part which is to be connected to the throttle valve or the expansion gear of the engine—should be at rest or in equilibrium for only one given strength of the current in the regulator. For if it could be in equilibrium for any other current, then it would evidently not move, and therefore not act to restore the original current strength, it would not regulate. Further, if there occurs an irregularity, then the movable part must move in a given direction, or in the reverse direction, according to the irregularity being above or below normal, and it should continue to move until the original current is restored, and then come at rest in its new position.

If we consider now my governing method, then we may state at once that in the case of a distribution at constant voltage, not any apparatus is to be inserted in a shunt current. Thus we see that Fig. 1, which I showed to be the only possible arrangement for a usual electric regulator in a distribution at constant voltage—for sake of simplicity we will only consider that case in the following explanation—is not applicable to my method:—Let we suppose a definite case. An engine driving a dynamo for a maximum of 50 ampères at 100 volts, and assume that each ten lamps of 0·5 ampères, each at 100, volts will correspond exactly with one actual horse-power.

Now, suppose ten lamps switched on, then the output of the dynamo is 5 × 100 = 500 watts, if we have the right voltage. According to our supposition we want exactly 1-horse power to give the required output, and if the the engine gives less, then of course the output of the dynamo must be less, and the ten lamps switched on will not receive the necessary voltage, say, only 90 volts. If the engine developes more than 1-horse power, then the output of the dynamo must be more too, and the lamps will get too high voltage, say, 110 volts. Now, to obtain 1-horse power we want to set the throttle valve—or expansion gear—T, Fig. 4, in position 1. If ten lamps more are switched on, then we want 2-horse power, and the throttle valve must be set in position 2. For thirty lamps 3-horse power are wanted, and the throttle valve must be set in position 3, or, in other words, when the throttle valve is set in such a position that the engine will develope 3-horse power, and if thirty lamps are switched on, then they will get the exact voltage, for as the dynamo receives from the engine 3-horse power, corresponding to an output of 3 × 500 = 1500 watts, and as each lamp takes 0·5 ampères, the voltage must necessarily be 100 volts.

But how will we know in the engine-house that 10, 20, 30, &c., lamps are switched on, and thus that the throttle valve must be set in positions 1, 2, 3, &c.? Or rather better, how will we obtain that the throttle valve is automatically set in the respective positions? Simply by inserting a suitable apparatus *v* in the main current, having a movable part which takes exact definite different positions, according to the different current strength corresponding with 10, 20, 30, &c., lamps in the circuit. I will discuss this apparatus further on, but to fix our mind, we may suppose it to be a wire coil or solenoid with iron core, the attraction being balanced in a suitable manner, by a spring for instance. Now, if this apparatus is so proportioned that the different positions of its movable part exactly correspond with the positions 1, 2, 3, &c., of the throttle valve, and if we connect that movable part to the throttle valve, then as soon as 10, 20, 30, &c., lamps are switched on, we will get immediately the required position of the throttle valve, and thus we will obtain for each number of lamps switched on the necessary horse-power, and therefore the required output and voltage from the dynamo.

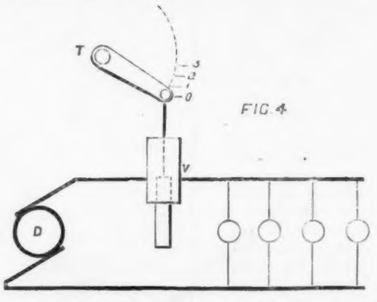


FIG. 4

You see that the electric connections for my governing method are similar to those indicated in Fig. 2. I showed that that arrangement is totally unfit for our purpose—constant voltage distribution—when a common regulator is used. It would therefore be nonsense to say that my method consists only in a change in the position of the regulator, for the apparatus V—Fig. 4—is not at all a regulator in the usual sense of the word. I showed before that the movable part of a regulator should only be at rest for a single current strength, and that if there occur an alteration, it ought to move in a given direction till the orginal current is restored, and then come again at rest in its new position. The movable part of the apparatus V, however, should only be at rest—or in a stable equilibrium—in a single position for a given current, and that position should vary in accordance with the current. The apparatus V could perhaps be named a "variator." I think it will be agreed that this state of stable equilibrium is much easier to obtain than the astatic movement in the common regulators, but perhaps it will be thought an insurmountable difficulty to obtain for each current exactly that position of the movable part required by the throttle valve. To this I may answer:—

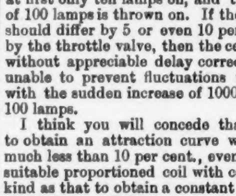


FIG. 5

(1) In the experiments in my laboratory, at the Polytechnical School in Berlin, at the laboratory of Professor Hospitalier, and at the Conservatoire des Arts et Métiers in Paris—reported by *l'Electrician* and *La Lumière Electrique*—I used the same coil, and had only to take a different iron core in some cases.

(2) There are a great number of electro-magnetic attraction apparatus from which we may take that which gives the most suitable curve. Moreover, we may also alter the movement of the throttle valve or expansion gear to suit the attraction of the variator, or a suitable mechanical device, such as a properly-curved excentric, may be used to transmit the movement of the variator.

(3) It is generally not at all necessary that the curve of the movement of the variator V corresponds exactly to that required by the throttle valve, as a relative large difference will only have a very small influence on the regularity of the engine. To explain this I beg it must be remembered that my governing method must be used in conjunction with a centrifugal regulator. Now suppose at first only ten lamps on, and that then suddenly the whole load of 100 lamps is thrown on. If then the new position of the variator should differ by 5 or even 10 per cent. from the position required by the throttle valve, then the centrifugal regulator will easily and without appreciable delay correct that, though it would be totally unable to prevent fluctuations in the light when it had to deal with the sudden increase of 1000 per cent. in the load, from ten to 100 lamps.

I think you will concede that it will not be a difficult matter to obtain an attraction curve with an approximation to within much less than 10 per cent., even without more complication than a suitable proportioned coil with core. The problem is of the same kind as that to obtain a constant voltage by the compound winding of a dynamo. Indeed, my method is for steam engine governing what the compound-winding is for dynamo governing, and just as a compound-wound dynamo will give a practically constant voltage, I maintain that only my method will practically prevent variation in the speed of the engine, while that is impossible with common electric regulators such as Richardson's, Willans', &c.

The Hague, December 1st. C. L. R. E. Menges.

### THEORY OF THE STEAM ENGINE.

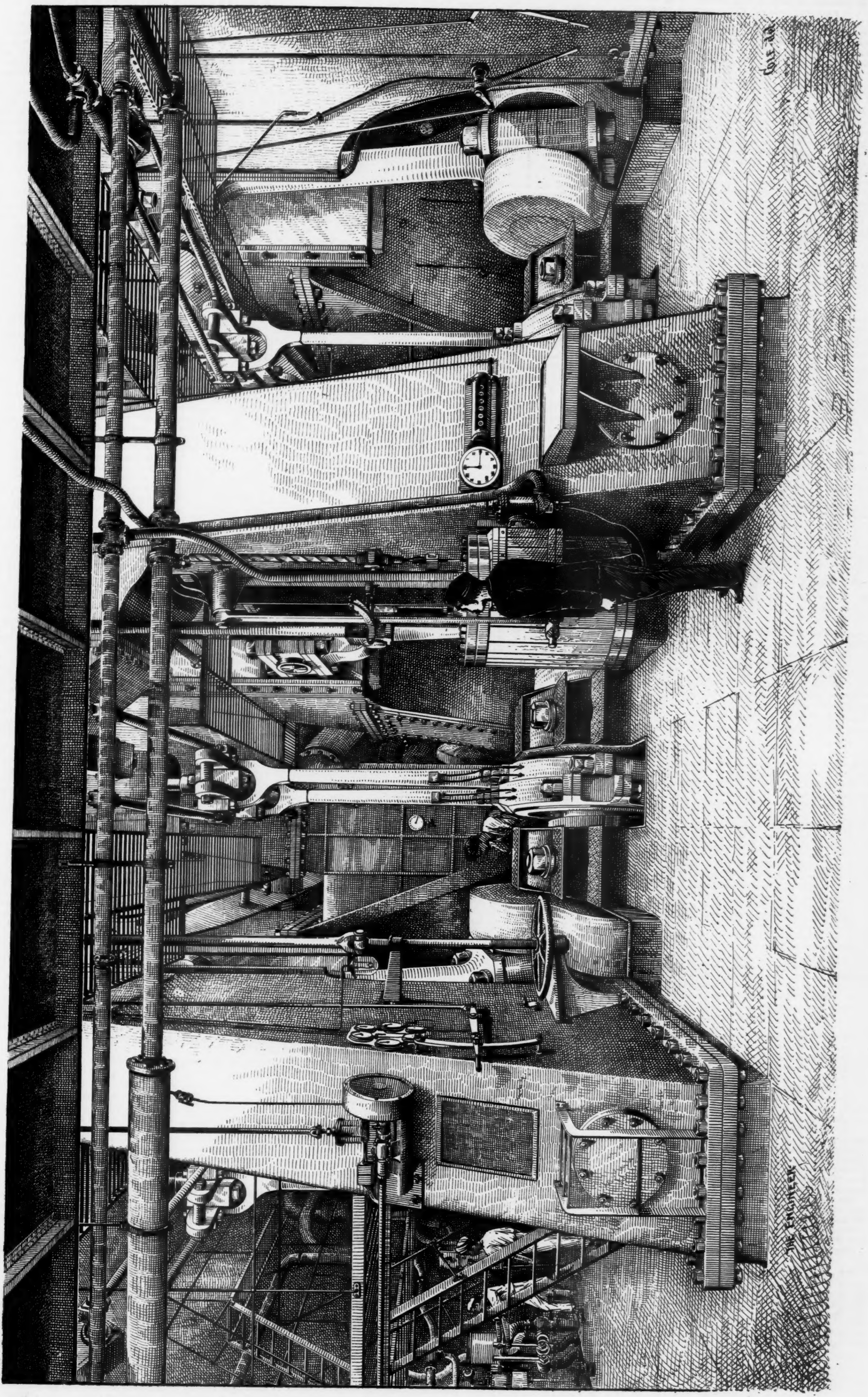
Sir,—In a former letter I gave Mr. Cross "three nuts to crack." Failing to "crack" any one of the three, he now writes a letter which he can hardly suppose I should consider a subject for serious reply. However, for the reasons mentioned in my letter appearing in your issue of the 30th ult., I will run it through as briefly as possible line by line.

(1) Will Mr. Cross refer me to any of my letters in which I have stated that "since the three angles of a triangle are equal to two right angles, therefore no heat engine can have a higher efficiency than that denoted by the fraction $\frac{T - t}{T}$?"

(2) He affirms that "the assertion that what is known as Carnot's theorem can prove of the smallest utility to inventors or designers of hot-air, steam, or gas engines is flatly untrue. Mr. Cherry ought to know perfectly well that it is untrue." Now this latter sentence appears to me presumptuous in the extreme. As a matter of fact, I have found the theorem of the greatest utility. Plausibly inventors frequently put forward preposterous claims to economy, which can be at once detected by a judicious application of the theorem. Hence, I have been able in several cases to prevent hesitating inventors by whom I have been consulted sacrificing their cash. You will doubtless remember a case in point, some years ago, in which an experimental engine was run on a "faked" brake.

(3) I am not aware that Mr. Cross has shown logically that "the fraction of the heat utilised in the cylinders of a good steam engine may be double that which, according to Carnot's theorem, it ought to be."

(4) He says, "I will go further, and challenge Mr. Cherry to prove." In point of fact, to prove that which I have distinctly asserted in my last letter is not proven. A very safe challenge surely, but, *cui bono*, if not to throw dust in the eyes of some of your readers.


COLE SC.
THE ENGINEER

IN THE ENGINE ROOM OF THE STEAMSHIP CALEDONIA—ON THE LOWER PLATFORM

*(For description see page 523)*

(5) He presents us with a long excerpt from the late Clerk Maxwell of respected memory, and appears to consider that an appeal to general experience is an inadequate form of proof. I think few physicists possessing the logical faculty will agree with Mr. Cross here. In the main, proofs of physical fact can be readily shown to depend ultimately on experience. In the present case, we have no experience on record of heat being conveyed from a colder to a hotter body without the expenditure of mechanical work. Does Mr. Cross consider that the universality of the law of gravitation throughout the visible universe rests on inadequate proof?

(6) As regards the three statements which he asks me to make. The first would occupy too much of your space and my time for categorical reply. The second would be answered in satisfying the first; and with reference to the third, I traverse the assertion made *in toto*. He then asserts that "no doubt his reply"—that is my reply—"will be that Carnot's theorem refers to a mathematical abstraction." This assertion again appears to me to savour of extreme presumption. My reply is nothing of the sort. I hope if Mr. Cross fails to appreciate my winnowing of his letter, the seed may not altogether fall on barren ground. He may note that Professor Smith even does not profess to defend him.

In the sentence of my letter appearing in your issue of the 30th ult., commencing, "Now, what Carnot's," &c., third line, "cannot" should be "can," and fifth line, "over the piston" should be "on the piston." Also, rightly or wrongly, I spelt such words as "cognize," "realize," &c., with a "z" and not an "s." HENRY CHERRY.

21, Festing-road, Putney, S.W.,
December 7th.

SIR,—It was Mr. Cross's letter of October 5th which gave rise to my letter of October 12th. It filled me with amazement to see that any one dreamed of obtaining greater efficiency than that indicated by $\frac{T - t}{T}$, where T and $t$ are the highest and lowest temperatures of the steam. This led me to think, and I still think, that such vagaries are greatly due to the slovenly teaching of thermodynamics in its application to the steam engine by writers on this subject.

Mr. Cross's letter in your latest issue, with his challenge to Mr. Cherry to find a flaw in his proof of October 5th, that the efficiency of a steam engine may be nearly twice as great as the theoretical efficiency, raised my curiosity to such a pitch that I took the trouble to examine Mr. Cross's proof carefully to see where the flaw is. The mistake is that he uses for the average pressure $\frac{150\,(1 + \log_e 10)}{10}$ —misprinted $\frac{150\,(1 + \log_e 2\cdot3}{10}$, which is the average pressure, on the supposition that the expansion is *isothermal*, and therefore that the steam is receiving heat from the cylinder while it is expanding, and this, of course, ought to be taken account of in estimating the efficiency.

Moreover, Mr. Cross uses 305·5 deg. Fah. for the temperature of dry saturated steam under a pressure of 150 lb. per square inch. Now, every book I have gives 358·5 deg. Fah as the temperature. On using this in the theoretic efficiency formula $\frac{T - t}{T}$, I get 17·7.

If Mr. Cross will calculate his mean pressure from $\frac{150\,(4\cdot29 - 3\cdot29 \times 10^{-\cdot304})}{10}$, which is calculated on the supposition of the expansion being adiabatic, he will get ·18, or 18 per cent. as his efficiency. As the work destroyed by the back pressure is omitted from the calculation, this is a little greater than the theoretical efficiency, 17·7 per cent.—see "Rankine's Steam Engine" §§ 297 and 298, and my treatise, pages 118-120. I am very much pleased with Mr. Cross's criticism of Maxwell's proof of Carnot's Principle —which is really Lord Kelvin's proof. I think Clausius' proof less objectionable. PETER ALEXANDER.

26, Smith-street, Hillhead, Glasgow,
December 10th.

### LOCOMOTIVES AND TRAINS.

SIR,—I am pleased to see that this matter has been so well taken up by your correspondents. I am strongly of opinion that our engines are being made too heavy in comparison to their boiler capacity. I cannot see the benefit of putting 19in. by 26in. cylinders in engines with only a little over 1000 square feet of heating surface, or even with 1200 or 1300 square feet.

The famous American engine, "999" has upwards of 1900 square feet, and still has cylinders only 19in. by 26in. There is a big contrast between the two. I am inclined to think that none of our engines would stand much chance of knocking her out, either as regards speed or hauling power. Although I do not believe in the 102 miles an hour speed, I should like to see her working over here, and I think the L. and N.W. corridor train would be a fair test; but there is little doubt but what she would be able to work it herself over any portion of the road.

I greatly dislike double engine running, but most of our railway companies make a practice of this of late. The L. and N. W. corridor is brought from London to Crewe and back by 1304 Jeannie Deans, and taken on to Carlisle by two of the Precedent class generally. Perhaps it may be necessary, but I think this might be avoided if one of the Greater Britain class was converted into a simple coupled engine with cylinders 20in. by 26in., as the position of the driving wheels is admirably adapted for the use of short coupling rods, and her boiler could be made to contain 2000ft. of heating surface. The L. and N. W. dining cars are very heavy, the kitchen cars weighing 33½ tons, from the particulars I have before me.

The other night two of the new Caledonian engines brought one of the mails into Carlisle, which consisted of a load equal to eighteen six-wheeled coaches. One of the big compounds was attached, Richard Trevithick, and she had the assistance of a coupled engine up the bank, when this was detached, and the compound brought it on to Crewe.

I should like to see one of the big compounds converted into a simple engine with 7ft. 6in. coupled wheels, 35 tons for adhesion, cylinders 20in. by 26in., and with a leading bogie.

Our express engines have greatly increased in weight. For instance, the L. and N. W. compounds 52 tons 2 cwt., North-Eastern engines 51 tons, and the Great Western of a similar weight; whereas the L. and N. W. old coupled engines weigh only 33 tons, and have 1102ft. of heating surface; and I think, therefore, the heating surface of these heavy engines should be correspondingly increased.

The one drawback of the compounds is the starting, as they are only equal to a single engine with cylinders 15in. by 24in. until the large cylinder gets into working order.

In conclusion, I think engines could be built which would haul any of our express trains without the assistance of a second engine.

December 8th. J. G.

SIR,—Does Mr. Bowles refer to the North-Eastern 1496 class of engine? This engine was constructed in 1884 by Messrs. R. and W. Hawthorn, Newcastle-on-Tyne, to the designs of Mr. Alexander McDonnell, then locomotive superintendent. The following are a few leading dimensions of this class of engine:—Cylinders, 17in. by 24in.; driving wheels, 6ft. 8¼in. diameter; trailing wheels, ditto; boiler pressure, 140 lb. per square inch; total heating surface, 1030·25 square feet; grate area, 16·8 square feet. Weight in working order: On the bogie, 12 tons 4 cwt.; on the driving wheels, 15 tons; on the trailing wheels, 12 tons 6 cwt. Total, 39 tons 10 cwt. Weight of engine and tender in working order, 67 tons 10 cwt.

If this is the engine referred to by Mr. Bowles, I would point out that the favourite Tennant class, with 18in. by 24in. cylinders and 7ft. wheels is far superior both as regards power and speed; but to compare such an engine to Mr. Worsdell's 1622 class with their 19in. by 26in. cylinders, 7ft. 1in. driving wheels, heating surface 1341 square feet, and a boiler pressure of 180 lb. to the square inch, is too absurd to notice. W. J. BARKER.

Hyde Park, Leeds, December 10th.

SIR,—I agree entirely with Mr. Norman Macdonald in your last issue, p. 486. We have indeed had a storm in a teacup over the North-Eastern engines, but when that gentleman goes on to say that it was "the big engine helping the small one," he is as wrong as wrong can be. Engine No. 1622 was the big train engine, with 19in. cylinders. It was this big one that was short of steam, and could not work its brake. The small engine No. 905 was taken on at Darlington in front to help the big one to York. What does Mr. Macdonald refer to when he says there was "an injured brake pump?" The pump was right and the brake was right, but with a falling steam pressure there was not enough steam to work the pump and obtain the necessary air. Mr. R C. Dowie is quite right, the modern express engine does not lose time, the time goes at the stations. A PRACTICAL MAN.

December 10th.

SIR,—I have read with interest your correspondence *re* train speeds, and particularly "Permanent Way's" remarks on Caledonian engines. I beg to correct a slight error. The Caledonian Co. has now, to the best of my knowledge, no engines with 19in. cylinders. One was built with cylinders of that size and Bryce-Douglas valve gear, as stated in Mr. Bowen Cooke's book, but this gear was removed, and 18in. cylinders with ordinary excentrics substituted some years ago. The latest express engines No. 13 to 17 have 18in. cylinders. Among other companies that have 19in. cylinder express engines should be included the Highland—93 class —and if I am not mistaken, the Great North of Scotland latest express, built in 1893—80 class—have cylinders of that size. The Highland have also a class of six-coupled bogie engines—Nos. 103-117—with outside cylinders 20in. by 26in. These engines which, however, can hardly be counted as express, are claimed to be the largest in Great Britain. STRATHNAIRN.

Perth, November 30th.

SIR,—Full particulars of the North-Eastern Railway, MacDonnell, engine appeared in the *Railway Engineer* for April, 1884. The weight is there given as 37 tons 10 cwt. I do not recollect having heard of the "pick-up" being used on the tenders of these engines, but these are unquestionably the MacDonnell engines referred to by your correspondents. J. E. D.

London, December 10th.

SIR,—In reply to "E. R.," I was of course referring to the South-Eastern Railway. W. B. THOMPSON.

London, December 11th.

### TRACTION ENGINES.

SIR,—I have for many years had a good deal to do with traction engines for road hauling. I have been a collector for years of information referring to traction engines and their wheels. I have before me two scrap books, containing newspaper cuttings referring exclusively to traction engines. I find in the great majority of cases the diagonal cross-bar wheels have been the main cause of getting the traction engine into trouble and disgrace. Any practical man knows that the common cross-bar wheels slip or skid. Could anybody devise a better arrangement for tearing our roads in pieces than this barbarous cross-bar wheel, no matter what the road is made of, when a cross-bar wheel slips—which it is constantly doing?

More or less it tears the road in pieces. It is quite useless writing on this subject, unless we adhere strictly to facts. Is it or is it not a fact, that there is amongst many of the traction engine builders a certain amount of combination, both as to prices and as to what shall or shall not be introduced in the shape of improvements? Now, what is really wanted for traction engines is a wheel with considerable bearing surface on the road: a wheel that will not slip or damage the road—in fact, a wheel as near to the one suggested in one of your articles, viz., india-rubber tires, which we all know are far too expensive and difficult to keep in repair. One of your correspondents suggests a wheel with a smooth surface 18in. wide. We know very well a wheel of that width, with a rigid periphery, on the majority of our roads, particularly a paved road, would seldom have more than a fraction of a square inch of bearing surface on the road at once, and this fraction is all the adhesion the engine has to enable it to draw its load. If an engine could depend upon adhesion, we know it would use very much less water, less fire, less wear and tear, and the men would be enabled to know when they were likely to finish their day's work.

I am very much inclined to think, if our surveyors who have had experience of cross-bar wheels were to give us their opinion, a great majority of them would say, Give us a better wheel.

We know great complaints are made about damaging the roads by slipping, and the great vibration caused in passing through towns to the adjoining property by the cross-bar wheels. They act like spur or cog wheels. We are mostly agreed that we want an improved traction engine, and my opinion is that we might make a beginning by asking the traction engine makers to give us a better wheel.

Then, again, in reply to "J. H. M.," in last week's ENGINEER, I quite agree that all engines should be licensed, but at the same time only two classes of licences should be issued, one for agricultural and one for hauling engines. Weight of engine should not be taken into account, as it is well known that engines, as at present designed cannot be weighed correctly to correspond with the weight plates placed on them by the makers.

With regard to the driving wheels, it is high time the cross-bar wheel was abandoned for hauling engines, as being inefficient and destructive, it being, as Mr. McLaren says in his paper read before the Civil Engineers, a barbarous arrangement. In the same paper he denounces single crank compound engines as now recommended by your correspondent, "J. H. M., of Leeds."

Wood block wheels are working daily on macadamised roads, and have been for years, without complaint from surveyors. Then why say they are too heavy? I wish that their actual performance was more fully inquired into, then I think any prejudice against them would cease, and they would gain more friends amongst makers and users, who do not know how well they are acting. E. R.

Manchester, December 11th.

### INDUCED *v.* FORCED DRAUGHT.

SIR,—It was my intention to have made a few remarks in the discussion that took place last week on the paper read by the engineer-in-chief at the Institution of Civil Engineers, but owing to want of time the chairman was unable to call upon me. In the paper reference was made to experiments with induced draught on board H.M.S. Gossamer; but as no details were given, perhaps I may be allowed to supplement the few remarks of the engineer-in-chief. The Gossamer has two stokeholds, each containing two boilers. The uptake of the forward boilers was fitted with my system of induced draught, the two after-boilers retaining the forced-draught system; everything in both boiler-rooms remaining the same, the object, it appears, being to test the merits of the two systems on equal conditions. The tubes of the boilers were 1½in. internal diameter, with reduced ends in the fire-box as a preventive against leaky tubes. The boilers, notwithstanding all this, had suffered considerably from leaky tubes, which had been rolled and re-rolled to make them tight. As a further precaution ferrules were added, so that the 1½in. tubes were reduced to ⅞in., or to nearly one-third of the actual tube area. These conditions may serve to explain to some extent Mr. Durstan's inference that "as regards absence of leaky tube ends no superiority can be claimed for induced draught," as in this case old sores broke out on several occasions to interrupt the trials, but after the tubes were again made tight nothing of the sort occurred. It is a system of induced draught which is used on every locomotive, and if that caused boiler tubes to leak it could certainly not be so universally adopted with immunity. At high speeds the exhaust will produce a partial vacuum in the furnace equal to 10in. or 12in. of water, more than sufficient to draw off five times the amount of heat generated in the furnace, so that concentration of heat is impossible.

Reverting to the "Gossamer" trials, I may be allowed to mention that the final trial between induced draught and forced draught was a run of twenty-four hours at 1000-horse power. This was completely carried through by the former, the horse-power being exceeded, whilst it was found impossible to carry it out at all with forced draught, and the trial had to be abandoned.

Pocock-street, Blackfriars, London, W. A. MARTIN.
December 12th.

### LABOUR AND LUXURIES.

SIR,—In despair of finding any probable basis for "Y. X.'s" views as to gold in more familiar treatises, I turned up the half-forgotten "Political Economy," of Malthus, the very writer whose supposed neglect of ethics caused impulsive moralists to dub political economy "the dismal science"; and in the very opening of his treatise I find that very chapter of the "Wealth of Nations," to which I at first called "Y. X.'s" attention, cited as the keystone of Adam Smith's work; and, further, he quotes, with critical approbation, the conclusion of the following passage, which, to my misfortune, I overlooked in my previous reference: "Whatever, therefore, we may imagine the real wealth and revenue of a country to consist in, whether in the value of the annual produce of its land and labour, as plain reason seems to dictate, or in the quantity of the precious metals which circulate within it, as vulgar prejudices suppose; in either view of the matter every prodigal appears to be a public enemy, and every frugal man a public benefactor."—"Wealth of Nations," Book II., Chapter III., pp. 343, Thorold Rogers' Edition.

In a subsequent passage of the chapter Smith explains at length that he is referring, not to the ethical but to the economical side of man. So that the word on which "Y. X." poured his contempt actually occurs in the central passage of the keystone chapter of the founder of our science. See also on the previous page:—"The same quantity of money cannot long remain in any country in which the value of the annual produce diminishes. The sole use of money is to circulate consumable goods." Be it clearly understood that by money he means gold and silver, the precious metals. And how can "Y. X." reconcile this:—"The quantity of money which can be annually employed in any country must be determined by the value of the consumable goods annually circulated within it," with the "instructive" (?) story of the man who found gold in a rivulet, which "Y. X." offered to us as an answer to one of the most complicated questions that can be asked, an outline of the answer to which takes some three chapters of Mill.

"Y. X." began by attacking what he was pleased to term a popular fallacy, and referred us to the most famous economists; but he has already admitted that his views on gold are contrary to that of *some* eminent economists: if he had said *all* his statement would have been accurate. The study of gold as such is a branch of physics. It is a part of wealth; that is—as the first chapter of any treatise will show, in relation to the wants and desires of men—that gold concerns political economy. What he says about the time element is the exact contrary to what all economists allege, and the story of the broken window which he assigns to ethics has been a favourite ever since it was so charmingly told by Bastiat, who, I need scarcely say, assigns to the ignorant crowd the view taken by "Y. X.," and that of "J. C. S." to the enlightened economist. There is a translation in Mrs. Fawcett's "Political Economy for Beginners." I hope that before "Y. X." again rushes into print with absurd charges of confused thought on the part of others, he will acquaint himself at all events with the ordinary definitions and postulates of the science he misrepresents. W. A. S. B.

SIR,—As has been conclusively proved by Flürscheim and Hertzka, no injury is done in the long run to the poor by expenditure on luxuries; indeed, if the entire surplus savings of the rich were so spent, lack of employment would soon cease and wages rapidly rise. The true cause, the only cause, of so-called "over-production," and the consequent idleness of multitudes of willing workers, is that the accumulations of the rich are not expended in the purchase of goods, whether necessaries, luxuries, or genuine capital—*i.e.*, machinery, buildings, ships, &c.—the creation of which must give employment to labour, but devoted in large measure to the further acquisition of titles to land, bonds, and other tribute rights. This, so far from increasing the demand for labour, only lays burdens upon industry and restricts the opportunities for employment, thus again lessening the demand for commodities. Hence the ever-recurring phenomena of what is in reality "under-consumption," trade depressions, and commercial crises. EVACUSTES A. PHIPSON.

Selly Oak, December 10th.

SIR,—If your correspondents "W. A. S. B." and others, instead of arguing with "Y. X." and attributing to him statements which, so far as I can see, he has not made, would state the case from their point of view, something would be gained.

May I ask "W. A. S. B.," then, to show how gold may be used in such a way that it can do most good—I mean commercially, not ethically? There is at this moment in the country an enormous amount of money. It would be interesting to learn how it can be best used. Not, I should think, in producing more commodities, of which at present we have more than we can either consume or sell. M.

Cannon-street, December 10th.

### SIMPLEX GAS ENGINES AND THE PANTIN FLOUR MILLS.

SIR,—The letter from "Progress"—which you published in your number of the 7th inst.—is indicative of the change now taking place in the production of motive power, and is one that I think most engineers will endorse, coupled with the fact of there being already so many makers of gas engines and so sharp a race for pre-eminence in this branch of the engineering business, proves that there is coming a general belief in gas—at any rate for small powers. The attempts made in this country hitherto for larger powers do not appear to have been so successful as in the smaller ones. The Otto principle for small engines seems to answer admirably and commercially, it being of a cheap form to make; but for higher powers I agree with "Progress," that something better is required, and I may I hope be allowed—without appearing egotistical—to refer him to my patents of 1893, Nos. 6453 and 9216. As to gas producers for bituminous coal: in this there appears to be considerable difficulties, but these will no doubt in time be overcome. J. C. R. OKES.

London, December 11th.

### THE FLYING MACHINE.

SIR,—Referring to the letter of "Contest" in last issue, may I suggest that a pendulous gravity-governor—which need not be too heavy, but should have plenty of leverage—might regulate the angle of the "tail" or the developed propulsive action of vertical screws on my system fitted at the ends of the air-ship to keep an even keel and lift also when desired.

It is obvious that the action of such screws could also lift, lower, keep steady, propel, reverse, alter speed, and nullify it; and suit the varying conditions of the fluid—in air as in water.

Selthurst, S.E., December 8th. ROBERT MCGLASSON.

## IN THE ENGINE ROOM OF A P. AND O. STEAMER.

It is practically impossible to convey an accurate impression of the appearance of the engine room of a great modern steamer by photographs. There is not sufficient light available, and what there is is uncertain and unsuitable for the photographer's purposes. Again, it is seldom possible to secure a sufficient distance between the camera and the portion of the machinery to be photographed. Nothing remains then but for an artist to make sketches, and to do this makes no small demand on the artist's skill and experience. We venture to think that our reproductions of drawings made in the engine room of the Peninsula and Oriental Co.'s new and splendid steamship Caledonia will convince our readers that, difficult as the task is, it is not impossible.

These drawings are seven in number. The first, on page 521, shows the lower platform, as seen from the port side of the ship, with Messrs. Brown Bros.' reversing gear. The Caledonia is a single-screw ship. Looking through the space between the A frames, the condenser is seen. On the extreme left is the bulkhead between the engine and boiler rooms. Against the bulkhead stands a Weir's feed pump. The small "wheel" on the A frame is the cylindrical casing of a Durham and Churchill marine governor. Immediately under it is the engine-room log slate. The clock, counter, and desk on the other frame speak for themselves. The grating at the top is the second platform at the level of the links.

The second view, on page 525, explains itself. We have here a drawing which conveys an excellent idea of the great size of the crank shaft and connecting-rods. The crank guards are supposed to be unshipped, and we are looking astern through the A frame.

The third view, on page 528, is taken on the third platform. At each end we see one of the two high-pressure cylinders. To the right of the centre is the top of the valve casing for the intermediate cylinder, and at the other end can be seen the rocking lever by which the high-pressure valve spindle is driven. An enlarged view of this lever will be found on this page. The pipes seen in the background are the main steam pipes; those in the foreground are the exhaust pipes to the intermediate cylinder. The pipes are all very heavily clothed with non-conducting composition, which greatly adds to their apparent diameter. The composition is covered with canvas, and that again with wire netting secured by iron bands; these are painted black, the canvas and netting light stone colour. Under the grating, in the extreme left-hand corner, may be noticed one of the exhaust pipes from the low-pressure cylinder to the condenser. Higher up in the picture, but still to the extreme left, is seen the steering engine. The inverted dome at the top is a portion of the Weir feed-water heater.

The fourth view page 527 was taken on the top platform, looking astern. In front is seen the piston valve casing of one of the high-pressure cylinders, the high-pressure cylinder, and the lifting gear for the intermediate cylinder cover attached to the transverse girder, in which position it remains while the ship is at sea. In the left-hand front corner is the upper portion of the Weir heater. The main steam stop valve can be seen at the off-side of the high-pressure valve casing.

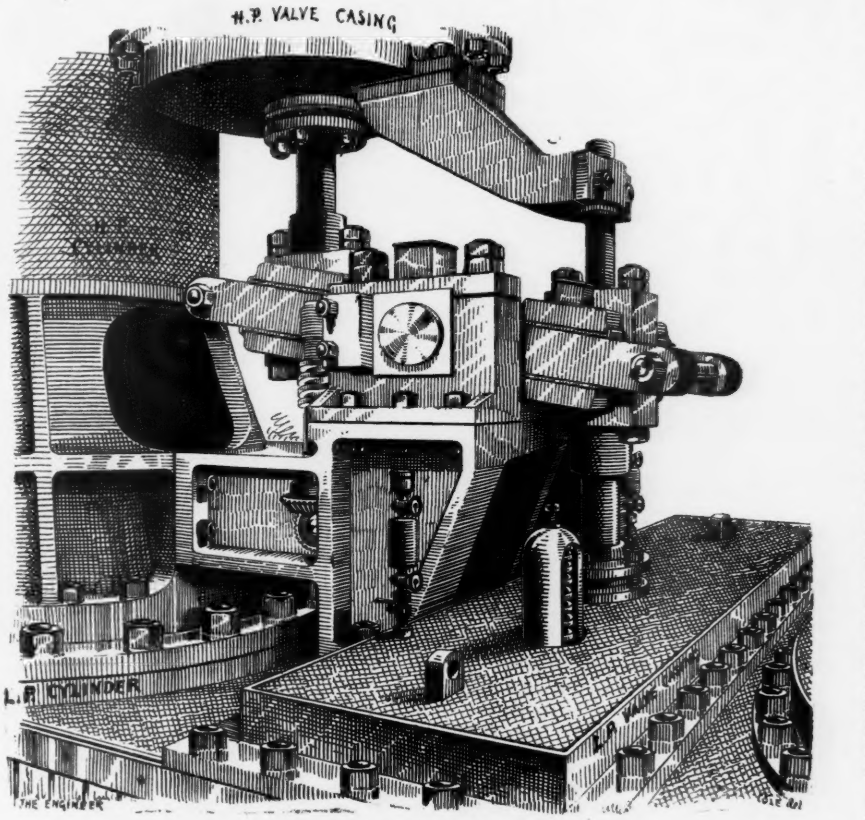
The fifth view page 531 affords an excellent example of the difficulties to which we have referred as standing in the way of an artist. Here it has been found necessary to suppose the main engines to be removed altogether, in order that the electric light engines and dynamos may be seen without obstruction. At the extreme left is seen the spare crank shaft up-ended against the bulkhead. Close to it is the hydraulic engine, supplying water under pressure for working derricks, &c. Right in front is a donkey pump.

The electric lighting on board this ship has been carried out by Messrs. Siemens Bros. and Co. There are 734 incandescent lamps of 16-candle power fitted up in the vessel, besides eight deck lanterns with three lamps each for use when discharging cargo, and two arc lamps for use in passing through the Suez Canal, one of 50 ampères in a projector for use at the bows, and the other of 20 ampères for a mast-head light. These lamps if all running at once would require 52 kilowatts, and this is provided for by three sets of generating plant, each of 23 kilowatts; usually one set is held in reserve. The three sets are quite similar, and each consist of a Siemens H.B. $\frac{15}{20}$ dynamo for 220 ampères at 105 volts, coupled direct to a Tangye Archer-type vertical compound engine, with 8in. and 16in. cylinders and 10in. stroke, running at 220 revolutions per minute, and working with 150 lb. steam pressure. We illustrate an engine and dynamo on page 533. Both slide valves are Trick ported. The wiring is carried out with highly-insulated india-rubber covered wires in teak casings, except in the engine and boiler-rooms, where they are enclosed in iron pipes; the iron structure of the ship is used for the return circuit. Joints in the wires are avoided by the use of special junction boxes, each serving for ten lights. The Caledonia is the forty-fourth Peninsular and Oriental vessel fitted by the same contractors, who besides have eight others just completed or in hand.

The sixth view page 527 on the starboard side of the engine room illustrates the two circulating pumps set at an angle. A portion of the condenser has been broken away in order that the Kingston valve may be seen. Just ahead of the forward centrifugal is a duplex pump. At the top left-hand corner is a portion of the Weir heater.

In our impression for September 14th we illustrated and described the Caledonia. She is a ship of 7500 tons, and 11,000 indicated horse-power, constructed and engined by Messrs. Caird and Co., Greenock. She is 486ft. long, 54ft. beam, and 37ft. deep. She has accommodation for 320 saloon passengers and 150 second cabin passengers, but no steerage accommodation whatever, none being provided in the Peninsular and Oriental Company's steamships, simply because there is no demand for it. She has space for 1500 tons of cargo. She is commanded by Capt. Andrews, and Mr. J. Stevenson is chief engineer. Her crew numbers about 300 all told, largely composed of Lascars and Seedy boys. The ship sailed on her maiden voyage, it will be remembered, on the 5th of October. On her trial trip, run from the Clyde to Queenstown, her maximum speed was 18·2 knots, a highly satisfactory result. She has four masts and two funnels.

Her engines very closely resemble those of the Campania and Lucania—illustrations of which, as they stood in the shops of the Fairfield Company, will be found in our impression for October 13, 1893. That is to say, there are five cylinders driving three cranks. The engines farthest forward and farthest aft are tandem. The central crank is driven by a single cylinder, the intermediate. Thus the two high-pressure cylinders exhaust, as shown in our third view, into the valve chest of the intermediate cylinder, and that cylinder in turn exhausts into the two low-pressure cylinders immediately under the high-pressure cylinders. The Atlantic liners have twin screws, the cylinders for each screw being two high-pressure 37in., one intermediate 79in., and two low-pressure 98in. in diameter. These are intended to indicate about 15,000 indicated horse-power, or 30,000 for the two.



VALVE GEAR ROCKING LEVER

The Caledonia has, as we have said, only one screw. The cylinders are two high-pressure 33in. diameter, one intermediate, 69in., and two low-pressure, 84in. diameter; which corresponds to one high-pressure cylinder, 46¾in. diameter, one intermediate 69in. diameter, and one low-pressure, 118¾ inch. The latter size is too great, and a far better result is got by using five cylinders instead of three. The turning moments are more regular and the risk of a broken cylinder is reduced. The high-pressure piston valves are, as we have said, driven off the low-pressure valve spindles by rocking levers, as shown. The piston valves might have been placed directly over the low-pressure valves, but the ports would then have been much too long, and the unbalanced weight would have been very great, the low-pressure slide alone weighing nearly 1½ ton; as it is the piston valve partly balances the weight of the slide valve.

The annexed tabular statement gives the principal dimensions of the Caledonia's engines.

The propeller is of manganese bronze, and is four-bladed; the diameter over all is 21ft.; the blade surface is 129 square feet; the pitch is variable, between 28ft. 6in. and 31ft. 6in.; when she sailed on her first voyage it was set at 30ft. 6in.; the length of blade is 9ft. 7¾in.

Steam is supplied by three double and four single-ended boilers. They have all the same diameter—15ft. The total number of fires is thirty. The heating surface in the three double-ended boilers is 14,139 square feet, and the grate surface, 358·8 square feet; the surface in the four single-ended boilers is 9870 8 square feet, and the grate surface is 229 2 square feet; thus the total heating surface of all the boilers is 24,000 square feet, which allows nearly 2¼ square feet per horse for 11,000-horse power, and nearly 19-horse power to the square foot of fire-grate.

*Dimensions of the Caledonia's Engines.*

| | |
|---|---|
| Number of cylinders ... ... ... ... ... | 5 |
| Diameter ... ... ... ... ... ... ... ... | 33in., 69in., 84in. |
| Stroke ... ... ... ... ... ... ... ... | 6ft. |
| Diameter of piston-rods ... ... ... ... | 11½in. |
| Valves:— | |
| High-pressure .. ... ... ... ... ... | Piston |
| Intermediate ... ... ... ... ... ... | Piston |
| Low-pressure ... ... ... ... ... ... | Slide |
| Crosshead pins—diameter ... ... ... ... | 11½in. × 12in. |
| Crank cheeks ... ... ... ... ... ... ... | 17½in. thick. |
| Excentric rods ... ... ... ... ... ... ... | 7in. at centre × 13ft. |
| *Diameter of thrust shaft ... ... ... ... | 21⅛in. |
| Number of thrust blocks ... ... ... ... | 2 |
| Total number of collars ... ... ... ... | 26 |
| Total surface ... ... ... ... ... ... | 6190 sq. in. |
| Diameter over collars ... ... ... ... ... | 28½in. |
| Diameter inside collars... ... ... ... .. | 21in. |
| Length of tunnel bearings ... ... ... ... | 2ft. 6in. |
| Number of tunnel bearings... ... ... ... | 8 |
| Diameter of tunnel shaft couplers ... ... | 41in. |

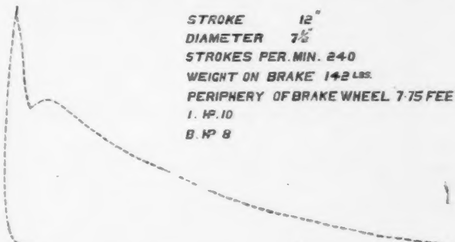
The ship is altogether a very splendid specimen of modern marine naval architecture. We have to express our thanks to the Peninsular and Oriental Company for the facilities afforded to our special artist while making his sketches.

## THE SMITHFIELD CLUB SHOW.

The show of machinery and implements in the Islington Agricultural Hall this week is not quite so large as in previous years, many of the occupied spaces in the implement and miscellaneous machinery departments not being filled, and numerous spaces being left quite vacant. There is apparently less reason for exhibiting on the part of the makers of some classes of machinery; while others, whose trade is either local or who have no novelties of importance, are unwilling to incur expense not warranted by the depressed condition of the farming industry in many parts of England. Most of the manufacturers of first-class engines and machinery have as much to do as they want, and several have done a larger foreign trade this year than ever. Almost all of the well-known firms exhibit at Islington, and have a considerable collection of their manufactures, and they thus provide a rendezvous for those who find the Smithfield Club Show a convenient place and time for business purposes. There are, however, few novelties in the Show to which we can draw attention.

One of the few novelties is the oil engine exhibited by Messrs. Howard, of Bedford. It is a well-finished 8 brake horse-power oil engine, the mechanical details of which are very simple. Like all others it works on what is known as the Otto cycle. It is of the type which is included in Classes 4 and 6 of our classification of these engines, namely, one which receives and converts the oil into a gaseous vapour in a vaporiser separately heated by an oil lamp with forced air combustion; and in which ignition is effected by an ignition tube, heated by an oil lamp with forced air combustion.

The oil is injected into a heated vaporiser, where it is met by a current of heated air and vaporised before it enters the cylinder, there to be mixed with the proper volume of air to form the combustible charge, which, when compressed by the return stroke of the piston, is fired by the ordinary ignition tube. A screw adjustment, varying the stroke given to the pump plunger, determines the quantity of oil for each explosion in the cylinder, the oil being admitted by an oil regulator, which is controlled by the hit-and-miss finger of the Holt governor. The arrangement and form of the vaporiser are shown by the



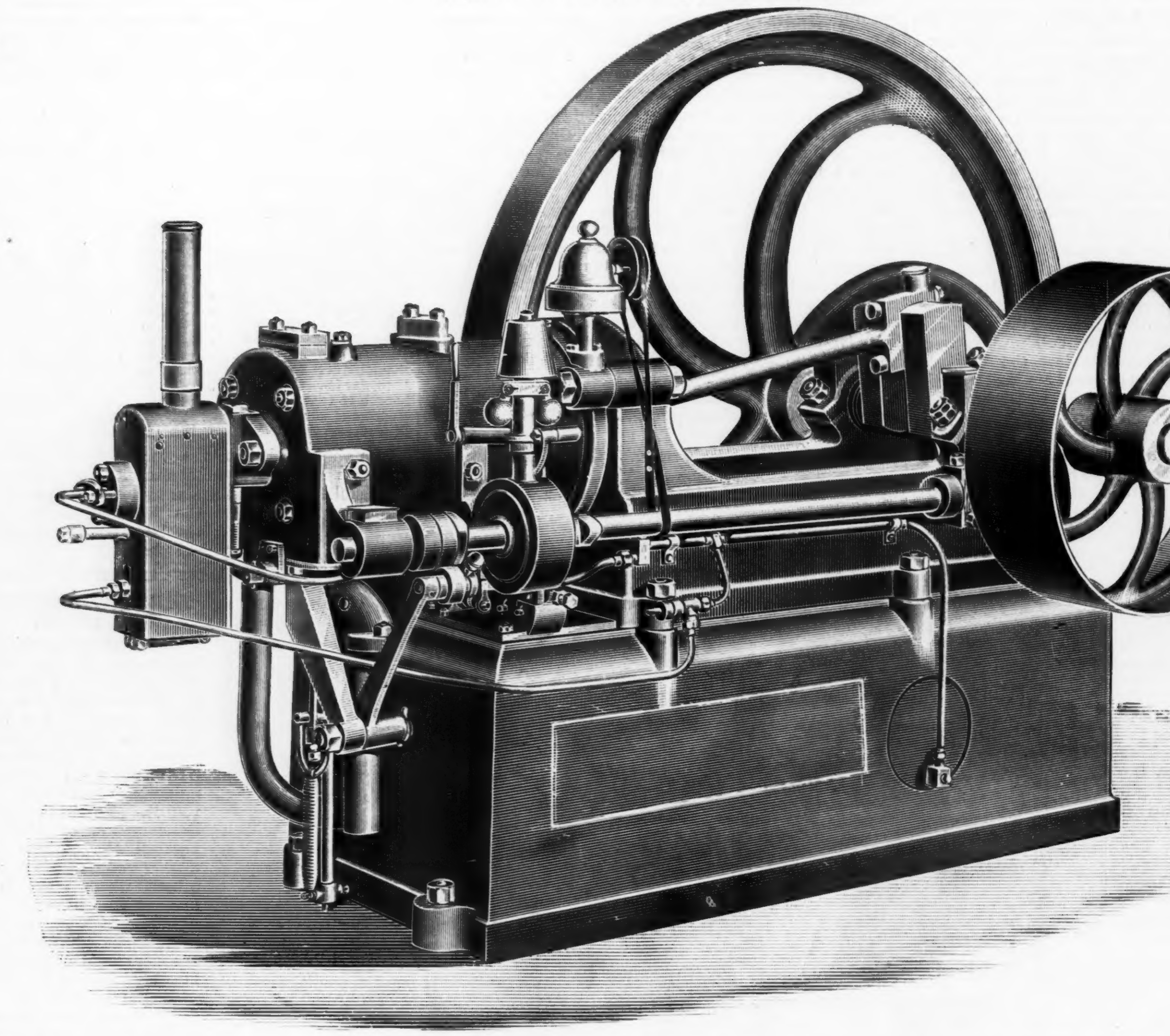
INDICATOR DIAGRAM—HOWARD'S OIL ENGINE

---

*Lucania's shaft 25¼in

# EIGHT-HORSE POWER OIL ENGINE

MESSRS. J. AND F. HOWARD, BEDFORD, ENGINEERS



engravings Figs. 1 and 2 herewith, the vaporiser being shown partly in section from a rough sketch. In this A is the back end of the cylinder, to which an inclined casting B is fixed. In the casting, section of which on the line N N is given in Fig. 2, there are two long round passages, and at the lower part is a flat passage G, this passage being the final gasifying chamber. Oil enters at D through a fine hole, through which it is injected under a small pressure into and hits the lower surface of the passage E. A small quantity of air is admitted by the valve V into the passage F, where it is heated. At the upper end of the passage F it enters the passage E, where it is further heated and comes into contact with the oil jet from the pipe D. By a connecting port at the lower end of the passage E, the air vapour passes into the hottest passage G, where the vapour is converted into a gas and passes into the working cylinder, when permitted to do so by the lifting of the valve W. The vaporiser is surrounded by an asbestos-lined case C, surmounted by a chimney H, and below the vaporiser is a lamp L, which heats the ignition tube T as well as the vaporiser. The bottom surface of the latter has cast upon it a number of pointed projections, which increase the heat receptivity of the bottom part of the chamber C. The passage G when it enters the valve case K is directed so that it passes over the valve, and the ignition tube T enters a separate port open to the cylinder.

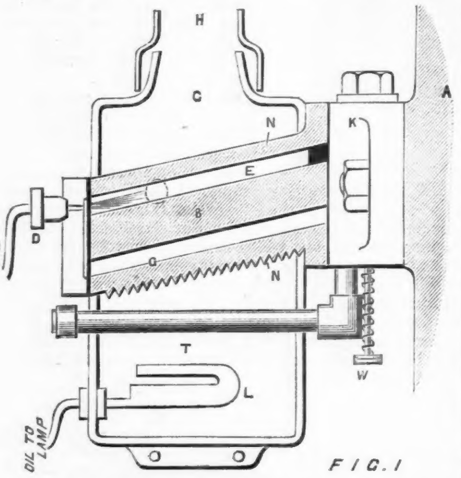
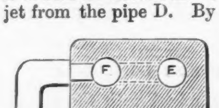


FIG. 1

Fig. 1—VAPORISER, HOWARD OIL ENGINE



SECTION N.N FIG. 2

An indicator diagram from the engine is reproduced by the engraving on p. 523. It is typical of a number which have been shown us by the makers, and is from an engine with a 7·5in. cylinder, 12in. stroke, 240 revolutions per minute, and using no oil. The maximum pressure shown by the diagram is 255 lb., and the brake horse-power is given as 8, with 10 indicated horse-power.

Messrs. Hornsby and Sons exhibit two of their oil engines, one a portable engine similar to that shown at Cambridge, but the side frame has been made stronger, the height of the centre of the cylinder above them lowered, and stay rods between cylinder and brackets dispensed with. They have also made a valuable addition in the form of a simple and powerful clutch for driving the wheel from which the power of the engine is taken. It is a radial action clutch operated by toggles and a sliding collar and lever in an accessible position. The collar and lever are not subject to wear when the clutch is in gear. By using this clutch the load may be started after the engine is running, and the starting is thus made a comparatively simple job, and no time is lost taking off and putting on the belt.

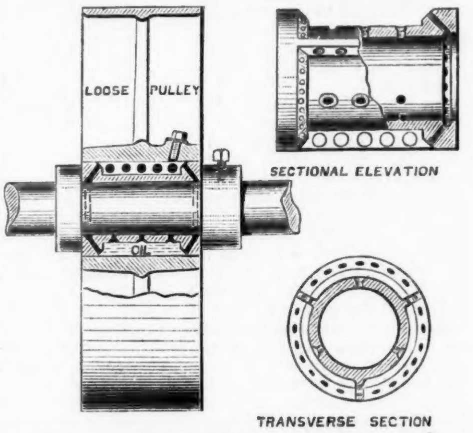
Messrs. Robey and Co. show an improvement in the starting lamp and fan of their engine, which reduces the time taken in heating the vaporiser and starting.

Messrs. Priestman Bros. exhibit two of their engines, one being a vertical launch engine fitted with their McGlasson reversible screw propeller, which enables the boat to be reversed in direction and manipulated without reversing the engine, or in any way interfering with its running. Messrs. Priestman have now a number of these screws at work with excellent results, and that exhibited at Islington shows how compact the screw gear is. Messrs. Priestman inform us that they have recently supplied an engine of this type of no less than 65 brake horse-power for use as auxiliary power on board a large sailing vessel, and have at present orders in hand for three more engines of the same size for trawlers on the East Coast fisheries. These engines are, however, we understand, double-acting, and two impulses are thus obtained, there being two cylinders, per revolution. The front end of the cylinder is closed, and a piston-rod employed, so that with the Otto cycle and no misses there may be one impulse in each cylinder per revolution.

Messrs. Robinson and Andrew, Wantage, exhibit amongst other things a neat little vertical engine of the turned front column type, and intended for small electric lighting plant; and they show a neat arrangement of stop valve on a vertical engine, which also serves as the regulating valve operated by the governor.

Messrs. Aveling and Porter exhibit a fine-looking road locomotive, with 7ft. 6in. wheels, and mounted on springs This we shall describe in a future issue.

Amongst the miscellaneous exhibits Messrs. Smith and Grace, of Thrapston, and 35, Queen Victoria-street, exhibit the new self-oiling loose pulley, illustrated by the accompanying engraving. It will be seen that the box of the pulley is made of large dimensions, and in it is fitted a large bush which is externally chambered, so that when in place in the pulley it provides a large annular oil space, only interrupted by perforated ribs. This space being filled with oil, perfectly and automatically lubricates the part of the shaft upon which the pulley runs, and only needs re-oiling at long intervals. A very great objection to loose pulleys is thus entirely removed. Experience proves it to work with complete success. A new mill for breaking down maize in large quantities is shown by Messrs. E. R. and F. Turner. The rollers used for the purpose are grooved, and are of chilled iron of the same character as that of the rolls used in the roller flour mills by the same maker.



SECTIONAL ELEVATION

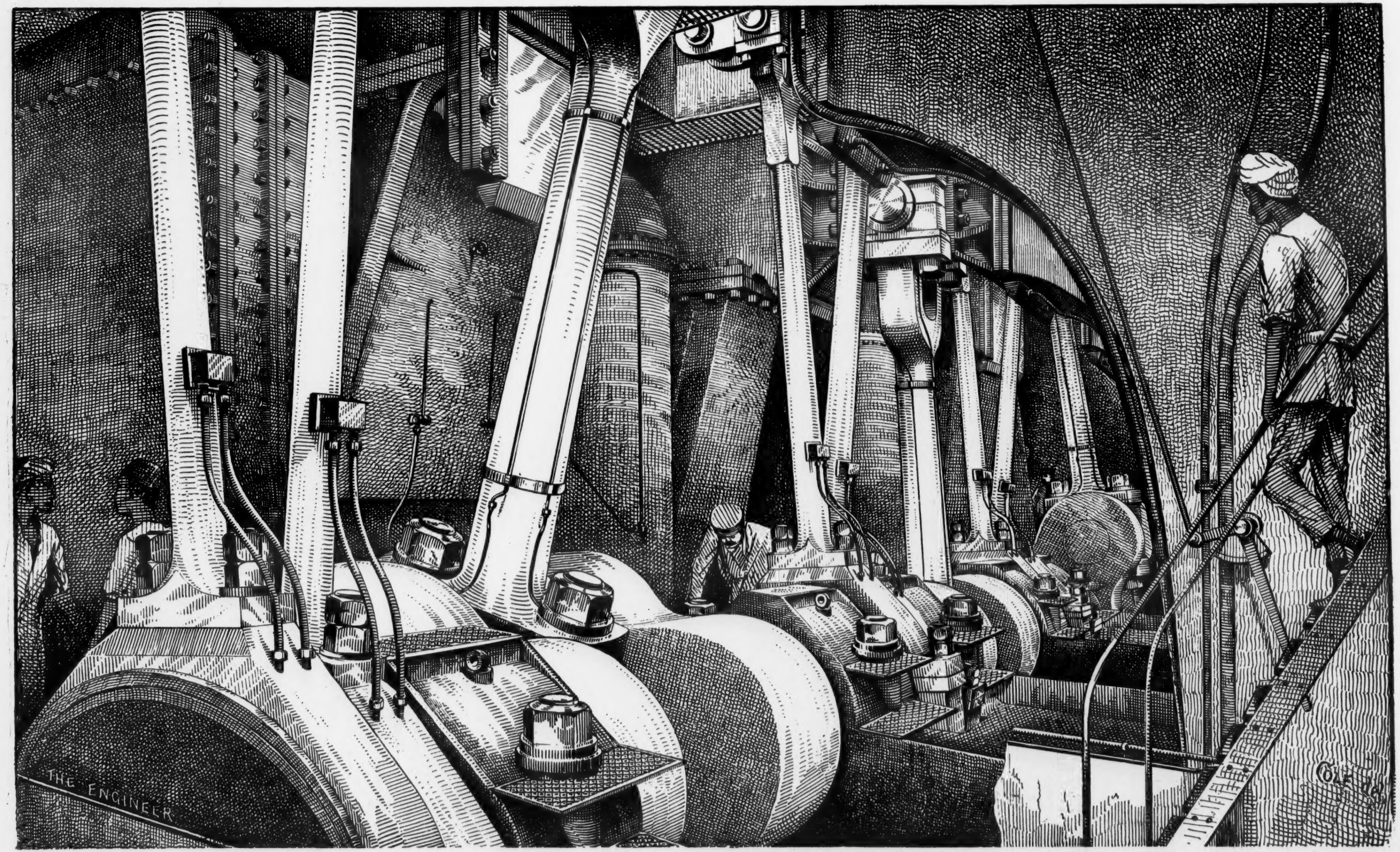
TRANSVERSE SECTION

SMITH AND GRACE'S SELF-OILING LOOSE PULLEY

Messrs. John Crossley and Co. exhibit some chaff cutters with Mr. S. Edwards' new arrangement of the guide pieces for the rising roller, by which a clear way between the side cheeks is secured, the hay or straw meeting nothing in its passage to the knives, which is not rotating. The machine is also made with a wheel cover, and every part of the gearing is cased in. Several makers exhibit chaff sifting machines and machines for taking dust out of the chaff. There is no indication at this show of what the makers will enter for the Royal Agricultural Society's competitive trials next year for haymakers.

IN THE ENGINE ROOM OF THE STEAMSHIP CALEDONIA—THE CRANK SHAFT

(*For description see page 523*)


THE ENGINEER
COLE DEL

## RAILWAY MATTERS.

An order for four locomotives and tenders for a Portuguese railway has been placed with Messrs. Neilson and Co., of Glasgow.

At the beginning of this year the total length of the railroads in Austria was 9918 miles, with seventy-six different proprietors, among which were five different governments, adjacent States having short sections of lines on Austrian territory.

The lines of railway in Park-avenue, New York, owned by the New York Central, the Newhaven and the New York and Harlem Railway Companies, are being removed and elevated similarly to the well-known elevated system in that city. The structure which is to carry them will span the centre of the road, which is 140ft. wide, the elevation of the tracks restoring to it a central area nearly 60ft. wide.

The construction of the proposed Jungfrau Railway has been sanctioned by the Swiss authorities. As planned, the railway will ascend the upper part of the mountain by a series of spiral tunnels. The railway will end on a little rocky plateau on the western slope, and a vertical elevator will carry passengers up the final ascent. A look-out will be made on the narrow summit ridge by blasting.

Although the New South Wales Government has offered to increase his salary by £1000 per annum, Mr. Eddy, their Chief Commissioner for Railways, will not accept a renewal of his term of office, which expires in October next. Great praise is bestowed upon him by the Government and the Press in the Colony for his administrative abilities and the high state of efficiency to which he has brought the New South Wales railways.

The directors of the London Tramways Company, encouraged by the satisfactory financial results which have attended the working of their Brixton cable line, have just decided to extend their cable lines to Streatham. Messrs. Dick, Kerr, and Co., have been entrusted with the carrying out of the work, which, it is anticipated, will be finished by next summer. When completed this line will be able to give a car every one and a-half minutes.

The London and North-Western Railway Company is said to contemplate extensive alterations at Crewe Station, the traffic through Crewe both north and south having for many years been so great, that considerable trouble has been experienced in adequately dealing with it. The scheme of extension suggested involves the removal of the large steam sheds from the north to the south side of the station, and the removal of the goods warehouse from the south side to near the existing site of the steam sheds.

The subject of continuing the Los Angeles and Independence Railway from Los Angeles to Independence, in Inyo county, is again under discussion. A company has been formed for the purpose, and it is probable that a railway will be constructed from Los Angeles to the Ouens Valley, Inyo county, if bonds to cover the cost can be sold in England. The British Vice-Consul at Los Angeles observes as to this, "that it is a mistake for the British public to subscribe for American railway bonds, when the whole cost of the enterprise is to be paid out of the money realised on the sale of such bonds."

The French and Spanish Governments have agreed upon the construction of two international railways crossing the frontier near the ports of Salou and Somport. The first is to start from Saint-Girons, in Arriège, ascend the Satat Valley and penetrate into Spain by Esterri de Anen, to terminate at Lerida; while the second will leave Oloron, in the Basses-Pyrénées, and form a junction at Zuera with the Barcelona and Saragossa line. An international station is to be built on each of the two slopes, and the two tunnels to be driven for each line will be from 7 to 8 kilos.—mean four and a-half miles—long. The works of the Oloron line, begun in Spain, must be completed in five years, and the duration of all the works is limited to ten years from the ratification of the convention.

According to the *Schweizerische Bauzeitung*, on five principal Swiss Railways, namely, the Central, the St. Gothard, the North Eastern, the Jena-Simplon and the United Swiss roads, the proportions of metal and wooden ways are as follows:—Metal ties, Central, 60·1; St. Gothard, 57·7; North-Eastern, 39·8; Jena-Simplon, 33 1; United Swiss roads, 17·9. Wooden ties, Central, 39 9; St. Gothard, 42 3; North-Eastern, 60·2; Jena-Simplon, 66·9; United Swiss roads, 82·1. Steel rails, Central, 65 9; St. Gothard, 95·1; North-Eastern, 73 9; Jena-Simplon, 72 4; United Swiss roads, 75·7. Iron rails, Central, 34·1; St. Gothard, 4 9; North-Eastern, 26·1; Jena-Simplon, 27 6; United Swiss roads, 24·3. On the smaller lines metal sleepers are used less extensively, although on some of them they have found much favour, especially on the various rack railways, on which they are employed almost to the exclusion of wooden ones.

According to the Austrian *Eisenbahn Zeitung*, Herr Lochner, of the Royal German Railroad Commission at Erfurt, has carried out a series of trials with two locomotives of exactly the same design and construction, except that one of them had two equal-sized cylinders, 430mm.—17·2in.—in diameter, working as a simple engine, while the other worked as a compound with a high-pressure cylinder 440 mm.—17 6in.—and a low-pressure cylinder 660 mm.—26·4in—in diameter. The trials showed that the compound locomotives gave better results in point of steam and coal consumption only when the grades and other working conditions permitted of running at speeds of over 40 kilom.—24·8—an hour. With increasing speed there was a steady increase of economy. With speeds below the above figure, on the other hand, the simple locomotive showed the better results. All the working conditions were exactly the same in the two sets of trials, and were considered to be favourable, rather than otherwise, to the compound engine, so that under average conditions the latter would probably have shown a less satisfactory performance. The choice of engine, therefore, whether simple or compound, should, the *Railroad Gazette* says, and Herr Lochner concludes, be made to depend largely upon the ruling traffic conditions and character of the service for which the locomotive is intended.

The present Pacific terminus of the Great Northern Railway, crossing the State of Washington from east to west, is Seattle, on Puget Sound. Since its completion in February last, this line has obtained a good share both of the transcontinental and Western traffic. As the line extends its feeders into the agricultural and mineral districts, very gratifying results may be expected both for the company and State. All the transcontinental lines—the Canadian Pacific, the Great Northern, the Northern Pacific, and the Union Pacific—have now traffic arrangements by which both goods and passengers can be brought through from Eastern points to Puget Sound without changing carriages. Goods rates from and to Eastern points have been considerably reduced, which stimulated the development of the resources of the State, as well as shipping them to other ports, and consequently extending trade. Very little has been done recently by the various railway companies in extending branches, economy being the first thing considered. Most of the lines have reduced their expenses to a minimum by lessening the number of employés, and lowering the scale of wages. The miles of rail laid in the State are 2823. The gross earnings of the Oregon Improvement Company—a State railway—for 1893 were £775,549, against £778,416 for 1892. The net earnings during the same years were £144,785 and £152,567 respectively. Although there was not any serious accident in the State, heavy delays occurred on many of the lines through washouts, landslips, and blockades from the snow storms in the mountain passes.

## NOTES AND MEMORANDA.

A useful drip for turning steel can be composed of petroleum two parts and turpentine one part.

Sulphuric acid can be concentrated electrically by means of heaters consisting of coils of platinum wire suspended in the acid, through which a current is passed.

A method of obtaining nitric acid from the nitrogen in the air by an electric process based on the action of ozone has, according to Dr. Froelich, been discovered, and will shortly be described.

At a depth of about 45ft. the temperature of the earth in these regions is uniform throughout the year. This isothermal zone is variable as to depth through great ranges in different countries and parts of the same country.

We read that a poor quality of coal which is found in a certain mine in Germany, and which is too poor to be transported to any distance, is made use of by the erection of a large electro-chemical factory next to the mines, in which chlorine and soda are manufactured by an electrical process.

An improved gunpowder recently patented by A. Schindler, of Breslau, consists of 12 parts by weight of potassium chlorate, 3 parts of sugar, and 5 parts of anthracite, all finely ground and mixed. It is stated that anthracite, being denser and less easily combustible than ordinary charcoal, prevents the chlorate powder made in the way described from being too rapid in its action.

An artificial paving block which has been tried in Munich is, according to the *Gesundheits-Ingenieur*, composed of finely ground serpentine, compacted together with a small quantity of binding material, the process being patented. It is moulded into blocks and fired in porcelain kilns at a high temperature to a state of incipient fusion. Each block is 4in. by 7in. by 7in. and can be used on all four faces. The price of the pavement is stated to be about 16s. a yard, and it is said to have been laid in Hamburg as well as Munich.

Recent Washington despatches have mentioned a test of aluminium in salt water, just finished by the Navy Department. Two sheets were immersed for three months at the Norfolk Navy Yard; one was of pure aluminium, the other alloyed with a small percentage of nickel. The plate of pure metal was thickly covered with barnacles, and more or less corroded. The alloyed plate was covered with smaller barnacles, and very badly corroded. It is said that the officers of the Navy decided that aluminium could not be used where it would be immersed in salt water for considerable time. On the other hand, the accounts of the aluminium torpedo boat, recently built by Yarrow and Co. for the French Government, say that the tests of the Admiralty were very favourable. Before the building of the boat commenced Mr. Yarrow had two plates accurately weighed, then secured to the sides of a wooden, coppered sailing ship, the copper being removed and replaced by the aluminium. This ship made a voyage around the world, then the aluminium plates were removed, weighed, and found to have suffered no appreciable loss. Nothing is said, however, about the barnacles.

The meetings of the Manchester Geological Society are usually devoted to the discussion of questions interesting to mining engineers, but their meeting on Tuesday was devoted entirely to purely geological subjects, and evolved what was rather an amusing geological puzzle. Amongst the papers was one on "A new Species of Prolecanites from the Carboniferous Limestones of Haw Bank Tunnel, Skipton, Yorkshire," and Professor Boyd-Dawkins, F.R.S., wished to be informed as to the exact meaning of the term "prolecanites." The reader of the paper expressed his inability to give any explanation as to the precise meaning of the term; but added, that Professor Hyatt and Professor Zettall were the authorities for its use in the paper. The President, Mr. W. Watts, F.G.S., remarked that he had spent considerable time in consulting all the books he thought would bear upon the subject, with a view of finding some elucidation of the meaning of this term—but without success; and Professor Dawkins intimated that he would himself write to Professor Hyatt, and ask that gentleman to give a precise definition of the term he had applied to this new geological species.

As our readers are aware, efforts have recently been made in France with the object of reducing air resistance to engines by means of cut air or taper fronts, after the manner of the experiments of many years ago, and those by M. Ricour in 1887. In these, inclined planes were placed in front of the engine, and by adopting this means, making the slanting planes four in three, and filling up the spokes of the wheels, the resistance was, it was said, diminished by one-half, but this is absolutely contrary to previous experience. This resulted in a notable increase of useful work, and an economy of 10 per cent. on the coal consumption. The results are so satisfactory that M. Ricour has fitted his apparatus on forty engines belonging to the Paris-Lyon-Mediterranée Railway, for general traffic. Similar experiments were carried out in 1890 by M. Dresdouit, chief engineer to the State railways, and they were of more prolonged character. The engines were run in this case 300,000 kilometres, and by means of this apparatus they saved 6 per cent. to 8 per cent. in coal consumption, and sometimes as high as 12 per cent. M. Max de Souty tells us, however, "il est vrai que le chauffer et le mécanicien étaient excellents." A few other experiments were tried with seemingly the same satisfactory results. The main point, however, that on an average a benefit of 4 per cent. to 5 per cent. is obtained by the use of these inclined planes, and it is asserted that this is more than the saving obtained from locomotives with compound and other systems. Perhaps the results after a month or two of running would be better than short runs which do not take in flange friction from side winds on heavy days.

A paper by Professor S. P. Thompson and Mr. Miles Walker, on "Mirrors of Magnetism," was read at a recent meeting of the Physical Society. It was pointed out that corresponding to the theory of electric images produced by insulated conductors, there is a theory of magnetic images produced by bodies of infinite magnetic permeability. A magnet pole in the latter theory is the analogue of an electric charge in the former, and a body of infinite magnetic permeability is the analogue of an insulated conductor—which is electrostatically indistinguishable from a body of infinite dielectric capacity. Experiments were made to determine how far the magnetic images due to thick sheets of iron accorded with those deduced by theory for the case of infinite permeability. The image of a north pole in an infinite plane sheet should consist of a south pole of the same strength at a point coinciding with the optical image of the north pole, together with an equal north pole distributed uniformly over the surface of the infinite sheet, as a free electric charge would be, and exerting no finite action. Working at distances of a few inches in front of the surface, a plate of iron a few feet in length and breadth, and a couple of inches thick was found to realise the theoretical conditions with very tolerable exactness. In a coil of wire placed on one side of the sheet a current was started or stopped, and the electro-motive impulse produced in a subsidiary exploring coil was detected by means of a ballistic galvanometer. That the effect of the actual mirror was equivalent to that of the theoretical image was verified by substituting for the iron a coil equal and similar to the first, and coinciding with its optical image. Sending the same primary current as before round the two coils—with due regard to its direction in the second coil—hardly any appreciable difference in the secondary impulse was observed. This was found to hold good whether the original primary coil had its axis perpendicular or oblique to the plane of the magnetic mirror. Some observations on spherical sheets were also recorded, but in this case the conclusions were less simple.

## MISCELLANEA.

Large works are to be erected in the neighbourhood of Oldbury for the production of cyanide of potassium at a much reduced cost.

On a recent contractor's trial of the engines of the torpedo-boat destroyer Shark, in the Clyde, some of the copper tubes of the water-tube boilers split, and in consequence six of the men were scalded, some seriously.

The Institution of Civil Engineers, under the presidency of Sir Robert Rawlinson, K.C.B., at the last meeting elected 8 members, 130 associate members, and 4 associates, besides which the Council reported that 102 students had been admitted this session.

A new cruiser is being built for the Russian Volunteer Fleet by Messrs. R. W. Hawthorn, Leslie, and Co., of Newcastle-on-Tyne. She is about 500ft. long, 54ft. broad, with a draught of 24ft. It is stipulated that the speed shall average 19 5 knots during a twelve hours' trial.

The Bordeaux Chamber of Commerce have received offers from the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, Messrs. Guilton and Bertolus, of St. Etienne, and Messrs. Lombard, Gérin, et Cie. for the supply of electric cranes for the quays of that city.

The United States torpedo-boat Ericsson again broke down undergoing her official trials on Nov. 22nd. The contract speed is 24 knots, and the vessel was making 23 knots when the accident occurred, viz., the breakdown of the starboard air-pump. This is the fourth time her official trials have had to be abandoned.

Countess Spencer has undertaken to perform the ceremony of naming the new barbette first-class battleship Magnificent, which is to be floated out at Chatham Dockyard on December 19th. The first keel plate was laid less than twelve months since, so that the building may be regarded as a remarkable feat in naval construction.

The Cunard Steamship Company is considering the advisability of sending its steamers from Southampton instead of Liverpool. Delays at Queenstown, the lack of direct railway connection with the docks at Liverpool, and the want of a deep-water landing pier at the same port are the causes stated for the proposed change of terminus.

Messrs. Weyman and Hitchcock have opened a London office at 11, Queen Victoria-street, E.C. This firm have recently moved into new and completely equipped works at Cheltenham, equal to an output of some 500 or more of their Trusty oil and gas engines per annum, and they have, we understand, perfected their launch engine.

H.M.S. Wild Swan, sloop, recently underwent a satisfactory trial, at Keyham, of a system of induced draught with which she has recently been fitted. The Martin system was used. The results of the trials of this system have so far shown a distinct economy as compared with the ordinary forced draught system, and other advantages are also secured by it.

A new type of Whitehead torpedo, especially adapted for dropping gear, is being introduced into her Majesty's Navy. Although its diameter is but 14in., it has proved itself to have all the advantages of the short 18in. type, with greater stability and a larger explosive charge, and will be admirably adapted for boat work and the armament of small cruisers. No more of the short 18in. are to be manufactured, and the first-class battleships now building, and the cruisers Powerful and Terrible, which it was intended should carry them for use with boats' dropping gear, will now be supplied with the new 14in. type.

The Lake Washington Canal Scheme, concerning which there has been considerable discussion in Seattle for a number of years back, is in a fair way to be carried out, according to the *Post-Intelligencer* of that city. This paper reports that a contract has been signed by the State Land Commissioner and Eugene Semple for the construction of the canal. The work is to commence not later than March 1st, 1895, and is to be completed in six years. The canal is to be of sufficient capacity to accommodate vessels 300ft. long, 75ft. beam, and 22ft. draught. The contractor is permitted to construct and operate locks on the canal and charge tolls until the Government takes charge of them under the provisions of the Act authorising the work.

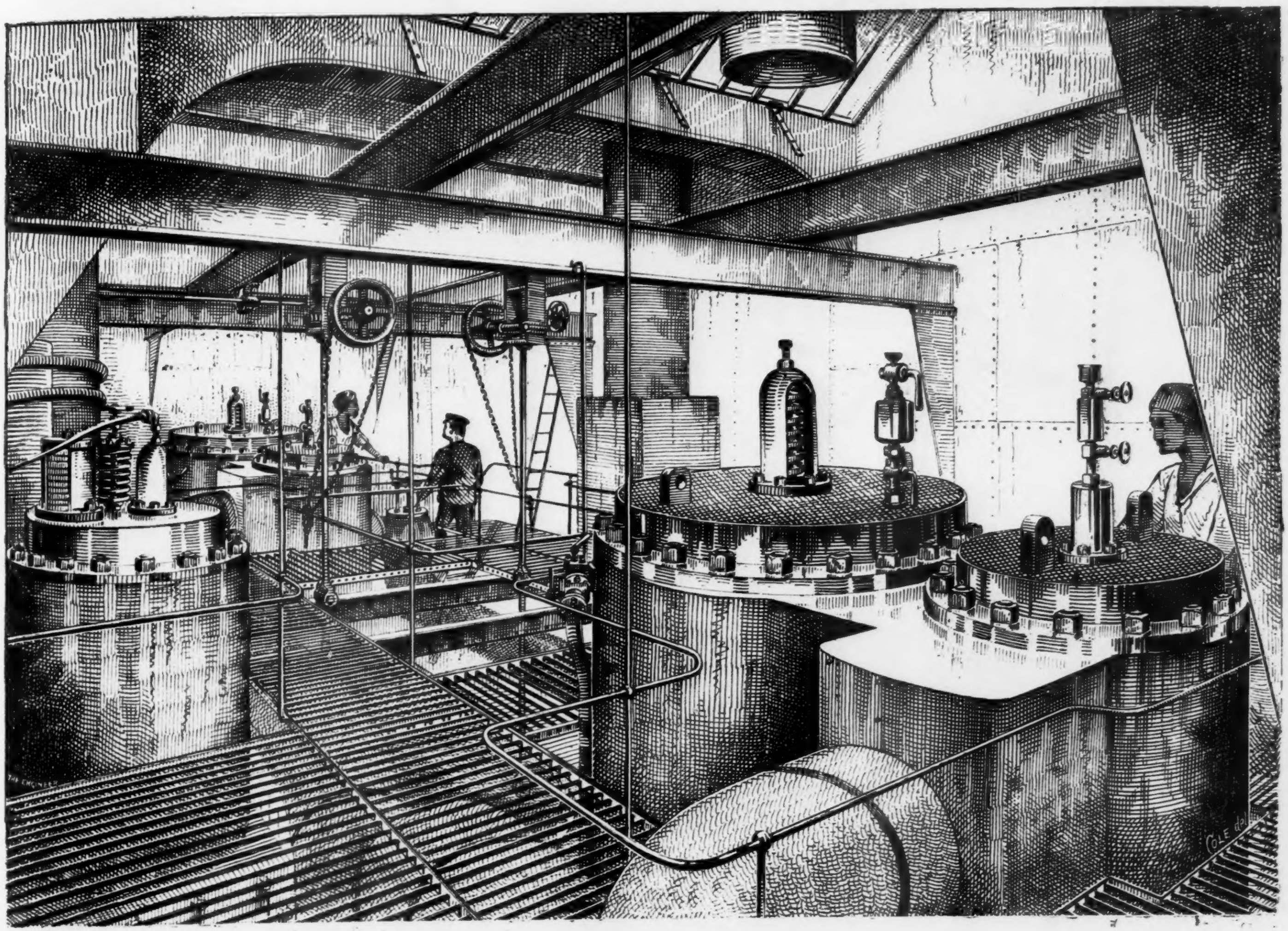
The Right Hon. A. J. Mundella, M.P. for the Brightside Division of Sheffield, was on Tuesday, at the Cutlers' Hall, Sheffield, presented with several gifts in recognition of his services in trade and commerce, during his twenty-five years' representation of Sheffield in Parliament. The principal present was his own portrait by Mr. A. S. Cope, A.R.A., which Mr. Mundella passed to the Mayor to be hung in the new City Hall. A replica of the portrait was presented to Miss Mundella. The other gifts were a beautiful cabinet of cutlery, consisting of nearly 200 pieces, and three silver bowls, of excellent design, manufactured by Messrs. James Dixon and Sons, of Cornish-place. There were several hundred contributors, irrespective of politics and creed, and the amount subscribed was £700.

The French Société Technique seem to be a munificent body. The following prizes are now offered by them to persons of any nationality:—£400 for a markedly better incandescent gas lamp, to be sent in before April 1st, 1895, the Council to decide whether the time may not be extended to May 1st, 1896; £320 in various prizes for essays on any subjects affecting the gas industry, particularly on mechanical handling of coal, coke, &c., on water gas or revivification, or on the substitution of hydrocarbons for cannel; £80 between those who have made the greatest progress in apparatus for making or using gas. Papers to be in French, and unpublished; motto, with name in envelope, and a declaration inside that the paper is unpublished, and that the author will not publish otherwise for a year. To be sent to the Société, 65, Rue Provence, Paris, by the end of April next. Also prizes of £10 to the authors of the best papers at the annual meeting, provided in this case that they are members of the Société; and the usual prizes of £8 each to deserving workmen long under the same company, or in the same gasworks, without a break.

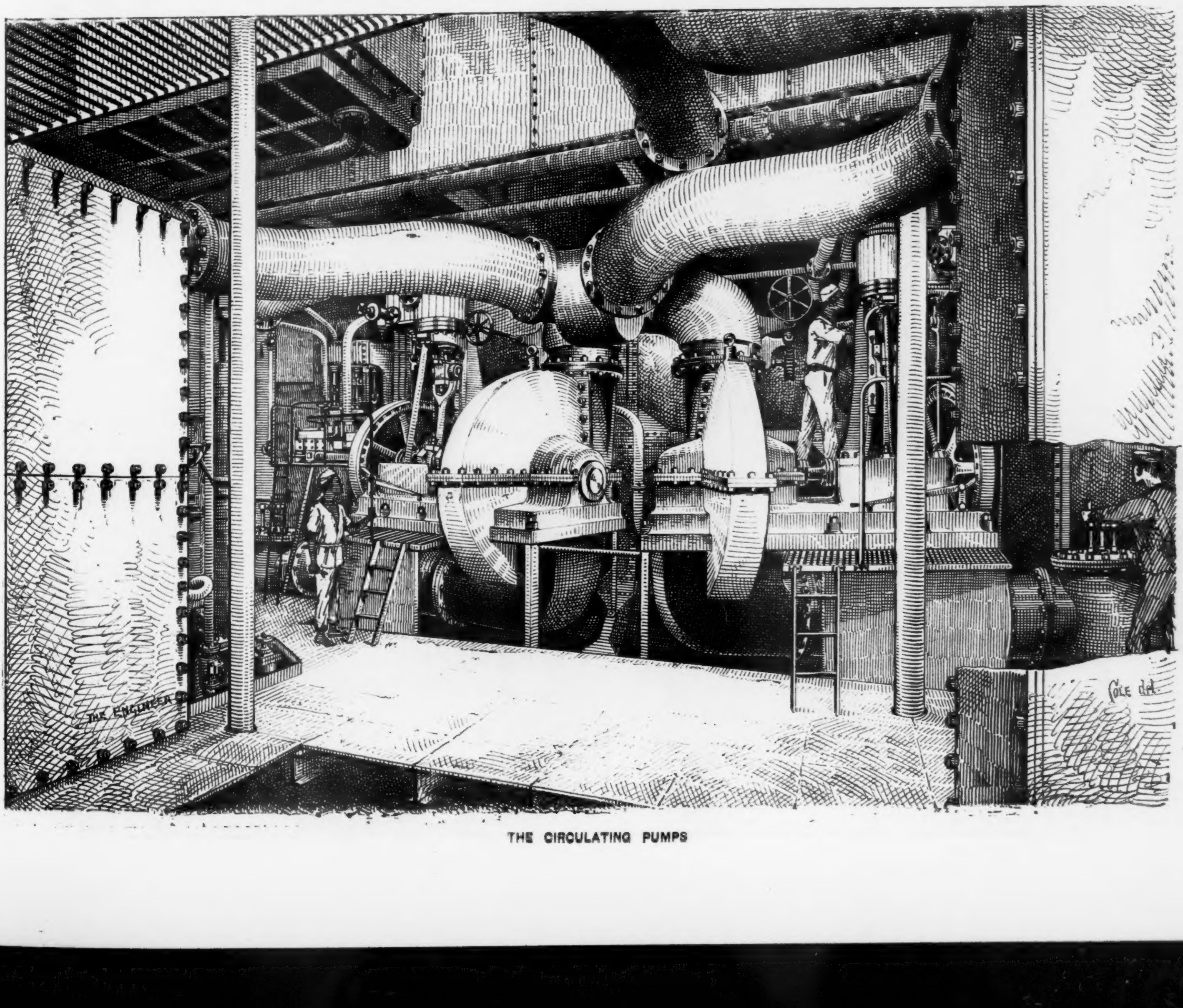
Concerning the French battleship Brennus, a correspondent, writing recently to the *Times*, says: "M. Marc Landry has written an interesting letter, which appears in the Paris *Figaro* of December 5th on the construction and failure of the Brennus. Her keel was laid on January 2nd, 1889, at Lorient; she was launched on October 17th, 1891, and has since that date been in the hands of the dockyard. Early in this summer she did her speed trial, and made good 16½ knots, a full knot less than her calculated speed. This autumn she was tested for gun fittings and stability, and is now to be largely reconstructed; when the guns are all trained on one side, as would probably have to be done at some period of an action, she listed so much that the hydraulic gear for working the guns was useless. The Brennus is a first-class battleship of 11,000 tons, designed to carry three 58-ton guns, ten 7-ton quick-firing guns, and twenty minor pieces. Her cost is already £1,200,000, and the contemplated alterations entail a further large expenditure. The excess of the top weights on the ship over the estimated weights has been caused by alterations made during construction. In our dockyards the comparative rapidity with which the warships are completed tends to lessen this mismanagement, but it is to be feared that pressure has been brought to bear on the construction department lately, which has caused expensive alterations of doubtful value to several of the already completed second-class cruisers."

# IN THE ENGINE ROOM OF THE STEAMSHIP CALEDONIA

(*For description see page 523*)



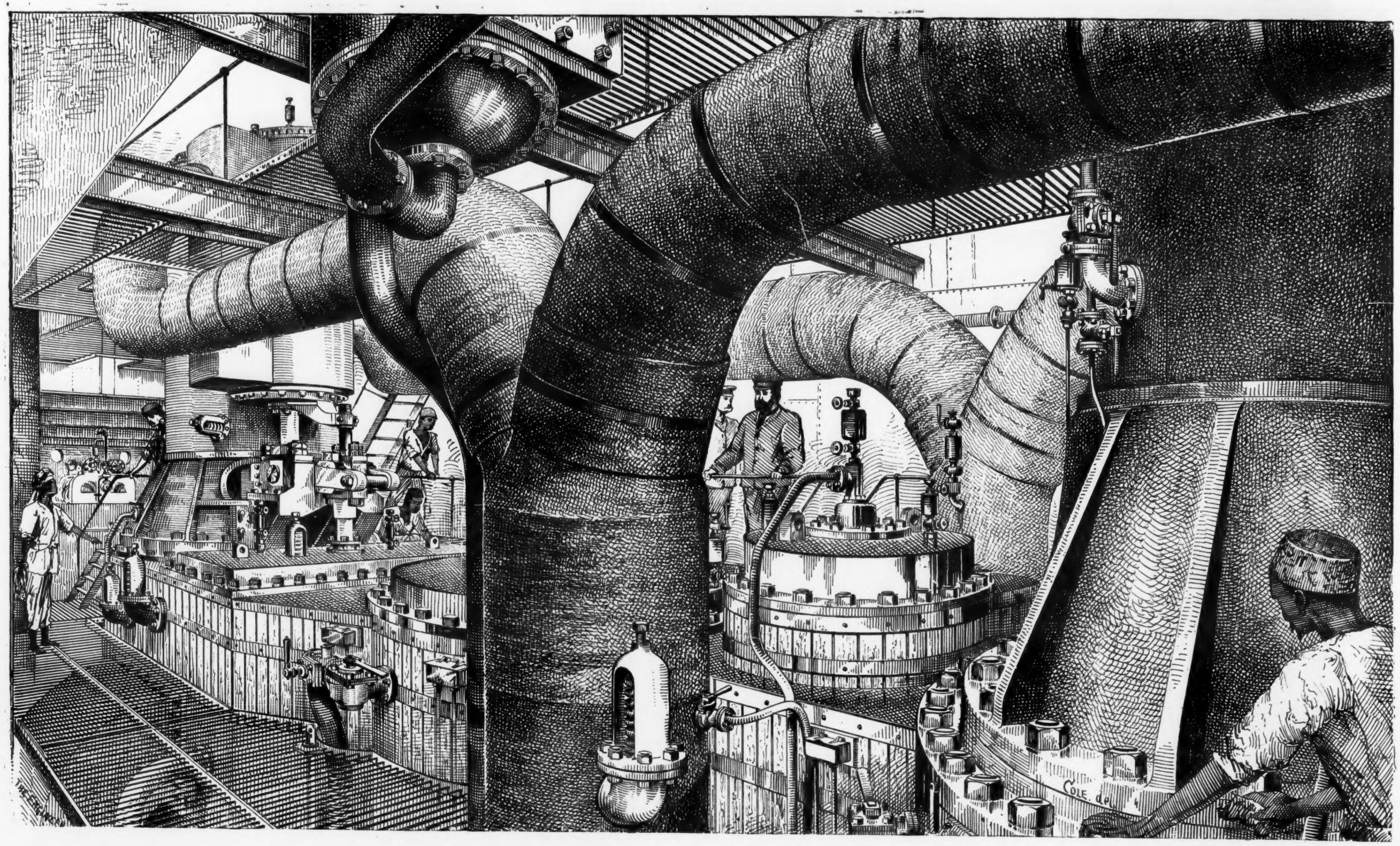
ON THE TOP PLATFORM


THE ENGINEER
COLE del.

THE CIRCULATING PUMPS

IN THE ENGINE ROOM OF THE STEAMSHIP CALEDONIA—ON THE THIRD PLATFORM

*(For description see page 523)*



Cole del
THE ENGINEER

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## PUBLISHER'S NOTICE.

*** *With this week's number is issued as Supplements a Four-page Engraving and a Four-page Tracing of a Six-coupled Bogie Goods Engine, Highland Railway. Every copy as issued by the Publisher includes a copy of the two Supplements, and subscribers are requested to notify the fact should they not receive them. Price 6d.*

## CONTENTS.

The Engineer, December 14th, 1894.

PAGE
The Chilian Cruiser Blanco Encalada. (Illustrated.) .. .. .. 501
Eighty-four Miles an Hour.. .. .. .. .. .. .. .. .. .. .. 509
The Atlas Works, Glasgow. (Illustrated.) .. .. .. .. .. .. 511
The Niagara Hall Ice Rink.. .. .. .. .. .. .. .. .. .. .. 520
Letters to the Editor—Governing Electric Light Engines—Theory of the Steam Engine .. .. .. .. .. .. .. .. .. .. .. 520
Locomotives and Trains—Traction Engines—Induced *v.* Forced Draught—Labour and Luxuries—Simplex Gas Engines and the Pantin Flour Mills—The Flying Machine.. .. .. .. .. .. 522
In the Engine-room of a P. and O. Steamer. (Illustrated.) .. 523
The Smithfield Club Show. (Illustrated ) .. .. .. .. .. .. 523
Railway Matters .. .. .. .. .. .. .. .. .. .. .. .. .. 525
Notes and Memoranda .. .. .. .. .. .. .. .. .. .. .. .. 526
Miscellanea .. .. .. .. .. .. .. .. .. .. .. .. .. .. 526
Leading Articles—The Machinery of Warships .. .. .. .. .. 529
Face-hardened Armour in the United States—Employers and the Unemployed .. .. .. .. .. .. .. .. .. .. .. .. .. .. 530
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. 530
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 532
Ferdinand de Lesseps .. .. .. .. .. .. .. .. .. .. .. .. 532
Lord Swansea .. .. .. .. .. .. .. .. .. .. .. .. .. .. 532
Electric Light Engine and Dynamo, S.S. Caledonia .. .. .. 533
Private Bill Legislation in Scotland, 1894-5 .. .. .. .. .. 533
Six-coupled Bogie Goods Engine, Highland Railway. (Illus ).. 534
Society of Engineers .. .. .. .. .. .. .. .. .. .. .. .. 535
American Engineering News .. .. .. .. .. .. .. .. .. .. 536
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire.. .. .. .. .. .. .. .. .. .. .. .. .. .. 536
The Sheffield District—The North of England .. .. .. .. .. 537
Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 538
American Notes .. .. .. .. .. .. .. .. .. .. .. .. .. 539
Launches and Trial Trips .. .. .. .. .. .. .. .. .. .. .. 539
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. 539
Selected American Patents .. .. .. .. .. .. .. .. .. .. 540
Two Four-page Supplements—Engraving and Tracing of Six-Coupled Bogie Goods Engine, Highland Railway.

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

A. H. W.—*The reel in your sketch simply takes the place of the pedals. The bicycle will move in the direction of the pull.*

E. du B.—*Small screw moorings are perfectly satisfactory if properly put down. They can be obtained to order from almost any ironfounder in a large seaport town.*

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*
*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

The Institution of Civil Engineers.—Tuesday, December 18th, at 8 p.m. Paper: "Colliery Surface Works," by Mr. Edward B. Wain, A.M. Inst C.E.

The Newcastle-upon-Tyne Association of Students of the Institution of Civil Engineers.—Wednesday, December 19th, at 7 p.m. Paper: "Newburn Bridge," will bé read by J. H. Barker, A.M. Inst. C.E.

The Institution of Junior Engineers.—Saturday, December 15th. Visit to Hampton Station of the Southwark and Vauxhall, Grand Junction, and West Middlesex Waterworks. Train leaves Waterloo at 2.15 p.m.

Cleveland Institution of Engineers.—Monday, December 17th, at 7.30 p.m. precisely. Paper: "On Economy in Steam Raising," by Mr. T. F. Meldrum, Manchester.

Royal Meteorological Society.—Wednesday, December 19th, at 7.30 p.m. Papers: "Report of the International Committee on the Cloud Atlas," by Robert H. Scott, M.A., F.R.S.; "Rainfall and Floods in the Catchment Basins of the Severn, Wye, and Usk, November 1894," by Henry Southall, F.R. Met. Soc; "Meteorological Observations at Mojanga, Madagascar, 1852-1894," by S. C. Knott.

Liverpool Engineering Society.—Wednesday, December 19th, at 8 p.m. Paper: "The Second Law of Thermo-dynamics," by Professor Oliver J. Lodge, D.Sc., LL.D., F.R.S.

Society of Arts.—Monday, December 17th, at 8 p.m. Cantor Lectures: "Modern Developments in Explosives," by Professor Vivian B. Lewes. Wednesday, December 19th, at 8 p.m. "Forestry," by General J. Michael, C.S.I. Clements Markham, C.B., F.R.S., P.R.G.S. will preside.

Aeronautical Society of Great Britain.—Saturday, December 15th, at 3 p.m. Reading and discussion of papers.

# THE ENGINEER.

*DECEMBER* 14, 1894.

### THE MACHINERY OF WARSHIPS.

We have already directed attention to some of the features of the paper which was read by Mr. A. J. Durston at the Institution of Civil Engineers on the 20th ult., but much remains to be said. As we have before stated, it was one of the most important of the marine engineering papers which have been contributed either to the Institution or to kindred societies. We regret that the discussion on it was hardly so full and complete as the subject deserved; indeed, some points of special interest in connection with warship machinery were passed over altogether. The paper itself is a statement of accomplished facts. Some particulars of the engines and boilers of 133 of the most recent war vessels are given, these including the whole of the seventy vessels built under the Naval Defence Act of 1889, and those vessels constructed during the few years immediately preceding the passing of that Act. Although the tables given look to be imposing with their large array of figures, it will be found by anyone who searches them for data upon which to base new designs, that practically no information can be got from them beyond the actual indicated horse-power obtained on trial trips, the total weight allotted to machinery, and the grate and heating surfaces of the boilers. The precise weights of boilers alone cannot be arrived at, as the weights given include, besides the boilers and their accessories, all casings, spare gear, and fittings in the boiler rooms; quantities which may vary with different designs and different arrangements. The other figures of the tables can be obtained from those already quoted.

We see from the paper that the period over which the building of the vessels extended embraced that marked by the important changes in design due to the substitution of the triple expansion engine for the two-cylinder compounds, and to the use of vertical in preference to horizontal engines. With the later designs the piston speed has been increased to 918ft. per minute, as compared with about 750ft. in the older vessels, while at the same time a considerable increase has been obtained in the power realised in proportion to the weight, in the way pointed out in our last impression. Especially is this true as regards the natural draught power. There is no doubt, also, that the more recent types of engines are more economical in coal consumption than those previously used, so that an all-round advance has been obtained.

It is not so much, however, with the information given in this paper that we are at present concerned, as with that which has been withheld or only briefly referred to. The Institution of Civil Engineers is a widely representative body, and amongst its marine engineering members the majority have not an intimate knowledge of the special requirements of the machinery of warships, and are therefore likely to judge of the particulars given, and the performances quoted, from the special standpoint of their own experience, which has been gained mainly or entirely with machinery of merchant vessels, in which the requirements are totally different. We think, therefore, that Mr. Durston would have done well, in placing a paper before this Institution, to have drawn attention to the very different requirements of the machinery in ordinary merchant vessels—where only one power, the full power, has to be provided for, and where economy at that power is of far greater importance than any question of weight or space which is likely to arise—from those of engines of warships in general, where not only is the production of a large power in proportion to weight an important consideration, but where the engines have to be so designed as to be as economical as possible at various rates of power, from the very highest to the very lowest. It would also have added much to the value of the paper if he had briefly indicated those special points which have determined differences of proportions of machinery under apparently similar conditions. As illustrating this, we may draw attention to the cases of the battleships Royal Sovereign and her sisters, and the Barfleur and Centurion. In each case the maximum power originally intended to be obtained was 13,000. In the former vessels a ratio of low to high-pressure cylinders of 4·84 to 1 was adopted, while in the two latter the proportion was 5·37 to 1; yet in the case of the latter, which presumably should be the more economical engines, the heating surfaces of the boilers exceeded those of the others by more than 10 per cent. A somewhat similar difference exists in comparing the machinery of the first-named battleships with that of the first-class cruisers. In the latter the cylinders are of identical dimensions with those of the former; but, instead of 13,000 indicated horse-power to be obtained, only 12,000 was attempted, and, to produce the lower power, boilers nearly 25 per cent. larger were provided. The proportion of power to heating surfaces in the battleships was thus nearly one-third more than in the cruisers. We do not question the wisdom of the Admiralty in adopting such differences of proportion; but we think that, without some explanation of the varied requirements of the two classes of vessels, very erroneous opinions may be formed on the subject.

Another very important point, to which attention was drawn by Sir Edward Reed, is the small amount of information given as to the reason why some of the battleships and first-class cruisers were not submitted to the ordinary full power or forced draught trials. The battleships were originally intended to indicate 9000 indicated horse-power at natural draught and 13,000 at forced draught. They all developed considerably over 9000 at the natural draught trials, but only one—the Royal Sovereign—was tested to the full power of 13,000, the average power obtained by the other seven vessels being only 11,500. In the case of the nine first-class cruisers the natural draught power was intended to be 10,000, and the forced draught 12,000. While all of them were tried at natural draught and successfully obtained the 10,000 horse-power expected, only three of them were subjected to the forced draught power trials. All that Mr. Durston tells us regarding this is that the valve gears were arranged for a maximum of 11,090 and 10,000 horse-power in the two classes of vessel, to enable them to steam more economically at the low powers usual when cruising. We are told also that the higher powers originally contemplated could at any time be developed by suitable modifications in the valve-gearing and propellers. On the face of it, this does not seem to us to be altogether satisfactory. We now learn that the leaky boiler tube question has been reduced to one of an insignificant character. Somehow or other the impression exists that this question had no little influence in determining the reduction of power referred to above, and if the trouble has been got over, by means other than the reduction of the power expected out of relatively small boilers, it appears to us that the full powers should now be obtained from these vessels, instead of our being contented with the reduced powers. If the less power is sufficient for all the needs of these ships, why was machinery of greater weight and cost than necessary placed in them? If, however, the present reduced power is the maximum which can with safety be obtained from the machinery as fitted, the fact should be fully recognised.

The impression that the leaky-boiler tube question helped largely to determine the reduction of power we are considering becomes strengthened when we look at the proportions between powers obtained and weights of boilers. In the Admiral class, where very little trouble was experienced from this cause, we find that 169 indicated horse-power was obtained per ton of boiler. These vessels were fitted with compound engines and only worked at 90 lb. pressure. Allowing that triple expansion engines are 20 per cent. more economical in use of steam than compounds, if the boilers of the later vessels were only forced to the same extent as those of the Admirals, and making no allowance whatever for the increased weight due to strength requirements for the higher pressures used, we should get 20·3 horse-power to the ton; but, allowing for the increased weight due to the strength requirements, somewhat less should be expected. In the Australia and her sisters 20·7 was actually obtained. In the third-class cruisers of the "M" type 25·3 horse-power per ton was realised; while in the Blenheim no less than 28·3 was developed. In the battleships at the reduced powers of 11,500, only 19·7 was obtained, while in the first-class cruisers at their reduced power the figures fall to 16·2. It is very significant that the leaky tube troubles increased as the power per ton increased, while with the considerable reduction in this proportion all trouble from this cause vanishes.

In reply to the discussion on his paper the author explained that, as an average, taking the so-called natural-draught power of war vessels to represent 100, the forced draught or full power would be about 120, while the actual full power expected to be maintained at sea continuously for long periods would be from 60 to 80. Remembering that the so-called natural draught power is really obtained with closed stokeholds, using ½in. air pressure in cases where ordinary boilers are used, and as much as 1in. where the boilers are of the locomotive type; it will be seen that the power which should really be called the natural draught power, and which can fairly be compared with that obtained in merchant vessels, is neither the forced draught nor the so-called natural draught power, but the power represented by the 60 to 80. In other words, it is only about one-half of the forced draught or full power. In comparing the machinery of war vessels with that of merchant vessels this should be borne in mind, and we think that the author would have done well to have pointed it out. Unless this is borne in mind by those who are familiar with the performances of our splendid mail boats, such as the Campania or Caledonia, which during their whole voyage of many days' work at full power, without any stoppage whatever, and this not once or twice only, but continuously and regularly, the statements of the Royal Sovereign, of nominally 13,000-horse power, maintaining 8180-horse power for seventy-two hours, or of the Sirius, of 9000-horse power, maintaining 4555-horse power for sixty-four hours, would appear to be condemnatory of these vessels, instead of being, as they really are, of a satisfactory character. The coal consumptions quoted are also liable to be misconstrued, if compared with those obtained with machinery designed specially with a view to economy, unless the special conditions dominating the designs are remembered.

The omissions of the explanations we have indicated are, however, in our opinion, not so important as the total silence regarding the reasons which have led the Admiralty to adopt the Belleville boiler for the new cruisers Powerful and Terrible in preference both to ordinary boilers and to water-tube boilers of other designs. We do not for one moment doubt that the Admiralty had good reasons for the course they have pursued; but at a time when marine engineers throughout the country, and shipowners as well, are anxiously looking for light and leading on the water-tube boiler question, any statement of the facts upon which the Admiralty must have based their decision to adopt this special type of boiler would have been extremely welcome. The choice of a type of boiler is no light matter. A mistake in this respect will be fatal to the success of almost any vessel, and it is not too much to say that information on this point was eagerly looked for, and the disappointment at its not being forthcoming is keen. It was also anticipated that some data would have been vouchsafed as to the evaporative efficiency of these boilers as determined by the experiments which have been made on the Sharpshooter. All we are told is that the boilers have given satisfaction. Surely here a great chance of obtaining the gratitude of engineers and shipowners in general has been missed.

There is one point raised by the paper which, although no reference was made to it in the discussion, gives us great concern. It is not so much to do with the machinery as with the men. We gather from Mr. Durston's paper that the only training our engineer officers and engine-room staffs have, when in commission, for using the powerful machinery fitted on board at anywhere near its full power, is limited to a four-hours' trial once in *three months* at the natural draught power, while the forced draught power is never obtained, or even attempted. This we consider is a very grave matter. It goes without saying that speeds and powers obtained once on the official trial trips are of no use whatever, unless they can be obtained when required, as emergencies arise, by the vessel's own staff. It is common knowledge that even on the trial trips, where the contractors employ as large a staff as they please of highly-trained men, from some reason or other the trials are sometimes unsuccessful, and it cannot be expected that such powers and speeds can be attained by the ordinary crews with certainty and safety unless they have special training at these powers. We hope that a similar course is not pursued of only occasionally training our gunners and torpedo staff with blank charges and with dummy torpedoes. This question of properly training our engine-room staff is of the utmost importance, and must be faced at once. It is more than ever necessary now that quite a fleet of destroyers is being added to the Navy. The engine department of these vessels is a complete departure from everything which has preceded them, and their wonderfully light and powerful machinery can only be properly utilised by training a sufficient number of engineer officers, artificers, and stokers in their use, not only at comparatively low powers but also at full power. We hope that the Admiralty will do this, otherwise when the time arrives for their use in actual warfare we shall find that they will have to be kept in harbour because we have no one who can properly keep them at sea.

### FACE-HARDENED ARMOUR IN THE UNITED STATES.

Captain Sampson, U.S.N., Chief of the Bureau of Ordnance, has contributed a paper to the American Society of Naval Architects on the "Present Status of Face-hardened Armour." The position of the author and the importance of American investigation in this question give special weight to this paper. The author states that although the shrinkage and change of angles in the various processes of cementation and tempering involved in face hardening, complicated by those of bending and rectification, seem to follow no definite law, still manufacturers have succeeded in foreseeing them with sufficient clearness to make most satisfactory butts and joints in the armoured structures thus far inspected. "The difficulty of securing structures to the hard face, in default of knowledge as to the exact location of the fastenings, is also in course of solution. It was found feasible to tap and drill holes in the face of the plate at any stage of the process prior to hardening without detracting from the plate's resistance; but as it was impossible to locate these holes with precision without fitting the armour into place, this method was abandoned in favour of one by which the carbon was prevented from penetrating over certain areas in the wake of the fastenings. This method had also its disadvantages, in that the carbon gases frequently seeped through the protecting material and carbonised the surface beneath. The most satisfactory method, and one which will probably be employed in the future, is that of electrically annealing the surface to be drilled." We have quoted verbatim those sentences which deal with the pith of the manufacturing question. It is curious to observe that for the moment the makers in the United States and England are moving in opposite directions in more than one respect. We say in England nickel treated plates cannot be acted on by the arc drill, and those plates which have no nickel in them are, after all, best dealt with by drilling holes before face hardening. On one occasion Brown's firm have submitted a plate with a soft margin to take drilled holes, but it was rather regarded as a possible than likely expedient. In the United States, on the other hand, soft places or holes drilled before hardening have been tried and superseded by the electric arc drill, and that with nickel Harveyed plates, which we consider do not admit of its application. Further experience must modify such sharp contradictions.

Captain Sampson considers that the greatest objection to face hardening, and the one likely to continue, is cost. Repeated machinery and other operations can hardly be dispensed with, which must involve expense. As to nickel, Captain Sampson speaks strongly in its favour. It enables armour to be made "far stronger and more resisting," and at the same same time tougher also. When its working has been mastered, its use diminishes risk of failure, because it is less susceptible to injury in working, though very susceptible to treatment. Hence the decreased percentage of failures will go far to wipe out the increased cost of machinery. "Nickel also appears to render the carbon more sensitive to hardening, and hence water-hardened Harvey plates of nickel steel are toughened at depths hardly affected in simple steel plates." The difficulties mentioned by Mr. Ellis have hardly been experienced in the United States. In short, the question now is, whether the present percentage of nickel, 3·25, cannot be increased. Captain Sampson states that the Witkowitz unhardened plate, which won the remarkable victory at Pole over treated competitors, contained 5 per cent. of nickel. Even in England, says the author, nickel steel is employed for unbacked structures. A word or two is called for here. We do not know what is referred to. Horizontal armour has been made of nickel steel in England, but it has been rejected, we believe, for all side armour. Personally we so far go with Captain Sampson that we hope that the final word on nickel has not been spoken in this country. We have held that we could not afford to let nickel drop, seeing that for shields which are exposed to an attack which is formidable from its long continuance, and not from the crushing force of a single blow, nickel steel is the best possible material speaking from present knowledge. An inland cupola or shield, for example, would be exposed to the long-continued breaching attack of siege guns of moderate power. It would be easy generally to supply an untreated nickel shield, capable of resisting a single blow, and such a shield would bear continued attack indefinitely long. It would, it fact, behave like a very superior kind of wrought iron. Further, without questioning the wisdom of supplying for our ships building at the moment the shields which we find best, namely, treated steel without nickel, we trust that nickel is not to be lost sight of, even for ships, as still possibly desirable. The experience in America deserves to carry weight enough to forbid our disregarding it. A competition between a champion treated nickel United States plate and an English all steel one would be specially valuable, and we think that he would be a bold man who would back the all steel plate confidently.

We need not follow Captain Sampson into the details of the conditions of French and United States plate tests. He sums up the firms who have adopted the Harvey process as follows:—In England, Cammel, Brown, and Vickers; in France, St. Chamond, Chatillon-Commentry, Marrel Frères, and St. Etienne, and Messrs. Schneider; also Krupp, Dillinger, and Witkowitz, although the five last-named had face-hardening processes of their own. Although the author considers that it is rather wild work to estimate the amount of increased resisting power due to Harvey's process, the French estimate of 1·8 and the English of 1·83, as compared with the same thickness of wrought iron, agree. Probably the case, when the same relation in America worked out as 2·14, is exceptional. The fact, however, is that any thoughtful man would, like Captain Sampson, refuse to be drawn into an exact estimate, seeing that the resistance of treated plates depends on their power to fracture the shot. How can the power of a breaking tool be a matter of close calculation? Further, could this even be done, circumstances may arise when the shot does not break, and when the conditions are consequently wholly changed, as in the case of occasional rounds fired at low velocities, or with caps on the point of the shot. On this last question the author expresses the opinion that the cap does not prevent fracture proper, but rather acts as a sort of lubricant or medium, on which the jagged edges of plate work, instead of gashing into the steel shot itself. As to this, while it is certainly true that capped shot, after obtaining much greater penetration than others, are often found broken, the explanation readily suggests itself that fracture was deferred till considerable work was done. As to Captain Sampson's objection that the metal of the wrought iron cap had not been found on the face of the plate, and therefore could not have worked back and formed a support round the shot head, we must remember that it is the hard skin alone which fractures the shot of the present day; the needed pad or support to help the tip of the shot through this is a very small one, the cap on the lower part of the head may act perhaps as Captain Sampson suggests. Judging from the tables, the cap has been rather less successful in America than in Russia and England, which accords with the author's belief that the hard film extends deeper in nickel than in plain steel armour. Captain Sampson concludes with the sound opinion that, let projectiles improve as they may, it must always be advantageous to harden the face of a plate.

Captain Jaques, in discussion, questioned the adoption of Harvey's process by all those who had other hardening processes of their own. He thought it difficult to accept England's conclusion that while the United States had led the way with treated armour, it was safe on the results obtained in England to throw over nickel, which has been found so valuable in America as well as by Krupp and St. Chamond. Captain Jaques' remark as to the English experience of treated plates being principally confined to 10·5in., and in a great measure to 6in. plates, bears upon the question of nickel, we think, holding as we do that hardness has its greatest value in the thin plates used for cruisers, while toughness grows in relative value in line-of-battle ships, attaining, as we have already said, its minimum value in inland shields. Captain Jaques made some allusion to the efficiency shown by the Japanese. It appears that he has rendered such assistance to Japan in the ordering of their armaments as to receive the decoration of the Rising Sun, a very significant decoration for an ambitious Eastern Power.

### EMPLOYERS AND THE UNEMPLOYED.

Manufacturers in the North and the Midlands are turning their attention more and more to the question of relief for workmen out of employment, as well as for those who are incapacitated by advancing years or sudden accident. In several districts a system of old-age pensions has been adopted. In Sheffield some of these organisations are now, and have been for some years, in active operation. It has been felt, however, that these are not quite adequate to meet the increasing requirements of our various industries. One of the leading manufacturers, Mr. Joseph Jonas, J.P., of the firm of Messrs. Jonas and Colver, Continental Steel Works, Attercliffe, has brought before the notice of the working men in that district a method which he found in operation in Berne, a Swiss town, with a population of between 35,000 to 40,000. Since April of last year there has existed at Berne an association, supported and subsidised by the Corporation, to insure members against unmerited loss of employment. Every member contributes 4½d. per month to the general fund, from which relief can only be had during the hard winter months of December, January, and February. No contributions are levied upon members when they are out of work. After a period of at least six months' membership, the unemployed can apply for employment or relief. If the committee fails to provide work to any member, he is entitled to a payment out of the Society's funds of 9½d. per day if single, and 1s. 2d. per day if married. The claim to the Society's benefits is forfeited if employment should have been lost through illness, drink, immorality, disobedience, or other bad conduct. It is also also provided that the relief fund shall not be available for those who give up their calling in consequence of wages' disputes or strikes. The fund, it may be mentioned, is maintained from four sources—(1) by the contribution of the members; (2) by contribution of the employers; (3) by subsidies from the Corporation; (4) by voluntary subscription. The subsidies voted by the Corporation are to supply any deficiency at the end of each financial year, the total amount not exceeding £200. The Committee of Management consists of seven members, of whom three are elected by the Town Council, two by the members entitled to the Society's benefits, and two by the contributory employers. These seven elect their own chairman. In December, 1893, the number of unemployed members who made application for relief was 118; in January and February, 1894, ninety-two and six respectively. Of this number, 216, the committee provided fifty with work, and the remaining applicants received £270, or an average of about £1 12s. 6d. each. The Corporation, to meet these claims, had to make up a deficiency of £190. Mr. Jonas does not think that the system has been in operation long enough to recommend its immediate application to England, but he points out that some properly organised insurance against loss of employment is a great aid to the authorities in dealing with the unemployed, whose numbers, in times of trade depression, often increase to a degree of general calamity. "Such institutions," he says, "enable them to distinguish and to refer to those of the unemployed, who have still some sense of the principle of self-help, and are ready to bear some sacrifice to that end." The Berne scheme is, of course, but an experiment, and the fact that £190 had to be provided by the Corporation out of a total of £270 is rather formidable when it is faced. Applied to our great cities, with their hundreds of thousands of people, the drain upon the municipal resources would in proportion be serious. But it is serious in any case. The difference between the present methods of relief, or to put it more accurately, the present want of method, and an organised scheme like that at Berne, is simply that in the first case the money is given almost haphazard, and relief works, which are inevitably resorted to, are costlier even than charity. This is inevitable, for men accustomed to a craft requiring delicate handling are suddenly set to road-making, or excavating, or street clearing, or some other rough occupations, for which they are utterly incapable. In the scheme explained by Mr. Jonas, on the other hand, there is the element of discretion and the recognition of the principle of self-help. There is no doubt that once a community recognises the right of people who are out of employment, through no fault of their own, to consideration at the public hands, that community will take the utmost care that the number of unemployed shall be reduced as low as possible. Friendly Societies can undoubtedly do a great deal in this direction, and the Berne scheme appears to point out a way in which their utility could be vastly extended. The discussion at all events of this, or any other such scheme, is decidedly helpful for arriving at a clear knowledge of the best means of meeting the great emergency of thousands of people without anything to do, and a whole community at its wits' end to give them sufficient to keep body and soul together.

## LITERATURE.

*Ways and Works in India: being an Account of the Public Works in that Country from the Earliest Times up to the Present Day.* By C. W. Macgeorge, M.I.C.E. London: Archibald Constable and Co. 1894.

The field that, according to his title, the author enters on is wide and interesting. He tells us at starting that his facts and figures have been mainly gathered from official publications, Government records, and reports or papers read before the Institute of Civil Engineers. He has, however, compiled a very readable volume, and has treated his subject so as to be useful to the student, while it interests the general reader. Although with much to approve, we must take exception to the introduction of much superfluous matter, such as expositions of the elementary principles of trigonometrical surveying and telegraphy, and the unnecessary references to English examples and practice in the case of railways. Even a tyro in engineering can hardly care to have served up in connection with Indian railways the oft-told tale of the Rocket, &c., and the history of the rise of the English railway locomotive system under Robert Stephenson, or the Board of Trade regulations. The book, however, when it comes to deal with the facts and descriptions of actual works, is at its best, and the reader is rewarded by the value and interest of the matters treated of. He traces up the road system of India from the time when roads were mere tracks or avenues for the use of foot passengers and pack animals, with a covering of soil only, to the condition when wheeled carriages demanded the improvement of the surface by moorum, gravel, kunker, or metal coverings.

His history of the introduction and development of railways in India is very full and interesting, and his selection of examples of works of construction on both roads and railways is very judicious, although in one or two cases, such, for instance, as the Kahan Bridge, we fancy, from rumours that have reached us, there remains more to be told. The subject of railways occupies more than one-third of the volume, and in the matter of statistics and finance, which he quotes in great detail, he brings us up to the end of the year 1891.

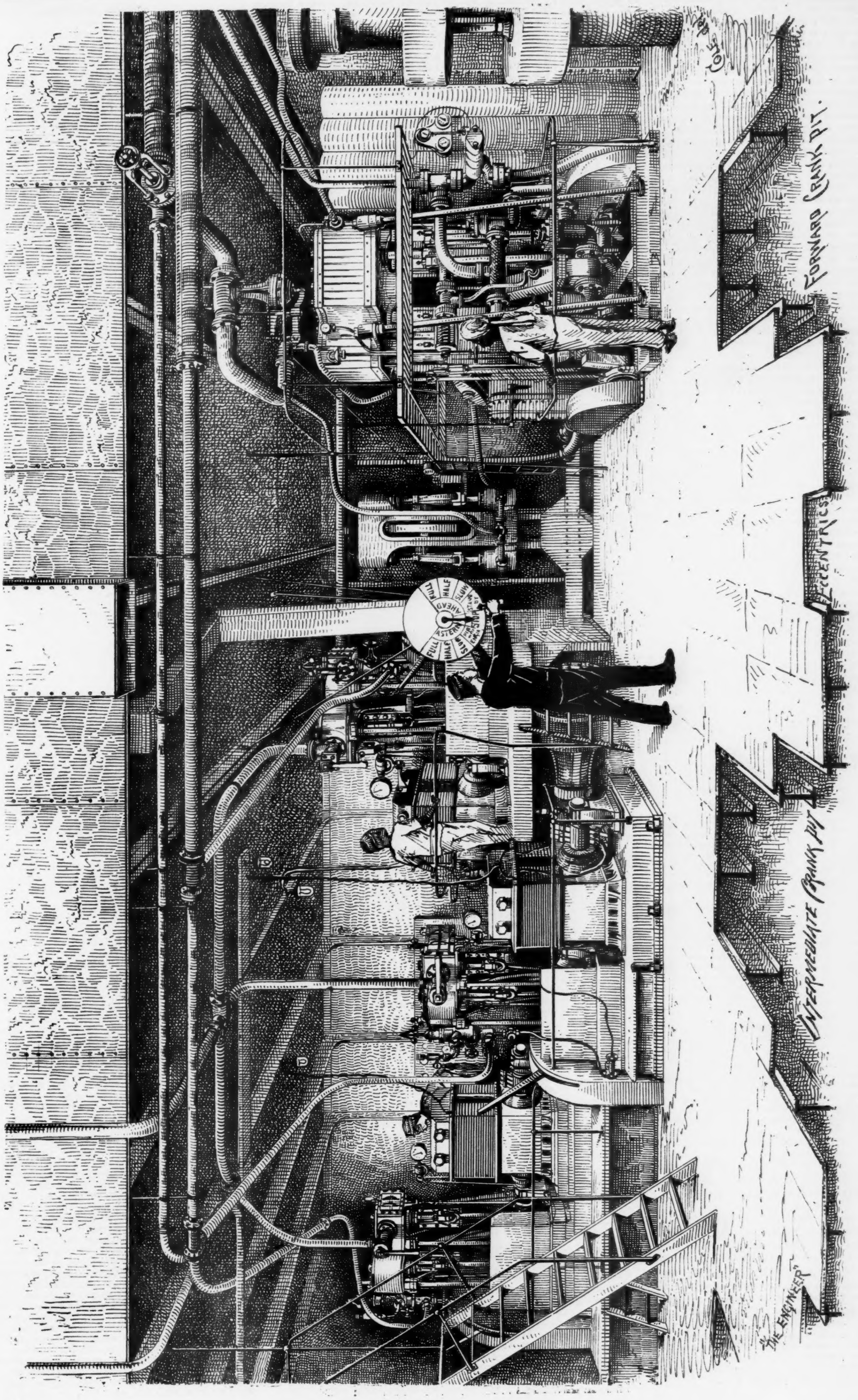
In India, next to railways, irrigation works are most important, and to this subject he devotes nine useful chapters, in which he sketches briefly the outlines of the more important works throughout the country. A few chapters on the water supply of towns, in which some useful information is collected, including the most recent additions to the supply of Bombay, Madras, Kurrachee, Jubbulpore, and elsewhere, disposes of this part of the subject. The book closes with articles on the electric telegraph system and the sea and harbour works of India, in which the information given regarding the very important works both in Bombay and Calcutta is meagre in the extreme. Some voluminous statistical tables and a good index, with a trigonometrical chart, complete this acceptable little volume.

*The Repair and Maintenance of Machinery.* By Thomas Walton Barber. Spon, London. 1894.

"Give a dog a bad name and hang him;" give a book an inappropriate title and it receives even more severe

IN THE ENGINE ROOM OF THE STEAMSHIP CALEDONIA—THE ELECTRIC LIGHT INSTALLATION

(*For description see page 523*)


FORWARD CRANK PIT.
ECCENTRICS
INTERMEDIATE CRANK PIT
AHEAD
ASTERN
FULL
HALF
SLOW
STOP
COLE del.
"THE ENGINEER"

treatment. Parts of the work before us might have passed muster under another cover; had the book, for example, been called an "Illustrated and Descriptive Catalogue of Certain Machines," one might have received it, if not with approval at least with patience, but the former emotion is never inspired, and the latter virtue is soon exhausted when the reader finds on page after page of a work professing to be written for a specific purpose, only the most trivial matters in connection with its ostensible subject. An excerpt or two will satisfy our readers that the strictness of this censure is deserved. On page 18, in a chapter entitled "Boiler Repairs," we find an important operation disposed of thus: "In bad cases it becomes necessary to cut out a fire-box or flue tube entire, repair or replace it by a new one, and then rivet in again. Such an extensive repair is very costly, especially if executed on the spot." No word whatever occurs about the means generally adopted for effecting this renewal. A tailor could have told us nearly as much about patching a boiler as this engineer has to say. No examples that are not absurdly evident are given. The author catalogues and illustrates the defective parts well enough, but in a work of this nature one is led to expect remedies and not diagnoses only. Again, on page 56, Mr. Barber has under consideration a cylinder in which the admission port allows steam to blow through into the exhaust. To mend the defect he says, "If the hole can be got at in any way it may be plugged, or covered by a plate carefully let in by a good fitter." No sketches, no example, no suggestion as to overcoming difficulties, nothing but this bald unneeded suggestion. On the opposite page a sketch of an ill-proportioned piston ring catches the eye. The letterpress accompanying it gives very bad instructions. "Piston rings," the author says, "should be turned a little larger than the bore, so that when cut they have sufficient spring in them to fit tightly in the cylinder." Now-a-days a good engine builder splits the rings after rough turning, presses the sections close and finish turns them to the bore of the cylinder. A very little fitting then makes them touch evenly all round. Mr. Barber's ring would rub hard in three or four places perhaps, not being of the same curvature as his cylinder. It is quite unnecessary to multiply examples of the weakness of this work. As regards repair and maintenance it is practically useless—except, perhaps, to a totally inexperienced person. Regarded as a catalogue, the section devoted to gas engines is the most complete and useful, though even in this we find a serious omission. Atkinson's gas engine is not illustrated, and an indifferent description only is given. As this engine is unique in its action and among the most economical in its working, it deserved fairer treatment. Most other types are illustrated and explained. This part forms the only redeeming feature of the book.

We must ask the author, too, to forgive us for suggesting that even technical English has a grammar and syntax, and that "style" in an author is esteemed a desirable quality.

## *BOOKS RECEIVED.*

*The Royal Indian Engineering College, Cooper's Hill. Calendar for* 1894-5. Containing a syllabus of the courses of study. Price 5s. London: W. H. Allen and Co. 1894.

*Workshop Appliances.* By C. P. B. Shelley, M.I.C.E. Revised and enlarged. Tenth edition. London: Longmans, Green, and Co. 1894.—The value of this book has been considerably increased by the addition of a chapter on "Milling," by R. R. Lister.

*Model Engine Construction. With Practical Instructions to Artificers and Amateurs.* By J. Alexander. London: Whittaker and Co. 1894.—Usually amateurs and boy engineers have to be satisfied with very inferior drawings of engines and other machines of which they wish to make models, but in this book Mr. Alexander, aided by the drawings of Mr. C. E. Jones, has made things considerably easier for the model maker. We do not, however, see why so thick a book should be made by leading the type out to a most unnecessary width, no advantage being gained, as far as we can see, in any way.

*The Electro-Platers' Handbook: A Practical Manual for Amateurs and Young Students in Electro-Metallurgy.* With sixty-one Illustrations. By G. E. Bonney. Second Edition, enlarged by an Appendix on Electrotyping, &c. London: Whittaker and Co. 1894.—But few modifications have been made in this edition, and these only to meet small changes in the structure of apparatus which have been made since the publication of the first edition. Electro-plating in the various ways as described in this book can be easily carried out by the amateur, as well as by those who conduct these operations for business purposes, and it may provide a useful as well as an interesting leisure occupation.

*Building Construction: A Key to Examinations of the Science and Art Department.* By Henry Adams, M.I.C.E., F.S.I. London: Chapman and Hall. 1894.—Although the author of this book says there is no royal road to success in examinations of the Science and Art Department, the object of his series of books, of which this is one, is, as far as possible, to provide that royal road. It relates to the construction of walls, that is, bricklayers' work, bonding, &c., foundations, methods of building in beams and key-plates, excavating for foundations, the construction of roofs and of diagrams showing the stresses upon them, construction of windows, doors, framework, stairs, iron roofs, and the strength of beams and floors.

## FERDINAND DE LESSEPS.

On the 6th instant passed away at a great age Count Ferdinand de Lesseps, after a brief illness. His name will be linked for centuries to come with the greatest engineering success and the most disastrous engineering failure recorded in the history of nations. The Suez Canal virtually revolutionised the construction of the world, bringing the east and west together. The Panama Canal, had it been ever so successful as a canal, could not possibly have had a similar influence on the doings and dealings of mankind. The Suez Canal reduced the time occupied in traversing the interval between Europe and India, not alone for ships, but for mankind. But the Panama Canal could do the world no similar service, because already the railway unites the western and eastern coasts of the North American Continent. Happy would it have been for multitudes if Count de Lesseps had remained content with his achievements in Africa and left the New World to younger men.

De Lesseps was not only a Frenchman, he was a Parisian. The difference is important. He was born at Versailles on the 19th November, 1805, at a period when railways were unknown and steam did little else than pump. In no real sense of the word was De Lesseps an engineer. He was a diplomatist by birth, education, and instinct. He received his education at the expense of the State, at the Lycée Napoléon. In 1825 he was appointed as Attaché to the French Consulate at Lisbon, and in 1828 he was Attaché to the Consulate-General at Tunis. He went to Egypt in 1831, and became Consul at Cairo in 1833, and subsequently at Rotterdam, Malaga, and Barcelona he filled a similar post.

The history of the Suez Canal has been very fully narrated in our pages. To reproduce it here would serve no good purpose; rather let us sketch, however briefly, the career of the man. In 1841 he seems to have first thought of the project. Wars and rumours of war, the events in the Crimea, the Indian Mutiny, stood in the way and stopped progress. No one would listen to Lesseps. When at last people opened their ears to him, England took fright, and the scheme was vigorously opposed. Only one daily journal, the *Times*, gave him a lukewarm support. We took from the first a different view. Leaving politics on one side, we dealt with the engineering aspect of the scheme. The following extract from The Engineer, July 17th, 1857, serves to illustrate our attitude:—"Lord Palmerston last week did not hesitate to give a very decided opinion as to the Suez Canal question, and if an opinion of his lordship is sufficient to prevent the carrying out of this scheme, it is of course shelved for this century at all events. We are not disposed to quarrel with the Premier as to his views, politically speaking—they may be sound or not, and it is not our province to discuss them—but when he asserts that the construction is impracticable, we take leave to say he is wrong. The practicability of the construction of the Suez Canal has been attested by the first engineers of the age, whose opinions none can venture to controvert. This is all we can say at present, and all we have ever said, so far. We leave other considerations for those better able than ourselves to settle, though we may venture to suggest that what is sauce for the goose is usually considered ditto for her helpmate; and if there be any weight in the suggestion that our Indian Possessions might be readily opened to the encroachment of Russia or France by the Suez Canal, it undoubtedly would, at the present time, were it constructed, contribute very greatly to the relief of the public mind by facilitating the arrival of our troops in our disturbed Indian Empire."

Late in 1855 nothing had been done, and De Lesseps was already fifty years old; at last the Emperor Napoleon III. gave him an audience, others lent aid, and finally, in January, 1856, he got a concession from Said Pasha, and in 1859 the works were commenced. A canal, with sufficient water to admit of the passage of steamboats, was opened on August 15th, 1865. The channel was widened and deepened by special machinery, and in March, 1867, small ships were able to make use of the canal. The waters of the Mediterranean mingled with those of the Red Sea in the Bitter Lakes on August 15th, 1869, and the event was commemorated by grand *fêtes* at Suez. On the 20th of the following November the canal was formally opened at Port Said amid a series of brilliant festivities, as recorded in our pages at the time. As to what this highway of nations has become, an idea may be formed when we say that the Peninsular and Oriental Company have paid in one year £240,000. In the year 1891 the canal receipts reached £3,260,000. The toll on a large cargo steamer sailing from England to Bombay amounts to from two to three times the cost of all the coal she burns on the voyage.

As to the way in which the canal was constructed, the disputes concerning the Sweet Water Canal Company, the questions about the difference of levels between the Mediterranean and the Red Sea, Robert Stephenson's report, the Corvée, and a dozen other matters, the history has been fully written. At one period Ferdinand de Lesseps was the most abused man in Europe. But his success conquered all opposition. The canal became a fact; so did De Lesseps' reputation. Honours were showered thickly on him, and at one time it required some courage tosay that he was not an engineer.

During the remainder of his life Count de Lesseps had one dominant desire. He wanted to cut more canals. At all times he believed with straightforward innocence in himself. The success of the canal, the laudation of the nation, only strengthened him in the conviction that he could do what he pleased with the face of the earth. It is in no wise remarkable. The history of the Panama Canal has yet to be written. For ourselves, we have no hesitation in saying that Count de Lesseps was perfectly honest in all that he said and did concerning it. Nothing was done in the way of actual work until 1881, when the Count was seventy-six. At that age pardonable vanity is likely to flourish. If it was difficult for De Lesseps to doubt his own capacity at fifty, while the Suez Canal had yet to be created, it was impossible at seventy-five. A mistake was made by the French nation. There is no reason to believe that any large number of shares are held outside the shores of France. It would be waste of time to repeat the scandalous story of the Panama Canal. During the latter stages the old man was lying utterly broken down in mind and body in his château at La Chesnaye. It is pleasant to think that the veteran knew nought of the storm that raged around his name; and so at last Ferdinand de Lesseps died quietly, probably without the least idea that his end was near. Indeed, for a considerable period he has been more dead than alive—mentally at all events. As to his character, we do not think that can be much better expressed than it is in the following words written by the *Times'* own correspondent. After quoting a passage from an address by the late M. Renan, emphasising the individuality of the man, our contemporary goes on:—"Public opinion, which has alternately regarded him as an impostor or as a brilliant engineer, as a consummate financier or as a heartless swindler, will probably finally settle down to this appreciation of the originator of the Suez Canal. He was neither a financier nor an engineer, neither an impostor nor a swindler. He was a man of great originality, of indomitable perseverance, of boundless faith in himself, and of singular powers of fascination over others."

Death of a Well-known Mining Engineer.—A well-known figure in connection with mining engineering and the management of collieries in South Yorkshire in years past passed away on Saturday last at Silkstone Common, near Barnsley, in the person of Mr. James Wilson, for many years manager of the well-known Oaks Collieries, near Barnsley. Mr. Wilson claimed to be one of the first colliery managers or mining engineers who descended the shaft after the sad explosion in December, 1866, when 360 men and boys perished. Mr. Wilson was a native of Chester-le-Street, Durham.

## LORD SWANSEA.

The late Lord Swansea, who will probably be better known to fame as Hussey Vivian, was distinctly a conspicuous figure in the panorama of names and faces which has passed over a stage that represents three-quarters of the life of the closing century. Bessemer and Siemens were, in a sense, his contemporaries; Tyndal and Huxley were his social friends, and sometimes his friendly critics. Lord Swansea had not the gift, perhaps not the opportunity, of discovery as in the one case; and he certainly lacked the talent of literary expression with which Huxley and Tyndal have been enabled to make science seductive with a grace of style entirely new to our generation. There must be two orders of genius recognisable in the modern work-a-day world. There is the man who invents or discovers, and there is the man who discovers what the invention or discovery is worth. It will scarcely be claimed for Lord Swansea that he was a gratuitous propounder of fruitful ideas. Everyone would rather give him praise for his quickness of appreciation of the new ideas as they came to him, and the really splendid enterprise he showed in putting every suggestion offered him to the trial, and sometimes a costly trial, of practical experiment. The spirit of enterprise and the love of experiment would seem in Lord Swansea's case to have been faculties or inclinations of hereditary transmission. His grandfather was Mr. John Vivian, who was Deputy Warden of the Stannaries, and who founded a Cornish Metal Company ten years over a century ago. His father was a John Henry Vivian, who developed in an amazing manner the original Copper Works at Penclawdd, and was in after years—that means an early decade of our century—the creator of the great copper and spelter works at Havod, by which the name of the Vivians, under Hussey Vivian's intelligent and vigorous management, has been made known in the chief ports of the world. "There has never been a serious strike in our works in my lifetime," said Lord Swansea to the writer, and this was at a time when the persons employed at the furnaces and in collieries must have numbered four thousand. "How was that?" it was asked, in not unnatural astonishment. "Because I know every workman, and every workman knows that if it came to the push I could handle his tools. There's the root of common sympathy," said Lord Swansea—he was only Hussey Vivian then—"convince them that you can do their work, and can feel for their occasional hardships, and they are as nice a set of men all round as you could wish to meet at your dinner table."

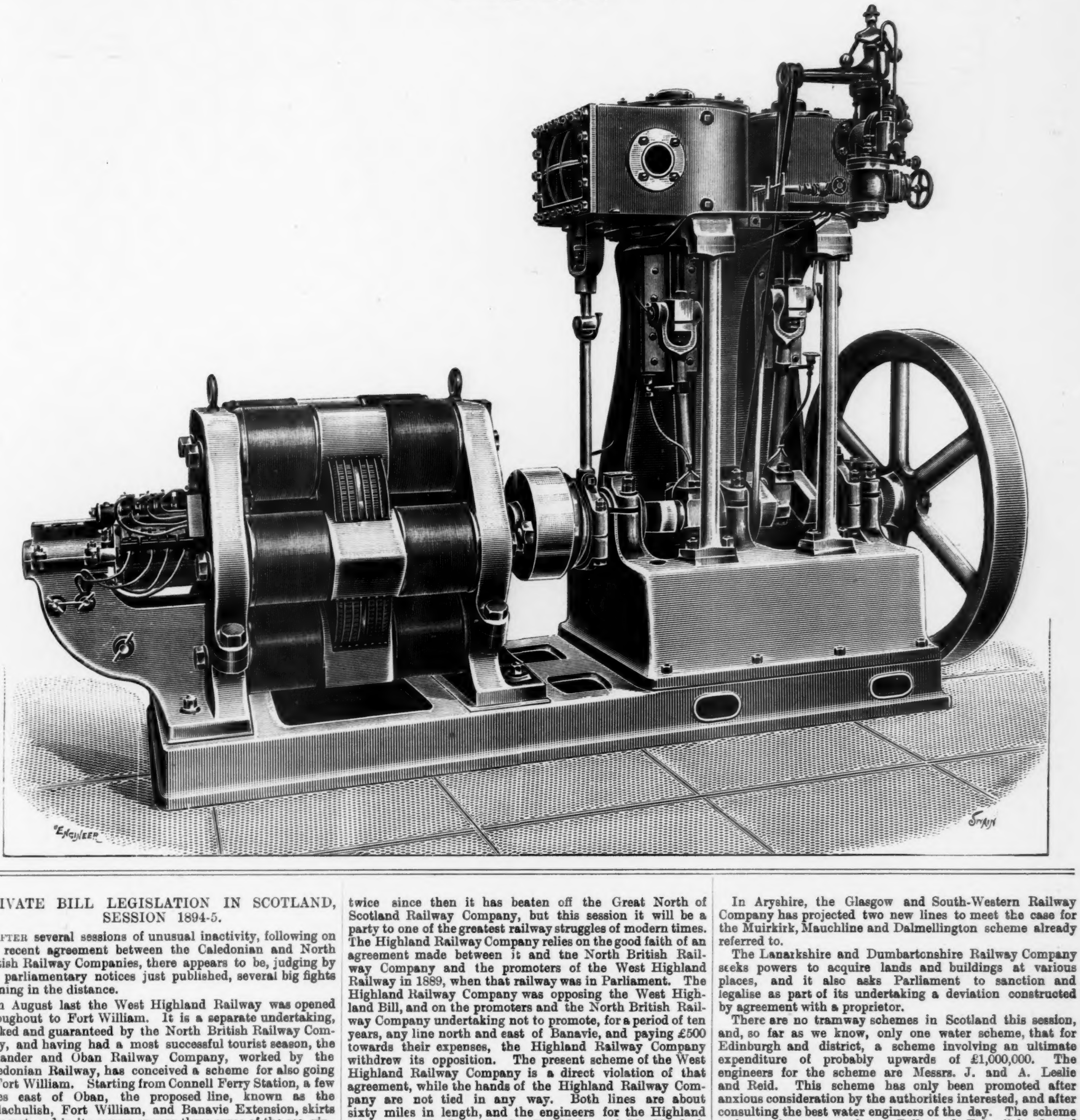
Lord Swansea could not have anticipated anybody, either in science or politics, and in both respects he must be regarded as a great assimilator rather than an originator. He had the keenest appreciation of the value of a new idea, and the conditions under which his early education had been gained will account at once for the comprehensiveness of his knowledge of his trade, and the keen apprehensiveness with which he welcomed—and adapted—other men's newer and more productive thoughts. Between Eton and Trinity College, Cambridge, he passed his elastic years, and employed his plastic mind in a "grand tour" of the technical colleges of the Continent. It may be said of him, to parody the epigram upon Whewell, that "metallurgy was his forte, and geology was his foible." He was from the beginning a metallurgist, and justified the traditions of his house. He became a chemist, because he needed knowledge of the solvents which would dissolve the ingredients of the rocks. But, however he gained his acquaintance with geology—or as he was wont to call it "lithological lore"—he most certainly must be said to have been a geologist so far advanced in his studies as to prove his equality to explorers of more conspicuous names, and to suggest that, if he told all he thought, the older geological school would have called him heterodox. It was his knowledge of chemistry which enabled him, at the Havod works, to capture and condense the sulphurous fumes belched out from the smelting fires. Sir Humphry Davy and Professor Faraday had been in consultation on the same subject in John Henry Vivian's time. It would seem that they tried every device, and succeeded in doing nothing to abate the nuisance. Then came out the Garsteinhoffer furnace. The Mr. Hussey Vivian of that day was quick to recognise its merits. The residuals, sulphates, and their cognates, proved to be more grist to the mill, and out of these experiments grew the one-time prosperous chemical works which Lord Swansea added to the rich estate his father left him.

But the deceased peer's geological knowledge became of greater public value at a date within the memory of most of our mining engineers. The great "Coal Scare" we are apt to associate with the names of Jukes, Hall, and Jevons. It will hardly be believed that there are public men who are still saying that our coal supplies will be exhausted in a couple of hundred years or so. Mr. Hussey Vivian, as he then was, knew more about our coal resources than the panic mongers. He moved for the Royal Commission, which in an unscientific way managed to arrive at something like a scientific conclusion. On this question of the coal supply Lord Swansea was always an optimist of the first water. There was, he said, at the time of the appointment of the Royal Commission, 24,000,000,000 tons of coal in the South Wales coal field unworked, but workable below the "imaginary and arbitrary limit" of a depth of 4000ft. Here was capital stock equal in value to £6,000,000,000, or about seven and a-half times the National Debt "cut off from the resources of South Wales alone by the assumed limit of 4000ft." And the optimism appears in a more pronounced manner when Lord Swansea wrote his notes of a tour through the United States in the year following the first Centennial Exhibition. It will be another tribute to his excellent memory to quote, for the benefit of those who have forgotten, the significant passages in which Mr. Hussey Vivian described the portentous dimensions of the North American coal fields. The coal area, he said, is enormous. It comprises 220,166 square miles, of which only 4800 are anthracite. There are, besides the true coal measures, 200,000 square miles of lignites, tertiary, and other inferior coals, but valuable fuel of their sort. "When we compare these stupendous areas with those of the United Kingdom, amounting to only 2920 square miles, and yet consider that our Commission arrived at the conclusion that we have more than 90,000,000,000 of tons yet unwrought, the probable amount of coal in America will appear too vast for the human mind to grasp—as impossible to realise as the distance of the nearest fixed star or the countless hosts of heaven." The shrewd observer in 1877, optimist as he was, saw some of the counterpoising conditions of the American coal trade. "The great disadvantage under which America most always labour as a coal-shipping country," he said, "is the distance of the coal fields from the seaboard;" and the laws which govern time and space leave that ultimate conclusion of Lord Swansea practically as true to-day as when he committed it to paper.

# ELECTRIC LIGHT ENGINE AND DYNAMO, STEAMSHIP CALEDONIA

MESSRS. TANGYES, BIRMINGHAM, AND SIEMENS BROS, LONDON, ENGINEERS

(*For description see page 523*)



## PRIVATE BILL LEGISLATION IN SCOTLAND, SESSION 1894-5.

After several sessions of unusual inactivity, following on the recent agreement between the Caledonian and North British Railway Companies, there appears to be, judging by the parliamentary notices just published, several big fights looming in the distance.

In August last the West Highland Railway was opened throughout to Fort William. It is a separate undertaking, worked and guaranteed by the North British Railway Company, and having had a most successful tourist season, the Callander and Oban Railway Company, worked by the Caledonian Railway, has conceived a scheme for also going to Fort William. Starting from Connell Ferry Station, a few miles east of Oban, the proposed line, known as the Ballachulish, Fort William, and Banavie Extension, skirts the coast, and in its course crosses three arms of the sea, viz., Loch Etive, Loch Creran, and Loch Leven. The bridges over these will be of some magnitude, but the name of the engineer, Mr. J. Wolfe Barry, C.B., is a guarantee that the line has been well laid out. As a matter of fact, the line was roughly surveyed in 1889, when the West Highland Railway Bill was in Parliament, and brought forward with the view of inducing the Committee to throw out the West Highland Bill. But the tactics were unsuccessful, as indeed was the Callander and Oban Company's Bill for a branch from Crianlarich down Glen Falloch to Loch Lomond, before the same Committee. Curiously enough, the Callander and Oban Company might have had this branch line, if it had been wise enough to support the Glen Falloch Railway scheme in the previous session. It remains to be seen whether the Callander and Oban Company will be more successful in the coming session. The Ballachulish, Fort William, and Banavie Extension is about forty miles in length, and the Bill asks for running powers over the Mallaig Extension of the West Highland Railway Company, in the event of that line being constructed by a Government grant.

From Fort William to Inverness two companies are contending for possession of the Great Glen through which the Caledonian Canal is formed. The Highland Railway Company, with its headquarters at Inverness, has projected a new line from Inverness down the north-west side of Loch Ness to Fort Augustus, thence to Spean Bridge and Fort William; while the West Highland Railway Company is projecting an extension of its line over very much the same ground. Hitherto the Highland Railway Company has been most successful in defending Inverness from every attack. In session 1883 it completely defeated the Glasgow and North-Western Bill to incorporate a new company, and twice since then it has beaten off the Great North of Scotland Railway Company, but this session it will be a party to one of the greatest railway struggles of modern times. The Highland Railway Company relies on the good faith of an agreement made between it and the North British Railway Company and the promoters of the West Highland Railway in 1889, when that railway was in Parliament. The Highland Railway Company was opposing the West Highland Bill, and on the promoters and the North British Railway Company undertaking not to promote, for a period of ten years, any line north and east of Banavie, and paying £500 towards their expenses, the Highland Railway Company withdrew its opposition. The present scheme of the West Highland Railway Company is a direct violation of that agreement, while the hands of the Highland Railway Company are not tied in any way. Both lines are about sixty miles in length, and the engineers for the Highland scheme are Sir John Fowler, K.C.M.G., and Mr. Murdoch Paterson, M. Inst. C.E., Inverness, while Messrs. Formans and McCall, of Glasgow, are the engineers for the West Highland scheme.

The Great North of Scotland Railway Company in its Bill does not contemplate the construction of any new works, but it seeks power to compel the Highland Railway Company to widen its line between Elgin and Inverness, and asks for running powers over that portion of the Highland Railway Company's system as well as over the branch line to the Caledonian Canal at Muirtown. As stated above, the Great North Company has been uniformly unsuccessful in its recent attempts to gain access to Inverness, the citadel of the Highland Railway Company. True, many years ago, before the existence of the Highland Railway Company, they had an Act for a railway to Inverness, but could not find the money to make it beyond Keith. Since then it has crept round to Elgin, but beyond Elgin it has never succeeded in getting the slightest foothold.

The Caledonian Railway Company is not directly in Parliament this session, but of course it is at the back of the Callander and Oban extension above described. And it is further interested in the Solway Junction Railway Bill seeking power to sell that undertaking to it. It still remains to be seen whether it is in any way identified with the invasion of the Glasgow and South-Western territory in Ayrshire by the Muirkirk, Mauchline and Dalmellington scheme.

The North British Railway Company seeks powers to widen the Helensburgh branch line, and to cut open the Dalreoch Tunnel on that line, improvements urgently required to accommodate the increasing traffic. It also seeks powers to make several new lines in connection with the Kirkcaldy and District Railway, and the East Fife Central Railway.

In Aryshire, the Glasgow and South-Western Railway Company has projected two new lines to meet the case for the Muirkirk, Mauchline and Dalmellington scheme already referred to.

The Lanarkshire and Dumbartonshire Railway Company seeks powers to acquire lands and buildings at various places, and it also asks Parliament to sanction and legalise as part of its undertaking a deviation constructed by agreement with a proprietor.

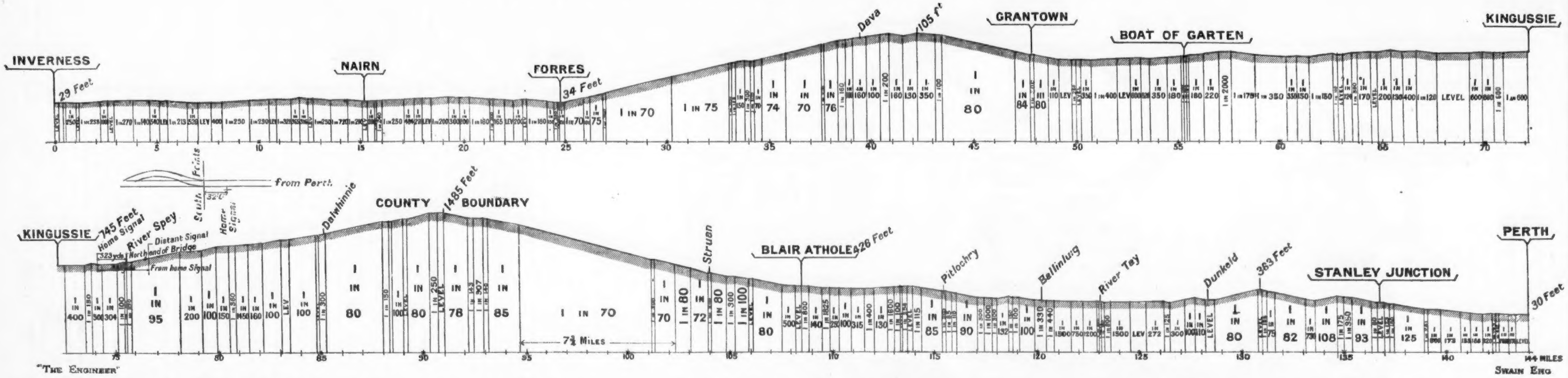
There are no tramway schemes in Scotland this session, and, so far as we know, only one water scheme, that for Edinburgh and district, a scheme involving an ultimate expenditure of probably upwards of £1,000,000. The engineers for the scheme are Messrs. J. and A. Leslie and Reid. This scheme has only been promoted after anxious consideration by the authorities interested, and after consulting the best water engineers of the day. The scheme embraces large reservoirs at Talla and Fairmilehead, and also some long aqueducts, besides railways for convenience in conveying men and materials.

The harbour and pier Bills are neither numerous nor important this session. Aberdeen seeks various powers, and Eyemouth proposes to construct several works for the greater convenience of the fishing industry, while Dunoon Burgh Pier may lead to a stiff fight between the Commissioners and the Hafton Trustees. Besides these, various powers are sought for Banff, Whitehills, and Blacksness.

Motherwell, a growing town closely identified with the coal, iron, and steel industries, seeks power to introduce the electric light, and notices have been given for Bills to introduce the electric light into Montrose and Brechin, evidently on behalf of the Scottish House-to-House Electricity Company, which recently started similar works at Coatbridge.

London Association of Foremen Engineers and Draughtsmen.—The usual monthly meeting of this Association was held in the K room of the Cannon-street Hotel on Saturday evening, the 1st inst., when the president, Mr. W. H. Bale, and the vice-president, Mr. R. J. Cook, were in the chairs. After the usual general business was over, which included the election of several new members, Mr. Cook gave an account of his recent visit to Newcastle, in connection with the annual dinner of the Newcastle Association. Mr. Cook stated that trade had been greatly interfered with by strikes, and at present some shops were busy, but most were quiet, a few very much so. He described the systems of working he saw in different shops, and gave a detailed description of the machinery in use in the North-Eastern Railway locomotive shops, where machinery seemed to be in use for everything it could be applied to, and organisation was such as to produce the best work at the lowest price. Some of the members made a few remarks on the report, and a vote of thanks having been passed to Mr. Cook, the meeting closed.

PROFILE OF THE HIGHLAND RAILWAY



# SIX COUPLED BOGIE GOODS ENGINE, HIGHLAND RAILWAY.

In 1888 we illustrated in our Christmas number Mr. Webb's compound locomotive, the Marchioness of Stafford. In 1890 we illustrated in the same way Mr. Worsdell's locomotive on the North-Eastern Railway. In December, 1892, we published drawings of Mr. Stirling's express engine on the Great Northern, all three remarkable locomotives. This year we publish drawings of what is, we believe, the most powerful locomotive in Great Britain—a goods engine, designed by Mr. David Jones, the locomotive superintendent of the Highland Railway, for working the heavy traffic, goods and passenger, on that exceptionally difficult road. Mr. Jones' engine has cylinders 20in. diameter, and 26in. stroke. This diameter of cylinder is not unknown in this country. It has been adopted for express engines by Mr. Dean on the Great Western, as will be seen from our impression for Nov. 2nd, 1894, where will be found illustrations of the latest types of express engines in use on that line. In 1867 Mr. Robert Burnett, when locomotive superintendent of the Metropolitan Railway, designed engines with 20in. inside cylinders, for working the St. John's Wood line, and six of these were constructed, and worked the traffic on that line for many years. These engines had, however, only 24in. stroke. These engines were six coupled, but in various ways they were less powerful than those of Mr. Jones. It is worth while to explain, however, why Mr. Burnett adopted these exceptional dimensions. In 1867 the Act of Parliament under which the St. John's Wood line was made provided for no physical junction with the Metropolitan Railway main line, the two companies being then distinct—although the Metropolitan entered into an agreement with the St. John's Wood Company to find rolling stock and work its traffic—and the St. John's Wood Company had obtained the authority of Parliament to extend its line from the Swiss Cottage Station to near the top of Hampstead Heath, by an incline of 1 in 27 in tunnel, with an intermediate station half way up the incline. As this section of the line would have had to be attacked *after* the engines had taken their loads up the steep incline from Baker-street to Swiss Cottage—a total rise of 94ft.—also in tunnel, where the engines had to "condense" most of the way, it was necessary to provide big cylinders to enable the engines to give out the required tractive force, with a boiler pressure diminished to 80 lb. or 90 lb. on arriving at the foot of the 1 in 27 incline. Now Mr. Jones' engines can, of course, keep the pressure all the way, and as they have 26in. stroke, we have no doubt that we are right in saying that they have the largest cylinder capacity ever found in a British locomotive. They have furthermore greater heating surface than other engines used in this country since the days of the Great Liverpool narrow gauge, and the Lord of the Isles class broad gauge engine.

It will be seen that in many respects the engine is a highly-improved American type. There are the outside cylinders and the bogie, and an enormous boiler. The driving and trailing wheels are provided with compensating levers. The driving wheels are without flanges, and the whole engine, notwithstanding its great length, is very flexible regarded as a vehicle.

Of recent years the traffic on the Highland Railway has been growing, and the company has been adding to its rolling stock. At the beginning of this year the directors decided on putting fifteen heavy locomotives on the road. These were designed by Mr. Jones, and constructed by Messrs. Sharp, Stewart and Co., of Glasgow. The traffic on the Highland Railway is very variable. At one season very heavy consignments of fish, which will stand no delay, have to be forwarded. At another agricultural produce, stones, and timber have to be dealt with. In the late autumn immense numbers of sheep have to be carried either to the southern markets or to lowland winter quarters. Then in summer there is exceptionally heavy tourist traffic to be dealt with. This stress of work has hitherto rendered the use of pilots necessary to an objectionable degree, and so Mr. Jones resolved that his new engines should be powerful enough to cope with any traffic almost, if not altogether, without help. The new engines accordingly keep time between Perth and Inverness with forty to forty-five loaded wagons, thus exceeding by more than a dozen wagons the power of the largest engines hitherto used on the line. A pilot is taken on only between Blair Athol and Dalnaspidal, where there is a long incline of 1 in 70, abounding in curves of only 20 or 22 chains radius to be faced. It must not be forgotten that the Highland Railway is a single line, and consequently the trains cannot be divided, for reasons which will be readily understood by our readers.

We have said that these engines are used to work heavy passenger trains, and their suitability for this has been proved by the fact that one of them has run down a five-mile bank with a mail train behind it in five minutes, or at the rate of sixty miles an hour, taking the curves of 30 chains radius with the utmost ease and smoothness.

The diagram which we give above is a profile of the road, and will give our readers a better idea of the difficulties of the traffic than a page of letterpress.

The contract for the construction of the fifteen engines was signed at the end of February, 1894. The first engine was delivered in September, and the remaining engines by the middle of November, and all the engines had run their 1000 miles guarantee by the end of the month.

Mr. Jones as designer, and Messrs. Sharp, Stewart, and Co. as builders, are to be congratulated on the success which they have obtained; and although it is as yet too soon to give figures, there can be no doubt that these powerful locomotives will effect a great saving in the cost of haulage.

Our supplements give an elevation and details of these fine engines. The principal dimensions will be found in the tracing. The louvres on the chimney are held to augment the draught.

By the courtesy of Mr. Jones, we are enabled to give a copy of the specification under which the engines were built.

### *Specification for Engine and Tender.*

The contract to comprise the making of fifteen locomotive engines and tenders. The same to be delivered free, and in complete working order, according to this specification, by the builders to the company, at Perth Station, not later than . . . . . . . . and prior to payment each engine and tender will be required to run 1000 miles; and the builders will be held responsible for all defects until they run that distance.

*Description.*—Outside cylinder six-wheeled coupled goods engine —four-wheeled circular and lateral bogie at leading end—and six-wheeled tender.

*Drawings.*—The locomotive engine and tender to be constructed to the design and dimensions shown on the accompanying drawings. Further drawings and particulars will be given if required.

*Materials.*—The quality of the materials used must be of the make specified, and when no such instructions are given, to be of the very best of their respective kinds. Boiler barrel, outside fire-box casing to be of mild steel. Longitudinal stays to be of mild steel. Copper for fire-box and fire-box stays to be of Bibby and Vivian's make. Tubes of boiler to be of copper, of Broughton and Everitt's make. All axles and tires to be crucible cast steel, of Vickers, Sons, and Co.—extra best. Springs to be manufactured by Thomas Turton and Sons, for engines, and Ibbotson Brothers, for tenders. Crucible cast steel castings to be ——. Bronze castings to be of J. Stone's make.

### DESCRIPTION OF ENGINE.

*Boiler.*—The barrel to be telescopic and formed of three plates, longitudinal joints butted and strapped, and placed above the water-line, transverse seams to be lapped, the whole of the boiler barrel and outside fire-box seams to be double-riveted, the tube plate ring that joins the boiler to tube plate to be bored and turned, all edges of plates to be planed, the dome with seat to be of mild steel or Yorkshire iron.

| | ft. | in. |
|---|---|---|
| Length | 13 | 9 |
| Diameter outside | 4 | $7\frac{7}{8}$ |
| Thickness of plates | 0 | $0\frac{9}{16}$ |
| ,, tube plates | 0 | $0\frac{5}{8}$ |
| Diameter of rivets | 0 | $0\frac{13}{16}$ |
| Pitch of rivets | 0 | $1\frac{7}{8}$ |

*Fire-box casing.*—Flush with boiler barrel, sides and crown to be one plate, to have eighteen longitudinal stays from back plate to front tube plate, stays to be screwed into the back plate, to have four T irons riveted to the crown part of casing, and to have on top a seat for safety valves, as shown.

| | ft. | in. |
|---|---|---|
| Length | 7 | 9 |
| Breadth | 4 | $10\frac{1}{2}$ |
| Thickness of front and back plates | 0 | $0\frac{5}{8}$ |
| Thickness of side and crown plate | 0 | $0\frac{9}{16}$ |

Bottom ring solid and slotted.

*Inside fire-box.*—To be of copper, seams to be riveted with iron rivets.

| | ft. | in. |
|---|---|---|
| Length inside at bottom | 7 | $0\frac{1}{2}$ |
| ,, ,, top | 6 | $10\frac{1}{2}$ |
| Breadth inside at bottom | 3 | $2\frac{1}{2}$ |
| ,, ,, top | 3 | 5 |
| Height (bars to crown) (mean) | 4 | $7\frac{1}{2}$ |
| Thickness of side and crown plate | 0 | $0\frac{1}{2}$ |
| ,, tube plate | $0\frac{5}{8}$ & $\frac{1}{2}$ | |
| Water space, front at bottom | 0 | $3\frac{1}{2}$ |
| ,, back ,, | 0 | 3 |
| ,, sides ,, | 0 | $2\frac{5}{8}$ |
| Distance between crown plates of fire-box | 1 | $5\frac{1}{2}$ |
| Fire door ring, $17\frac{1}{2}$in. × $13\frac{1}{2}$in.; nine roof stays (bars); pitch of stays centre to centre | 0 | 4 |
| Depth of bar stays | 0 | 8 |
| Thickness ,, | 0 | 2 |
| Number of bolts in each bar stay, 18 | | |
| Centre to centre of copper stays | 0 | 4 |
| Diameter do. | 0 | 1 |
| Pitch of thread, 12 to the inch. | | |
| Rivets (of iron) diameter | 0 | $0\frac{3}{4}$ |
| Distance of centres | 0 | $1\frac{7}{8}$ |

*Tubes.*—Copper: to be seamless and patent drawn.

Number of tubes, 211, in vertical rows. Gauge, Nos. 11 and 13. To be ferruled at fire-box end only, with steel ferrules perfectly true.

| | ft. | in. |
|---|---|---|
| Length | 14 | 5 |
| Diameter outside | 0 | 2 |
| Least distance of centres | 0 | $2\frac{5}{8}$ |

*Smoke-box*—

| | ft. | in. |
|---|---|---|
| Length outside | 3 | $1\frac{1}{2}$ |
| Breadth | 5 | 4 |
| Diameter of doorway | 3 | 10 |
| Thickness of plates | 0 | $0\frac{3}{8}$ |
| Diameter of rivets | 0 | $0\frac{3}{8}$ |
| Pitch of rivets | 0 | $2\frac{1}{2}$ |

*Chimney.*—Double, with annular chamber closed at the bottom, open at top, outside chimney to be louvred as shown, to have a polished copper top.

| | ft. | in. |
|---|---|---|
| Length | 3 | 0 |
| Outside chimney, diameter | 1 | 7 |
| Inside ,, ,, at top | 1 | $4\frac{1}{2}$ |
| ,, ,, ,, at bottom | 1 | $3\frac{1}{2}$ |

*Regulator.*—Double beat valve, brass head; vertical steam pipe in dome, cast iron; steam pipe in boiler of copper, to be fastened n tube plate with turned iron ferrule; steam pipes in smoke-box of copper.

| | ft. | in. |
|---|---|---|
| Diameter of steam pipe inside boiler … … (bore) | 0 | 5 |
| ,, ,, in smoke-box … … ,, | 0 | 3½ |

*Blast pipe*—

| | ft. | in. |
|---|---|---|
| Cast iron (hinged)—Diameter at top … … … … | 0 | 7 |
| Brass top ,, ,, … … … … | 0 | 5 |
| Area at bottom of cast iron branches in square inches | 0 | 40 |
| Height above centre of boiler… … … … … … | 1 | 0 |

*Safety valves.*—Two in number.

| | ft. | in. |
|---|---|---|
| Diameter … … … … … … … … … … | 0 | 3½ |

*Injectors.*—In brass, two of Gresham's Combination, No. 10.

| | ft. | in. |
|---|---|---|
| Diameter of steam pipe … … … … … … … | 0 | 1½ |
| ,, water supply pipe … … … … … | 0 | 1¾ |
| ,, overflow pipe … … … … … … | 0 | 1¾ |

*Cylinders*—

Angle, 1 in 24.

| | ft. | in. |
|---|---|---|
| Diameter … … … … … … … … … … | 1 | 8 |
| Length of stroke … … … … … … … … | 2 | 2 |
| Distance of centre … … … … … … … … | 6 | 7 |
| ,, valve spindles … … … … … … | 2 | 4½ |
| Diameter ,, ,, … … … … … … | 0 | 2 |
| Distance from centre of cylinders to centre of valve spindles … … … … … … … … … … | 2 | 1¼ |
| Thickness of cylinder … … … … … … … | 0 | 1⅛ |
| Diameter of piston-rod … … … … … … … | 0 | 3⅜ |
| Piston, bronze, depth … … … … … … … | 0 | 4 |
| Two cast iron packing rings— | | |
| Distance between inside ports… … … … … | 2 | 4½ |
| ,, ,, covers … … … … … | 2 | 9¾ |

*Ports*—

| | ft. | in. |
|---|---|---|
| Breadth … … … … … … … … … … | 1 | 4 |
| Length of steam… … … … … … … … … | 0 | 1⅝ |
| ,, exhaust … … … … … … … … | 0 | 3¼ |
| Thickness of bridges … … … … … … … … | 0 | 1¼ |

*Slide valves.*—To be of best toughened cast iron.

| | ft. | in. |
|---|---|---|
| Travel … … … … … … … … … … … | 0 | 4¼ |
| Lead … … … … … … … … … … … | 0 | 0$\frac{3}{16}$ |
| Lap over each port … … … … … … … … | 0 | 0⅝ |
| Centre of spindle to face … … … … … … … | 2 | 0¼ |

Cut-off full forward (p.c. of stroke 75)
Back notch do. ( do. 15)

*Excentrics and s raps.*—To be of the very best toughened cast iron, with brass strips let into excentrics.

| | ft. | in. |
|---|---|---|
| Throw … … … … … … … … … … … | 0 | 6½ |
| Breadth … … … … … … … … … … | 0 | 2⅞ |
| ,, of straps … … … … … … … … | 0 | 2¾ |

*Link motion.*—Straight: To be of the very best Yorkshire iron, to be carefully and well fitted, and case-hardened.

| | ft. | in. |
|---|---|---|
| Length of excentric rods … … … … … … … | 8 | 1½ |
| Diameter of reversing shaft … … … … … … | 0 | 3½ |

*Motion bars.*—Wrought iron case-hardened.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 4 | 9 |
| Breadth … … … … … … … … … … | 0 | 5½ |
| Thickness … … … … … … … … … … | 0 | 2¼ |
| Distance apart … … … … … … … … … | 0 | 11½ |
| Length of slide block (cast iron) … … … … … | 1 | 3 |

*Crossheads* and piston-rod solid, gudgeon pin and bushes to be well fitted, and case-hardened—all to be of best Yorkshire iron.

| | ft. | in. |
|---|---|---|
| Diameter of gudgeon pin .. … … … … … … | 0 | 3¼ |
| ,, pin for slide blocks … … … … … | 0 | 3½ |

*Connecting-rods.*—To be of steel.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 9 | 4 |
| Small end … … … … … 2¼in. by 3¾in. | | |
| At centre … … … … … 2¼in. by 5¼in. | | |
| Big end… … … … … … 2¼in. by 4¾in. | | |

*Coupling-rods.*—To be of steel.

| | ft. | in. |
|---|---|---|
| Length of centres … … … … … 5ft. 6in. and | 7 | 9 |
| Depth at centre … … … … … … … … … | 0 | 4½ |
| ,, ends … … … … … … … … … | 0 | 4½ |
| Thickness … … … … … … … … … … | 0 | 1½ |

*Leading, driving, and trailing axles*—

| | ft. | in. |
|---|---|---|
| Diameter at centre (driving) … … … … … … | 0 | 7½ |
| ,, ,, (leading and trailing) … … … | 0 | 7¼ |
| ,, in boss of wheel (driving) … … … … | 0 | 9 |
| ,, ,, ,, (leading and trailing) … | 0 | 8½ |
| ,, bearing (driving) … … … … … … | 0 | 8 |
| ,, ,, (leading and trailing) … … … | 0 | 7½ |
| Length of ,, (all) … … … … … … … | 0 | 7½ |
| ,, axles (all) … … … … … … … | 5 | 6¼ |
| Distance of centres of bearings (all) … … … … | 3 | 9½ |

*Leading, driving, and trailing wheels.*—Cast steel.

| | ft. | in. |
|---|---|---|
| Diameter without tires … … … … … … … | 4 | 8½ |
| Breadth of rim … … … … … … … … … | 0 | 4½ |
| Thickness of rim… … … … … … … … … | 0 | 2 |
| Spokes, flat, fifteen in number: | | |
| Section at rim … … … … … 3¼in. by 1½in. | | |
| ,, boss … … … … … 3¾in. by 1¾in. | | |
| Axle boss diameter (driving) … … … … … … | 1 | 8 |
| ,, ,, (leading and trailing) … … … | 1 | 7 |
| ,, breadth (all) … … … … … … … … | 0 | 6½ |
| Crank boss diameter (driving)… … … … … … | 1 | 1 |
| ,, ,, (leading and trailing)… … … | 0 | 11 |
| ,, breadth (all)… … … … … … … … | 0 | 6⅜ |

Tires, crucible cast steel, and all to be 3½in. thick.
Leading and trailing tires, 5¼in. broad.
Driving tires, 5½in. broad.

| | ft. | in. |
|---|---|---|
| Diameter of hole for crank pin (driving) … … … | 0 | 6½ |
| ,, ,, ,, (leading and trailing) | 0 | 5½ |
| ,, coupling-rod pin (driving) … … … | 0 | 6¼ |
| ,, ,, (leading and trailing)… | 0 | 5¼ |
| Breadth of ,, (driving) … … … | 0 | 4¼ |
| ,, ,, (leading and trailing)… | 0 | 3½ |
| Diameter of connecting-rod crank pin … … … … | 0 | 5 |
| Breadth ,, ,, … … … … | 0 | 4½ |

Crank pins, crucible cast steel.
Axle-boxes and bearings of bronze.

*Inside frames.*—Mild steel plates, with crucible cast steel horn blocks, with wrought iron case-hardened liners. A strong cast iron block to be placed between frames at trailing end, carefully fitted and secured to frames with turned bolts. Rivets of frame stays to be turned and riveted cold. Horn blocks to be fastened to frames with turned bolts.

| | ft. | in. |
|---|---|---|
| Extreme length … … … … … … … … … | 32 | 11 |
| Least depth… … … … … … … … … … | 1 | 6 |
| Thickness … … … … … … … … … … | 0 | 1¼ |
| Distances between … … … … … … … … | 4 | 1½ |
| ,, driving and trailing centres … … | 7 | 9 |
| Distance between driving and centre of leading … | 5 | 6 |
| ,, leading and centre of bogie … … | 8 | 6 |
| Total wheel base … … … … … … … … | 25 | 0 |
| Distances between front end of framing and centre of bogie … … … … … … … … … … | 5 | 7 |
| Distance between back end of framing and centre of trailing axle … … … … … … … … … | 5 | 7 |

*Outside frames.*—Angle iron, 4¼in. by 3in. by ½in.

| | ft. | in. |
|---|---|---|
| Extreme length … … … … … … … … … | 32 | 11 |
| Distance over side platform … … … … … … | 8 | 4 |

*Driving and trailing springs.*—Steel plates ½in. thick, with a solid wrought iron buckle.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 3 | 3 |
| Breadth … … … … … … … … … … | 0 | 5 |
| Depth … … … … … … … … … … … | 0 | 6 |
| Cambre, with weight on … … … … … … … | 0 | 3 |

(To be attached to compensating levers.)
Leading to be fitted with Timmiss's springs.)

*Bogie.*—Framing of best mild steel.

| | ft. | in. |
|---|---|---|
| Thickness … … … … … … … … … … | 0 | 1 |
| Horn blocks and cross stays of cast steel. | | |
| Distance between frames … … … … … … … | 4 | 0¾ |

*Axles*—

| | ft. | in. |
|---|---|---|
| Diameter at middle … … … … … … … … | 0 | 5½ |
| ,, in boss of wheel … … … … … … | 0 | 7 |
| ,, of bearing … … … … … … … … | 0 | 6 |
| Length ,, … … … … … … … … | 0 | 8 |
| ,, of axles … … … … … … … … … | 5 | 5¾ |
| Distance of centre of bearings… … … … … … | 3 | 7½ |

*Wheels.*—Crucible cast steel; four in number.

| | ft. | in. |
|---|---|---|
| Distance of centres … … … … … … … … | 6 | 6 |
| Diameter without tires … … … … … … … | 2 | 8½ |
| Breadth of rim … … … … … … … … … | 0 | 4½ |
| Thickness of rim… … … … … … … … … | 0 | 2 |
| Spokes flat, eight in number. | | |
| Section at rim … … … … 3¼in. by 1½in. | | |
| Do. at boss … … … … 3¾in. by 1¾in. | | |
| Boss—diameter … … … … … … … … … | 1 | 1½ |
| ,, breadth … … … … … … … … … | 0 | 7 |
| Tires … … … … … 3in. thick by 5in. broad. | | |

Axle-boxes and bearings—bronze.

*Springs.*—Steel; four in number. Plates ½in. thick, with solid wrought iron buckle.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 2 | 6 |
| Breadth … … … … … … … … … … | 0 | 3½ |
| Depth … … … … … … … … … … … | 0 | 5 |

### General Description.

*Mountings, &c.*—Boiler to be fitted with all gauge cocks, clack boxes, feed pipes, blower cock and pipe, whistle, washing out plugs, ash-pan with two air-tight dampers, as shown. A patent steam pressure gauge of approved kind. Boiler to be lagged with dry pine wood, and covered with clean sheet iron, No. 14 W.G., fastened with iron hoops in the usual way. Cylinders each to have one lubricator of approved design, two easing cocks, and one from steam chest worked from the foot-plate, and to have one vacuum sight-feed lubricator. Wheels all to be keyed on shafts with one steel key, after being forced on with a pressure not less than 10 tons per inch diameter, balance weights to be solid in coupled wheels, distance between backs of all tires 4ft. 5½in., flanges to be 1½in. high. Bolts and nuts must be of Whitworth's standard threads, every nut to be hexagonal, and those for same diameter of bolt to be exactly same size. All gland nuts to be case hardened. Nuts inside smoke-box to be of hard brass. All rivets visible in completed engine and tender to be countersunk. Brands of makers of axles, tires, and boiler plates must be left visible outside. Buffer beam, buffers, draw-hook, and life-guards, as per drawings. Engine buffers to be Platt and Turton's patent, with wrought iron cases and heads polished. All india-rubber springs to be of Spencer, Moulton and Co. Dome covers to be of charcoal iron or mild steel. Each engine will have a number plate of brass on each trailing splasher, also four sand boxes for dry sand, and to be worked from the foot-plate—steam sanding for leading boxes. House over foot-plate to be made according to drawing. The plates carefully hammered and riveted; to be provided with windows as shown. Manufacturers' name plate to be put on driving splasher. A gong on right side of tender. To have one set of fire-bars; one set of tools complete, including two 16-ton screw-jacks, traversing, with ratchets, stand to be of brass, the base of wrought iron; one set of fire-irons complete; also a full set of lamps. These engines and tenders to be fitted with automatic vacuum brake, arranged as shown in drawing.

*Painting of engines and tenders.*—To be of the colours used by this company. A sample board will be sent to show colours and lines. The boiler to receive two coats of boiled oil and red lead, previous to being lagged with wood; the wood outside and cleading inside to have one coat of lead colour. The cleading, house, splashers, frames, tender, and wheels to have two coats of lead colour, three coats of filling up paint, and to be well rubbed down; two coats of light green colour, one coat of coloured varnish, then finished with two coats of the very best body varnish. Chimney and smoke-box to have one coat asbestos black and one coat locomotive black.

### Description of Tender.

The tender to be complete in every respect. The tender tank to hold about 3000 gallons of water; this, with the under frame, to be made of mild steel plates. The whole to be mounted on six wheels, the wheel base being 13ft. Feed pipes to be of copper, with brass flanges. India-rubber pipes, with coupling nuts between engine and tender. Axle-boxes to be of the best toughened cast iron, and to have bronze bearings, to be fitted with wrought iron liner in crown of box to enable bearing bush to be taken out; also to have wrought iron case-hardened sliding cover on top.

*Tank.*—To be made of ¼in. plates, all rivet holes outside to be countersunk, and rivets flush with plates. Side plates to be without seam.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 18 | 6 |
| Breadth … … … … … … … … … … | 7 | 9 |
| Depth … … … … … … … … … … … | 3 | 10½ |

*Frames.*—Mild steel (to be cut as shown), with best toughened cast iron horn blocks riveted on; stays and plates as shown.

| | ft. | in. |
|---|---|---|
| Extreme length, without buffer plates… … … … | 21 | 0 |
| Depth … … … … … … … … … … … | 2 | 11 |
| Thickness … … … … … … … … … … | 0 | 0⅞ |
| Distance between … … … … … … … … | 5 | 8 |

*Wheels.*—Crucible cast steel; six in number.

| | ft. | in. |
|---|---|---|
| Distance of centres … … … … … … … … | 6 | 6 |
| Diameter without tires … … … … … … … | 3 | 2½ |
| Breadth of rim … … … … … … … … … | 0 | 4½ |
| Thickness of rim… … … … … … … … … | 0 | 2 |
| Spokes flat, ten in number: | | |
| Section at rim … … … … … … .. 3¼ by 1½ | | |
| Section at boss … … … … … … .. 3¾ by 1¾ | | |
| Boss: Diameter … … … … … … … … … | 1 | 2 |
| Breadth … … … … … … … … … | 0 | 6½ |
| Tires: Thickness in tread… … … … … … … | 0 | 3½ |
| Breadth … … … … … … … … … | 0 | 5¼ |

Axle-boxes of cast iron.
Bearings of bronze.

*Axles.*—Crucible cast steel.

| | ft. | in. |
|---|---|---|
| Diameter at centre … … … … … … … … | 0 | 6 |
| ,, in boss … … … … … … … … | 0 | 7½ |
| ,, of bearing … … … … … … … … | 0 | 5¾ |
| Length of bearing … … … … … … … … | 0 | 9 |
| ,, axle … … … … … … … … … | 7 | 3 |
| Distances of centres … … … … … … … … | 6 | 4 |

*Springs.*—Steel plates ½in. thick, with wrought iron buckle.

| | ft. | in. |
|---|---|---|
| Length … … … … … … … … … … … | 3 | 0 |
| Breadth … … … … … … … … … … | 0 | 4 |
| Depth … … … … … … … … … … … | 0 | 6⅛ |
| Camber, with weight on … … … … … … … | 0 | 3 |

### General Stipulations.

The sole design of this specification and accompanying drawings being to explain as fully as possible to the contractors the locomotive engines and tenders required by this company, no advantage is to be taken of any error or omission in either, as full particulars will be given on application to the locomotive superintendent, who will have power of inspecting them personally or by deputy during their construction, and of rejecting either material or workmanship which he or his substitute may deem to be not in accordance with the proper fulfilment of this contract. No alterations to be made, unless instructed by letter from the locomotive superintendent. The contractors to pay all patent rights involved in this contract, and show satisfactory proof thereof to this company prior to the final settlement. Everything of its respective kind, both of engines and tenders, must be interchangeable. All the holes in the boiler and fire-box plates must be drilled. No drift or mandril allowed to draw holes straight or in line. The boiler to be tested by the contractors to a pressure of 200 lb. per square inch, with hot water, and to remain under that pressure for thirty minutes, and after to 175 lb. per square inch in steam. The boiler must be tight, and show no signs of weakness under these pressures, before being lagged; to be tested in the presence of the engineer or his substitute, and the safety valves to be ferruled to a working pressure of 175 lb. per square inch.

D. Jones,
Locomotive Engineer.
Inverness.

*The Highland Railway Company.—Six-wheels Coupled Bogie Goods Engine, No. 103 Class.*

Cylinders 20in. diameter, 26in. stroke.
Tractive force, 165 lb. per lb. of effective cylinder pressure.

| | | Tons. | | ft. | in. |
|---|---|---|---|---|---|
| Weight on bogie … … … … | | 14 | Diameter of wheels | 3 | 2 |
| ,, leading wheels | Coupled | 13½ | ,, ,, | 5 | 3 |
| ,, driving wheels | Coupled | 14½ | ,, ,, | 5 | 3 |
| ,, trailing wheels | Coupled | 14 | ,, ,, | 5 | 3 |
| | | 56 | | | |
| Weight of tender (with coal and water) … … … … … … | | 36 | Diameter of wheels | 3 | 9 |
| Total weight… … … … | | 92 tons | | | |

| Heating surface— | |
|---|---|
| Tubes … … … … … … … … … | 1559 sq. ft. |
| Fire-box … … … … … … … … … | 113 5 ,, |
| Total heating surface … … … … | 1672 5 ,, |
| Fire-grate area… … … … … … … … | 22·6 ,, |

Boiler pressure—175 lb. per square inch.
Tender contents—3000 gallons water, 5 tons coal.

## SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held at the Town Hall, Westminster, on Monday evening, December 3rd, 1894, Mr. George A. Goodwin, President, in the chair, a paper was read by Mr. H. B. Ransom on "The Principles and Practice of Hydro-Extraction."

The author commenced with a brief outline of the laws governing centrifugal force, and illustrated them in various ways. The applications to which hydro-extractors could be applied were also dealt with, and the reasons why some materials could be satisfactorily dealt with in that way and others could not, were referred to. After stating the ordinary centrifugal force formula, examples were given to illustrate the danger attending the use of centrifugal machines when driven by badly governed engines. From some experiments which the author had made, it appeared that in one instance a little grit getting into the joints of the governor so influenced the speed that the pressure on the walls of the basket of a centrifugal machine would have increased 56 per cent. if driven from such an engine. Although this was taken as an extreme case, it was stated that very great increase in speed, and consequent risk, was frequently incurred owing to ill-governed engines and improper attention. Some figures were next given to illustrate the advantages and disadvantages of a safe system of constructing centrifugal baskets. The factor of safety of a plate basket was found to be only 3, as compared with the factor of safety of a steel wire basket of nearly 13. Although these figures are clearly largely the result of calculation, the discrepancy between them is obviously so great that the broad truth in practice—that a wire basket is stronger than a plate basket—is almost undoubted Attention was drawn to the fact that whereas marine boilers are subjected to smaller stress than is common in centrifugal baskets, the latter are not submitted in any way to official inspection or regulation. The construction of direct driven centrifugals was also dealt with, and some very interesting figures given in relation to the inertia of the reciprocating portions of these engines. It appeared, for instance, that in a 12in. by 8in. engine, making 1200 revolutions per minute, the force necessary to start the piston at the beginning of a stroke would amount to nearly 3½ tons.

The paper was accompanied by several tables and diagrams.

English Engines for the United States.—Messrs. Galloways Limited are now making for the Johnson Company, Ohio, U.S.A., two large pairs of horizontal high-pressure non-condensing engines. The larger engine has cylinders 55in. bore by 5ft. stroke, with crank shaft bearings 22½in. diameter, and the total weight of this engine will be about 300 tons. The smaller engine has cylinders 48in. bore by 4ft. 2in. stroke, with bearings 19½in. diameter, and the total weight will be about 200 tons. The pressure at which both will work is 150 lb. per square inch, and it will be seen that the engines are probably as large as any that have ever been made in connection with rolling plant.

The Institution of Junior Engineers.—The members have recently had the opportunity of visiting the *Globe* printing office, and Linotype machine installation. Under special arrangements made by the manager, Mr. W. T. Madge, they were each enabled to make a close and thorough inspection of the Linotypes, of which there are eight in operation. In the machine-room two Victory machines were seen running, and another printing machine of the same make, but much larger and of the latest type, was shown which had just been erected. The stereotyping department, contents-bill machine, and other features of engineering interest were seen. The chairman of the institution, Mr. H. J. Young, conveyed the members' thanks for the facilities extended to them in connection with the visit. At the meeting held on Dec. 7th, at the Westminster Palace Hotel, Mr. H. J. Young in the chair, a paper on "Waterworks and their Appliances" was read by Mr. William Mallock. There was a large attendance of the members. Dealing first with source of supply, the author described generally the formation of the soil over or through which the rain passed on its way to the two classes of source—above-ground and underground; and reference was made to the systems adopted by the larger cities throughout the kingdom for obtaining their supplies. Diagrams were exhibited showing the arrangements and appliances in connection with London waterworks for well-sinking, boring, and driving headings into the chalk to the underground sources. The supply derived from London wells was gradually being exhausted, as was proved by their fall of water level to the extent of 10in. average per year; the above-ground source of supply would, however, be sufficient for many years to come. The geological formation of the Thames watershed, comprising an area of 3500 square miles, was described, from which it was noticed how that on account of the extensive natural filtration it undergoes before passing to the river, the Thames water was so much purer than the river waters of the north country, where the soil was generally impervious, and therefore unfit for filtering processes. In considering the question of storage, to which great importance was attached, various schemes were investigated applying to London, including Hunter and Fraser's, which had been accepted by the Royal Commission; and a proposal of the author's, whereby pumping expenses would be avoided, and other advantages obtained. A detailed account followed of the latest practice in regard to the different appliances in connection with the process through which the water passed from the intake, through screens, subsiding reservoirs, filters, pumps, service reservoirs, valves, and mains to the consumer. The paper concluded with some remarks on waste prevention, which could best be secured by the adoption of Deacon's meters. They were being largely used by the more advanced water companies, and resulted in a great saving, in many cases of as much as over 50 per cent. In the discussion which followed, Messrs. R. W. Newman, Walter Hunter, F. L'Estrange, F. Fisher, B.Sc., W. Powrie, S. Boulding, and others took part.

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

100-*ton shear legs.*—At the Philadelphia navy yard shear legs of 100 tons hoisting capacity are to be erected. The front legs will be 26ft. 9in. apart at the base, and the bottom of the back leg will be 39ft. 4in., and 93ft. 10in. from the front legs in its forward and back positions respectively. The three legs will be connected at the top by a pin, from which the hoisting falls and blocks will be suspended. The back leg will be 134ft. 6in. long, and the front legs 114ft. 6in. The latter will be composed of eight angle irons 6in. by 4in., and four 4in. by 4in., riveted together and connected by lattice angles to form a column 4ft. square. The back leg will be built up of twelve angle irons 6in. by 6in., riveted by ⅞in. rivets in the same arrangement as the front legs, and connected by lattice angles 5in. by 3½in. to form a column 4ft. square. The pin connecting the heads of the three legs will be 16in. diameter and 8ft. 4in. long, carrying two cast iron sheaves, the pin holes of which are bushed with bronze ½in. thick. For the hoisting mechanism there are twelve sheaves and two idlers 42in. diameter. The foot of the back leg rests on a crosshead which is moved to and fro by a screw gearing, the crosshead traversing between two upper rails of 20in. rolled beams and lower rails of 12in. rolled beams, the length of traverse being 60ft. The screw is 65ft. 3in. long, 11in. diameter over the thread, and 14in. over the thrust collars. The screw has a double thread of 4in. pitch. There will be two engines with cylinders 10in. by 10in. with a vertical boiler carrying 100 lb. pressure. The hoisting rope will be a wire cable 1¼in. diameter and 1800ft. long.

*Trench excavating machine.*—For excavating sewer trenches in city streets, where it is important to obstruct as little of the width of the street as possible, several forms of hoisting and conveying machines are used, some of which—consisting essentially of a fixed cable over the trench on which run carriers with buckets which are raised, lowered, and hauled by running cables—I have previously described. The Moore machine, which has been used in several cities, has a steel trestle or frame over the trench, a car with hoisting attachments running along the trestle and hoisting, lowering, and conveying the buckets. The trestle is 288ft. long, consisting of sixteen steel frames in the shape of the lower half of letter A, the feet having wheels which run on rails on each side of the trench, and the top horizontal portion carrying the track for the conveyor car. With ten bottom-dumping buckets of 30⅓ cubic feet capacity the machine will excavate 800 cubic yards per day. The width over base of frames is 14ft. The conveyor car has double-flanged wheels, has a hoisting plant controlled by men on the car, and is run in and out along the trestle by a wire cable. A brake is used to hold it in any position on a grade. The buckets are of steel, with hinged bottoms. At the rear end of the trestle is the engine-house, carried on wheels. The 25-horse power main engine has two cylinders 7in. by 10in., two drums 18in. by 27in., and is geared for high speed. All the levers are worked from an elevated platform from which the engine man has a full view of the trench. A vertical boiler 42in. by 93in. supplies steam. Boulders of three tons weight can be handled by chain slings. One bucket can be hoisted, conveyed, and returned in thirty seconds, the bucket raising earth from the excavation at the front end of the trestle and dumping it as back filling over the completed sewer at the back end. It can work to a depth of 35ft.

*Aluminium for boats.*—The Navy Department has just completed a test of aluminium as a material for ship boats, with the object of determining its adaptability to naval uses, with results that demolish some of the elaborate claims made for the new metal. On account of its comparatively light weight its utility on board ship would be almost inestimable, if it were not for the fact that it has been now shown to be exceedingly susceptible to the corrosive action of salt water. Two sheets, one-sixteenth of an inch thick, were immersed for three months at the Norfolk Navy Yard. One was stated to be pure metal, and the other slightly alloyed with nickel. The pure plate was thickly covered with large barnacles throughout its surface, and was more or less pitted by the action of salt water. The alloyed plate was encrusted with smaller barnacles and was badly corroded, being perforated and eaten away over much of its exposed surface. This plate was as injuriously affected as a combination of iron and copper would have been with the same exposure. In the opinion of naval experts it will not be advisable to build aluminium boats if they are intended to remain any length of time in the water, though its use may be advantageous on account of the great gain in lightness for metal work exposed to salt water only occasionally.

*Launch of the St. Louis.*—The steamer St. Louis, built for the transatlantic service of the American line, was launched at Philadelphia November 12th, a number of distinguished persons and a great crowd being present, including a delegation of representative men from the city of St. Louis. The ceremony of christening was performed by Mrs. Cleveland, wife of the President of the United States. The sister ship St. Paul is on the stocks, and both vessels may go into service next year. The stern tubes of the screw shafts run through what look like horizontal fins projecting on each side of the hull, the shafts thus being entirely enclosed, and shaft brackets being dispensed with. The leading dimensions are as follows:—Length over all, 554ft. 2in.; length between perpendiculars, 535ft. 8in.; extreme breadth, 63ft.; moulded breadth, 62ft. 9in.; moulded depth, 42ft.; depth from top of keel to top of first deck, 51ft.; designed load draught, 26ft.; number of decks, five, from 7ft. 2in. to 9ft. high each; 24 water-tight compartments; collision bulkhead, 33ft. from stem; gross tonnage, 10,770 tons; displacement at 26ft. draught, about 16,000 tons of salt water; cargo capacity on same draught, 1820 tons; but loaded to 28ft., cargo capacity is 3200 tons. The motive power will consist of two quadruple expansion, vertical, six-cylinder engines with four cranks, driving twin screws, and using steam at 200 lb. pressure. The estimated aggregate horse-power is 20,000. The first frames for the St. Louis and the sister ship St. Paul were laid on July 27th, 1893. Every item entering into their construction is of domestic material and manufacture, and they will be fitted throughout with every convenience and labour-saving device. Each of these ships will carry 320 first cabin and 220 second cabin passengers, 900 steerage, and 400 in the crew, including stewards, or 1840 persons in all. Economy in coal consumption is to be one of the features of these American ships.

*Shields for naval guns.*—Among the numerous investigations and experiments conducted by the Ordnance Bureau of the Navy Department, are tests of shield plates for deck guns which are otherwise practically unprotected. A report has recently been made on the latest experiments with specially-treated plates intended for shields for light calibre rapid-fire guns. The shields now in use in the navy on small guns are too thick and heavy, and naval officials are trying to find thinner and lighter plates of special manufacture which will give equal or increased resistance to penetration. The plates tested for this report had been previously tried at the Indian Head Proving Grounds; but having failed to come up to the requirements, they were sent to the Naval Gun Foundry and re-treated by a process calculated to give good results. There were four separate plates tried, all of which were of chrome steel. The first test was with a ½in. plate, manufactured by the Midvale Company. The gun used was a 1 lb. Hotchkiss, firing steel armour-piercing shells. The target was 113 yards away from the gun. Four rounds were discharged. In the first round the shell had a striking velocity of 1480 foot-seconds. It glanced on the plate and was broken up, making a gouge 1½in. wide, 3½in. long, and 1in. deep, and a through crack 4in. long. In the second round the striking velocity was 1609 foot-seconds. The shell was cracked, but did not break up. Excepting a slight gouge at the point of impact, the plate was not damaged. In the third round the striking velocity was 1750 foot-seconds. A piece of the plate was broken off, and two through cracks were developed. The fourth shell had the reduced striking velocity of 932 foot-seconds. Its point barely got through the plate. Two new through cracks were made in it. In earlier firing by the same gun previous to the re-treatment of the plate, the shells either went through the plate or penetrated to a much greater depth. The latter experiments showed, therefore, that the re-treatment produced higher resisting qualities, a fact which ordnance experts regard as encouraging. The second plate tested was ¼in. thick, and was also a product of the Midvale Company. It was attacked but once with one 1 lb. shell fired from a Hotchkiss gun. The shell went through the plate and was broken up by the impact. A small piece of the plate was dislodged, and a through crack 1½in. long was developed. Apparently no good results had followed the re-treating process. Subsequently the plate was fired at by the new model naval small arm. One bullet with a muzzle velocity of 2650 foot-seconds went through the target at a distance of 130 yards. A second ball with the same velocity nearly got through. Then followed tests of two plates manufactured by the Brooklyn Chrome Steel Works. The first plate tried had a thickness of half an inch, and the second a thickness of a quarter inch. The heavier plate was attacked by a 1-pounder Hotchkiss gun. The shell struck the target at an angle of forty degrees, with a velocity of 1256 foot-seconds. It broke off with an irregular fragment of the plate, and developed a through crack from the point of impact to the top, and from that point 4in. downward. The result of the shot was about the same as that which followed the earlier attack under similar conditions, except that the crack was less serious. The Brooklyn Company's ¼in. plate was fired at twice—first, by the 1-pounder Hotchkiss gun, afterwards by the ·236-calibre naval rifle. It had been badly cracked in the previous trials. In the first round the striking velocity was 578 foot-seconds. The shell glanced off the plate, gouging it to the depth of ¾in., and was broken up. Two through cracks, one 7in. long and another 2in. in length, were developed. The cracks were not as deep or as long as those made in the earlier trials, showing that the re-treatment had been beneficial. Four bullets from the navy musket were next fired, with a striking velocity of 1650 foot-seconds. Two balls, at a distance of fifty yards, perforated the plate, but at a range of 100 yards others splashed on the target, doing no damage. In the previous experiments all the ·236 bullets went through the plate. In relation to the experiments, it is stated that although the results were not as satisfactory as expected, it is believed that the navy will soon find thin gun shield plates that will make a better showing with respect to penetration than the heavier ones now in use. Only domestic plates are to be tested.

*Express locomotive for heavy work.*—The Boston and Albany Railroad has had built two powerful express engines to haul express trains of 200 to 250 tons over grades as steep as 1 in 66. The engines are of the eight-wheel type, having four coupled driving wheels, and a four-wheel leading truck or "bogie." The cab is of iron. The connecting and coupling rods are of I section. An extension smoke-box is used, with a short cylindrical smoke stack. The leading dimensions of these engines are as follows:—

| | |
|---|---|
| Cylinders | 19in. by 24in. |
| Diameter of driving wheels | 5ft. 1in. |
| Diameter of bogie wheels | 2ft. 9in. |
| Weight on driving wheels | 74,000 lb. |
| Weight on bogie wheels | 40,700 lb. |
| Total weight of engine | 114,700 lb. |
| Boiler, diameter at smaller end | 5ft. |
| Boiler pressure | 180 lb. per sq. in. |
| Fire-box size | 7ft. 6in. by 3ft. 4in. |
| Tubes, No. 13. B.W.G., number | 298 |
| Tubes, diameter | 2in. |
| Tubes, length | 11ft. |
| Grate area | 25½ sq. ft. |
| Heating surface, tubes | 1703 sq. ft. |
| Heating surface, fire-box | 141 sq. ft. |
| Heating surface, total | 1844 sq. ft. |
| Smoke stack, inside diameter | 14in. to 16in. at top |
| Height from rail to top of smoke stack | 14ft. 2in. |
| Driving and rigid wheel base | 8ft. 6in. |
| Total wheel base | 22ft. 11in. |
| Steam ports | 1¼in. by 18in. |
| Exhaust ports | 2¾in. by 18in. |
| Slide valve travel | 5½in. |
| Exhaust pipe, double, with nozzles | 3¼in. and 3⅜in. |
| Journals of driving axles | 8in. by 11in. |
| Journals of main crank-pin | 5½in. by 5½in. |
| Journals of coupling rod crank-pin | 4¼in. by 3½in. |
| Tender, eight wheels, diameter | 3ft. |
| Tender, wheel base | 14ft. 2in. |
| Tender, weight empty | 37,200 lb. |
| Tender, coal | 8 tons |
| Tender, water | 4000 gallons |
| Wheel base of engine and tender | 45ft. 11in. |
| Total length of engine and tender | 55ft. 7½in. |

The engine is fitted with the Martin steam heating fittings for the train, and with the Westinghouse brake on driving wheels, tender wheels, and for train.

*Storm window.*—There is frequent inconvenience in locomotive cabs, steamboat pilot houses, &c., from the obscuring of the glass by frost and snow on the outside, or steam on the inside, requiring the engineman or pilot to open the window in order to keep a lookout, which is very objectionable in severely cold and stormy weather. To obviate this, a window has been designed having two panes of glass about ⅝in. apart, the space between being filled with water which is heated to about 100 deg. by a tube around the edge through which steam is passed. The steam is not in contact with the water, and there is no pressure on the water. It has been found very useful on locomotives during the severe winters which are experienced in the Eastern States. The window is also adapted for lighthouse purposes.

*Forests and forestry.*—The recent annual report of the Chief of the Forestry Division shows that the seventeen forest reservations now aggregate 17½ million acres, and the four national parks 3⅓ million acres. The sale of ripe timber on the reservations and public timber lands is permitted under supervision. The exports of wood and wood products in 1893 amounted to 43 million dollars, and the imports to 2½ million dollars. The total annual consumption of timber of all kinds is about 22,000 million cubic feet, or 350 cubic feet per capita, and the inadequacy of the present forest area to meet growing demands is very evident. This bureau has for some years been urging the adoption of a rational forestry policy, providing for the protection of the timber resources, the regulation of cutting, and the provision for reforestation where required. Its investigations into the strength and qualities of timbers show conclusively that the strength of pine is not affected by the withdrawal of resin for commercial purposes.

*Snow plough for electric railways.*—City and country tramways in districts subjected to much snow during the winter usually have a number of snow ploughs for keeping the track clear, and on electric railways they are very successful. For keeping the snow from settling or drifting deep, or to clear the pavement after the plough has passed, street sweepers with revolving brooms about 7ft. long are run over the line; but where the snow is deep it has to be ploughed off. The Taunton plough is a four-wheeled car with the corners bevelled, and sliding windows fitted in the ends and bevelled parts, so as to afford a good view. In front projects the plough, about 3ft. high at the nose and 4ft. at the back, formed of steel plates carried to a point in front and flaring out, to clear the side of the body of the car. Back of the plough is an adjustable wing on each side of the car, so as to increase the width of space cleared. For single track the edge of the plough is in the middle, delivering snow on each side; but for double track the edge is over the inner rail, delivering all the snow on one side of the road. The plough is raised and lowered by a lever; and is fitted with a rail cleaner held up to its work by a spring, which will give if the cleaver strikes a switch or crossing. There is a plough at each end of the car, the two being balanced, and the rear plough being 8½in. above the rail. The car is carried on four 33in. wheels with flanges ⅞in. deep, and the wheel base is 6ft. 6in. An electric motor is carried on one or both axles, as desired. Boxes for sand or salt are in the car, with pipes leading down in front of each wheel.

*Express locomotive.*—The following are the leading dimensions of the latest express engines on the Pennsylvania Railroad, which engines are of the eight-wheel type—four-coupled driving wheels and a four-wheel leading truck or bogie—and have tenders carried on two four-wheel trucks or bogies:—

| | |
|---|---|
| Cylinders | 19 × 24in. |
| Driving wheels | 7ft. |
| Truck wheels | 3ft. |
| Tender wheels | 3ft. |
| Wheel-base of engine truck | 6ft. 7in. |
| „ driving wheels | 7ft. 9in. |
| „ engine | 19ft. 9½in. |
| „ tender trucks | 5ft. 7in. |
| „ tender | 16ft. 2in. |
| „ engine and tender | 49ft. 3¼in. |
| Centre of truck to centre of driving axle | 11ft. 9in. |
| Centre of coupled wheel to front tender wheel | 10ft. 4¾in. |
| Centre to centre of tender trucks | 5ft. |
| Length from nose of pilot—or cow-catcher—to back of automatic coupler on tender | 57ft. 6½in. |
| Weight on driving wheels | 86,900 lb. |
| Weight on truck wheels | 38,900 lb. |
| Weight, total, of engine | 125,800 lb. |
| Boiler, diameter | 4ft. 10¾in. |
| Size of fire-box | 119¾ × 40in. |
| Tubes (number, 258), outside diameter | 1⅞in. |
| Tubes, length between tube-plates | 11ft. 4in. |
| Length of smoke-box, including extended front | 5ft. 7¾in. |
| Height from rail to centre of cylinder | 3ft. 6in. |
| „ „ centre of boiler | 8ft. 4in. |
| „ „ top of smoke stack | 15ft. |
| Length from front of smoke-box to back of fire box | 27ft. 8¼in. |
| Length of pilot or cow-catcher | 4ft. 3in. |
| Height of ditto | 3ft. 4in. |
| Back of pilot to middle of cylinder | 5ft. 4in. |
| From centre of smoke stack to centre of bell | 2ft. 7¼in. |
| From centre of bell to centre of sand-box | 3ft. 0¼in. |
| From centre of sand-box to centre of dome | 4ft. 4¾in. |
| From centre of dome to centre of safety valve case | 5ft. 2in. |
| Centre of dome to back of fire-box | 13ft. 6¾in. |
| Draw-bar pins of engine and tender, apart | 2ft. 9in. |
| Tender, height of frame from rail | 3ft. 4in. |
| „ length over frame | 21ft. 8in. |
| „ length of tank | 19ft. |
| „ coal capacity | 7½ tons. |
| „ water capacity | 3000 gals. |
| „ weight, loaded | 70,000 lb. |
| „ height from rail to centre of coupler | 2ft. 11in. |

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE negotiations entered into this week for manufactured iron have been for limited quantities only. In very few cases is there any conspicuous activity, and the end of the year will close quietly with one or two exceptions. The sheet mills are tolerably well situated for orders, and in most instances operations are carried on the whole of the week. Values of galvanised sheets are slightly firmer at £9 10s. to £9 12s. 6d. for 24 w.g. f.o.b., Liverpool. Some firms possessing a good reputation will not, however, accept these rates, quoting 10s. to 20s. above them as their minimum. Sheets for galvanising and working-up purposes are nominal at £6 10s.; doubles and trebles, £7. Iron suitable for heavy engineering requirements is tolerably active. Marked bars are £7 10s.; second-branded sorts, £6 10s.; common bars, £5 7s. 6d.; hoops and thin strip, £6 7s. 6d.; stamping sheets, £8; best thin sheets, £10; and tank plates, £6 15s. to £7. Current sales of pig iron are restricted to small parcels for prompt delivery. Staffordshire all-mine hot blast is selling at 52s. 6d.; part-mines, 40s.; and cinder, 37s. 6d. Lincolnshire metal is quoted here, net, 40s. to 41s.; Derbyshire, 39s. to 40s.; and Northamptons, 38s. to 39s., less 2½; West Coast ordinary forge hematites, 54s., and foundry, 56s. 6d. to 57s. 6d., with best ditto, 60s.

The new works of Thomas Parker, Limited, electrical engineers, were opened at Wolverhampton on Monday, the machinery being set in motion by the Mayoress. The Mayor, Lieutenant C. T. Mander, is chairman of the board, and the position of managing director is occupied by Mr. Thomas Parker, late engineer and works manager to the Electric Construction Corporation, Bushbury and London—formerly Elwell Parker, Limited. Mr. Parker's name is well known in connection with the Liverpool Overhead Electric Railway, and other public undertakings. The erecting shop has four bays, each 150ft. in length, two being 42ft. 6in. in span, and two 32ft. 6in. There is also a foundry 40ft. by 120ft., and a pattern shop 80ft. by 40ft. The large shop is equipped with three overhead travelling cranes, and the foundry has a large cupola and a 10-ton crane. There is some splendid machinery for milling, planing, boring, &c. &c., of the most modern type, and from first-class firms, including Hulse and Co., Manchester; Kendall and Gent, Manchester; Muir and Co., Manchester; Tangyes Machine Tool Company, Birmingham; Campbell and Hunter, Leeds, and others. The current for driving the machinery and lighting the works is generated by a 100 kilowatt dynamo, actuated by a 250-horse power compound engine, by Bellis and Co., of Birmingham. One of the side-planing machines by Hulse and Co. has a 20ft. stroke. A two-spindle vertical milling machine, by Kendall and Gent, is ten-speeded, and mills over surfaces 5ft. by 10ft. by 3ft. high. The roofs are on the special timber principle of McTear and Co., Belfast. Much of the ironwork throughout is by Heenan and Froude, Manchester. The works were built from the designs of Mr. Archibald Brevitt by Mr. Henry Lovatt, both of Wolverhampton. All classes of electrical engineering work, both for power and lighting, will be turned out. Considerable orders are already in hand.

The new form of Siemens gas-fired furnace is coming increasingly into favour in this district. So pleased have the Staffordshire Steel and Ingot Iron Company been with its fuel saving capabilities and general efficiency, that they have laid down a second one for re-heating large steel ingots. It is also meeting with growing approval for iron manufacturing purposes, among the Midland mills and forges.

A correspondent of one of the Birmingham newspapers, dealing with the question of road engines for agricultural traffic *versus* light railways, states this week that in Herefordshire, with about 120,000 inhabitants, there are some 600 engines at work, and during the last year they have moved about 250,000 tons from three to thirty miles, mostly in loads of from ten to twenty tons. Owing to prohibitive bye-law restrictions the engines are, however, of very restricted use to farmers, although they are of much use to manufacturers.

Very few farmers can produce loads of ten tons or over. It is stated that what the farmers require are light and speedy engines that collect smaller loads from the farms, and which would find them in great abundance. The design of the present heavy road engine is, it is suggested, entirely the outcome of the regulations, while if the regulations were made for the assistance of steam traffic "we should soon have engines that would be formidable competitors with the railways, and would show that the proposed light railways would be a very expensive competitor."

In the Herefordshire district a light railway might be made for £2000 per mile, costing £24,000 or thereabouts, while the cost of one single mile of such a line would, it is urged, provide road engines and carriages to move the whole of the produce of the district, except what would be always moved by light horse traffic. Such views are confirmatory of the opinions expressed in a recent leader in THE ENGINEER on this subject.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—With the close of the year so near at hand, there is naturally a disinclination to enter into business operations beyond such as are requisite to cover immediate actual pressing requirements, and this, added to the previous exceptionally depressed condition of the iron market, gives a more than ever quiet tone to the trade generally. Both in raw and manufactured material the buying going on is just now of the most limited weight, and there is a good deal of under-quoting to effect sales; in fact, at what may be termed makers' quotations, very little business is practicable, but in the present condition of the market perhaps no great importance can be attached to the excessively low prices which, in some instances, are being taken to secure business. The outlook of the future, however, does not in any way improve, and there is a continued more or less despondent tone as to the prospects for the ensuing year.

There was again only an extremely flat market on the Manchester Iron Exchange on Tuesday, business for the most part coming forward only in the most limited quantities. Pig iron still meets with only a slow hand-to-mouth sort of demand, with rather a weakening tendency in prices, transactions of any moment that do come upon the market being competed for at under makers' quotations. With regard to Lancashire pig iron, the position remains much as reported recently; local makers still quote nominally on the basis of about 39s. for forge, up to 42s. for foundry, less 2½, at the works, but they have no chance of competing with Lincolnshire brands at these figures, and the only business local makers are doing is confined to occasional sales of foundry to regular customers, where they are favourably situated with regard to the rates of carriage. Some extremely low figures have been quoted during the week for Lincolnshire pig iron, prices for which are lower, out of all proportion as compared with other brands offering here. Forge qualities could be readily bought at about 37s., net cash, delivered Manchester, although makers do not actually quote under 37s. 6d., with foundry qualities averaging about 38s. 6d. to 39s., and Derbyshire foundry still nominally quoted, according to brand, from about 42s. 6d. and 43s. up to 45s., net cash, delivered Manchester. In outside brands there is a good deal of underquoting to get hold of business, but the current market quotations remain steady at about late rates, Middlesbrough averaging 43s. 10d. to 44s. 4d., net cash, delivered Manchester, Eglinton about 46s. 6d., and Glengarnock about 47s. 6d., net prompt cash, delivered at the Lancashire ports.

A very depressed tone continues throughout the finished iron trade, forges for the most part being only very partially employed, and prices gradually settling down to what were previously the minimum quotations to effect special sales. Lancashire bars do not now average more than £5 5s., with North Staffordshire about £5 5s. to £5 7s. 6d.; Lancashire and Staffordshire sheets range from £6 17s. 6d. to £7 2s. 6d., and Lancashire hoops are quoted £5 15s. for random to £6 for special cut lengths, delivered Manchester or Liverpool.

Only a very quiet business is still reported throughout the steel trade, with no really quotable change in prices; ordinary foundry hematites nominally average about 52s., less 2½ per cent.; low-class steel billets, £3 17s. 6d. to £4, and better qualities, £4 7s. 6d. to £4 10s.; steel boiler plates, £6 2s. 6d. to £6 5s.; and ordinary steel bars, £6 to £6 2s. 6d. per ton, delivered in this district.

The reports I gather from representatives of the engineering trades throughout the district do not indicate any material change in the position generally, and the reports issued this month by the engineering trades union organisations also are to much the same effect. The Amalgamated Society of Engineers, however, are able to report a further decrease in the number of unemployed members on the books of the society both generally and in this immediate district. This has been going on for the last couple of months, and, as I previously intimated, it is regarded as an exceptionally satisfactory sign that at this season of the year there should be even a small decrease in the number of unemployed, when usually an increase is looked for. The returns of the society from the various branches throughout the organisation do not show more than about 9 per cent. now in receipt of out-of-work benefit, whilst the returns in this immediate district, which a month back were quite 10 per cent., are now barely over 9 per cent. The returns of the Steam Engine Makers' Society show no material change, the number of out-of-work members remaining practically the same as last month, there being still about 5¼ per cent. of the total membership in receipt of donation benefit. With regard to the condition of trade, the reports from the various districts show no appreciable improvement, except that in one or two of the shipbuilding centres there are better prospects, and in some quarters the belief is prevalent that there will be a return to activity in this branch of industry with the ensuing year. In most branches of heavy engineering a fair amount of work is reported, but amongst locomotive builders trade is extremely slack, whilst boilermakers continue but indifferently employed.

A week or so back I referred to some possible friction between the employers and the workmen in the engineering trades of this district on the question of overtime. A conference has since been held of representatives of the Amalgamated Society of Engineers, Steam Engine Makers' Society, Pattern Makers, Brass Finishers, and Metal Planers, United Machine Workers, Amalgamated Smiths and Strikers, and Amalgamated General Tool Makers and Machinists, in this immediate district, at which the whole matter was fully discussed. The men take it as a grievance that, whilst so large a number of their members are out of employment, some of the shops should be persistently working overtime, and it was decided to send out a circular to the employers in the Manchester district, requesting that they would give due thought to the unemployed by abolishing overtime on new work, and where the staff of workmen was insufficient to cope with the work in hand, to adopt night shifts and engage extra men, so as to distribute the wage list among a greater number of men than was the case where excessive overtime was resorted to. No definite reply has yet been received from the Employers' Association with regard to this circular, but I understand it is under consideration. It does not appear that the men working overtime have any fault to find with the arrangement.

Messrs. Richard Johnson, Clapham, and Morris, of Manchester, have just added to their already large business, as manufacturers of safety lamps, screens, &c., by the purchase from the Deflector Safety Lamp and Miners' Appliance Company, which has ceased the manufacture of lamps and colliery requisites, the whole of their stock of miners' safety lamps, glasses, gauzes, lamp cleaning machines, patterns, &c., and also the safety lamp patents belonging to the above company.

At the annual meeting of the Northern Society of Electrical Engineers, held on Monday in Manchester, Mr. Henry Edmunds was elected president for the ensuing year, in place of Dr. John Hopkinson, F.R.S., who has held the office during the past year, Messrs. G. E. Preece, and W. P. J. Fawcus vice-presidents; Mr. John Darney, hon. secretary, and Messrs, A. B. Blackburn, Thomas Browett, E. Claremont, S. V. Clirehugh, G. S. Corlett, E. W. Cowan, C. M. Dorman, G. W. Lowcock, E. Manville, J. H. Rider, J. Taylor, and C. H. Wordingham, members of the Council of the Society. At the same meeting Mr. Alfred H. Gibbings read a paper on the "Commercial Possibilities of Tramcar Traction considered as a Municipal Undertaking," in which he referred to the three forms of electric traction now in use, viz., the underground channel, or conduit system, overhead wires, or trolley system, and accumulators, and described in detail an accumulator system he had recommended for adoption by the Corporation of Hull. Dealing with the general question, he said he had, however, come to the conclusion that the secret of success lay not so much in the adoption of any particular method of electric traction, however superior it might be, as upon enlisting and utilising services to which other enterprises could be made to contribute. Separately they might be only just paying their way, but combined it might be possible to make an exceptional success of both, and he urged that in connection with the accumulator systems corporations who had erected destructors for dealing with their refuse might combine these very effectively and economically in generating the power for application to electric traction.

Throughout the coal trade extreme depression continues the general complaint, all descriptions of fuel meeting with only a very slow demand, and three to four days per week continues the average that pits are working. Considering the season of the year, the sale of house-fire qualities continues extremely moderate, and the reductions made last week by one of the leading firms in the Manchester district have been followed by similar concessions on the part of other colliery concerns in the immediate neighbourhood. Generally, however, in other districts quoted rates remain unchanged, but there is a good deal of irregularity as regards actual selling prices in the open market. Best house coals do not average more than 10s. 6d. to 11s., seconds qualities 9s. 6d. to 10s., with common house coals about 7s. up to 8s. per ton at the pit mouth.

There is also but a very poor demand for the lower descriptions of fuel suitable for iron-making, steam, and general manufacturing requirements, and with excessive supplies offering, prices are extremely low, scarcely averaging more than 6s. 6d. for steam and forge coals, at the pit mouth. With regard to engine classes of fuel, common slack ranges from 3s. 6d. to 4s., with better qualities about 4s. 6d. to 5s., 5s. 6d. per ton being got in special cases, at the pit mouth.

For shipment only a very limited weight of business is reported, and prices are rather lower, if anything, common steam coal being readily obtainable at about 8s., with better qualities 8s. 6d. per ton, delivered at the Garston Docks, or the High Level, Liverpool.

*Barrow.*—In the hematite pig iron trade business is still very quiet, and neither on home or foreign account is any life shown. Prices are easy at 43s. 4½d. net cash, sellers of warrant iron, and 43s. 3½d., buyers. Makers still quote 44s. to 45s. per ton for parcels of mixed Bessemer Nos., net f.o.b. Stocks of iron have been increased during the week to the extent of 1000 tons, and now stand at 170,632 tons, being an increase on the year of 76,000 tons. Another furnace has been blown out, and now there are only 31 in blast, compared with 33 in the corresponding week of last year.

Steel makers are short of orders well nigh all round. Rails are quiet, although prices are down at £3 10s. for heavy sections. No new transactions are noted in plates, but the mills are busy. Slabs, blooms and wire rods are quiet. Billets and hoops in slow request, tin bars in small inquiry. Heavy steel castings are wanted.

The shipbuilding and engineering trades are by far the most brisk industries in the district, although no new orders are reported, but the contracts already in hand are considerable, and are likely to maintain activity for a couple of years to come. During this year the Naval Construction and Armaments Company has built shipping representing 20,656 tons, and has constructed engines of 29,550 indicated horse-power. Last year this company built 19,552 tons of shipping, and engines of 30,800 indicated horse-power.

Iron ore is still very depressed, and even the local demand showed further shrinkage. Prices are easy at old rates, 8s. 6d. for ordinary, and 13s. 6d. per ton for the best sorts net at mines. Coal and coke are depressed, the demand is very quiet. Deliveries are plentiful. Prices are steady at late rates.

Shipments of pig iron during the past week from West Coast ports amounted to 6310 tons, and of steel 3893 tons, compared with 4000 tons of pig iron, and 6053 tons of steel in the corresponding week of last year, an increase of 2310 tons of pig iron, and a decrease of 2160 tons of steel. The aggregate shipments up to date this year are 333,055 tons of pig iron, and 367,660 tons of steel, compared with 262,842 tons of pig iron and 413,012 tons of steel in the corresponding period of last year, an increase in pig iron shipments of 70,213 tons, and a decrease of 75,352 tons of steel.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The slight improvement noted in the house coal trade last week has had the effect of stiffening prices a little. It has not been materially felt at the collieries, some of which are still working on short time. Trade is pretty quiet, and should the present mild weather continue, it will not make much progress at present. The supply is still considerably above the demand in all sorts. Railway companies who have running powers to London, and are connected with local collieries, have materially advanced their tonnage during the week, but the metropolis is not taking the usual average at this period of the year. The only appreciable difference the Scotch strike seems to have had on the trade of this district is the fact that it maintained the business at a time when it was likely to be very dull, and caused a temporary stimulus. The men are complaining bitterly of their small earnings, and state that, even with the 30 per cent. on their wages, it makes little difference, as when they are in the colliery they are not fully engaged. The seaborne coal is in keen competition in the London market, and, owing to the more favourable terms on which it can be sold, prevents anything like better prices being obtained. Everything seems to point to a further decline in demand and a continued abundant supply.

Prices are about the same as when last reported. Silkstones are 9s. 6d. to 10s. 6d. per ton; Barnsley house, from 8s. 6d. to 9s.; Flockton is selling at the same rates; secondary qualities and thin seam coal are at present being mostly sold for locomotive purposes; the best qualities fetch from 7s. to 7s. 6d. per ton at the pits. Although steam fuel is not in very good request, a fair tonnage is being taken to Hull and the other Humber ports. Grimsby is also doing a moderate trade with South Yorkshire pits, notwithstanding the fact that Derbyshire colliery owners are energetic rivals for business with that port. Local proprietors have not much opportunity to compete for the Goole trade, owing to the improved railway facilities provided for West Riding manufacturers. When the Sheffield Canal is in working operation district pits will have a better chance. Steam coal ranges in price from 7s. 9d. to 8s. 3d., but Flockton, which is admirably suited for these purposes, can be had at 6s. 9d. to 7s. 3d. at the pits. There is certain to be a stiff struggle when railway companies commence the placing of their contracts. As yet there has been but little done in that direction. Gas coal, which is in increased request, is now being supplied at 7s. 3d. to 8s. per ton. Lower prices have prevailed lately owing to the large amount of fuel in the market. Small coal is in poor demand, fetching only about 1s. 9d. per ton. Manufacturing slack is plentiful at 3s. to 5s. per ton. Coke is fairly active, and Derbyshire, North Lincolnshire, and other parts are taking a good average tonnage.

In the heavy iron and steel branches there is generally little change to report. The season trade is now about over, and the operations for the year can scarcely be set down as satisfactory. One or two firms are exceedingly well off for work. That condition of things, however, is not of wide application. There is a disposition to regard the outlook as somewhat gloomy for the future. Other manufacturers look forward hopefully to better business during the New Year, and their view of affairs is strengthened by certain sure signs, such as the large withdrawal of money from the banks, to make preparations for an augmented volume of business in the beginning of 1895. Recent railway traffic returns have been so unsatisfactory, that many of the principal companies, although they are admittedly short of locomotives, wagons, carriages and stores, have not sufficient confidence in the immediate future to place their orders. One we hear of is the Midland Railway Company, which has recently given out some work in rolling stock, although not to any great extent. The North-Eastern Railway Company is also asking for tenders for a considerable quantity of stock. An improvement in railway traffics would at once favourably affect business in the Sheffield district, as the production of this class of material forms a very large part of the work done in the heavy trades.

The anticipations entertained a few months ago that the present year, in regard to railway traffics, would equal at least the returns for 1892, are not being justified. Less has come into the Sheffield district by rail, and a good deal less has also gone out. If the business done during the opening months of the year had been maintained, the condition of affairs would have left little to complain of. In the East End districts, the summer and autumn months have found sufficient employment for the workpeople, and it is now pretty certain that a good deal of distress will have to be provided for before the spring of 1895.

Iron quotations remain as last reported, East Coast hematites at 50s.; West Coast hematites, 52s.; Lincolnshire forge iron, 38s. per ton, all delivered in the district. Bessemer billets are still quoted at £5 7s. 6d. The Scotch business, which used to be important at this season, has fallen away very considerably. Manufacturers attribute the lessened demand from the North to the effects of the coal strike, which operated there, as it did here, preventing the manufacturers from taking orders, which went elsewhere, many of them abroad. It would be interesting to know, but the information, of course, can only be obtained by the firms giving it themselves, how much good British business was lost—practically given to the foreigner—through the great coal stoppages in England last season and in Scotland this year.

At the works of Messrs. William Jessop and Sons, Brightside, there is in operation a new type of Siemens-Martin furnace, which has several advantages. One of its main features is the saving of coal, which is considerable. Another is in respect of repairs to the brickwork, &c., which, as well as being greatly lessened, are, when necessary, easily made, owing to the improved construction of the furnace. It has now been working for a considerable time on high-class steels, and has proved very successful. It is the joint invention and patent of Mr. Sydney J. Robinson and Mr. S. Pope.

Cutlery manufacturers report that they have not done so well this season in winter goods, neither in the home nor the foreign markets. An exception is the United States, which is rapidly recovering from the evil effects of the protracted suspense before the tariff arrangements were completed. Special goods for the American market are being largely ordered, and some goods, which have not been sent to the States for years, are again being manufactured to the order of American storekeepers. The tendency of the tariff to increase the quantity of cheap goods is still apparent, but in nearly every class of table cutlery there is more doing for that country. The spring knife cutlers are very poorly employed. The Australian markets are looking up and the Canadian demand is also hopeful of important business in the spring. The South African trade is not quite so brisk as in the autumn. Makers of edge tools are still well off for work, and the joiners' tool manufacturers report very good business. Skate makers, in spite of the mild weather, are making extensive preparations for the winter pastime. That trade comes suddenly, "like a thief in the night," and skate makers must not observe too carefully the signs of the weather, but go on making their skates to be ready to take advantage of the nipping frost when it comes.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

In spite of the unsatisfactory local statistics that were issued last week the market for iron and steel has not become worse as expected, but is, on the contrary, showing some improvement, for imperial statistics—the Board of Trade export and the revenue returns—have had more influence. They are more encouraging on the whole, and indicate that the general trade of the country is becoming more satisfactory. On this account, not only consumers, but also speculators are more inclined to speculate, and a decidedly brisker business than for some time past has been done this week, and in some branches at higher prices than have recently been quoted. In other metals than iron and steel, prices have moved upwards this week, and this has favourably influenced the iron market. The advanced rates have chiefly been in plates and angles, and the commoner qualities of Cleveland pig iron. The last-named have of late been unduly depressed, because the output was so much in excess of the requirements, and Cleveland forge pigs became absolutely "a drug upon the market." They have therefore had to take such steps that their furnaces should produce less forge iron, which they could not readily sell, and more of the foundry qualities which were in demand; the consequence is that the quantity of forge iron offering has declined, and the price for it has stiffened. A fair business in Cleveland pig iron has been done this week, and traders are not disposed to take such a despondent view of the prospects as they have held for some time past. Pig ironmakers have this year done a larger business, especially in Cleveland ordinary pig iron, the consumption of which this year so far has been 1,260,776 tons, as compared with 1,230,401 tons in the first eleven months of last year. The total production of Cleveland pig iron this year has been 1,298,513 tons (18,052 tons more than in 1893), and of hematite, spiegel, and basic pig iron 1,405,142 tons (185,041 tons increase on last year). Thus for the first time in the history of the North of England pig iron trade has the production of ordinary Cleveland iron been surpassed by that of hematite and other kinds, and the excess of the latter over the former has been 106,629 tons, every month this year contributing to that excess. The total production of all kinds of pig iron in the North of England has this year so far reached 2,703,655 tons, the largest on record, and surpassing that of 1890—the next best year—by nearly 100,000 tons. Of the Cleveland ordinary pig iron it is worthy of note that two-thirds has been exported (802,751 tons), but of the hematite, &c., only an eleventh part has been exported, the other ten-elevenths being either consumed in the district or sent to Sheffield and a few other inland places. Only 127,524 tons of hematite pig iron has been exported this year, against 165,803 tons last year.

A fair business has this week been done in Cleveland pig iron, and the tone of the market may be described as cheerful. The quotation for prompt f.o.b. deliveries of No. 3 Cleveland g.m.b. pig iron has this week been firmly maintained at 35s. 6d. per ton, and nothing below that has been taken. For delivery over the first quarter of next year, 35s. 9d. is asked and paid. There has this week been more speculation in Cleveland warrants than for a long time past, and up to 35s. 7d. cash has been quoted, but Wednesday's price dropped to 35s. 6d. The stock of Cleveland pig iron held by Messrs. Connal and Co. on Wednesday night was 90,964 tons, or 249 tons decrease this month. No. 4 Cleveland foundry pig has been advanced to 34s. 9d., and grey forge to 33s. 9d. The hematite pig iron trade does not yet show any improvement, but if the improvement in the plate and angle trades continues, the demand for hematite pig iron must likewise increase. Sellers of mixed numbers are asking 42s. 6d. per ton for early f.o.b. deliveries, and will readily take that, as their stocks accumulate. In Connal's stores alone there has this year been an increase of 41,482 tons of hematite iron, raising the total quantity held in the stores to 76,210 tons, and in makers' hands also there must have been a heavy increase, but statistics in respect to these are not procurable. This is very unsatisfactory for producers of hematite pig iron, and accounts for their having reduced their prices 3s. 6d. per ton where makers of ordinary Cleveland pig iron have not found it necessary to reduce theirs more than 1s. Exports of pig iron this month from the Tees are very fair, there being a large increase to Scotland, which counterbalances the loss in the continental trade. Up to Wednesday night the quantity of pig iron shipped this month reached 25,732 tons, as compared with 29,881 tons last month, and 25,472 tons in the corresponding month last year to 12th.

Some improvement has been reported this week in the shipbuilding industry, the low prices which builders quote for new vessels, coupled with better prospects for shipping and higher freights, have tempted owners to give out orders more fully than for some time past, and builders have been buying materials freely during the last few days. They will thus enter upon the New Year with better prospects than they expected. This year, in the

North of England, in spite of the interruptions to operations caused by the moulders' strike, shipbuilders will have launched a heavier tonnage than in 1893, and during most of the year they have been fairly well occupied, their worst time being the present. The fourteen builders on the Wear this year have launched vessels aggregating 166,503 tons gross register, 43,968 tons in excess of the 1893 return. The Tees shipbuilders have launched vessels as under:—

| | Gross register. Tons. |
|---|---|
| *Middlesbrough.* | |
| Sir Raylton Dixon and Co. | 32,220 |
| W. Harkess and Sons | 1,470 |
| R. Craggs and Sons | 4,003 |
| *Stockton and Thornaby.* | |
| R. Ropner and Sons | 28,028 |
| Richardson, Duck, and Co. | 23,312 |
| Craig, Taylor, and Co. | 12,809 |
| | 101,842 |

Last year's launches on the Tees totalled 93,915 tons, but in 1890 were 127,739 tons.

In the engineering industries some slight improvement is noticeable, and the brightening up of the shipbuilding industry will add to it. Some of the marine engineers having found trade so very bad of late have gone in for other kinds of work—the building of engines for electric lighting and power, a trade which they believe has a good future before it. Several firms in this district are using electricity to drive their smaller machinery. Ironfounders are doing only a very moderate trade. The creditors of the Egglescliffe Ironworks Company, Egglescliffe Foundry, near Stockton, had a meeting on Tuesday, and had such a satisfactory report presented to them by the official accountant that it was decided that the reconstruction of the concern be proceeded with at once, and it was expected that the works will not have to cease running. They were one of the few which were kept in operation throughout the Durham strike.

The demand for manufactured iron and steel is somewhat more active, and shipbuilders have this week bought more freely than for a long time, while the number of inquiries has increased, one being for quotations for a large quantity of plates for vessels that are to be built at Hamburg. Some of the ship-plate makers have put up their prices 2s. 6d. per ton, and ask £4 15s., less 2½ per cent. f.o.t. Angles are also in better request, and while some producers will accept £4 10s., less 2½ per cent. f.o.t., for both iron and steel angles, others do not come below £4 12s. 6d., less 2½ per cent. Boiler-plates are £1 per ton dearer than ship-plates, and girder plates 5s. dearer. Heavy steel rails are at £3 12s. 6d. net at works, and demand is very quiet. There has been a slight movement upward in the shares of some of the iron and coal companies this week, and in connection with those of Sir W. G. Armstrong, Mitchell and Co., it has been remarkable, viz., £10 per share and the £100 shares are now at 191. At the annual meeting of the shareholders of Messrs. Dorman, Long and Co., Middlesbrough, the chairman was asked whether the stocks had been taken at cost or invoice prices, and replied that unfortunately the prices were so nearly alike that it was of little consequence which price was adopted. He said also that the firm found orders very scarce, and what orders were about were very keenly competed for. He asserted that they were in a position to make angles and joists as cheaply as any other works in the country. He mentioned that they had now a very efficient bridge-building plant. They did not go in for large bridges, but were endeavouring to persuade engineers to adopt their joists for short spans, and they were doing so in a manner that was very encouraging.

The arrangement devised some two years ago by Mr. Thomas Mudd, of Hartlepool, for preventing the destruction of the propeller shafts of steamers by galvanic action and corrosion appears to have proved very successful. The shafts of some of the vessels then fitted with the device have just been examined, and show no trace of galvanic action or corrosion. Some eighteen months ago the s.s. Guernsey had her tail-shaft fitted with the arrangement, and on the shaft being drawn while the vessel was in dry dock lately, and the preserver pulled loose from its attachment to the shaft, it was found that the shaft had been entirely preserved, and the rubber sleeve itself had taken no harm, and was capable of being cemented down again for a further period at sea. The examination of the shafts of other vessels fitted with the sleeve showed that the sleeve itself was in a flexible and good condition, and when turned back from its attachment to the shaft the shaft and the ends of the brass liners were found in the same condition as when they left the lathe when new.

At the meeting of the North of England Institute of Mining and Mechanical Engineers, at Newcastle on Saturday, the president—Mr. Thomas Douglas—delivered his inaugural address, in which he referred to the greater security of life in mines which had now been attained in this country, and he criticised the report of the Commission which had been inquiring into the question of the part which coal dust took in causing explosions in mines. He expressed a hope that the Home-office, with the means at its disposal, would take up the question of stamping with its authority such explosives as they found could with safety be used under varying, and—if possible—under any circumstances. In relation to the application of electricity to coal mines, the president expressed the belief that it would ultimately lead to the adoption of locomotive traction under ground.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been somewhat firmer in the last few days, with a considerable business in Scotch warrants, the prices of which have been on the basis of 42s. 4½d. to 42s. 6d. cash. Business in Cleveland iron has been limited, and the prices are a shade easier. For hematite warrants the inquiry is comparatively inactive, with little alteration in values.

Since last report the output of pig iron has been increased by the addition of three furnaces at Glengarnock, these producing ordinary iron. There are now 45 furnaces making ordinary and 25 hematite pigs—total 70, against 15 at this time last year, when a large number of the furnaces were out temporarily in consequence of a strike of miners.

The inquiry for makers' pig iron is fair, special brands selling pretty well, although the prices are difficult to maintain, being in several instances this week quoted 6d. to 1s. per ton lower:—G.M.B., f.o.b. at Glasgow, No. 1. is quoted 44s. per ton; No. 3, 42s.; Monkland, No. 1, 45s.; No. 3, 42s.; Carnbroe, No. 1, 45s. 6d.; No. 3, 44s.; Clyde, No. 1, 50s.; No. 3, 47s.; Gartsherrie, No. 1, 51s. 6d.; No. 3, 47s. 6d.; Calder, No. 1, 51s. 6d.; No. 3, 48s.; Summerlee, No. 1, 52s. 6d.; No. 3, 47s. 6d.; Coltness, No. 1, 54s. 6d.; No. 3, 51s.; Glengarnock at Ardrossan, No. 1, 50s.; No. 3, 47s. 6d.; Eglinton, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Dalmellington at Ayr, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 53s.; No. 3, 50s. 6d.

The shipments of pig iron from Scottish ports in the course of the week have been 6772 tons, compared with 4345 tons in the corresponding week of last year. Of the total there was despatched to South America 200 tons, India 222, Australia 480, France 80, Italy 1020, Belgium 33, Spain and Portugal 120, China and Japan 618, other countries 150; the quantity sent coastwise being 3834, against 2766 in the same week of 1893.

The market for finished iron is in an inactive state. Abroad the Scotch product does not meet with much demand. Freights from Germany to the East are so slow, comparatively speaking, that with the cheaper prices for iron also prevailing on the Continent there is little chance of placing any orders here at present for unbranded iron. For common bars the demand is quiet. The steel trade is in an unsatisfactory state, the result, it is believed, indirectly of over-production. An understanding has for some time existed among the Scotch steelmakers as to prices, and a strenuous effort has been made by their Association to maintain these, as the only chance of making the business yield any return. In one or two cases, however, firms have been compelled to withdraw from the Association, as they could not keep their works going otherwise than by taking orders at reduced rates. The firmer prices quoted for ship plates, however, in the North of England within the last few days, and the placing of considerable orders for shipbuilding steel in this district, is expected to produce a rather better feeling—especially as the approach of the new year can scarcely be without its influence.

The shipments of manufactured goods from Glasgow in the past week embraced sewing machines to the value of £7585, other machinery £5130, steel goods £1820, and miscellaneous iron articles £18,820.

The coal trade is dull, or rather supplies are so ample that the market is in an easy condition, with prices tending downwards. The shipments in the past week fell short of those for the week preceding by 11,700 tons. In some districts the colliers are but partially employed, and by this time the men must be convinced of the unwisdom of their leaders in recently attempting to get up a fresh agitation in favour of an advance of wages.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Up to the time of my despatch there has been an absence of the rush for steam coal which takes place generally before Christmas time, and, while collieries have been working less busily, complaints are heard on 'Change, Cardiff, of a lessened buoyancy of tone. Midweek there was a little freer inquiry, and it is not at all unlikely that next week will be a busy one. Prices have varied to the extent of 3d. on best steam coal during the last week, but as a rule no quotation has been below 11s. The latest prices, Cardiff, were:—Best steam, 11s. to 11s. 3d.; seconds, 10s. 3d. to 10s. 9d.; best Monmouthshire, 10s. 3d. to 10s. 6d.; dry coal, 9s. 6d. to 9s. 9d.; best small, 5s. 6d. to 5s. 9d. House coal remains in a steady condition, and there are strong grounds for believing in an appreciable advance, both in demand and price. At present prices are as follows:—Best house coal, 10s. 6d. to 11s; No. 3 Rhondda, 10s.; brush, 8s. 3d. to 8s. 6d.; small 6s. 6d. to 6s. 9d.; No. 2 Rhondda, 8s. 6d. to 8s. 9d.; small, 4s. 6d. to 4s. 9d.; through, 6s. 3d. For some kinds prices have increased 3d. per ton during the week. There is not much doing in coke. Furnace coke is selling at 14s. to 14s. 1d.; foundry, 15s. to 16s., Cardiff.

Pitwood has been coming into Newport and Cardiff freely of late, consigned from Bordeaux, l'Orient, Uddevalla, Hennebont, and Youghall. Now that good supplies have been coming in, prices have begun to recede, and this week quotations were at 16s. to 16s. 6d. Patent fuel is only in moderate demand; prices from 10s. 6d. to 11s. according to brand. As regards quality, both Cardiff, Swansea, and Newport, Mon., are turning out some of the best. In iron ore, as the end of the year is approaching, consignments are lessening, and this week only a few cargoes have come in. Cardiff and Newport prices are:—Best Rubio, 11s. to 11s. 3d.; Tafna and Garucha, 10s. 9d.; Porman, 10s. 6d. Markets dull.

Compilers of statistics are getting ready for their annual survey, and this week I have been favoured with totals including those of November, so that a fair idea can now be gained of the work of the year. I find that the aggregate coal shipments from the ports of South Wales for November amounted to 1,462,408 tons, showing a falling off to the extent of 27,760 tons. During the year, so far, Cardiff has shipped to foreign destinations 11,998,591 tons; Newport, Monmouthshire, 3,423,948 tons; Swansea, 1,634,108 tons; Llanelly, 209,587 tons. In the same period of eleven months, Cardiff has shipped 30,231 tons of iron and steel, 92,888 tons of coke, and 265.604 tons of patent fuel; Newport, 23,854 tons iron and steel, 5180 tons coke, 41,330 tons of patent fuel; Swansea, 2544 tons of iron and steel, 3009 tons of coke, and 293,297 tons of patent fuel; Llanelly, 197 tons iron and steel, no coke, and no patent fuel. As compared with other ports, Cardiff, as coal shippers to foreign destinations, maintains its lead for November, having despatched 867,891 tons, while Newcastle, the next, figures with 386,903 tons, and Newport, I am glad to note, comes in a good third of all the ports of the kingdom, with 215,420 tons, thus beating Blyth, Sunderland, and Hull.

With reference to the statistics for tin-plate, November shows but indifferently, as regards Russia, Holland, and Germany, with November, 1893. In November, 1893, the value of plates sent to Russia amounted to £19,235; in November, 1894, £1227. In November, 1893, America, the largest customer, took plates of the value of £201,026; in November, 1894, £274,114. The total value of all tin-plate shipments during the past month was £392,893, as compared with £344,326 in November, 1893. Australia and the East Indies showed a marked increase.

Cardiff is steadily adding to its fleet of steamers. A fine one has just been launched at McMillan and Sons' Dumbarton, thoroughly Welsh in name—the Gorsedd. It was built for Hurley, Matthews and Co., of Cardiff, and breaks Cardiff record by having a dead weight tonnage of 5600 tons to 5700 tons, or nearly 1000 tons more than the largest steamer at present registered at Cardiff port. Length between perpendiculars, 350ft.; breadth, extreme, 45ft.; depth, moulded, 28ft. 10½in.; to be classed A1 at Lloyds' under special survey. The engines, by Dunsmuir and Jackson, Govan, Glasgow, are of the triple-expansion type, with cylinders 25in. by 40in. by 66in., and stroke of 45in., with two boilers each of 16ft. diameter by 10ft. 9in. length, with a working pressure of 170 lb. The Gorsedd is, I hear, to have six steam winches, steam windlass, steam steering gear, and all the advanced inventions and methods.

Coal contracts are now being placed and at fairly good prices. Some of the latest reported have been secured by Lewis's Merthyr Nangabon Company and the Dowlais Company for delivery during 1895 to the Compagnie Générale Transatlantique. Prices are stated to be by the first 10s. 3d. less 3d., and 2½ per cent. discount; by the second about 10s. f.o.b.

At Cardiff on Saturday the Adare Colliery was put up for sale, but the reserve price was not reached, and it was withdrawn for private arrangement if possible.

I am pleased to hear that work has been resumed at the Bwllfa Colliery, Ton Pentre, one of the Ocean Collieries' pits. The men, to the number of 300, began work on Monday—after being idle for five months. This case is another illustration of the mistakes colliers—unfortunately for themselves—and others make. The general manager of the Ocean Collieries is a gentleman of marked ability, and a wide reputation for thorough conscientious ruling between man and man. The offer made by him five months ago after careful consideration was refused. It has now been accepted; but the collier has suffered, and so have the company.

The iron and steel trades continue to flag, and at no works can one see anything but moderate activity. A quiet hand-to-mouth trade appears to be the general characteristic, and tin bars, pig iron, merchant bars, and small goods constitute the chief requirements. As for steel rails, an exceptionally sluggish condition prevails, and will, I suppose, until the turn of the year. There is no change in iron and steel quotations, which remain at the last figures. I have heard of heavy steel rails at £3 12s. 6d., a drop of 2s. 6d. since last quotation; but it is evident makers have literally "touched bottom," and any change must be upward. I have not a solitary cargo of rails to chronicle for the week as despatched, but a quantity of tin bar imported.

The shipments of tin-plates last week were numerous, amounting to 69,808 boxes. The quantity received from works totalled 66,731 boxes, so stocks are decreasing though slowly. Swansea stock at present consists of 250,285 boxes. The market is lethargic, and the opinion on 'Change, Swansea, is that it will remain so until the wage question, now under discussion, is settled. Loadings are due next week to America four vessels, one to Russia, one Genoa and Leghorn, one to Dantzic and Revel, and one for Lisbon.

Blaenavon and Dowlais have been importing foreign ore largely this week, preparing, I hope, for better times.

Mr. Galloway's experiments at Merthyr last week, in demonstrating to a large number of colliers that coal-dust played no unimportant part in colliery explosions, elicited this week a letter from the secretary of the Dowlais, Cyfarthfa, and Plymouth Joint Committee, expressing the satisfaction of the workmen with the experiments. The workmen are "now satisfied," they say, "that coal-dust is a dangerous factor in explosions from its inflammability."

The electric light in Cardiff is improving steadily, and I anticipate will soon be generally used. The illuminating power shows a stride.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THIS week again business has only been quiet in the iron and steel trades, and whatever push there has been for supplies has been confined to immediate requirements. Prices, as a rule, show a want of firmness, but that is only what might be looked for. Demand for all descriptions of iron has been very limited for months past, and there is an increase in stocks to be noticed, while the cheap offers from foreign houses continue.

The Silesian iron trade in some of its branches is showing a little more activity on account of some fair orders for malleable iron which have been secured lately, but to get these orders makers had to further reduce their quotations. Generally, however, very little life is stirring in the iron industry. The steel works are in a most unfavourable position, nor is it at all likely that there will be an improvement in activity for the next months.

There are no orders for railway and engineering requirements holding out, and those previously secured have already for the greater part been effected. Few transactions of importance are reported on the Austro-Hungarian iron market, demand having on the whole lessened since former weeks. The pig iron trade continues very languid, consumers being of opinion that the inland makers, in consideration of the ever increasing foreign competition, must, sooner or later, agree to almost any price. Buying is, therefore, limited to the utmost. In the malleable iron department, girders and other articles of structural iron are tolerably well inquired for, while bars and plates remain in poor request; the steel trade is also very quiet all though. Contrary to all expectations, French iron business has not improved upon the week.

There are decidedly more offers than inquiries for both raw and finished iron, and the tendency of prices has been a trifle more weak in some instances. On the whole, however, a fairly good employment is reported at the mills, the contracts secured, though of small weight, reaching in most instances up to the end of the year.

In Belgium pig iron is somewhat neglected, but shows nevertheless a pretty firm tendency. The different articles of manufactured iron are also but weakly called for, with the exception of heavy plates, for which a fair inquiry is reported. The rail works and machine factories are irregularly employed. The present low quotations appear to have induced the State Railways to come forward with their orders; one for 1375 load wagons was given out last week, and so the shops are likely to be pretty actively occupied in the immediate future. The Belgian Government is reported to have resolved the abolition of the import tariff on foreign pig iron. There are still no indications of an improvement in the iron trade of Rheinland-Westphalia, on the contrary, demand is poorer than has been reported for several weeks past: in most branches prices have decreased, and the tone of the iron market is altogether depressed. In the iron ore trade there is little or no movement of any importance; Siegerland ores meet with a tolerable inquiry. During the last week the following prices have been quoted: Spathosee iron ore, M. 7·10 to 7·50 p.t.; roasted ditto, M. 10 to 10·30, best sorts M. 11 p.t. net at mines. Nassau red iron ore, 50 per cent. contents, stands at M. 9 p.t. free Dillenburg. Except that a downward tendency has been noticeable here and there, Luxemburg-Lorraine minette remains in much the same condition as before. Present notations are: M. 3·20 to 3·40 p.t. for red minette, 40 per cent. contents and M. 2·50 to 2·70 p.t. for the minor qualities.

On the pig iron market demand has, in a few instances, been a trifle more lively, and prices are rather well maintained. In the Siegerland, spiegeleisen has been brisk of sale during the past weeks, the majority of inland consumers having already ordered their supplies for the first quarter in 1895. Basis prices for spiegeleisen is still M. 52 p.t. For Rhenish-Westphalian forge pig, No. 1, M. 46 to 57 p.t. is given; No. 3, M. 40 p.t.; Siegerland good forge quality costs M. 44 p.t.; hematite, M. 63; foundry pig, No. 1, is paid with M. 63 p.t.; No. 3, M. 54 p.t. Basic only fetches M. 45 p.t.; Bessemer, M. 50 to 51 p.t. Iron for making steel continues to be offered at M. 45 to 47 p.t., according to quality. The situation of the malleable iron industry is still unfavourable, and prices are disappointingly low.

Inland as well as foreign demand for bars has decreased rather than improved upon the week. Most of the mills are fortunately pretty well supplied with orders for the next months, but a continued downward inclination is to be noticed with regard to prices. Structural iron, especially girders, is in moderate call; the hoop mills remain generally in very limited occupation, which may account for the willingness on the part of buyers to agree to reductions where orders for immediate delivery are concerned. In the plate and sheet trade a slow inquiry is reported; unremunerative prices and weak employment remaining the general complaint.

The appearance of both the wire and the rivet business continues very unfavourable, and the occupation of the machine and construction shops is anything but good. At the wagon shops there is also but a very moderate activity to be perceived; the order for 800 goods wagons recently given out did not cause any perceptible improvement in the general employment, as the contract had to be divided among the shops, and so each got a few wagons only.

Latest list quotations, per ton at works, are as under:—Good merchant bars, M. 100 to 105; rivet iron, M. 125; angles, M. 110 to 115; girders, M. 85 to 90; hoops, M. 105 to 110; billets in basic and Bessemer, M. 73 to 77; heavy plates, for boiler-making purposes, M. 140 to 145; tank do., M. 130 to 135; steel plates, M. 120 to 125; tank do., M. 110 to 115; sheets, M. 140; Siegen thin sheets, M. 120 to 125; in steel M. 110. Iron wire rods, common quality, M. 92 to 95; wire nails, M. 113 to 115; rivets, M. 145 to 150; steel rails, M. 112 to 115; steel sleepers, M. 106; fish-plates, M. 110 to 120; complete sets of wheels and axles; M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230.

ROYAL INSTITUTION.—The Christmas course of lectures at the Royal Institution, adapted to children, will be delivered by Professor F. A. Fleming, F.R.S., Professor of Electrical Engineering in University College, London. The subject will be "The Work of an Electric Current," and the first lecture will be delivered on Thursday, December 27th, at three p.m.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Fleet Engineers, W. H. Gulliver to the Nile, and Thomas Burnes to the Hotspur. Chief Engineers, John J. Carey to the Amphion, and George Ramsay to the Blanche. Engineer, W. Gaisford to the Wild Swan. Assistant Engineers, new entries—George H. Elgar and Henry O. Andrews, to the Pembroke; George R. Byles and Hugh L. M. Ford, to the Victory; Arthur L. Butt and David H. W. Bain, to the Vivid; Harry Lashmore, to the Brisk; George G. Sisley, to the Brisk, temporarily; and Ernest L. Sagar, to the Jason.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, December 6th.

The meeting of Congress is watched with special interest by financial and manufacturing interests. Manufacturers are anxious to know if "pop-gun" tariff bills are to be passed, and the banking interests are anxious to know what sort of tinkering is to be done with finances. Public sentiment demands that both subjects be let alone. The iron trade is quiet. Small orders are coming in at all iron centres. Prices are steady, excepting in steel rails, which dropped to 22 dols., and will be driven to 20 dols., which ought to be the price, with billets at 15 dols.

Railway requirements are increasing. Large lots of old iron rails are being offered in western markets, and southern pig iron makers are endeavouring to place iron for delivery during the first four months of next year in western markets at present quotations.

## LAUNCHES AND TRIAL TRIPS.

Messrs. Wm. Simons and Co., Renfrew, have received from the Agent-General for Natal an order for a powerful suction pump dredger, which when completed will carry at least 1200 tons of its own dredgings. It will be fitted with two powerful sand suction pumps capable of raising about 4000 tons of sand per hour. This dredger will be employed in connection with the deepening operations on the Natal harbour bar.

On Wednesday, December 6th, 1894, the s.s. Saxony, built to the order of Messrs. David Mac Iver, Sons and Co., of Liverpool and London, left the Cleveland Dockyard of Sir Raylton Dixon and Co., Middlesbrough, for her official trial trip. She is a fine lined vessel of the partial awning deck type, with a long raised quarter-deck and poop, and has been specially designed and fitted for the River Plate trade. Her principal dimensions are 305ft. by 41ft. 3in. by 20ft. 3in., with a large deadweight capacity on a very light draught. She is rigged as a fore-and-aft schooner, the topmasts being fitted with Sidgwick's patent hinge arrangement, so that they can be lowered quickly when passing under low bridges. The engines have been fitted by Messrs. Blair and Co., Limited, Stockton-on-Tees, and are of the triple expansion type, having cylinders 23in., 37in., and 61in. by 42in. stroke, with two extra large steel boilers, working at 160 lb. pressure. The vessel and machinery have been constructed under the personal supervision of Mr. Roscoe, of Liverpool, consulting engineer to the owners, and she will be commanded by Captain J. B. Gordon, who has been many years in their service. The trial trip passed off most satisfactorily.

Ships launched during 1894 by Sir Raylton Dixon and Co., Cleveland Dockyard, Middlesbrough:—

| | Name. | Material. | Steam or sail. | British or foreign. | Gross register tonnage. | Indicated horse-power. |
|---|---|---|---|---|---|---|
| 1 | Ceylon .. .. | steel | steam | British | 4094 | 3000 |
| 2 | Claverley . | „ | „ | „ | 2837 | 1150 |
| 3 | Bearn .. . | „ | „ | Foreign | 1235 | 650 |
| 4 | Leyden .. .. | „ | „ | „ | 3378 | 1800 |
| 5 | Marlstow .. | „ | „ | British | 2386 | 1150 |
| 6 | Cierbana .. | „ | „ | Foreign | 1230 | 550 |
| 7 | Leopoldville | „ | „ | British | 3400 | 1800 |
| 8 | Saxony .. .. | „ | „ | „ | 2430 | 1250 |
| 9 | Normandy .. | „ | „ | „ | 2430 | 1250 |
| 10 | Lombardy . | „ | „ | „ | 2430 | 1250 |
| 11 | Homer .. . | „ | „ | „ | 2710 | 1500 |
| 12 | Steinberger .. | „ | „ | Foreign | 3600 | 1750 |
| | | | | | 32,220 | 17,100 |

The work has been very considerably stopped by strikes during the summer and autumn or the output would have been much larger. In addition to building the above-named steamers, a large amount of repairing work has been done both in dry dock and on the hydraulic slipway in the yard of the firm, over 160 vessels having been repaired, some of which had received very serious damage. Some extensive alterations to steamers have also been effected.

The Yorkshire College Engineering Society.—At a recent meeting of the Yorkshire College Engineering Society, presided over by Mr. Ewing Matheson, M. Inst. C.E., a paper was read by Mr. W. D. Wansbrough, of Lincoln, upon the "Building of a Boiler." The lecturer confined his remarks to the locomotive type of boiler. In tracing the growth of boiler construction during the last half century, one is struck by the improvement in the character of the work; instead of boiler plates of small dimensions made of inferior material and having punched rivet holes, inaccurately spaced and brought into coincidence by the frequent use of the drift, we see now a splendid material, plates of the largest dimensions, rivet holes drilled in position, hydraulic riveting, double riveted longitudinal seams with inside and outside butt strips, planed or tooled plate edge, careful annealing, and many other improvements. We may consider therefore that our boilers of to-day are as carefully fitted together as the parts of a steam engine. After describing the building and machinery of a modern boiler factory, the lecturer exhibited several samples of steel plates, sections, through rivets, and test pieces. In describing the hydraulic flanging of plates, the lecturer showed, by means of a small model in lead, how the throat plate of a boiler may be made in pairs and afterwards cut. This, of course, enables the throat to be pressed out of the centre as a ring, the operation of the hydraulic press being much assisted by the symmetry of the plate thus treated. In the discussion which followed, Mr. Ewing Matheson described a punch of special design which punches a small centre out first and then clears the hole out to its full size by shearing a ring of metal out equal to one-twelfth of the rivet diameter, thus cutting away the damaged material. This punch is being used where previously punching was not allowed. Messrs. J. H. Wicksteed, Watson, Hewson, the chairman and others spoke in the debate. The usual votes of thanks brought the proceedings to a close.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*28th November*, 1894.

23,060. Production of Stereoscopic Photographs, T. Brown, Salisbury.
23 061. Utilising Waste-heat, C. J. Bagley, L. Roberts and The Moor Steel and Iron Company, Stockton-on-Tees.
23,062. Hosiery Fabrics, J. Potterton, Leicester.
23,063. Firegrates, E. Hallam, Derby.
23,064. Supplying Fog Signals, W. Holmes and S. Jackson.
23,065. Manufacture of Tin Plates, A. J. Maskrey, Bristol.
23,066. Pipe Cover and Plug, W. Pearce, Birmingham.
23,067. Label-holder, W. Jones, Liverpool.
23,068. Printing of Photographs, H. W. Searle, Liverpool.
23,069. A Game of Defence Draughts, W. Wood, Manchester.
23,070. Boiler Furnaces, J. M. Robertson, Glasgow.
23,071. Construction of Wheels, S. T. Richardson, A. Smallwood and R. Price, Birmingham.
23,072. Locking Arrangements of Gates, W. T. Page, London.
23,073. Packing for Piston-rods, E. Samuel, London.
23 074. Tips for Boots, G. Mahaffy, London.
23 075. Flushing Water-closets, R. P. Stafford, London.
23,076. Automatic Catch for Doors, J. W. Harrison and J. Robinson, London.
23,077. Spinning Machines, R. Hassler, London.
23,078. Non-slipping Cover for Tires, A. Pellant, London.
23,079. Cloth Materials, J. G. Kinmond, Glasgow.
23 080. Wire-cloth, A. Cousland and Co. and G. H. May, Glasgow.
22,081. Tree Propagating, G. F. Griffin, Manchester.
23,082. Locks, J. M. Lockerbie and A. W. Wilkinson, Birmingham.
23,083. Extracting Shives from Casks, J. T. Thompson and A Slatter, London.
23,084. Producing Tinted Material, M. B. Church, London.
23,085. Brick Machine Table, A. Jolley and G. Hewett, London.
23 086 Electric Traction System, R. Kennedy, London.
23,087. Advertising on Cycles, S. T. Brown, London.
23,088. Suspensory Belts, W. P. Thompson.—(*W. J. Teufel, Germany.*)
23 089. Machines for Cutting Rubber, S. H. Foden, Liverpool.
22,090. Woven-wire Mattresses, T. Hilton, Manchester.
23,091. Washing Machine, W. Quait, London.
23,092. Casting Chains, W. H. Palmer and W. Gibson, London.
23,093. A New Toy, W. J. Lockwood, London.
23,094. Toy, G. Royle, London.
23,095. Radiators, C. F. Kite, London.
23,096. Reciprocating Cranks, J. Turnbull, Plumstead, Kent.
23,097. Cycle Driving Mechanism, F. W. Golby.—(*E Sauvain, France*)
23,098. Arc Lamp Feeding Mechanism, W. K. Partington, London.
23,099. Insulator to Prevent Humming, W. S. Cottis, London.
23,100. Speed Indicators, W. Milner and W. Wilson, London.
23,101. Insect Killing Composition, A. A Bécheraz, London.
23,102. Lamp Stoves, E. Rippingille and W. Porter, London.
23,103 Lotion, E. Horton, Bristol.
23,104. Roundabouts, A. Goodwin, London.
23,105. Cycles, A. Trouvé, London.
23,106. Axle Boxes, I. A. Timmis, London.
23,107. Firegrates or Stoves, W. and J. S. Elliott, London.
23,108. Dress Fastening, M. Stirling, London.
23,109. Coin-freed Machines, W. Northorpe London.
23,110. Window Sashes, F. J. Commin, London.
23,111. Method of Carbon Printing, V. Blanchard, Cambridgeshire.
23,112. Return Tickets for Railways, M. Vezzosi, London.
23,113. Photographic Mounts, Strong and Co. and C. Welsh, London.
23,114. Toy, P. D. W. Greville, London.
23,115. Watch Pockets, G. Henley and J. Henley, London.
23,116. Chimney Cowl, E. Pearson, London.
23,117. Apparatus for obtaining Alloys, L. P. Hulin, London.
23,118. Decorating Ramie Plants, P. P. Faure, London.
23,119. Dyeing, J. Arnold, London.
23,120. Athletic Boots and Shoes, J. W. Ward, London.
23,121. Tiles for Covering Walls, H. H. Lake.—(*J. H. C. G. Brandes, Germany.*)
23,122. Envelopes, H. H. Lake.—(*J. D. Petersen, Germany.*)
23,123. Mixing Clays, W. P. Campbell-Everdon and E. Prime, London.
23,124. Spraying Apparatus, R. Wallwork and A. C. Wells, London.
23,125. Stopping Runaway Horses, N. Sotiropoulo, London.
23,126. Window-catch Fasteners, F. Constable and F. P. Naldrett, London.
23,127. A Golf Scorer, W. Potter, London.
23,128. Small-arms, W. G. Froome, London.
23,129. Road Locomotives, T. L. Aveling, London.
23,130. Linotype Machines, The Linotype Company, Ld, and E. Girod, London.

*29th November*, 1894.

23,131. Manufacture of Stair Rods, E. W. Dobbs, Wolverhampton.
23,132. Improved Tackle for Fishing, S. Allcock, Redditch.
23 133. Manufacture of Laced Boots, J. Sullivan, Cardiff.
23,134. Puzzles, W., W. J., and H. H. Middleton, Birmingham.
23,135 Disinfecting, &c., Fluid, C. T. Gardner, Brighton.
23,136. Date Indicator, J. A. J. Morton, Gloucestershire.
23,137. Rotary Printing Machines, R. Sanson, jun., Edinburgh.
23,138. Turning Leaves of Music, A. Bale, Merthyr Tydvil.
23,139. Curvilinear Instruments, C. H. White, jun, Birmingham.
23,140 Combination Cruet, S. Skerritt and C Barker, Sheffield.
23 141. Sounding Machines, H. L. Allen and H. Boyd, Govan, N.B.
23,142. Utilising Heat from Gas, T. Sykes, Huddersfield.
23,143. Drawing Beer from Barrels, T. Bell, Liverpool.
23,144. Driving Nap-raising Machines, W. Holland, Manchester.
23,145. Coal Wrapper, F. H. Hall, London.
23,146. Pneumatic Tires, T. W. J. Martin and E. F. Walker, Dublin.
23,147. Vessel for Preserves, &c., W. S. Bell and T. J. Honeybourne, London.
23,148. Gully-dish and Grate, F. Thackeray, Darwin, Lancs.
23,149. Cycles, P. Frodsham, Manchester.
23,150. Cuff-link Holding Appliances, C. Horner, Halifax.
23,151. Window Sashes, W. Taylor, Glasgow.
23,152. Pressure Gauges, H. Brier and The Scotch and Irish Oxygen Company, Glasgow.
23,153. Wire Mattress Machinery, W. Waterhouse and T. W. Blantern, Birmingham.
23,154. Wire Mattress Machinery, W. Waterhouse and T. W. Blantern, Birmingham.
23,155. Spoonless Pot for Mustard, H. W. Handcock, London.
23,156. Baking Bread and Biscuits, G. Lawson, jun., Glasgow.
23 157. Warp Let-off Motions for Looms, R. Wilby, Huddersfield.
23,158. Wire Brushes, E. L. Levetus, Birmingham.
23,159. Electric Brushes, &c, E. L. Levetus, Birmingham.
23,160. Primary Batteries, &c, E. L. Levetus, Birmingham.
23,161. Pumps, R. Richardson, Glasgow.
23,162. Roller Thrust Bearings, W. J. Fanning, Manchester.
23,163. Brush Fastener, A. Everett, Folkingham, Lincs.
23 164. Vehicle Couplings, G. L, Lavington and E. A. Wright, London.
23,165. Protector, I. Kaufmann, London.
23,166. Waiters' Trays and the like, C. E. Corbitt, London.
23,167. Clay Tobacco Pipes, C. J. Saunders, Birmingham.
23,168. Holders for Candles, W. H. Bulpitt, Birmingham.
23,169. Brake for Beaming Frames, E. Ratcliffe, London.
23 170. Projector and Catapultum, G. S. Sidey, London.
23 171. Safety Boiler Clip and Cover, E. J. Frost, London.
23,172. Treating Heated Metals, G. A. Dick, London.
23,173. Protectors for Trousers, W. F. Tuson, London.
23,174. Closing Canisters, Boxes, &c., T. A. Prince, London.
23,175 Mechanism of Reaping Machines, W. Johnson, London.
23,176. Tongs for Coals, &c., J. P. Funt, London.
23.177. Dynamos, A. G. New and A. J. Mayne, London.
23,178. Supporting Rail for Piano Actions, A. Lexow, London.
23 179. Rearing Infants, H. H. Lake.—(*A. Lion, France.*)
23,180. Lock for Window Sashes, R. W. Barker.—(*T. W. Meyer, United States.*)
23,181. Automatic Brick-cutting Tables, S. Jefferies, London.
23,182. Locks for Railway Carriage Doors, S. Hammond, London.
23,183. Obtaining Arithmetical Results, R. F. Stein, London.
23,184. Stand for Gas Cylinders, T. P. Watson and J. G. Castle, London.
23,185. Fog-signalling on Railways, I. A. McDonnell, London.
23,186. Roof-lamps, W. McLaren and H. E. Brown, London.
23,187. Perfecting Printing Presses, H. P. Feister, London.
23,188. Die and other Stamping, M. M. Dessau, London.
23,189. Medallions and Checks, M. M. Dessau, London.
23,190. Lift, A. Renner, London.
23,191. Heating Apparatus, J. Grummitt, London.
23,192. Bells, J. M. Rimington and T. Shepherd, London.
23 193. Cams of Knitting Machines, H. H. Donner, London.
23,194. Preservation of Alimentary Substances, J. Imray.—(*La Société Anonyme des Matieres Colorantes et produits Chimiques de St. Denis, France.*)
23,195. Tipping-trucks, A. Chambers.—(*A. L Chambers, South Africa*)
23,196. Truck Axles and Lubricators, A. Chambers.—(*A. L Chambers, South Africa*)
23,197. Frames of Velocipedes, O. Imray.—(*A. Chobert, Belgium.*)
23,198. Treatment of Metallic Alloys, L. P. Hulin, London.
23,199. Portable Tent, E. S Farrow and W. Cumming, London.
23,200. Impermeable Hats, F. J. Elliott.—(*Mathias and Co., France*)
23,201. Printing Presses, A. J. Boult.—(*A. Pabst, Germany.*)
23 202. Self-opening Doors, P. R. J. Willis.—(*M. C. Plummer, United States*)
23,203. Springs for Electrical Switches, W. T. Burbey, London.
23,204. Heel Tips for Boots and Shoes, J. E. Evans, London.
23,205. Automatic Photographic Apparatus, J. F. y Girbau, London.

*30th November*, 1894.

23,206. Combination Gearing, A. R. Albert, Manchester.
23,207. Scaffold Fastener, J. Dennis, Leicester.
23,208. Setting Lacing Hooks, M. H. Pearson and C. Bennion, Leicester.
23,209 Automatic Tilter, T. L. Jennings and H. H. Stabler, Leeds.
23,210. Scenting the Atmosphere, J. Wheeler, Ilfracombe.
23,211. Windows and Window Cases, W. Cruickshanks, Glasgow.
23,212. Manufacture of Wire and Rods, J. C. Bull, London.
23,213. Earthenware Ventilators, F. Smith, J. J. Green, and W. Oates, Halifax.
23,214. Spiral Pencil-holder, &c., J. Rigby, Manchester.
23,215. Lanterns, V. Groom, Birmingham.
23,216. Draw-rolls of Cotton Machinery, J. Leese, Manchester.
23,217. Hanging-up Pictures, &c, J. K. Comrie, Glasgow.
23,218. Hydrocarbon Motors, E. Wiseman and J. Holroyd, Manchester.
23,219. Fixing Electric Arc Lamps, G. M. Harriss, Bray.
23,220. Producing Animal Charcoal, J. A. Yeadon and W. Adgie, Leeds.
23,221. Tool for Making Pile Fabrics, J. Whitfield, Northumberland.
23,222. Wringing Machines, J. Pain, London.
23,223. New Advertising Medium, P. Watson, Bradford.
23,224. Velocipede Crank or Pedal, W. Evans, Manchester.
23,225. Rubber Shield or Casing, W. Moores, Manchester.
23,226. Handles for Files, A. R. Bellamy and A. J. Hobson, Manchester.
23,227. Inkwells, E. M. B. Smith, London.
23,228. Recovery of Oils from Clay, &c, S. Crowder, London.
23,229. Fence Advertisement, L. B. Bethell, Epsom.
23,230. Retorts for Distilling Oils, R. V. Horsfall, Manchester.
23 231. Carpet Fastener, A. F. F. Kislingbury, Bristol.
23,232. Clamps, A. E. S. C. L. Classey, Bristol.
23,233. Refrigerators, &c., A. E. S. C. L. Classey Bristol.
23,234. Sugar-cane Mills, W. and H. O. Smith.—(*A. D. Smith, Australia.*)
23,235. Evaporating Apparatus, J. Foster, Glasgow.
23,236. Fixed Shafts Support, H. L. Thomas, Thorpe.
23,237. Sheet Metal and Composite Boxes, W. Orr, Glasgow.
23,238. Thread Spool, A. Conkling, Glasgow.
23,239. Couplings for Railway Vehicles, R. Haub and B. A. Schenck, Manchester.
23,240. Connecting Link for Chains, F. C. Paul, Birmingham.
23,241. Candle-holder, F. R. Koss, London.
23,242. Buckles and Harness Fasteners, R. A. King, London.
23,243. Workmen's Time Recorders, W. P. Thompson.—(*W. Le G. Bundy and The Bundy Manufacturing Company, United States.*)
23 244. Distillation of Water, J. S. Pearson and E. L. Newsome, Manchester.
23,245. Trousers Suspender, R. oh. Flemming, London.
23,246. Raising Sunken Vessels, &c., G. A. Savile Harrogate.
23,247. Pads for Supplying Colour to Stamping Blocks, H. S. Woodyer, Manchester.
23,248. Railway Wagons, C. Hunt, Birmingham.
23,249. Collapsible Tubes, J. A. Ehrenfest and J. C. Martin, London.
23,250. Gauges of Electric Exhaustion, E. S. and E. S. d'Odiardi, London.
23,251. Appliance for Mail-cart Shafts, H. V. Lloyd, London.
23,252. Carving Forks, A. H. Bogle, London.
23 253. Sanitary Dust or Waste Bins, H. J. Adams, London.
23,254. Extracting Pickles from Bottles, J. T. H. Ward, London.
23,255. Protecting Pockets, &c, A. H. Carley, London.
23,256. Stirrups, M. Sleeman, London.
23,257. Filters, D. Richards, London.
23,258. Manufacture of Forks, &c., E. de Pass.—(*La Société Française d'Alliages des Métaux, France*)
23,259. Easels, W. Luker, jun., London.
23,260. Preparation of Smokeless Powders, C. P. Du Buit, London.
23,261. Envelopes for Letters, &c., S. Saw, jun, London.
23,262. Roasting of Sulphide Ores, C. F. Claus, London.
23,263. Attachment for Beer Taps, A. Parmenter, London.
23,264. Mechanically Checking Accounts, P. W. Turquand, London.
23,265. Tobacco Pipes, E. H. and F. H. R. Neville, London.
23,266. Decapping Cartridges, P. R. J. Willis.—(*W. A. Wright, United States.*)
23,267. Railroad Sleeper, P. R. J. Willis.—(*H. Gilmore and H. C. Marlatt, Canada*)
23,268. Toe-sweeper, A. Volland, Berlin.
23,269. Motor applicable to Velocipedes, F. N. Blanc, London.
23,270. Medicinal and Nutritive Compound, G. A. Clowes, London.
23,271. Hydraulic Pump, A. G. Browning.—(*J. W. Anderson, Canada.*)
23,272. Velocipedes, W. T. Wilson, London.
23,273. Stop Valve, C. Davy, London.
23,274. Manufacture of Metallic Peroxides and Caustic Alkalies, L. P. Hulin, London.
23,275. Coal-boxes, A. M. Chambers, London.
23,276. Fasteners for Window Sashes, &c., C. Sears, London.
23,277. Obtaining Motive Power, D. and I. Jones, London.
23 278. Manufacture of Gas, J. M Bosselaar and J. F. M. van den Eishout, London.
23,279. Electrically-propelled Carriages, F. King, London.
23,280. Applying Disinfectant to Dustbins, &c, F. S. Salberg, London.
23,281. Lace Grip, J. Batty, London.
23,282. Washing Machines, G. Viner.—(*H. H. Evans and A. J. Viner, Australia.*)
23 283 Holder for Umbrellas, &c, E. H. Goold, London.
23,284. Continuous Spinning, &c, Machines, G. Laurency, London.
23,285. Packing for Piston-rods, &c, E. A. Bryant, London.
23,286. Mitre Block, C. E Smith and M. Vedder, London.
23,287. Sowing Seeds, W. R. Bowen and T. C. Butler, London.
23 288. Combined Churn and Butter Worker, A. M. Bingham, London.
23,289. Curtains for Windows, &c, S. Townsend, London.
23,290. Wooden Skewer Peg, J. N. Harmer, London.
23,291. Device for Cutting Cotton, B. A. Spaull, London.

*1st December*, 1894.

23,292. Toe-clips of Cycle Pedals, W. T. Cantrill and T. C. Whitehouse, Birmingham.
23,293. Obtaining Gold from Ore Tailings, S. Crowder, London.
23,294. Electrical Lamp, E. Grahame, London.
23,295. Combined Paper Weight, &c., H. Berry, Devon.
23,296. Bed Frame, J. F. Dowling and J. E. Dowling, Co. Dublin.
23,297. Causing Chemical Changes of Gases, N. van der Sleen and A. Schnellen, London.
23,298. Steam Economiser, C. Saville, Harrogate.
23,299 Looms for Weaving Tufted Fabrics, W. Kennedy, Glasgow.
23,300. Holders for Exhibiting Drawings, E. M. Brodie, Glasgow.
23 301. Pneumatic Seats, R. R. Jardine, Birmingham.
23,302. Egg Whisks, W. Johnson, R. Crabtree, and S. Thompson, Manchester.
23,303. Securing Pneumatic Tires to Wheels, J. Boyd, Dublin.
23,304. Hydraulic Lifts, J. S. Stevens and C. G. Major, London.
23,305. Suspenders for Portable Mangers, A. Duncan, Glasgow.
23,306. Pneumatic Tires, J. Andrew, Glasgow.
23,307. Regulating Weft Fork Holder, B. Kay, Darwen.
23,308. Drawing-room Football, J. A. Kennedy, London
23,309. Oil Tanks of Cycle Lamps, J. Parker, Birmingham.
23,310. Manufacture of Envelopes, J. J. Brock, Birmingham.
23,311. Safety Lamps, A. Storey, jun, Newcastle-on-Tyne.
23,312. Button-hole Appliance, S. Chapman, Manchester.
23,313. Padlocks, E. Lawton, Birmingham.
23,314. Fuel Economisers, A. Lowcock, Manchester.
23,315. Fuel Economisers, A. Lowcock, Manchester.
23,316. Water-marking Paper, F. Price and H. G. Gallop, Bristol.
23,317. Hosiery Frames, F. M. Hilscher, Manchester.
23 318. Ball-bearings for Vehicles, J. Schoch-Fisher, Manchester.
23,319. Connecting Hose Pipes, J. C. Hudson, London.
23,320. Method of Tip and Brim Stretching, A. Dyson, Huddersfield.
23,321. Umbrellas, W. Coathupe, Bristol.
23,322. Combined Fruit Knife and Nut Cracker, T. Hirschfield, Manchester.

23,323. Screw-keys, M. Stefani, Glasgow.
23,324. Hermetically Stoppering Bottles, W. Hinchliffe, Wakefield.
23,325. Draw Bar Gear of Railway Vehicles, J. Wallace, Wigan.
23,326. Inking Apparatus, J. G. Schelter and Giesecke, Germany.
23 327. Apparatus for Pistonless Pumps, W. H. Morgan, Birmingham.
23,328. Teaching Mine Surveying, T. A. O'Donahue, Liverpool.
23,329. Golf Club Support or Rest, G. W. Buxton, Manchester.
23 330. Treating Grain Extracts, W. H. Walker, Liverpool.
23,331. Railway Signalling Apparatus, R. M. Richardson and F. Delacour, London.
23,332. Horse Food Rest, J. Lee. Edinburgh.
23,333. Springs, &c., for Cycle Saddles, T. Harvey, Walsall.
23,334. Yarn Warping Apparatus, R. L. Hattersley and S. Jackson, Bradford.
23,335. Music Leaf Turner, J. T. Browne, West Grinstead, Sussex.
23,336. Bed Airer, J. T. and A. F. Browne, West Grinstead, Sussex.
23,337. Appointment Indicators, &c., J. D. Davies, London.
23 338. Carriers for Cash and Letters, J. G. Ingram, London.
23.339. Whist Point Recorder, &c., W. G. Browne, London.
23,340. Securing Paper Capsules, W. F. and A. E. Hunt, London.
23,341. Tobacco Pipes, A. Weekes, London.
23,342. Rotary Printing Machines, J. Michaud, London.
23,343. Tobacco Pipe Stem Cleaners, W. S. Roe, Birmingham.
23,344. Mail or Go-carts and other Vehicles, L. L. Hollier, Birmingham.
23 345 Hair Curlers, T. Thompson and G. Grice, London.
23,346. Belt Fastener, W. H. Cranstone, London.
23 347. Hat and Umbrella Stands, F. T. Hirsch, London.
23,348. Parallel Rulers, J. G. Lister, London.
23,349. Gas Shades, G. Hayes, London.
23,350. Metallic Bungs, E., G., and J. Regnac, Berlin.
23,351. Fire-bar for Boiler Furnaces, R. Lewis, Aberdare.
23 352. Tail Stocks for Lathes, J. Ward, Southminster, Essex.
23,353. Applying Runners to Vehicles, J. Ward, Southminster, Essex.
23,354. Heating Carriages, E. J. Preston and A. B. Gill, London.
23,355. Bodkins, J. R. Green, London.
23,356. Metallic Mining, &c., Props, W. E. Kenway, London.
23,357. Plastic Material, W. White, London.
23,358. Fire-arms, J. Luciani, London.
23,359. Manufacture of Oxycarbon Acids, L. Lederer, London.
23,360. Cooking Ranges or Stoves, K. N. Nenadovitch, London.
23 361. Cycle for Advertising, L. C. Martonfalvy, London.
23 362 Combined Rack and Adhesion Locomotives, R Peacock, London.
23,363. Beetroot Digging Apparatus, L. Frennet-Wauthier, London.
23 364. Oil and Gas Engines, E. T. Bousfield, London.
23 365. Process for Covering Flowers, A. Escroignard, London.
23,366. Pianofortes, H. J. W. Raphael, London.
23 367. Drop-down Guns, H. A. A. Thorn, and W. Bodin, London.
23 368. Tires, C. G. Neat, London.
23 369. Fly Traps, A. Tuffnell, London.
23,370. Manufacture of Caustic Alkalies, L. P. Hulin, London.
23,371. Pistons for Steam Cylinders, D. Kidson, London.
23 372. Hat Ventilator and Guard Reel, B. Richards, London.
23,373. Simultaneous Carbonisation, A. Weil and A. Goutierre, London.
23,374. Covers of Pneumatic Tires, R. Pritt, London.
23,375. Wheels for Cycles, H. P. Madsen, London.
23,376. Furnace-grates, H. and H. J. Warington, London.
23,377. Type-writing Machines, G. J. Lysaght, London.
23,378. Manufacture of a New Kind of Lace, E Davenière, London.
23,379. Beds for Children, H. H. Lake.—(*J. Stuttgard, Germany.*)
23,380. Modelling, R. Wallwork, A. C. Wells, and M. B. Church, London.
23,381. Apparatus for Propelling Cycles, H. Hargreaves, London.
23 382. Tread Surfaces, J. M. and W. Starley, London.
23,383. Covers for Pipes, J. Hewitt and F. R. Baker, London.

*3rd December*, 1894.

23,384. Corset, M. K. Green, London.
23 385. Manufacture of Iron, A. Carter and E. Purser, Manchester.
23,386 Adjustment of Footboard of Mail-cart, C. C. Beetles, London.
23,387. Photographic Printing Frames, H. J., A. S., and G. A. Spratt, London.
23,388. Word-numbering Attachment for Typewriting Machines, H. H. O'Farrell, London.
23,389. Construction of Centrifugal Fans, G. M. Capell, Stratford.
23,390. Hoisting Apparatus, F. J. Eastmead, London.
23 391. Aluminium Golf club Heads, C. Playfair, Belfast.
23,392. Incandescent Gas Lamps, J. Armstrong, London.
23,393. Metallic Fittings for Belts, J. Pailey, Birmingham.
23 394. Securing Terminals to Rods, G. T. Piggott, Birmingham.
23,395. Nail Nipper, &c., J. R. Watts, Sheffield.
23,396. Boiling Apparatus, T. Moore, Bristol.
23,397. Shuttle Checking Motion, J. Kaye and W. Schofield, Huddersfield.
23,398. Electric Batteries, R. M. and A. McDonald, Glasgow.
23,399. Apparatus for Feeding Elevators, W. Johnston, Liverpool.
23,400. Manufacture and Lacing of Boots, &c., J. Cottrell, jun., Bristol.
23,401. Driving Gear of Cycles, R. Reynolds, Dublin.
23,402. Pickers for Looms, W. Muir, Glasgow.
23,403. Desiccated Locust for Cattle Food, W. J. Mackey, Kent.
23,404. Drawing Bags through Warehouse Doors, W. J. Willmore, Liverpool.
23 405. Producing Watermarks in Paper, H. G. Forbes and E. M. Somerville, Bitton, near Bristol.
23,406. Clip for Attaching Jewellery to Show Cards, A. Scott, Birmingham.
23,407. Flushing Cisterns, S. Gratrix, jun., and Brother and H. Brocklesby, Manchester.
23,408. The Plug Pipe, C. Lees, Leominster.
23 409. Felt Hats, R. Robinson, Gee Cross.
23,410. Chambers for Children, C. J. Watts, London.
23,411. Puncture-proof Material for Tires of Cycles, M. Lyons, Cork.
23,412, Grooving Machine, J. Cook, W. Swarbrick, and H. Bernard, Lancashire.
23,413. Automatic Balancing Toe clip, G. Lawler, London.
23,414. Hair Pins, N. F. Dean, Liverpool.
23,415. Precipitation Tanks, J. S. Pickering, Birmingham.
23,416. Tramcar Wheels and Axles, J. Willoughby, London.
23,417. Mechanically-driven Shears, G. Bowmar, London.
23 418. Bedsteads for Invalids, A. M. Douglas, Birmingham.
23,419. Brakes, G. L. Hillier, London.
23,420. Brush-making Machines, C. Rehse, London.
23 421. Combinations for Ladies, &c., K. M. Moran, London.
23,422. Velocipede Mechanism, W. J. and E. Freeman, London.
23,423. Closing Devices for Doors, G. A. Farini, London.
23,424. Fastener for Wearing Apparel, K. Brighten, London.
23,425. Last-socket, W. Whiffin, London.
23,426. Hermetically Closing Boxes, A. W. Marshall, London.
23,427. Sewing Machine, T. J. Roome, London.
23,428. Taps, J. S T. Beveridge, London.
23,429. Ventilating Manholes, E. C. Peirson and T. Smith, London.
23.430. Apparatus for Polishing Knives, W. Kiersch, London.
23.431. Mortice Locks and Latches, W. Bywater, London.
23 432. Garments, W. J. Gray, London.
23,433. Brooms, G. Rochlitz, London.
23,434. Railway Points and Signals, W. S. Frost, London.
23,435. Colouring Matters, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
23 436. Water-tube Steam Boilers, E. Petersen, London.
23.437. Boats, &c , W. H. F. Gerald, London.
23,438. Manufacture of Acetone, R. Jurgensen and A. Bauschlicher, London.
23,439. Pedal Bearings for Cycles, J. Billebrandt, London.
23.440. Axle Bearings of Cycle Wheels, J. Hillebrandt, London.
23,441. Galvanic Batteries, J. C. and G. Fuller, London.
23 442. Closing Lead Pipes, J. J. Burton and S. Cooper, London.
23 443. Steam-tight Packing, A. J. Boult —(*H. Engler, Germany.*)
23,444. Targets, A. Mantel-Rieter and E. Meyer, London.
23,445. Tip Carts, B. Norrington, London.
23 446. A Carrier, I. J. Gudendag, London.
23,447. Middlings Purifiers, W. H. Ince, London.
23,448. Extinguishing Flames in Burners, H. Terrett, London.
23,449. Measuring Dimensions of Eggs, C. Bird, London.
23 450. Canning Lobsters, &c., L. Wutzburg, London.
23,451. Apparatus for Measuring Liquids, J. Tabel, Germany.
23,452. Alarm of Approaching Trains, R. Page, Shropshire.
23,453. Cycles, A. Rousselle, London.
23,454. Water-gas Apparatus, O. N. Guldlin, London.
23,455. Oil-feeding Apparatus, O. N. Guldlin, London.
23,456. Respirators, J. A. Wittard, London.
23,457. Mounting Spinning Baits, W. and J. J. Hardy, London.
23,458. Hernia Trusses, W. W. Turver, London.
23,459. Heat Resisting Boot, L. N. Thierry and T. E. Penrose, London.
23 460. Gangway Rollers, R. Simpson, Westminster.
23,461. Sack-holders, J. Marshall. —(*H. Graepel, Austria.*)
23,462. Automatic Funnels, R. A. Brown and F. S. Bond, London.
23,463. Car Fender, W. Hofmeister, London.
23,464. Extension Tie Plates, W. R. Funk and A. G. Henry, London.
23,465. Incubators, J. Vaughan-Sherrin, London.
23,466. Track Clearer for Tramways, G. Beit, London.
23,467. Closets, N. Hessler, London.
23 468. Apparatus for Heating Purposes, G. Kern, London.
23,469. Flushing Apparatus for Closets, J. T. Tennant, London.
23,470. Hair-pins, A. Knippenberg, London.
23,471. Shifters of Linotype Machines, The Linotype Company, C. L. Ireland, and J. Plaice, London.
23,472. Telephony, C. Adams-Randall, London.
23,473. Water-closets, H. E. Baden, London.
23,474. Controlling Mechanism for Gun Turrets, R. Wright, London.
23,475. An Automatic Rein Holder, N. Behrens, London.
23,476. Skirt, I. A. Margesson, London.
23,477. Game, H. R. Troup, London.

*4th December*, 1894.

23,478. Button Fastener or Attachment, J. Chalke, London.
23,479. Strainers and Tea-pots, F. W. Bettall, London.
23,480. Combined Mat and Electric Alarum, J. J. Pye, London.
23.481. Tube Stopper, J. R. Reedman and J. Scott, London.
23,482. Sash Attachments, F. Bitchmough, Liverpool.
23.483. Mixing India-rubber, A. G. Brookes.—(*J. E. Davis, United States.*)
23,484. Screw-covers and Wreath-carriers, W. Nicholls, Birmingham.
23,485. Blind Cords, H. Wardingley and W. M. Cooke, Sheffield.
23,486. Accumulators, F. L. Berners and F. Griffin, London.
23,487. Boxing Gloves, C. Playfair, Belfast.
23,488. Combination Penholder, W. B. Robinson and C. L. Wilkinson, Manchester.
23,489. Steam Generators, H. Wilcke, Liverpool.
23,490. Furnaces, R. Evans and T. W. Jones, Liverpool.
23 491. Taps or Valves for Barrels, C. Preston, Manchester.
23,492. Rectal Dilator and Irrigator, F. Trinder, London.
23 493. Kindergarten System, &c., H. Richardson, Bradford.
23,494. Electric Current Indicators, S. P. Thompson, London.
23,495. Cigarette Holders, D. Thomas, Llanishen.
23 496. Fastening Retort Mouthpieces, G. Winstanley and G. H. Robinson, Coventry.
23,497. Fire Back, E. Hulley, Ashton-under-Lyne.
23,498. Securing Clothing to Flats, J. T. Scowcroft, London.
23,499. Tips for Umbrellas and Sticks, J. Wright, London.
23,500. Pincers for Dentists' Use, J. Burwell, Colwyn Bay.
23,501. Ankle Protector, J. R. Jones, Llanon *viâ* Aberystwith.
23,502 Plate Coils for Furnaces, J. Paterson, Workington.
23,503. Wire Mattress, G Lane, T. M. Hewetson, and H. J. Lane, Birmingham.
23,504. Golfers' Hand-bag, E. A. Jones, Dudley.
23,505. Electric Light Fittings, J. McFarlane, Glasgow.
23,506 Waterproof Feet Coverings, J. Wilson, Manchester.
23,507. Saddles for Velocipedes, &c., W. Lowe, Leicester.
23,508. Fastening Blinds on Rollers, J. Whitehead, Birmingham.
23,509. Phantom Baits, G. Forrest, Glasgow.
23,510. Burglar-proof Locks, A. Dalziel, Glasgow.
23 511. Applying Tooth-powder, R. M. and J. S. Sanger, Glasgow.
23,512. "Collar" for Horses, T. Staines, J. Leadbeater and A. Preston, Leeds.
23,513. Woven Wire Mattresses, D. Hewitt, Birmingham.
23,514. Securing Broom Handles, J. S. Walford, Birmingham.
23,515. Cycle Lamps, R. W. Neale, Birmingham.
23,516. Adjustable Joint, J. Brookes, H. J. Brookes, and P. L. Renouf, Smethwick.
23,517. Games, E. H. Durnford, Hawley.
23,518. Recovering Gold from Ores, W. Fairweather. —(*G. W. Webber, United States.*)
23,519. Lighting Bicycle Lamps, &c., A. F. Mabon, Glasgow.
23,520. Weighing Hot Ingots or Slabs, T. Williamson, Glasgow.
23,521. Collapsible Bag, E. Gillman and J. H. Calvert, Cork.
23,522. Securing Blades in Handles, J. Kleefisch, Cologne.
23 523. Match Striker, J. Hind, Sheffield.
23,524. Tension Spools, T. M. Clark, Keighley.
23 525. Electric Switches, C. P. Ehmann, Manchester.
23,526. Traps for Baths and Lavatories, I. Barnsley, Sheffield.
23 527. Compasses, T. McDermott, Birmingham.
23,528. Cycle Pedals, G. T. Jolland, London.
23,529. Electric Lighting, G. Lyon and H. Bevis, London.
23 530. Automatic Pheasant Stop, R. Coleridge, London.
23,531. Steam Generators, J. Thom, Liverpool.
23,532. Cooking Apparatus, J. D. and H. F. Adams, London.
23 533. Towing and Mooring Gear for Ships, J. Sutcliffe, London.
23,534. Towing and Mooring Gear for Ships, J. Sutcliffe, London.
23 535. Tube Stoppers for Boilers, S. A. Johnson, London.
23 536. Furnaces, T. Richards, St. Austell.
23 537. Driving Gear of Cycles, J. Cottrell, sen., Bristol.
23 538. Mechanical Toys, A. J. Boult.—(*A. Reiche, Germany.*)
23 539. Toys, T. S. Thorn, London.
23 540. Car Brakes, A. J. Boult.—(*G. H. Kinter and G. D. Teller, United States.*)
23 541. Velocipedes, W. F. Taylor and J. R. Trigwell, Croydon.
23,542. Method of Thawing Frozen Meat, R. Long, London.
23,543. Vending Machines, T. S. Wheatcroft, London.
23,544. Producing Spiral Mouldings, W. Osment, London.
23,545. Hooks, C. A. Williams, London.
23,546. Hot-creasing Machines, A. Maxwell and J. C. Day, London.
23,547. Cotton Openers, H. S. Houghton, London.
23,548. Rulers, E. H. Fitch, London.
23,549. Directory Posts and Call-boxes, J. T. Field, London.
23 550. Belt-stretching Machine, A. Palencsar and T. Fischer, London.
23 551. Tables, F. W. Köhler and T. Druzba, London.
23,552. Oil, Gas, or Vapour Burners, F. R. Fennessy, London.
23 553. Treatment of Beer, L. Wagner and J. Marr, London.
23 554. Home-trainers for Cyclists, J. Hutson, London.
23 555. Inkstands or Inkpots, F. J. Sedgewycke London.
23 556. Stone Crushers, H. H. Lake.—(*P. W. and R. D. Gates and C. L. Carman, United States.*)
23,557. Extraction of Gold from Ores, J. Pfleger, London.
23,558. Method of Utilising Garbage, N. B. Powter, London.
23,559. Manufacture of Artificial Fuel, F. J. Koopman, London.
23,560. Sorting Cartridges, H. H. Lake.—(*Deutsche Metallpatronenfabrik, Germany.*)
23,561. Levelling Soles of Boots, E. C. Judd and H. E. Cilley, London.
23,562. Washstands, M. P. Vassiliou, London.
23 563. Rest for Golf Clubs, C S. Good, London.
23 564. Apparatus for Aerial Navigation, N. H. Borgfeldt, London.
23,565. Transmitting from an Electromotor, A. Bergtheil and R. Marples, London.
23,566. Clearing Railway Rails, G. Nobes, R. H. Jackson, and H. Penn, London.
23,567. Apparatus for Moistening Air, E. Mertz, London.
23,568. Paper-feeding Devices, H. B. Cooley, J. M. Noble, and J. E. Trevor, London.
23,569. Stove for Drying Tea Leaf, W. Jackson, London.
23,570. Re-heating Cooked Foods, H. H. Leigh.—(*V. Baraban, France.*)
23,571. Vapour Burners, C. Ostlund, London.
23,572. Meters for Measuring Liquids, A. Goodwin, London.
23,573. Carding Engines, E. Edwards.—(*E. Zapp and F. Jelinek, Austria.*)
23,574. Hair Curlers and Wavers, C. Lewis, London
23 575. Boarded Flooring, O. Imray.—(*O. Hetzer, Germany.*)
23 576. Pistons, W. Mather, London.
23,577. Heating Fluids, W. P. Thompson.—(*A. Doerrens, Germany.*)
23,578. Printing Apparatus, W. P. Thompson.—(*C Sears, United States.*)
23,579. Tie-joints, W. P. Thompson.—(*W. Livingstone, United States.*)

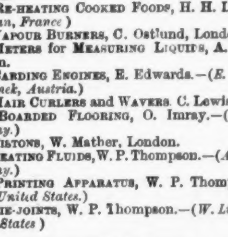
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**525,697.** Winding for Drum Armatures in Dynamo Machines, *R. Eickemeyer, Yonkers, N.Y.—Filed March 9th*, 1892.

*Claim.*—The combination with the armature drum, of a group of independent or individual coils, each of which has a long and a short side lying along the periphery of the said drum, and inclined ends lying across the ends of said drum, the several inclined ends of the several members of the said group at either end of said drum crossing that end of the drum in two radial lines connected by a line substantially parallel to the periphery or edge of the core, and the said several members being separated on the periphery of the drum, substantially as described.

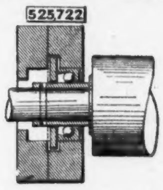
525697



**525,722.** Bearing for Clothes-wringers, *A. R. Sauters, Cleveland, Ohio.—Filed May 23rd*, 1894.

*Claim.*—The wringer frame, in combination with the roller shaft and the horizontal sleeves fixed thereon to take the wear, the bearing block E having a groove about its inside for anti-friction balls, the anti-friction balls in said groove, and the plate G confining said balls, and flanges extending laterally from said plate and engaging in the guide ways in the wringer frame, substantially as set forth.

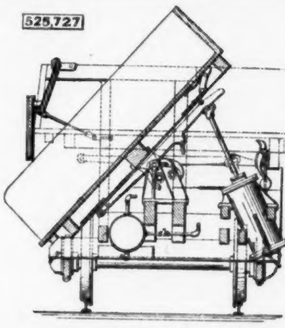
525722



**525,727.** Dumping Car, *E. A. Trapp, New York, N.Y.—Filed February 27th*, 1894.

*Claim.*—In a dumping car, the combination of the truck and supporting frame thereon, the swinging car body, the pin and slot connections between said supporting frame and said swinging car body, one or more pins mounted on one of the two last-mentioned elements of the combination, to wit, the supporting frame or the swinging car body, and curved jaws mounted on the other of the said two last mentioned elements and embracing the above described pin or pins, said pin or pins and co-operating jaws, together with the pin and slot connection, positively controlling the motion of the car body in dumping, substantially as described.

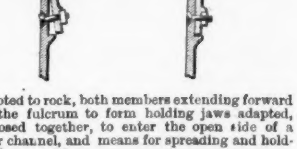
525,727



**525,756.** Joint for School Furniture, *G. M. Bennett, Grand Rapids, Mich.—Filed June 29th*, 1893.

*Claim.*—In a furniture joint or fastening of the character described, the combination with the fixed member, of a movable member having a fixed, in contradistinction to a movable fulcrum thereon on which it is adapted to rock, both members extending forward beyond the fulcrum to form holding jaws adapted, when closed together, to enter the open side of a groove or channel, and means for spreading and holding said jaws apart.

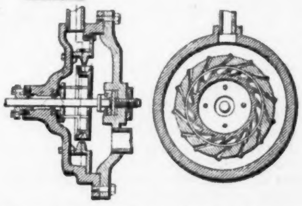
525756



**525,793.** Rotary Engine, *J. F. McElroy, Albany, N.Y.—Filed January 16th*, 1894.

*Claim.*—(1) In a rotary motor, a wheel comprising a solid metal rim having a series of pairs of inclined pockets therein, the pockets of each pair being divided by a tapering ridge, and a circular steam ring having a circular series of jet nozzles extending therefrom into close proximity to and in line with the tapering dividing wall of the pockets, whereby a free passage for the steam is formed at the sides of the nozzles, substantially as described. (2) In a rotary motor, a wheel having a series of peripheral pockets therein arranged in pairs, a tapering dividing wall between the pockets of each pair, and a flat inclined cut-away portion M, at the rear of the wall, and a circular series of protruding jet nozzles arranged in proximity to and in line with the said wall, substantially as described.

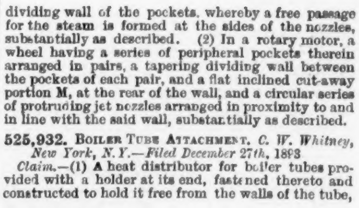
525,793



**525,932.** Boiler Tube Attachment, *C. W. Whitney, New York, N.Y.—Filed December 27th*, 1893

*Claim.*—(1) A heat distributor for boiler tubes provided with a holder at its end, fastened thereto and constructed to hold it free from the walls of the tube, substantially as described. (2) In combination with a tube protector, a heat distributor having one end divided and attached to said tube protector, substantially as described. (3) As a new article of manufacture, a combined tube protector and heat distributor constructed and arranged substantially as shown and described.

525932



Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided for our breakfast and supper a delicately flavoured beverage which may save us many heavy doctors bills."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled, "James Epps and Co, Homœopathic Chemists, London.'

## LIGHT RAILWAYS.

The Conference on the subject of light railways, proposed by the Board of Trade commenced its sittings on the 6th inst., under the presidency of Mr. Bryce. So far as space permitted, the meeting was representative of the various interests concerned, but it could not be said to be fully representative, inasmuch as the boardroom of the railways department of the Board of Trade could not hold half the persons who desired to attend.

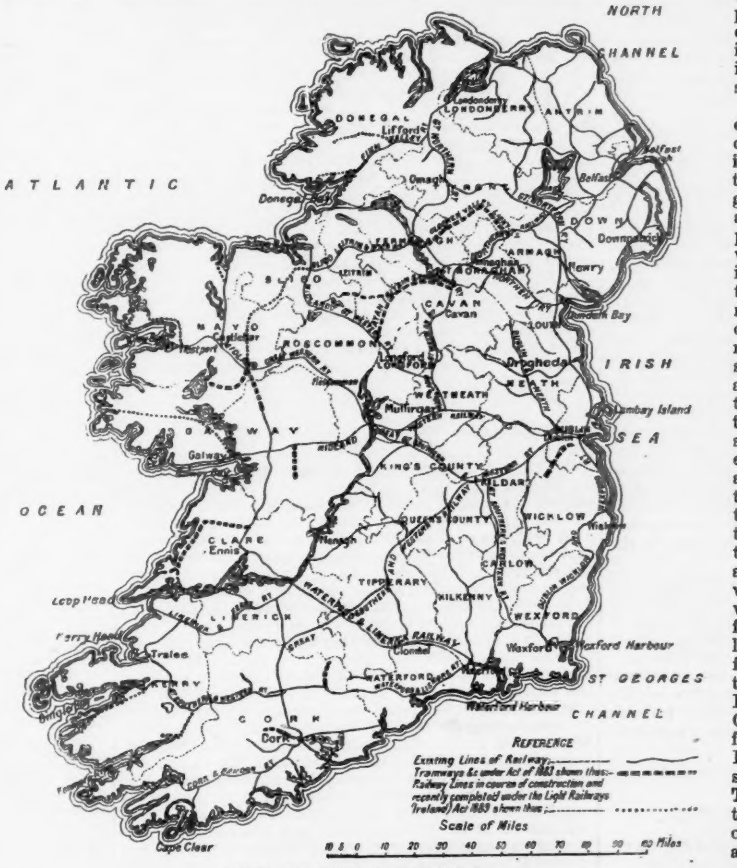
The meeting was held by invitation from the Board of Trade, and amongst those who attended were:—The Duke of Sutherland; Lord Thring, Lord Edmond Fitzmaurice, and Mr. H. Hobhouse, M.P. (Association of County Councils); Sir Albert Rollit, M.P., Sir Bernhard Samuelson, M.P., Sir A. Hickman, M.P., and Mr. F. Corbett (Association of Chambers of Commerce); Lord Claud Hamilton, M.P., Mr. J. C. Bolton, and Mr. W. L. Jackson, M.P. (Railway Companies' Association); as well as Major Rasch, M.P., Mr. S. Storey, M.P., Sir Benjamin Baker, Mr. Channing, M.P., Earl Cathcart, Sir E. Carbutt, and many others. Mr. Bryce, in welcoming those present, said that the Conference was called not to place any views of the Department before them, but to ascertain the views of those invited to it. The depression in agricultural matters had been one motive for calling a conference on the subject, which many persons felt might offer some amelioration for a state of things which had continued for some years past, and amongst the remedies suggested was the opening of better means of communication between rural districts, following the example of Belgium, France, and other countries. It was now fifty years since most of the great trunk lines were built, and comparatively little had been done towards extending the means of locomotion to the less populous districts. Notwithstanding that the mileage of the country had increased in the interval by 40 per cent., enough had not been done for the minor means of locomotion, especially in the conveyance of produce, while there was increasing evidence on the part of the public that accommodation of the kind was wanted. The Board of Trade had not been indifferent to this demand; but the Department was restricted by statutes and usage, and it would require the sanction and permission of Parliament to enable it to make any departure from the rules by which it was guided in approving schemes of railway construction. It must always be led by public opinion; and he invited the views of the Conference on two heads of inquiry—as to agriculture and congested populations. If the cost of transport was an element in the competition of Danish and French produce, it was a matter that ought to meet with their earnest consideration. On the industrial side they should consider whether they could enable workmen in the towns to live in the healthier suburbs by cheapening the cost of transit between the crowded city and the open country. Then they had also to consider the cost of construction: whether the lines could be built more cheaply; and also whether parliamentary powers could be obtained at less expense than at present. It was clear that if they wished to cheapen the normal cost of railway building they must drop something, either in speed, or safety and comfort of passengers, or of convenience in the transport of goods; and this was a matter in which the Department must follow and not lead public opinion.

The chairman then referred to the requirements which the Board of Trade might dispense with, but said very clearly that the subject of aid granted by the State was not worth discussion, as that was quite out of the question. He believed that there was a real need for cheaper and more extended means of communication, and that the enterprise would pay if the lines could be made at a lower rate than at present. If the Board of Trade had reason to believe that public opinion was ready for a forward move in this matter, there would be on the part of that Department no want of earnestness or activity in promoting such an object. He suggested that it would be well to wind up the proceedings of the Conference by appointing a committee, which should present the report to the Board of Trade before the end of January, in order, if thought necessary, that legislative action could be taken in the next session of Parliament. A discussion then followed, in which several of those present joined.

After the adjournment for luncheon, the chairman proposed that before resuming the general subject the committee of which he had spoken should be nominated. This was done. The Duke of Sutherland proposed, and Lord E. Fitzmaurice seconded the selection of the following gentlemen, among others, as a committee to inquire into the question at issue:—Sir Michael Hicks-Beach, Sir B. Samuelson, Sir A. Hickman, Mr. W. Jackson, Mr. Beachcroft, Lord Claud Hamilton (Colonel Makins to act in his absence), Lord Cathcart, Sir C. Boyle, Mr. Hopwood, Lord Thring, Mr. W. Meik, Mr. H. Hobhouse, Mr. Ackworth, Mr. Storey, Mr. Humphreys Owen, Sir B. Baker, Sir A. Rendel, Sir A. Clarke, Mr. A. Siemens, Lord E. Fitzmaurice, Mr. Sellon, Mr. Channing, Sir A. Rollit, Mr. Wain, and himself, the committee to meet at once, so as to present their report before the end of January. Further discussion followed, much information being afforded by Mr. W. L. Jackson, M.P., and General Sir R. Sankey, President of the Irish Board of Works, on the construction and working of light railways in Ireland. Ultimately the Conference was adjourned till January, 1895.

A *résumé* of the results of Government and local government efforts in Ireland for some ten or eleven years will probably throw some light of experience on the proposals which may be broached at the resumption of the Conference. From the commencement of the railway system the British Government has scarcely even contemplated State aid to railways in Great Britain; but from a period as early as 1836 there were proposals to assist Irish lines, if not to construct them, by the State. Government aid was sought and obtained in many instances, and several sums were advanced out of the Consolidated Fund for the construction of Irish railways from 1842 to 1847. In the latter year, in consequence of the famine of 1846, large advances were made; and up to 1893 £4,000,000 or over had been advanced, most of which has already been repaid, and no default in interest or repayment has occurred.

There has also been much assistance given to Irish railways in their earlier stages, when some of them were little better than what would be called "light railways" now, by landed proprietors interested for their own sakes in the construction of the earlier lines; and the system of guarantees secured upon the rates by counties and baronies has been largely employed to aid in raising the required capital. In some cases these local guarantees were limited to a maximum sum in each year, in others to a maximum rate on the ground valuation. In some, the revenue of the line has much reduced these rates in aid, whilst in others there has been no diminution of the tax. The total amount thus guaranteed for what may be called main lines is a little over a million sterling.



LIGHT RAILWAYS IN IRELAND

When, however, we come to 1880, the construction of main lines may be said to have ended; and the Government, under various ministries, came forward to help the promotion of what in France would be called "vicinal" railways, ending with the well-remembered Light Railways (Ireland) Act of 1889.

In 1880 the "Relief of Distress Amendment Act" was passed, by which the Treasury was allowed to lend on favourable terms, and on the security of baronial guarantee, to some lines specified in the Act. It was found, however, that but little use could be made of the powers granted under this law, and in 1883, the "Tramways and Public Companies Act" gave, subject to the control of the Commissioners of Public Works, Ireland, certain facilities in the procedure for obtaining powers, and instituted the principle of building branch lines with capital guaranteed, half by the Imperial Government and half by the baronies interested. Under this Act about 300 miles of railway have been constructed, as shown on the accompanying map, of which more than 200 are 3ft. gauge, the rest on the Irish standard of 5ft. 3in. They have, on the whole, paid somewhat more than their working expenses, so that less than the guarantees on capital account has been called for; but they cannot be called "light railways," for in generally easy countries they have cost £5000 a mile, and they were always made to connect some town or small port with the general system, and not, therefore, "agricultural railways" in the strict sense of the word. The net result of this Act has been that 288 miles of railway—fifteen distinct short lines—have been built for about £1,190,000 raised by guarantee of 2 per cent. by the Government, and from 2 to 3 per cent. by the baronies. In almost every case the Treasury has had to pay its whole contribution, and the barony most of its liability.

In 1889 came the so-called "Light Railways (Ireland) Act," though why it was so called it would be hard to say, except for the same reason that the Romans gave its name to a grove.

The report of the Commissioners of Public Works in Ireland gives the following account of the inception and working of this Act, under which 240 miles of line, nearly all of standard gauge, have been laid at a cost of about £7500 per mile, of which Government has contributed by grant about two-thirds:—

"The Royal Commission on Irish Public Works, of which Sir James Allport was chairman, reported in 1888 that the results of the Act of 1883 had not been such as had been hoped and expected. They attributed this comparative failure—(1) To the cumbrous, and consequently expensive, procedure under the Act; (2) to the form which the guarantee takes in practice, no payment being capable of being made for any half-year till several months after its close, and the Government contribution, from its indirect character, giving practically no additional value to the stock; (3) to the great liabilities imposed upon the district, not only for interest, but for working expenses; (4) to the great responsibility thrown upon the Privy Council; (5) to the fact that no existing railway company could promote a line under the Act; (6) to the encouragement given by the executive Government to the promotion of lines on the 3ft. gauge. The Commission also passed some general criticisms on the principles of the Act based on the want of independent control throughout the proceedings, the constitution of the public bodies, by whom the guarantees were given, and the danger that such lines might become a means of investing money simply on the strength of the guarantee, the holders of the stock having no personal concern in the success or efficient working of the line, or even in its proper construction, inasmuch as the interest on their capital is in any case secured to them under the guarantee.*

"The Royal Commission come to the conclusion (1) that railway extensions cannot be made without State assistance in the parts of Ireland in most need of them; (2) that if such assistance were given it should be given in the clearest and most direct way, consistent with the preservation of local responsibility, and with the existence of some provision for its ultimate discontinuance, and they, therefore, recommended that the Government should grant to the constructors of any approved line 3 per cent. on the necessary capital, and that the district should guarantee in addition the equivalent of a rate of sixpence in the £1 on the annual rateable value, this local contribution being allotted in the first instance to meeting any excess of working expenses above the income of the line, and subject to this to the reduction of the payments by the Government under the guarantee. As regards the gauge they recommended that wherever possible the gauge should be the standard gauge, and that the lines should be 'light railways.' The light railways recommended were:—From Downpatrick to Ardglass; from Letterkenny *via* Kilmacrenan, Cresslough, and Dunfanaghy to Cross Roads; from Stranorlar *via* Glenties and Ardara to Killybegs; from Ballina *via* Killala to Belmullet; from Galway to Clifden *via* Oughterard; from Killorglin to Valentia; from Skibbereen to Baltimore; from Kinsale Station to Kinsale Harbour; short branches at Bantry and Dungarvan. These recommendations are in addition to lines which have been, since the date of the report, constructed under other arrangements.

"In the session of 1889 the Government introduced the Light Railways (Ireland) Bill, the object of which was to give effect to some of the recommendations of the Commission. It provided that the Lord-Lieutenant in Council might from time to time declare that it is desirable that light railways should be constructed between certain places for the development of fisheries and other industries; but that, owing to the circumstances of the district, special assistance from the State is required for their construction. The State assistance was to be derived (*a*) from the balance of the annuity of £40,000 given by the Tramways and Public Companies Act, 1883; (*b*) from a capital sum of £600,000 to be provided by Parliament; (*c*) from an additional annuity of £2000. Owing to Parliamentary exigencies, the Bill, as finally passed, was confined practically to these provisions and to the incorporation of the procedure of the Tramways Acts, and none of the desirable amendments in previous legislation were included. The Act was to apply only (*a*) where the promoters of the light railways are an Irish railway company having a railway open for traffic; or (*b*) where the promoters have made an agreement approved by the Treasury for the maintenance, management, and working of the light railway by such railway company; or (*c*) where a baronial guarantee was given for the payment of dividends upon a portion of the capital pursuant to the provisions of the Act of 1888. The aid of the Treasury might take the form of a capital sum or of an annual payment, or partly one and partly the other, and the capital sum might be a free grant or a loan, or partly one and partly the other. The adjustment of the two forms of aid — annual payment and capital sum — so as not to exceed the limits of the Treasury assistance already stated, was directed to be made on the basis of 3 per cent."

---

* This is indeed the case. These Government and baronial guaranteed stocks are held at a considerable premium by investors who have no interest in the railways, but simply as so much Government funds.

We have given the principal statistics of the railways constructed under the Act of 1883. It is too early to judge of the results attained under the Act of 1889, but it may safely be taken that scarcely one of these lines would have been made by capitalists for profit. In most instances they will benefit the localities through which they run and the main lines which they feed; but the reason why of some of them is hard to find out.

. So far, therefore, as the Irish experience is of use, it tells us that some 500 miles of extensions of railways have been made, at Government cost, in the last ten years. They have not been light railways, having cost between £6000 and £8000 a mile in always a reasonable country. More than half of them have come into working; for three or more years very few have paid more than working expenses, very many less.

The experience in Belgium, as given in a very concise report by Major Addison, R.E., to the Board of Trade this month, is in many respects more pertinent to the conditions of the proposed aid to light railways in England in aid of agriculture, &c., but in some other respects it falls short of possibility in this country.

He tells us that no less than 730 miles of railway have been constructed in Belgium during the last eight years with capital, the interest and sinking fund of which—3½ per cent.—has been guaranteed, one-fourth by the Government and three-fourths by the localities. Scarcely any of the capital has been found by private subscribers or persons interested in the lines; yet they are now paying as a whole 2·8 per cent. out of the 3½ per cent. for interest and sinking fund, over and above working expenses. The demand for them also increases; forty miles more are in construction, and about 900 miles are projected. They are "vicinal" lines in the true sense of the word; 615 miles are of 1 metre guage, 125 of 1·067 metre, to suit the Netherlands gauge, and only 30 miles of the 4ft. 8½in. They cost, all found, under £2700 a mile. This sounds very well for "light" railways, but there are other sides to the picture.

First of all these lines are, almost without exception, laid beside or upon the sides of high roads, of which they must practically occupy at least 10ft. wide, for the public are warned not to approach nearer than within 5ft. of the railway.

Now, it is hardly necessary to say that the English and Scotch high roads could not be subjected to this kind of treatment; they are not straight enough, nor wide enough, nor generally level enough; therefore our "vicinal" lines must be railways through the country, and not steam tramways. But even a stronger reason for not laying unfenced railways beside our roads is the very high mortality caused by this system of working. These seven hundred and odd miles of Belgian railways killed in 1893 twenty of the Belgian public who were *not* passengers, and five who were; they did not kill any railway servants, and only injured three. None of the accidents to passengers were the result of collisions or derailments, therefore they were most probably all simply cases of persons run over. Now with this testimony before him we should not be surprised to find Mr. Bryce or any of his successors strongly objecting to reduce the standard of safety required by the Board of Trade down to the Belgian level.

The gradients allowed also, up to 1 in 20, and the curves down to 1½ chains radius, would be a considerable relaxation of our practice for passenger lines; and it is to be remarked that these are properly passenger lines, three-fourths of the receipts coming from that source.

From the above considerations it is clear that our "vicinal" lines must follow more the type of the Irish light railways than the Belgian, and that we cannot hope to construct anything on so cheap a scale as that adopted in the latter country.

## THE IRON GATES OF THE DANUBE.

By BELA GONDA, Chief of the Department of Navigation of the Interior.

(*Concluded from page 464*)

CONSIDERING the great and international character of the works, it was thought proper that they should be inaugurated in the presence of all the various interests, and the ceremonial took place on the 18th September, 1890, the works being commenced by the blasting of the peak of Greben. To commemorate this day, the contractors cut a memorial table in the wall, on the Hungarian shore over the rock Alibeg, with the following inscription:—"These works, sanctioned by the XXVI. Law of 1888, and destined to remove the navigation hindrances at the Iron Gate and other cataracts, were begun in the reign of the Hungarian king Francis Joseph I., in the time of the prime minister Count Julius Szapàry, by the minister of commerce Gabriel Baross de Bellus, on the 15th September, 1890. God bless this work and its creators."

The building of dykes at the Greben and at the Iron Gate was commenced at the same time. The material resulting from the cutting a width of 150 metres of the Greben is built into the training dyke of the Greben-Milanovacz. This important work was rendered more difficult by the circumstance that the mount Greben runs steeply to the edge of the channel. But this difficulty was soon surmounted. The cutting began on both sides of the mount Greben at several heights at the same time, and for the easier transport of the spoil, a tunnel was made through the peak of the Greben. The removal of the rock was effected by great mines filled with 2000 to 8000 kilos. of explosives—carboarotin, haloxilin, and dynamite. From the loosened material, the stone corresponding to the conditions stipulated in the contract was picked out and transported to the workyards and over the dyke on railways in wagons. On the way its weight was taken, and afterwards it was thrown into the body of the dyke. From the weight of the stones used—on the basis of previous exact and often confirmed measurings—the cube of the utilised stone is calculated, and the sums are paid to the contractors in conformity with the prices stipulated in the contract.

But only that part of the dyke is built in this manner, which starts from the shore; on the other parts the stone is transported on boats, where the cube of the material is exactly fixed. The stones are thrown from the ships into the projected line of the dyke by manual labour, the work being carried on at several points.

The dykes of the Iron Gate are built entirely by the aid of railway, and the material is transported in long trains on rails laid on the sections of the dyke, and it is thrown from the wagons into the corresponding profiles of the dyke. All wagons are weighed as the trains are running to their destination. The employés of the technical bureau being present at the loading of the wagons, certify the quality of the material; a controller of the bureau takes the weight of the load, and another certifies that the load was duly built into the dyke.

The material of the Iron Gate Canal consists of limestone mixed with slate beds. The extraction of this material is done in a simple and expeditious manner, and in such great quantities that there were days, even months, when the quantity extracted reached 1000 cubic metres per day. The bottom of the canal is provided with a net of railways, and long trains carry the extracted material to the shore, whence the materials which are to be used for the dykes are transported again over the dykes, and there they are built in, and the rest serves to fill in the channel parts and depths behind the right dyke of the canal.

On those parts of the canal which could not have been stopped in this manner American boring-machines—system Ingersoll—placed on rafts will be employed to deepen the bottom, and the rocks will be blown out by dynamite placed in the bore-holes, while for the removing of the extracted material dredges are applied.

The canal to be dug at the Iron Gate is the most prominent and interesting part of these works; but, in point of view of technical difficulties, it is not the canal which constitutes the most interesting part of the works, it is the deepening of the rocky bottoms of the canals to be established in the open river through the cataracts. The rocky masses to be extracted and taken away from the channels to be established in the cataracts of the Stenka, Kozla-Dojke, Izlasz, Tachtalia, and Jucz, are forming a total of 160,000 cubic metres in round numbers; and this all must be operated under the water, in different depths, in currents excessively swift, and forming falls and whirlpools. A similar work with such difficult conditions was never executed. The extraction under the water executed at Bingerloch on the Rhine was less important, and operated quieter water; as for the technical difficulties, we cannot compare it with these works, however similar they may look. The extractions under the water executed on the Saint Lawrence above from Montreal can be compared with our large works, but there the circumstances were more favourable, because they had not to struggle against the excessive and unequal velocities of the current against the violent falls, as at the cataracts of the Lower Danube.

Thus, the arrangement of the works, the just choice of the working engines under such favourable and difficult circumstances, demanded profound reflection, great circumspection, and professional knowledge.

The ordinary modes of the depth measuring, viz., with poles and ropes, were insufficient; more exact instruments were looked for, and the contractors succeeded in obtaining at the Budapest Dockyard, Danubius, the depth-measuring boat.

The depth-measuring ship consists essentially of a horizontal floor, fastened on iron pontoons, which is provided with a slot for each metre, and above two slots two measuring wagons running on rails are placed. The measuring wagon is so constructed that its four corners form exactly the corner points of a square metre, and in these iron pipes, with rods, are applied between the gears in such a manner that they are to be plunged into the splits to the bottom of the channel, and the water depth, viz., the bottom height can be precisely read off at the upper part of the iron pipe. The depths can be measured in all positions of the ship, viz., at four points, a metre distant from each other.

The floor of the measuring ship being 9 metres wide and 16 metres long, the ship placed on a certain point can measure at once a space of 200 square metres, and shows the depth in a regular interval of 1 metre. When the measuring wagon has run down the rail it can be switched by using a turntable to the following rail, and the measurement can be continued in such a manner in the length of the next part. The fixing of the measuring ship on the due place of the canal to be deepened is marked by signs. The floor of the ship corresponding to a length of 20 metres, the canal is divided by the flags—signs—on the shore into sections of 20 to 20 metres each, and these are fixed in a similar way lengthways on the boat. Broadways, the boat is divided into sections of 10 to 10 metres, which comply with the width of the canal to be constructed. As these canals will be 60 metres wide, the depth measurement, for sake of safety, is extended to a width of 70 metres, viz., to seven positions of the boat.

The depth measurements are executed independently of the changing water line mark, the height above the sea being fixed. The rail placed in the centre of the ship is fixed by exact measures executed by two instruments from the shore, showing in every position of the ship the height above the sea. Besides this, the formation of the bottom is marked, on the basis of the surveyed points, in a graphical manner, so that the condition can be seen at a glance. Such exact determination of the depth guarantees that the canals to be cut through the cataracts were really carried out with the projected dimensions.

The loosening of the rocks to be removed under the water is executed by breaking and blasting, while the loosened rocks are taken out with spoon-and-bucket dredges and with Priestman excavators. The breaking machines were constructed after the system of Lobnitz, a Scotch shipbuilder, and were made partly at Messrs. Lobnitz' works, Renfrew. The construction is very simple, and is based purely upon the free fall. For the breaking an iron chisel is employed, which is 9 metres long, square in form, is 15·75in. square in the centre, 16·5in. square at the upper end, weighs 8·5 tons, and in the centre of the lower end a steel bill is fitted. On the upper end are holes for lifting attachment.

This chisel or crusher is mounted upon a vessel with a stage of a height of 12 metres. This stage or framework is placed in two of the vessels over a square hole in the centre of the hull, while on the third it is placed upon two coupled vessels. These vessels were illustrated in THE ENGINEER of the 20th April last, page 332. The ships are of wood, and are equipped with steam anchoring and levelling gear. The working of this machine is very simple. The boats are placed in the centre of the canal to be dug, and fastened by four anchors. When the crusher has smashed the rocky mass to the required depth, which is marked on the crusher chisel, the boat is moved by the steam winches towards the side, and when a strip of half a metre is cut off, the boat advances on the anchor chains to attack the following strip.

For blasting the rocks, boring machines are employed, such as have done good service for many years on the river Saint Lawrence. One of these was also illustrated in THE ENGINEER. There are three or four movable borers fitted to a frame on a wooden boat, which can be, by the help of four legs, raised above the level of the water in order to protect the boat against the movements of the waves. These borers are on the Ingersoll system, driven by steam, and are raised out of water by hydraulic cylinders. Every borer is placed in a pipe provided with narrow slits. This pipe is pressed against the bottom so that the current should not trouble the movement of the engine. Every pipe is, moreover, provided with a strong wire ties, so that the current does not affect the borer which can be maintained vertical.

An automatic Worthington pump is used for raising the frame of the borer by hydraulic pressure, and is supplied by the boiler which drives the borer. The boring and blasting of the rocks under the water with this floating boring boat are executed in the following manner:—Firstly, the survey boat establishes exactly the section of the canal which is to be blown up. The boat bearing the borer is placed at the lower edge of the section, and is anchored. The four supporting frames are lowered to the bottom. After this the borer is placed over the points which were previously determined, and the height of which is known, so that the depth to be attained is easily found. The borer pipes are lowered, the pipe to the bottom, and the borer descends into the pipe as far as the bottom, and the borer set to work.

When the bottom is bored to the required depth—which, in consequence of the conical shape of the hole left by the blasting, must be taken always deeper than the intended mean depth of the canal—the hole is washed out with a strong flush of water in order to clean it, then the charge of dynamite is introduced through the pipe and provided with a fuse, the dynamite being so heavy that the waves cannot carry it away. The above-mentioned slot is provided in the pipe so that the fuse can pass out. When all the holes are bored on the section corresponding to the position of the boat, and all the holes are charged, the fuse is connected with the electrical battery, the boat is lowered into the water, and is withdrawn to 10—15 metres, and then the mines are exploded. After this they begin the boring on the following strip till the whole is blasted.

It may be mentioned that with a blow of the Lobnitz chisel 0·0307 cubic metre of rock is removed, while the blasting of a bored hole loosens 2·50 cubic metres of rock. Experience has proved that the Lobnitz boats work with advantage when the average height of the rock to be removed is not more than 1 metre, while the boring boats are working with advantage in beds which are thicker than 1 metre.

The average work of the crushing machines and boring ships per day was, in 1892 and 1893, as follows:—

| | 1892. Cubic metres. | 1893. Cubic metres. |
|---|---|---|
| One crusher (Lobnitz) | 12·5 | 73·4 |
| Two crushers | 31·9 | 75·5 |
| Three crushers | 28·2 | 73·7 |
| One boring boat | 18·2 | 77·6 |
| Two boring boats | 27·2 | 66·1 |
| Three boring boats | 19·9 | 75·9 |
| Four boring boats | 12·5 | 99·6 |
| Five boring boats | — | 28·5 |
| Total | 150·7 | 477·0 |

And this has increased with the progress of the work.

The material loosened by blasting or crushing is taken out by dredges. The dredges employed on the Lower Danube are partly of a fork-grab form of Priestman excavators, partly of a spoon or bucket form; for some special works a very large dredger with buckets, which excavates large quantities of rock without difficulty. One of these was illustrated in THE ENGINEER of the date above given.

This dredge was constructed at Renfrew, Scotland, in the works of Messrs. Lobnitz; it is 40 metres long, 10 metres wide. The vessel is of very strong construction, on account of the large engine and heavy stresses upon dredger. There are two steam engines, one of 200-horse power, the other of 50-horse power. The construction of this dredge differs from the other dredges only by its large dimensions, except that it has a screw propeller. By this it propelled itself from the works in Scotland, traversed the canal, the Atlantic Ocean, the Mediterranean, the Bosphorus, and the Black Sea, and safely arrived at the cataracts of the Lower Danube. In order to appreciate this passage, we must mention that the ship—being designed for special excavating work—has a flat bottom and flat stem, and a draught of only 7ft. The passage occupied forty-five days.

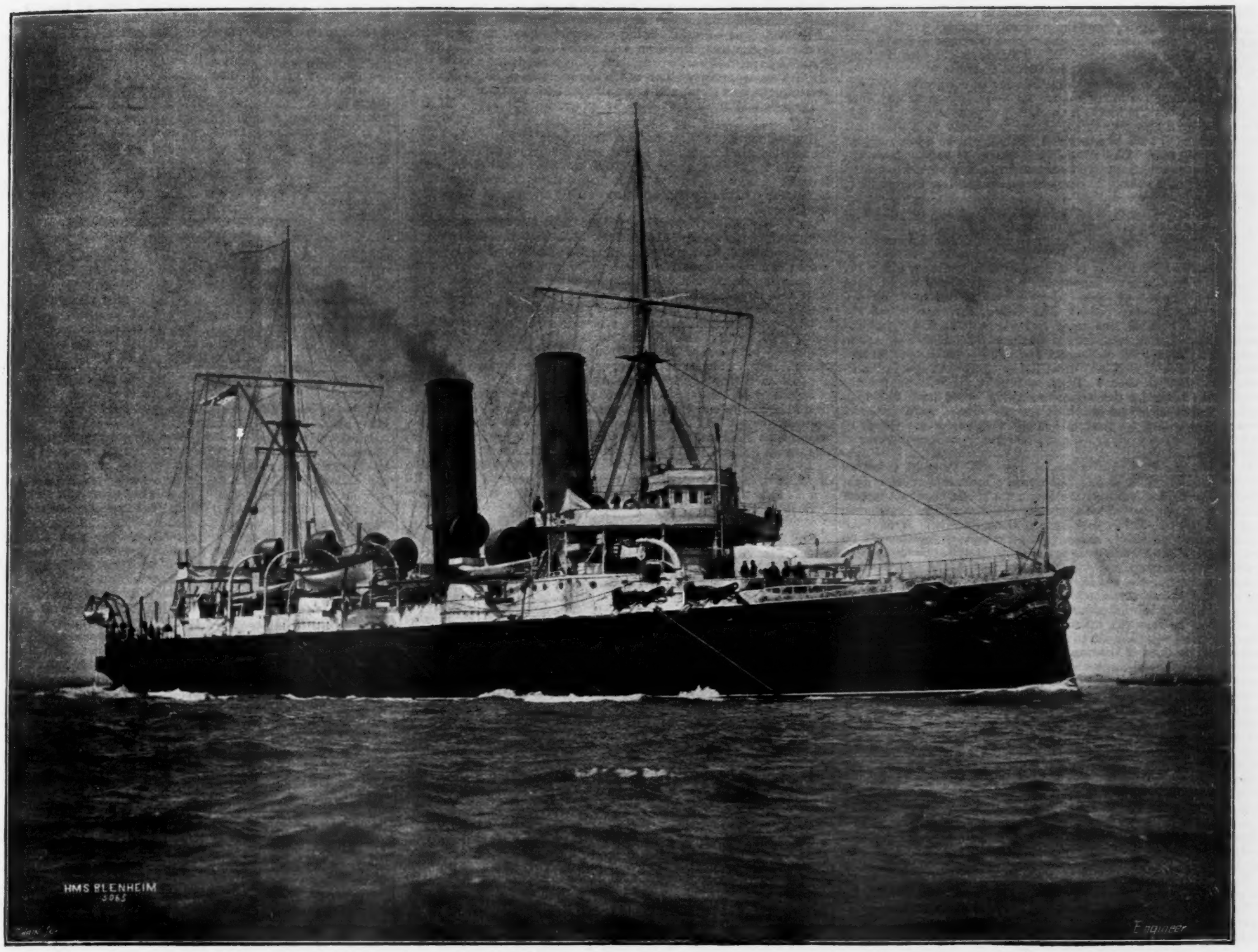
The average work of the Hone dredging machines per day was in 1893-94 as follows:—

| | Cubic metres. |
|---|---|
| Great dredging machine "Vaskapu" (Lobnitz) | 500 |
| Dredging machine "Halados" | 150 |
| Dredging machine "Kozla" | 150 |
| 1.—Crane excavator | 30 |
| 2.—Crane excavator | 100 |
| 1.—Priestman excavator | 10 |
| 2.—Priestman excavator | 10 |

Besides these engines and machinery the contractors employ, for the removing from rocks below the water, a tug of 500-horse power, another smaller one, a screw steamer, and for the purpose of transporting the Lobnitz, crushers, borers, and numerous boats. They put down nearly ten miles rails, of a length of more than 15 kiloms., on which six locomotives and more than 500 dumping cars are transporting the materials. Everything possible has been done to secure the completion of the works on the 31st December, 1895, as stipulated in the contract. And by this Hungary will fulfil a great mission, with which the powers have charged it by the Berlin Treaty of 1879. The navigation being assured at the cataracts of the Lower Danube, the gates of the Orient will be open not only for Hungary, but for the whole Occident.

A recently-issued report by Mr. Percy Sanderson, British Consul-General for Roumania, gives an interesting account of the improvements made in the navigation of the Lower Danube during the years 1878 to 1893 inclusive. The engineering works, which have been carried out under the able superintendence of Sir Charles Hartley, K.C.M.G., chief engineer to the Danube Commission, may be classed under three heads, viz., those on the Black Sea coast-line, those in the port of Sulina, and those in the river. The approaches to the port have been made safe by beacons, as well as by fog-signals and a "whistling" buoy, and the south pier at Sulina has been prolonged considerably. An even depth of 20½ft. has been maintained at the mouth of the river, and will be increased to 23½ft. by the completion next year of parallel dams. In the river numerous cuttings have been made, with the result that a minimum depth of 15ft. has been obtained on the whole of the Sulina branch of the river, while the course of the river has been shortened by six nautical miles.

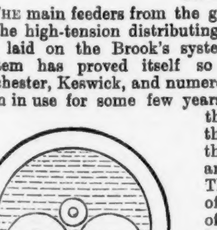
# HER MAJESTY'S PROTECTED CRUISER BLENHEIM



## H.M.S. BLENHEIM.

Her Majesty's ship Blenheim has been told off to bear the body of Sir J. Thompson, the late Premier of Canada, across the Atlantic. The Blenheim is in many respects a remarkable ship. She is a protected cruiser of 9000 tons, and is probably for her size the fastest warship in the world; the Blanco Encalada, for example, being much smaller. The Blenheim attained 22·5 knots under trial. She was launched in 1890; she was built by the Thames Ironworks Company, and her engines indicated 21,411-horse power, by Messrs. Humphrys, of Deptford. She is 375ft. long, 65ft. beam, and draws 25ft. 9in. She carries two 22-ton guns, ten 6in. guns, quick-firers, seven machine guns, besides small weapons. She can stow 1500 tons of coal; she has no side armour. Our engraving has been reproduced from a very excellent photograph of the ship, taken by Messrs. Symonds, marine photographers, Portsmouth. The Blenheim, which arrived at Spithead at midnight on Tuesday from Gibraltar, steamed into Portsmouth Harbour, and was berthed alongside the south railway jetty to await the body. The ship is to be painted black throughout, and a mortuary will be erected in the cabin, which will be draped. The remains are not expected to reach Portsmouth until Saturday. It is stated that the Admiralty propose to build four more ships of the Blake and Blenheim type, but much larger, and apparently to be slower, because the power is to be only 13,000 horses.

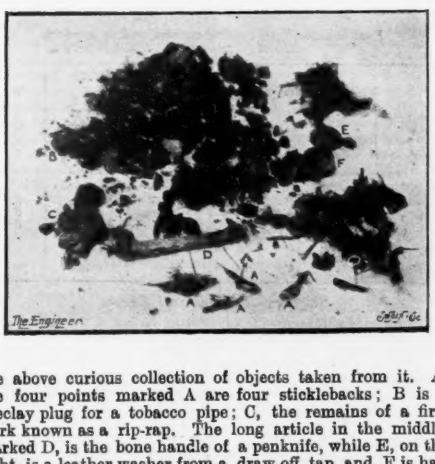
## HIGH TENSION FEEDERS, WORCESTER.



The main feeders from the generating station at Powick to the high-tension distributing sub-station at All Hallows are laid on the Brook's system of oil insulation, which system has proved itself so satisfactory at Chatham, Rochester, Keswick, and numerous other places where it has been in use for some few years. These feeders consist of three heavy wrought iron tubes, the metal having a mimimum thickness of ·25 of an inch, and an internal diameter of 2in. The conductors drawn into two of these tubes are made up of two $\frac{19}{14}$, and two pilot wires laid up together into one cable — the remaining tube being left spare. Special joint and junction boxes are placed at various points along the line, from which branch connections may be taken as required. Midway along the line an oil pressure tower has been erected, allowing for expansion and contraction—due to variations in temperature—of the thick heavy insulation oil. During the laying a very careful test was kept on the cable, and they were finally flashed with double the working pressure, namely, 5000 volts. The contract for the supply and laying of these feeders was given to Messrs. Johnson and Phillips, who are the sole makers of this system, which we do not doubt will now be more universally used.

## CURIOSITIES OF WATER SUPPLY.

We illustrate here an example of the curious nature of objects which, in spite of all precautions, make their way into the water supply of large towns. In a district which obtains its water from the Manchester Corporation, water was drawn for a special purpose from various street hydrants in different parts of the district, and had to pass through a rather finely perforated rose of about 4in. in diameter. The rose becoming choked, it was examined, and the above curious collection of objects taken from it. At the four points marked A are four sticklebacks; B is a fireclay plug for a tobacco pipe; C, the remains of a firework known as a rip-rap. The long article in the middle, marked D, is the bone handle of a penknife, while E, on the right, is a leather washer from a draw-off tap, and F is half of a walnut shell. It is easy to understand how these articles might chance to be found in the open filter-beds, but how they can make their way into the mains is somewhat of a puzzle, especially when the excellent quality of the Manchester water supply is considered. The conclusion is inevitable that these things must have found their way into the pipes or mains in the course of some repair or plumber's work, and probably in the neighbourhood in which they were found.



## TRIER'S "SPLIT-GRIP" COLLAR.

The split collar illustrated by the accompanying engravings is for shafting and axles of all kinds. It is made in halves, so that it can be taken off or put on without disturbing the shaft or spindle. It grips the shaft all round, and as it has no projections the danger to workmen of the ordinary collar with set-screw is obviated, and it will remain tight more certainly than with a set-screw, especially on shafts which are not true to gauge, or on which the ordinary collar is slack. By slightly recessing the shaft, the collar can be made to serve in place of a collar solid with the shaft, as shown by the engraving, Fig. 2. In this form the collar is capable of resisting thrust as effectively as if solid with the shaft. The two halves of the collar are united by the single cheese-headed screw T and the double right and left-handed screw S. The barrel-shaped head of the screw S is provided with tommyholes, lies wholly within a gap formed by the ends of the collar halves, and having the same radius as the raised central web, forms a practically unbroken continuation of the latter. The collar is fixed in place by first drawing the halves together with the screw S, a slight gap remaining; the screw T is then inserted and screwed tight; and lastly, the screw S is used to produce the tension and to cause the collar to firmly grip the shaft all round. The tension set up by the screw S imparts itself to screw T. The collars are made of toughened cast iron, turned bright all over, and although of light and elegant shape are very strong, the bursting tendency of the set-screw in ordinary collars being absent. Messrs. Trier Brothers, Westminster, have recently brought this useful invention before the public at a price which compare favourably with that of the ordinary collar.

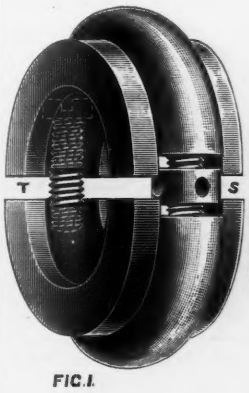


FIG. 1.

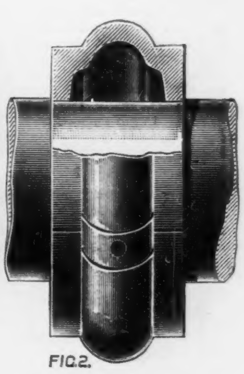


FIG. 2.

The deepening of the channel of the Port Adelaide River to a low water depth of 23ft., for a width of 250ft. from the semaphore anchorage to the port wharves, has been completed.

# LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

## LABOUR AND LUXURIES.

SIR,—The first I saw of the controversy in THE ENGINEER, upon "Labour and Luxuries," was the admirable letter by "Hirn," in your issue of November 2nd. Since then it seems to me that no attack has been made on "Y. X.'s" fundamental idea without making use of reasoning which he cannot understand.

"Y. X." seems to confuse the principles of economics with the principles of conservation of mass. He objects also to any time limit, unless I mistake him. He certainly objects to any moderate time limit, such as a year or so. Does he object to a time limit such as that of the life of a nation? This might be a few hundred or thousand years. The nation then ceases to exist. Does the money it has spent on foreign beer return to it after it has ceased to exist? Or if a nation, having spent much gold on foreign beer, is on the verge of bankruptcy—a not impossible case—is the money it has spent gradually coming back to it without any special effort to produce goods on the part of that nation?

The receivers of that gold are as well off as if it had been spent on iron or Bibles, according to "Y. X." The nation in question is worse off, so that what is commonly called mis-spending has produced a less sum of benefit than spending well would have done? Will somebody some day be better off to bring the balance straight? If so, who? The nation, the receivers of the gold, or the rest of the world? Perhaps "Y. X." objects to these limits. Let us consider the whole world. If three-quarters of the world spend all their gold for some years on beer, except what they must spend on bare living, will that gold "ultimately return" to them? Suppose it does, it will be greatly lessened in value, for three-quarters of the world have failed to replace their spades and other tools as they have worn out, and have not bought oil for their machinery, and so forth. Goods of all kind, including food, are scarce, and the purchasing power of gold is lessened.

Now, I hold that if this be true of nearly all the gold, it is true of any proportion that can be named; the value of the gold diminishing in proportion to the amount spent on beer rather than on tools or materials. This applies to the case of the shoemaker suggested by "Y. X." in your issue of December 7th. Even if the sovereign does ultimately return to the shoemaker, its value will be less than it might have been in some proportion to the number of shoes the shoemaker might have made had he bought leather instead of beer. For the fewer shoes made the dearer shoes will be, and the dearer therefore other things will be. According to the usual answer to workmen who want to raise wages and prices, it will soon be followed up all round. This will be seen more clearly if we go back again to a broader case. Put all the shoemakers in the place of the one, and let them spend, say, half their money for material, upon drink. But should this method of reasoning not be suited to "Y. X.," there is still another way of looking at the question. Suppose the sovereign to have been lost in a shipwreck in the publican's pocket.

Most men, "Y. X." among them, think there is some loss in the disappearance of the gold. Let "Y. X." admit further that in this case the sovereign—which the shoemaker had new from the Mint—has done less good to the community—represented by the shoemaker—than it would have done had it gone down at sea with the seller of leather. This being so, could the unexpected appearance of the publican or the seller of leather on a raft, sovereign in pocket, affect what the sovereign did, and the effect that it had while on shore? Surely not. Now is not the whole career of the sovereign made up of small transactions such as this? And does not the principle of integration hold as in mathematics? So that under a different series of circumstances—buying and selling—to any given series of circumstances, a sovereign will effect a different amount of benefit. To have no time test at all is equivalent to saying that the effect of certain atoms of gold during infinite ages will be good. In a dim kind of way "Y. X." seems to see this, but he does not see that the life of a nation, much more of a generation or less, is but a short event in the course of these ages, and that the effects of those atoms of gold collected into different masses may be good or ill in cases of different masses, during a generation or less.

Let us take "Y. X.'s" other case in which a man finds gold. Call this case 1. A. lives with unsatisfied desires. Coachbuilders live in want of employment. Horses are more numerous than purchasers. A. finds gold, orders horses and carriages, employing coachbuilders, who spend the gold in their turn. Now "Y. X." says that the whole community share the advantage. It is absurd to stop at such a statement. Let us analyse it. A. benefits by carriage and horses. The coachbuilder benefits by the profit on his work. His tailor and bootmaker benefit in the same way. Now I say that that lump of gold has done no more good than the same amount would have done had A. earned it—in the community.

It has enabled A. to get his carriage and horses without working for them. But let us take this case. Case 2: A. works as a consulting engineer, and earns the same value of gold as in Case 1, and spends it in the same way.

Now, the men who buy A.'s advice are not worse off for it; they have the advice—which is worth more to them, and through them to the community, than the gold they willingly exchanged for it. This I consider makes up for A.'s trouble in working, as against finding gold in Case 1. A. has his carriages and horses. The coachbuilders, and the community through them, are in the same position as before. In both cases the community finds horses rather dearer. In my case—Case 2—it finds good advice rather cheaper, for an increase in any commodity tends to make it cheaper. Cheap bread, clothing, and good advice are an advantage to the community—always in pure "Y. X." economics, usually in ethical economics.

"Y. X." says labour can be wasted, gold cannot. I consider that gold is being wasted if it causes labour to be wasted. If I spend three years making castles in the sand, there is a loss to the community—even if I become sane and diligent at the end of the three years. On the whole, Sir, the mistake made by your reader "Y. X." is, that he is always dealing with gold, while he should think as well of men and their work.

R.

December 19th.

SIR,—I am much obliged to "W. A. S. B." for supplying me with a definition I lacked. Smith says, "the sole use of money is to circulate consumable goods." That is precisely what I have contended for all along. So far as gold is concerned it matters not a whit what the goods are. When a man has received a sovereign he has received all the potentialities of that sovereign. The gold can do no more for him. It matters not whether it was got honestly or not. The gold represents so much power. But the quantity of gold in any country is limited. If one man has it another man must go without. Peabody's buildings were built not only at Peabody's expense, but at that of some other body of individuals, not builders, who would have received his money if he had not been charitably disposed. The passages quoted by your correspondent really have nothing to do with my contention. But they admit of being traversed. I do not know whether "W. A. S. B." has ever read a little book, by an author whose name I forget, showing that although thrift was the best thing possible for the individual, it is the worst for the nation. Thus, one man spends his sovereign on boots, let us say, while another invests it abroad, and goes with worn-out boots from motives of economy and thrift. It is quite evident that the former gives more employment than the latter at home, and so far is a better friend to his country.

Mr. Phipson falls into an amusing error. The quantity of land available for purchase is a constant quantity, and it matters nothing to the wealth of the community who has it so long as it is used. If a man sells land and gets gold for it, it is to be presumed that he will spend the gold—distribute it, that is, to circulate consumable goods. We have on the one hand land, on the other gold. A has the former, B the latter. They exchange. I cannot see that this alters the position of affairs in any way.

If a man sells land or anything else, and sends the gold out of the country, while he gets bonds in return, then the country losing the gold is the worse of the transaction; the potentialities of the instrument for circulating consumable goods are transferred to another country. But even that is not necessarily a loss, for it is well-known that vast works have been carried out abroad with English money, nearly all of which has come back to us for rails and engines, and ships, and engineers, and contractors.

December 17th. Y. X.

SIR,—The view that I set out to enforce is that it is highly inexpedient, in treating of labour questions, to put forward debateable theorems of abstract political economy; and that the case is made worse when, as usually happens, these theorems prove to be contrary to the opinions of the great writers upon whom they are fathered.

As to the original question, I hold that Government employ ought to be as steady as possible, and that the discharge of labourers during winter suggests mismanagement. But I see no reason to suppose that the economic position would be improved by reducing the salaries of clerks. Probably "Y. X." would agree with this much, which is not abstract economy, nor for that matter is it ethics, but a question of statecraft.

This was the original question, soon shifted to an obscure debate as to gold, as to which I wish to add that on pages 50-52 of Mahan's "Influence of Sea Power upon History," there is a lucid account of the collapse of Spanish and Portuguese commerce, consequent on their discovery of the American mines.

Finally, "M." asks for practical remedies for depressed trade, or do I misrepresent him? Will he kindly read Mr. John Inglis's address on page 368 of your number for October 26th, and say whether he finds that an accurate outline of the present position, or in what he finds it deficient? If we can come to an agreement as to the past, we shall better our chance of profitably discussing the future, though we can hardly expect that abstract science will point out to us safe 5 per cent. investments. W. A. S. B.

December 17th.

SIR,—It would be interesting if "W. A. S. B.," or some other of your correspondents, would say something concerning the rate at which gold circulates, and the influence of that rate upon the prosperity of a country. In a certain community there is one sovereign, which passes from hand to hand, and serves as the medium of trade. The man who has not got the sovereign cannot buy. There are, let us say, 100 persons in the community. The sovereign circulates at a certain speed, and answers every purpose. The colony now receives an addition of 100 individuals, but no more money. It appears to me that the single sovereign can still do the work of the colony, provided it circulates twice as fast as it did before. It would appear therefore that the trading power of a nation depends not so much on the quantity of the circulating medium which it possesses, as on the rate at which that changes hands. How, in practice, is the rate fixed? I cannot call to mind any discussion of this question in your columns, or indeed elsewhere. ALAN STEWARD.

Bath-street, Glasgow, December 19th.

## THE MACHINERY OF SHIPS OF WAR.

SIR,—In the article headed "The Machinery of Warships," appearing in your impression of the 14th inst., reference is made to the omission of explanations respecting the reasons which have induced the Admiralty to adopt the Belleville boiler so extensively. These reasons are known to many, but perhaps the following information may be of service to those who are sceptical as to the advantages and capabilities of this system of water-tube boiler:—In order to ascertain the comparative evaporative efficiency between the ordinary cylindrical single-ended boiler and boilers of the Belleville type, the following trials were made:—A vessel with cylindrical single-ended three-furnace boilers was selected. Two of these boilers worked in battery were used, the total grate surface being 138 square feet, and the total heating surface 3880 square feet. A group of four Belleville boilers, having a total grate surface of 135 square feet and heating surface 3842 square feet, was then selected for experiment. It will be observed that as regards grate and heating surface the boilers above mentioned are practically identical, the cylindrical with the water-tube.

Trials were made in order to ascertain how many pounds of water could be converted into dry steam per pound of coal, burning the same with natural draught and at approximately equal rates of combustion. The vessels were moored alongside the quay, and water was taken from the town main and measured carefully into tanks before being pumped into the boilers. The trials were made at the same place, by the same staff, with the same quality coal, and under as nearly as possible the same conditions, in order to render the comparative trials perfectly fair. The following particulars give the results:—

*Belleville Boilers—Evaporative Trials.*

Four boilers—Total heating surface, 3842 square feet.
Total grate surface, 135 square feet.

| Duration of trial. | Coal consumed in lb. per sq. ft. of grate. | Water evaporated per lb. of coal from temp. of feed. | Steam pressure in boilers. | Temperature of feed water, deg. Fah. | Quality of coal. |
|---|---|---|---|---|---|
| 8 hours | 18·8 | 8·3 | 200 lb. | 40 deg. | B'st Welsh |
| do. | 19·43 | 9·1 | do. | 40 deg. | do. |
| do. | 19·4 | 9·0 | do. | 40 deg. | do. |
| do. | 24·5 | 7·83 | do. | 50 deg. | do. |
| do. | 12·0 | 8·5 | do. | 50 deg. | do. |
| do. | 12·0 | 9·16 | do. | 50 deg. | do. |
| do. | 9·2 | 8·64 | do. | 50 deg. | do. |

*Single-ended Cylindrical Boilers.*

Grate surface, 138 square feet. Heating surface, 3880 square feet.

| | | | | | |
|---|---|---|---|---|---|
| 8 hours | 12 | 7·59 | 124 lb. | 50 deg. | B'st Welsh |
| do. | 20 | 8·02 | 124 lb. | 50 deg. | do. |
| do. | 28 | 7·85 | 138 lb. | 50 deg. | do. |
| do. | 12 | 8·44 | 110 lb. | 50 deg. | do. |
| do. | 20 | 8·09 | 110 lb. | 50 deg. | do. |
| do. | 28 | 7·86 | 132 lb. | 50 deg. | do. |

It should be noted that the above results were obtained from feed-water, and that the water-tube boiler raised steam to 200 lb. pressure, against the cylindrical boiler at from 110 lb. to 138 lb. This was necessary in order to make the comparative tests perfectly fair, because although in the Belleville boiler steam was raised to 200 lb. per square inch, it was reduced to 135 lb. per square inch at the engines; whereas, in the cylindrical single-ended boilers the engines were supplied direct from the boiler at the working pressure. In all the trials the water-tube boilers had very much the best of the battle. Moreover, owing to the reduction of pressure between the boilers and engines, the steam was delivered to the engines in a superheated condition in the case of the Belleville, and was consequently plus this advantage.

Now the question of weights. The cylindrical boilers were to Admiralty scantlings, and weighed, together with water, lagging, fittings, and uptakes complete, about 100 tons. The Belleville boilers weighed, with casings, brickwork, fittings, water, and all appurtenances peculiar to this system, about 50 tons, showing a saving of, say, 50 tons in favour of the water-tube boiler.

Having so dealt with the important questions of evaporation and weight, there is still another feature which, in the opinion of those who thoroughly understand the system, places the Belleville boiler before other water-tube boilers as a serious sea-going steam generator. We allude to the fact of the boiler being composed of separate elements, all interchangeable and readily accessible, which enables the engineers to examine and clean all heating surfaces with the greatest facility, thereby ensuring that the boiler maintains its original efficiency. Should a tube leak at sea it is the work of a few minutes to remove the element containing the damaged tube, and replace it by a spare one. In short, whereas the majority of water-tube boilers in the market retain certain features of the water-tank boilers, inasmuch as they have tube-plates and tubes expanding therein, the Belleville boiler consists of tubes pure and simple, and may be considered rather in the light of a high-class and ingenious mechanical contrivance for the generation of steam than a boiler in the generally accepted sense of the word.

(For Maudslay, Sons, and Field, Limited)
London, December 18th. JOHN SAMPSON, Director.

## THEORY OF THE STEAM ENGINE.

SIR,—Mr. Cherry has a vivid imagination. Nothing short of a vivid imagination could connect—as he has done—Carnot's theorem with a "faked brake." Mr. Cherry must pardon me if I say that he deceives himself if he fancies that Carnot's theorem has ever enabled him to prove that an inventor of a steam or other heat engine, was wrong. I am not surprised, however, that he should imagine such things, seeing that he takes the trouble to assure your readers that he never asserted, that because the three angles of a triangle are equal to two right angles, therefore the efficiency of a heat engine cannot exceed $\frac{T - t}{T}$. If Mr. Cherry will read my letter with care half a dozen times, perhaps he will understand it. Here I take leave of Mr. Cherry.

I am much obliged to Professor Alexander for correcting the statement in my last letter. I fear that hurry and indifferent eyesight must plead my excuse. The temperature of 150 lb. steam is 358·3 deg. Fah. But in reality it matters very little whether the efficiency of the steam engine is or is not greatly in excess of that of a Carnot engine working within the same limits of temperature. If it be equal to the latter that is enough for my contention, because the steam engine does not comply with Carnot's conditions. It is not reversible; it does not work on a closed cycle; it does not take all its heat at the same temperature; and yet it equals the efficiency of the Carnot system.

It is worth while, however, to push the inquiry a little further, and for this purpose I shall use figures given in D. K. Clark's "Rules, Tables, and Memoranda." I take an engine working with steam of 100 lb. pressure, with an eight-fold expansion, and 7 per cent. clearance. The terminal pressure is 12·5 lb. Such an engine, calculating the heat in the steam from 102 deg. Fah., which may be taken as that of the feed-water, utilises 18·6 per cent.

Now the initial temperature in the cylinder is 328 deg. The terminal temperature is 204 deg. omitting fractions, and the efficiency fraction $\frac{T - t}{T}$ is 15·7. Rankine, page 410 of the "Steam Engine and other Prime Movers," gives the efficiency of an engine using 100 lb. steam, expanded 10-fold, and allowing 4 lb. back pressure, as ·177 per cent.; calculated by temperatures its efficiency is 17·1 per cent.

I must now turn to Professor Alexander's observation about isothermal and adiabatic expansion. So far as I can ascertain, no one has ever yet calculated with any certainty the adiabatic curve for steam. I do not believe it can be so calculated. There are three different constants in use for the purpose, which is right no one knows. There is $pv^{\frac{10}{9}}$ and $pv^{\frac{17}{16}}$, and one other used in the United States which I forget. Under the circumstances I have used, as all engineers do, the ordinary hyp. log. method, which, so far as I know, very nearly coincides with practice. The difference between the adiabatic and isothermal is very small. The 7 per cent. clearance given by Clark is against economy. But further, I need scarcely tell Professor Alexander that by the addition of a very small additional quantity of heat for superheating the steam a few degrees, I can much augment the efficiency of an engine, in practice going a long way to keep up the expansion curve to the isothermal line. Furthermore, I would remark that if we raise the temperature of the feed-water to that of the steam, which can easily be done by the waste heat, the efficiency of the engine will much exceed 18·6 per cent. Thus, if the feed went in at 212 deg. the proportion of the heat supplied to the water in the boiler utilised by the engine would be 20·7 per cent.

Perhaps Professor Alexander will pardon me if I ask him to give me some information on a question which puzzles me much, and concerning which I can obtain nothing directly to the point from Maxwell, Cotterill, Isherwood, or, indeed, any other writer on thermodynamics. Of course it is possible that my question is not susceptible of being answered, but nevertheless I put it. To make its bearing quite clear I must suppose a case.

In a long cylinder I place one pound of water, and on top of that a piston with 144 square inches of area, loaded with 21,600 lb.—that is to say, 150 lb. on the square inch, including the atmosphere. The cylinder walls, &c., are non-conducting, the water at 32 deg. Fah. I apply heat, and I pour into the water 358 B T U. No external work whatever is done by this heat; only the temperature of the water is raised. When 358 deg. have been slightly exceeded the piston will rise. When it has risen 3ft. all the water will have disappeared, and we shall have one pound of steam at 150 lb. pressure and 358 deg. temperature. The work done will have been 64,800 foot-pounds, and the thermal units spent 861·5. Is this latter figure correct? It seems to me that it is not. The specific heat of saturated steam is ·305, that of water being 1. The water required 358 units to raise its temperature to 358 deg., but the steam cannot require more than 358 × ·305 = 109·19 units, say, in round numbers, 109 units, to maintain its temperature. Is not the difference between this and 358—that is say 249 units, set free, either to augment what is called the latent heat of the steam, or if it does not do this, then to reduce the number of units required from the fire to convert the water into steam?

"It may be noted," says D. K. Clark, "that ·305 is the quantity by which the total heat of saturated steam is increased for each degree of temperature." If it is urged that this only applies to steam already made and not to steam in process of formation, I cite the following further passage from Clark: "The expression ·305 for specific heat is taken in a compound sense, comprising the changes both of volume and of pressure, *which take place in the production* of saturated steam." The italics are mine. Turning now to Maxwell, page 171, we have the following suggestive passage: "A third mode of defining specific heat is sometimes adopted in the case of saturated steam. In this case the steam is supposed to remain at the point of saturation as the temperature rises. It appears from the experiments of M. Regnault that heat leaves the saturated steam as its temperature rises, so that its specific heat is *negative*, a result pointed out by Clausius and Rankine."

I am not sure how far this latter statement bears on my question. I take it for granted that the steam in this case is supposed to be in process of formation, the pressure gradually rising in the boiler. But I do not quite see why if the specific heat, be it what it may, is constant, any heat should be given up by the steam simply because its temperature rises.

However, it seems to me, that whereas 358 units would be needed to maintain the temperature of a pound of water under 150 lb. to the inch pressure at 358 deg., only 109 units are required to keep a pound of steam at the same temperature, the pressure being 150 lb.; and I want to know, if this is the case, what becomes of the 249 units difference, representing as they do 192,228 foot-pounds

The most intelligible way in which the question can be answered would be, I think, to give a table of steam pressures, &c., in a way something like the following. Perhaps Professor Alexander will do this:—

| Total pressure. lb. | Temperature. Fah. | Units per lb. of steam. | Units latent. | Total units per lb. of steam. |
|---|---|---|---|---|
| 150 | 358 | 192 | 999 | 1191 |

At the risk of making this letter too long, I must seek a little further information. If one pound of steam of 150 lb. is expanded fifteen-fold, it will occupy 45 cubic feet very nearly; what will be its terminal temperature, supposing that it has expanded in a non-conducting cylinder behind a piston? Will the pressure be that proper to that temperature, whatever it is, as set forth in steam tables? Let me, for the sake of argument, assume that the terminal pressure will be 10 lb. Now, in the steam tables the temperature for this is 193·3 Fah. Will that of the expanded steam be more or less than this? At first sight it would appear that it must be less, but this is not quite clear. A pound of steam at 10 lb. pressure will fill a space of only 37·84 cubic feet; but a pound of 150 lb. steam expanded fifteen-fold will fill—ostensibly—a volume of 45 cubic feet, nearly. The total heat units in the high-pressure steam are 50 in excess of those in the low-pressure steam. Now, if the steam expanded without doing work, these 50 units would go to superheat it, I presume, as Rankine suggests, but as the steam is supposed to do work, will not these 50 units tend to keep up the expansion line of the diagram? Will not they be converted into work before liquefaction takes place? and will not the terminal pressure be something near 10 lb.?

One question more and I have done. The specific heat of water being greater than that of steam, then every ounce of water produced in a cylinder, either by the performance of work or otherwise, must rob a further portion of steam of its heat, because the water will be at the same temperature as the steam; but it requires much more heat to keep an ounce of water at a given temperature than an ounce of steam. To reverse Regnault's proposition: when the pressure of steam falls it must part with heat to any water present, in order that the latter may maintain its temperature.

Finally, it is quite likely that Mr. Cherry and others may tell me to go and look in my books for an answer to my questions. My reply is that I have looked—in Maxwell, Rankine, Isherwood, and several other authors—and that I can find no definite reply; if I could I should not trouble Professor Alexander. Indeed it appears to me that possibly because of the great difficulty of carrying out experiments with steam, very little more is known about it than is set forth in the ordinary steam tables. I can see that very great difficulties must be encountered in any attempt to ascertain how many units of heat have been converted to maintain the temperature of a pound of steam. Such diagrams as that given by Clerk-Maxwell on page 135 of his book, are very good in their way; but they seem to me to be just a little make-believe, and after all they tell us next to nothing concerning the way in which heat is distributed. With air, and gas generally, the matter is quite different. Perhaps Professor Alexander can settle the whole question in a few words, by referring me to some paper or treatise in which the answer to my question is set forth. MAURICE CROSS.

December 17th.

Sir,—It appears that Carnot's argument is based on the assumption that no matter what the nature of the working fluid, the capacity of the fluid for performing external work will always vary exactly as the temperature. Now, taking Maxwell's proof, as quoted by Mr. Cross in your last impression, the following suggests itself: Let us take two heat engines working with different fluids within the same limits of temperature. Then, if the fluid in one is more efficient, in the sense that it has a greater capacity for doing external work than the fluid in the other engine, then this last can drive in a reverse direction the first engine, and such driving would, I think, be in no way inconsistent with experience. But it would quite demolish Maxwell's proof.

Unless it can be proved that the capacity for doing external work varies in all cases as the temperature, then the whole proposition breaks down. Because, let us have a reversible Carnot engine working, say, with air within certain limits of temperature, T and *t*. This is by Carnot's theorem the most economical engine it is possible to construct. But if a second engine working, say, with ether or chloroform, can within the same limits of temperature do more external work, then it would be more efficient than the most efficient engine; but this is impossible. Therefore the air engine, although complying with Carnot's condition, is not the most economical that it is possible to construct. X.

Brixton, December 14th.

## PROPOSED ASSOCIATION OF PORTLAND CEMENT MANUFACTURERS.

Sir,—In reference to the attempt made by Messrs. Knight, Bevan, and Sturge to form an "Association of English Cement Manufacturers," we should like to call the attention of all interested in the matter to some points which may have been obscured or may have escaped notice. Any firm which joined that Association would practically have declared that it never had and never would make any improvement in the manufacture of Portland cement. Of course, those who were willing to pledge themselves never to advance sought to cast a stigma on the progressives by substituting the word "adulteration" for improvement; but this little interested move was quickly exposed by several speakers at the Cannon-street meeting. In the circular issued to convene this meeting, it was stated that the admixture of ragstone and other inert materials with Portland cement was "bringing disrepute upon the good name that English cement has hitherto borne in comparison for quality with cement of foreign manufacture." Now, in reference to this point, *Fairplay*, in an article on cement in its issue of November 30th, pathetically remarks, "It is ridiculous to suppose that with the purest chalk and purest clay the English possess they cannot make better cement than the Germans, who have none such." In the *Brickbuilder*, a journal published in Boston, articles on cements and cement tests have recently appeared, in which two classifications of cement were made:—(1) German cements of first quality; (2) English cements, generally bracketed with Belgian cements, as of second quality. "This is a serious matter for the commerce of this country, and is well entitled to the attention of engineers, who should show how thoroughly unfounded is such a supposition."

Casually remarking that *Fairplay* and Mr. Bevan appear to be remarkably unanimous, their contention scarcely looks as though the quality of English cement bore such a high character as Mr. Bevan assumed. The policy they propose for the reinstatement of English cement is so remarkably guileless and childlike as to deserve special notice. We are not to make any endeavour to improve our cement, not to compete with German skill, but to fold our hands and say, "Our cement is made of chalk and clay—as it has been since the Flood—and nothing else. If foreign cement gives better tests, we can't help it; it only proves that it is adulterated."

Mr. Leedham White, however, fully recognised the necessity for English manufacturers not thus sitting with folded hands while foreign competitors are working, when, at the Cannon-street meeting, he said that English cements had not recently been brought into disrepute in comparison with foreign cements, seeing that English manufacturers were actually exporting even better cement than they did a few years ago. "But," said Mr. White, "we have been distanced by German skill and German competition, which is a different thing. I am most anxious that we should not be debarred from imitating the German skill. We do not want to be debarred, as people who intend to make progress in every shape and way, from taking advantage of scientific research."

It must be remembered that the various tests were not invented in the interests of the manufacturer, but in those of the consumer. The engineers and chemists who invented the tests invented them to compel the manufacturer to improve his cement. It is therefore rather illogical, when a manufacturer improves his cement to meet the higher specifications, to throw doubt upon the efficacy of the tests. English manufacturers would, if this were accepted, be placed in the position of having foreign cements preferred to theirs because they passed higher tests, and at the same time they would be forbidden to so improve their manufactures as to make it meet these higher tests. But, as Mr. White pointed out, when a manufacturer supplies cement which meets all provided tests and analyses, he has fulfilled his legal obligations, and when he goes beyond this and supplies cement, which, besides meeting all tests, will give enduring satisfaction he has fulfilled his whole moral duty.

Now, leaving the general aspects of the question, we should like to point out that at the Cannon-street meeting Mr. Holt, on our behalf, frankly owned that we had improved our cement by the addition to it of Kentish ragstone of a special quality and in a carefully considered proportion. He strongly deprecated such an addition to the cement being stigmatised as an adulteration, and courted the fullest inquiry into the improved manufacture. A subsequent highly influential meeting of the cement trade at the London Chamber of Commerce has acceded to his request by the appointment of a committee having power to call in expert evidence in reference to the addition of Kentish ragstone in the manufacture of Portland cement.

At the Cannon-street meeting Mr. Holt, in spite of an attempt which was made to prevent his giving the information, brought out the fact that his manufacture improved the cement in colour, in tensile strength, and in the sand tests. They were:—At seven days, 492 lb.; at three weeks, 556 lb.; at seven weeks, 656 lb.; at three months, 740 lb.; at six months, 790 lb; at nine months, 975 lb.; at eleven months, 1000 lb.; and at twelve months, 1010 lb. With sand tests—three and one—nine months gave 410 lb. in one case, and 460 lb. in another. In reference to these tests, we should like to call especial attention to the excellence of the long-time tests.

The long-time test, when three parts of sand were added to the cement, is most important, as no cement of indifferent quality could give such high results when mixed with these proportions of an inert matter such as sand. This shows that our improved cement in the neat state must contain less inert matter than the old-fashioned cement, because if it were no better than the old cement it would, when mixed with three parts of sand, be bound to give a worse result for tensile strain when tested. Since the Cannon-street meeting our tests have been witnessed by other cement manufacturers; and we cordially invite any manufacturers, engineers, or customers to come down to our works and judge the tests for themselves.

It must be borne in mind that Portland cement is only the name for an article of admixture, which, if it satisfies the provided standard tests and chemical analyses, and, in addition, the tests of time and exposure in actual use, cannot be said, with the least show of reason, to be adulterated because there may happen to enter into its composition an ingredient or ingredients whose beneficial action has only lately been discovered. Still less justifiably can it be called adulterated when it gives results under all tests far beyond anything hitherto demanded in any specification. In a previous part of this letter are mentioned the high results which the new cement has given under all conditions. Its principal points are its improved colour and its very markedly improved results in the long-time tests, especially noticeable when the cement is mixed with sand.

In conclusion, we would remark that we should hardly be guilty of such a suicidal business policy as to place on the market a cement which we had not put to the severest tests. Our improved production has come out triumphantly, not only from all the provided scientific tests, but it has been used in work which has borne the more solid and satisfactory tests of time and exposure to varying temperatures, including the severe cold of last winter. In addition, so far from having had the slightest complaints about it, we have received nothing but the highest commendation of its unchangeable qualities. MACEVOY AND HOLT.

Britannia Cement Works, Northfleet, Kent, December 17th.

## TRACTION ENGINES.

Sir,—The letter of your correspondent "J. H. M." deals with the traction question in a full and comprehensive manner. Unless I am much mistaken in the identity of "J. H. M.," his letter carries much weight, coming from one with large experience in such matters. With regard to engines appearing before a licensing committee, it would result in little improvement unless the committee were technically advised. Such bodies—as Corporation Building Committees and the like—are often composed of men ignorant in the matters at issue, and their knowledge of steam engines is about as comprehensive as that of the driver so often quoted. Even if the committee were technically advised I am afraid much scamped work would be done. Proprietors repairing for inspection only would leave their engines for the rest of the year in the present usual state. What is wanted are inspectors engaged by the municipal and district council authorities. The owner's licence would then depend upon their report as to the condition of the engines. I am of the opinion that some such course would be the only means to keep owners and drivers attentive to their charges. I have seen engines come in for repairs when almost past such treatment, their bad state being due to only a few months' work and gross negligence, whereas a clean up every week would have prolonged their existence considerably. Cannot owners see it is against their best interests to allow such a state of affairs? There is a firm that allows "muck money" to men engaged on such repair work, to enable them to meet their increased washing bill, and shovels are constantly used to remove the accumulated dirt from fire-box sides.

I can fully endorse "J. H. M.'s" remarks on "rack steerage," having known accidents due to breakage of chains. As to compounding, I am somewhat surprised to learn that its theoretical value disappears, and should be still more so if Mr. Gakee informed us that its practical value also disappeared. "J. H. M." could, no doubt, give us some interesting results on the matter. Will he do so?

Prescot, December 15th. VIARY.

Sir,—The excellent leaders and ample correspondence lately published in your columns have so well discussed the *pros* and *cons* of this subject, that one feels any further contribution may appear like "carrying coals to Newcastle."

In your issue of the 7th inst. "J. H. M." writes with much authority and displays some knowledge of the subject, but his suggestions remind one of the old danger of "jumping out of the fry-pan into the fire." Had he had much experience in the working of traction engines he would have hesitated, I think, to make such complicated and bewildering proposals. He says it is "against progress to prohibit," and yet suggests regulations which, to my mind, are practically prohibitive. His definition of "the best engine," and his recommendations—in the last paragraph of his letter—are very well in their way; but he may be assured that what is best will always come to the front and claim adoption.

After a long experience amongst ploughing engines, agricultural and road engines of all types, I feel certain it would be for the good of the nation at large if most of the existing legal regulations—and all the bye-laws—by which such engines are now surrounded were abolished; and I would suggest that both the engines and the traffic should be permitted a free growth. The inexorable laws of "natural selection" and "the survival of the fittest" surely apply to this matter as to everything else. You may depend upon it, if engine owners, steam hauliers, engine builders, and the public—not excepting road authorities—were allowed a free hand, it would be found that they are all well able to take care of themselves; and further, such a course would of necessity tend to develope a perfect road engine or steam carriage, such as would meet the varied requirements of users, and arrangements for working traffic would naturally adjust themselves. Such freedom would at the present moment be a great boon to agriculturists, who are in such urgent need of facilities for cheap and speedy transport.

If, however, public opinion—to which, rightly or wrongly, we must all bow—demands strict statutory regulations for road engines, a thorough revision and amendment of the existing road locomotive Acts is imperative, and should be made at once, such revision and amendment to be dealt with by a competent Parliamentary Committee or Commission. The amended enactments, in my opinion, should embody or provide for the following:—(1) One licence—to cover Great Britain—granted by one central authority. (2) Uniformity as to the hours engines may travel. (3) Granting certificates to engine drivers. (4) All bridges, main and turnpike roads to be constructed for traction engine traffic, which should be considered as ordinary and necessary traffic. In the present state of British industries and agriculture, it is needless to argue the necessity of the road engine. "It has come to stay," as one of your correspondents pithily remarks. Those who would hamper or unduly restrict such engines, or raise paltry objections to their use, can only be classed among those who "have eyes and see not." Any obstructive or restrictive policy will, in the long run, have to make way for necessary progress. J. A. C. B.

December 17th.

Sir,—I have read your articles and the correspondence on the above subject. I would like to speak on the subject from a practical point of view. I have been driving road engines for a great number of years, and have removed thousands of tons of boilers and other heavy pieces of machinery, as well as done ordinary road travelling over thousands of miles. I am a practical mechanic, and do not let my engine get into the disgraceful condition spoken of in your article and correspondence. If road roller practice is the satisfactory state an engine should be in, I keep all in condition equal to the best of them. I have used cross-bar wheels, both rigid and spring spokes, and can say, with a heavy load on slippery roads and pavement they are a real nuisance, annoying to a driver as well as trying to the temper of any ordinary mortal, to say nothing of the damage the diagonal strips do to the road. It has been my privilege to drive engines both simple and compound, fitted with many different kinds of wheels, india-rubber tires, spring spokes and spring block wheels, as well as the wood block wheels. The india-rubber is a wonderful wheel, but the chain armour is a great trouble to keep in order. The next best wheel I consider the wood block wheel, which can travel where and when the cross-bar wheel is useless.

Your correspondent, "J. H. M.," knows these wheels and says they are too heavy for ordinary macadam; this in practice I have not found to be so. Such a large surface of wood blocks is presented to the road that there is little pressure on the square inch of road, and if these wheels are kept in order they will satisfy both owners, drivers, and road authorities. I am surprised that the use of something of this sort is not made compulsory. If neglected, any kind of driving-wheel is unfit to go on the road. The advantage of the wood block wheel is that the blocks adapt themselves to the inequalities of the road, while the ordinary wheels of equal diameter back and front, running on hard round-topped roads, the wheels only tread on a very few inches of the inner edges, thus forming a knife edge that cuts through macadam and chips and breaks sets, and is a prime cause of breaking axles. Any wheelwright used to setting heavy road wheels would laugh at the ordinary engine wheels. For the ordinary cross-bar wheel to get a proper bearing, the hard road would have to be made specially to suit it, billiard table fashion.

I should like to see the law so altered that one licence would allow an engine on any road in the kingdom at any time, and no restrictions whatever but those in the Imperial Act. At present hours are wasted to meet local bye-laws, as though men's time and engine's delay were not of the slightest consideration. I am often compelled to be working two days to do one day's work.

Manchester, December 18th. JAMES LOCKWOOD.

Sir,—The valuable and interesting correspondence in which you are taking such a kindly interest is of the greatest importance to engineers and others. The valuable suggestions as to the modification of the present Act of Parliament and local bye-laws are pretty sure to have some good result.

I notice the various suggestions by various men who I know have had considerable experience, but I am afraid that some of them lose sight of the fact that what we really want is a road locomotive for hauling road traffic only. The traction engine in its present form has done very good work as a general servant. We know pretty well how it had its origin. It would be quite as consistent for any of our large farmers to attempt to use one of their nearly thoroughbred hackney or carriage horses for a wagon horse or for ploughing as it is to use the traction engine with its cross-bar wheels for road hauling. Seven years ago I took out a patent for an improved traction engine and traction engine wheel. This was the result of forty years' practical experience with steam on common roads. I propose to put my engine, as I have done many a one, on three wheels. This at once overcomes the danger that one of your correspondents suggests might happen at high speeds to an engine with two leading wheels steered by a chain. In my arrangement the whole of the working parts are out of sight. I do away with the multiplicity of gearing. The engine altogether is as effectually and freely on springs as a railway locomotive. I have travelled many hundreds of miles by steam on common roads with three-wheeled engines, and never had the slightest difficulty in steering. It is much quicker and easier than with four wheels.

Then as to boilers in the present locomotive boiler form, we know that it is a daily occurrence on common roads that an engine going down a steep hill dare not stop because the surface of the water has left the fire-box top bare, the water having gone to the lowest part of the boiler at the chimney end, and the man must either pull out his fire or move at once or drop his lead plug.

What the road locomotive wants is an improved simple vertical multitubular boiler with horizontal tubes. The engine embodying these rough suggestions can be hung efficiently on springs, everything completely boxed in and out of sight, and the outward appearance as snug and sightly as any conveyance we meet on the road to-day. I. W. B.

Ashton-under-Lyne, December 18th.

## RADIAL DRILL TABLES.

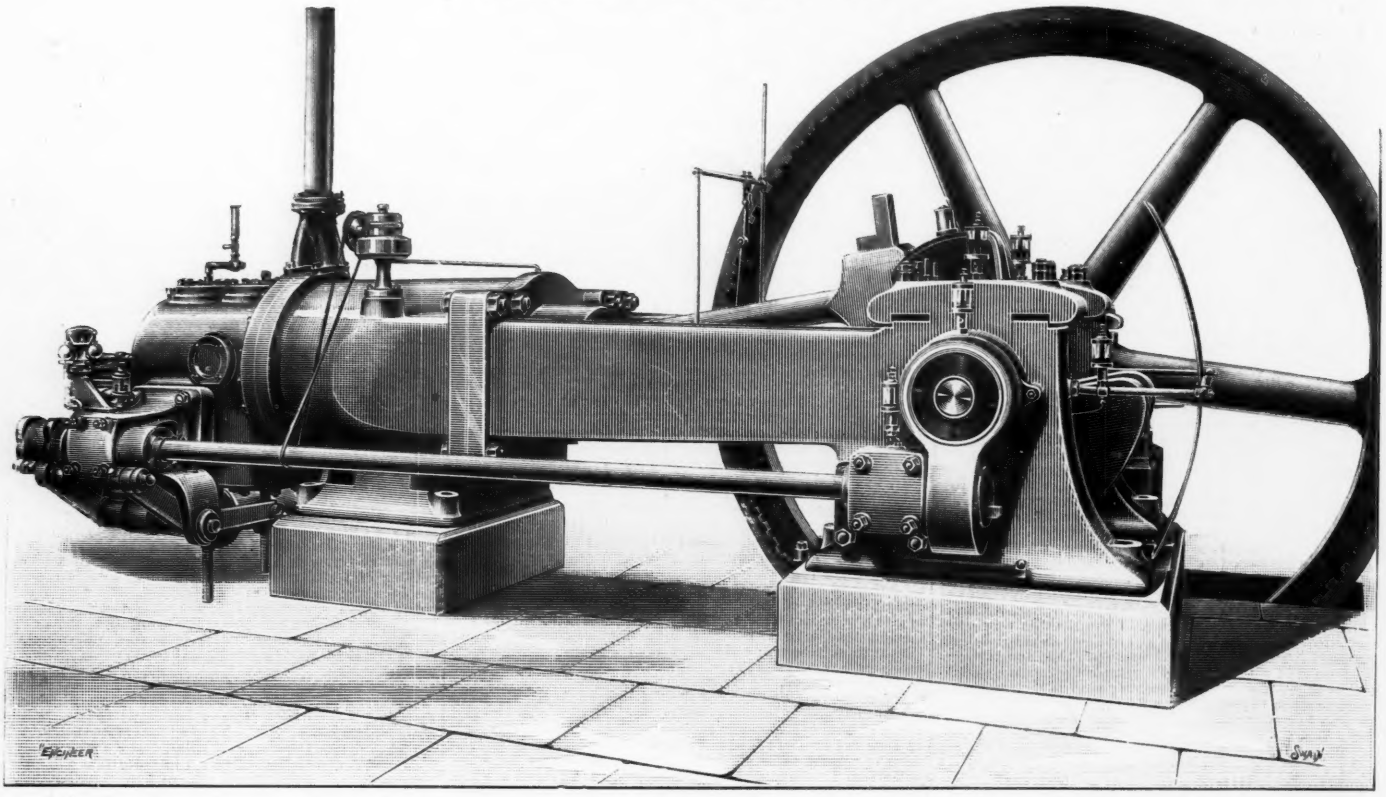
Sir,—In the excellent description of the Atlas Locomotive Works in your issue of the 14th inst., reference is made to the turnabout table attached to the radial drill in the boiler shop as if it were a novelty. This table was one of the many inventions of my father, the late Mr. George Crow, who was works manager here for many years, and who had the first table made at these works and put in use as far back as 1869. The demand for these by the same makers still continues. At the latter part of 1869 my father made an arrangement with Messrs. Fairbairn, Kennedy, and Naylor, Leeds, by which for a term of years they had the sole right to make and sell them, and they supplied both private firms and railway companies with them under that agreement. We have six of these tables in use at our locomotive shops and at our marine boiler works at Hebburn-on-Tyne, and I am surprised that they have not come into even more extensive use for general work.

Newcastle-upon-Tyne, W. H. CROW.
December 17th.

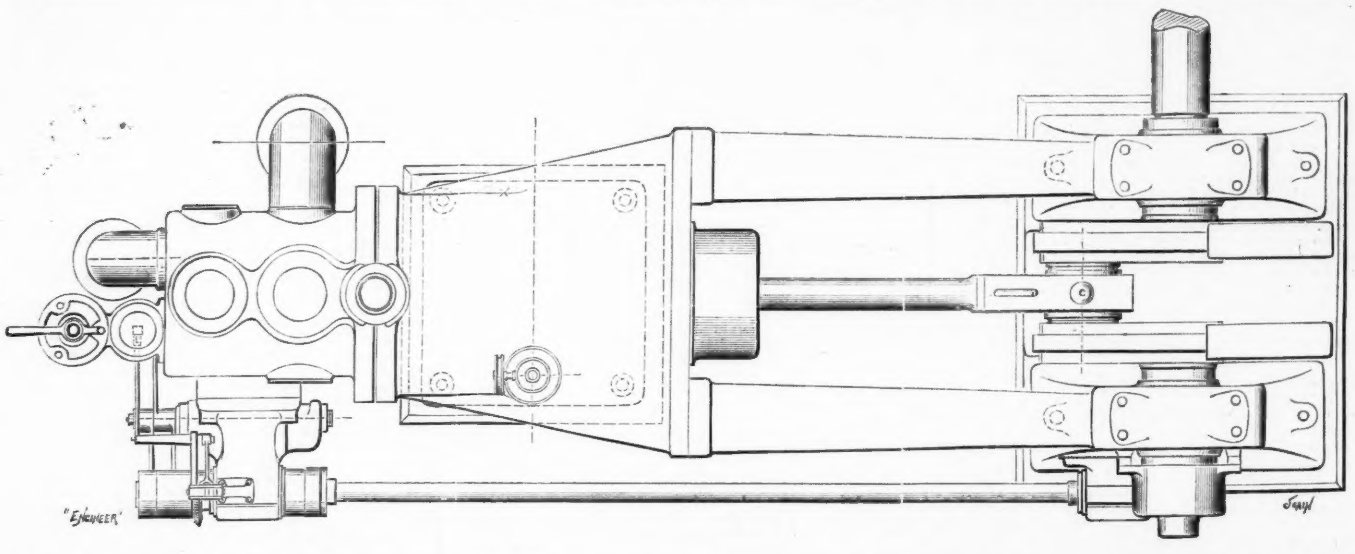
(*For continuation of Letters see page* 557)

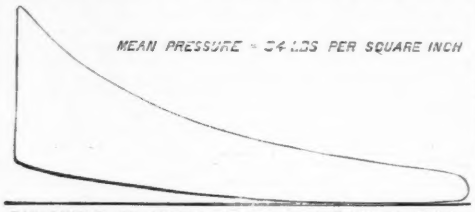
# ONE HUNDRED-HORSE POWER GAS ENGINE

MESSRS. ROBEY AND CO., LINCOLN, ENGINEERS

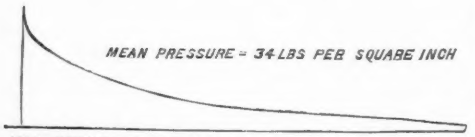


## 100-HORSE POWER ROBEY GAS ENGINF.

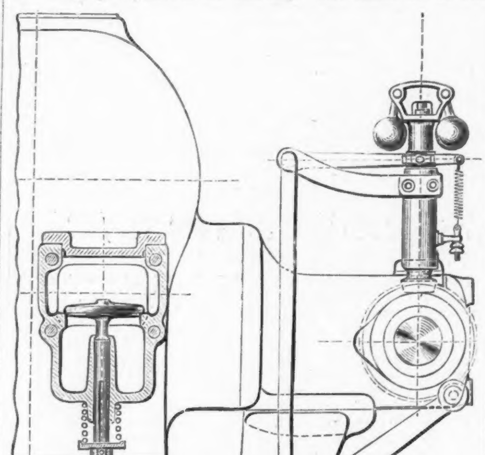


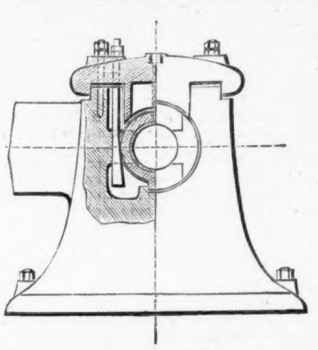


FAC-SIMILE OF ACTUAL ORDINARY WORKING DIAGRAM



FAC-SIMILE OF ACTUAL STARTING DIAGRAM



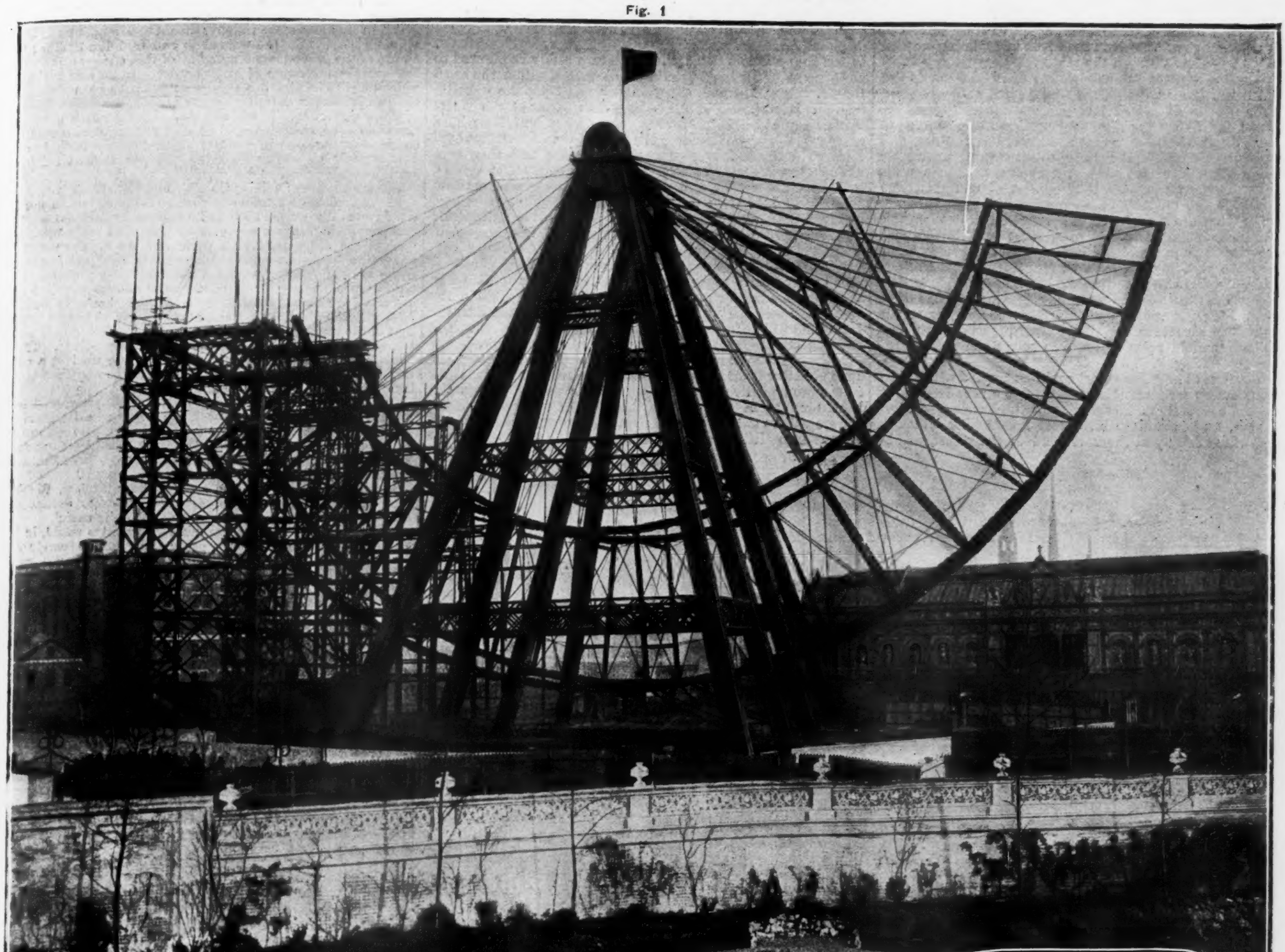


THE gas engine illustrated by the engravings on this page and on this page, show the construction of the improved form of the Robey girder-frame gas engine of 100 effective horse-power. The engine is of the four-cycle single-acting type, the operation of which is now so well known as to need no description. The general design of the engine is well shown by the engravings, and will commend itself to our readers as being well suited to the heavy and impact stresses to which internal combustion engines are exposed. It is another example, in addition to the several we have recently and at different times given, of the growing size and rapid extension of the use of large gas engines. The engine illustrated is started by means of a Clark-Lanchester pressure starter, a diagram from which—or rather from the engine when the starter is used—is shown above. The maximum pressure given by this starter is, it will be seen, about 50 lb. per square inch, and it is an important point that this pressure generated outside the combustion chamber in no case exceeds about 50 lb. per square inch. Barring gear is provided, which enables one man to turn the fly-wheel round to the proper position for starting. The crank is cut out from a solid forging of Siemens-Martin steel, the webs and reciprocating parts being balanced by cast iron balance weights, secured to webs by steel hoops; this being undoubtedly the best method of counteracting the weight of moving parts, and thus enabling the engine to run at a high speed, which is so conducive to economy, without excessive vibration and wear and tear. The practice of balancing by fly-wheel weights is not to be commended for such purposes. The main bearings, see engraving below, are in four parts, and adjustable vertically and horizontally, and are of very ample size. All the bearings are arranged for continuous lubrication without stopping the engine. The engine is provided with an outer bearing, the fly-wheel and driving pulley being placed between the engine and this outer bearing. Improvements have been made with a view to the improvement of the governing of such large gas engines. Hitherto this has been somewhat imperfect, necessitating renewal of the working parts. In the governor and gear as used, the centrifugal governor has only to determine the position of the hit-and-miss finger, which is made of tool steel, and having very broad striking edges is practically indestructible. The work of lifting the gas valve is performed by separate lever and cam, as shown by the annexed engraving.

# THE GIGANTIC WHEEL AT EARL'S COURT

MESSRS. BASSETT AND WEBSTER, LONDON, ENGINEERS

Fig. 1



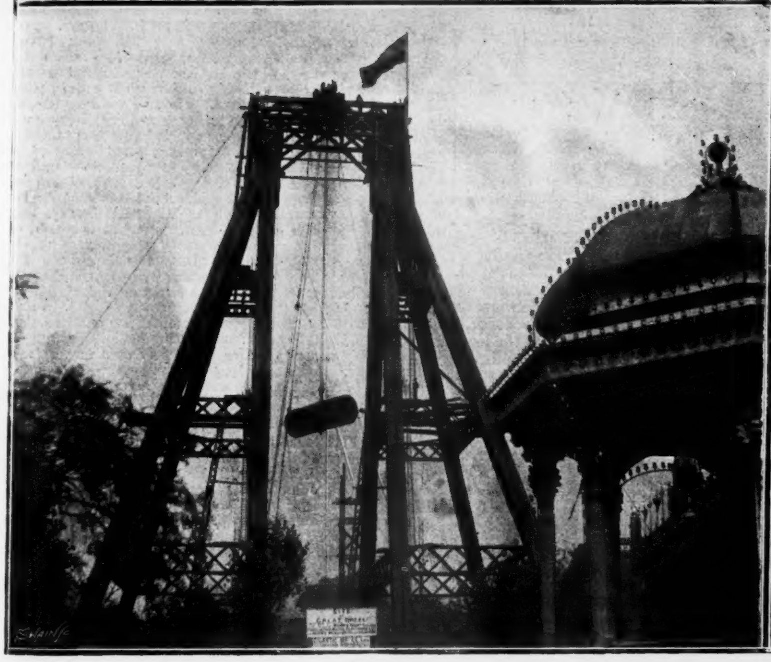


Fig. 2

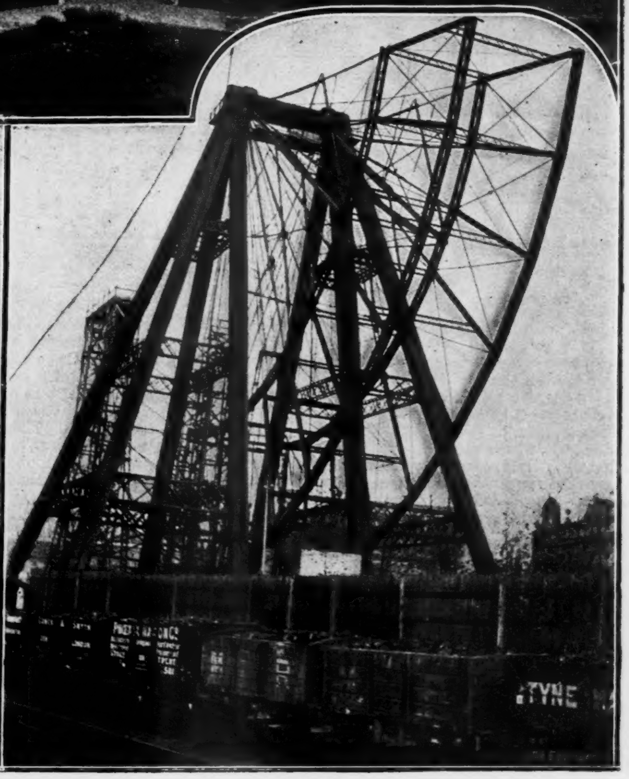


Fig. 3

## THE GIGANTIC WHEEL.

On the 20th of last April, page 324, we described the construction which, under the name of "The Gigantic Wheel," was then being commenced in the grounds which lie between the West Kensington, Earl's Court, and West Brompton railway stations. The progress of this work was considered to be one of the attractions of the Industrial Exhibition, and whilst that was open, the axle was hoisted, and the first few spokes were put in place. Since the closing of the Industrial Exhibition the work has gone steadily on, and is now entering its most interesting phase.

In the illustrations, Fig. 2 shows the framework of the towers completed, and a section of the axle in process of being lifted. In Fig. 3, one quarter of the wheel has been erected. This includes the inner and outer periphery, with spokes, and most of the bracing, but not driving gear or cars. Fig. 1 shows the state of the work on November 30th. Several further sections have been added since that date, and by Christmas, 21 out of the 40 pairs of spokes will be in place. Fig. 4 shows the side and end elevations, longitudinal and cross sections of the great axle. This, instead of being solid, as in the Ferris wheel, is a steel tube, made of plate 1in. thick, and 7ft. internal diameter. The total weight of this axle is 58 tons, and it was hoisted in three pieces. To erect it, a wooden stage was built, forming a bridge from one tower to the other. This gantry carried a line of rails 10ft. 6in. gauge, and the lifting was done by a traveller running on these rails. The plummer blocks were first hoisted, run sideways to their position, and lowered into place. The end lengths of the axle were then lifted and slung, one in its correct position, and the other overhanging for 2ft. Then the middle length was raised, slid into one of the end lengths, and riveted up. Finally, the other side length was drawn over the centre one, riveted up, and the axle completed. They are a fairly tight fit, but were brought together with union screws. As will be seen by the illustration, the two end lengths overlap the middle one for 11in. on each side, and the joint is stiffened by an internal ring of 6in. by 3in. by ½in. T steel. The rings stiffening the ends of the axle are much heavier. Besides an external plate 1¼in. thick, there are, on the inside at each end, six rings of 9in.

by 7in. by $\frac{13}{16}$in. steel joist, of which the outer flanges are riveted to the main tube, and the inner are united by another plate of steel 1in. thick, so that the internal diameter at the bearings is reduced to 5ft. 6in. Close to the inner edges of the bearings, are rings to carry the spokes. These rings form circular girders, being built of $1\frac{1}{4}$in. plate, the outer edge of $4\frac{1}{2}$in. by $4\frac{1}{2}$in. by $\frac{3}{4}$in. angles, and the inner of 6in. by 6in. by $\frac{3}{4}$in. angles. They are in pairs, 3in. apart, so that the heads of the spokes may come between them, the latter being secured by 3in. pins passing through the plates.

The axle was in place and completely finished towards the end of August, and the first spoke was hoisted and connected with it on the 1st of September. By referring either to the drawing of the whole wheel on page 324 of April 20th, or to Figs. 1 and 3, it will be seen that the wheel has an inner and outer periphery; and that the spokes between these two are solidly constructed with plates and angles, whilst from the inner periphery to the axle they consist of comparatively slight rods, being only $2\frac{3}{16}$in. in diameter, though they are 90ft. long. They are brought on to the ground in two lengths, and the ends being screwed with right and left-handed threads, they are joined together by a socket before being lifted. Each rod is suspended in four different places, and hoisted by two tackles simultaneously; but even then they sag very much whilst they are being raised; and until they can act as tension rods, they naturally add nothing to the strength of the structure. On the contrary, it has been necessary to lash scaffold poles to them to keep them straight, as may be seen in Fig. 3.

The question of how the wheel could be erected without an enormous outlay for scaffolding was clearly a very important one for the contractor. The staging of the Ferris wheel was 300ft. high, and is said to have cost £5000. Mr. Basset's staging, which is only at the north end of the wheel, will be 150ft. high when finished, and will not have cost more than £500. It is being built entirely of Devonshire larch, which has been brought to London especially for this work. The first step towards the erection of the spokes and periphery was to put down a very strong anchor in the grounds to the south of the wheel. This is made of two 12in. joists with timber between, entering the ground at about 60 deg., to the depth of 9ft. or 10ft., where they bear against strong cross beams. The first two pairs of spokes were then lifted, and connected with the axle. The segments of the inner and outer periphery which join them were added, including the cross bracing, and the whole was then drawn forward towards the anchor, the axle revolving without any difficulty. A third couple of spokes were added, and then a fourth, till ten pairs, or one quarter of the wheel, had been erected. This stage of the work is shown in Fig. 3. The approximate weight of a quadrant of the wheel is 150 tons, and the strain required to pull it round, when in the most unfavourable position, is 90 tons. For this work two sets of 50-ton blocks are being used, with a Latch and Batchelor's flat-lay corded steel wire rope, $4\frac{1}{2}$in. circumference. Each rope is considered safe for 36 tons, and, as they pass twice through the blocks, the strain on each is only $12\frac{1}{2}$ tons. Mr. Basset has tested each tackle at Messrs. Maudslay's works by lifting 50-ton boilers, filled with water, with them. For making the connection between spokes and axle, a pendulum stage has been hung to the latter, which always remains in a horizontal position however the axle may be turned.

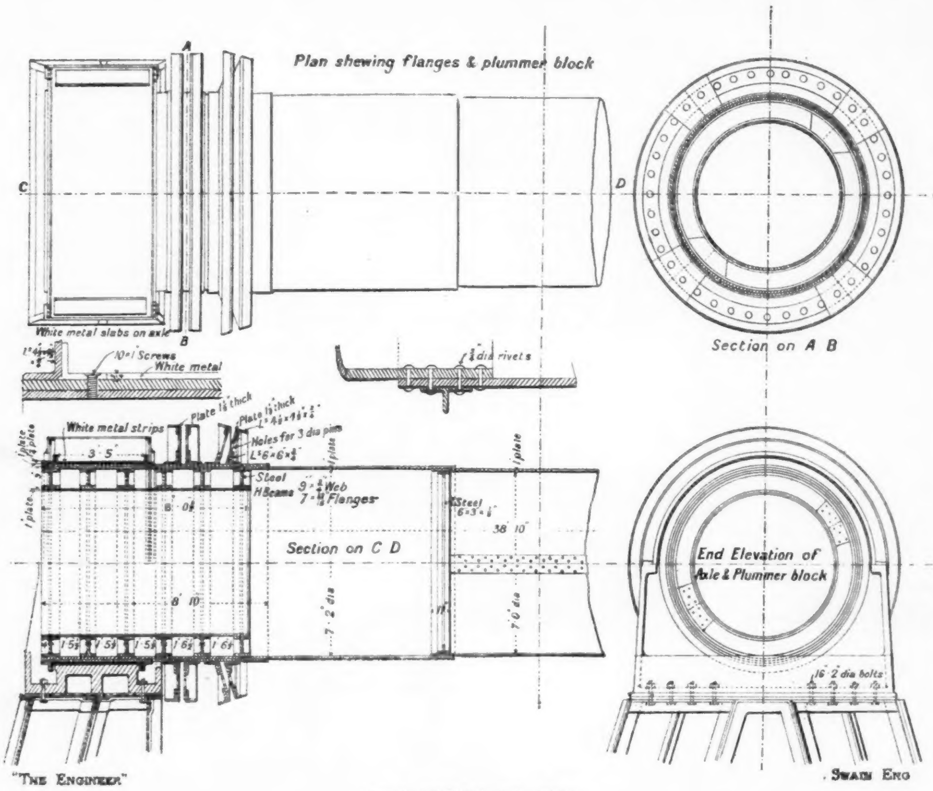

Plan shewing flanges & plummer block
A
B
C
D
White metal slabs on axle
10 × 1 Screws
White metal
$\frac{3}{4}$ dia rivets
Section on A B
White metal strips
Plate $1\frac{1}{2}$ thick
Plate $1\frac{1}{2}$ thick
L$^s$ $4\frac{1}{2}$ × $4\frac{1}{2}$ × $\frac{3}{4}$
Holes for 3 dia pins
L$^s$ 6 × 6 × $\frac{3}{4}$
3' 5"
1 plate
$\frac{3}{4}$ plate
Steel H Beams
9 × $\frac{3}{4}$ Web
7 × $\frac{11}{16}$ Flanges
8' 0$\frac{1}{2}$
Section on C D
8' 10"
1' 5$\frac{1}{2}$
1' 6$\frac{1}{2}$
7' 2" dia
Steel 6 × 3 × $\frac{1}{2}$
38' 10"
7' 0" dia
End Elevation of Axle & Plummer block
16 2 dia bolts
"The Engineer"
Swain Eng

Fig. 4—DETAILS OF AXLE

As soon as the first quadrant of the wheel had been erected by drawing the completed portion forward, spoke by spoke, the second quarter was commenced on the northern side. For this part of the work the axle was not required to revolve. Section after section was built up, the pieces being hoisted from the scaffolding, so that the twenty-first pair of spokes, which are now being put in place, are in a horizontal position, exactly opposite the first pair.

It is evident that if the building were to be continued without other precautions being taken, the periphery would be subjected to strains for which it is not designed. Whether the erection were continued with the axle in its present position, or whether it were turned, all spokes above the horizontal line would cease to be in tension, and would have a tendency to draw the periphery towards the centre. To counteract this struts are being put up in the first quadrant, from the axle to the inner periphery. There are three pairs of struts, placed at distances of one-twentieth of the circumference apart. They are made of squared pitch pine 12in. by 12in., and are 89ft. 6in. long. For a length of 32ft. in the middle, there are scarfs 6in. thick on each side, so that the section is increased to 24in. by 24in. These six strutts are connected in both directions, by five rows of light steel joists, and braced diagonally, also in both directions by $1\frac{3}{8}$in. round steel bars. When they are completed, the wheel may safely be allowed to be turned still further in the same direction, whilst the erection is continued from the top of the staging at the opposite end. It is proposed to put up another quarter of the wheel in this manner, and the first pair of spokes will then have assumed a perpendicular position, and will only be kept straight by the timber struts. Strong chains will then connect the outer ends of the first and the thirty-first spokes, and the wheel will be turned back one-eighth of a revolution. It is not proposed to use timber strutts at the northern end, as Mr. Basset considers that the periphery will be sufficiently rigid to carry itself, whilst the fourth quadrant is being erected. Then the inner ring and inner spokes will be lifted and suspended from the chains. When these are in place the wheel will be once more moved to the position it occupied when the third quadrant was completed, and in that position the rest of the periphery will be finished. It is expected that the last spoke will be in its place by the end of February, provided the weather offers no impediment to continuous work.

Although all the material has been finished long ago, the space to stow it on the site is so limited, that there are still 80 tons to be delivered on the ground. As soon as this has been brought in and erected, the lifts and other work at the towers will be able to proceed; and meanwhile the cars will be put into their places and the rest of the accessories completed. The machinery for turning the wheel is also in hand. It will be driven by two semi-portable engines by Messrs. Robey and Co., each of 16 nominal and 50 indicated horse-power. A third engine by the same makers, for driving a dynamo, is also in position. Instead of the wire hawsers, as described in our previous account, it has now been decided to use chains. These chains will go from the engine-house, through a culvert, to pulleys secured to the further or southern legs, and then round the wheel to pulleys secured to the legs at the northern end, and thence return through the culvert to the engine-house. Each of these pulleys will be provided with an arrangement for taking up the slack, so as to keep the tension equal. The driving motion will be communicated to the intermediate shaft by means of a forged steel pinion, gearing into a wheel with shrouded teeth.

The design and details of this structure are the joint work of Mr. Walter B. Basset, of the firm of Messrs. Maudslay, Sons, and Field; and of Mr. J. J. Webster, who designed the full-sized model of the Eddystone Lighthouse, which was shown at the Naval Exhibition a few years ago.

## THE INSTITUTION OF CIVIL ENGINEERS.

### COLLIERY SURFACE WORKS.

At the ordinary meeting on Tuesday, December 11th, Sir Robert Rawlinson, K.C.B., President, in the chair, the paper read was on "Colliery Surface Works," by Mr. Edw. B. Wain, Assoc. M. Inst. C.E.

As an instance of the development of mining operations during the past twelve years, the North Staffordshire coalfield was cited, where the output had been increased 40 per cent., and this was due to the fact that there was hardly a colliery in the district the plant of which had not been considerably improved during the period referred to. Under the varying conditions consequent upon the increasing depth at which it was necessary to work the coal the work of laying out the surface works was said to have been one of evolution, and comparisons between such works and those laid out recently on modern principles for a definite output would probably indicate much waste and inconvenience resulting from spasmodic and desultory extensions.

It was of the highest importance that the works should be concentrated as far as possible, so as to permit efficient supervision and to reduce the staff of mechanics and general labourers. An example case was mentioned of a colliery, where in 1876 six small and scattered plants were at work on the property, and were raising less than one-half of the material now being obtained from two shafts. As the plant at each shaft required its staff of enginemen, stokers, pit-banksmen and foremen, it was evident that great economy was effected by reducing the number of such establishments. In the instance mentioned, the reduction in surface-charges effected by concentration was 4·67d. per ton.

Where practicable, the railways should be arranged so as to allow a gentle descent for the wagons to and from the screens; if the nature of the ground would not admit of this, endless ropes working between the rails were of great service. In no case ought dead-end sidings to be used if a regular output is to be maintained, as the loss of time in shunting wagons would cause serious hindrance to the coal-winding. It was also desirable that each quality and size of coal should be delivered on a separate road, so as to allow of continuous loading. In a set of colliery sidings so laid out the cost of shunting was only 0·09d. per ton, or about 0·5d. per ton per mile.

The author was of opinion that it was not advisable to undertake new work of importance in colliery workshops, but to use them simply for the purpose of making such repairs as might be necessary. In districts where there were good engineering works near to the collieries, even a portion of the repairs might with advantage be sent out; but where there were not facilities for doing it near at hand, it was of the highest importance that all tools and machinery for maintenance should be provided at the colliery. Where practicable, the workshops should be built on a level with the pit-bank, and light tramways of the same gauge as that of the underground roads should be provided to facilitate the transport of material from the shops to the pit-shaft. The particulars were given of a range of workshops used at a colliery raising 2000 tons per day, with details of the construction of safety lamp room and cost of cleaning, &c., lamps.

Creeper-chains, gravity-roads, and balance-cages worked in connection with double-deck pit-bank platforms were described; also Fowler's hydraulic arrangement for use where more than two decks had to be changed. The most convenient size of pit-wagons was discussed, a gross weight of 18 cwt. to 20 cwt. being mentioned as the maximum which might be conveniently handled.

Four types of tipplers—the ordinary back tipplers, Rigg's and mechanically worked end-and-side tipplers—were described, the side tipplers being considered the most generally useful.

The subject of screening and picking-apparatus would, in itself, afford material for a lengthy paper. The author therefore only briefly noticed some of the types of screen in general use. In laying out the heapstead, it was important that there should be sufficient height between the pit-banks and screen-siding levels. The height would vary considerably according to the type of screen and the number of sizes desired. In general practice it was found that fixed bar screens with not less than 20ft. was required, if the coal was to be separated into three sizes, whilst with jigging screens it was possible to do the same work with 16ft. where no picking-belts were wanted. Fixed bar-screens were said to be objectionable on account of the steep gradient and consequent breakage of the coal in screening. Mechanical screens might be classed under three heads: First, revolving barrel screens; secondly, endless belt screens, such as the Lührig belt and the Greenwell screen; and thirdly, jigging screens. For dealing with a large output from a tender seam, containing a high proportion of small, the author advocated end-driven jiggers with a flat gradient and driven by cranks or cams with a throw of 4in. or 5in., working at about 100 revolutions per minute. The Greenwell screen, suitable as serving both as picking belt and screen, was noted as being specially advantageous where little elevation was available.

The particulars were given in a tabular form of several modern winding plants, with the speed of winding, the average load, and the maximum possible quantity which could be raised per shift of eight hours. An example, a net load of 52 cwt. of coal was raised 550 yards in 44 seconds, with an average speed of $37\frac{1}{2}$ft. per second, and a maximum speed of 60ft. per second. Under such circumstances all complications in the winding engines must be avoided. With the higher steam pressures now used, there should be, however, no difficulty in taking advantage of compound working, provided the high and low-pressure cylinders were both duplicated.

Owing to the variable load due to the decreasing weight of the rope in ascending, and the increasing weight in descending, winding engines were generally wasteful in working. There were various contrivances to balance the load, but the best and simplest was a plain balance-rope worked with a parallel drum.

The economy of fuel in colliery work had received too little attention in the past, the boilers being often supplied with inferior coal or slack which had been considered unsaleable. The amount of coal consumed in colliery work was probably not less than 5 per cent. of the total output of the kingdom, and as slack had now become more valuable, colliery engineers were beginning to give greater attention to the questions of compound working, expansion gear, condensation, and balanced loads. The engines had been as a rule, designed to admit steam into the cylinder for almost the whole length of the stroke. Although such an arrangement enabled the inertia of the load to be more easily overcome in starting, the back-pressure was considerable in the cases of engines running at high speeds, and it was by no means uncommon to obtain from engines working at 80 lb. per square inch diagrams giving a back-pressure of 10 lb. per square inch. The general practice was now, however, to cut off steam at about 20 per cent. before the end of the stroke. Condensation, as applied to modern winding engines, could only be said to have reached the experimental stage, but it was probable that independent surface-condensing apparatus, to maintain a steady vacuum, would be largely used in the future in colliery works.

H.M.S. Magnificent.—The first-class battleship Magnificent was floated out of dock on Wednesday last. Her stokeholds, which will contain eight boilers of the ordinary marine type, will be arranged on Martin's system of induced draught. The propelling machinery is by John Penn and Sons, estimated to give 12,000 indicated horse-power with induced draught. The length of the Magnificent is 390ft. between perpendiculars, breadth 75ft., mean draught 27ft. 6in., the displacement at load draught being estimated at 14,900 tons. The armour-plating is "Harveyised" throughout.

Society of Engineers.—The forty-first annual general meeting of the Society of Engineers was held on December 10th, at the rooms of the Society, 17, Victoria-street, Westminster, S.W. The chair was occupied by Mr. George A. Goodwin, president. The following gentlemen were duly elected by ballot, as the council and officers for 1895, viz.: as president, Mr. Wm. George Peirce; as vice-presidents, Mr. Charles Claude Carpenter, Mr. Samuel Herbert Cox, and Mr. George Maxwell Lawford; as ordinary members of council. Messrs. W. Worby Beaumont, Joseph Bernays, R. W. Peregrine Birch, William Bradford, John Corry Fell, Charles Gandon, Henry O'Connor, and Stephen Sellon; as hon. sec. and treasurer. Mr. Perry, Fairfax Nursey; as hon. auditors, Messrs. Alfred Lass, F.C.A., and Samuel Wood, F.C.A. The proceedings were terminated by a vote of thanks to the president, council, and officers for 1894, which was duly acknowledged by the president. The annual dinner of the society took place on the 12th inst. at the Holborn Restaurant. This was the 41st annual dinner, and a large number of members and visitors were present, including Mr. A. Goodwin, president; Sir Robert Rawlinson, Mr. Alexander Siemens, Professor Henry Robinson, Mr. Arthur T. Walmisley, Mr. A. J. Durston, Colonel Davis, Mr. W. G. Peirce, Mr. G. M. Lawford, and others.

## RAILWAY MATTERS.

It is stated that a French engineer has designed and perfected a compressed air locomotive buffer, which will shortly be put to practical test on an English line.

The North British and Caledonian Railways are engaged in testing rival systems of carriage heating with the view of ascertaining the most convenient and efficient substitute for the foot-pan.

The first sod of the new Snowdon Railway was cut on Saturday last. This new mountain line starts from Llanberis Station on the North-Western Railway, giving direct access to the Snowdon Railway.

The London and North-Western Railway Company have, it is understood, obtained powers to promote a line from Leeds *vid* Gomersall to Mirfield, from which place they will run direct to Liverpool.

Recent heavy rains have done great damage to the permanent way of the East Coast Railway of India. Three small bridges have suffered most. The central piers have been clean washed away, not by a regular stream of river, but by an unusual flow of water.

It is stated that the Manchester, Sheffield, and Lincolnshire Railway Company have a very important Bill to come before Parliament with reference to diverting their railway line between Grimsby and Cleethorpes in order to enable them to construct larger and more convenient docks.

The Brooks Locomotive Works, of Pennsylvania, has for some time been engaged upon an order of sixty locomotives for the "Estrada de Ferro Central do Brazil." The engines are of three types, the Mastodon type, for a track of 3ft. 3⅜in.—1 metre—gauge, the same type for a 5ft. 3in. gauge, and a suburban engine of the same gauge.

A deputation of Liverpool and Glasgow shipowners recently waited on the directors of the London and North-Western Railway, asking for a reduction of railway rates between Liverpool and Manchester, in view of the competition of the Manchester Ship Canal. The directors, however, did not see their way to make any concession.

A Reuter's cablegram from Calcutta says that it is understood that the India-office has now practically agreed in full to the proposals of the Government of India in the matter of further railway construction. The programme arranged a month or two ago will therefore, with only a few reservations, be carried out in due course.

The contract for the construction of the Jamaica Railway has been let to an American contractor, Mr. James P. McDonald, of Knoxville, Tenn. In addition to the ordinary construction work, Mr. McDonald has the following extras, viz., 29 tunnels, 193 girder bridges, 9 truss bridges, and 11 viaducts, some of great size, all of steel, and on piers of masonry.

Excellent results have been given by Holden's system of oil-burning on the Austrian State Lines. The action of the oil is so energetic that the steam pressure of a locomotive heated in this way can be raised in three minutes from three to ten atmospheres, while with coal alone six and a-half minutes are required. On long runs the steam pressure can be kept at maximum pressure, while the engineer has absolute control of the fire, which he can check or increase in intensity as production of steam may require. This method is to be also used on the Metropolitan Railway of Vienna.

Serious inconvenience has this week been caused to those South Staffordshire towns joining up to Birmingham which are served by the South Staffordshire Tramways Company, by a sudden cessation of the service owing to a dispute with the Electric Construction Company as to payment for the working of the trams. The district affected extends fourteen miles in length, eight of which are worked by electricity, and the other six by steam. Complaint has been made by the local authorities of the present state of things, and it is understood that negotiations are being conducted which, it is hoped, may result in an early resumption. The existing difficulty is likely to bring to a head the objections of the West Bromwich, Handsworth, and Wednesbury authorities to the continued use of steam on their portion of the line, and to issue either in the extension of the electric systems throughout the entire length, or the adoption of the cable method through the towns mentioned. The local authorities would prefer the cable system, but the tramway company contend that electricity works much better and is cheaper than any other method.

A circular letter has been issued by the Secretary of the Royal Agricultural Society of England to the members of that society referring to the fact that a conference on light railways has lately been held under the auspices of the Board of Trade, and a committee, on which the society is represented, appointed to report upon the subject. It being desirable that the agricultural aspects of the question should be fully considered, the council desire to receive any suggestions which the members may have to offer on the agricultural light railway requirements of any particular district in which they are interested, and a schedule of questions is given to which answers are desired. These questions are as follows:—"(1) Please state county or counties to which the subjoined observations apply; (2) district to be agriculturally developed, naming terminal towns, places, or stations; (3) description of light railway considered most suitable; (4) the main line of railway, if any, with which a suggested light railway should have connections; (5) how funds for construction and equipment might possibly be provided—by local subscription, by rates, or advances on the security of rates, or by a combination of these sources or otherwise; (6) any other observations likely to prove useful for the purposes of the inquiry."

During the five winter months 25,500 cubic fathoms of earth were added to the embankment on the Western Siberian Railway between the town of Tchelyabinsk and Omsk. According to the *Times* a distance of ten versts of line is ready, and 116 station houses and other buildings are finished. There have been prepared 270,000 sleepers and 4000 transportable "snow-protectors" to prevent the line from being snow-blocked. The manufacturers have supplied over 608,000 puds—nearly 9650 tons—of rails, 37,000 puds—about 587 tons—of fastenings, 12,000 puds—about 190 tons—of water pipes, two water reservoirs, 11 hydraulic cranes, and three turntables of a diameter of 56ft. On the same line from Omsk to the River Obi the survey has been completed for a distance of 142 versts, and the plans have been drawn up. Over 21,000 cubic fathoms of embankment have been made. On the Central Siberian Railway between the Obi and the station of Krasnoyarsk 390 dessiatins—about 426 hectares—of wood have been cut down, and 41 dessiatins—nearly 44 hectares—of stumps have been uprooted. Earthworks to the extent of 25,000 cubic fathoms have been constructed, as well as over 3000 square fathoms of protective escarpment. Five stations and other buildings have been erected. Nineteen versts of the railway and 40 versts of the telegraph wire are ready. The manufacturers have supplied more than 18,000 puds—over 285 tons—of iron for the bridge across the Tom, as well as 140,000 puds—about 2200 tons—of rails, and nearly 44,000 puds—about 700 tons—of fastenings. On this line over 200,000 sleepers have been laid and 6000 telegraph poles erected. Sixty-three versts of the Ussuri line between Vladivostok and the Grafskaya station are complete, and 37,000 cubic fathoms of earthworks have been laid. The second telegraph line is ready for a distance of 45 versts. Thirty-six station houses and other buildings have been erected.

## NOTES AND MEMORANDA.

In a recent number of the *Comptes Rendus* is a paper on the laws of air resistance, by M. E. Vallier. Formulæ are derived which express the specific resistance of a body (*a*) where the velocity is greater than 330 metres, (*b*) where the velocity is between 330 and 100 metres, and (*c*) where the velocity is less than 100 metres per second.

In a report which has just been issued by a Board of United States Engineer Officer on the maximum practicable length of a suspension bridge, they state that using steel wire cables having a tensile strength of 84 tons per square inch, and a factor of safety of 3, the limiting span for a railway bridge to carry heavy traffic is 4335ft. The total suspended dead load in this case works out to about 233,900 tons.

Before the Paris Academy of Sciences a paper was read on the 3rd ult., on the reduction of alumina by carbon, by M. Henri Moissan. The author describes the reduction of pure corundum by means of his now well-known electric furnace. Liquid alumina is not reduced by carbon; the reduction only takes place when the vapours of these substances are carried to a very high temperature, metallic aluminium is then produced and partially combines with carbon.

In a paper on "The Solubility of Ozone," M. l'Abbe Mailfert recently stated that at a pressure of 76 mm. water dissolves two-thirds of its volume of ozone at 0 deg. C., at 12 deg. about one-half. The solubility of ozone in water acidified with sulphuric acid is the same as its solubility in pure water up to about 20 deg. C.; more ozone is dissolved by the acid solution above this temperature. The suggestion is made that oxonised water might be employed as a disinfectant and antiseptic.

In a paper communicated to the *Physical Review*, Mr. S. H. Brackett gives an account of some experiments he has made on the magnetic properties of iridium. The samples used—says *Nature*—contained 98 per cent. iridium, with some platinum, and a trace of phosphorus, but no iron. A bar of the metal 13·3 mm. long, 3·2 mm. wide, and 0·9 mm. thick, when brought into the field of an electro-magnet, set itself at right angles to the lines of force, and became permanently magnetised in a transverse direction, and when suspended, freely set itself E. and W. The permeability of a larger bar was tested, and was found to be unity; and although the specimen was sharply struck while in the magnetising coil, no induced magnetisation was produced.

Mr. Michele's test for Portland cement for 1895 is as follows:—Pats ½in. thick in water, absolutely sound at seven days; tensile strength, 400 lb. per square inch at seven days; fineness, 5 per cent. residue on a 50 sieve. The pats to be gauged on glass, immersed in water immediately, and left there for the whole period. One pat to each three bricks. The test bricks to be gauged by a skilled man, with a minimum quantity of water, and well rammed into moulds. The average of three to be taken, which shall represent about 100 tons or less. The strain to be applied as quickly as possible. The sieve to have 2500 holes per square inch, and to be of wire not less than ·007 of an inch—34 B.W.G.—in diameter. Shaking to be continued for five minutes.

Professor Joly, of the Paris Ecole Normale, who has been making a study of the metal ruthenium, claims it to be, of all known elements, that which presents the most original properties. He recently submitted to the Académie des Sciences several samples of a red colouring matter, resulting from an association not yet definitely determined—oxychloride of ammoniacal ruthenium—giving a tinctorial power equivalent to that of the richest dye materials obtained from coal tar, to that of fuchsine, for instance. A five-millionth part of the substance suffices to colour water. It dyes silk directly, and the colour thus procured is stable. The chemical reactions of this new colouring matter are equally interesting. Acids transform it into yellow, and alkalines bring it back to red.

In their report on the water supplied to London for the month ending November 30th, Professor W. Crookes, F.R.S., and Professor Dewar, F.R.S., say:—"The floods in the Thames Valley during the month of November have been the severest since the year 1821, and it was not to be expected that the water supplied from the river would not show some signs of the flood. The average rainfall at Oxford during November is 2·31in., while the actual rain has amounted to no less than 4·8in., showing an excess of 2·49in. There is one striking peculiarity connected with the rainfall during November. In most exceptionally wet seasons the fall of rain is more or less evenly distributed over the month. The month which has just closed had, however, seventeen days on which no rain fell, and eight other days on each of which less than 2-10ths fell. On the remaining five days—the 7th, 11th, 12th, 13th, and 14th—no less than 4·02in. fell, while the rest of the month must be called very dry, only 0 17in. of rain having fallen since the 14th. The sudden downpour of four inches of rain in five days—amounting to 69½ million gallons per square mile—largely overtaxed the capacity of the river to carry it off, whereas had this amount been more evenly distributed over two or three weeks no harm would have been done."

At the Society of Arts meeting on Monday last, Professor Vivian B. Lewes gave a lecture on blasting explosives. Remarking upon the cause of explosions in dusty mines free from firedamp, he pointed that until quite recently explosions in mines were always attributed to the accidental ignition of mixtures of air and methane, to which the name of firedamp was given, but it was now recognised that explosions in mines might be brought about—first, by the ignition of a mixture of methane and air, in which the former rose above a certain percentage; secondly, by mixtures of air, coal dust, and methane, in which the amount of the last mentioned may be excessively small; lastly, by mixtures of coal dust and air. In cases recently investigated powder was the blasting agent used, and such powder as was employed for this purpose gave, amongst the products of combustion, nearly half the volume of permanent gases in the condition of carbon monoxide, methane, and hydrogen. The experiments and investigations in various colliery explosions made it abundantly manifest that no explosive should be licensed for use in mines unless it could be absolutely proved that it gave off no inflammable products of combustion. He urged the absolute necessity of legislative enactments at once forbidding the use of blasting powder in any coal mines, no matter how free they might appear to be from firedamp or from dust.

Observations on the variations in level of well-water have been made for the last three years at the Observatory of Catania in Sicily, and the first results are described in a paper by A. Riccò and S. Arcidiacono—*Boll. mens. dell' Acc. Cioenia di Sci. Nat. in Catania*, fasc. 37, June 10th, 1894. They classify the movements into progressive, annual and accidental, subdividing the latter into meteoric and geodynamic. The accidental variations of geodynamic origin consist of small abrupt changes of level, generally downwards, which frequently correspond to movements of the ground. Shortly before the eruption of Etna in 1892, and for several months after, the changes in level of the water-surface were extremely irregular. From June 1st to December 31st, 1892, corresponding to thirty-nine groups of earthquakes, there were abrupt changes of level within twenty-four hours in twenty-one cases; there were, *Nature* says, also fifty small but marked changes coinciding with strong oscillations of the tromometer. Somewhat similar observations have been made in Wisconsin, by Professor F. H. King, United States Department of Agriculture Weather Bureau, *Bull*, No. 5. Here the shock was imparted by heavily-laden trains passing less than fifty yards from the well; but the surface of the water invariably rose, sometimes as much as one-tenth of an inch, returning to its former level after a few seconds.

## MISCELLANEA.

The Corinth Canal is once more reported free for navigation.

In connection with the Dortmund-Ems Canal, the river Ems will undergo a thorough "correction" in the Rhede-Papenberg section.

The Brazilian Government has ordered the waterway leading into Santos Harbour, as well as the anchorage ground, to be deepened, and the sandbanks removed.

It is stated that the construction of the Niagara Falls Utilisation having been completed, Professor George Forbes, F.R.S., who has been engaged for the last three years on the work, is expected to return to this country almost immediately.

Messrs. Laird Bros., Birkenhead, launched, on Saturday last, the new torpedo-boat destroyer Dragon. The Dragon is a sister ship to the Contest, launched a fortnight since; she is 208ft. long and 19ft. beam, and her machinery will be similar to that of the Ferret, now ready.

It is stated that a number of inspectors and assistant-inspectors of mines have been appointed inspectors of factories and workshops to enable them to enforce in the pit banks of metalliferous mines, and in quarries, certain provisions of the Factory and Workshops Acts that are applicable thereto.

The optical department of Dr. Schott's works at Jena, Germany, is at present occupied with the casting of an objective for an astronomical telescope, which is to be, when finished, the largest lens in the world. According to the *American Manufacturer*, its diameter will be 110 cm., or about 43¼in.—or 5in. more than the one at the Lick Observatory. The lens weighs about 2000 lb., rough cast, and will cost, when finished, 300,000 marks, or about £15,000.

There are now fifty-three merchant steamships which the Admiralty have the option of equipping as armed cruisers in case of emergency. Of this number eleven only, according to the *Times*, are in receipt of annual subventions, the remainder being at the disposition of the Admiralty without further subsidy. The Admiralty have just been furnished with a report that of this auxiliary fleet four can maintain an ocean speed of over 19 knots, and five over 17 knots, 37 over 15, and the remainder nearly 15 knots.

A plan recently suggested by Mr. Geo. F. Cole, Chicago, to obviate the difficulties met with in the construction of the Panama Canal consists, of a tunnel through which ships can pass if their masts are specially constructed to collapse either telescopically or by being hinged. A ship entering would pass between a pair of cranes, the yards having been first placed in a vertical position by the crew, and the masts would be lowered to be raised again by a similar pair of mast cranes on emerging. We fear that shipowners might consider this more pretty than practicable.

Messrs. William Wilkinson and Co., Holme House Foundry, Wigan, have completed and set to work a large pair of horizontal underground pumping engines, to deliver 60,000 gallons an hour to a vertical height of 600ft. The engines are compound, working at 100 lb. boiler pressure, cylinders 32in. and 60in. diameter by 36in. piston stroke. Quadruple pumps, 10½in. diameter by 36in. stroke; steam carried down pit shaft from surface, and exhaust brought up to the surface and condensed there by separate condensers and air pump. The total weight of the engines complete is 110 tons, including 16 tons of forgings and wrought iron work, and 5575 lb. of brass work.

The official trial of her Majesty's torpedo-boat destroyer Ardent took place on Saturday last. The Ardent is 200ft. long, 19ft. wide, and 14ft. deep. The first run was made against tide, the time occupied being 2 min. 22 sec. The revolutions were 393 per minute for the starboard engines and 397 for the port. The next run, with tide, was made in 1 min. 59 sec., the revolutions being 390 and 400 for the starboard and port engines respectively. The next two runs against tide were rather better than the first, the time for each being 2 min. 19·4 sec., but the corresponding runs with tide were not quite so good as the first. The maximum revolutions during the trial for both sets of engines were made on the third run, the rate being 404 6 per minute for the starboard and 406·7 for the port engines. The mean speed for the six runs was 27·843 knots. The mean speed on the whole run was just on 28 knots, actually 27·971 knots.

A lock with a total lift of 140ft. is proposed as a substitute for the flight of sixteen locks on the Erie Canal between West Troy and Cohoes. At present two to three hours are required for the passage of those locks, the delay being especially great because the locks are all single length. Thus far, says the *Engineering News*, forty out of the remaining seventy-two locks on the Erie Canal have been enlarged to double length; but to carry out this improvement on the flight of sixteen would be very difficult on account of lack of space, increased demand for water, and the great expense involved. The proposed high-lift lock would consist of two steel tanks, each large enough to contain a boat and its consort, or equal in capacity to the largest locks now in use on the canal. The two would balance each other, one ascending as the other descends, so that the only power required would be that necessary to overcome the friction of the machinery. The scheme is being investigated by the State Engineer, Mr. Campbell W. Adams.

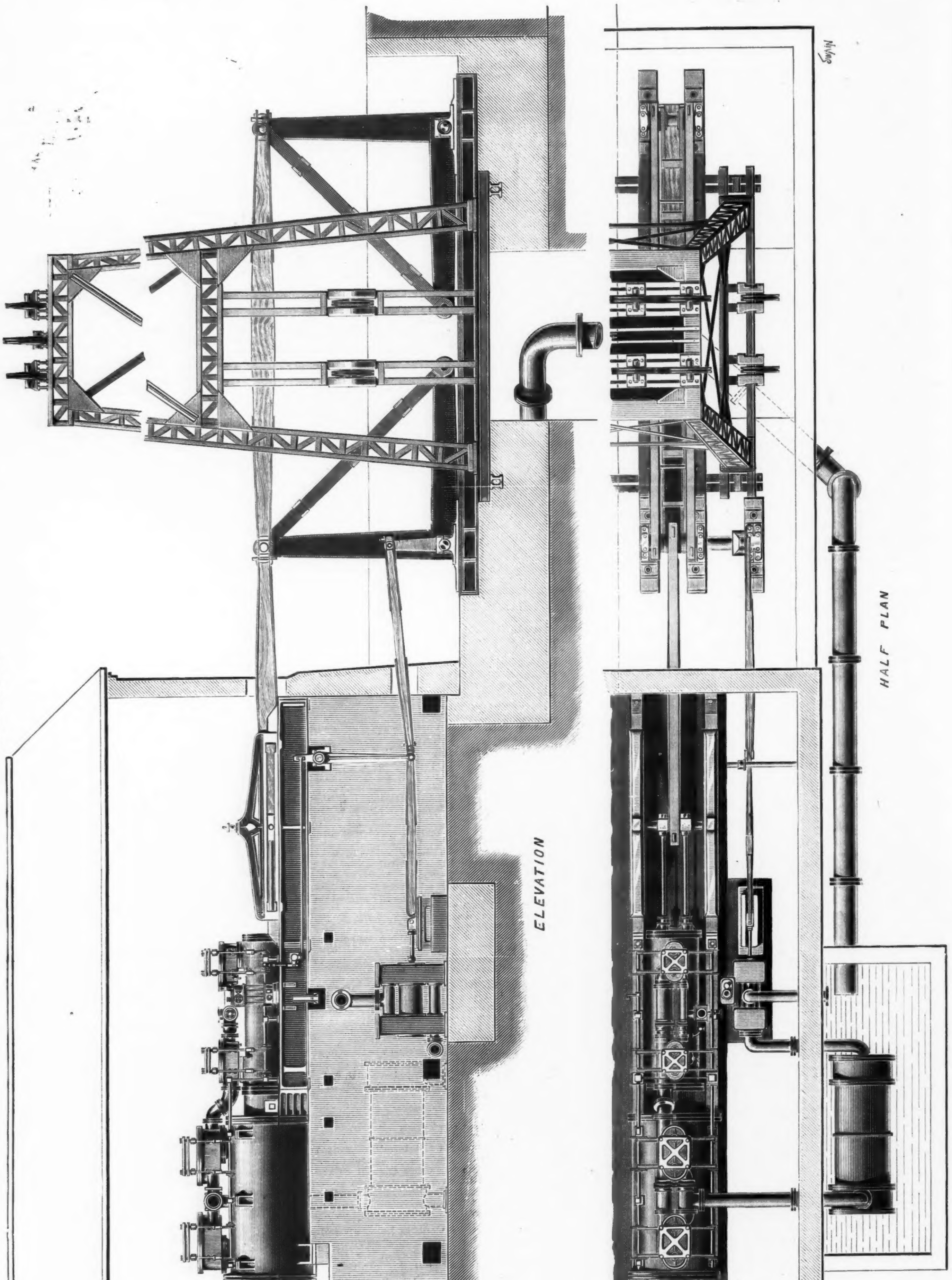
The following specimen of Admiralty cheeseparing we abstract from the *Naval and Military Record*:—"As far back as April last the gunboat Sharpshooter, when returning from a steam trial, was compelled, on account of serious defects to her steering gear, to have towing assistance. The service was rendered by the Government tug Trusty, the master of which piloted the Sharpshooter into the Hamoaze. A report of this special duty was sent to headquarters, and the officer received, as pilotage fee, the sum of £10 4s. Since then the case has been reviewed, and the Admiralty point out that the service regulations state that the master of a tug, when employed in towing and piloting a ship into or out of his own port, is not entitled to any allowance for pilotage, unless the draught of the ship towed exceeds the maximum draught of his own vessel. At the time the service in question was rendered, the Trusty's maximum draught was 12ft., whilst that of the Sharpshooter was a foot less. Under these circumstances their lordships have ordered that the amount paid to the master of the tug is to be deducted from the salary due to him at the end of the year."

A conference has been recently held at the Board of Trade between the electric lighting companies and various local authorities with reference to the proposals of the electric lighting companies to place beneath the public streets and footways electric transforming chambers, and as to the conditions under which such chambers should be allowed to be made. Representatives of various vestries and electric lighting companies attended. In the course of the proceedings it was suggested that the Legislature never contemplated in authorising junction boxes to be placed beneath the streets, that the much larger space involved in the formation of transforming chambers should be permitted. It was urged on behalf of these authorities that the existence of the transforming chambers would be a source of great public danger, inasmuch as it would be impossible to construct them of a water-tight character, that there would be a risk of gas and water leakage and consequent explosions and electrolysis. It was therefore contended that the chambers should not be allowed to be placed under the public streets, and that the companies should, if necessary, obtain private property in which to construct them, and pay rent for such property.

# ONE THOUSAND HORSE-POWER DAVEY PUMPING ENGINES

MESSRS. HATHORN DAVEY AND CO., LEEDS, ENGINEERS

*(For description see page 551)*


ELEVATION
HALF PLAN
"THE ENGINEER"

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, December 21st, 1894.

PAGE
Light Railways. (Illustrated.) .. .. .. .. .. .. .. .. .. 541
The Iron Gates of the Danube .. .. .. .. .. .. .. .. .. 542
H.M.S. Blenheim. (Illustrated.) .. .. .. .. .. .. .. .. 543
High Tension Feeders, Worcester .. .. .. .. .. .. .. .. 543
Curiosities of Water Supply. (Illustrated.) .. .. .. .. .. 543
Trier's "Split-grip" Collar. (Illustrated.) .. .. .. .. .. 543
Letters to the Editor—Labour and Luxuries—The Machinery of Ships of War—Theory of the Steam Engine .. .. .. .. .. 544
Proposed Association of Portland Cement Manufacturers—Traction Engines—Radial Drill Tables .. .. .. .. .. .. .. 545
100-H.P. Robey Gas Engine. (Illustrated.) .. .. .. .. .. 546
The Gigantic Wheel. (Illustrated.) .. .. .. .. .. .. .. 547
The Institution of Civil Engineers.. .. .. .. .. .. .. .. 548
Railway Matters—Notes and Memoranda—Miscellanea .. .. 549
Leading Articles—High-pressure Compound Engines—The End of a Trade Union .. .. .. .. .. .. .. .. .. .. .. 551
The Paris Metropolitan Railway—American Tin-plate Manufacture—Locomotive Coal .. .. .. .. .. .. .. .. .. .. 552
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. 552
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 553
Davey Pumping Engine. (Illustrated.) .. .. .. .. .. .. 554
Pitway and Nord's Fish-plate. (Illustrated.) .. .. .. .. 554
Gravitation Water Supplies and Electric Energy.. .. .. .. 554
Surfacing and Boring Lathe. (Illustrated.).. .. .. .. .. 554
Filtration of Nile Water for Sugar Works. (Illustrated.) .. 555
High-speed Engine. (Illustrated.) .. .. .. .. .. .. .. 555
Legal Intelligence .. .. .. .. .. .. .. .. .. .. .. .. 556
Report of the Secretary of the United States Navy .. .. .. 556
Cleveland Institution of Engineers .. .. .. .. .. .. .. 557
Letters to the Editor—Uensold's Ice Rink—Locomotive Capacity 557
Locomotives and Trains.. .. .. .. .. .. .. .. .. .. .. 558
Australian Notes—American Engineering News .. .. .. .. 558
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts—Notes from Lancashire.. .. .. .. .. .. .. .. .. .. .. .. 558
The Sheffield District—The North of England .. .. .. .. 559
Notes from Scotland—Wales and Adjoining Counties—Germany.. 560
The Patent Journal.. .. .. .. .. .. .. .. .. .. .. .. 561
Selected American Patents.. .. .. .. .. .. .. .. .. .. 562

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

E. B. D.—*The figures should read 1050ft.*

N. D. P. (Swan)—*Try wrought iron welded tubing, which can easily be obtained from several firms. It will probably last a considerable time, certainly much longer than cast iron.*

J. S. (Chester)—*The methods of moulding and the mixtures used you will find in "The Ironfounder," by S. Bolland, published by John Wiley and Sons, New York, and in England by Gay and Bird, London.*

W. O. G.—*You can calculate the stresses for yourself. Multiply the weight by the square of the speed, and divide by thirty-two times the radius of gyration. In your case the distance from the centre of rotation to the centre of the thickness of the piston may be taken for the radius with sufficient accuracy. By setting out on a drawing board the piston in various positions you can easily obtain the stresses.*

J. B. J. (Manchester).—*We fear you have read books on the steam engine to small purpose. You have evidently not mastered the principle of expansive working. None of the forms of steam engine which you have sketched is necessarily more economical than the others. You should consult such a book as "Bourne on the Steam Engine," which you can see in your Free Library. A very good elementary explanation of the principle will be found in Lardner's treatise on the steam engine, in Weales' series. You can see in the Patent Museum, South Kensington, a sectional model of such an engine as that shown in your sketches No. 2 and No. 3. It was patented more than forty years ago.*

### TENDERS AND ADVERTISERS.

(*To the Editor of The Engineer.*)

Sir,—We shall be glad to know whether any of your correspondents have had any experience similar to the following:—(1) An advertisement appears in The Engineer, inviting tenders for certain work; specification and tracings on receipt of a deposit of so many guineas, applications to be addressed to an engineer, a M. Inst. C.E., in a certain part of England. (2) Cheque duly received and cashed, but no specifications or drawings sent. (3) Delays and all kinds of excuses, extending over several months; but still no specifications or tracings sent, and no return of the deposit. If any of your readers have had similar experience, we shall be glad to get into communication with them through you, in order that we may take concerted steps to insure the return of our money, and to expose this method of doing business. Manufacturer.

London, December 19th.

### DRYING FUEL.

(*To the Editor of The Engineer.*)

Sir,—We are desirous of ascertaining the best known system of drying cylindrical blocks of fuel about 2½in. by 2½in. which contain, say, 25 per cent. moisture. There would be no objection to the flue gases passing over the blocks. Any information which your readers could give us as to the quickest and most economical process would be much esteemed.

London, December 13th. T. A. M.

### SUBSCRIPTIONS.

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers)*.. .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

### ADVERTISEMENTS.

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

### DEATH.

On December 14th, at 29, Lightfoot-road, Hornsey, London, Benjamin Williams, mining engineer, formerly of Goldsithney, Cornwall, aged 65 years.

### MEETINGS NEXT WEEK.

Royal Institution of Great Britain.—Thursday and Saturday, December 27th and 29th. Paper: "The Working of an Electric Current," by Professor J. A. Fleming, F.R.S., M.R.I.

# THE ENGINEER.

*DECEMBER* 21, 1894.

## HIGH-PRESSURE COMPOUND ENGINES.

By a fortunate coincidence, very shortly after the publication in our issue of the Nov. 23rd, containing an article on "Practical Steam Engineering," we received an advance copy of a paper to be read at the December meeting of the American Society of Engineers, by Mr. F. W. Dean, of Boston, giving particulars of "Trials of a Recent Compound Engine with a Cylinder Ratio of 7 to 1." It will be remembered that we pointed out that high pressure and long range of expansion represented the never-failing combination which in practice secured economy. Mr. Dean's paper amply verifies the accuracy of our statements and the soundness of the opinions we have expressed. It can scarcely have escaped our more observant readers that of late little or nothing has been heard about the influence of range of temperature and its effects on economy. This is natural enough. That reduction of range should diminish cylinder condensation appeared to be obvious, and it was argued that in the triple-expansion engine, cylinder condensation must be much smaller in amount than it would be in a compound engine. But the experiments since carried out by many persons, Professor Kennedy in particular, proved that in this case at all events, theory and practice do not coincide, the cylinder condensation in triple-expansion engines being quite as heavy as in any other reasonable type of engine. When, indeed, we come to consider that the reduction in range can only be obtained by largely increasing the amount of metallic condensing and re-evaporating surface, it is difficult to imagine how it has been possible that the extravagant notions formed by some persons concerning the triple-expansion engine could have been conceived. The truth is that the triple-expansion type has been more economical than the compound simply because the former works at higher pressure and greater range of expansion than does the latter, and, as we have said, this condition is sufficient to secure economy. In the same way the quadruple-expansion engine will, no doubt, prove better than the triple-expansion engine, not because it has four cylinders, but in spite of that fact, solely because a higher pressure of steam will be used and a much greater range of expansion.

If, now, the views we have thus expressed are really sound, then we should expect to find a compound engine working with high-pressure steam just as economical as any other type of engine working within the same limits of pressure and back pressure. Unfortunately, there is not as yet much evidence in this direction available. We may cite Mr. Asplin's experience with the steamers of Messrs. Leyland's line; but that is limited to a general practical result, which is that the compound engines of such boats as the Minho are, on the whole, as good as triple-expansion engines. It is worth notice that some eminent makers of engines in the North have recently tendered for large electric light compound engines with a cylinder ratio of 1 to 6, and 180 lb. boiler pressure. But these engines have yet to be built. Mr. Dean has, however, supplied us with evidence which, so far as it goes, is conclusive, a cross compound engine indicating nearly 600-horse power using but 12·84 lb. of dry saturated steam per horse per hour. This is a result which has hardly ever been beaten save by a few triple expansion engines working under very special conditions. The engine tested by Mr. Dean has cylinders 18·44in. and 48·5in. in diameter. The stroke is 4ft. The piston speed was 612ft. per minute; the average pressure close to the engine 159 lb. above the atmosphere. The engine was specially built by the Wheelock Engine Company, of Worcester, Mass., for Messrs. Knight, of Providence, to drive a mill in Natick. The cylinders have a volume ratio of 7 to 1, which, Mr. Dean tells us, is held to possess a special virtue. The trials appear to have been carried out with the greatest possible care on January 26th and 27th. The first trial lasted four and a-half hours, the second five hours. More time was not available, because the engine was doing its regular work in driving the mill. No attempt was made to weigh coal. All the feed-water was weighed, not measured. During the first trial, 34,089 lb. were used; during the second, 37,677 lb.—quantities so large that even a considerable error would be a small percentage of the whole. The engine was 400ft. away from the Babcock boiler, which was quite distinct from the rest of the boiler plant. There was a steam separator close to the engine, and a calorimeter was placed between it and the valve chests. The percentage of moisture was under 2. The high-pressure cylinder is jacketed all over; the low-pressure covers only. Between the cylinders is a re-heater—which, however, seems to have been comparatively inoperative, the surface being inadequate. The vacuum was only 25·4in. and 25·2in., although the condensing water was very cold. The condenser was of the injection type, but did not perform very well. The jackets seem to have been badly piped, and Mr. Dean states that the circulation in them was probably not good. Thus it will be seen that in certain small matters the engine was deficient in those particulars which secure the highest results. Nevertheless, the engine gave results altogether excellent. The diagrams are very good, as was to be expected from valves working with Wheelock gear and a clearance of only 2·75 per cent. in the high-pressure and 2·5 per cent. in the low-pressure cylinder.

In considering the causes which conduced to these results, we find that in the first place the pressure was very high, and in the second the range of expansion was unusually large, amounting by volume to not less than 33 to 1 on the 26th January, and 33·4 on the 27th January. The initial cylinder pressure as given by the indicator was 168 lb.; the terminal in the low-pressure 5·4 lb. absolute in one set of diagrams, this is a ratio of 1 to 31. In other diagrams no doubt the pressures gave the result stated by Mr. Dean as the average. So far as we can learn, the working of the engine was in all respects quite satisfactory. Mr. Dean holds that the large intermediate receiver augmented drop and caused loss, but on this point we do not agree with him. It would certainly have been impossible without such a receiver to have maintained the back pressure in the high-pressure cylinder so uniform as the diagrams show it to have been. Mr. Dean holds that better results might have been got had the vacuum been better. "Although," he writes, "the performance of the engine is remarkably good, I believe that it was realised in spite of great defects, and that it would have been much better if these defects had not existed. The economy, in my judgment, is due to high steam pressure, with the resultant high degree of expansion, small clearances, and tight pistons and valves." This is to all intents and purposes our own opinion.

It will be seen that such results open up an encouraging prospect for many mill owners. Triple-expansion engines are not very convenient for mill work. The cotton mill engine always has either one or two cranks. The favourite type is the horizontal cross compound. To secure a considerable saving in steam, it would seem to be sufficient to line up the existing high-pressure cylinder, or to substitute a new one, and to put down new boilers carrying 150 lb. or 160 lb. instead of the present boiler carrying 90 lb. or 100 lb. With good coal and economisers, there ought to be no difficulty in evaporating 9 lb. of water per pound of coal. This, with 13 lb. of feed-water per horse per hour, would give a coal consumption of less than 1½ lb. per horse per hour. At this rate the cost of the alteration would soon be repaid. It seems to us that it would be worth while to push the experiment begun in Liverpool and continued in the United States further here. The advantages of the compound engine as a machine over the triple-expansion engine are sufficiently obvious not to need explanation.

In marine work, while for small power the compound two-cylinder type would answer very well, for large power it would be no doubt necessary to resort to three cylinders, otherwise the diameter of the low-pressure cylinder would be too great. We should thus revert to engines of the Etruria type, with one high-pressure cylinder and two low. It is worth notice that the Etruria's boilers carried 120 lb. pressure, which is very high for a large compound job, and yet the performance of her machinery has been altogether satisfactory. If the pressure had been 160 lb.—the high-pressure cylinder being in proportion smaller in diameter—it is probable that no one would have thought of substituting triple expansion engines for the compounds. The objection which has been raised to admitting steam of a very high pressure on to a large piston has no force in such a case, because the high-pressure piston is reduced in diameter; and for the rest, improved materials and methods of construction, the use of steel for pistons instead of cast iron, and so on, have eliminated all cause for apprehension as regards power to bear stresses. We repeat that, so far as can be seen, the high-pressure compound engine is full of promise of success, and we hope that experiments will be undertaken in this country to settle whether that promise will or will not be fulfilled.

## THE END OF A TRADE UNION.

The National Amalgamated Sailor's and Firemen's Union has ceased to exist. The Union owed, it is said, £3871, and had in hand £210 to meet its liabilities; at least that is the statement made in the balance sheet for the Board of Trade. The Union has had a short, stormy, and mischievous life. Its history is instructive as an example of the lengths to which the tyranny of unionism can be pushed, and an illustration of the power which lies latent in the nation for maintaining freedom. The Union was got up by Mr. Havelock Wilson, who kept a little coffee shop in High-street, Sunderland. The first meeting of the Union was held in August, 1887, and almost from the beginning it assumed tyrannical powers. Mr. Wilson is an energetic man, and he acquired great influence over a class which is certainly not the best educated or the most intelligent in the country. Strikes were ordered and took place. The Union men refused to sail with the non-Unionist. At one time there were more than 60,000 men on the books of the Union. They had power and they exerted it. Mr. Wilson boasted that he was able to make every sailor and fireman pay into the Union whether he belonged to it or not. The condition of the Union funds goes to prove that this was a vain boast. Meanwhile the shipowners took apparently little notice of the Union. Indeed, the policy of Mr. Wilson was, in the first instance, to let the shipowners alone and get as many members as possible. His operations were conducted rather against the men than the masters. His object was to get the whole seafaring population of Great Britain into the hollow of his hand, and then dictate terms to the shipowners. If he had succeeded he would have controlled the seagoing carrying trade, and with it the commerce of the country. In pursuit of this object, and rendered bold by preliminary success, he at length attempted to draw the officers and engineers into his net. He ruled that no crew should sail in a ship the captain, mates, and engineers of which did not hold his "ticket" or licence. Then the shipowners awoke and bestirred themselves. In August, 1890, they formed the Shipping Federation, and they prepared to fight Mr. Wilson on his own ground. They flatly refused to take only men with the Union ticket. They allowed no distinctions. They took Union and non-Union men alike. When the former having signed articles, refused to sail with the non-Unionists, the Shipping Federation prosecuted them to conviction. It was in vain that great strikes were got up in the Bristol Channel ports and elsewhere. It was all to no purpose that Mr. Wilson stormed and raved and denounced the Federation. Thousands of men who had been coerced into joining the Union refused to starve; they deserted Mr. Wilson and signed articles. Disaster followed disaster. The Union has ceased to exist, and Mr. Wilson has only the satisfaction of knowing that he is still a Member of Parliament. A new Union with, appropriately enough, offices in Jeremiah-street, Poplar, has been formed, and such members of the old Union as remain, and its officers, have been enrolled on the lists of the new body. The theory seems to be that in this way the debts will be discharged without giving the creditors anything. It is open to doubt, however, that this theory can be put into practice. Meanwhile certain statements concerning Mr. Wilson are floating about which, for his own sake, he ought to answer.

It would obviously be impossible to carry on the commercial operations of a great country if the control of those operations rested in a single individual. It is not easy, however, to see how such mercantile conditions could fail to come into being if Mr. Wilson had succeeded in leading his army to victory. The modern sailor comes from almost every country on the face of the earth, and so far as Great Britain is concerned, he has no national ties. Norwegians, Danes, Lascars, Russians, and negroes will fight each for his own hand, without the smallest regard for Englishmen or English interests. It is true that there is a large number of English sailors and sailormen who go in steamers; but these are found for the most part in the ships of great mail lines, and in correspondingly superior positions. To find Englishmen afloat we must go to the quarter-deck; they are all too scarce in the forecastle. But no matter what the nationality of the men who handle ships sailing under the British flag, they do their work, and they must be left free to do it. The heterogeneity of the crews with whom he had to do was at once the strong and the weak element in Mr. Wilson's programme. On the one hand, these men are very ignorant and easily led by promises. On the other hand, they have no fellow feeling or bond to hold them to each other. Thus, they could easily be persuaded to unite; but the task of keeping them together subsequently is not easily performed. Sporadic mischief they may easily be persuaded to do; for sustained effort they are not suited. The weakest element, however, in the Union was want of money. It used to be said of naval officers in the early years of the century that they often paid their debts with the fore topsail sheet, which was a polite way of saying that when pressed for money the captain put to sea and went to another port. The difficulty of getting money out of a forecastle hand is proverbial. Mr. Wilson seems to have had little success in the way of getting in subscriptions; and strikes with no strike pay are like "Hamlet" with the Danish Prince left out. No doubt the shipowners argued very much in this way, and attached less importance to the Union than it deserved. They did not take account with the strong individuality of the leader; or the somewhat sheep-like nature of the men, who, receiving abundant promises of good times to come eagerly, followed their leader without asking too many questions. If the Federation had been formed sooner there would have been less mischief done. In the shipping trade above all others it is essential that the principle of free labour should obtain. A ship has been compared to a factory, but this is no real analogy. The movement of the ship from port to port; the varying conditions under which she is employed; the rigid rules laid down by the Board of Trade for, not diet alone, but a hundred and one other things; the protective legislation which surrounds the sailor, all represent conditions which are quite unlike any that can be found in a factory. If there is a strike at one port the ship can go to another. If men strike having signed articles, their punishment comes sharply, promptly, and surely. The importance of seafaring men has been recognised and acted upon by Parliament after Parliament. The sailor is lifted out of the ordinary category of working men, and if he is to be deprived by a Union of the power of signing articles when he thinks fit, and for any pay he pleases, he will practically be deprived of liberty altogether.

The action of the shipowner is very instructive. In this, as in every other country, there is a great body of public opinion which, as a rule, never makes itself heard or felt. It is represented, for instance, by voters who do not go to the poll. These men really hold the Government of the country in their own hands. Now and then they exert themselves. When they do they make themselves felt. In the same way the employers of Great Britain have vast powers which they seldom exert. That this power should be exercised tyrannically is in the present day impossible, whatever Union leaders may say. Public opinion on the one hand, self-interest on the other, to say nothing of meritorious feeling, would step in and prevent injustice. To say the least of the shipowner, he has at all times fostered freedom of contract. He has not refused to employ a man either because he held a Union ticket or did not. It is noteworthy that a great common danger was needed to secure a great combination. Mr. Wilson has succeeded in not only calling the Sailors' and Firemen's Union into existence, but the Shipping Federation as well. Henceforth the relations of the sailor and the shipowner are placed on a new footing—it remains to be seen whether for good or evil. We believe that the formation of the Federation will do good by steadying trade. Strikes among dock labourers, sailors, and firemen have always been peculiarly disastrous. In their nature they must be local, and the harried shipowner or merchant simply leaves one port for another, and so trade is lost to a port. The very men who strike at Hull will go to Sunderland and work for the wages which they will not accept at the first-named town. When Southampton was the scene of a strike, the dock labourer sought work elsewhere. But none the less the port suffers. London has not yet recovered from the disastrous trade warfare carried on a few years ago. When it is known that the shipowners are powerful, it is less likely that wanton strikes will be undertaken lightly at the beck and call of ambitious men of the Wilson type. But the better trade is, the better will life be for the sailors and the firemen. Combinations, whether of men or masters, are fraught with risks. They must be regarded as necessary evils. But, after all, public opinion is so powerful now-a-days that the risk is minimised. In any case, great or little, it is worth incurring if by incurring it liberty is secured. Our ocean carrying trade is of too much value to be permitted to fall into the hands of demagogues. A union of shipowners is the best security against the occurrence of such a deplorable event.

### THE PARIS METROPOLITAN RAILWAY.

The antagonism that has long existed between the Municipal Council of Paris and the Government is responsible in some measure for the rejection of the project that was recently presented to the Council by M. Barthou, the Minister of Public Works, for the construction of two transverse lines across the city in connection with the Ceinture and all the main lines having their termini in Paris. The scheme had been so carefully prepared, and seemed to fulfil all the conditions of a Metropolitan in such a satisfactory manner, that its rejection has come as a surprise to everyone. The Council states that it will have nothing to do with the scheme on the following grounds. It places too much power in the hands of the railway companies, who would have authority to construct that part of the system in which they would be immediately interested, and the Council contends that the whole of the Metropolitan, being an essentially local work, should be carried out by private enterprise. This is a point upon which the Council and the Government have been in conflict on many previous occasions. It is also asserted that the project does not sufficiently serve the interests of the central quarters of Paris, and notably the Rue Reaumur, upon which the Council has already spent a large sum of money, and it is further urged that the benefits accruing to the Council from the carrying out of the scheme would not compensate it for the loss, amounting, it is estimated, to £1,200,000, that would result from the proposed free admission of the material to be used in the construction of the railway. Some other points of minor importance are also raised against the project, and it has consequently been definitely rejected. It is not now believed possible that the Metropolitan will be completed in time for the Exhibition of 1900, in which event it is difficult to see how the vast amount of traffic that will take place during that period can be dealt with. The only hope of the Metropolitan now lies in the possibility of the Government being able to rapidly draw up and pass another project that will receive the approval of the Municipal Council in time for the work to be put in hand during next year; but it is the general impression that the Council is entirely opposed to a scheme of any sort that will facilitate a displacement of population from the centre of Paris to the suburbs, and that the Government will be too busily occupied next year with the preliminary works in connection with the Exhibition to be able to pay any more attention to the underground railway.

### AMERICAN TIN-PLATE MANUFACTURE.

Whatever the Welsh tin-plate manufacturers may think of the position, and however much they could wish that it was otherwise, there would seem to be no manner of doubt that the making of tin-plates in America is a growing industry. The United States ironmasters having once determined upon taking up tin-plate production, seem resolved to go on with it, whether confronted by tariff reductions or strikes by workpeople. Returns issued by the American Treasury Department for the fiscal year ended June last, and only now available, show that in that period American manufacturers turned out of tin and terne plates from native-made black sheets, 9,000,334 lb. weight in excess of the net imports. The total production was 88,642,000 lb. For the completed year 1893 the total make from imported and American black plate alike was 123,606,000 lb., of which 54,337,000 lb. was from native black plate. In 1892 the aggregate output was 42,119,000 lb., of which more than one-half was from native raw material. In the latter half of 1891, where the industry took its rise, the make was only 2,236,000 lb. weight. It will thus be seen what gigantic strides are being made in the business. Forty firms have now established themselves as tin-plate manufacturers, of which twenty describe themselves as using solely American plates; fifteen as using both American and foreign plates, and five as employing foreign plates entirely. But it is not alone the tin-plate industry which is growing. Production of American black plate is increasing vigorously. The figures for 1893, and for the first six months of 1894, are as follows:—1893, 71,673,000 lb.; first half of 1894, 67,935,000 lb. Thus, the make of black plate in the first portion of this year has almost equalled the whole output of last year; and it is considered certain that the totals of the last half of the year will be even more favourable.

### LOCOMOTIVE COAL.

It is now certain that in the next year there will be a considerable reduction in the cost of the coal for locomotive power for the railway companies in the north-east of England. Where a year ago the scarcity of coal through the strikes caused about 8s. 9d. to 9s. per ton to be paid for coal for locomotive purposes, tenders that are accepted for the coal for next year's supply are from 9d. to 1s. per ton lower, which is a reduction that will have the effect of reducing the total cost in an appreciable manner. When the coal bill for the supply for locomotive power purposes is £26,000 monthly, the largeness of the reduction will be at once evident. Nor is the alteration an unfair one to the coal-owner, for it is certain that the selling price of some kinds of coal has fallen more since the end of autumn lessened the demand for coal for shipment. At present in the North best steam coal is quoted about 9s. 3d. per ton; and if to the 8s. per ton for railway coal, free into wagons at the collieries, there be added the cost of the carriage to the shipping port at which it is sold free on board for 9s. 3d. per ton, it will be seen that the railway price is a good one; whilst the coal-owner has the advantage of having a contract which is not liable to be disarranged by storms such as sometimes affect the ability of buyers of coal for shipment to provide steam tonnage as promptly as is sometimes needed to keep collieries fully employed. Altogether, the prospect of cheaper coal is one that will benefit the railways at a time when demands increase in other directions; and it should lead to an increase of consumption, as cheaper fuel allows a fuller use for purposes of manufacture which have been impeded in districts for want of cheap coal in the last year or two of strikes in the coal trade.

## LITERATURE.

*Charpenterie Métallique Menuisirie en Fer et Serrurerie* Par J. Denfer, Architecte, Professor A. l'Ecole Centrale. Tome premier. Paris: Gauthier-Villars et fils, Imprimeurs-Libraires. Quai des Grands-Augustins. 1894. Tous droits réserves.

The volume before us is one of the most recent additions to the well-known "Encyclopédie des Travaux Publics," which comprises some sixty valuable works relating to nearly every branch of the engineering profession. It might perhaps be considered by some readers that a couple of chapters are devoted to subjects which more strictly pertain to the province of the architect and the builder than to that of the engineer, but the extensive scale upon which steel and iron are employed—the only materials allowed by the author—the numerous forms, simple and compound, into which they are cast and wrought, and the heavy loads to which they are subjected, bring them fairly within our own domain. As an excellent and appropriate example of our meaning, we may mention the new Parcels Office of the Great Eastern Railway at the Liverpool-street terminus, recently illustrated and described in our columns.

In treating in Chapter I. of the general properties of both natural and artificial steel and iron, M. Denfer divides the former metal into seven separate classes, and assigns to each its especial *rôle* in production, manufacture, and construction, from the hardest cutting tool to the mildest drawn wire. While no doubt, so far as the extremes of this division are concerned, there prevails no marked disagreement, yet with respect to some of the intermediate gradations, different nations are not by any means at one. The Germans, for instance, in their bridges and other constructive designs, employ steel of a quality very much milder than that hitherto in use among our engineers, and consequently consider our unit strains too high. They are certainly too high for the German steel, which is obviously inferior to our own, and leads to the conclusion we have expressed on a former occasion, that they do not know in that part of the Continent how to produce steel of a quality that will stand our unit standards. It is possible that while able to actually produce it, the Germans cannot reduce the cost of the manufacture within marketable limits. The remainder of this chapter treats of every form of rolled iron, from rails to sash bars. It is stated that the flanged, or Vignoles rail, is the section most in use. In France, yes; but not in England, where the double-headed rail in heavy sections is preferred. The somewhat peculiar form in the shape of a truncated V inverted—termed "Zorès," from the name of its inventor—though much used in the platforms of bridges, has not yet supplanted the ordinary rolled joist with its simple equal upper and lower flanges. *Fer tubulaire* is a name sometimes given to rolled joists of the Zorès section. Amid the multitude of examples of this description of ironwork, all of which are drawn to a large scale and fully figured with dimensions, we do not find the *fer à coulisse*, which was the section employed for the principal joists in the construction of fireproof floors in France some years ago.

Chapter II. treats of the stresses to which columns, beams, and girders are subjected under different conditions of loading, of which both analytical and graphical demonstrations are given. The formulæ are those usually applicable, but in some instances might be simplified, as at page 68, where, instead of the equation as there represented, the shorter one might be used in which

$$\mu = \frac{p \times a\,(l - x)}{l}$$

At page 70, $\frac{p\,l}{2}$ should obviously read $\frac{p\,l}{4}$, and at page 171 the cube of $d$ is written instead of the square. After determining the moments of inertia for the various sections usually employed, the subject of the practical determination of the dimensions of them is entered into. To facilitate the calculation, a series of careful and laborious tables, occupying some sixty pages, have been made available.

Since the moment of resistance is the maximum bending moment to which a bar may be safely subjected, and the latter is represented by the general equation $\mu = \frac{I}{V}$, then, if $\mu^1$ be the moment of resistance and R the safe maximum working unit stress of the material,

$$\mu^1 = R\,\frac{I}{V}.$$

From this equation the values for $\frac{I}{V}$ are calculated and inserted in their proper column, and the moment of resistance is readily obtained by simply multiplying by R. But in order to render all calculation unnecessary, in the tables are given the safe loads for each bar, or other form of section, for spans varying from 3ft. to 33ft. The bars are supposed to be supported at both ends at the same level, and the load to be uniformly distributed. Should the load be applied at the centre, it is a simple matter to double it, and the conditions of the tables are complied with. The first series of tables relates to round and square bars, and flat thin sections set on edge; c the value for R, for both compression and tension, is made equal to 4·36 tons per square inch. In the other columns the dimensions, the weight per lineal unit, and the gross sectional area are tabulated.

Under the conditions already assumed, if P be the total load and $l$ the span, the greatest bending moment will be at the centre of the bar, and expressed by

$$\mu = \frac{P\,l}{8},$$

which will equal the moment of resistance, and consequently we have $\mu = \mu^1$, or substituting their repective values,

$$\frac{P\,l}{8} = R\,\frac{I}{V}.$$

In the tables R is equal to 7, so that

$$P = 56\,\frac{I}{V} \times \frac{1}{l}.$$

From which formula the safe loads corresponding to different spans can be obtained, or those two data known, the value of $\frac{I}{V}$ can be ascertained by inspection. It is doubtful whether the elaborate set of tables, occupying thirty pages, compiled for the calculation of the moments of resistance of ordinary built-up plate girders, are of much practical use. The author states that in the first place it is necessary to find the maximum bending moment to which the girder will be subjected. Once this calculation is made, the arrangement of the built-up section presents no difficulty, and besides, the general dimensions of girders of this class are frequently determined by other than theoretical considerations, and for which tables are useless.

Chapter III. is of a more practical character than its predecessor, and relates to the building up or putting together of the various component members which constitute in the aggregate a girder, truss, or other description of metallic framework. Semicircular, "drop of tallow," coned and countersunk rivet heads, are described and illustrated, but neither the segmental nor the cheese-headed form is mentioned. The "drop of tallow" shape answers to our ellipsoidal head. Lap and fish plate or butt joints, double and single, are briefly alluded to, but there is no analysis or any attempt made to delineate the best and most economical form. The different methods of joining various sections of iron in one, or in several planes, are well shown in numerous cuts, although some of these combinations convey the idea that they represent, as in Figs. 96 and 103, examples rather of the nature of a *tour de force* than of a real practical joint. With gussets and junction pieces of special form almost any combination can be effected.

The three remaining chapters are altogether of a practical character. In the fourth, wall ties, lintels, brackets, and bressumers are very fully dealt with and profusely illustrated. Chapter V. is devoted to the subjects of iron floors for railway stations, warehouses, theatres, stores, and private mansions, and the sixth and last treats of pillars and columns of cast, wrought iron, and steel of various sections, and of different methods of building up, including the twin columns and many ribbed base or bed plate. While simple and sufficient rules are given for calulation, it is not as a theoretical treatise that the volume of M. Denfer is to be regarded, but rather as a valuable collection of practical information, and numerous actual examples of constructive ironwork, useful alike to the student and professional man. The author reserves the subjects "Menuisirie et Serruririe" for the contents of the second volume.

---

*The Vale of Nantgwilt, a Submerged Valley.* Illustrative and descriptive of the Elan and Caerwen Valleys in Radnorshire, shortly to be submerged by the reservoirs for the water supply of Birmingham. By R. Eustace Tickell, A.M. Inst. C.E. London: J. S. Virtue and Co., 1894.

The object of this book is to preserve a record of one of the most charming valleys in Great Britain, scenes which are soon to be lost for ever, submerged beneath the waters of a chain of lakes, the reservoirs of the Corporation of Birmingham. The Vale of Nantgwilt lies at the junction of the rivers Elan and Caerwen on the borders of Radnor and Brecon. The united rivers flow into the Wye near the little market town of Rhayader. In this district 45,000 acres of land have been acquired by the Corporation of Birmingham for the purposes of its undertaking, and, when the works are completed, the valleys where now the rivers flow will be filled by a series of lakes, six in all. The sites of the Manor House of Nantgwilt, where Shelley settled in 1812 for a time, of Cwm Elan, which then belonged to his uncle, of two chapels, schoolhouse, and twenty farmsteads, will lie in depths varying from 40ft. to 90ft. of water.

More than thirty years ago the Elan Valley was selected as a suitable storage ground, and in 1871 Sir Robert Rawlinson reported upon it to the Corporation of Birmingham. Nothing came of this at the time, and in the autumn of 1890 the Corporation consulted Mr. Mansergh on the question of the extension of their water undertaking, who, after consideration of various schemes, advised the appropriation of the Elan site. Parliament gave its sanction in 1892.

Mr. Mansergh has contributed a chapter on the scheme to the work before us, from which we gather that under the powers of their Act the inhabitants of Birmingham may ultimately divert to themselves 73 million gallons a day. The aqueduct will have a length of 73 miles, with a fall of 170ft., delivering into a reservoir 600ft. above Ordnance Datum, in order that the whole district may be supplied by gravitation. The works authorised are intended to be carried out by instalments, the first of which, when completed, will be competent to supply 27 million gallons a day to Birmingham, and a like quantity of compensation water to the river. Mr. W. M. Rossetti contributes a chapter on Shelley at Cwm Elan and Nantgwilt, and probably no one is more competent for the task. The early history of the Manor is dealt with by Mr. Stephen W. Williams, F.S.A.

Besides a map of the district and a model of the watershed with some of the sections of the contemplated work, the book contains twelve full-page etchings from drawings made on the spot by Mr. Tickell himself. The greater part of the etching has been done by Mr. E. J. Burrow, of Cheltenham. The drawings are not all of the same standard of quality. Some subjects have been more congenial to Mr. Tickell than others. But they are all interesting and valuable, and some of them, in our opinion, show considerable artistic feeling and judgment. The plate "Dol-y-Mynach" is especially deserving of praise, the effect of sunlight and the distribution of masses being very pleasant. "Tan-y-Foel" and "Glan-yr-Avon" are also good. In "Pont-ar-Elan," and in a less degree "Cwm-Elan," Mr. Tickell has experienced and striven with the difficulty of rendering in black and white strongly illuminated surfaces of green. In his endeavour to reproduce the effect of light he has lost the advantage of colour, with the result that the pictures are rather snow-like. The plates are printed without affectation. There is no attempt at concealment or meretricious effect by *rétroussage*. The volume is interesting and attractive, and will no doubt be popular.

---

*Josiah Wedgwood, F.R.S.: His Personal History.* By Samuel Smiles, LL.D. London: John Murray. 1894.

We confess that our perusal of this book has resulted in some disappointment. It is now eight-and-twenty years since the publication of Miss Meteyard's "Life of Wedgwood," a work of long and laborious research, and which was generally accepted as exhaustive of the subject. It was, of course, more than possible that during the time which has elapsed since 1866, some further facts might have come to light, and the publication of Mr. Smiles's book naturally gave rise to the hope that he had struck new ground, and was in a position to tell us a good deal more than we already knew of Wedgwood and his work. This hope has, unfortunately, not been realised. Mr. Smiles tells us in his preface that he has had an opportunity of consulting the materials collected by Mr. Charles T. Gatty from the Wedgwood family manuscripts, which documents "for the most part had not been investigated by former biographers;" but Miss Meteyard—to whose work Mr. Smiles only refers in the most casual manner—acknowledges her obligation to the Wedgwood family and others, including Mr. Smiles himself, for the assistance they gave her. Mr. Smiles tells us that the papers include Wedgwood's diaries and commonplace books, his correspondence, invoices, &c.; but as he does not refer specifically to his authorities as he proceeds, we are left to our own resourses to discover what is the new matter of which he makes use. We have done our best, and we repeat that we are disappointed with the result. Some fresh documents are apparent, notably a few relating to Flaxman, one of which Mr. Smiles considers of great importance, as proving the authorship of the well-known bust of Mercury, but we were not aware that there ever was any doubt that Flaxman was the modeller. He has also found Sir William Hamilton's reply to Wedgwood's letter of June, 1786, to which Miss Meteyard confesses she has no clue. There are some further details of Wedgwood's journey to Cornwall in search of clay deposits, and here and there other new lights; but, upon the whole, we cannot say that the central personage or any of his contemporaries are made much better known to us, and, so far as we can find, we are told nothing new as to the potter's technology. In many places, as we read Mr. Smiles, we seem to be reading familiar passages from Miss Meteyard; but this may be due to the fact that both were working with the same materials before them. Mr. Smiles passes lightly over the vexed question of the mysterious Barberini or Portland vase. In one place he describes it as "perhaps the finest work of the kind made by the ancient Greeks;" in another he calls it "a splendid example of Greek or Etruscan art." But he does not deal with the suggestion of Alexandrian origin at all. Everything from the pen of Mr. Smiles is read with so much interest that criticism is inevitable, and probably invited; but, notwithstanding shortcomings, there is no doubt that within the compass of this little volume the author has presented us with a just and very readable biography of a most interesting person.

---

*Transportation Exhibits at the Columbian Exhibition,* 1893 By James Dredge. London: Office of *Engineering*, Bedford-street. New York: James Wyley and Sons. 1894.

This is a colossal folio, beautifully printed on excellent paper, and copiously illustrated. We are somewhat at a loss to imagine how one busy man could, in a very few months, produce such a work. The title is, moreover, in some sense a misnomer, because the book treats of multitudinous matters which have only a remote connection with transportation. Thus, for example, stationary engines and electric lighting plant are not necessarily connected with transport; and this is also true of guns—unless, indeed, we regard them as means of transporting projectiles from place to place in a hurry.

Mainly, however, the volume is devoted to rolling stock and steamships. The American locomotive has never been more fully described and illustrated in all its types and varieties. Everything in the book has been well done, and the result is, as a whole, in this sense quite satisfactory. But the work has a defect which will militate against its utility. It is quite too unwieldy. Had it been divided into two volumes, each would still have been too large. By far the better arrangement would have consisted in treating each subject to itself. As a record the book will be in the future invaluable. Its utility in the present is as a work of reference, and for that it is too unhandy. The age of ponderous tomes has passed away, and our appreciation of Mr. Dredge's book is tempered by the reflection that it is a survival of an all but extinct type. It can, however, fairly claim that it is the finest record of a great exhibition that has ever been published.

---

### BOOKS RECEIVED.

*Tempera e Cementazione per l'Ingegnere Starnislo Fadda.* Milano, Ulrico Hoepli. Editore-Libraio della Real Casa. 1894.

*The Elementary Properties of the Elliptic Functions.* With examples. By Alfred Cardew Dixon, M.A. Price 5s. London: Macmillan and Co. 1894.

*An Elementary Treatise on Theoretical Mechanics.* By Alexander Ziwet. Part III.: Kinetics. Price 8s. 6d., net. London: Macmillan and Co. 1894.

*Eleventh Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution,* 1889-90. By J. W. Powell, Director. Washington Government Printing Office. 1894.

*Tenth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution,* 1888-89. By J. W. Powell, Director. Washington: Government Printing Office. 1893.

*Elliptical Orbits: Their Distinctive Mechanical Characteristics and their Possible Origin.* By Henry Larkin. With original illustrations. Price 1s. London: T. Fisher Unwin. 1895.

*Twelfth Annual Report of the United States Geological Survey to the Secretary of the Interior,* 1890-91. By J. W. Powell, Director. Part I., Geology. Part II., Irrigation. Washington Government Printing Office. 1891.

*A Treatise on Industrial Photometry, with special application to Electric Lighting.* By A. Palaz, Sc.D. Authorised translation from the French by George W. Patterson, jun., M.A.B.S., and Merib Rowley Patterson, B.A. London: Sampson Low, Marston and Co. 1894.

*Provisional Orders of the Board of Trade in reference to Gas and Water, Tramway, Pier, and Harbour, and Electric Light Undertakings, being a Manual of Practice for Promoters, Opponents, and others.* By Francis J. Crowther. Second edition. London: Jordan and Sons. 1894.

*The Railway Diary and Officials' Directory,* 1895, *and The Railway Almanack.* London: McCorquodale and Co., Limited, and W. H. Smith and Son. The almanack is a very useful sheet of information, relating to our railways and railway traffic and officials, and the diary maintains the high character it has earned as a most useful reference book on railway matters.

*History of the Tower Bridge and of other Bridges over the Thames built by the Corporation of London.* Including an account of the Bridge House Trust from the Twelfth Century, based on the records of the Bridge House Estates Committee. By Charles Welch, F.S.A.; with a description of the Tower Bridge by J. Wolfe Barry, C.B., M. Inst. C.E., and an introduction by the Rev. Canon Benham, B.D., F.S.A. Prepared under the direction of the Bridge House Estates Committee—Sir Albert J. Altman, chairman. London: Smith, Elder and Co. 1894. 25s. net.

*Hazell's Annual for* 1895: *A Cyclopædic Record of Men and Topics of the Day.* Edited by W. Palmer, B.A. (Lond.). Revised to November 26th, 1894. Tenth year of issue. London: Hazell, Watson, & Viney, Limited. Hodder and Stoughton. 1895. Among the new articles written specially for this edition, we notice those on astronomy, bullet-proof cuirasses, electricity, engineering inventions during the year 1894, mining and railways, all of which are terse and well worth reading—giving, as they do, leading dates, figures, and facts connected with these subjects. Apart from this, the "Annual" is a valuable book of reference and fund of information to all who wish their general knowledge to be up to date.

*Toothed Gearing: A Practical Book for Offices and Workshops.* By a Foreman Patternmaker. London: Crosby Lockwood and Sons. *Helical Gears: A Practical Treatise.* By a Foreman Patternmaker. London: Whittaker and Co. These are practical and useful books, and though written a good deal from the pattern-making point of view, which is most important in connection with gearing, they show that the author's knowledge would enable him to describe himself by several other titles. The book on helical gears, how to design and mould them, was necessary, and will be found a useful guide in the office and workshop. We notice that, like other authors on gearing, he omits to deal with internal toothed gear.

*Forty-three Graphic Tables and Diagrams for the Conversion of Measurements in Different Units.* By Robert H. Smith, Professor of Engineering, Mason College, Birmingham. Price 7s. 6d. London: Charles Griffin and Co. 1895—The tables are intended to show at a glance the figures which correspond in one system with their values in another in questions relating to length, area, volume, weight, stress, density, work, and energy in mechanical, thermal, and electrical units, horse-power, and temperature. These tables are very useful for showing at a glance figures which would take much longer time to obtain in other ways. One of the horse-power tables, for instance, gives at a glance English and French horse-power, and English or French horse-power compared with kilowatts.

*Turning Lathes: A Manual for Technical Schools and Apprentices; a Guide to Turning, Screw Cutting, Metal Spinning, Ornamental Turning, &c.* With 225 Illustrations. Edited by James Lukin, B.A. Fourth edition. Britannia Company, Colchester.—The additions to this edition form a most interesting as well as a large part of the book. They deal particularly with the use of excentric, oval, and dome chucks and the horizontal cutting frame, all of which are so useful in the ornamental turning in which amateurs delight. Some additions, however, relate to important work in connection with pattern-making and with the turning of various shapes required in instrument and other construction. The engravings of this edition are an improvement on those of the first edition.

*The London Building Act,* 1894. *With Bye-laws and Regulations of the London County Council, and Introduction, Notes, Cases, and Index.* By Alex. J. David, B.A., LL. M. (Cantab.), of the Inner Temple, barrister-at-law. Price 3s. 6d. London: Crosby Lockwood and Son. 1894.—This book sets forth and explains the new Act which comes into force on the 1st of January, 1895. It consolidates all the existing enactments, and places them under a single Act. Its importance is shown by the fact that no less than three papers are about to be or are now under discussion before the Architectural and Sanitary Engineering Societies. Cases forming precedents in each section are given throughout the book. It may be hoped that some of the inconsistencies and useless restrictions common under the existing Acts will not be possible under the new one.

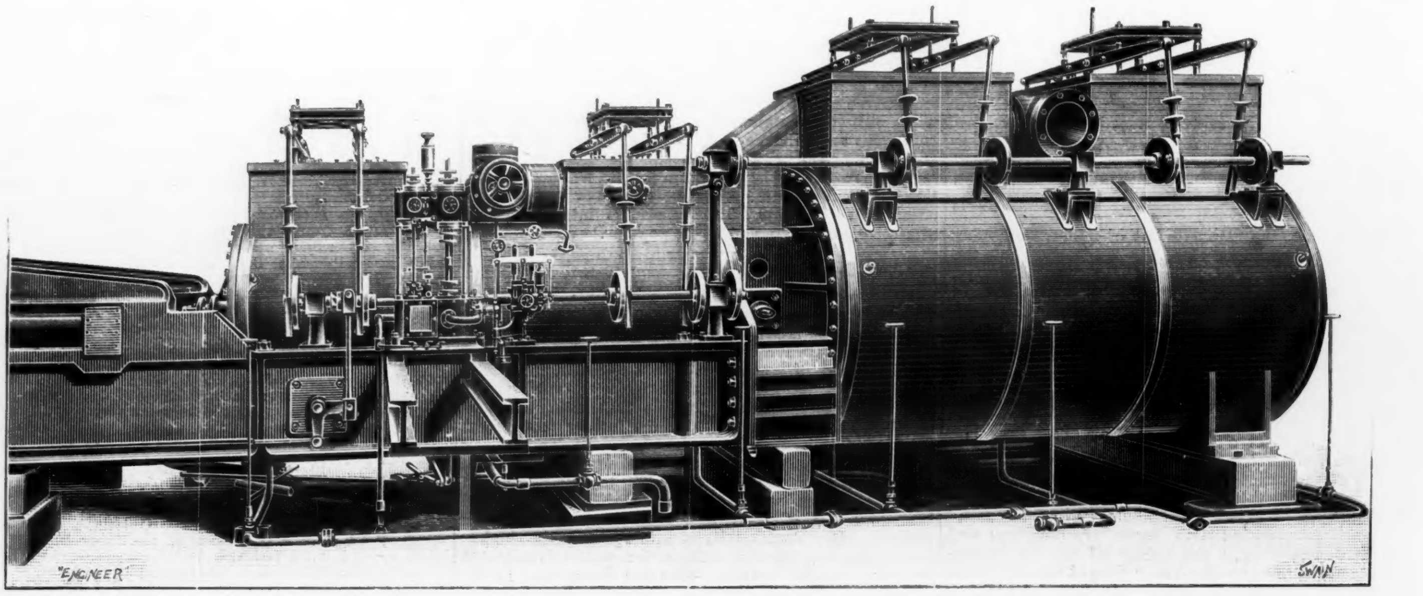
*The "Fifty-One Hour" Wages Reckoner.* Consisting of computations per week and computations per hour for a working month, with a supplementary comparative table, applicable to weeks of forty-eight, fifty-four, fifty-seven, and sixty hours respectively. By a Retired Banker. Price 2s. 6d. Edinburgh: Johnstone, Hunter, and Co. 1894.—These tables give the wages for any number of hours and parts of hours, from one hour to fifty-one, and at wages varying from 2s. to £2 10s. per week of fifty-one hours. The tables occupy 244 pages, and extend from the quarter of an hour to 231 hours or twenty-seven working days, so that they suit for monthly payments. A supplementary table is given, which shows the value of one hour's labour contained in the fifty-one hours' table as compared with the value when the hours are forty-eight, fifty-four, fifty-seven, or sixty per week.

---

On Tuesday last the Metal Trade Section of the London Chamber of Commerce met to consider the desirability of recommending the Council of the Chamber to take steps with a view to preventing the unfair competition of insolvent companies for Government work by urging the insertion of a clause in all Admiralty contracts for chains, cables, anchors, &c., similar to that which is inserted in the conditions of contract of the War-office, India-office, and Trinity House, *i.e.*—That should the contractor be adjudged bankrupt or have a receiving order made against him, or make or enter into any arrangement or composition with his creditors, or suspend payment, or being a company, should enter into any liquidation, compulsory or voluntary, the contract may be determined summarily by the Lords Commissioners of the Admiralty without compensation to the contractors.

# ONE THOUSAND HORSE-POWER PUMPING ENGINES

MESSRS. HATHORN DAVEY AND CO., LEEDS, ENGINEERS

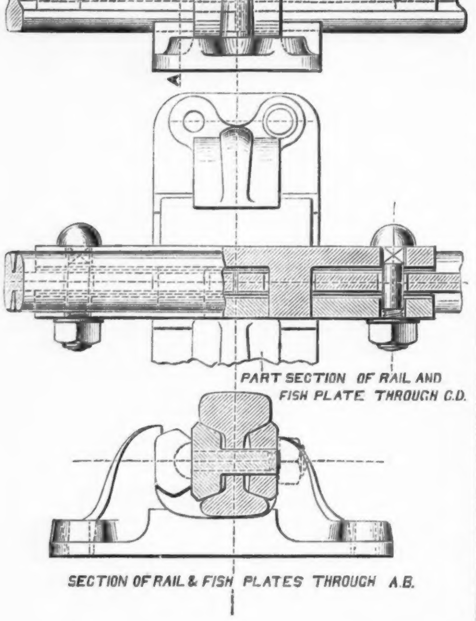


## DAVEY PUMPING ENGINE.

We illustrate a pair of Davey pumping engines of large size recently made by Messrs. Hathorn, Davey, and Co., of Leeds, for draining mines. Three pairs were made from the same designs—two pairs were sent abroad, and one pair to South Wales. The pair of engines are erected side by side and pump from the same pit, both engines and pumps being duplicates of each other. Together they represent 1000-horse power in water lifted. The cylinders are 40in. and 76in. by 10ft. stroke. In one case the pumps are placed at the bottom of the pit 800ft. from the surface, the connection between the engine and the pumps being made with spur rods 20in. square of pitch pine. This system—which was originated, and has been developed by Mr. Davey—of pumping to great heights in one lift with spear pumps, is now very largely employed. The old system was to divide the depth into lifts not exceeding 250ft., one pump lifting to the next one above it. These pumping plants are very heavy, one pair of the engines which we illustrate, with its pumps complete, weighing upwards of 1000 tons. The valve gear is a modification of the well-known differential gear. If a breakdown takes place, steam is immediately and completely shut off.

## PITTWAY AND WOOD'S FISH-PLATE.

The fish-plate illustrated by the engravings below is and has been under trial on the Manchester, Sheffield, and Lincolnshire Railway under heavy mineral traffic, which they have, we are informed, now carried for over nine months.



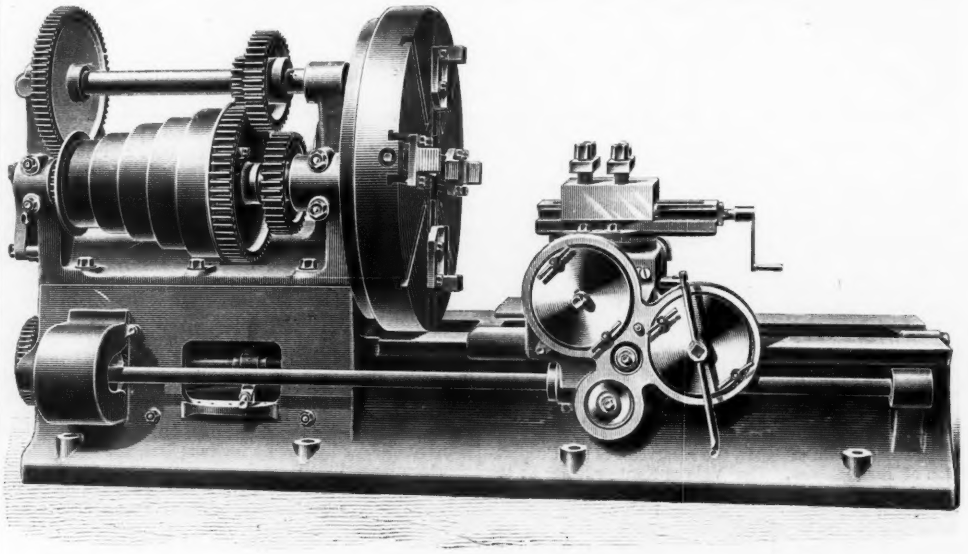
PART SECTION OF RAIL AND FISH PLATE THROUGH C.D.

SECTION OF RAIL & FISH PLATES THROUGH A.B.

The claims made for the new fish-plate are, that while it supports the rails where they butt, a chair may be placed under the fish-plate, which cannot be satisfactorily done with those now generally in use. Further, the spigot being part of the fish-plate, and going through the rails, keeps both ends level, and thus prevents the wearing of the ends of the rails, and the harmful hammering which consequently takes place at these joints. They are made by Mr. W. O. Wood, of Anerley, London.

## SURFACING AND BORING LATHE.

We herewith illustrate a surfacing and boring lathe, arranged to produce chuck work rapidly. It possesses features which, though not novel in principle, are sufficiently so in application to deserve notice. The feeds, which are positive and continuous, admit of change by movement of a handle in front of the headstock, without stopping the lathe, the alterations taking place almost instantaneously. The feed can also be started or stopped by means of the thumbscrews, shown on discs. The principal dimensions of this lathe, which weighs 110 cwt., are as follows:—Height of centre from bed 24in., swing 48in., chuck 45in. diameter. The makers are Messrs. John Lang and Sons, Johnstone, N.B.



SURFACING AND BORING LATHE

## GRAVITATION WATER SUPPLIES AND ELECTRIC ENERGY.

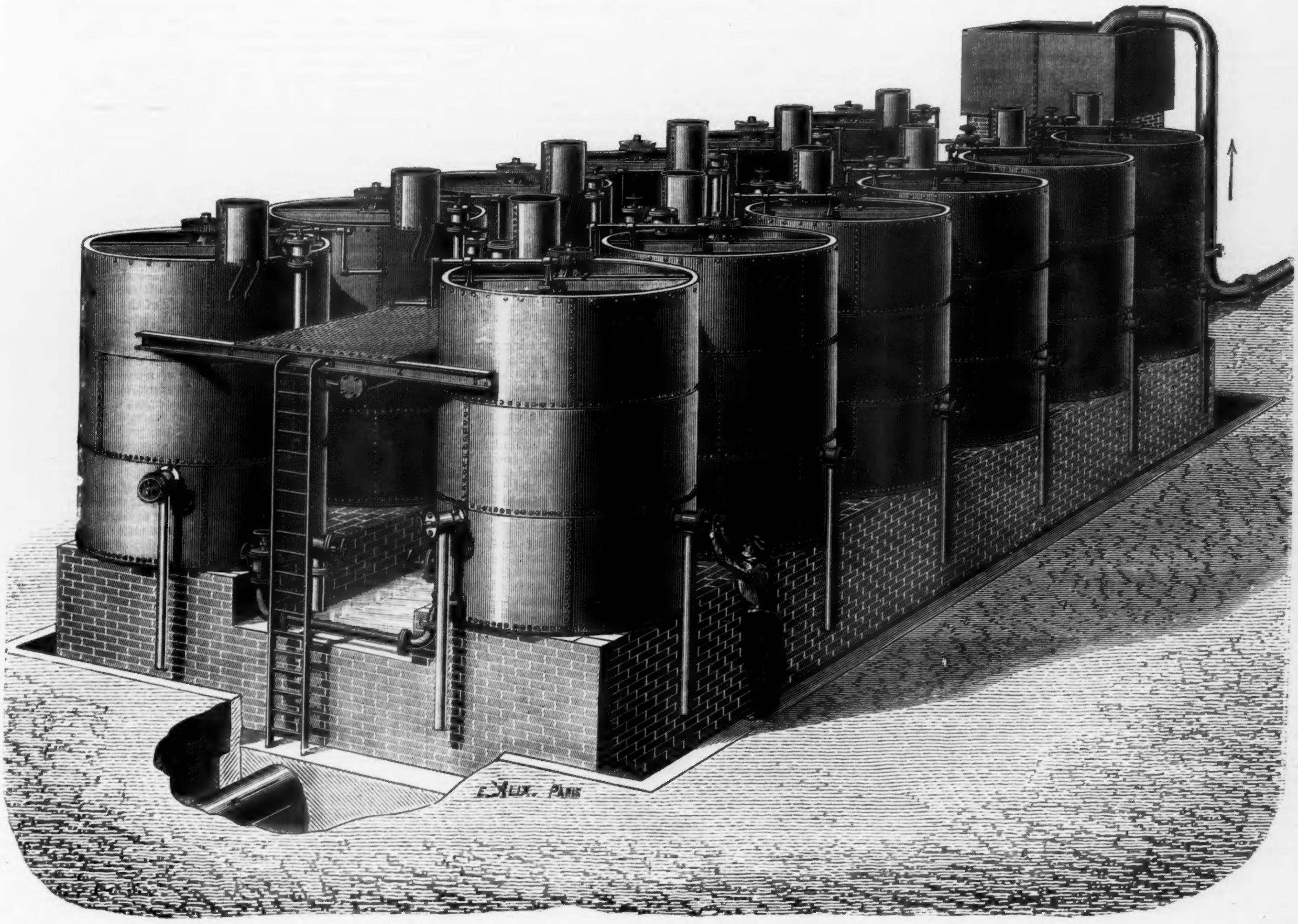
The rapidly extending use of water power for the generation of electricity at many places abroad has naturally directed attention to the home possibilities in this direction. These are soon found to be disappointing, the best water power locations having been long ago utilised for various motive purposes. There are, it is true, numberless points on the smaller streams throughout the country capable of furnishing power for small lighting installations; but generally the water power in Great Britain, not subject to old established rights, is meagre or capricious. In some parts of Ireland, however, there is abundance of water power capable of utilisation. But apart from natural sources, there is another and constantly increasing form of water power in the great works, completed and in progress, for supplying the inhabitants of cities, towns, and villages, with potable water. Here also, however, a very slight amount of investigation shows that though the power represented in many cases by the flow of water and its fall may be great, the energy capable of utilisation is generally small, and often practically non-existent. For instance, at Glasgow nearly 50,000,000 gallons of water flow daily into the city and suburbs from Loch Katrine, which has an elevation of about 350ft. above the lower streets of the town. The power represented by these figures would, if capable of employment for lighting by electricity, effect a great saving in the corporation coal bill. But, of course, the water does not run direct from the highest to the lowest point. It runs first into the distributing reservoirs at Craigmaddie, situated some 50ft. below the level of Loch Katrine, and is conveyed mainly in open culverts, so that little power is derivable at its debouchment. From Craigmaddie the water is piped; but some of the natural elevations in Glasgow are over 250ft. in height, with buildings of about 50ft. elevation on their summits; so that in some cases the head of water does not suffice for the supply, and pumping is resorted to. In short, though in some of the lower districts there may be at times an excess of pressure, practically all the energy due to the head and volume of water is absorbed in its own distribution. Very similar conditions obtain in cities like Manchester and Liverpool. There are, however—especially in Scotland—many towns where the gravitation water supplies are capable of furnishing considerable quantities of electrical energy at a comparatively small outlay and without detriment to the water distribution. To cite a case—a small town on Clyde, with reservoirs at over 500ft. above the river level, gives its inhabitants a liberal supply of 600,000 gallons per day. To keep the pressure at the lower parts of the town within reasonable limits, the main pipe is broken 250ft. below the level of the reservoirs, the water discharging into a distributing tank with an amount of energy equal to nearly one hundred horse-power—in the meantime unutilised. To have undertaken the construction of the works merely to get this power would have been out of the question; but the instance shows that it may be quite worth the attention of engineers, when laying out new works in hilly districts, to consider the power possibilities of their schemes, as there are no doubt many localities adapted for the combination of a power station and water supply works.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Engineers, George W. Roome, to Royal Naval College; G. E. Wheatley, to the Cockatrice. Assistant Engineer, J. W. Mountifield, to the Blenheim. Probationary Assistant Engineer, Charles J. M. Wallace, to the Hood.

Patents in Japan.—The following is an extract from a letter concerning patents and trade marks in Japan, which has been received by Mr. J. E. Evans-Jackson:—"A new treaty has been concluded with Japan. Article 17 of the treaty provides that 'the subjects of each of the high contracting parties shall enjoy in the dominions and possessions of the other the same protection as native subjects in regard to patents, trade-marks, and designs, upon fulfilment of the formalities prescribed by law." By a proctocol signed at the same time, and which, together with the treaty, will shortly be published, the Japanese Government undertake before the cessation of British Consular jurisdiction in Japan, to join the international conventions for the protection of industrial property and copyright. The treaty will, however, not come into force for at last five years, and, until it does, British Consular jurisdiction in Japan will continue to be exercised.

# BATTERY OF FILTERS, LAY SUGAR FACTORY, CAIRO

MESSRS. THWAITES BROS., BRADFORD, ENGINEERS



## FILTRATION OF NILE WATER FOR SUGAR WORKS.

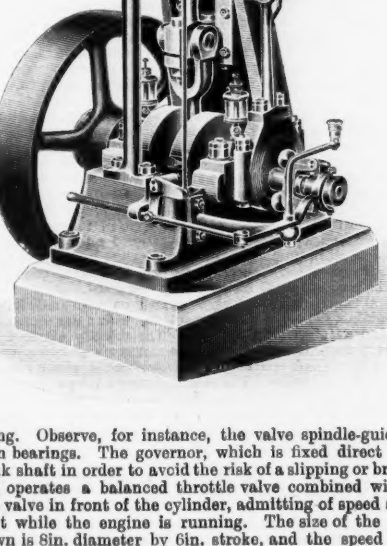
The above illustration is from a photograph of a battery of filters lately erected at the "Lay Sugar Refinery," Cairo. The plant was erected for the purpose of filtering water drawn from the river Nile, which brings down large quantities of mineral and organic matter in suspension, all of which must be removed. Each of these filters is 9ft. diameter by 11ft. high, and is, we are informed, capable of passing 220,000 gallons per 24 hours, giving a total output for the whole battery of over 2½ million gallons per 24 hours. The filters, the essential features of the construction of which we described in our impression for January 4th last, are so arranged that the cleansing of each filter bed can be easily and rapidly effected by causing filtered water to flow upwards through the bed, which is composed of 2ft. of specially prepared and graded crushed silex; and by the simultaneous use of the circular rake or agitator, with which each filter is fitted, and worked from the gangway by means of a crank handle and worm and wheel gearing. The small tank at the top of each filter is to hold a solution of sulphate of aluminium or some similar material, which is allowed to drop into the filter, and by reason of its properties of coagulation is able to assist the filter bed in its work. The whole of this precipitant or coagulant is caught in the bed, and its presence cannot be detected in the filtered water. The rate at which these filters do their work of separation and filtration is remarkable. The aggregate area of the twelve filter beds is 763·44 square feet, through which the water passes at an approximate speed of 23ft. per hour, giving a duty of 144 gallons per square foot per hour. These filters have, we are informed, proved most successful where it has been necessary to remove matter in suspension from organically pure water, or from water which is to be organically purified by a secondary and slower filtration through some oxidising medium, such as "Polarite," the virtue of which would be to a large extent destroyed were it allowed io become clogged by suspended matter. The filters are made under Howatson's patents by Thwaites Bros., Ld., Bradford.

---

Dock Pumping by Gas Engines.—Messrs. Crossley Brothers, Limited, of Manchester, have secured an important contract for the River Wear Commissioners at Sunderland. The work is in connection with a large graving dock. It consists of discharging 14,800 tons of water in two hours. Three of Messrs. Crossley Brothers' new patent scavenging engines will be used, coupled direct to three large centrifugal pumps, made by Messrs. Gwynne and Co., of Brooke-street Works, Holborn. A smaller engine and centrifugal pump is also to be used for keeping down the leakage water after the dock is emptied. The whole arrangement has been carefully thought out under the direction of Mr. H. H. Wake, C.E., the Commissioners' engineer; and as this is a new departure in direct gas engine driving with centrifugal pumps, the results may be looked forward to with considerable interest. When completed it will be the largest gas engine pumping plant in the country. The great advantage in using gas engines for this purpose is that the power is available as soon as wanted, and there is no occasion to keep steam up all day on the offchance of the engines being required. We may add that the ordinary town's gas is being used in this instance for driving the engines.

## HIGH SPEED ENGINE.

The illustration shows a high-speed engine suitable for coupling direct to dynamos, although it can be used for belt driving besides. The back column and sole-plate are cast together, and the general design of the engine is unusually strong. Observe, for instance, the valve spindle-guide and main bearings. The governor, which is fixed direct to the crank shaft in order to avoid the risk of a slipping or breaking belt, operates a balanced throttle valve combined with the stop valve in front of the cylinder, admitting of speed adjustment while the engine is running. The size of the engine shown is 8in. diameter by 6in. stroke, and the speed is 325 revolutions per minute. These engines are made in various sizes by Alex. Shanks and Son, Limited, of 110, Cannon-street, E.C., and Arbroath.



---

The Civil and Mechanical Engineers' Society.—On Wednesday week a large number of members of this Society visited the works of the East London Water Company at Lea Bridge, and were kindly shown over, by the Chief Engineer, Mr. W. B. Bryan, M.I.C.E., the various engine-houses, turbine-houses, and other works of this ancient water company. The members inspected four Cornish pumping engines, three sets of triple expansion Corliss gear engines, and a new set of triple expansion overhead marine type pumping engines, two compound horizontal pumping engines, and four Hercules turbines used for pumping. The members were also shown a rotary pump made by the Drum Engineering Co., working under a head of 200ft., which had been tested, and was stated to have yielded an efficiency of 80 per cent.; many and various apparatus for facilitating communication between districts; the working and governing of the engines and pumps, amongst these being notably that of the electrically-worked stop valve, and many ingenious contrivances designed by Mr. W. B. Bryan. The members were also shown over the new boiler-house, inspected the sluices, the tubular aqueduct over the canal, and had a very interesting description, given to them by the engineer, of the working arrangements of the company, the difficulties met with and overcome in obtaining water from their wells; and also were shown some of the original receipts of Messrs. Bolton and Watt for money paid to them at the end of last century for coal saved by those pumping engines that had been erected by them. Among those present were Messrs. C. T. Walrond, C.E. (the President), R. Booth, C.E., Rowan, C.E., Kuhne, C.E., E. H. G. Brewster, C.E. (hon. sec.), A. Wollheim, C.E., J. F. Reade, C.E., W. M. Binny, C.E.

Institution of Civil Engineers: Manchester Association of Students.—A meeting of this society was held on the 12th, when Mr. C. H. Wordingham, Assoc. M. Inst. C.E., read a paper describing the Manchester Electric Lighting Works. Mr. A Ross, M. Inst. of C.E., President of the Association, occupied the chair. The author first referred to the interest excited among engineers by the Manchester electric supply on account of its magnitude and importance, and more especially because the five-wire system decided upon by the engineer, Dr. John Hopkinson, F.R.S., M. Inst. C.E., is entirely new in this country, and has not been largely used either in Europe or America. He stated that after rather more than a year's working Dr. Hopkinson's boldness has been fully justified, and it is interesting to note that the St. Pancras Vestry are on the point of converting their three-wire into a five-wire system. He then described in detail the arrangement of the fire-wire system and the method of working the same, comparing the method and arrangement of the two and three-wire systems. He next explained the system of mains and the method of running the conductors and the switching arrangements, passing on to a description of the dynamos, engines, boilers, and coaling arrangements. The author stated that up to date 55,700 incandescent lamps, reckoned in the equivalent of 8-candle power each, 311 arc lamps and eleven motors, have been connected to the mains, and that the number of applications at present is very large. Considerable extensions are contemplated for next winter, and there is every indication that this will be the largest municipal station in the kingdom. Messrs. J. W. Welch, J. F. Conradi, H. M. Allott, and A. J. Jenkins took part in the discussion which followed, and a hearty vote of thanks was passed to Mr. Wordingham for his interesting paper, on the motion of Mr. Allott seconded by Mr. Parkinson.

# LEGAL INTELLIGENCE.

## SUPREME COURT OF JUSTICE.—COURT OF APPEAL.

(*Before the* Master of the Rolls, Lord Justice Lopes, *and* Lord Justice Rigby.)

December 18th, 1894.

### MUIRHEAD AND OTHERS V. COMMERCIAL CABLE COMPANY.

This was an appeal of the defendants from the judgment of Mr. Justice Kennedy at the trial of the action without a jury, a report of which, with the judgment, was given in The Engineer of the 4th of May last. The plaintiffs, who are the patentees and proprietors of certain patents for the system of duplicating cables known as the Muirhead duplex system of telegraphy, sued the defendants, a foreign company, incorporated under the laws of the United States of America, and the owners of certain telegraph cables between North America and Ireland, to recover £356 for royalties in respect of a part of the year 1891, under a deed dated January 2nd, 1884, giving the defendants a licence to use certain patents of the plaintiffs in consideration of certain yearly payments. The defendants admitted the deed, but alleged that the patents in question had expired at a certain date, and that they were not liable to pay the royalties claimed. As set forth in our impression above referred to, that Messrs. Muirhead took out an English patent in 1876 for duplex telegraphy, and in 1880 they took out a patent in the United States for duplex telegraphy. The English patent expired in 1890, and the defendants contended that the American patent of 1880 was substantially identical with the English patent of 1876, and that the American patent expired at the same date as the English patent, inasmuch as the law of the United States provides that every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent. They, therefore, contended that the American patent had expired, and that they were not liable to pay the royalties claimed. If, on the other hand, as the plaintiffs contended, the American patent were not substantially identical with the English patent, the American patent would last for seventeen years from 1880, and the defendants would, therefore, be liable not only in this action, but also for royalties up to the expiration of the American patent. It appeared that by means of Muirhead's duplex system of telegraphy two submarine telegraphic messages could be sent along the same cable at the same moment in opposite directions. Formerly, when a message was sent along the cable from, say, England to America, the receiving instrument on the English side as well as that on the American side was affected by the electric current. Muirhead's patents were to render the receiving instrument at the end from which the message was sent unaffected by a message sent from that end, with the result that a message could be sent from the opposite end at the same time. The chief essential was to maintain a perfect balance of electrical pressure, and this was done by means of a mechanical contrivance, used at both ends of the cable and known as Muirhead's artificial cable, in combination with certain resistances and other known electrical appliances. At the trial a large number of scientific witnesses were called upon both sides as to whether the two patents were substantially identical—that is, whether the two inventions claimed were the same. The learned Judge came to the conclusion that the English patent of 1876 did not contain the same combination as was found in the American patent of 1880, and that the latter was a good and novel patent. He accordingly gave judgment for the plaintiffs. The defendants appealed.

Sir Richard Webster, Q C., and Mr. Moulton, Q.C.—Mr. A. J. Walter with them—appeared for the defendants; Mr. Finlay, Q.C., and Mr. Bousfield, Q C.—Mr. Pollard with them—appeared for the plaintiffs.

The Court, having taken time to consider, delivered judgment on Tuesday last, allowing the appeal, the Master of the Rolls dissenting.

The Master of the Rolls said that the question in the action related to two patents, one in England and the other in America. If the American patent had not expired the plaintiffs were entitled to recover. The case was tried before Mr. Justice Kennedy, and he (the Master of the Rolls) was prepared to say that he had never read a judgment more accurately written, in which the learned Judge went step by step through the case most carefully, and the judgment was so admirably expressed that he was unable now to add anything to it, and he was prepared to adopt it as his own. The learned Judge stated the law correctly, and the question was whether the invention patented in America was the same invention as was patented in England. The patent in America was for a combination. It was so in terms, and was so claimed. That combination consisted in the relative position of certain things in it which were to do the work, and the patent was for a combination of those things in that position. Then how could the English invention be the same unless it was for the same combination? The English invention was not claimed as a combination, nor was it used as a combination. Certain of the scientific witnesses stated that the particular placing of the things as described in the American patent was a most useful invention, and that between the time of the English and the American patents the combination was not used because it was not discovered. Therefore, he came to the conclusion that the American patent was not the same as the English patent. He came to the conclusion that Mr. Justice Kennedy was right. But if the matter was left in any doubt, in order to shorten the period of the American patent the whole burden of proof rested on the defendants, and, the matter being left in doubt, that burden had not been discharged. In his opinion the appeal should be dismissed.

Lord Justice Rigby read the judgment of Lord Justice Lopes and himself, in the course of which he said that the decision in the case depended upon one point, and one point only—namely, whether or not the United States patent of 1880 came to an end when the English patent of 1876 expired. He did not think that Mr. Justice Kennedy's findings as to the United States law could be impeached, and he agreed with the learned Judge that a test of the identity of the patents was whether a structure made according to the foreign patent would infringe the United States patent. He also agreed that the burden of proving the identity of the two inventions lay upon the defendants, and that the principle of introducing into any patent by implication any claim not expressly contained therein, ought to be applied with the greatest possible caution. His Lordship then proceeded to consider the construction of the two patents and the evidence relating thereto, and, having elaborately examined the two patents and having gone through the scientific evidence upon the point, came to the conclusion that the defendants had made out their case affirmatively, and that there was no room for the application of the principle that, where there was a doubt, the doubt should be resolved in favour of the United States patentee. He did not in any way differ upon the law from the learned Judge, whose judgment, he agreed, was most admirably expressed, but he did differ rom him in the conclusions of fact at which he had arrived.

---

*Before* Lord Halsbury *and* Lords Justices Lindley *and* A. L. Smith.)

### HELFER *v.* THE CITY OF LONDON ELECTRIC LIGHTING COMPANY—MEUX'S BREWERY COMPANY (LIMITED) *v.* THE SAME.

These appeals were against a decision in April last by Mr. Justice Kekewich refusing an injunction to restrain the City of London Electric Company from causing a nuisance by noise and vibration resulting from the running of their engines and generating machinery. Their Lordships reversed the decision of Mr. Justice Kekewich, and decided that the injunction must be granted.

# REPORT OF THE SECRETARY OF THE UNITED STATES NAVY.

The annual report of Mr. Herbert, Secretary of the Navy of the United States, was issued in November, and the following are some extracts therefrom :—

The following new vessels have been completed and tried since the date of my last report :—Marblehead, 18 44 knots ; Columbia, 22·80 knots ; Olympia, 21·69 knots ; Montgomery, 19,056 knots ; Minneapolis, 23·076 knots. The Indiana, Texas, and Oregon have had unofficial preliminary trials under the direction of the contractors, and the Maine had her official machinery trial on October 17th, 1894, her engines developing 9224·3 indicated horse-power for four hours, and showing an average speed of 17 knots.

The last Naval Appropriation Act contained a provision authorising the construction of three additional torpedo-boats. The department has carefully considered questions relating to the development of this type of vessel, both at home and abroad, and has finally decided upon the construction of torpedo-boats of the general type of the Ericsson, and with a slightly greater displacement, and to attain an average speed of not less than 24·5 knots on the acceptance trial. No speed premiums will be provided for in the contracts for the building of these vessels. In the contracts for the construction of gunboats Nos. 7, 8, and 9 small premiums and penalties were provided for. This system undoubtedly has its advantages when adopted, but reflection has convinced the department that the time has come when with the experience that has been gained by it may with profit be abandoned.

Work on the first-class battleship Iowa is progressing as rapidly as the requirements of good workmanship will permit, and it is expected that the vessel will be completed during the latter part of 1896. The first-class battleships Indiana, Massachusetts, and Oregon are well advanced toward completion, and will be in condition for acceptance by the Government within the coming year. The second-class battleship Maine will be ready for commissioning before the end of this fiscal year. She is being built at the New York naval yard, and her recent machinery trial at sea indicates that she is to be a gratifying success. The second-class battleship Texas is practically ready for her machinery trial, and should be completed and ready for commissioning a few months later.

Work on the armoured cruiser Brooklyn is progressing favourably, and it is expected that this vessel will be completed during the early months of 1896. Rapid progress is being made on the double-turreted monitors Puritan and Monadnock, and these vessels will probably be ready for trial before the end of this fiscal year. Work on the double-turreted monitors Terror and Amphitrite is so well advanced that, in case of an emergency, these vessels could be prepared for service within a few months. The armoured ram Katahdin will probably be completed during the early part of the next fiscal year. The protected cruiser Olympia has been successfully tried, and is now practically ready for commissioning. The progress of work on the three gunboats Nos. 7, 8, and 9 is such as to indicate that they will be completed within the contract time. Such an examination as the department has been able to make, with the information at its disposal, appears to justify the conclusion that these vessels have been contracted for at a price per ton fully as low as is paid for similar work in France and England.

Shortly before my last annual report was submitted, the department discovered that the Detroit and her sister ships, the Montgomery and Marblehead, and the Machias and her sister ship, the Castine, all then nearing completion, were deficient in initial stability. In order to obtain positive and accurate knowledge, a board, of which Rear-Admiral J. G. Walker, United States Navy, was president, and consisting of officers who had been in nowise connected with the designing or construction of these ships, was appointed to thoroughly examine these ships, and make such recommendations as might be deemed necessary. The changes recommended in the three ships of the Detroit class have been made, and these vessels are now fully equal to the exigencies of the naval service, and are in commission. The board recommended removing certain top weights from the Machias and Castine, placing ballast in their bottoms, and lengthening each of them by 14ft. This has also been done, and the result of the alterations has justified the wisdom of the recommendations. The discovery of the errors in the construction of the two last-mentioned ships induced the department to extend the functions of the Walker Board, and to order a thorough examination of all vessels then in process of construction about whose stability there could be any possible question. If errors existed in the designs of these other ships, it was important that the department should have knowledge of them at the very earliest moment. The report of the board was highly satisfactory, and especially as to the battleships, the board reporting that "The result of the inclining experiment of the calculations of these vessels is a most satisfactory and gratifying verification of the results of the original design, demonstrating a remarkable degree of accuracy in the calculations." The difference between the estimates and the actual result was five-eighths of an inch less metacentric height than design.

The guns required for the new vessels heretofore authorised are now so nearly completed that the construction of a sufficient reserve supply should be begun without delay, and the department recommends an appropriation to that end. Congress should give careful attention to the ordnance requirements of vessels that are liable to be called into service as auxiliaries in time of war, in accordance with the Acts of Congress approved March 3, 1891, and May 10, 1892, providing that steamers registered under the provisions of said Acts can be used by the United States as transports or cruisers. To mention no others, the Paris and New York, of the Inman Line, are now receiving large sums of money annually on condition that they hold themselves in readiness to serve the Government whenever demanded. When they hauled down the English to hoist the American flag they were receiving pay from the British Government to hold themselves in readiness to serve that nation, and the English had guns and gun-mounts ready to be put upon them at a moment's notice. We have now been paying subsidies to these ships for months, and have not a gun to put upon them.

With the exception of common shells for 13in. guns, the number of projectiles already ordered will suffice to complete the outfits of all ships thus far authorised. The higher development of armour-piercing projectiles, necessitated by the advent of hard-faced armour, is being carefully sought after, and all possible encouragement has been given to projectile makers. Of the different types already experimented with, some cast steel projectiles of large calibre made by J. G. Johnson and Co. have given very satisfactory results, such as to indicate that as good a projectile can be made of cast steel, properly treated, as has yet been produced by forging. If subsequent experiment should bear out this conclusion, the cost of projectiles will be materially decreased.

Practical experiments have been carried on with an 80 lb. 6 in. shell, containing 11 lb. of wet gun-cotton, with a dry gun-cotton primer and a fulminate detonator. The velocity attained was about 1400 foot-seconds, while at the maximum elevation usually attainable from ship's sponsons or turrets, would give a range of not less than three miles. The results obtained were so favourable as to lead to continuing the experiments with a 10in. shell containing about 70 lb. of gun-cotton, and fired with a charge giving an initial velocity of about 1700 foot-seconds, sufficient at the maximum elevation attainable from closed turrets, to give a range of over four miles.

As was stated in my last report, this department adopted a calibre of 6 mm. (0 236) for the new Navy rifle. During the last year exhaustive experiments have been conducted with a view to the determination of the length and metal of barrel, the most suitable powder charge, and all the other essential features of the modern rifle, these conditions to be observed in competitive trials which the department has decided to conduct prior to adopting a type of small arm for the Navy. In the experimental firings with the new rifle, muzzle velocities of about 2,900 foot-seconds were attained; but a charge of 36 grains was finally fixed upon in order to keep the chamber pressure well within a safe limit, and also to increase the lifetime of the rifle barrels. This charge gives a muzzle velocity of 2500 foot-seconds. With this velocity the point blank range is about 700 yards, and the effective range fully 4000 yards. At short range the penetration is about 5ft. of pine wood. The enormous increase of effectiveness over the old-fashioned rifle is apparent from these figures.

After the date of my last report, exhaustive practical experiments were conducted to determine the effect upon the crew of a submerged boat of the detonation near by of a high explosive under water. These experiments were carried on at the Naval Torpedo Station, at Newport, R.I., by exploding gun-cotton charges at various distances from a submerged structure containing living animals. An old Lay torpedo, about 28ft. long, was submerged 15ft., and 80 lb. charges—dry weight—of gun cotton moored at the same depth were detonated at the following distances from it :—400ft., 305ft., 200ft., 150ft., 100ft., and 80ft. The first experiment resulted in sinking the boat, drowning the contained animals; but it was found on raising that no injury had been done to the boat by the explosion beyond opening the seams, causing leakage with resultant sinking, and after slight repairs the other experiments were carried out, the boat being raised after each explosion and the animals examined. It was not until the 80ft. distance was reached that there was any signs of injury to the hull of the boat. At this distance the explosion made a number of depressions in the hull, and it was clear that at a slightly shorter distance the plating would have been completely ruptured. No damage, however, was done to the inmates, and, consequently, it was demonstrated that the shock of an explosion upon the crew of a submarine boat will be harmless, so long as it is insufficient to rupture the hull of the boat itself. That these experiments do show that the danger to a submarine vessel from the detonation of submerged high explosives is an element to be considered in solving the problems entering into the construction of such a vessel is, however, very apparent. That such a boat, if successful, would be an important factor in naval warfare is self-evident, but after a careful study of results obtained at home and abroad, in connection with the almost insurmountable difficulty of definitely directing such a craft under water, I again referred the question to a board for an exhaustive examination. The report of this board, which was in the main favourable, is now receiving the careful consideration of the department.

Important improvements have been made in the Howell torpedo, which have resulted in making the explosive more efficient. Two of the thirty of these originally ordered have been accepted, and twenty-one are undergoing acceptance trials. The remainder will be ready for testing within a few weeks. The trials thus far conducted having proved satisfactory, the department, in accordance with the provisions of the contract, has increased the number of torpedoes to be supplied from thirty to fifty. All of the Whitehead torpedoes called for in the contract of May, 1891, with the E. W. Bliss Company, have been completed, and carefully conducted trials have, it is believed, shown them to be equal to the very best made abroad. The department entered into a contract with this company for fifty additional torpedoes of an improved type and designated as Mark II. Twenty of these have already been delivered. Nearly all of the launching apparatus connected with these two types of torpedoes have been delivered by the contractors.

Again I feel it my duty to call your attention to the great and pressing need for Congressional action in reference to the *personnel* of the line of the navy. The evils presented in my last report are even greater to-day than then, and will increase until the situation becomes so serious that only the most stringent, far-reaching, and harsh measures will suffice to remove them. The joint commission from the Committees on Naval Affairs of both Houses, referred to in my last report, had the entire subject of the *personnel* under consideration during the greater part of the first session of this Congress, during which plans were presented by myself and officers of the different corps of the navy looking to a thorough reorganisation.

I again renew my recommendation of last year, that the enlisted force be increased by 2000 men. A careful study of the services of the navy for several years past convinces me that the number of vessels which must be kept in commission and ready for service is greater than the present enlisted force allowed the navy will suffice to man. Calculations place this increase at not less than 2000 men, and the law to authorise such increase should be so worded as to permit the department to enlist them whenever needed.

For some years after the subject was first brought to my attention, I was not inclined to believe that the advantages to be derived from a naval war college—as it was established—were sufficient to justify the expenditure necessary to keep it in operation. A visit, however, to that institution at Newport—in the summer of 1893—and a careful study of the whole subject, have sufficed to change my convictions on the subject. My careful examination of this whole question greatly impressed me with the importance of at once establishing the institution upon a firm and substantial basis, and at the same time marking out and limiting within proper bounds its scope and general purposes.

With these ends in view the department detailed Captain H. C. Taylor, United States Navy, as the president of the institution, and afterwards approved a theoretical and practical course of instruction prepared by him. Under the able supervision of this officer, the results obtained during the session beginning June 12th and ending September 29th were very satisfactory, and clearly demonstrated the wisdom of the department's action. Quite a number of officers were detailed to attend the college and participate in its exercises. Able and exhaustive lectures were delivered on sea power, naval tactics, naval ordnance, signalling, fleet manœuvres, torpedoes, tactical and structural questions, electricity, naval hygiene, coast defence, and international law. In addition to these lectures, a feature of the course this year was the study of war problems, specially selected from their natural application to possible future necessities of offence and defence.

Interest in the Naval Militia continues unabated, and it is apparent to the department that its efficiency has materially increased within the past year. During this period organisations have been perfected in Michigan and Connecticut, and the formation of others has been authorised by the Legislatures of Vermont, New Jersey, Virginia, and Georgia. At the present time the number of officers and men of the various States mustered in and serving, is as follows :—Massachusetts, 448; Rhode Island, 113; Connecticut, 65; New York, 442; Pennsylvania, 217; Maryland, 128; North Carolina, 168; South Carolina, 208; California, 320; Illinois, 367; Michigan, 73; total, 2549.

During the first session of the present Congress an Act was passed to promote the efficiency of the Naval Militia which contained provisions authorising the loan by the department of such vessels, boats, and equipments as are not required for the general service, on the requisitions of Governors of States possessing regularly organised naval militia. Under this Act the department has already provided for loaning vessels as follows: The New-Hampshire to New York, the St. Louis to Pennsylvania, the Wyandotte to Maryland, the Nantucket to North Carolina, the Swatara to California.

This movement is still in its infancy, and certainly promises gratifying results, but the exact relations of the Naval Militia to the regular service, and how the two shall best and most efficiently co-operate in any regular plan of national defence, is not as yet distinctly marked out. There are, however, undoubtedly many directions in which the splendid bodies of young men now being organised can in case of need render effective service. We are at present affording them the fullest opportunities for an acquaintance with the service and its requirements, leaving it in great measure to themselves to decide upon what will be the best and most practicable field for their conjunction with the navy. The department will continue to extend all the material aid in its power, and will always be ready, by suggestions and otherwise, to assist in perfecting any plans that may promise to secure the helpful and harmonious co-operation of the militia with the regular navy.

It is noticeable that this movement has developed rare strength and enthusiasm along the great lakes and rivers on our northern frontier. It is also rapidly crystallising and increasing on our western coast, and it is hoped that the authorities of the South Atlantic and Gulf States will encourage the splendid *personnel* which is there ready to be organised. Laws have been passed in many of those States creating a Naval Militia.

The Naval Committee of the House of Representatives has now under consideration the subject of the transfer of the work of the Coast and Geodetic Survey partly to the Hydrographic Office of the Navy Department, and the remainder to the Geological Survey, under the Interior Department. After a careful personal investigation of this subject, begun years ago, I am convinced that the coast survey work proper now remaining to be done along our coasts can be carried on quite as efficiently and much more economically by the Navy Department than under the Coast and Geodetic Survey.

The work of the Coast Survey, for which that organisation is peculiarly fitted, is the topography of the shore lines and immediate adjacent lands. This work has been done with great care and accuracy, but it is practically all completed. Only very small patches of the topographic work along the lines of the Gulf of Mexico and the shores of California remain undone. That this work has long been considered by the Coast Survey officials to be of little immediate value is apparent from the fact that it has been left undone for many years. It is believed that if a very small proportion of the annual expenditures of the survey for the last ten years, say one-tenth, had been devoted to the purpose, this unfinished topography would all have been completed years ago. Should the work of the Coast Survey be transferred to the navy, it is safe to say that all the topographic work along our shores, excluding Alaska, would be completed promptly, as the navy is deeply interested in having complete charts of our coasts.

Without considering the effect of the cessation of this work on industrial conditions, and disclaiming all obligation of the Government to engage in public works for the sole purpose of giving employment to any class, however deserving, I respectfully urge that from the standpoint of national defence it will be unwise to stop entirely the work of naval up-building; that wisdom and experience demand that the present well organised, highly trained, and exceedingly efficient body of mechanics and skilled labourers engaged in the work of naval shipbuilding shall not, at least, be entirely disbanded. With the stoppage of this work many large plants now at work for the navy will have to shut down either completely or in part, and their corps of skilled workmen employed in the various phases of naval construction and development be discharged and scattered, while the plant and machinery for the production of vessels of war must of necessity become idle and be allowed to deteriorate.

I beg to recommend that Congress be asked to authorise the construction of three battleships of about 10,000 tons displacement each, to cost, exclusive of armament, not exceeding 4,000,000 dols. each, and twelve torpedo-boats of from 100 to 300 tons each, at the discretion of the Secretary of the Navy, to cost not exceeding an average of 170,000 dols.

## CLEVELAND INSTITUTION OF ENGINEERS.

### PRESIDENT'S INAUGURAL ADDRESS.

A MEETING of the Cleveland Institution of Engineers was held at Middlesbrough on Monday evening. The president, Mr. J. E. Stead, delivered his address, of which the following is an abstract:—

He said his remarks would bear more upon scientific metallurgical matters, with which he was most familiar, than on purely engineering subjects. He first drew attention to certain facts regarding the waste which had occurred in the past, and was still occurring, in the manufacture of iron and steel, for although all such sources of loss were well known, it was of the utmost importance that they should not be lost sight of, because though at present they apparently could not be avoided, they might in the future prove rich harvest fields for the patient, intelligent, and successful investigator. Refuse of all kinds had been made the subject of careful research, and masses of matter, which at one time was considered as useless, was now utilised to advantage. Formerly the waste refuse—puddlers' slag—was rarely used, excepting in small quantities, and was considered practically of no value. Thousands of tons had been buried, and most of it lost for ever; but thanks to the advances made in the manufacture of basic steel, the phosphorus which was looked upon as the *bête noir*, which rendered useless the otherwise valuable material, was now eagerly sought for, and happy was the man who discovered an old burial-place of such cinder. In many ironworks in the North of England this puddler's slag was being dug out and utilised, and such was the demand for it that all that was now made or found was rapidly disposed of, while as it was getting scarcer and scarcer its price was being augmented. It would appear that the day was not far distant when the supply would fall short of the demand, and some other cheap phosphoretic material would have to be substituted, or a portion of the basic slag from the steel works would have to be charged to the blast furnace in order to obtain the pig iron high in phosphorus, to make basic cinder sufficiently high in phosphoric acid to meet the demand of the farmer, and give a profit to the steel maker. The objection to the latter course was not as great as it seemed, for every substance in the basic slag, with the exception of 10 to 12 per cent. silica and the necessary lime to flux it, was of value in the blast furnace; on an average there was 80 per cent. of valuable matter. The available lime and magnesia were present to the extent of about 30 per cent., and were valuable as a flux, and the oxides of iron, some of the manganese, and all the phosphorus would be reduced and pass into the pig iron.

This basic steel slag was once considered worthless, but in the course of time energetic research proved its undoubted manurial value, and by the simple process of grinding to fine powder it was made into a valuable material. The President mentioned that the suggestion to utilise basic slag in the manner referred to was first publicly made in a paper read before the Cleveland Institution of Engineers, in 1879. [Quite recently Professor Dr. Paul Wagner had shown that the basic slag—which he called Bolckow slag—made from pure Middlesbrough raw iron at the Cleveland Steel Works, was a much more rapid fertiliser than the slags made from specially-produced pig iron, which were exceptionally low in silica. The Professor asserted that the phosphoric acid in Bolckow slag was so easily dissolved, that its efficiency was scarcely less than that of superphosphate. Professor Wagner in his experiments had observed that the most soluble basic slag contained the greatest amount of silica, and those very low in that element were sparingly soluble in a special solution of acid citrate of ammonia, a reagent which was extensively used on the Continent to determine the solubility of basic slags and other phosphates. Professor Wagner concluded that the manurial value of basic slag approximately decreased in value in the same proportion as its solubility in the citrate solution decreased. That practically meant that the rich phosphate basic slags containing 25 per cent. phosphoric acid, of which 50 per cent. or 60 per cent. might be insoluble in the citrate solution, was of no more value than silicious cinder containing 10 per cent. to 12 per cent phosphoric acid. Mr. Stead, thinking that such a statement should not go unchallenged, had repeated and extended Dr. Wagner's experiments. He thought from them that the statements made were stronger than were perhaps justifiable. The subject, however, was of so much importance that he—the president—had embodied his results in a short paper which would be read at the next meeting of the Institution.

With regard to the waste in the manufacture of both acid and basic Bessemer steel, there was more of metal and a corresponding less yield of ingots than theory justified. One source of loss was more or less unavoidable with the apparatus as at present constructed, and that was the mechanical projection of molten metal from the converter during blowing. To alter the apparatus in such a way as to avoid that loss was a study for engineers, and one worth serious consideration. Some loss was also occasioned by the entanglement of small particles of the steel in the scoria or cinder, a condition of things most pronounced in the case of acid Bessemer cinder. From time to time attempts had been made to separate the steel from the Bessemer slag. On one occasion a trial was made at Sheffield, in which Bessemer slags were crushed and the metal separated, and the steel so obtained amounted to 27 per cent. on the raw slag. Slags made on blowing East Coast iron, however, did not contain more than 10 per cent. free steel. Assuming that the average amount present was 7 per cent., and that the quantity of slag produced was 10 per cent. on the weight of the steel produced, that would account for 0·7 per cent. loss in the yield. The cost of grinding and separating 7 per cent. steel from such material by properly constructed grinding and magneto machines would probably be about 2s. 6d. per ton, and the steel separated weighing 1·4 cwt. at scrap price of 42s. might be valued at 2s. 5d. There was thus not much inducement to recover the steel by such a process unless the ground slag could be utilised for some practical purposes. Practically all the entangled steel was recovered from basic slag during its conversion into manure powder.

The President next referred to the waste in the manufacture of ferro-manganese in the blast furnace, a portion of the manganese being found in the slag, 5 to 12 per cent., and a certain quantity was volatilised and passed off as fumes at the top of the furnace. A portion of the waste manganiferous slag was used in the blast furnaces making basic iron. He had hopes that furnaces would be so altered as to meet the required conditions for the more complete reduction of the manganese, and that without increasing the amount of silicon in the metal. Dealing with ordinary blast furnace slag, which continued to rise in higher and higher mounds in the Cleveland district, or was sunk in colossal quantities in the German Ocean, it was remarked that at an early date Mr. Charles Wood and others had converted it into bricks for building purposes. The use of concrete paving flags which contained crushed slag as their base was extending, and they were superior to best Yorkshire flagstones. Some years ago a process by which Cleveland slag could be made into excellent cement was fully described to the Institution, and the pier at Skinningrove was constructed of it. There were other developments under trial now, but it was premature to speak of them.

Turning to the vast loss of heat from the molten slag and iron after leaving the furnace, there was, the President remarked, a seductive field for research. Excepting the application in one single works in the North of hot slag balls for evaporating the salt brine, practically the whole of the heat from the cooling slag from the blast furnaces was wasted. The loss in that direction was so prodigious that it was a disgrace. One of the most important applications to modern practice was the use of the hot metal mixer, originally invented by Colonel Jones, of Pittsburg, and since modified by Herr Massenez. It had resulted in the production of steel of regular quality. During the last twelve months, in Great Britain alone, 338,000 tons had been mixed, and probably a much greater quantity had been mixed outside. About fifteen mixers were now in use, and seven more were in course of erection. Two of these mixers, which held about 150 tons each, had been constructed at Eston, and after a fair trial had given greatly improved results. The result of this mixing was that the length of the operations in the converter, and the amount of scrap used, was made almost uniform, thus increasing the life of the converter linings and bottoms to a considerable extent. It also gave almost uniform carbons in the steel, thereby reducing the percentage of defectives. The mixer had been found even more valuable in the basic than in the acid process, enabling the use of iron lower in silicon.

The Saniter process for desulphurising iron was continued at the Wigan works, and during the past year about 18,000 tons had been treated by it. When hematite forge was treated an average of 64 per cent. of the sulphur was removed; with crude basic iron, 70 per cent., and 40 per cent. of the silicon. The sulphur could be removed with success and regularity at a cost not exceeding 6d. per ton. It was strange that the first Cleveland pig iron treated by the Saniter process in the open-hearth furnace was at the Ligure works in Italy. Cleveland white iron was used. Mr. Stead gave at length particulars of the trials. The steel was of excellent quality, and was probably the first basic open-hearth steel made from Cleveland white iron. Messrs. Dorman, Long, and Co. had recently been successful in making very pure steel from Cleveland white iron in the basic open-hearth furnace, with the assistance of the Saniter invention. Probably when there was sufficient demand for the metal for open-hearth work, blast furnaces might be worked on forge and mottled iron, and the pig iron be purified by Saniter's process, by which means the sulphur and, if necessary, the silicon would be removed in the first instance, and thus less work be left for the open-hearth furnace to do. This was a question worthy of consideration.

Treating of the Howson and Hawdon form of lining blast furnaces, the President said that the advantages claimed were (1) a concentration of the heat at the tuyeres; (2) the melting zone was enlarged—in the horizontal plane—in order to secure and to obtain larger makes and more equal quality; (3) the diameter of the barrel of the furnace was diminished in order to bring the bosh within the melting zone or nearly so, so as to prevent scaffolds, and in order to make it of such size that the materials would pass down to the melting zone in as equal a manner as possible, for with wide bosh and barrel this was not and could not be effected; (4) the top bosh was introduced to support the materials and keep the furnace open for good working, and also to enlarge the capacity of the furnace, which had been much reduced below. The effect of all this had been that one furnace had been reduced from 33,000 cubic feet capacity to 22,300 cubic feet, and was doing better work, was making better quality, and nearly 70 per cent. more iron, working on Cleveland iron. Another furnace working on hematite iron had been reduced to 16ft. diameter and 15,000 cubic feet capacity, and was extremely economical as regarded coke, while very regular as to quality, never having made a pig of forge iron since blowing in eighteen months ago. There could be no doubt that the very large capacity of furnace which was thought necessary was a source of danger to good, steady, and economical working. A small furnace was under much better control, and if it could be deepened so as to give large output and economical results, it must be the furnace of the future. Sir B. Samuelson and Co. had such faith in the Howson and Hawdon furnace, that they had four at work and others would be relined on that system. One great feature was that soft cokes could be used with much more economical results, the upper bosh and smaller capacity diminishing the crushing strain. Distinctly less limestone was used than in furnaces on the old type. The furnaces when on Cleveland iron had produced on the average 802 tons weekly, and when on hematite 1000 tons per furnace.

Mr. W. P. Ingham, of Middlesbrough, had invented a new system for lining blast furnaces, hot blast stoves, kilns, cupolas, &c. Generally in lining circular structures, the bricks were so placed that the vertical joints between them formed lines radiating from the centre. In Mr. Ingham's system, the bricks were made so that the joints were tangential and not radial, and in placing the bricks alternately in alternate layers, each brick tied several others, a combination much stronger than in the older system. Several blast furnaces were now being relined with the new lining.

Mr. Stead next dealt at considerable length with the question of alloying other metals with steel, such as tungsten, manganese, nickel, chromium, and aluminium. This age, he said, must be called the alloy period, for the careful study and application of alloys in the arts and manufactures was becoming more and more pronounced. Steel with 10 per cent. tungsten was extensively used for lathe tools, and was self-hardening. Manganese steel, discovered by Mr. R. A. Hadfield, of Sheffield, afforded the first instance on record in which an element or metal, added to steel in medium quantities, resulted in rotten, worthless material, but when added in larger quantities, between 8 per cent. to 14 per cent. produced steel of an excessively strong and tough character. Castings and forgings, where machining could be dispensed with, have been extensively made of this steel. It was used for grinding and crushing machinery, the wearing parts of dredgers, tram wheels, &c. Dredger pins of this steel after working eighteen months in sand, gravel, and shingle, only wore ¼in., whereas if mild steel pins had been used, four sets would have been worn out. Nickel gave to steel great strength and toughness, but its price was against its use. One of the most important developments in the steel trade was the extensive application of aluminium in its manufacture, and practically half the aluminium made was taken by the steel maker.

The behaviour of arsenic in steel was not like that of either sulphur, or phosphorus, though the theories were that it was. So important was it that this question should be fully investigated that he—the president—and several of his friends had undertaken an extensive study of the matter, and before long their results would be made public. The effect of copper in steel was not thoroughly understood. Some manufacturers would not have any copper in pig, and considered 0·10 per cent. as fatal to the steel produced from it, and yet in America steel with 0·2 per cent. and more had been regularly made of good quality. The physical effect of sulphur in producing red shortness was well established, but its effect on the mechanical properties of steel had not been exhaustively studied. The effect of phosphorus, silicon, and manganese was well understood, but there was much work required to determine the effect of two or more elements when present together in varying proportions.

The President then advocated the amalgamation of the various engineering societies on similar lines to those adopted in the chemical industry, where the Society of Chemical Industry was formed. The Cleveland Institution of Engineers had so far advanced in that direction with the West of Scotland Iron and Steel Institute as to exchange printed "Proceedings" with them, so that every member of each Institution would be supplied with the deliberations and papers of the other.

In concluding the President advocated that in our free libraries and every large metallurgical centre there should be a technical library containing all the standard works which bear upon the particular industry followed. All the transactions of learned, metallurgical, and engineering societies should be found in them, also all the weekly periodicals which contain articles and treat on matters relating to the industry in this country, America, and the Continent. The head of each department should be required to read and review periodically all the current literature bearing upon matters relating to his particular department, and send such reviews, together with his own criticisms, to the head director. Thus he and his subordinates would be kept abreast of the times, and that was very necessary in these go-ahead days.

At the conclusion of the address the President exhibited lantern slides giving diagrams of the Howson and Hawdon type of furnace, and also the Ingham method of lining furnaces.

Mr. Hawdon explained the diagrams of the blast furnace, and said the first was built two years ago, another had been working eighteen months, another which the President referred to as having been at work eighteen months and not made a ton of forge iron had only been blowing some fourteen months. In reply to questions, he said that when producing Cleveland ordinary iron 840 tons per week were made, and when producing hematite 1000 tons. They had six tuyeres to each furnace, and the pressure of blast was 6½ lb. They had tried 6 lb., but found they ran off quality. They used raw limestone, and it was a singular thing that with the heavier pressure of blast they used a smaller quantity than in the old furnaces, both in Cleveland and hematite.

With regard to the Ingham method of lining, Mr. Keith, of the Normanby Ironworks, said they had a new furnace lined in the way shown. It was very suitable for the upper part of the furnace, but below the tuyeres he thought the old way was the better, especially for convenience of repairing.

Mr. Head proposed, and Mr. Hawdon seconded, a vote of thanks to the President for his address, which Mr. Stead acknowledged, and Mr. T. F. Meldrum, of Manchester, then read a paper on "Economy in Steam Raising." A discussion followed.

## LETTERS TO THE EDITOR.

*(Continued from page 545)*

### UENSOLD'S ICE RINK.

SIR,—The statement in your interesting account of the Niagara Hall Ice Rink, that hitherto ice rinks have been constructed on concrete or similar floors, is not quite correct. The Southport ice rink—which was in use for ten years—was built with a wooden floor, on wooden joists, with an air space underneath. The only rink with a cast iron floor was the first one ever frozen—a purely experimental one. The floor was not a cast iron tank, but formed of broad, flat cast iron pipes laid side by side on a concrete foundation. In the second rink frozen flat copper pipes were employed, and similarly shaped pipes were used in the Southport rink, placed on a wooden floor as stated above.

You do not state the thickness of wood used for the floor at Niagara Hall, nor the distance apart of the iron girders. With these data given I think it would be interesting if some one would calculate the weight required to deflect a floor consisting of 5in. of ice—in which a network of 2in. iron pipes is imbedded—when frozen to the wooden floor.

The idea that a natural sheet of ice yields under the movement of a skater is a very common fallacy. If the ice be not frozen to the banks of the pond, and if there be only a dangerous margin of safety, some slight movement may take place, but, as a rule, a natural sheet of ice is perfectly rigid. The difference between a fall on ice and, say, on a roller rink floor, is entirely due to the slide which usually results on ice. A dead fall on ice is as painful to the human frame as a similar fall on, say, wood or marble. A thickness of 5in. of ice is unnecessary and prejudicial in an ice rink. Ice being a non-conductor, it renders more difficult the task of keeping the surface dry when skaters are active and plentiful and the weather is warm. If the floor is properly constructed 2in. of ice are ample, but if a bad system of piping be employed a greater thickness is required to prevent ridges and give a perfectly smooth surface. I have skated on a rink with less than ½in. of ice above the pipes with the surface level as a billiard table.

December 18th. DAVID GUILLOD.

### LOCOMOTIVE CYLINDER CAPACITY.

SIR,—I have read with interest your full and admirably illustrated notice of the new bogie goods engines on the Highland Railway in your last issue. They are undoubtedly very powerful engines, well designed for their work and the character of the line. But in describing them as having "the largest cylinder capacity ever found in a British locomotive" you appear to have overlooked for the moment the first of the two classes of engines constructed by Messrs. Beyer, Peacock and Co. for the Mersey Tunnel Railway in 1885, illustrated on page 150 of THE ENGINEER of February 19th, 1886, which have cylinders 21in. diameter by 26in. stroke. These engines have six-coupled driving wheels 4ft. 7in. diameter, and have therefore a tractive power of 208·5 lb. per pound of effective pressure in the cylinders, as compared with only 165 lb. in the Highland engines.

Further, it will be seen by reference to the leading dimensions given at page 143 of the above last-named issue that in several important dimensions of the boiler and fire-box determining the "power" of a locomotive, the Mersey Tunnel engines of the "Major" class are not inferior to those of the Highland Railway under notice.

NEMO.

December 18th.

### LOCOMOTIVES AND TRAINS.

SIR,—Your correspondent, Mr. McDonald, still seems in doubt about the engines on the express train at Northallerton. Let me, therefore, for his information, once more state that the leading engine was No. 905, an old engine built by Mr. Fletcher over twenty years ago, and that the train engine was No. 1622, one of the latest and heaviest engines in England.

The position of the respective engines in the photograph, taken after the accident, seems to be quite irrelevant.

Friends of the N.E.R., in trying to minimise the fact that the big engine, 1622, had to all intents failed, put forward the excuse that only because there was not sufficient steam to keep the air brake reservoirs fully charged, a pilot was taken at Darlington; but it yet remains to be shown that No. 1622, with—according to "A Practical Man"—only 80 lb. of steam, could pull a train of about 200 tons over such a road at a speed requiring a continuous brake at all.

E. B. D.

London, December 12th.

## AUSTRALIAN ENGINEERING NOTES.

(*From our own Correspondent.*)

A DEPLORABLE railway accident occurred at Sydney station on Wednesday, October 31st, which has resulted in the death of thirteen persons; it is the most serious accident that has ever occurred on the New South Wales lines. An outgoing train at Goulburn ran into an incoming suburban train as the latter was crossing the rails to an out platform. The result of the inquiry showed that the accident was attributable to the driver of the outgoing train starting before the signal was lowered; the interlocking gear was proved to be perfect, and so far as mechanical precautions are possible, everything has been done that is possible to ensure the safety of passengers.

The Reid Ministry—N.S.W.—appear to be doing some practical legislation already which is considered here to augur well for the prosperity of the country. Already a comprehensive Land Bill has passed through committee, and it is intended to bring in immediately a Local Government Bill, to place a land tax on unimproved value of land, and an income tax. As soon as these measures are passed the present protective duties will be taken off. It is expected that the free trade tariff will be brought into operation from July next.

The continued decrease in revenue on the Victorian railways is still an unsolved problem to the people of that colony. The latest phase of the question was the Victorian Premier inviting the Commissioners of the other colonies to meet in conference for the purpose of investigating the matter, but as the Governments of New South Wales and Queensland have declined to let their Railway Commissioners go, the Victorian Government intend to call in some business experts to advise.

A few months ago the Victorian Commissioners lowered their goods rates considerably in certain districts for the purpose of inducing the traffic in wool, &c., to be sent over their lines to Melbourne from the inland districts in New South Wales, also to compete against the road traffic—horse teams—a competition of a minor extent which has sprung up lately owing to want of employment and cheap horse feed. The decrease in revenue for the eighteen weeks of the financial year, compared with a corresponding period of last year, now amounts to £86,566, or an average decrease of £4810 per week.

In the report of the directors of the Sydney Tramway and Omnibus Company, for the year ending September, 1894, they state the continued depression has resulted in a further reduction of revenue amounting to fully £5000, but the loss has to some extent been counterbalanced owing to the very favourable state of the market for forage, together with reductions that it has been necessary to effect. A dividend of 5 per cent. has been declared, while £469 has been carried forward, and £1750 transferred to property reconstruction account. The company is worked on a net paid-up capital of £60,750.

The report of the South Australian railways for the year ending 30th June last is only now just published. The net return on capital expended is shown as 3·54 per cent. The coaching receipts fell off to the extent of £28,525, while the mineral traffic increased £35,197; the latter apparent increase over last year is owing to the strike which prevailed at Broken Hill.

The net decrease on all the items of revenue was £7352, while the working expenses were reduced by £70,530, but while the exigency of the times necessitated a number of the employés being put on short time, with the exception of a few of the professional and clerical staff, no servant of the department has been retrenched or dismissed during the year, except for misconduct.

The following is a comparative summary of the principal items —exclusive of the Palmerston line, Northern Territory:—

| | 1893-4. | | 1892-3. |
|---|---|---|---|
| Average miles open for the year.. | 1,664¾ | .. | 1,662¼ |
| Capital cost on lines open .. .. | £12.154,417 | .. | £11,936,256 |
| Gross earnings .. .. .. .. .. .. | £999,707 | .. | £1,007,059 |
| Working expenses .. .. .. .. .. | £569,592 | .. | £640,122 |
| Net revenue .. .. .. .. .. .. | £430,115 | .. | £366,937 |
| Percentage of working expenses to revenue .. .. .. .. .. .. | 56·98 | .. | 63·56 |
| Percentage of net revenue to capital cost .. .. .. .. .. .. | 3·54 | .. | 3·07 |
| Train miles.. .. .. .. .. .. .. | 3,470,125 | .. | 3,670,390 |
| Earnings per train mile .. .. | 69·14d. | .. | 65·85d. |
| Working expenses per train mile | 39·39d. | .. | 41·86d. |
| Earnings per average mile open.. | £601 | .. | £606 |
| Working expenses per average mile open .. .. .. .. .. .. | £342 | .. | £385 |
| Minerals carried .. .. ..tons | 348,490 | .. | 323,464 |
| Grain carried .. .. .. ..tons | 183,519 | .. | 140,006 |
| Wool carried .. .. .. ..tons | 24,702 | .. | 22,117 |
| Goods carried other than the above .. .. .. .. ..tons | 438,959 | .. | 465,721 |
| Livestock carried .. .. ..tons | 18,340 | .. | 19,497 |
| Locomotives .. .. .. .. No. | 277 | .. | 258 |
| Coaching vehicles .. .. .. No. | 351 | .. | 342 |
| Goods and livestock vehicles No. | 6,045 | .. | 6,180 |
| Average miles travelled per passenger .. .. .. .. .. .. | 12·79 | .. | 12·94 |
| Average miles travelled per ton of goods.. .. .. .. .. .. .. | 116·16 | .. | 114·45 |
| Miles of line per thousand of population .. .. .. .. .. .. | 4·90 | .. | 4·97 |
| Population per mile of line open.. | 204 | .. | 201 |

## AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

*Garbage disposal.*—As already noted in a former letter, the question of the best means of disposing of garbage or house refuse and street refuse is being taken up by several cities, and various systems of cremation furnaces are in use, while in New York the garbage is loaded on dump scows or barges and towed out to sea. This is very unsatisfactory, as the stuff washes up on the shore, spoiling the bathing beaches, especially when in bad weather, or when a bargeman or tugboat captain thinks he can escape notice, the load is dumped before reaching the deep-water limit. The report recently presented by the New York Committee pronounces against the system of towing the refuse out to sea, and concludes that it cannot be dumped within 200 miles of the harbour without defiling the shores. Therefore attention was turned to other methods. In response to public notice, seventy different schemes were submitted, in most cases accompanied with complete drawings of proposed plants, or of those in actual operation. After an examination of these various schemes, twenty-one of them were rejected as impracticable, and the projectors of the remaining forty-nine were invited to appear before the Commission at specified dates to explain in detail the merits and workings of their respective systems. The Commission visited different cities, examined the plants in operation and the systems in use, and made recommendations as follows:—(1) That dumping city refuse in any waters of the harbour, or its adjacent or tributary waters, should be absolutely prohibited. (2) That the ordinance requiring householders to keep separate the garbage, or ashes and other house refuse, should be rigidly enforced. (2) That all house refuse should be collected in galvanised iron vessels with tight-fitting metallic covers, and of such size that when full it can easily be handled by one man. (4) That daily collections of garbage should be made by the city and delivered at the dumping wharves into the temporary storage, or to self-propelling boats of an improved type, furnished by the party having a contract with the city for final disposition of the garbage. (5) That the garbage should be disposed of by a reduction process, producing fertiliser and commercial grease, that the city should invite competition by the various companies controlling such systems, in order that the greatest benefit to the city may result. As the plant for the reduction of the garbage of this city would necessarily be extensive and costly, a contract for a sufficient length of time should be offered by the city to warrant the investment, say, not less than ten years, with proper provision for the transfer of the propety of the contractor, at fair value when the contract is terminated. Ample provision should also be made and abundant security required for the performance of the work on the part of the contractor, in a clean, inoffensive and sanitary manner, and removal of the garbage daily from the city to the reduction works, which should be located at a suitable point beyond the city limits. (6) That a separate collection should be made of the remainder of the refuse of the city not otherwise provided for, which would be used for filling in at Riker's Island or elsewhere, and for the transportation of this material a sufficient number of self-propelled boats of an improved type should be constructed and owned by the city. It should, however, be provided that whenever the whole or any considerable portion of the street sweepings can be disposed of by contract or sale for fertilising purposes, at a price greater than their value to the city for filling, then such disposition should undoubtedly be made of them. (7) That the city should adopt metal water-tight covered carts or trucks of a uniform pattern for the collection of ail refuse, and mechanical dust-collecting sweepers when a satisfactory type can be obtained. That whenever the sweeping of the streets causes dust to arise they shall first be sprinkled. (8) That each refuse cart or truck depositing its contents should be disinfected and washed out thoroughly before leaving the wharf. In conclusion the commission suggests that, if the substance of this report be approved, as little delay as possible should intervene in carrying the recommendations into effect, in order to prevent a recurrence of the serious causes of complaint of the past summer. Six months at least will be required to make the necessary preparations. While the first cost of the necessary plant to carry out these recommendations will be considerable, the commission is convinced that the public good demands it; that the scheme here outlined, fully carried out and properly administered, will abate the nuisances so long complained of and place this city in the front rank of the cities of the world in the cleanliness of its streets and the sanitary and economical disposition of its refuse.

*Tests of capped projectiles.*—A report has recently been made on a series of tests of armour-piercing shells having soft steel caps over the points. In the preliminary experiments the shells tested were of the Wheeler-Sterling 6in. type. The gun used was the 6in. wire-wound rifle, mounted on the centre-pivot gravity return carriage. The distance between the plate and the gun was 330ft. The line of fire was normal at the point of impact. The target was a 6in. curved Harveyised nickel steel plate manufactured by the Carnegie Company, which had been attacked in other tests. The weight of the fragment of plate fired at was about seven tons. The portion struck was in good condition and was held in position by four armour bolts and heavy oak blocking. The plate was unbacked. The charge of powder was 45 lb. The shell had a striking velocity of 1900 foot-seconds, and a striking energy of 2506 foot-tons, or about 358 foot-tons per ton of plate. The cap was fastened to the lower edge of the bourrelet. The shell struck the plate normally 30in. from the bottom, 22in. from the left edge, 30in. from a former impact, and 18in. from a vertical surface crack developed in earlier trials. The shell penetrated the plate, cut through one armour bolt, about 3ft. of oak blocking, 10ft. of earth, 3ft. of solid oak, and buried itself to the depth of 2ft. in the gravel bank behind the structure. When recovered it was found entire and uncracked, only slightly swollen in the rear of the bourrelet, and with the point $\frac{1}{8}$in. to $\frac{1}{4}$in. out of line. The shell was scored from the point to the after portion of the bourrelet, and the extreme point was somewhat blunted. The shot-hole in the plate was 6in. in diameter, and smooth for an impact in a Harveyised plate. The face of the plate was scored irregularly from 2in. to 8in. from the circumference of the shot-hole to a maximum depth of 1in., the back bulge was about 12in. in diameter, and one-half of it was broken off. The disc in the plate was slight, only $\frac{2}{10}$in. The set-back was 1in, and the set to the right 1½in. The plate was not cracked by the impact, nor were the old cracks in it materially affected. The general features of the shell are:—Length with cap on, 19½in.; weight, 104 lb.; weight of cap, 5 lb.; length of cap, 3½in.

## CATALOGUES.

J. P. Hall and Co., Oldham. Illustrated price list of Dynamos.

John Spencer, Wednesbury. Price List of Iron and Steel Tubes.

Mosses and Mitchell, London, E.C. Price List of Vulcanised Fibre.

Beaman and Deas, Warrington. Pamphlet descriptive of Refuse Destructor.

The "Dowson" Gas Engines Syndicate, Limited, London. Illustrated price list.

Henry F. Joel and Co. Illustrated Catalogue of Dynamos, Storage Batteries, Arc Lamps, and other apparatus.

Musgrave Bros., Leeds. Illustrated Catalogue of Hydraulic Machine Tools and other Special Machinery. 1894.

Dorman and Smith, Manchester. Catalogue of Lamp Fittings, Switches, &c. A complete and well illustrated catalogue.

Green and Boulding, London, E.C. Illustrated Catalogue of "Buffalo" Injectors, "Shipman" Engines, &c.

Sir Joseph Whitworth and Co., Limited, Manchester. Illustrated Price List of Screwing Apparatus and Taps, for Hand and Machine Use.

King, Mendham, and Co., Bristol. Illustrated Price List of Electric and Magnetic Experimental Apparatus. This is a very complete catalogue, and should be useful to young experimenters.

Entwisle and Glass, Limited, Bolton. Corrected Wheel List. Sixth Edition. This is a neatly-bound catalogue, clearly printed and arranged, containing tables of wheels of the spur, bevel, mitre, worm, pulley, and fly varieties.

Tannett, Walker, and Co., Leeds. Catalogue of Hydraulic Presses, Cranes, &c. This catalogue is illustrated by means of photographs taken of the cranes, &c., when delivered and at work, which system greatly assists in demonstrating the adaptability of the many various hydraulic appliances made by this well-known firm.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

As next week will prove almost an entire blank for the ironworks, operations this week have been pushed on with all speed. For Australia, New Zealand, and other Colonial markets merchants have recently distributed some fair lines. Competition for these orders is, however, severe, and it is reported that one local firm is prepared to spend £10,000 in the endeavour to obtain a monopoly of the New Zealand galvanised iron market. The price quoted here for corrugated sheets, doubles, is £9 10s. to £9 15s., and in some cases £10 f.o.b. Liverpool. Sheets, ungalvanised, are £6 10s. doubles, and £7 trebles. Much interest is aroused by the information from Sydney that there has been a heavy fall in the price of galvanised iron on that market, due to a new departure by Messrs. J. Lysaght, Limited, of Wolverhampton and Bristol, the proprietors of the "Orb brand," which holds a prominent place in the market. Hitherto this iron has only been purchasable in large parcels, but, in order to meet growing competition, it is now being offered in small lots, at a sliding scale according to quality, and at a lower basis price than has hitherto prevailed. The prices of other descriptions of manufactured iron, as well as pig iron, are unaltered since last report. The steel works are well employed, but complaint is made in this department also of low prices. The Staffordshire Steel and Ingot Iron Company quotes its bridge plates £5 15s., girders and angles £5 5s., bars up to large sizes £5 5s. to £5 15s., tees £5 15s., and boiler plates £6 5s.

"Recent Improvements in Locomotives" was the title of a paper read before the Association of Birmingham Students in connection with the Institution of Civil Engineers, since last report, by Mr. W. Rowland, of Crewe Works. Dealing with the Dreadnought class of engines built by the London and North-Western Railway Company in 1884, Mr. Rowland mentioned as an instance of their capabilities that an engine of that type, in March, 1885, worked the Scotch express from Euston to Carlisle, a distance of 300 miles, at an average speed of 44·7 an hour, between the stations. The total weight of the train was 207 tons, or excluding the engine and tender, 139·10 tons. A load of eighteen coaches weighing about 230 tons could easily be drawn by these engines at 45 miles an hour. In 1891 a still more interesting class of engine was constructed, called the Greater Britain. This ran daily from the 17th to the 22nd of April, 1893, between London and Carlisle, covering 3612 miles. The average weight of the train was 237 tons, and the mean speed 47·66 miles an hour. Upon this engine improvements have recently been introduced. As illustrating the greater demand for increased weight and higher running speed with locomotives during the past twenty years, he pointed out that in 1863 the Scotch express from Euston averaged 312ft. in length, and weighed, excluding the engine and tender, 77½ tons.

Machinery firms in this district are interested in noticing that a new company, under the title of W. and T. Avery, has been registered with a capital of £200,000 in £5 shares, to acquire the business of weighing machine manufacturers, hitherto carried on under the same name at Digbeth, Birmingham. A company under the title of Gibbons Bros. has also been formed, with a capital of £20,000, to acquire the business of Messrs. B. and W. P. Gibbons, gas engineers, and contractors, and brick manufacturers, at Dudley.

As a leading seat of the ammunition trade, Birmingham is much interested in the information that special officers have just been deputed to ascertain under what circumstances the Chinese and Japanese forces are supplied with ammunition, as it is alleged, by English firms. The inquiries that have been made reveal the fact that the United States are as great offenders in this respect as England. Several American officers are in the employ of China, and it is said to have been discovered that these gentlemen have given large orders for ammunition and arms to some well-known American firms. At the same time, it is beyond doubt that much of the ammunition comes from English firms, but, as the orders are executed through another country, there can be no direct evidence against them.

The figure "600" occurring in this letter last week with reference to the employment of traction engines in Herefordshire was a slip of the pen for sixty.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—The year is closing very unsatisfactorily for all branches of trade connected with the engineering, iron, and coal industries of this district. A general slackening off is of course looked for at this season of the year, but there is more than the usual quietude, and an absence of any indication of material improvement when the holiday and stock-taking season is over. The continued further downward tendency in the iron market would seem to indicate rather a want of confidence in the future, and the fact that sellers here and there are still prepared to book forward at under current rates is not at all an encouraging feature, considering that prices have already touched a point that is anything but remunerative to either makers or manufacturers. The outlook as regards the coal trade is perhaps even still worse, and the agreement which was entered into with the Miners' Federation with regard to wages is looked upon as likely to prove a very serious matter for many of the coalowners.

The Manchester Iron Exchange on Tuesday brought together a fairly good attendance, but business remained in just the same depressed condition that has been reported for some time past, and a general absence of buying was again the report all through. Inquiries coming upon the market for pig iron are not only few in number, but, for the most part, extremely small in weight, and prices show a continued want of firmness; makers, rather than allow orders to pass, being disposed to entertain low offers which they were declining a week or so back. For Lancashire pig iron quotations remain nominally unchanged, but as regards forge qualities, for which local makers are asking about 38s. 6d. to 39s., less 2½d. at the works, they are completely out of the market, owing perhaps as much to the absence of requirements on the part of consumers as to the much lower figures at which Lincolnshire iron is being offered.

Occasional small sales of foundry iron are, however, being made by the local makers to regular customers on the basis of about 42s., less 2½, at the works. In Lincolnshire iron some transactions have been put through at excessively low figures, there being no difficulty in buying forge qualities at about 37s., and foundry at about 38s. 6d. net cash delivered Manchester, although makers are in most cases quoting quite 6d. above these figures. Quotations for Derbyshire foundry remain nominally about 43s. up to 44s. 6d. and 45s. net cash for the best brands delivered here, but as there is no buying going on to test prices these quotations are altogether nominal. For outside brands offering here sellers have been prepared to take lower prices, good foundry Middlesbrough being readily obtainable at 43s. 10d. net cash delivered Manchester, whilst as regards Scotch iron, some brands of which have given way about 6d. per ton, Eglinton could now be bought at about 46s. to 46s. 6d. and Glengarnock at 47s. to 47s. 6d. net prompt cash, delivered at the Lancashire pits.

The manufactured iron trade remains in a most unsatisfactory condition—in fact, a representative of one large works told me on 'Change that during his whole thirty years' experience he had never known it to be worse; their works were only being kept going alternate weeks, and such a state of things as the above had never before prevailed, especially at this season of the year. Generally throughout the district forges continue but very indifferently employed, either not starting until Tuesday or Wednesday, or only running a portion of their plant. Prices remain much as last quoted, having, with the present cost of production, got to about as low a point as they can possibly touch. Lancashire bars do not average more than £5 5s., North Staffordshire qualities only in exceptional cases fetching more than £5 7s. 6d., Lancashire sheets ranging from £6 15s., and Staffordshire sheets £7, with Lancashire hoops quoted £5 15s. for random, and £6 for special cut lengths, delivered Manchester or Liverpool. Nut and bolt makers still report only a very limited weight of business coming forward, engineering and other branches of industry not taking anything like their usual weight of this class of material, and prices have to be cut excessively low to get hold of orders.

The steel trade continues all through very quiet, with prices about as last quoted, ordinary foundry hematites averaging nominally 52s., less 2½ per cent.; low-class billets, £3 17s. 6d. to £4; better qualities, £4 5s. up to £4 10s.; ordinary steel bars, £6 to £6 2s. 6d.; and boiler plates, £6 2s. 6d. to £6 5s. per ton, delivered in this district.

In the metal market only a slow hand-to-mouth business is reported, with quoted list rates for manufactured goods unchanged.

The position as regards the engineering industries remains without material change, very few establishments being what may be termed fully engaged, and this chiefly on special work for abroad. For the most part engineers throughout the district are still very indifferently off for orders, and for the present there is no increased weight of work coming forward or in prospect upon which to base any sanguine anticipations of reviving activity next year. Discussing on 'Change the other day the condition of trade with a representative Lancashire engineer who had just returned from a special tour on the Continent, he said that he had been particularly struck with the contrast presented by the position of the engineering establishments in Switzerland and similar works here. Whilst in this country engineering establishments were for the most part dragging on with difficulty from hand to mouth, and many of them extremely slack, in Switzerland they were all busy and full of work. The engineering establishments in Switzerland were, in fact, doing the work which we used to do; and one reason for this was, the better organisation and supervision of the works. The men were more amenable to discipline, and they worked 10 per cent. more time at 15 per cent. less wages, whilst excellent arrangements were carried out for carefully noting every point where improvements could be made and expenditure lessened by trained men, specially set apart for this purpose. In other continental engineering centres also, the large engineering works were decidedly better off for orders than establishments in this country.

With regard to the overtime question and the circulars sent in to the employers in this district by representatives of all the principal engineering trades union societies, asking that restrictions should be placed upon overtime as it is now being worked in some establishments, and abolished altogether on new work, to which I referred last week, I understand that although the leading members of the Employers' Association have had the matter under consideration, no definite action has so far been taken. There is a strong feeling amongst some of the members that if a definite reply has to be sent to the circular, it should be an intimation that if any step is taken in the present depressed condition of trade, it will necessitate a reduction in wages, but whether any course of action such as this will be adopted is only a matter of conjecture.

An ingeniously designed machine specially for cutting spur, worm, and bevel wheels, in brass, by means of a fly-cutter, has just been completed by Messrs. Cunliffe and Croom, of the Broughton Ironworks, Manchester. In this machine the centre of the body is provided with an adjustable mandril holder, admitting mandrils of different diameters and lengths, and so arranged that a number of wheels can be placed in position, divided, and cut in one operation. For cutting spur gear, a perfectly parallel motion is secured by means of a swing frame, which moves in hardened steel centres, connected by levers, and the cutter spindle is always in the correct position for driving and cutting the teeth in any position of adjustment. When cutting worm wheels the entire headstock is thrown to the requisite angle on a radius quadrant, between the headstock and the frame, and for cutting bevel gear the required adjustments are effected by setting the radius quadrant to either side, and throwing the sliding block carrying the end of the cutter spindle over to the right angle by setting a swing frame, which is provided for the purpose. For dividing the teeth a drilled plate is provided, with a spring finger adjustable to all the circles, the periphery of the plate being also machine-cut into a dividing wheel, and fitted with a steel worm and a machine-cut indexed wheel to divide and subdivide into any count of teeth required to be cut. The motion of passing the cutter through the work is controlled by a balance-weighted lever, worked by hand by the attendant. The machine, which has been specially designed for makers of the pre-payment gas-meter attachments to the automatic delivery motion work, and is also particularly applicable for electricians and manufacturers of other intricate appliances, will admit and cut spur wheels, bevel, or worm wheels up to 9in. diameter and 2½in. wide, and produces correct and highly-finished work at a very rapid rate.

All descriptions of fuel continue in the slowest possible demand, either for house fire requirements or steam, forge, and general manufacturing purposes, and with pits in many cases not working three and only in exceptional cases more than four days per week, supplies are more than ample to meet present requirements. All descriptions of round coal are excessively low in price; in fact, 1s. to 1s. 6d. per ton below last summer's rates. At the pit mouth best house fire coals average 10s. 6d. to 11s.; second qualities, 9s. 6d. to 10s.; and common house coals, 7s. to 7s. 6d. up to 8s. per ton; but the minimum figures represent more nearly the average prices at which sales are actually put through. The lower descriptions of round coal continue in but very poor request for steam and forge purposes, and at the pit mouth do not average more than about 6s. 6d. per ton. Supplies of engine fuel are, perhaps, not quite so plentiful as they have been, owing to the present very restricted production of slack, but prices show no improvement, common sorts being readily obtainable at 3s. to 3s. 6d., better qualities 4s. 6d. to 4s. 9d., with some special sorts quoted 5s. to 5s. 3d. per ton at the pit mouth.

In the shipping trade business is very quiet, with extremely low prices taken to effect clearances of common round coals, 7s. 9d. to 8s. per ton representing the figures that have been readily accepted, with better qualities of steam coal not averaging more than 8s. 6d. per ton, delivered at the ports on the Mersey.

*Barrow.*—Business during the past week has been very quiet in the hematite pig iron trade. The new orders booked are of small volume, representing but a limited tonnage, and not anything like what is necessary to keep the present output from running into stock. The stores of iron in North Lancashire still continue to rise, a further 375 tons having been added this week. There are fourteen furnaces blowing, and fourteen standing idle, and in West Cumberland seventeen are blowing, and thirty-one standing idle. Prices are down a trifle on the week, warrant holders now quoting 43s. per ton, net cash. Makers are asking 44s. to 45s. per ton for Bessemer iron. The orders in hand are not large, for on every hand the requirements of consumers are limited.

In the steel trade there is again much quietness. Several of the orders recently booked have been finished and delivered, and the rail mills at Barrow are again standing. Orders for rails are scarce, for the producing power is so great that buyers are kept completely supplied, and new railways are not being put down with much activity. For shipbuilding material there is some inquiry, but it is not a very brisk one. The mills at Barrow are fairly well employed on the manufacture of plates for Barrow, Belfast, and other places; but new orders are coming to hand slowly. The business doing in tin-plate bars is small. Prices this week show no change, and are as follows:—Heavy rails, £3 15s.; light sections, £5 5s.; colliery rails, £5 10s.; ship-plates, £5 2s. 6d.; angles, £5 10s.; boiler-plates, £5 12s. 6d.; and tin bars, £3 17s. 6d.

In the engineering and shipbuilding trades there is nothing new to report. The shops are well employed, particularly in the engineering department; and on the shipyard side there is considerable activity noticeable, and all orders are well in hand. New orders are scarce.

Iron ore is in poor demand at 8s. 6d. to 9s. 6d. per ton net at mines for average sorts. Coal and coke are in fair consumption.

The shipping trades are depressed, both on coasting and foreign accounts. The exports of iron and steel show a decline on the year of 2000 tons.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE mild weather which at present prevails in this district has the effect of checking the demand for household sorts, and interferes as well with the consumption of coal for all heating purposes. Many of the collieries are now making on an average from three to four days a week, the only instance where five days are worked being at pits which are busily engaged on contract account. The stacking of house coal has commenced at not a few of the thick seam pits, which is a very unusual thing at this season of the year. London has taken a very moderate demand by rail of both Silkstone and Barnsley this week. Agents in the metropolis state that business is very quiet, and sales can only be effected at low rates. This is on account of seaborne fuel being sent in large quantities, and owing to the cheaper rates paid for this mode of carrying, stocks are more easily disposed of. Summer prices are hardly kept up. Last week's quotations are still ruling. Silkstone is at 9s. to 10s. 6d.; Barnsley House, from 8s. 6d. to 9s. 6d.; Flockton, about the same rates; secondary qualities at 7s. to 7s. 6d. per ton. The steam coal trade is fairly active for this period of the year. A good tonnage is being dispatched on the Hull and Barnsley Railway from Denaby, Stairfoot, and Cudworth. The business with Hull and the other Humber ports is well up to the average; the export trade, in spite of the railway rate to the seaboard, shows a disposition to steadily advance. Inquiries for next year's export trade are reported to be pretty numerous, and there is every probability of a larger business being done in Barnsley hards. In railway contracts the Great Eastern Railway has been taking some supplies of house and gas coal from Doncaster. Tenders were submitted a fortnight ago, but as yet not much business has been done. The companies whose contracts are already placed are taking a good average tonnage. Prices range from 7s. 6d. to 8s. per ton for South Yorkshire hards, secondary qualities only fetching 6s. 9d. to 7s. 3d. per ton. Gas coal is in large demand, mainly on contract account, prices being from 7s. 3d. to 8s. Small coal and slack are in a very depressed condition, supplies being largely in excess of demand, and prices very low. Common pit slack can be had at 3s. per ton, and riddled qualities at from 4s. to 5s. Smudge is as low as 1s. 9d. to 2s. per ton at the pits. The request for coke is well sustained, and a good tonnage continues to be forwarded to North Lincolnshire and Derbyshire, prices ranging from 9s. to 11s. per ton.

The iron trade keeps as dull as ever, and the low prices already quoted are not likely to be altered this year. Hematites delivered in Sheffield remain at 50s. to 52s., according to brand; and Lincolnshire forge iron is at 38s. per ton. Bessemer billets are £5 7s. 6d. per ton when largely ordered, and a little firmer for smaller quantities. For Siemens-Martin steel the brisk demand noted during the year has been maintained. Swedish Bessemer billets exhibit more animation, and in both branches brisker trade is anticipated in the early part of 1895. The rolling mills are rather better engaged on orders for the city, which practically means that the lesser staple industries are affording a larger amount of work to the employés. Still, a good many workmen are applying for engagement at the offices of the larger and more enterprising firms, where the condition of affairs is reported to be much better than was expected two months ago. A very important business indeed has been done by several of our East-end steel houses, in the better classes of steel required for military, watch, clock, and similar purposes.

Railway companies are giving out very few orders owing to the unsatisfactory traffic returns. A few fair orders for rolling stock have recently been placed. The productive powers of our Sheffield establishments, however, are now so large that an immense volume of work is required to keep them fully employed, and as there is now no probability of any such stimulus being obtained this season, there will be not a little distress amongst workpeople, who have been so indifferently employed during the whole year. In fact, with the exception of the armour-plate department, very few of the heavy trades have given regular work to their hands this season. A great disappointment has been the absence of orders for ordnance and shells. A large amount of money has been spent in laying down costly plant for the production of armour-piercing projectiles, and a staff of skilled artisans has been kept in the expectation of adequate work being found for them—the necessary complement, as it was thought, of the Admiralty programme. But these anticipations have not been realised, and the firms who have laid themselves out for this special work have found the department entirely unremunerative through sheer lack of employment. The armour-plate firms are working at high pressure to expedite the delivery of plates ordered this year under the new Admiralty programme. These are for H.M.S. Magnificent, Mars, Majestic, Jupiter, Prince George, Hannibal, and Victorious. Each ship requires 2500 tons of armour-plates. The Magnificent, which was launched on the 19th inst., has just been a year and a day in completion. The superficial area of the citadel armour of the Magnificent is about 8150ft., and the thickness 9in., 12in., and 14in., and the weight 1460 tons. Work is also in hand for the cruisers Powerful, Terrible, Dido, and Isis.

In the lighter trades a steady improvement is noted in the demand for cutlery from America, and a fairly satisfactory volume of business is now being done. When the commercial aspect in the States has had time to clear, the full benefit of the reduced tariff will be felt. The outlook at present is unusually gratifying, as the goods sent to the States increase every week. There is also a perceptible change for the better from Australia, which is steadily recovering from a succession of severe financial distresses. There is more doing as well with South American markets, particularly as regards the grades of cutlery peculiar to these countries, as well as in tools and the higher class of forks and spoons. Silver and electro-plate are in brisk demand, the output of sterling silver work increasing every week, while the call for the best plate is not seriously affected by the preference shown for silver goods.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

IT is decidedly the exception to find anyone engaged in any branch of trade of this district expressing satisfaction with either his position or prospects, but the most general complaint is that it is almost impossible to make receipts cover expenditure, and as far as regards the capitalist a large amount of work has to be done for nothing. The year is closing with business in a very unsatisfactory state; indeed, taken as a whole, it has not at any one time been worse during the year, and prices generally are at the lowest point which has been reported during the twelve months. The highest prices ruled in the first month of the year, when No. 3 Cleveland pig iron was 1s. 6d. above the present figure; grey forge pig, 2s.; hematite pig iron, 3s. 6d.; steel plates, 12s. 6d.; steel angles, 7s. 6d.; common iron bars, 5s.; iron ship-plates, 5s.; and iron angles, 7s. 6d., and it is much more difficult to secure orders. To those pig iron makers who have to buy their materials in the open market the task of keeping their furnaces going without loss must be almost impossible, seeing that 12s. 3d. per ton delivered on Tees-side is the rate to be paid for coke, 4s. for limestone, and something like 5s. 6d., the average price of Cleveland ironstone. One of the leading ironmasters has publicly stated that several of the Cleveland pig iron making establishments are being carried on at a loss, and if we look at the prices of materials and the sum paid for the pig iron itself, such a statement may well be believed, more especially where the furnaces are producing hematite pig. The ore at 12s. per ton will cost per ton of pig iron made something like 24s., the limestone 1s. 6d., the coke at 12s. 3d. per ton 13s., and labour 3s., or altogether 41s. 6d., which is only a little under the present selling price of mixed numbers of Cleveland hematite, and in this calculation there is nothing allowed for water, depreciation, interest on capital, rates and taxes, &c. There is no question that the prices of materials have not this year come down in the same proportion as the prices of the manufactured article, but that, as far as regards pig iron, is due to the fact that the consumption has not only not been reduced, but has increased, and the producers of the raw materials have had no difficulty in disposing of all they had to sell. Under such circumstances it was not likely that they would reduce their prices. That the consumption has increased is indicated by the fact that while a year ago only 84 furnaces were in operation, now there are 95, and this latter number have been working for some months. Thus the production of pig iron has been augmented, and, in fact, will be the largest that has ever been recorded in the North of England, the estimate for the year as compared with the actual figures for last year, and with 1890, which was the previous best year, being as under:—

| | Cleveland<br>Tons. | Hematite<br>Tons. | Total<br>Tons. |
|---|---|---|---|
| 1894 .. .. .. | 1,423,000 .. .. | 1,540,000 .. .. | 2,963,000 |
| 1893 .. .. .. | 1,388,043 .. .. | 1,336,141 .. .. | 2,724,184 |
| 1890 .. .. .. | 1,539,250 .. .. | 1,306,839 .. .. | 2,846,089 |

Thus the production exceeds the previous best by over 120,000 tons, and over half the iron made was other than ordinary Cleveland. The best year for Cleveland ordinary iron alone was in 1881, when 1,998,824 tons were made. Never was there such a large import of foreign ore, the quantity received in the Tees alone will reach 1,468,000 tons this year, as compared with 1,268,702 tons in 1893, and 886,352 tons in 1892. And from the Cleveland ironstone mines alone over 5,000,000 tons will have been raised, or about 375,000 tons more than in 1893. But in spite of this increase in make, it is to be feared that the balance of the makers at the bankers will not have increased much, for prices have not on the whole been unsatisfactory, and the production has been kept somewhat in excess of the requirements during the greater part of the year, so that stocks of Cleveland iron will have increased in the aggregate over 43,000 tons, and probably a good deal more than that in hematite, but there are no complete figures available, though in Connal's warrant stores alone the stock of hematite iron will have increased 45,000 tons, or more than in Cleveland iron altogether.

Makers have not this week reduced their prices of Cleveland pig iron below 35s. 3d., but merchants and speculative holders have been selling at 35s. 1½d. for prompt f.o.b. delivery, as some of them do not want to carry iron over to next year, and various speculators are not in a position to accept the iron due to them for delivery this month, and have to sell at what they can get. It is thought that we shall see 35s. generally taken before the year is out, and this is the minimum of the year. No one is buying for forward delivery when prices are drooping, and the production exceeds the requirements. Cleveland warrants have declined to under 35s., for on Wednesday 34s. 11d. cash was taken. The stock of Cleveland pig iron in Connal's warrant stores on Wednesday night was 92,047 tons, or 834 tons increase this month, and 9408 tons decrease for the year. The lower qualities of Cleveland pig iron have not fallen in sympathy with No. 3 and warrants, as they had their season of declining prices some time ago, and they are not now being offered so freely as they were. Thus No. 4 Cleveland pig iron is quoted at 34s. 6d., and grey forge at 33s. 6d., and makers are pretty firm at these rates. Mixed numbers of hematite pig iron are readily obtained at 42s. 6d. per ton, producers being anxious to sell as their stocks are increasing. They will obtain a little amelioration in the cost of foreign ore, because freights are somewhat easier, and almost anyone will sell good Rubio at 12s. per ton, delivered on Tees-side next year; while some cargoes for immediate delivery have been sold at 11s. 10½d. The closing of the Black Sea ports has thrown a considerable amount of tonnage into other trades, and ore shippers have this week had no difficulty in engaging vessels at the lower freights, which are 4s. 9d. Bilbao-Middlesbrough, 4s. 6d. Bilbao-Jarrow, 7s. 7½d. Huelva-Middlesbrough, 7s. 10½d. Benisaf-Middlesbrough, 7s. 10½d. Garucha-Tyne. The best price for Rubio ore this year has been 12s. 9d., paid in March, so that the fall has been fully 9d. per ton. The ironmasters in Cleveland have arranged to give 2s. 6d. in excess of his regular wages to every shift man at their blast furnaces who does not absent himself from work, except by arrangement with the foreman, between December 24th and January 2nd. The men wanted this bonus given for Christmas day and Christmas night alone, and not to extend over the seven shifts.

The finished iron and steel manufacturers report no change this week, but they are rather better off than they were last month, and adhere to their higher quotations. For steel ship plates, £4 15s., less 2½ per cent. f.o.t., is quoted; steel boiler plates, £5 15s., less 2½ per cent. f.o.t., and iron plates are at the same figures. Iron and steel ship angles are both at £4 10s., less 2½ per cent. f.o.t., and engineering angles, £4 15s., less 2½ per cent.

It is satisfactory to see that more desire is shown to give out orders for new vessels, and this must have a good effect upon the plate and angle trades. One of the Tyneside yards has got an order within the last few days for one of the largest vessels ever built in this district. Her deadweight capacity is to be 10,200 tons, and beam 56ft. Messrs. Wm. Gray and Co., of West Hartlepool, have also secured orders for two large vessels. They have during this year launched seventeen vessels—all steel screw steamers—of 49,733 tons and 20,990 horse-power, while Messrs. Furness, Withy and Co. have launched nine vessels—all steel screw steamers, except one of iron—of 23,319 tons and 2025 horse-power. Messrs. R. Irvine and Co. have launched three steel screw steamers of 6141 tons and 2765 horse-power. Altogether at the Hartlepools twenty-nine vessels have been launched, or five more than last year, and the total tonnage is over 79,000 tons, or 13,000 more than in 1893.

The engineering trade is quiet, as it has been all the year. During this year the Central Marine Engine Works, at West Hartlepool, have provided engines for nineteen new vessels, besides which two vessels have had their boilers renewed, and their engines converted to high-pressure compounds. Four boilers have been built for dredgers and tugs, making altogether forty-four boilers of the marine type built at the works. The total production falls considerably short of that of last year, which may be partly attributed to the prolonged strike of moulders and patternmakers. The average indicated horse-power of the new engines built this year has been 1571, as against 1548 in 1893, and 1500 in 1892. The total number of vessels dealt with was twenty-one, and the indicated horse-power of the engines was 32,050, while in 1893 the number of vessels was twenty-five, with 36,550 indicated horse-power.

The death is announced at Grange-over-Sands of Mr. Edgar Gilkes, who was one of the pioneers of the Cleveland iron trade. Mr. Gilkes was a native of Berkshire, and came into the North in 1839, where he was engaged at Shildon as one of the engineers of the Stockton and Darlington Railway. In 1843 a branch establishment was started at Middlesbrough under the name of the Tees Engine Works, for the repair of rolling stock, and Mr. Gilkes was made manager. Shortly afterwards he joined Mr. Isaac Wilson, the late member of Parliament for Middlesbrough, in carrying on the works under the style of Gilkes, Wilson and Co., that being the first engineering establishment at Middlesbrough. They built a considerable number of locomotives for the old Stockton and Darlington. At the works they also made a speciality of the construction of viaducts. In 1852 Mr. Gilkes joined in erecting blast furnaces, and his firm were one of the first to follow the example of Mr. John Vaughan, soon after the discovery of the main seam of Cleveland ironstone. He was one of the first councillors of the borough of Middlesbrough, and filled the post of Mayor in 1863.

The coal trade is dull, shipments falling off and prices weak. The North-Eastern Railway Company have placed their contracts for next half-year's supplies of locomotive coal at 8s. per ton for the Northern division, which is equal to about 9s. 6d. f.o.b. or 1s. below the contracts now in force. The supplies will be obtained from the Stella, Lord Durham's, the Stanley, and Sir James Joney's collieries. The price of best steam coal is 9s., and small 4s. f.o.b. The gas coal syndicate keeps the price of best at 7s. 3d., and the cokemakers' syndicate does not allow the price of best coke to fall below 12s. 3d. per ton, delivered on Teesside. The Durham Miners' Council have intimated to the owners' secretary that they do not this year intend to stop the pits to take the usual week's holiday between Christmas Day and New Year's Day.

The members of the Boilermakers' and Iron Shipbuilders' Society—one of the most important trade organisations in the country—have adopted, by a substantial majority, their secretary's suggestion that the society shall withdraw from the Trades' Union Congress, owing to the power that the new unionism has obtained there, and the impracticable character of the resolutions which are now discussed and passed there. Probably more of the older unions will follow the example of the Boilermakers' Union.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has been depressed. Large quantities of Scotch warrants were disposed of last week, prices falling about 6d. per ton. This week the downward tendency has continued, and business has been down to 41s. 10d. cash. Cleveland warrants have sold in small quantity at 35s., showing a decline of 6d. on the week, and Cumberland hematite at 43s., a fall of a similar rate. These declines have caused a good deal of uneasiness in the market, especially as some influential holders, who supported prices for a long time, are understood to have cleared out and gone on the bare tack.

An additional furnace has been lighted, and there are now forty-six producing ordinary, and twenty-five hematite pig iron.

There is a quiet business in makers' iron, the prices of which have been receding in sympathy with warrants. G.M.B., f.o.b. at Glasgow, No. 1, is quoted 43s. 9d. per ton; No. 3, 41s. 9d.; Monkland, No. 1, 45s.; No. 3, 42s.; Carnbroe, No. 1, 46s.; No. 3, 44s.; Clyde, No. 1, 49s. 6d.; No. 3, 46s. 6d.; Calder and Gartsherrie, Nos. 1, 51s. 6d.; Nos. 3, 47s. 6d.; Summerlee, No. 1, 52s. 6d.; No. 3, 47s. 6d.; Coltness, No. 1, 54s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 50s.; No. 3, 47s.; Eglinton, No. 1, 47s. 6d.; No. 3, 45s.; Dalmellington at Ayr, No. 1, 47s. 6d.; No. 3, 45s. 6d.; Shotts at Leith, No. 1, 53s.; No. 3, 50s. 6d.

The shipments of pig iron from Scottish ports in the last week amounted to 4875 tons, compared with 5616 in the corresponding week of last year. There was shipped to Italy 390 tons, Australia 350, India 234, South America 60, France 61, Germany 175, Holland 220, Belgium 30, China and Japan 400, other countries 60; the coastwise shipments being 2866, against 4599 tons in the same week of 1893.

There has been rather more doing in the malleable iron trade for home consumption, but the shipping inquiry is reported to be in a backward state. The steel makers have reduced prices 2s. 6d. per ton, finding this to be a necessity on account of one or two firms taking work at lower rates. The output is large and competition keen. The demand for shipbuilding steel has lately been on the increase in consequence of the placing of numerous contracts for the shipbuilders.

The locomotive builders are now getting well supplied with orders, and boiler makers are in many cases doing well, but the general machinery trades remain quiet.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced locomotives valued at £2070, sewing machines £5280, other machinery £10,400, steel goods £8193, and miscellaneous iron goods £16,696.

The coal trade is flat, especially in the shipping department, the shipments, compared with those of the preceding week, showing a decrease of fully 30,000 tons. About 10,000 tons of the decrease arose at Glasgow, and the remainder at Ayrshire and Fife ports. Business in Ayrshire is in a very backward state, the export trade particularly having fallen off materially.

Full returns are now available regarding the Clyde shipbuilding trade in 1894. The launches number 75 sailing vessels, with a tonnage of 72,130, and 182 steamers of 268,755 tons—total, 340,885 tons, compared with 280,160 in 1893. The output has only been exceeded on two previous occasions, viz., in 1882, when it was 391,934, and in 1883, when the highest tonnage ever launched—419,664—was launched. The year has been a busy one in the engine shops, which turned out 290,945 indicated horse-power, against 256,545 in the preceding year. It is calculated that the work on hand in the Clyde shipyards amounts to 225,000 tons.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Last week proved, as anticipated, a busy week in coal shipping at all ports, Cardiff alone dispatching over 300,000 tons. During the week I had an opportunity on both the chief lines of rails from the principal collieries, those of the Taff Vale and the Rhymney, of seeing the coal traffic, and it was considerable. The collection of first-class steam coal at Llanishen, Roath sidings, and Cardiff terminus was excellent.

Some more big orders have been booked for coal, in addition to those I have announced of late. On 'Change this week at Cardiff it was reported that the Campagnie Generale Transatlantique had concluded contracts with the Harris Navigation—now Ocean—for 50,000 tons steam coal, and with the Ferndale Company for 60,000 tons, to be delivered in 1895. The exact figures for which both were booked are not known, but the impression is that they range between 10s. 9d. and 11s. per ton. In either case the outlook is satisfactory, and shows that the opinion in good quarters of fair prices being retained is a sound one.

Prices have been fairly well maintained of late. Quotations on 'Change, Cardiff, mid-week, were as follows:—Best steam, 11s. to 11s. 3d.; seconds, 10s. 3d. to 10s. 6d.; dry coal, 9s. 9d. to 10s.; small, 5s. to 5s. 6d. This may be regarded as a good price for small, which is rather a glut in the market. I saw a large quantity tipped at a leading colliery a few days ago, which, unless prices advanced materially, would scarcely pay to be re-trucked.

In house coal there is a good demand, but coal owners express some little disappointment that demands have not increased in sufficient volume to send prices up. Practically quotations remain. The latest at Cardiff are:—Best household, 10s. 6d. to 11s.; No. 3, Rhondda, 10s. 3d.; brush, 8s. 3d. to 8s. 6d; small, 6s. 9d. No. 2, Rhondda, 8s. 6d. to 8s. 9d.; through, 6s. 6d.; small, 4s. 6d. Quotations in coke remain unaffected, and very likely will continue so until there is an improvement in the iron and steel trades. Cardiff prices are:—Furnace, 14s. to 14s. 6d.; foundry, 15s. to 15s. 6d.; special foundry, 21s.

Patent fuel is only in moderate request; prices remain. The pitwood stocks are now filling up, and prices are getting easier. Cardiff quotations now are 15s. 6d. to 15s. 9d. for ordinary ex ship.

A local authority has published, at an opportune moment, a list of the losses to capitalists which have occurred in the coalfield of Wales—a formidable sum, by the way—showing the necessity that the men, ere abandoning the sliding scale and bringing about confusion in the trade, should exercise the greatest caution. The contention on the side of capitalists is that their bed is not one of roses, and that losses such as £200,000 in a single venture, closed pits in one direction, and long periods of inaction in another, might fairly tempt men of means to choose a less hazardous employment for their money than coal-mining affords.

That the men are beginning to see that they have been too impulsive, in giving notice to terminate the sliding scale, is evident from recent occurrences. On Tuesday there was a meeting of colliers' representatives at Cardiff, Mr. Abraham, M.P.—Mabon—in the chair. The meeting was called to consider the financial position of the sliding scale and other business. It transpired during the meeting that efforts have been made of late to bring about an interview with the employers' representatives, with a view to discuss a revised sliding scale, but that, so far, they had been unsuccessful—a fact the meeting regretted. An annual levy of 6d. per member, in support of the sliding scale committee, was called for.

Some of Sir W. T. Lewis's latest efforts in ameliorating the condition of the working classes have been in the establishment of hospitals in the colliery districts. Merthyr and Aberdare now have one each, thanks to him, and both have done great service this week. I learn from the secretary of the Merthyr Hospital that Sir William called there a day or two ago, and, finding that colliery accidents and general accidents were treated in the same ward, submitted that, if a receiving ward were built by the committee, he would give £1000 to endow one bed for colliery accidents. This, of course, was gratefully received, and has given rise to much satisfaction.

I am still unable to report any change for the better in the iron and steel trades, which have drifted into such a stagnant condition that even on 'Change quotations are ignored, and all kinds and descriptions regarded as "unchanged." Things are not only in a slow state, but it is quite possible there may be only partial stoppages. As for steel rails, it was pleasant to see two cargoes of 160 tons a day or two since going to a local railway from Newport, Mon.

In the bar there is only a quiet average trade, and until the wage difficulty in the tin-plate trade is settled at Swansea and Llanelly, little more can be anticipated. Last week I saw some good make from the Treforest Works, and here and there workmen are going on fairly in harmony with employers; but the general condition is unsatisfactory. Last week, owing to the non-arrival of tonnage at Swansea, only 42,999 boxes were dispatched of tin-plate, while 75,153 boxes were received from works. Stocks are now at 282,459 boxes. However, though the outlook is bad there are some encouraging signs. Nine steamers are due in to load at Swansea, and any day I may have the gratification of announcing, not only a brightening up of prospects in the tin-plate trade, but the conclusion of satisfactory arrangements between the men and employers. Some employers have succeeded in effecting a reduction of wages for a few months, but there is no official statement made, and arrangements fluctuate considerably, some being at the rate of 7½, I hear, and others 25 per cent. off existing wages. At Lydney a 10 per cent. reduction has been effected, and it is expected a similar one will be carried out at Melingriffith, near Cardiff.

On Saturday last there was a special meeting held in Cardiff of the council representing the workmen in the tin-plate trade of South Wales and Monmouthshire; 80 delegates were present. The chief subject was the reduction in wages demanded by employers, and it was resolved to solicit a vote on the subject from the several branches.

On the same day it was under discussion at Swansea, at a large meeting, to form a rival union. The question was adjourned for a fortnight.

A temporary stop has taken place at Blaina Iron and Tin-plate Works on account of slack trade.

The Saxony, a fine liner, belonging to D. McIver and Sons, of Liverpool, came into the Roath Basin this week to load, and attracted a good deal of attention. She is under charter to the River Plate, with Messrs. Worms, Josse and Co.

Newport, like Cardiff, is adding to its steamers. The Refugio, a new steel screw steamer, of the Remedic Steamship Company—Orders and Handford, Newport—has just completed a most satisfactory trial trip, and is loading coal at Cardiff for St. Nazaire. She was built by the Campbelltown Shipbuilding Company, and is a fine construction, with all modern and latest appliances. Her engines are on the triple-expansion principle, and are by Kincaid and Co., of Greenock.

The electric lighting of Swansea, as regards the compulsory area, has been decided upon, on the high-tension alternating current, and a refuse destructor is to be used in connection.

A register of unemployed men is to be kept by the Cardiff Corporation, the influx of strangers to the port being so great, and it is found that vessels are becoming larger, yet fewer in number, and less hands are required. Work for 100 men for three months has been laid out.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

The reports concerning iron trade over here continue unfavourable, and the general tone of the market is anything but firm, the more so because appearances seem to indicate that an improvement will not take place for weeks, probably months.

No material change can be stated to have occurred on the Silesian iron market since former letters. There is, perhaps, a slightly better demand for some articles, and activity is tolerably well maintained, especially at the rolling mills, but with regard to prices no improvement is perceptible, and makers are content if they can realise the cost of production. Export is worse than it has been for several years.

On the Austro-Hungarian iron market very few contracts have been booked upon the week, the reserve among consumers and dealers having increased rather than diminished. All sorts of iron, raw as well as finished, are being offered at the lowest prices imaginable. There is still much iron coming to the Austrian market from Germany, and in a great many cases the inland producers were beaten by their rivals. Just lately, however, the Austrians have, on the other hand, been successful in getting a German contract; underquoting several of the Rhenish-Westphalian firms, the Wittkowitz Ironworks got an order for steel tires at M. 290 p.t. free Oderberg.

In France the state of the iron industry leaves much to be desired, and there are many establishments which can only be kept going part of the week. In Paris prices are nominally unaltered, but in reality any price almost is accepted. In the Meurthe-et-Moselle department the tone among ironmasters is disheartened; it is expected that the meetings of the different syndicates which take place at this time of the year will put a stop to the quarrels and the underquoting of the ironworks.

The condition of the French coal market is not a good one. A number of collieries are only being worked five days in the week; stocks are heavy, and the coal market is altogether suffering from over-production, but still the coal companies cannot resolve on a decided restriction of output, which would be the only means to overcome the difficulties with which producers have had to battle for more than two years. Noteworthy changes in quotations have not taken place recently. Output of pit coal in the Nord Department has been during the last ten years as follows:—

| | Tons. | | Tons. |
|---|---|---|---|
| 1884 .. .. .. .. | 3,401,517 | .. 1889 .. .. .. | 4,719,328 |
| 1885 .. .. .. .. | 3,582,760 | .. 1890 .. .. .. | 5,184,774 |
| 1886 .. .. .. .. | 3,910,141 | .. 1891 .. .. .. | 4,759,162 |
| 1887 .. .. .. .. | 4,197,795 | .. 1892 .. .. .. | 4,637,316 |
| 1888 .. .. .. .. | 4,416,185 | .. 1893 .. .. .. | 4,707,368 |

The number of men employed in 1893 was 20,890, against 20,809 in 1892. Of these 16,060 men were working underground, and 4830 aboveground.

There is no change in demand or employment on the Belgian iron market. Prices are tolerably firm, producers having, at a recent meeting, resolved to steadily maintain list rates for at least some weeks. Comparing the figures for November 1st and October 1st of present year, little or no difference can be perceived. Luxemburg foundry pig has been well maintained at 48f. p.t.; basic, 51f. p.t.; Luxemburg forge pig rose from 43f. on 44f. p.t. Bars, No. 1, still note 115f. p.t., free Belgian railways, while 110f. p.t. is quoted f.o.b. Antwerp. Plates, No. 4, have decreased from 220·50f. p.t. on 217·50f. p.t. free Belgian railways. Steel rails remain unaltered at 95f. p.t.

In spite of considerable quantities being imported, pig iron continues to be tolerably well inquired for. Since the beginning of the year, import of pig iron into Belgium has increased 71,000 t., or 70 per cent., during the first nine months of the year. 170,482,460 t. were imported, against 99,471,928 t. in the previous year, and against 108,815,094 t. in 1892. For September alone figures are 36,998,394 t. in 1894, 30,165,556 t. in 1893, and 30,375,220 t. in 1892. On the 1st of November 28 blast furnaces were in blow out of 42 existing, of which 14 produce forge pig, 3 foundry pig, and 11 basic. The following shows production of pig iron in October, and for the first ten months of present year and of the year before.

| | October. | | January to October. | |
|---|---|---|---|---|
| | 1894. | 1893. | 1894. | 1893. |
| | t. | t. | t. | t. |
| Forge pig .. | 37,820 | .. 33,480 .. .. | 338,060 | .. 325,080 |
| Foundry pig.. | 6,820 | .. 6,510 .. .. | 66,220 | .. 63,210 |
| Basic .. .. | 20,860 | .. 20,150 .. .. | 343,660 | .. 195,650 |
| | 65,500 | 60,140 | 747,940 | 583,940 |

A quiet tone prevails on the Belgian coal market. Prices for house coal are, on the whole, well maintained, although demand has been but small hitherto. Engine classes of fuel and coke are also pretty firm in quotation. Export in artificial coal was for September of present year, 49,921 t., against 56,324 t. in the year before, and against 33,804 in September, 1892. Total export during the first nine months of present year amounted to 441,881 t., against 370,906 t. for the same period the year before, and against 253,040 t. in 1892, which shows an increase of 188,841 t., against 1892.

Rhenish-Westphalian iron industry continues in a lifeless condition, and there have been more blast furnaces blown out during the week. Almost no orders for pig iron are received from abroad, and the works of the Rhenish-Westphalian district have only secured contracts for one or two markets at the best. The producers of the Siegerland have been more fortunate; some of them report their order books pretty well filled. The rolling mills are in a miserable condition, the demand for bars and girders becoming more flat from week to week. Hoops are also neglected, and the same can be told of plates and sheets.

Everything seems to be going from bad to worse, the slightly improving demand which was a short time ago noticeable for some articles of manufactured iron having now given place to an extreme depression and general lack of employment. Foundries, as well as machine and wagon factories, remain in irregular activity, and justly complain of the low prices they realise for their work. At a recent tendering at Cologne, lowest offers were, for steel rails, M. 113·70 p.t.; sleepers, M. 108·70 p.t.; and for fish-plates, M. 113·70 p.t., free at works.

The collieries of the Saar district produced in November of present year 550,200 t., consumption amounting to 560,765 t. Output for the same month last year was 524,400 t.; consumption, 543,400 t.

A Large Sewer Tunnel being built at Niagara, Falls, NY.,. will be 7ft. by 9ft. in cross section, and about 3500ft. in length. In connection with this tunnel over a mile of 5ft. brick trunk sewer is to be built, the aim being to provide for the needs of a large manufacturing city, which the cheap power furnished by the Niagara Power Company is expected to bring into existence.

The Cement Trade and Adulteration.—The cement trade recently held a meeting at the London Chamber of Commerce for the purpose of receiving and adopting or otherwise certain recommendations of the special committee which had been appointed to investigate and report upon the extent of the practice of admixtures with Portland cement and as to the justifiability thereof. The trade, with only one dissentient, adopted the recommendation of the committee that it was advisable that all manufacturers of Portland cement, who have used any outside material or materials in the manufacture of that article, should at once discontinue the practice. The use, however, of not more than two per cent. of gypsum, as practised by the German manufacturers for the purpose of regulating the setting of the cement, is considered optional. Messrs. Stanger and Blount, who are experts, have been instructed to report early in January, if possible, on the admixtures with Portland cement of the Thames and Medway, and the extent to which they are used.

Rack-railway in Japan. — Japan possesses a rack-railway, which is a connecting link in a main line, having more favourable ground for the other portions of its course, which is worked by ordinary locomotives. While, therefore, the stations of the rack-railway are for it terminal stations, they may also be regarded junction stations for the whole main line. The distance between these two points, measured horizontally, is five and a-half miles, but the actual length is, of course, somewhat more than this on the incline. Iron trough sleepers, inverted, are used to support the rails, and also to carry the rack apparatus, which has a double grip, and is placed in the centre of the track, which is single. A loop or bye-pass laid near the half length of the line, enables the trains to clear one another in mid-passage. The locomotives are all six-wheeled, coupled, having a diameter of 3ft. and furnished with cylinders 1ft. 3in. in diameter, and having length of stroke of 1ft. 8in. When in full working order, the locomotives weigh about thirty-six tons and carry some three tons of water, and over one ton of coal, and carry steam up to a pressure of 175 lb. A pair of cylinders work the pinions of the rack, which have a diameter of 1ft. 3in., and with a train weighing 100 tons, the usual speed does not much exceed five or six miles an hour. It is about two years since this little mountain line was opened for traffic, and it has been found to be of great service, and in all respects to work in a most satisfactory manner.

Royal Meteorological Society.—The monthly meeting of this society was held on Wednesday evening, the 19th inst., at the Institution of Civil Engineers, Great George-street, Westminster; Mr. R. Inwards, F.R.A.S., president, in the chair. Twenty-six new Fellows were elected. Mr. H. Southall, F.R. Met. Soc., read a paper on "Floods in the West Midlands," in which he gave an interesting account of the great floods which have occurred in the rivers Severn, Wye, Usk, and Avon. He has collected a valuable record of the floods on the Wye at Ross, which he arranges in three classes, viz.: (1) Primary or highest of all, those of 14ft. 6in. and above; (2) secondary, those with a height of 12ft. to 14½ft.; and (3) tertiary, those with a height of 10ft. to 12ft. The dates of the floods above 14ft. 6in. are as follows: 1770, November 16th and 18th; 1795, February 11th and 12th; 1809, January 27th; 1824, November 24th; 1831, February 10th; 1852, February 8th and November 12th. The height of the recent flood on November 15th, 1894, was 14ft. 3in., which was higher than any flood since November, 1852. The flood on the Avon at Bath on November 15th, 1894, is believed to have been the highest on record. Mr. R. H. Scott, F.R.S., gave an account of the proceedings of the International Meteorological Committee at Upsala in August last, with special reference to their recommendations on the classification of clouds and the issue of a Cloud Atlas. A paper by Mr. S. C. Knott was also read, giving the result of meteorological observations made at Mojanga, Madagascar, during 1892 to 1894.

## AMERICAN NOTES.

(*From our own Correspondent.*)

New York, December 14th.

More or less uneasiness exists in financial circles over the possibilities of large gold exportations. General trade is good, considering the season. In manufacturing lines the policy is still pursued of ordering only a little more than sufficient to fill orders. Compared to sixty days ago, production shows a decided increase, but railroad traffic, while improving, is not such as to strengthen confidence in better dividends. Pig iron is weak and dull. Buyers know production can be increased 20 per cent. and stocks expanded to a limit that might depress prices. Steel billets are 15·25 dols. at Pittsburgh, and rails 22 dols. Merchant iron and steel mills are working satisfactorily. Large orders for skelp, pipe, plate, and rods have been placed during the past few weeks, and manufacturers feel encouraged for the future. Users of every form of iron and steel are in need of supplies, but all buy only enough to keep going.

No radical legislation is probable this winter, but the country will feel safer when March 4th is past. The country has suffered enough for the politicians, and public sentiment now demands a cessation from all unnecessary agitation.

Conditions are favourable to a much larger consumption after the opening of the spring trade.

## LAUNCHES AND TRIAL TRIPS.

The Royalist, turret deck screw steamer, was launched from the yard of Messrs. William Doxford and Sons, of Sunderland, on the 13th inst., having been built to the order of Messrs. Angier Brothers, of London, and will receive the highest class in both the British Corporation and Bureau Veritas Registries.

On Thursday, December 13th, Sir Raylton Dixon and Co. launched from the Cleveland Dockyard, Middlesbrough, the fine spar-deck steamer Steinberger, which has been built to the order of the Hansa Steamship Company, Bremen. This is the fourth steamer Sir Raylton Dixon and Co. have launched for the same owners within eighteen months, and a fifth is now on the stocks. The principal dimensions are:—Length, 352ft.; breadth, 44ft.; depth moulded, 29ft. 7in., and she is built to Lloyd's highest class. The spar deck is of steel sheathed with teak, main deck of steel, and the poop bridge and forecastle decks are of teak. The steamer has a deadweight capacity of about 5500 tons, and web frames are fitted throughout the holds in lieu of hold beams. The accommodation for the captain, officers, and engineers is fitted amidships. The vessel will be fitted with Sidgwick's patent hinged topmasts, so that they can be readily lowered when required. Triple-expansion engines will be supplied by Messrs. T. Richardson and Sons, Hartlepool, having cylinders 21½in., 39in., and 57in., by 45in. stroke, with two large single-ended steel boilers working at 180 lb. pressure. The steamer, on leaving the ways, was named Steinberger. This vessel brings up the gross tonnage launched by Sir Raylton Dixon and Co. this year to 32,220 tons.

The Inchanga, the latest addition to Messrs. John T. Rennie, Son, and Co.'s Aberdeen line of steamers to Natal, was successfully launched from Messrs. Hall Russell's yard at Aberdeen, on the 14th inst. She is built from a fine model, having dimensions of 288ft. by 25ft. 9in., designed for high speed at sea. She will be fitted out with all conveniences for about fifty first-class passengers, with handsome saloons, ladies' saloon, smoking-room, &c., being lighted throughout with electricity upon the latest practice, to ensure safety and provide against accidental failure. Her deck machinery includes steam steering gear and windlass, and all needed machinery for quick handling of the ship and cargo. Messrs. Rennie's long experience in the Natal Colony has shown them what is needed in designing for the special service of their steamers, and they have been assisted by their consulting engineers, Messrs. Flannery, Baggallay, and Johnson, of London and Liverpool, who designed and have inspected the machinery during her construction. The vessel was named by Mrs. Hamilton, of Glasgow, sister to Mr. G. Rennie, and she took the water in the most successful and easy manner. She proceeded to the machinery quay to take in her engines and boilers. The former will have cylinders 24in. by 39½in. by 64½in. by 42in. stroke, driven by three powerful boilers at 180 lb. pressure of steam. Her auxiliary machinery will consist of independent sets of feed pumping engines, in addition to the usual feed pumps, feed heating and filtering machinery, evaporating and distilling machinery for boilers and passengers to provide hot and cold water, and the many necessaries in a steamer intended for special service.

Liverpool Engineering Society.—The fourth ordinary meeting was held at the Royal Institution, Colquitt-street, on Wednesday evening, the 5th inst., the president, Professor S. S. Hele Shaw, M. Inst. C.E., in the chair. The West premiums for the past session were presented to Messrs. Morgan and Duncanson. The remainder of the evening was devoted to the reading of a paper "On the Whirling and Vibration of Shafts," by Stanley Dunkerley, M.Sc., in which the author stated that a shaft, however nearly balanced, when driven at a particular speed, bends, and unless the amount of deflection be limited might even break, although at higher speeds the shaft again runs true. The particular or critical speed depends on the manner in which the shaft is supported, its size and modulus of elasticity, and the sizes, weights, and positions of any pulley it carries. The formulæ giving this speed have been worked out, for two simple cases with unloaded shafts, by Professors Rankine and Greenhill. A general theory applicable to all cases has been deduced by Professor Reynolds; and the author has obtained mathematical formulæ giving the critical speed in terms of the diameter and length of the shaft, weights and positions of the pulleys, &c., in the particular cases applicable to the different conditions under which a shaft works. The formulæ so obtained cover all cases which are likely to arise in practice, and the object of the present paper is to give those results in such a form that they can be applied directly to practice by engineers.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*4th December*, 1894.

23,580. Preservative Food Compounds, C. Stern, Liverpool.

23,581. Signal Apparatus, W. P. Thompson.—(*G. J. Schoeffel, United States.*)

23,582. Cycle Ambulance, W. P. Thompson.—(*D. Hönig, Germany.*)

23,583. Sand-blast Apparatus, J. E. Mathewson, London.

23,584. Colouring Matter Production, H. E Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)

23,585. Rendering Glue Insoluble, A. Zimmermann.—(*The Chemische Fabrik auf Actien vormals E. Schering, Germany.*)

23,586. Millstones, C. J. Potter, London.

23,587. Photographic Cameras, S. M. T. Amherst, London.

23,588. Furniture Polish, T. J. W. Lott, London.

23,589. Manufacture of Cocoa-fibre Brushes, W. P. Thompson.—(*J. G. Roth, Germany.*)

*5th December*, 1894.

23,590. Gas Batteries, H. T. Barnett, London.

23,591. Protecting the Legs of Cyclists from Rain, W. Stokes, Dublin.

23,592. Working Chemical Furnaces, G. T. Beilby, Midlothian.

23,593. Pneumatic Tires for Cycles, J. Silbermann, Glasgow.

23,594. Manufacturing Split Lifts, R. Kershaw and The Bristol Cut Leather Company, Bristol.

23,595. Method of Stopping Rabbeth Spindles, E. Sykes, Halifax.

23,596. Sewing Needle Threaders, E. S. Restieaux, Neath.

23,597. Securing the Doors of Cages, H. Kinsey and C. Maggs, Swansea.

23,598. A Roller Bearing, J. C. Stringer, Wincobank.

23,599. Cycle Wheels, J. W. and E. Fulwell, London.

23,600. Picking Motions for Looms, I. Jackson, Manchester.

23,601. Display Scoops, W. Parnall, Bristol.

23,602. Brace Fittings, C. N. Eyland, Birmingham.

23,603. Knitting Machines, R. Challands, F. W. Pare and J. H. Smith, London.

23,604. Supporting Shelves, J. C. Rimmington, London.

23,605. Fastener for Ships, W. Matheson, Hebburn-on-Tyne.

23,606. Peaked Flat-topped Caps, A. E. Horder, Bristol.

23,607. A New Nail, C. F. Rothé, Manchester.

23,608. Mounting of Metal Shells, J. Gregson, Preston.

23,609. Tramway Trucks, J. E. Wallis and Wallis and Steevens, Hants.

23,610. Draught Excluder, W. Walks, Bradford.

23,611. Mechanism of Pulley Blocks, R. Priest and W. Morrall, Birmingham.

23,612. Operating Haulage Winding Drums, T. Sorbie, Glasgow.

23,613. Automatically Opening of Road Doors, T. Sorbie, Glasgow.

23,614. Steam Motors, W. M. Walters, Liverpool.

23,615. Tandem Engines, W. M. Walters, Liverpool.

23,616. Pneumatic Wheels, W. H. Hanson.

22,617. Lamp Chimney, J. Lamb, Middlesbrough.

23,618. Steam Boilers, J. F. and M. Rankin, Glasgow.

23,619. Tuning Fork, J. H. Carr, Sheffield.

23,620. Driving-off Contents of Barrels, W. Platten, Sheffield.

23,621. Tobacco Pipes, D. Anderson, London.

23,622. Raising Curtains, F. Carter, Brighton.

23,623. Liquid Measures, J. Frankland, London.

23,624. Device for Detaching Horses, F. Zipperling, London.

23,625. Cushions for Billiard Tables, W. Defries, London.

23,626. Window Frames, D. Keith and W. McGeoch, Glasgow.

23,627. Paper Slitting Machines, D. N. Bertram, Glasgow.

23,628. Transmitting Signals, J. B. A. Légé, J. C. E. Carré, and M. L. Isaacs, London.

23,629. Carrying of Umbrellas, &c., A. Bolanachi, London.

23,630. Tobacco Pipes, &c., C. Mason and P. Mason, London.

23,631. Purifying of Wood Gas for Lighting, A. Greg, London.

23,632. Railway Signalling, W. Gray and C. M. Wawn, London.

23,633. Pressing Light Metallic Scrap, T. W. Ward, Sheffield.

23,634. Cycle Spanners, H. Jones, Birmingham.

23,635. Massage Apparatus, W. P. Thompson.—(*M. Goetze and H. Simons, Germany.*)

23,636. Pneumatic Tires, W. Stelfox and J. W. O. Walker, Manchester.

23,637. Spectacles and Eyeglasses, A. Brunner, sen., Liverpool.

23,638. Smoothing Irons, H. McKibbin, Manchester.

23,639. Arm Action Tricycle Mechanism, J. Munn, London.

23,640. Match Strikers, J. G. Glover, London.

23,641. Attaching Pneumatic Tires to Rims, J. Dring, London.

23,642. Machines for Decorticating Flax, G. E. Subra, London.

23,643. Boiling Water by Steam, F. W. Simmons, London.

23,644. Movable Bridges, T. W. Barber, London.

23,645. Earth Screws, T. W. Barber, London.

23,646. Surgical Tables and Chairs, H. G. Leisenring, London.

23,647. Vessel for Holding Two Liquids, M. Moore-Lane, Kent.

23,648. Photographic Cameras, J. Pearse, London.

23,649. Lugs for Tubes, F. H. Parkyn and J. Simmons, London.

23,650. Method of Dividing Angles, L. von Köppen, London.

23,651. Oil Engines, F. W. Kitto and W. Haworth, London.

23,652. Indicating the Position of Drowning Bodies, A. Belt, Hull.

23,653. Ice Cup, L. W. Tulloh, London.

23,654. Metal Clamp Binding Machine, J. Temler, London.

23,655. Matchbox, T. Remus, London.

23,656. Electric Heating Appliances, F. W. Schindler, London.

23,657. Padlocks, C. E. Schulte, London.

23,658. Restaurant and other Counters, N. Aubertin, London.

23,659. Self-acting Sheave, R. D. Glaister, London.

23,660. Delivering Coal on to Fires, J. F. Nicholls, London.

23,661. Electric Telegraph Instruments, J. Willmot, London.

23,662. Gas Retorts and Apparatus, J. Henderson, London.

23,663. Folding or Rolling Scale, J. W. Addy, London.

23,664. Velocipedes and other Vehicles, N. D. Pihet, London.

23,665. Lamps, S. Falk, London.

23,666. Cutting Tool for Lead Pipe, C. Fowler, London.

23,667. Trap for Beetles and Vermin, J. O. Spong, London.

23,668. Electric Impedence Coils, W. J. Davy, London.

23,669. Electro Depositing Zinc, The Cowper-Coles Galvanising Syndicate, Ld., and S. O. Cowper-Coles, London.

23,670. Composition for Preserving Fruit, W. O. Gilchrist.—(*A. Morris and J. A. Parker, Australia.*)

23,671. Treating Liquid Hydrocarbons, P. Dvorkovitz, London.

23,672. Tires, M. Adler, London.

23,673. Socks for Boots and Shoes, A. Graham, London.

23,674. Air Valves, H. Hadden, London.

23,675. Condenser Rollers, J. H. Robertshaw, W., J., and L. Hartley, London.

23,676. Saddle Clips for Cycles, J. F. Steele, H. V. Currie, and J. Jones, London.

23,677. Spring Bird Trap, J. and W. H. Walker, Birmingham.

23,678. Velocipedes, J. Fletcher, London.

23,679. Metallic Articles, La Société des Cuivres de France, London.

23,680. Electrolytic Copper, A. M. Clark.—(*La Société des Cuivres de France, France.*)

23,681. Thermometric Regulator Alarm, J. Dockree, London.

23,682. Operating Tramway Line Points, G. Gibbons, London.

23,683. Letter Cards, H. Jones, London.

23,684. Composing and Casting Type, G. A. Goodson, London.

23,685. Telegraph Poles, Siemens Bros. and Co. and W. Perry, London.

23,686. Packing Powdered Materials, F. Kraus, London.

23,687. Boot Protectors, P. Dews, London.

23,688. Galvanic Charging Elements, G. Platner, London.

23,689. Boilers, H. Postle Read, London.

*6th December*, 1894.

23,690. Leverage Gear for Bicycles, J. McKane, Belfast.

23,691. Pudding-bowl Fastener, J. Everett, London.

23,692. Non-slipping Pneumatic Cover, R. J. Stanley, Cardiff.

23,693. Garden Loop, W. E. Edwards, Stratford-upon-Avon.

23,694. Transfer Papers, J. Scott, Manchester.

23,695. Converting Bicycles and Tricycles, J. Parr, Leicester.

23,696. Order Transmitting Apparatus, W. Chadburn, Liverpool.

23,697. Construction of Electrodes, A. B. Woakes, London.

23,693. Bending Casks or Barrels, W. H. Tonkin, Stockport.

23,699. Construction of Shoes, F. Sternberg, Liverpool.

23,700. Crumb Sweeper, C. S. Pocock, London.

23,701. Starting Valve for Steam Engines, J. T. Dawes, Liverpool.

23,702. Cycle Gear, G. Taylor and C. D. Turrall, Coventry.

23,703. Cycles, F. Bowden, London.

23,704. Looms for Weaving Fire Hose, F. McClellan, Manchester.

23,705. Hair Curlers, R. Whitaker, Birmingham.

23,706. Riveting Metal Cisterns, &c., R. B. Waters, London.

23,707. Adjustable Wardrobe Hook, R. B. Waters, London.

23,708. Lehr for Annealing Glass, D. Moore, Newcastle-on-Tyne.

23,709. Fireplaces, W. Barraclough and A. Rhodes, Glasgow.

23,710. Removing Steam from Buildings, J. W. Taylor, Manchester.

23,711. Lenses for Optical Instruments, C. W. Parnell Cambridge.

23,712. Preventing Horses Slipping, G. Brown and A. J. Kearn, Charlton.

23,713. Printing Machines, W. H. and A. J. Dawson and J. Stott, Bradford.

23,714. Trunks and Bags, J. Waugh.—(*Amos and Co., Germany.*)

23,715. Method of Mounting Gas Burners, T. Redman, Bradford.

23,716. Driving Gear for Cycles, F. Brown.—(*H. Brown, Spain.*)

23,717. Lantern, B. Brockhues, Cologne.

23,718. Couplings for Railway Wagons, M. Walicki, Glasgow.

23,719. Heating Railway Carriages, W. Allman, Manchester.

23,720. Treatment of Skins and Leather, J. Hall, London.

23,721. Steam Traps, B. Blaiberg, London.

23,722. Cycles, G. Wishart and A. Jeffrey, Glasgow.

23,723. Casements, W. Youlten, London.

23,724. Assortment of Small Coal, W. C. Blackett, Durham.

23,725. Removing Mud from Cycle Tires, J. W. E. Peyton, London.

23,726. Magazine Fire-arms, M. C. Lisle and W. A. Berkey, London.

23,727. Permanent Way of Railways, H. Williams, Glasgow.

23,728. Braces, P. D. Lawson, Glasgow.

23,729. Mouldings for Picture Frames, W. P. Thompson.—(*W. Meyer, Germany.*)

23,730. Power Presses, C. Seybold and the Seybold Machine Company, London.

23,731. Cycle Rims, J. W. Fulwell and E. Fulwell, London.

23,732. Opening Postal Wrappers, H. E. Hudson, London.

23,733. Sprays, C. F. Slater, London.

23,734. Signalling, G. Lopes, London.

23,735. Pneumatic Tires, R. W. Huss, London.

23,736. Bedsteads, J. Cistez and G. Discher, London.

23,737. Controlling Supply of Oil, J. Dewrance, London.

23,738. Tube Cleaners, W. F. Bradbury, London.

23,739. Extracting Metals from Ores, J. Pfleger, London.

23,740. Metal Canisters, F. H. Breininger, London.

23,741. Designs for Textile Felted Fabrics, S. Sharp, London.

23,742. Hearthrugs, Mats, and Carpets, J. Lancaster, London.

23,743. Brooms, W. Sterkel, London.

23,744. Pneumatic Wheels, P. McCartan, London.

23,745. Electricity Meters, G. A. J. Telge, London.

23,746. Knife-machines, Hope-street Factory, Ld., and J. Laird, London.

23,747. Automatic Water Regulation, G. R. Martin, London.

23,748. Dynamo-electric Machines, F. M. Newton and T. Hawkins, London.

23,749. Spraying Machines, G. F. Strawson, London.

23,750. Tap, H. Gover, London.

23,751. Small-arms, H. W. Holland and T. Woodward, London.

23,752. Book Covers, W. Symons, London.

23,753. Holding Plush, G. F. Mathews, London.

23,754. Saddles, W. Robins, London.

23,755. Tongs, A. J. M. Simpson, London.

*7th December*, 1894.

23,756. Coin-freed Machine, J. F. and R. H. Shaw, Manchester.

23,757. Tires, R. J. Stanley, Cardiff.

23,758. Chairs, C. S. Bensted and G. Castleden, London.

23,759. Safety-pin, W. Beverley and J. C. Riddell, Glasgow.

23,760. Door Handles, H. F. Christie, Halifax.

23,761. Flower Pots, D. Tuley, Hatfield.

23,762. Cranes, F. W. S. Stokes, London.

23,763. Darner, M. J. Orphoot, Edinburgh.

23,764. Metallic Packings, G. W. Sutherland, Glasgow.

23,765. Bicycles, H. J. S. Ainsworth and W. Bradley, Halifax.

23,766. Smoke Consumer, W. McGlashan and J. P. Rawlings, Leith.

23,767. Rifle Black, W. D. Luff, Portsmouth.

23,768. Embossing Designs on Woven Fabrics, W. S. Boyd, Halifax.

23,769. Hypodermic Syringe for Dentists, P. B. Laskey, Glasgow.

23,770. Manufacture of Nails, A. George, Manchester.

23,771. Brakes and Foot-rests for Cycles, H. Holt, Grantham.

23,772. Comb, J. A. V. Baude, Derby.

23,773. Dressing Silk, H. Hoyle and E. Scarborough, Halifax.

23,774. Burners for Ignition Tubes of Motors, H. E. Kear, Bristol.

23,775. Bricks, H. R. Stockman, Dover.

23,776. Stirrups, H. Frost, Birmingham.

23,777. Latches, E. H. Warden and C. P. Bickin, Birmingham.

23,778. Brushes, R. Phillips, Halifax.

23,779. Egg-timers, C. W. Clark, Birmingham.

23,780. Fire-grates, J. Rigby, Sutton.

23,781. Gearing, W. Jackson, London.

23,782. Slates, S. B. Jackson, London.

23,783. Cycle Locks, W. J. Midelton, London.

23,784. Door Catches, W. J. Midelton, London.

23,785. Puzzles, N. O. Burns, London.

23,786. Book-markers, J. R. Eno, London.

23,787. Weighing Appliances, &c., W. B. Avery, London.

23,788. Apparatus for Churning, S. H. Wright, Liverpool.

23,789. Steam Generators, J. Thom, Liverpool.

23,790. Preventing the Bursting of Lead Pipes, S. Barwise, Derby.

23,791. Edge-setting Machines, H. A. Oldershaw, Leicester.

23,792. Securing Railway Rails, J. H. Lynde.—(*F. G. Lynde, India.*)

23,793. Valves for Steam Engines, C. R. Boswell, Kent.

23,794. Automatic Flushing Apparatus, A. J. Bond, Port Talbot.

23,795. Sanitary Closets, M. J. Adams, York.

23,796. Bodkin, W. Cook, Redditch.

23,797. Turning Leaves of Music, A. E. Hawks, Newcastle-on-Tyne.

23,798. Springs of Watches, &c., J. Hawley, Birmingham.

23,799. Domestic Hearthstands, W. H. Clews, Birmingham.

23,800. Feed-water Filters, W. J. H. Adam, Glasgow.

23,801. Steam Engine Indicators, D. Black and W. Stewart, Glasgow.

23,802. Oil Engines, G. Pollock and M. Whyte, Glasgow.

23,803. Strap Fasteners, G. H. and W. Thomson, Manchester.

23,804. Pneumatic Tires for Vehicles, W. Swain, Manchester.

23,805. Sorting Barm, M. Stenglein, Manchester.

23,806. Tires for Wheels of Vehicles, W. Pirrie, London.

23,807. Tube Joints, J. Brotherton, London.

23,808. Manufacturing Drain Pipes, B. Ames, London.

23,809. Key Rings, F. W. Grierson, Brighton.

23,810. Preventing Windows from Rattling, P. C. Hamilton, Loudon.

23,811. Brake for Cycles, E. W. Evans, London.

23,812. Adjustable Spanners, R. A. Day, London.

23,813. Broiling Apparatus for Bread, H. T. Poate, London.

23,814. Ventilation of Main Sewers, W. Mockett, London.

23,815. Manufacture of Cat-head Davits, W. Somers and E. G. Thomas, London.

23,816. Rotary Engines, W. P. Thompson.—(*W. C. Smith and H. P. Wheeler, United States.*)

23,817. Stays, W. B. Garniss, Liverpool.

23,818. System of Construction of Buildings, &c., A. F. Malgarni, London.

23,819. Surveyors' Adjustable Centreing-rod, C. Bristow, London.

23,820. Brakes for Cycles, A. H. Bond, London.

23,821. Material for Covering Surfaces, D. Marcus, London.

23,822. Framework for Carriages, D. Marcus and E. Horner, London.

23,823. Connecting Device, W. A. Lord, London.

23,824. Setting of Lithographic Stones, E. Bush, London.

23,825. Electric Arc Lamps, J. Brockie, London.

23,826. Gas Holders, F. Livesey and W. T. Sugg, London.

23,827. Pneumatic Tires, R. R. Gubbins, London.

23,828. Means for Propelling Cycles, H. Fleck, London.

23,829. Latch for Field Gates, S. Rolfe, London.

23,830. Tag Laces, J. S. V. Bickford, London.

23,831. Tobacco Pipes, W. Wall, London.

23,832. Railway Signalling, J. McGurk, London.

23,833. Securing Snaps of Bracelets, C. Dreyfus, London.

23,834. Apparatus for Firing Cartridges, H. Bonser and A. W. Bennett, London.

23,835. Dyeing of Lace, F. Hill, London.

23,856. Treads for Stairs, A. B. Soar, London.

23,837. Necktie Fastener, J. W. Jones, London.

23,838. Wort Cooler, H. E. Deckebach, London.

23,839. Flushing Apparatus, F. B. Hill and R. D. Brett, London.

23,840. Apparatus for Transporting Cash, N. Guthridge, London.

23,841. Clips for Bicycle Bells, C. Lohmann, London.

23,842. Buckles, A. H. Bugle, London.

23,843. Pocket Knives, J. T. Partington, London.

23,844. Couplings for Railway Vehicles, R. George, London.

23,845. Driving Gear for Cycles, W. Raimes, London.

23,846. Pulleys for Venetian Blinds, A. Ellwood, London.

23,847. Treating Sewage Sludge, Bacillite Sewage Purification Syndicate, Limited, and A. P. Hope, London.

23,848. Conveying Sewage Sludge, Bacillite Sewage Purification Syndicate, Limited and A. P. Hope, London.

23,849. Anti-fouling Paint, J. Holliday and A. Cameron, London.

23,850. Looms, G. Race and A. Wood, London.

23,851. Sheet-metal Cans, F. W. Durham and J. H. Moysey, London.

23,852. Cigarette Coverings, A. H. Sylvester, London.

23,853. Pasteurising Liquids, G. Gaertner, London.

23,854. System of Electrical Distribution, R. Wood, London.

23,855. Producing Magnetic Oxide, P. H. Bertrand, London.

23,856. Packing for Vessels, P. M. Justice.—(*M. W. Marsden, United States.*)

23,857. Apparatus for Moulding Pipes, W. Liehmann, London.

23,858. Measuring Electric Currents, F. H. Nalder, C. W. S. Crawley, and A. Soames, London.

23,859. Utilising Mineral Oils, W. S. Tailyour, London.

23,860. Rein-holders, A. Lipsky, London.

23,861. Ocean Steamers, P. Jensen.—(*T. Pringle, New Zealand.*)

23,862. Stoves, F. Balsamello, London.

23,863. Sabretasches, Wallets, &c., E. Doherty, London.

*8th December*, 1894.

23,864. Feed-bag for Horses, J. C. Meyers, Dublin.

23,865. Crushing Machinery, G. E. Sherwin, Birmingham.

23,866. Fog Signal, T. Thompson, Leeds.
23,867. Apparatus for Tilting Barrels, T. Bridge, Bolton.
23,868. Heeled Soles, W. C. Gilles, Beckenham.
23,869. Hydraulic and Pumping Engines, D. Johnston, Glasgow.
23,870. Velocipedes, W. J. Walford and T. T. Harrison, Bristol.
23,871. Cleaning Grain and Seeds, J. S. Cochran, Liverpool.
23,872. Rendering Fabrics Waterproof, W. Warburton, Stockport.
23,873. Slip Soles for Boots, R. A. Gardner, Newcastle-on-Tyne.
23,874. Propelling Cycles, A. R. Sawyer, Newcastle-on-Tyne.
23,875. Pneumatic Life Jacket, W. White, Cumberland.
23,876. Carts, J. Stenner, Bristol.
23,877. Ovens, J. T. Tompkinson and B. Butterworth, Rochdale.
23,878. Fuel-feeding Appliances, L. Burnet and S. Couper, Glasgow.
23,879. Preventing Persons Falling from Ladders, F. W. Golby.—(*E. Brucksch, Germany.*)
23,880. Blasting Minerals, M. R. Lawrence, Derby.
23,881. Tobacco Pipes, J. Colley, Staffordshire.
23,882. Construction of Furniture Castors, W. T. Eades, Birmingham.
23,883. Hose Pipes, F. Rowley, Manchester.
23,884. Linoleum Cork Carpets, J. Ingleby, Leeds.
23,885. Lamp Chimneys, H. M. Darrah, Manchester.
23,886. Lap Scutching Machines, W. Shore and J. Winterbottom, Shaw.
23,887. Fastening Boxes, C. Coomer, Bristol.
23,888. Window Sashes, J. Paterson, Glasgow.
23,889. Inkpots, J. M. Young, Glasgow.
23,890. Incandescent Gas Lamps, H. S. Kingston, Norfolk.
23,891. Seamless Inside Leg Pantaloon Hunting Breeches, W. G. Dyson, Leeds.
23,892. Quadruple Helical-pointed Bolt, M. A. Dubuc, France.
23,893. Metallic Bedsteads, J. and H. J. Brookes, Staffordshire.
23,894. Adhesive Stamps, &c., L. E. G. de Woolfson, Shrewsbury.
23,895. Cigarettes, A. C. Thomson, Glasgow.
23,896. Saddles, R. Mason, H. Gumbley, and P. L. Renouf, Birmingham.
23,897. Adjustment for Chains of Velocipedes, D. Dods, Paris.
23,898. Pneumatic Cab Tire, J. Whittall, London.
23,899. Tires for Road Vehicles, H. E. Smith, London.
23,900. Cuff Fastening, W. P. Thompson.—(*J. Koop, Germany.*)
23,901. Spring Clips and Axle Flaps, J. Farr, Liverpool.
23,902. Non-heat Conducting Coverings, S. Simon, Liverpool.
23,903. Machines for Clipping Hair, J. W. Newall, London.
23,904. Marking Soap, E. C. Lea and M. J. Gashion, London.
23,905. Manufacture of Bricks, &c., J. E. Stephenson, London.
23,906. Billiard Tables, W. Wood, London.
23,907. Apparatus for Sweeping Chimneys, J. P. Farnington, London.
23,908. Saws, F. G. Gwilliam, London.
23,909. Rulers, C. C. Brydon, London.
23,910. New Game, R. Walters, London.
23,911. Table for Billiards, A. R. Caudle, London.
23,912. Wheels for Traction Engines, S. P. Starsmore, London.
23,913. Infants' Feeding Bottles, T. J. R. Clarkson, London.
23,914. Holder for Infants' Feeding Bottles, W. S. Woodmancy, London.
23,915. Fastening Flowers into a Coat, E. A. Sherley-Price, London.
23,916. Fastening for Door Knobs, W. T. Ranson, London.
23,917. Bending and Shaping Sheet Glass, W. Cutler, London.
23,918. Construction of Fireproof Floors, T. Potter, Croydon.
23,919. Pressure Gauges, J. W. F. Warder and L. M. Luscombe, London.
23,920. Sewing Machines, D. Jones, London.
23,921. Steam Engine Valve Gear, G. A. J. Telge, London.
23,922. Busks for Corsets, Leggings, &c., F. M. Lehnig, London.
23,923. Slop Basin for Use with Tea Infusers, F. W. Bentall, London.
3,924. Painters' Pencils and Brushes, W. Sterkel, London.
23,925. Device for Stopping Wheels, &c., J. Wrede, London.
23,926. Kettles for Surgical Use, J. C. Richardson, London.
23,927. Derivatives of Hydroxyanthraquinone, H. E. Newton.—(*The Farbenfabriken vormals Friedrich Bayer and Co., Germany.*)
23,928. Thermometers and Barometers, J. Harrington, London.
23,929. Removing Boiler Scale, A. J. Boult.—(*W. H. Tebeau and W. J. Baker, United States.*)
23,930. Threshing Machines, V. Corbani, London.
23,931. Scuttle or Receptacle for Coal, E. Godfrey, London.
23,932. Obtaining Infusions of Coffee, W. Dray, London.
23,933. School or College Caps, R. C. Graham, London.
23,934. Folding Invoices, F. W. Lacey and G. H. Marshall, London.
23,935. Mining Machines, O. Imray.—(*J. A. Jeffrey, United States.*)
23,936. Electrical Fire Alarms, J. R. Shearer, London.
23,937. Grain Cleaning Cylinders, C. E. Mumford, London.
23,938. Ladies' Knickerbockers, R. Stapley and W. and H. Smith, London.
23,939. Light Narrow Gauge Railways, R. Harris, London.
23,940. Box for Cigarette Papers, F. J. Bell, London.
23,941. Cleaning Vegetable Fibres, S. Shorter and S. Stanbridge, London.
23,942. Clutches for Transmitting Power, C. and A. Edmeston, Manchester.
23,943. Golf Caddies, A. N. Charley, London.
23,944. Propelling Vehicles on Tramways, A. Diatto, London.
23,945. Tobacco Pipes, O. H. Cohen, London.
23,946. Water Gauges, J. A. and J. Hopkinson, London.
23,947. Cleaning Steam Boiler Tubes, J. Popper, London.
23,948. Playing Cards, P. Lehmann, London.
23,949. Weighing Machines, F. R. Simms and The Daimler Motor Syndicate, Ld., London.
23,950. Shut-off Valves for Engines, A. E. Olsen, London.
23,951. Printing, F. T. Felton and G. W. Bonney, London.

*10th December*, 1894.

23,952. Steam or other Engines, J. B. Johnston, Manchester.
23,953. Sanitary Combination, E. C. St. A. and E. Newby, Cardiff.
23,954. Forming Cylindrical Tenons, W. T. Robertshaw, Manchester.
23,955. Elevators and Fire Escapes, J. Youngson, Ontario, Canada.
23,956. Regenerative Furnaces, S. J. Robinson and S. Pope, Sheffield.
23,957. Rims or Fellies for Wheels, W. W. Stall, Birmingham.
23,958. Spoons and Forks, J. Maxfield and A. Staniforth, Sheffield.
23,959. Water Injector, J. Davies, Liverpool.
23,960. Traction Engines, F. J. Burrell, Thetford.
23,961. Steam-heated Evaporators, J. Weir, Glasgow.
23,962. Washing Machine Manufacture, J. T. Tullis, Glasgow.
23,963. Fastenings for Cuff Links, F. Griffith, Birmingham.
23,964. Wheel Hubs, W. F. Taylor and G. J. Philpott, Croydon.
23,965. Cycle Brakes, A. Duke, Cheltenham.
23,966. Movable Bath Lavatory Basin, D. McNish, Nottingham.
23,967. Stop and Wheel Valves, T. L. Davidson, Glasgow.
23,968. Mechanical Toy Cyclist, H. J. Hayes, Norwich.
23,969. Hooks and Eyes for Dresses, C. Crowther, Manchester.
23,970. Electric Conductor Supports, A. and J. M. Anderson, Glasgow.
23,971. Shearing Iron Bars, J. and H. W. Smith, Glasgow.
23,972. Watertight Doors, J. Chalmers and A. Aitken, Glasgow.
23,973. Method of Binding Books, R. C. Davies, Formby.
23,974. Thimble Pins, T., H. T., and J. Arrowsmith, Longport, Staffs.
23,975. Oil Stoves, F. S. Rippingille, London.
23,976. Pulley Blocks, Alldays and Onions Pneumatic Engineering Company, F. Lightbourne, and C. Gibson, London.
23,977. Steam Boiler and other Furnaces, E. Howl, London.
23,978. Watch Holder and Indicator, S. Lazarus, London.
23,979. Train Ventilating System, C. A. Erhart, London.
23,980. Sentinel Electrical Alarm, A. M. Morin, London.
23,981. Filling Aerated Liquid Bottles, J. McEwen, London.
23,982. Pocket Cigarette-making Machine, J. Moss, London.
23,983. Fruit Case, W. J. Kelley, J. W. Dorey, and G. F. Peek, London.
23,984. Fruit Case, W. J. Kelley, J. W. Dorey, and G. F. Peek, London.
23,985. Sunshade Holder for Cycles, M. Strohbach, London.
23,986. Preventing Bottles Overflowing, A. Ellis, London.
23,987. Axles for Vehicles, P. M. Justice.—(*La Société Charles Vermont, France.*)
23,988. Electric-lighting Devices, R. W. Inman, London.
23,989. Flushing Apparatus, W. H. Aitchison, London.
23,990. Racing Plates, W. J. Kent, London.
23,991. Horseshoes, W. J. Kent, London.
23,992. Typewriting Machines, B. Hoffmann, London.
23,993. Buttons, H. Goffey, London.
23,994. Decoration for Advertising Plates, B. Bradford, Liverpool.
23,995. Manufacture of Saponaceous Products, C. Weygang and The Petroleum Products Syndicate, London.
23,996. Manufacture of Artificial Fuel, C. Weygang and The Petroleum Products Syndicate, London.
23,997. Pedals for Cycles, E. Bolbrinker, London.
23,998. Tea-pots, T. D. Davies, London.
23,999. Controlling the Speed of Motor Engines, R. M. Macdonald, London.
24,000. Hand-saws, E. Benninghoven, London.
24,001. Waterproofing Boots, W. R. Searle, London.
24,002. Armatures for Electric Bells, I. H. Parsons, London.
24,003. Steam Boilers, E. Edwards.—(*E. Murbe, Germany.*)
24,004. Producing a Uniform Mixture of Air and Inflammable Vapour, E. Edwards.—(*L. Feil, Germany.*)
24,005. Carburetting Water-gas, A. G. Glasgow, London.
24,006. Gear Cases for Cycles, A. B. Soar and E. W. Collier, London.
24,007. Fire-grates, H. H. Lake.—(*J. Reagan, United States.*)
24,008. Chain Pumps, C. T. Burgess, London.
24,009. Production of Artifical Silk, F. Lehner, London.
24,010. Sockets or "Save-all" for Candles, F. Breese, London.
24,011. Screws, E. P. Cowcher, London.
24,012. Cycles, P. Fleuret, London.
24,013. Composition for Improving Soil, A. J. Thovoye, London.
24,014. Air-passage of Vent Taps, W. C. Alexander, Barnstaple.

*11th December*, 1894.

24,015. Purses for Delivering Coins Automatically, M. J. Jessop, London.
24,016. Toy Projectiles, C. E. Gyngell, London.
24,017. Cutting Textile Fabrics, J. J. Story and G. Blackburn, Nottingham.
24,018. Pump Clip, H. B. Newbold, Manchester.
24,019. Flexible Lever and Mud-guard Brake, L. Rushworth, Manchester.
24,020. Measuring Liquids, A. H. Reckless and W. Davenport, Derby.
24,021. Combined Terminal-box, &c., W. D. Reid, London.
24,022. Baitless Trap, J. Warburton, Ramsbottom, near Bury.
24,023. Cycle Stands, C. Allen, Birmingham.
24,024. Pressure-regulating Device, H. C. Longsdon, Keighley.
24,025. Umbrellas, W. Holland, jun., and J. W. Woodcock, Birmingham.
24,026. Desk, C. Mansford, Guildford.
24,027. Bathing and Sketching Tent, E. Rickard, Dublin.
24,028. Handles for Teapots, J. Meeson, Sheffield.
24,029. Coke Ovens, J. Dutson, Sheffield.
24,030. Sash Fasteners, S. C. Srawley, Birmingham.
24,031. Locomotive for Land or Water, C. Watkins, London.
24,032. Gas-meters, W. Alexander, Glasgow.
24,033. Steam Engines, W. D. Sherman, Glasgow.
24,034. Flours, E. B. Mitchell, Bristol.
24,035. Tires, W. McPhail, Wicklow.
24,036. Taps, A. Clifford, Dartford.
24,037. Making Ice, D. L. Holden and L. W. Serrell, London.
24,038. Roller Skates, F. I. Gibbs and W. Wright, Birmingham.
24,039. Roller Skates, F. I. Gibbs and W. Wright, Birmingham.
24,040. Knee-cap, J. Davies, Grimsby.
24,041. Sewing Machines, G. Benson and J. Kerr, Belfast.
24,042. Fog Signalling Apparatus, A. Stewart, Newcastle-on-Tyne.
24,043. Apparatus for Washing Barrels, C. L. Kline, Manchester.
24,044. Railway Chair, W. J. Ward, Newcastle-on-Tyne.
24,045. Recreation Railway, W. D. Pitt, London.
24,046. Nail-brush, E. A. Cunningham, Horsley, near Nailsworth.
24,047. Pianofortes, W. H. Dunkley, Birmingham.
24,048. Cycles, The Roulette Cycle Company and H. Cook, Coventry.
24,049. Substitute for India-rubber, J. Moore, J. Sampson, and E. T. Whitelow, Manchester.
24,050. Construction of Cycle Wheels, E. Vasey, London.
24,051. Greenhouse Light Lifter, A. W. Warren and C. Arnold, Waltham Cross.
24,052. Cycle Stands, E. Monkhouse, Bromley.
24,053. Shaping Dough, F. Dührkop, London.
24,054. Manifolding Sales Register, W. Assheton, D. Stewart, and C. J. Carroll, London.
24,055. Vehicle Wheels, E. G. Edmands and the Grappler Pneumatic Tire and Cycle Company, London.
24,056. Adjustable Level or Inclined "Floor," J. Barnet, Kirkcaldy.
24,057. Wringing Machines, E. Spannagel, London.
24,058. Stirrup, G. Martin, London.
24,059. Autoharps and other Instruments, C. Sucker, London.
24,060. Till, O. M. A. Davidson, London.
24,061. Reamers, R. H. Elliott and J. B. Carrington, Stockton-on-Tees.
24,062. Indicating Mechanism, B. Cawthorn and J. Brown, Stockton-on-Tees.
24,063. Obtaining Dry Manure, W. P. Thompson.—(*Wirth and Co., Germany.*)

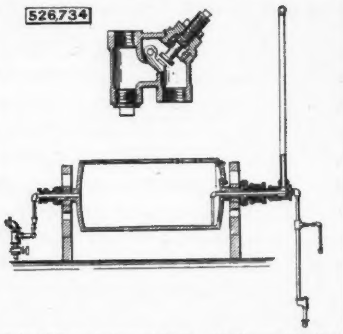
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**526,734.** Drying Cylinder, *A. G. Paul, Boston, Mass.—Filed January 22nd*, 1894.

*Claim.*—(1) The combination of a drying or heating cylinder with a discharge pipe connected with one of the journals thereof, and a trap consisting of a valve device at the lower end of the said discharge pipe, substantially as before set forth. (2) The combination of two or more drying or heating cylinders, separate discharge pipes, one connected with each cylinder, a trap consisting of a valve device at the outer end of each discharge pipe, a regulating device to regulate the amount of water that can be discharged from each discharge pipe, and a common drain pipe into which the discharge pipes empty, substantially as before set forth.

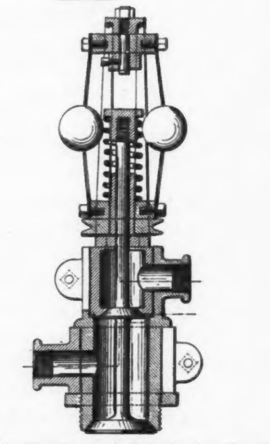
526,734



**526,837.** Gas Engine, *C. F. Hirsch, San Francisco, Cal.—Filed February 20th*, 1893.

*Claim.*—(1) In a gas engine, the combination of the gas inlet valve and the air inlet valve, both carried by a common stem and moving simultaneously therewith, a valve-supporting shell or chamber for each of these valves and split collars or shells embracing the aforesaid valve-supporting shells and having openings to coincide to a greater or less degree with corresponding openings in the valve supporting shells accordingly as the embracing collars are adjusted, together with adjusting bolts engaging lugs in the ends of the split shells, substantially as described.

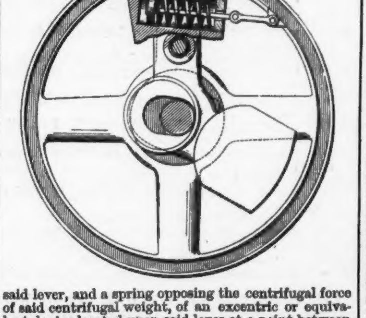
526,837



**526,856.** Governor, *R. C. Carpenter, Ithaca, N.Y.—Filed November 13th*, 1893.

*Claim.*—(1) In a governor the combination, with a fly-wheel revolubly mounted, a lever pivoted thereto at a point excentric to the centre of the fly-wheel, a centrifugal weight secured to one end of said lever, a counterbalance weight secured to the other end of said lever, and a spring opposing the centrifugal force of said centrifugal weight, of an excentric or equivalent device located upon said lever at a point between said pivot and said centrifugal weight, the centre of the excentric being out of line with said pivot and centrifugal weight, substantially as described.

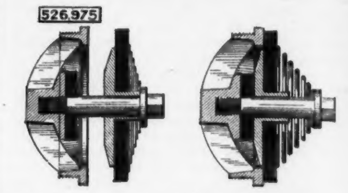
526,856



**526,975.** Pump Valve, *T. S. la France, Elmira, N.Y.—Filed September 27th*, 1892.

*Claim.*—(1) The combination of the valve seat having an outer bearing, a central bearing, and a pad or cushion on the said central bearing, the valve proper fitted to said outer bearing, the supporting plate under said valve proper and arranged to abut against the cushion of the central bearing when the valve is closed, such supporting plate being formed to nearly fill the port or valve space when the valve is closed, all substantially as and for the purposes set forth. (2) The improvement in valves herein described, consisting of the seat having an outer bearing, an inner or central bearing provided with a pad or cushion, the stem on which the valve slides, the valve proper, fitted to the outer bearing of the valve seat, the supporting plate under said valve proper, made to nearly fill the port within the outer bearing and arranged to abut against the pad or cushion of the central bearing when the valve is closed, all substantially as and for the purposes set forth.

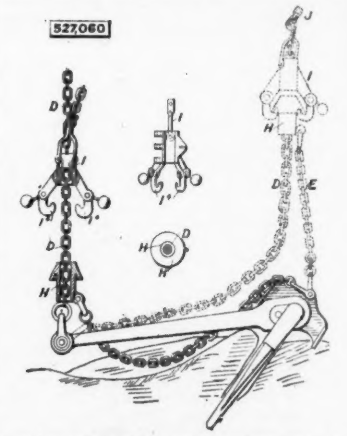
526,975



**527,060.** Means for Raising Anchors, *H. A. House and H. A. House, Jr., Bridgeport, Conn.—Filed November 25th*, 1893.

*Claim.*—(1) The means or devices for raising anchors by transferring the lifting point from the shackle end of the shank to the head or fluke end of the anchor, which consist of a sleeve sliding on the main cable, a chain connecting the said sleeve to the head or fluke end of the anchor and grappling apparatus adapted to slide on the main cable and to engage with the aforesaid sleeve combined, arranged and operating, substantially as described. (2) The means or devices for raising anchors which consist of a sleeve H free to slide on the main cable D and provided with a lip H′ adapted to be engaged by the hooks of the grappling apparatus, a chain or rope E connecting the sleeve H with the head or fluke end of the anchor, and grappling apparatus I sliding on the main cable D and provided with hooks I⁴ adapted to engage with the sleeve H, so as to connect the chain J with the chain E combined and operating, substantially as described.

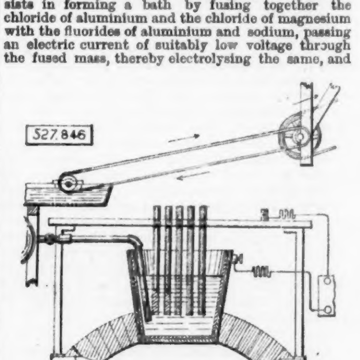
527,060



**527,846.** Process of Reducing Aluminium, *L. Waldo, Bridgeport, and F. A. Gooch, New Haven, Conn.—Filed March 23rd*, 1894.

*Claim.*—(1) As an improvement in the art of manufacturing aluminium, the herein-described process, which consists in forming a bath by fusing the chloride of aluminium and the chloride of an alkaline earth metal with the fluoride of aluminium and the fluoride of sodium, passing an electric current of suitably low voltage through the fused mass, thereby electrolysing the same, and supplying hydrogen to the bath, substantially as and for the purposes set forth. (2) As an improvement in the art of manufacturing aluminium, the herein-described process, which consists in forming a bath by fusing together the chloride of aluminium and the chloride of magnesium with the fluorides of aluminium and sodium, passing an electric current of suitably low voltage through the fused mass, thereby electrolysing the same, and supplying hydrogen to the bath, substantially as and for the purposes set forth. (3) As an improvement in the art of manufacturing aluminium, the herein-described process, which consists in forming a bath by fusing together the chloride of aluminium, the chloride of an alkaline earth metal and the chloride of sodium with the fluorides of aluminium and sodium, passing an electric current of suitably low voltage through the fused mass, thereby electrolysing the same, and supplying hydrogen to the bath, substantially as and for the purposes set forth. (4) As an improvement in the art of manufacturing aluminium, the herein-described process, which consists in forming a bath by fusing together the chlorides of aluminium, magnesium, and sodium, and the fluorides of aluminium and sodium, passing an electric current of suitably low voltage through the fused mass, thereby electrolysing the same, and supplying hydrogen to the bath, substantially as and for the purposes set forth.

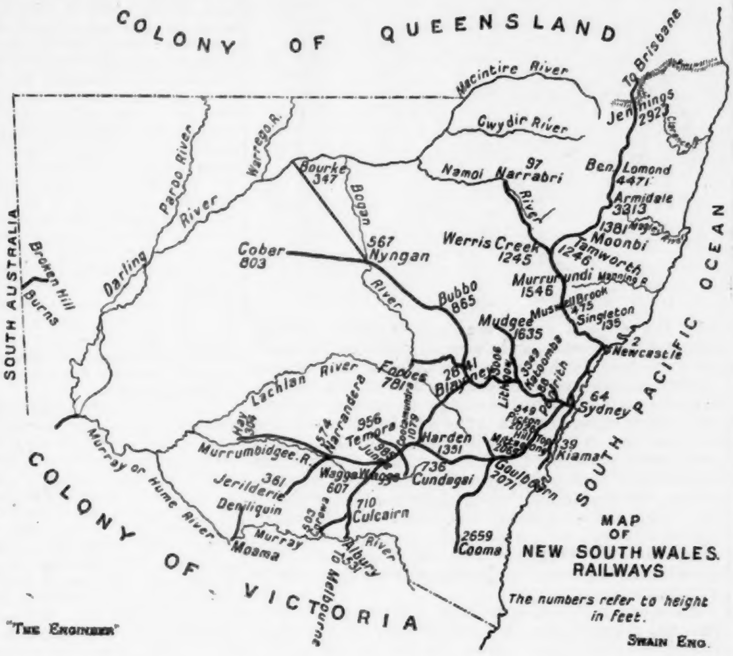
527,846



Throat Irritation and Cough.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. In contact with the glands at the moment they are excited by the act of sucking, the Glycerine in these agreeable confections becomes actively healing. Sold only in boxes, 7½d.; tins, 1s. 1½d., labelled, "James Epps and Co., Homœopathic Chemists, London."

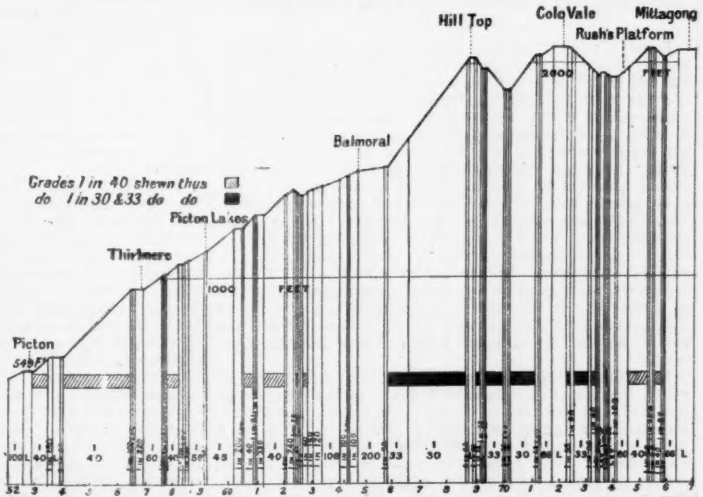
## THE RAILWAYS OF NEW SOUTH WALES.

Very little seems to be known in this country about the railways of our Colonies, judging from articles and letters appearing from time to time in our newspapers. For instance, the *Morning Post*, in a leading article in its issue of October 26th, makes the following statement:—"Perth, Adelaide, Melbourne, Sydney, and Brisbane are now joined together by railways." Now there is no railway between Perth and Adelaide, the country between these two cities is practically a desert, and it will be many years before a railway will be built joining these capitals. At present the quickest way to get from Adelaide to Perth is by steamer, a three days' trip across the Australian Bight, to Albany, and thence by rail to Perth. Many such misleading statements have appeared from time to time, so a short account of the railways of one of our most important Colonies may not be amiss.



The railways of New South Wales, unlike those in this country, are owned and worked by the Government. The conditions there were so different that everything pointed to the advantage of State ownership of railways, and the Government have, in many cases, adopted the very sensible plan of building lines to open up the country, not waiting, as a private company would have to do, until the line would pay at once for the making; the consequence is that much of the country has been opened up by lines that have not paid in the past, and some that are still worked at a loss, but which should in the future prove paying concerns and add much to the revenue and prosperity of the Colony.

The three Colonies on the east coast of Australia, namely, New South Wales, Victoria, and Queensland, have adopted the suicidal policy of each building its lines of a different gauge. New South Wales has the standard gauge of 4ft. 8½in., Victoria 5ft. 3in., and Queensland 3ft. 6in. In the case of the latter it was to some extent excusable, as it has a large extent of country sparsely populated, and therefore could not afford to build long lengths of line of broad gauge, so preferred to construct more line of the cheaper narrow gauge rather than build less of the broader. But it is impossible to understand why New South Wales and Victoria should have constructed their lines of a different gauge; the difference in gauge is so little, and the difference in cost so small, that well knowing, as they must have done in the beginning, that their lines must meet in the near future, it seems little short of madness on their part to have adopted different gauges. The discomfort and folly of this is keenly felt now the railways extend in a continuous line from Melbourne to Brisbane. It means that there can be but little through goods traffic, as the cost is largely augmented by the enforced transhipment at Albury — the junction of the New South Wales and Victorian lines— and great discomfort is caused to passengers between Sydney and Melbourne, who at Albury are turned out on to a bleak platform at 5.45 a.m., to have their hand baggage examined by the Victorian customs officials, and to change into the Victorian train. This is the most keenly felt by those who have availed themselves of sleeping accommodation.



PROFILE OF SOUTHERN LINE.

But to return to the South Wales railways. A few years back they were in a very bad state in every way, and were managed politically, one of the worst evils that can befall a railway system. In 1888 this was changed, and three railway commissioners were appointed. Mr. Eddy, the chief commissioner, came from the Caledonian Railway in this country, and since he took charge the railways of the Colony have undergone a complete change, and instead of being, as before, badly equipped and badly managed, have become a railway system of which any new country might well be proud.

The line between Sydney and Hornebush—eight miles —has been quadrupled, and all the stations on this section have been rebuilt, large portions of the lines have been relaid and reballasted, and in all cases where renewal of the rails is required, T rails of steel, 80 lb. to the yard, are being laid. This 80 lb. steel rail is now the standard rail of the Colony—the others up to the present in use are 70 lb. and 75 lb. iron, and 71 lb. and 75 lb. steel. Chairs are not used, the rails being spiked direct to the sleepers, which are of a very hard and durable wood— —ironbark—split and adzed to size, and not sawn, thus securing timber straight in grain. These sleepers weigh nearly twice as much as the pine sleepers used in this country; they are spaced 2ft. 7in. centre to centre, and 1ft. 8in. at the rail joints. The grades in many instances are very heavy. On the western line from Penrith—thirty-four miles from Sydney—to Katoomba—sixty-six miles from Sydney—there is a rise of 3261ft. in the thirty-two miles, there being a short distance out of Penrith a stretch of 1 in 30, and between Penrith and Katoomba about twelve miles of 1 in 33, the sharpest curve being eight chains radius.

On the southern line, between Picton and Hilltop, there is a rise of 1477ft. in sixteen miles, there being a stretch of two miles in one place of 1 in 30, and several miles of 1 in 33 and 1 in 40; the sharpest curve is of 16 chains radius.

On the northern line, between Moonbi and Walcha Road, there is a rise of 2005ft. in twenty-eight miles; and between Tamworth and Ben Lomond, a distance of 119 miles (including the last-mentioned incline), a rise of 3225ft., the height of Ben Lomond station being 4471ft. The sharpest curve is of 12 chains radius.

From the foregoing it will be seen that the haulage is of a very heavy nature on the New South Wales railways, requiring large locomotives of great pulling power. In former times two engines were generally used, but in order to reduce expense and to meet the demands of heavier traffic, the following locomotives were ordered from the Baldwin Company, U.S.A., in 1891: Twelve 10-wheeled bogie passenger engines of 90 tons 7 cwt. in working order, with six coupled wheels 5ft. 1in. in diameter—the centre pair without flanges—and twenty 10-wheeled goods engines, 94 tons 12 cwt. in working order. These have eight wheels coupled 4ft. 3in. in diameter, the two centre pairs without flanges, and a two-wheeled truck. These locomotives were ordered from America because they were wanted badly and the English makers could not deliver them in time. At first they were not quite up to the mark, but, when altered, proved satisfactory, hauling trains over the inclines which in former times were always drawn by two engines, they have much reduced the cost of haulage. At a later date some fine 10-wheeled bogie passenger engines were procured from Messrs. Beyer, Peacock and Co., with six wheels coupled 5ft. in diameter, 88 tons 7 cwt. in running order, as well as some powerful 8-wheeled suburban tank engines from the same firm. The latter have proved very useful for the large suburban traffic which has grown during the last few years.

The carriage stock has also been greatly improved of late, the new vestibule cars on the Sydney to Melbourne service, over 70ft. long, on six-wheeled bogies, ranking among the finest and easiest-running carriages in the world. The ordinary passenger coaches recently built are also good, and are in many cases fitted with lavatory accommodation. There are only two classes, first and second, on the New South Wales railways. With regard to the goods rolling stock, it has received considerable attention. The new 10-ton trucks with steel frames may be mentioned. Most of the goods rolling stock is fitted with spring buffers. The Westinghouse brake is used on all passenger trains; and here another anomaly crops up, for Queensland has adopted the vacuum brake—so that if the difference in gauge should be overcome in the future, there would still be the drawback of two systems of brakes to contend with. One would have thought that, after the lesson learned in this country on this subject, and the great extra cost and trouble caused on this side, all through stock having to be fitted with both kinds of brake, it would at least have had the effect of causing all the Colonies to adopt one standard brake.

Now let us turn to the train service and the speed of the best trains. New South Wales has 2500 miles of line, the greater part, of course, being single. The fastest and best equipped train is the Melbourne express, which leaves Sydney at 5.15 p.m. every day except Saturday, running to Mittagong, the first stop, seventy-seven miles, in 2 hours 43 minutes—28·34 miles per hour. This appears to be very slow running, but the fact of Mittagong being 2000ft. above Sydney must be taken into consideration. The corresponding express in the opposite direction covers this distance in 2 hours 6 minutes, including stop for collecting tickets—which is at a rate of 36·6 miles per hour. The distance from Sydney to Melbourne is 576 miles, and the express runs this in 18 hours 33 minutes, including over two hours of stoppages—which is a trifle over 31 miles per hour. There are twenty stops, two being of twenty-five minutes each and four other stations at which the train may be stopped by signal. Vestibuled sleeping-cars are run on this train at an extra charge on the first-class fare of 12s. 6d. for a lower and 10s. for an upper berth. The first-class fare is: Single £4 1s., return £6 1s. 6d.; and second class, single £3 0s. 8d., return £4 11s.

The service from Sydney to Brisbane is not so important as that to Melbourne, nevertheless the express is a creditable train, leaving Sydney each day, except Saturday, at 6.15 p.m., arriving at Jennings—the Queensland border—491 miles from Sydney, at 11.30 a.m. next morning, and at Brisbane 10.50 p.m., a distance of 723 miles in 28 hours 35 minutes, equal to 25·36 miles per hour, including thirty-four stops and thirteen other stations at which the train may be stopped by signal.

From the above it will be seen that, although not coming up to the English standard of expresses, these trains are very creditable, taking into consideration the number of stops, the heavy nature of the grades, and sharpness of curves, and that, except for a short distance at either end, they are running on single line.

The scenery along the lines is in several places very beautiful, the grandest is on the Western line through the Blue Mountains from Penrith to Lithgow, also between Sydney and Kiama on the south, and between Sydney and Newcastle on the north. On this section the line crosses the Hawkesbury River by the Hawkesbury Bridge, the largest in the Colony, and which is noted more especially for the difficulty experienced in getting a good foundation, the cylinders in the case of one pier having to pierce 170ft. of mud. It is near the bridge that the scenery is finest on this section.

The time has now come when the want of railway communication between North and South Sydney is felt, the great difficulty being that the point where a railway would be required to cross the harbour is about the busiest part, and much used by the largest ships, which would necessitate a high-level bridge or tunnel; the latter would perhaps be preferable, but the harbour is very deep at this point. In the course of a few years either one or other must be built, and whichever it is it will be a great undertaking.

Two short sections of the New South Wales railways occupy the somewhat unique position of acting as feeders for the railways of other Colonies, namely, the line from Deniliquin joining the Victoria line at Moama, and the line from Broken Hill, which joins the South Australian line at Burns. Strange as it may appear, the quickest and easiest—in fact, the only practicable way to get from Sydney to Broken Hill, one of the largest and most important mining centres in the Colonies, is by rail *viâ* Melbourne and Adelaide. No doubt in the near future a line will be opened up from Sydney to Broken Hill, which will divert to Sydney a great deal of traffic which is at present carried over the South Australian line to Adelaide. As will be seen from the railway map of New South Wales, there are three lines which might be pushed on to Broken Hill; but the northern line from Cobar is the most likely. Whichever route is chosen will open up much country which at present has no railway communication. We have said enough to give a fair general idea of the railways of the Colony. Much of interest has of necessity been omitted, owing to want of space; but this short account will show that New South Wales possesses a railway system worthy of so important a Colony. C.

---

The U.S. torpedo-boat Ericsson continues to break down. Two weeks ago we reported her fourth failure. Her fifth occurred on November 30th, owing to the low-pressure piston-rod giving way, wrecking the low-pressure cylinder and necessitating a long delay for repairs.

## ACCIDENTS ON PUBLIC ELECTRIC SUPPLY MAINS.

The attention of all engineers interested in the public supply of the electric current must have been attracted very strongly to the consideration of the present methods of installation of electric conductors. During 1894, and the latter half of the year 1893, a number of accidents happened which were caused by imperfect systems of electric conductors, or in which the imperfection of certain electric conductors was one of the secondary causes of the accident. The bulk of the accidents which have occurred in connection with the electric supply mains have been caused by the presence of coal gas in the conduits or inspection boxes, by a leakage of electric current, or by both these causes jointly.

Two well-defined systems of laying electric conductors exist: (1) The system of bare copper strip conductors, carried on insulating material fixed in built conduits. (2) The system of insulated conductors laid in the earth, or drawn into pipes of metal or of some composition. The first system is only applicable to low-pressure direct-current supply, while the second may be used for either direct or alternate current installations. Various theories were propounded before the facts of the cases were well understood. According to one theory, the water was liable to leak into the conduits specially built for bare conductors, and electrolysis took place, the hydrogen collected, and might be exploded in the air by a spark. Another theory was, that if a conductor became partially severed an arc might be formed, which would heat the air in a junction box to so high a temperature as to cause the upheaval of the lid with a report. Either of these explanations are quite thinkable, as Mr. Herbert Spencer would say; but so far as we are aware, neither agrees with the actual facts of the cases, as obtained by subsequent investigation and examination of eye witnesses.

We believe that in all cases where an explosion in a junction box has occurred, it has been caused by the application of a light to an explosive mixture of coal gas and air. Other accidents which were not attended with explosions were caused by leakage of the electric current to earth. In Norwich there was an explosion caused by an accumulation of coal gas. A similar one occurred in Sloane-square. Four explosions took place in Glasgow in the six weeks ending December 29th, 1893; the last accident injuring three men. A serious accident occurred at Bournemouth on February 8th, 1894, when a horse was killed, as noticed in our issue of 2nd March, 1894, and subsequently there have been several accidents in London which culminated in the Cannon-street explosions, described on page 451, 23rd November, 1894.

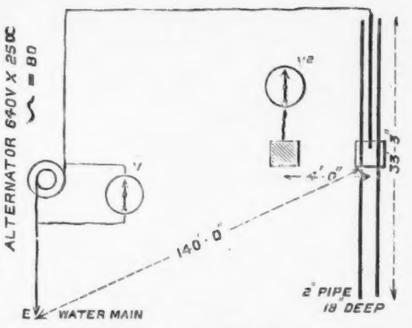
The Board of Trade have caused an inquiry to be made in each of the more recent cases as to the causes of the accident; and Major Cardew found in the case at Bournemouth that the insulation of a certain cable of seven No. 21 gauge wires was insufficient, the india-rubber being only $\frac{1}{20}$in. thick for a pressure of 2000 volts alternating current. He, therefore, advised that the insulation should in future consist of india-rubber of at least 0·1in. thick; and that inside junction boxes the cables should be covered with either lead or iron, and that this metal should be put into good electrical connection with the iron pipes into which the cables were drawn, so that there should be good earth connection of the pipes throughout the entire system.

Last January it was thought very surprising that a horse could be killed by an electric shock caused by leakage from the street mains while the horse itself was apparently standing upon the ordinary surface of the road, but the very similar accident in Cannon-street proves that the danger is a very real one.

After the Bournemouth accident Major Cardew decided to make some careful experiments in order to determine what difference of potential could exist on the surface of the ground between two points about 4ft. apart when a leakage of electric current was taking place about 18in. below the surface. At Bournemouth the leakage was found to have taken place from a fault in an insulated main placed in an iron pipe 32ft. long and 1½in. external diameter. The pipe was not in metallic connection with the remainder of the pipe service, and its ends were fairly insulated as they were let into brick and cement walls, while the rest of it was in good connection with the earth. Experiments were carried out by Major Cardew and Major Bagnold at St. Mary's Barracks, Chatham, and the results were reported in the form of a paper communicated to the Royal Society by Lord Kelvin, and printed in the "Proceedings," vol. 56.

In order to repeat the conditions as nearly as possible, a length of 33ft. 3in. of 2in. iron pipe was buried to a depth of 18in. A piece of 37 strand, No. 16 gauge cable, was inserted in the pipe, so that the ends of the conductors made good contact with the inside of the pipe at its centre point. Over the centre of the pipe two 56 lb. weights were placed on the surface of the ground, and at a distance of 4ft. laterally another pair of 56 lb. weights were similarly placed; these represented the feet of a horse. A 16 kilowatt alternator was connected by means of an underground cable laid in stoneware pipes to the piece of cable in the 2in. pipe. The arrangement is shown in the cut, where V and $V_2$ represent voltmeters. The other pole of the alternator was connected to the 1½in. service pipe in connection with the barrack water mains. One end of the service pipe was in connection with a hydraulic ram, set in the ground at a distance of 140ft. from the centre of the buried pipe.

An 800 volt Thomson static voltmeter V was connected across the terminals of the alternator, and a pair of well insulated leads were attached by means of screws to the two pairs of weights situated over the buried pipe. These leads were run back to the experiment-room, and were connected alternately to a 140 volt static voltmeter and a Cardew voltmeter. As the earth resistance was rather low, the alternator could not be run up above 400 volts without overheating the armature. The results showed a potential difference between points 4ft. apart on the surface of over 20 per cent. of the whole potential difference used to charge the pipe when measured statically, and even when a current of nearly 0·1 ampère was drawn from the ground through a Cardew voltmeter, the potential difference was more than 10 per cent. of the whole. The frequency was about eighty periods per second. Another set of tests was then made. The soil in which the pipe was buried was loamy, and when digging the trench no worms were noticed; but towards the conclusion of the experiments it was noticed that hundreds of worms came to the surface, between 3ft. and 9ft. on either side of the pipe. No worms, however, appeared immediately over the pipe. In this experiment the weights were placed in a row, the first weight over the pipe, and the others in a line at right angles to the pipe, and 4ft. 5in. centre to centre.



In the original paper the authors have carefully tabulated their results, and the experiments on the whole show conclusively that under very different conditions of weather and amount of moisture in the soil, it is possible to produce a fall of potential energy amounting to 25 per cent. of the whole pressure in the supply between points on the surface of the ground 4ft. apart, a distance which most horses stand over; and further, that although the connection of such points by a conducting body naturally reduces this potential difference, yet when this conductor has about the resistance of a horse, say 400 ohms, sufficient current will pass to give a severe shock. The authors add that they hope to make further tests with pipes buried to greater depths, and with direct current as well as alternating current.

There can, however, be no doubt that one of the most essential requirements in a supply station is that there should be a trustworthy system of testing for leakage, and that tests should be made at short intervals; and, besides this, some thorough system of ventilation is, in our opinion, required to keep the conduits or pipes clear of the explosive mixtures of air and gas which are liable to be present. Infiltration of gas seems hardly a sufficient cause to account for the quantities of gas found in some boxes, as in that at Dowgate Hill, where 12 per cent. of gas was found to be present. It is probable that the gas pipes are fractured or joints loosened by the settling of the ground, and that in some cases connection is made between such leaks and the electric conduits direct. A system of mechanical ventilation seems called for, as somewhat tall columns would be required to induce a sufficient current of fresh air to flow through the pipes.

## ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

*Denmark: North Sea and Baltic Canal.*—The conclusions arrived at in a recent Danish pamphlet, entitled "The North Sea and Baltic Canal and the Free Port of Copenhagen," are that the canal is being constructed principally for military purposes, and it will not be of any commercial importance in relation to the Baltic trade. German authorities show the dangers attending the navigation of the Elbe, which during the winter months will be increased by frequent obstruction. On the other hand, there are two routes open to ships passing north of the Skaw on their way to the Baltic, viz., the Sound and Great Belt, both being very seldom closed simultaneously, and the dangers of navigating them being very much exaggerated, whereas the Elbe is closed during a part of each year. In the twenty winters—1871-91—the Sound was only closed for any considerable period during two of them. In the very severe winter of 1892-3, the Sound was closed by ice for a long period, but navigation was stopped at Kiel for an equal length of time from the same cause.

In examining the question of distance saved by using the canal, the island of Barnholm is taken as the terminus at one end and the port of Dover at the other. The saving, according to a German estimate, is 200 miles. This, at a speed of from nine to ten miles an hour, gives a saving of about twenty hours, from which must be deducted nine to ten hours caused by using the canal at a reduced speed. The result is that, from the most southerly port, Dover, under circumstances so favourable as to be hardly ever realised, the saving by using the canal is ten hours, the profit on which would be less than the canal dues. From the east coast of England, West Hartlepool, Newcastle, Sunderland, whence a very considerable part of the coal for the Baltic is exported, according to a German authority the saving is ninety miles. Whereas the Danish contention is that by following the same calculation as the preceding, the new route takes longer time than the old. From Scotch ports—Methill, Grangemouth, Burnt Island, and Leith—whence the voyage is supposed to be forty miles, and with Moën for a terminus, eighty-three miles shorter, the saving by going north of the Skaw is very considerable, which must also be the case with ships passing north of Scotland. The free port of Copenhagen, now in course of construction, will be accessible to ships drawing over 31ft., and navigable during the whole of the twenty-four hours nearly all the year round, while Hamburg and Bremen are about seventy and fifty-six miles respectively from the mouths of the Elbe and Weser, which are impassable by tide for half of the twenty-four hours, and are often subject to ice obstructions, with comparatively slight frosts. With a view to encourage the entry of shipping, the Danish Government have decided to reduce the dues on the free port of Copenhagen, so as to make it one of the cheapest instead of, as at present, one of the most expensive ports. The port and other charges for a steamer of 1000 tons register, inward and outward, amount to £74 12s. 3d. In the free port they will be reduced to £14 0s. 5d.

*Belgian patent designs.*—The United States Consul at Ghent reports:—The Belgian law now in force provides that all plans, designs, and models of patented articles deposited in view of securing an exclusive privilege shall be kept in secret unless litigation arises in respect to them owing to this secrecy. Many persons may be working to invent some article which is already patented, but of whose details they have no knowledge. A great hardship is thus inflicted upon those who only at the completion of their task learn that some other person has already the exclusive right to manufacture and sell the special article invented anew.

*Germany: Consuls and trade of.*—The United States commercial agent at Bamberg reports:—The ceaseless efforts of the representatives of German industries to open up new fields for the sale of their products has received special encouragement and support from the German Government since the holding of the World's Columbian Exposition. German consular officers in foreign countries are devoting themselves to advancing the interests of German industries by employing a novel but thoroughly practical method of securing sources of demand for German manufactures. Through the German Consuls in the United States, agencies have been established at nearly all the important centres, in charge of persons conversant with both English and German, and thoroughly furnished with information relating to the exporting industries of their country. At these bureaus interested parties can obtain advice and information as to German sources of supply, and the relative condition of market prices, freight rates, and tariff duties, so that, benefiting by this, the importer of even small quantities will in future be able to order goods from Germany at first hand. Such bureaus of information, if entrusted to the direction of the right persons, will in time prove to be of inestimable value to all interested. The otherwise wide-awake representatives of American industries could—as has often been urged in Consular Reports—profit by the examples of their German colleagues.

The British Vice-Consul at Kiel, in a recent report on the trade of that district, observes:—The conclusion to be drawn from a study of the statistics as to commerce and trade of Germany, as represented by its leading seaport, is that in the future Germany will not fail—and especially as new markets are developed—to extend her mercantile interests through her own enterprise, one of the factors of which is that German emissaries are either sent or go abroad liberally, and subsequently establish a trade for themselves or their principals. In the former case where this has been, they return home with the gains of their industry, from thence to proceed with their labours. It behoves my countrymen to realise this, and to see that they do not, from a false feeling of superiority, fall behind in the competition, or the day of awakening may come too late. The deduction to be drawn from the facts in this report is that they are not of a congratulatory nature, if it is considered that our commercial welfare is to a large extent dependent upon the maintenance by Great Britain of its position as the great carrying nation of the world. It is a common complaint with British seamen that British vessels are now filled with foreign seamen. The fault is purely their own, and the remedy lies only in their hands. It is a most difficult thing to ship British seamen here, because shipmasters prefer Germans and Scandinavians. They acknowledge the superiority of their own, and that when in difficulty or danger they prefer to have a British crew at their backs; but the chief cause of preference for the Germans and Scandinavians is their superiority in order and sobriety. There is a great improvement among our seamen compared with twenty or twenty-five years ago, better education and training ships having effected a good deal, but the British seaman has only himself to blame if foreigners take his place.

Not a tithe of the pains is devoted by my countrymen to ascertaining the commercial needs and tastes of the rest of the world with which they trade as is given by the Germans. The latter endeavour to find out the wants and consult the taste of their customers, while the former thinks such details outside his consideration, being confident that his manufactures are superior to all others. They are good, but convenience, fastidiousness, and other details which seem of little importance, are studied by German exporters and manufacturers.

The British Consul-General at Hamburg, in a later report, observes:—The principal fact shown by a review of the past year is the general lack of prosperity. In looking for the cause, it must be sought for more at home than abroad; and it is not far to seek. To the difficulties arising out of the interruption of the supplies of fuel, more than to anything else, is assigned the cause. This still largely hampers, if it does not wholly keep down, any improvement or revival in industries and trade generally. Another prominent fact is that the Germans are every year doing more carrying for themselves. This is apparent from a study of the figures of the British imports. Where there is a decline in certain articles it is because more of them are carried direct in German vessels than formerly. A word of warning to those interested at home! At present and in the future it will be found that strikes in the coal industry have alienated important customers and wholesale trade from the home collieries—trade which has never belonged to any but ourselves, and which has now, thanks to ill-judged counsels, passed for ever out of our hands, and which not all the agitators or strike leaders in the United Kingdom will ever succeed in recovering.

*Germany: Improvements of River Weser.*—Much has been done of late to improve the navigation of the Weser, with the result that sea-going ships, drawing from 15½ft. to 17½ft. of water, to Bremen Docks. Steamships of the North German Lloyd line navigate the river up to Bremen, one 311ft. long and 2571 tons register, steamed up in ballast, specially with a view to tell whether a vessel of her length could navigate the many turns in the river, the experiment being successful. The other, a steamship of 2334 tons, came up with the greater part of her cargo, and drawing 17ft. 5in., entered the Bremen Dock. The tonnage of sea-going vessels entering the city dock was in 1890, 173,404 tons; in 1891, 317,006 tons; in 1892, 433,164 tons; in 1893, 521,607 tons. The enlargement of the principal dock at Bremerhaven rendered necessary by the increasing size of the North German Lloyd's steamers, is progressing rapidly, and is likely to be completed in three years, so as to make ships of 32ft. draught to enter. The lock chamber—656ft. 2½in. long—was originally intended to be 82ft. wide, but in consideration of the increasing size of ocean liners, its width will be 91ft. 10½in.

## THE PRESENT STATUS OF FACE-HARDENED ARMOUR.[*]

The apparent difficulties which at first delayed the development of face-hardened armour in the United States have either disappeared upon closer inspection or been practically overcome. The armour manufacturers have been able to devise methods of controlling, within certain limits, the distortions due to water hardening, and where this distortion occasionally exceeds a practical tolerance, the subsequent rectification has become, with increased experience, more frequently possible without re-tempering. The tolerances of final shape and dimensions have been made slightly greater than in the case of homogeneous plates, to avoid, as much as possible, the stresses of cold rectification or the loss of surface carbon in re-heating. This has necessitated arrangements by which, in certain cases, the lengths of the armour bolts are determined by actual measurement after the plate is in position. The shrinkages and change of angles in the various processes of cementation and tempering, complicated as they were by those of bending and rectification, seemed to follow no definite law; still the manufacturers have succeeded in foreseeing them with sufficient clearness to make most satisfactory butts and joints in the armoured structures thus far inspected.

The difficulty of securing structures to the hard face, in default of knowledge as to the exact location of the fastenings is also in course of solution. It was found feasible to tap and drill holes in the face of the plate at any stage of the process prior to hardening without detracting from the plate's resistance; but, as it was impossible to locate these holes with precision without fitting the armour into place, this method was abandoned in favour of one by which the carbon was prevented from penetrating over certain areas in the wake of the fastenings. This method also had its disadvantages in that the carbon gases frequently seeped through the protecting material and carbonised the surface beneath. The most satisfactory method, and one which will probably be employed in the future, is that of electrically annealing the surface to be drilled.

The greatest objection to the face-hardening or Harvey process, and one which seems least likely to be overcome in the immediate future, is its expense. The thickest plates are exposed to high temperatures for weeks at a time, and the charges for repairs, fuel, and labour are very great. It seems possible, however, that means may yet be determined for shortening this stage of the process and reducing somewhat the temperature required for cementation. The repeated machining, however, can hardly be dispensed with; shrinkage and distortion occur not only in the hardening, but in the cementation as well. Plates must be at least approximately machined before cementation; they must then be shaped and machined to such dimensions as experience has taught will, after hardening, be satisfactory. Even then it may be necessary to anneal, machine, and re-temper, before obtaining satisfactory results. These difficulties of the manufacturer, although reduced by skill and experience to the minimum, are likely to remain permanent.

The following is a table of the Harveyed plates now manufactured for the U. S. Navy:—

*Dimensions and Shapes of Harveyed Armour Plates now Manufactured for the U.S. Navy.*

| Length and width. | Thickness of plate. | Shape of section. | Curvature. | No. of plates now manufactured. |
|---|---|---|---|---|
| 16' 7" × 7' 6" | 18" | Tapered, 18" for 4', then tapered to 8" in 3' 6". | Shaped to side. | 27 |
| 12' × 8' 4" | 17" | Rectangular. | 25°, radius 15' 10" | 52 |
| 19' × 6' 9"·5<br>17' 6" × 6' 9"·5 | 15" | Rectangular. | 66°, radius 14' 3" | 16 |
| 20' × 6' 11" | 12" | Tapered, 12" for 4', then tapered to 7" in 2' 6". | Shaped to side. | 21 |
| 19' × 6' 6" | 12" | Tapered, 12" for 3' 4", then tapered to 7" in 3'. | Shaped to side. | 15 |
| 25' 9" × 4' 8" to 16' 8" × 4' 8" | 8" | Rectangular. | 120°, radius 9' 3" | 16 |
| ,, | 8" | ,, | 103°, ,, 11' 06" | 6 |
| ,, | 8" | ,, | 76°, ,, 11' 00" | 6 |
| ,, | 8" | ,, | 72°, ,, 9' 5" | 19 |
| ,, | 7"·5 | ,, | 72°, ,, 11' 06" | 10 |
| ,, | 6" | ,, | 120°, ,, 8' 3" | 46 |
| 19' 4" × 4' 8" | 4" | ,, | 180°, ,, 9' 6" | 2 |
| 8' 8" × 4' 8" | 4" | ,, | 52°, ,, 9' 6" | 2 |
| 12' × 7' 10" | 4" | ,, | Curved to side. | 31 |
| 17' 8" × 4' 4" | 3"·5 | ,, | 120° | 6 |
| 13' × 8' 6" | 3" | ,, | Curved to side | 32 |

The decision of the Armour Board of 1890 that the Schneider nickel steel plate was softer than that of steel, and allowed greater penetration, was correct for those two plates. Our armour makers, however, have had no difficulty in making oil-tempered nickel steel armour far stronger and more resisting than that of simple steel, while it still retained the characteristic toughness of the nickel. To any metallurgist acquainted with the infinitude of results that may be obtained by a variation in the composition and treatment of simple steel, the advantageous possibilities arising from the introduction of so benign an ingredient as nickel must be apparent. In other words, where simple steel is strong and tough, both qualities may be improved by adding the proper amount of nickel. The susceptibility of nickel steel to treatment is remarkable, and yet this steel may be abused in the most shameful way without failure. For this reason the smaller percentage of losses in manufacture will go far towards wiping out the increased cost of machining the tougher material. Nickel appears to render the carbon more sensitive to hardening, and hence water-hardened Harvey plates of nickel steel are toughened at depths hardly affected in simple steel plates. Not only that, but the hardening is accomplished with less risk to the plate, and it is for this reason that the manufacturers of the Loire have been able to forego entirely oil-tempering armour plates and obtain the increased resistance due to the more severe operation of water hardening. Doubtless the difficulty of spontaneous hardening, which Mr. Ellis mentions as occurring in carbonised nickel steel plates, is due to the sensitiveness of the alloy after its long heat soaking, the plates being removed from the cementing furnace or uncovered in a cold moist atmosphere while still at a high temperature. It is very rare that any difficulty of this sort occurs in the United States. In fact, the only doubt concerning the use of nickel in this country is the feasibility of raising its percentage—now 3·25 per cent.—still higher, the improvement and cheapening of the processes of reduction having considerably reduced its cost. In this reduction, it is well to note that in the Pola, Austria, competitive armour trial of November, 1893, a Witkowitz unhardened plate, said to contain 5 per cent. of nickel, defeated five competitors, including a Vickers-Harveyed simple steel plate and a Krupp gas-hardened plate. These plates contained between 2 per cent. and 3 per cent. of nickel. Finally, in England, where the nickel in Harveyed armour rarely exceeds 2·5 per cent., its peculiar toughening effect is taken advantage of by employing it for unbacked structures, while the Harveyed all-steel armour, being more susceptible to backing, is now only fitted on backing. There is, therefore, nothing in the present application of the Harvey process, nor its future possibilities, to indicate the disuse of nickel in armour; rather that by increasing its percentage the toughness of the foundation plate and its resistance as a whole may be increased.

The service tests for Harveyed plates for United States naval vessels require them to withstand two shots, the first delivered with the velocity which, according to the Gâvre formula, would cause the perforation of a wrought-iron plate 10 per cent. greater in thickness, together with 36in. of oak backing, the requirements being that no crack shall extend from the impact to the edge, or from one edge to another of the plate, and at the same time through the entire thickness of the plate at an edge. The second shot is at the velocity which, according to the De Marre formula, would cause the perforation of a Creuzot steel plate 15 per cent. greater in thickness, together with 36in. of oak backing, the requirement in this instance being that the projectile, or any fragment thereof, shall not pass entirely through the plate and backing. These tests are but 15 per cent. more severe than those required for oil-tempered nickel steel plates, and are now 3 per cent. less severe than those fixed by the latest contracts in France. It has been claimed that the larger calibres employed in France make the test more severe. This is hardly the case, as in France cracking is not barred. The plate must resist perforation, no part of the backing must be exposed, and the plate must remain in such condition, as regards cracks, as to enable a second shot to be fired upon it. The velocity of the second shot will be 1·26 as compared with that for ordinary steel as obtained from the De Marre formula, and the blow of this shot shall fall at a point distant three to four calibres from the first. Should the plate stop this shot, a premium of 8 per cent. of the contract price will be paid. Should the plate fail to fill the conditions imposed for the first shot, then another shot will be fired with a velocity of 12 per cent. greater than that capable of piercing an equal thickness of steel, and if the plate successfully resists this attack, the lot may be accepted, but at a price reduced 8 per cent. below that agreed to in the contract. It would thus seem that the minimum requirement in France, after all, is hardly as severe as our own; still there are three grades of quality and three prices under the same contract. It must be remembered, however, that the tests in the United States do not, as abroad, fix a standard of excellence. They mark the inferior limit, as does the last shot mentioned in the French contract above. The poorest, not the average, plate in an armour group of from 300 to 500 tons must pass this test or the entire lot is rejected. With the careful inspection of the various delicate operations of manufacture, aided by physical and chemical tests, it has been possible for the inspectors to select a Harveyed plate believed in every instance to be less resisting than any other in the group. Our service plates must, therefore, be regarded as generally exceeding the resistance of the plates tested by a considerable amount. It is to be hoped that an actual comparison of the products of American and foreign armour makers may be arranged at no distant day, if for no other reason than to correct certain false impressions that exist abroad as to the standard of acceptance in this country.

Thus far twenty-eight Harveyed plates, all but seven being of nickel steel, have been tested in the United States, and forty, all of which but fourteen were of nickel steel, having been tested abroad. In addition, nine plates tested were face-hardened in various other ways. The owners of these special processes of face-hardening have, however, in every instance also acquired the right to Harvey armour. In England about 20,000 tons of armour of this description have been ordered, the latest contract being for 12,500 tons, intended for the barbettes and citadels of the first-class battleships Prince George, Hannibal, Victorious, Jupiter, and Mars. Harveyed armour is now being manufactured for the battleships Renown, Majestic, and Magnificent in England, the St. Louis and Charlemagne in France, one Danish vessel, and two Japanese. The great English firms of Cammell, Brown, and Vickers are all provided with Harveying plants. In France the St. Chamond, Chatillon-Commentry, Marrel Frères, and St. Etienne works have adopted the process, the first three accepting contracts to furnish plates up to a thickness of 15·75in., St. Etienne making plates under 8in. in thickness. Schneider and Co. have also acquired the process, as well as the firms of Krupp, Dillingen, and Witkowitz, all of whom had previously employed special face-hardening processes of their own.

There is naturally a wide range in the comparison of the resistance of homogeneous and Harveyed plates, for, even were the plates before treatment made as uniform in composition and quality as the art permits, the accumulated effect of uncontemplated variations in cementation and hardening, especially at different establishments, is sufficiently great to produce a marked difference in their resistance. Equally important are the variations in quality and make of the projectiles. It would be presumptuous, therefore, to state, except in the most general terms, what the resistance of a Harveyed plate is in terms of that of an iron or simple steel plate of equal thickness. Certain French authorities place the resistance of Harveyed plates at about 1·35 that of simple steel, or 1·80 that of iron. English authorities regard the results of the trial of a 6in. Harveyed plate as indicating a superiority, when compared with iron, of 1·83. Another French authority states his belief that good Harveyed plates are able to keep out projectiles whose calibre equals their thickness at velocities of from 1968ft. to 2132ft. American plates compare very favourably with these estimates, Carnegie 6in. plates having kept out 6in. projectiles with velocities up to 2110 foot-seconds, exhibiting a resistance, as compared with iron, of 1 93; while a Bethlehem 8in. plate kept out an 8in. projectile with a velocity of 2004 foot-seconds, showing a resistance 2·14 times that of iron. Nevertheless, the unjust and erroneous comparison is frequently made of the severity of the acceptance tests of armour in this country and the competitive tests abroad. It is difficult to explain some of the errors of an essayist in the journal, *Le Génie Civil*, of August last, who confuses the trials of our homogeneous oil-tempered and Harveyed plates, and calls attention to the low velocity with which the former are attacked in comparison with those employed against face-hardened armour abroad. The American oil-tempered plates classed by him with Harveyed armour are as follows:—The Indiana 13in. B.L.R. turret—actually the Indiana 14in. diagonal armour—manufactured by the Bethlehem Iron Co., and tested May 21st, 1892. The Montereys 12in. B.L.R. turret, manufactured by the Carnegie Steel Co. The Monadnocks 11·5in. barbette plate: This plate in the table is classed as a Bethlehem plate, in the text as manufactured by the Carnegie Steel Co. The latter is correct. The plate contained an extensive defect in its upper end. In discussing the trial of the 18in. side armour plates for the Indiana, the velocity of the first short is given as that merely necessary to perforate 18in. of iron instead of 19·8in. of iron and 36in. of oak backing. There are many other errors unfavourable to American armour in this essay, which are all the more remarkable as the press of this country, invariably well informed, has correctly reported the trials in every instance.

A table for the purpose of reference rather than comparison is appended, giving a synopsis of the tests to which Harveyed armour has been subjected in this country. In one respect this table is less favourable to American armour than those published abroad, as the full thickness of backing employed is considered in calculating the velocities of perforation. Obviously, in the comparison of the behaviour of two target structures, one of which is barely perforated, and the other not even severely taxed, the ratio of the velocity employed to that necessary to perforate a similar target of iron is without meaning or value in the second instance. Only those ratios are available for comparison where the behaviour of targets and projectiles are identical. It will be noticed that the American trials have not had for their object the determination of the ultimate resistance of the plates, except in the case of one or two containing surface cracks, so much as the test and development of Harvey armour-piercing projectiles.

The above remarks are intended to refer to the practical and commercial status of face-hardened armour with regard to the service, rather than its experimental and speculative condition. Necessarily the latter is considerably in advance of the former in so new and complicated a process, especially as the only means of gauging the advances made are involved with the comparative quality of projectiles, themselves in course of development. Harveyed armour has been attacked both in this country and abroad by projectiles fitted with soft steel caps on the plan first devised by Colonel Inglis, of the English Ordnance Committee, in 1883, for trial against compound armour. The theory of these caps is twofold. First, upon impact they are penetrated by the shell point and swaged back along the bourrelet, jacketing and supporting it against rupture until it enters the plate and is supported by the walls of the shot hole. There does not seem much advantage in this procedure, as the point of rupture of the projectile is usually quite near the bourrelet; and the cap would have become too much attenuated and weakened, before slipping back to that point, to offer much assistance. There is, in fact, reason to believe that the cap does not act in this manner at all, as in no instance has it been possible to discover a trace of it before the plate, where it would probably have remained had it merely served as a support to the projectile. The second and most plausible explanation of the benefit ascribed to the cap is that it acts as a lubricant or sleeve which is carried into the plate surrounded by the jagged fragments of hardened surface. These pieces, incapable of flowing, surround the head of the projectile, scoring and abrading it while preventing the forward flow or displacement of the metal, thus bottling up and bracing the resistance of the plate against the advancing projectile. It is evident that if any part of the cap can be carried into the face of the plate with the projectile, the resistance of this non-viscous material is felt over only a part of the ogival instead of the whole of it. There is strong reason to believe that in the latest tests made in this country with capped shell the quality of the projectile had more to do with its success than the presence of the cap, as in two instances the point of the projectile was either broken off or smashed in. In all cases, however, the action of the hard, inextensible face surrounding the head of the entering projectile is plainly shown in the spiral scores and grooves cut on the ogival of a shot which has perforated a Harveyed plate. When, therefore, we are shown the photographs of French and Russian shells which have either perforated, or rebounded after penetrating, a Harveyed plate, without exhibiting a sign of a scratch, we are compelled to state in the light of past experience that the plate was not a good type plate, being too soft, and tough rather than hard.

It was but recently that foreign compliments were showered upon our projectile makers, who were declared to lead the world in certain respects. It may be most positively asserted that there is no reason to believe they have suddenly lost that position. The advent of Harveyed armour, and the necessity of our Navy being provided with projectiles capable of piercing it, if such projectiles could be made, were almost simultaneous. The standard of excellence to be struggled for was far in advance of what was, until very recently, regarded as attainable. The improvement in quality, however, has been remarkable. Two months ago our Harveyed armour, as mounted on the ships, was regarded as impenetrable to calibres equalling its thickness up to 8in., the impact occurring with service muzzle velocity. This was owing to the smashing of the projectile on the hardened face. Projectiles of the latest design, however, would probably be able to perforate such plates practically undeformed at a fighting range of 1500 yards. It has been reported that the Russians so easily overcame Harveyed armour with their special shells that they decided against it in favour of tempered homogeneous plates. They are yet to be heard from in this matter, however, and it is hardly possible that they have followed a policy which, if generally adopted at any time in the history of armour, would have effectually stopped progress. Neither in the arts of the gun-maker nor those of the shipbuilder have the application of improvements been deferred until they appeared fully perfected and final in character. It is only by keeping close up with the advance line that full advantage may be taken of new developments in arts and processes, or the scientific discoveries daily taking place around us.

The theory has been advanced, however, that with the improvement of projectiles—not necessarily capped, as that feature can hardly be regarded as practicable and serviceable—the Harveyed plate will lose its peculiar advantage now due to its smashing the projectile, and will become really less resisting than a homogeneous plate of equal thickness, on

---

[*] Abstract of a paper by Captain W. T. Sampson, United States Navy (Chief of the Bureau of Ordnance), read at the annual meeting of the American Society of Naval Architects and Naval Engineers, held in New York, November 15th and 16th, 1894.

# APPENDIX I.

## RESULTS OF TRIALS OF EXPERIMENTAL HARVEYED PLATES IN THE UNITED STATES.

| Maker and kind of metal. | Date of trial. | Place of trial. | Dimensions. | | | Shape. | Projectile. | | | Impacts and kind of projectile. | Velocity to perforate iron and 36" oak. | Ratios. | | Penetration. | Effects on projectile. | Effects on plate. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length. | Width | Thickness. | | Calibre. | Weight. | Velocity. | | | To perforate iron. | Of calibre to thickness. | | | |
| Linden Steel Co. O.H. steel | June 28, '90 | Annapolis | 2' 6" | 2' | 6" | Plane | 6 pdr. | 6 lbs. | 1742 | 1, 2, and 3. Hotchkiss A.P. | — | — | — | ⅛" to ¼" | Smashed | Nil. |
| " " " " | Nov. 4, '90 | " | 2' 6" | 2' | 6" | " | 4" | 36 | 1890 | 4. Service A. P. | 1690 | 1·12 | ·75 | 1"·25 | " | Broken in three pieces. |
| Carnegie O.H. steel | May 7, '91 | " | 8' | 6' | 3"·198 | Perforated by 12 2" bolt holes | 6 pdr. | 6 | 1804 | 20. Hotchkiss A.P. | — | — | — | 0"·5, one 1"·5 | " | Three through cracks. |
| Carnegie nickel steel | May 8, '91 | " | 8' | 6' | 3"·14 | Do. | " | 6 | 1804 | 21. " " | — | — | — | In all but three 0, in one 1¾" | " | No. 12 caused through crack to bolt hole. |
| | | | | | | | 4" | 36 | 1800 | 1, 2, and 3. Carpenter A. P. | 1274 | — | 1·27 | 1. Into backing | " | One through crack. |
| | | | | | | | | | | | | | | 2. Into backing | " | Circumferential cracks. |
| | | | | | | | | | | | | | | 3. 2" | " | " " |
| Carnegie open-hearth steel | July 10, '91 | Indi'n Head | 8' | 6' | 3" | Plane | 6 pdr. | 6 | 1811 | 14. Hotchkiss | — | — | — | 7/16" to 1⅛" | " | Uncracked. |
| " " " | July 10, '91 | " | 8' | 6' | 3" | " | " | 6 | 1811 | 14. " | — | — | — | 1" to 1¼" | " | " |
| Creuzot simple steel | Feb. 14, '91 | " | 8' | 6' | 10"·5 | " | 6" | 100 | 2065 | 1. Holtzer | 1975 | 1·04 | ·57 | 3"·5 | Broken up | Formed through cracks. |
| | | | | | | | | | | 2. " | " | " | " | 4" | " | " " " |
| | | | | | | | | | | 3. Carpenter | " | " | " | 4" | " | " " " |
| | | | | | | | | | | 4. " | " | " | " | 4" | " | " " " |
| | | | | | | | | | | 5. Holtzer | " | " | " | 14"·8 | " | " " " |
| | | | | | | | | | | 6. Carpenter | " | " | " | 3"·75 | " | " " " |
| Bethlehem high carbon nickel steel. | Nov. 14, '91 | " | 8' | 6' | 10"·5 | " | 6" | 100 | 2075 | 1. Holtzer | 1975 | 1·04 | ·57 | 12" | " | Radial hair cracks in bulge. |
| | | | | | | | | | | 2. " | " | " | " | 6"·8 | Scattered | " " " |
| | | | | | | | | | | 3. " | " | " | " | 12"·25 | Rebounded whole, cracked | " " " |
| | | | | | | | | | | 4. " | " | " | " | 7"·3 | Scattered | " " " |
| | | | | | | | 8" | 210 | 1850 | 5. Firminy | 1575 | 1·17 | ·76 | 12"·87 | Rebounded whole | Two through cracks. |
| Carnegie low carbon nickel steel. | Nov. 14, '91 | " | 8' | 6' | 10"·5 | " | 6" | 100 | 2075 | 1. Holtzer | 1975 | 1·04 | ·57 | 14"·6 | Remained intact | One hair crack. |
| | | | | | | | | | | 2. " | " | " | " | 14"·86 | Same | Same. |
| | | | | | | | | | | 3. " | " | " | " | 9"·75 | Rebounded whole | Same. |
| | | | | | | | | | | 4. " | " | " | " | 20"·5 | Remained intact | Same. |
| | | | | | | | 8" | 210 | 1850 | 5. Firminy | 1575 | 1·17 | ·76 | 17"·25 | Rebounded and broke up | Through cracks. |
| Bethlehem low carbon steel | Oct. 31, '91 | " | 8' | 6' | 10"·5 | " | 6" | 100 | 2075 | 1. Holtzer | 1975 | 1·04 | ·57 | 10" | Broken up | No cracks. |
| | | | | | | | | | | 2. " | " | " | " | 9"·7 | Same | Crack to side. |
| | | | | | | | | | | 3. " | " | " | " | 29"·9 | In backing intact | Many surface, one through crack. |
| | | | | | | | | | | 4. " | " | " | " | 10" | In plate, set up, and cracked | Three surface cracks. |
| | | | | | | | 8" | 210 | 1850 | 5. Firminy | 1575 | 1·17 | ·76 | 43"·48 | Intact in backing | Two through cracks, old cracks opened. |
| Carnegie high carbon nickel steel. | Jan. 30, '92 | " | 6' 4" | 6' | 10"·5 | " | 6" | 100 | 2075 | 1. Holtzer | 1975 | 1·04 | ·57 | 11"·5 | Rebounded broken | No cracks. |
| | | | | | | | | | | 2. " | " | " | " | 13"·32 | Broken up | " " |
| | | | | | | | | | | 3. " | " | " | " | 11"·22 | Remained in plate intact | One through crack. |
| | | | | | | | 8" | 250 | 1700 | 4. Carpenter | 1445 | 1·17 | ·76 | Through all | Broken in butt | Broken in three pieces, one wrenched off [backing. |
| Carnegie low carbon steel | Jan. 13, '92 | " | 8' | 6' | 10"·5 | " | 6" | 100 | 2075 | 1. Holtzer | 1975 | 1·04 | ·57 | 39"·34 | Intact in backing | Few hair cracks, one through crack. |
| | | | | | | | | | | 2. " | " | " | " | 29"·82 | " " | Old cracks opened, one new crack. |
| | | | | | | | | | | 3. " | " | " | " | 34"·23 | " " | " " " " |
| | | | | | | | | | | 4. " | " | " | " | 42"·85 | " " | Old cracks opened. |
| | | | | | | | 8" | 250 | 1700 | 5. Carpenter | 1445 | 1·17 | ·76 | Through all | Intact, 100 yards beyond target | Badly cracked, one new crack. |
| Bethlehem nickel steel | July 23, '92 | " | 8' | 6' | 10"·5 | " | 8" | 250 | 1700 | 1. Holtzer | 1445 | 1·17 | ·76 | 1"·25 | Smashed | No cracks. |
| | | | | | | | | | | 2. " | " | " | " | 1"·75 | " | " " |
| | | | | | | | | | | 3. " | " | " | " | 13" | Rebounded intact | Cracked. |
| | | | | | | | | | | 4. " | " | " | " | 13" | " " | No cracks. |
| | | | | | | | | | | 5. " | " | " | " | 1"·75 | Smashed | " " |
| Bethlehem nickel steel (face of this plate had numerous surface cracks formed in rectifying). | July 30, '92 | Bethlehem | 8' | 6' | 10"·5 | " | 8" | 250 | 1700 | 1. Holtzer | 1445 | 1·17 | ·76 | 3"–4 | " | " " |
| | | | | | | | | | | 2. " | " | " | " | 3"–4 | " | " " |
| | | | | | | | | | | 3. " | " | " | " | 3"–4 | " | Crack opened—old tempering crack. |
| | | | | | | | | | | 4. " | " | " | " | 3"–4 | " | No cracks. |
| | | | | | | | | | | 5. " | " | " | " | 3"–4 | " | " " |
| Bethlehem nickel steel | Dec. 19, '92 | Indi'n Head | 9' 6"·5 | 6' | 10"·5 | Curved | 8" | 250 | 1800 | 1. Holtzer | 1445 | 1·25 | ·76 | 4"–5" | " | Cracked top to bottom. |
| | | | | | | | | | 1900 | 2. " | " | 1·31 | " | 5"·2 | " | Cracked through. |
| | | | | | | | | | 1900 | 3. " | " | " | " | 5"·5 | " | " " |
| | | | | | | | | | 1900 | 4. Carpenter | " | " | " | 6" | " | " " |
| Bethlehem nickel steel | Feb. 11, '93 | " | 9' | 7' | 14" | Plane | 10" | 500 | 1472 | 1. Holtzer | 1381 | 1·07 | ·71 | 2" | " | No cracks. |
| | | | | | | | | | 1859 | 2. " | " | 1·35 | " | 5" | Broken up | One through crack, one fine crack. |
| | | | | | | | | | 1959 | 3. " | " | 1·42 | " | 6" | " | Cracked into three equal fragments. |
| | | | | | | | | | 2059 | 4. " | " | 1·49 | " | 10"–11" | " | Broke fragment into seven pieces. |
| Carnegie nickel steel | Mar. 21, '94 | " | 8' | 6' | 10"·5 | Plane face, contained tap rivet holes, soft strips, &c., edges tempered. | 8" | 250 | 1841 | 1. Carpenter, 3 cal. ogive | 1419 | 1·30 | ·76 | 3"·25 | Smashed | Cracked to edge. |
| | | | Backing 2' thick. | | | | 8" | 250 | 2000 | 2. Holtzer | " | 1·41 | " | 6" | " | Two through cracks. |
| | | | | | | | 10" | 500 | 1500 | 3. Johnson cast steel shot | 1122 | 1·34 | ·95 | 6"–7" | " | Wrecked top half of plate. |
| Carnegie nickel steel | Mar. 12, '94 | " | 8' | 6' 2" | 12" | Plane, rivet holes in face, soft strips, edges tempered. | 10" | 504 | 1600 | 1. Johnson cast steel shot | 1118 | 1·43 | ·83 | 4"·5 | Smashed | Two through cracks. |
| | | | Backing 2' thick. | | | | 10" | 500 | 1600 | 2. Carpenter | 1122 | " | " | 7"·5 | " | " " " |
| | | | | | | | 10" | 506 | 1600 | 3. Johnson cast steel shot | 1113 | " | " | 4"·5 | " | Additional cracks. |
| | | | | | | | 10" | 510·5 | 1600 | 4. Same, with cap of soft steel | 1104 | 1·44 | " | 5" | Broken up | Wrecked plate. |

# APPENDIX I.—(*Continued.*)

## RESULTS OF TRIALS OF SERVICE HARVEYED PLATES IN THE UNITED STATES.

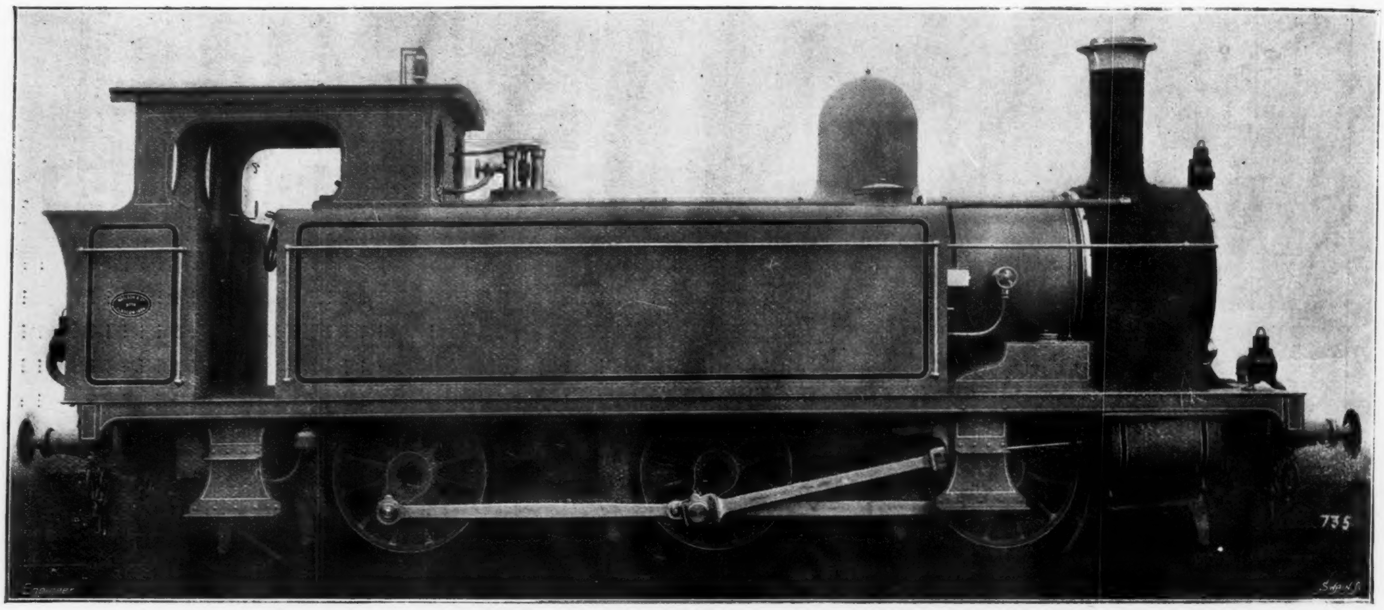
| Maker and kind of metal. | Date of trial. | Place of trial. | Dimensions. | | | Shape. | Projectile. | | | Impacts and kind of projectile. | Velocity to perforate iron and 36" oak. | Ratios. | | Penetration. | Effects on projectile. | Effects on plate. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Length. | Width | Thickness. | | Calibre. | Weight. | Velocity. | | | To perforate iron. | Of calibre to thickness | | | |
| Bethlehem nickel steel (Maine's belt). | Oct. 14, '93 | Indi'n Head | 13' 7" | 6' 11" | 12" for 3' 11" then tapering to 6"·75 | Slight curve to fit side of ship. | 8" | 250 | 1678 | 1. Holtzer | 1577 | 1·06 | ·66 | 3"·5 | Smashed | Uncracked. |
| | | | | | | | 8" | 250 | 2004 | 2. Carpenter | „ | 1·27 | „ | 8" | „ | „ |
| | | | | | | | 8" | 249 | 2004 | 3. Wheeler-Sterling, blunt point. | „ | „ | „ | 4"–5" | „ | „ |
| | | | Inclined 30 deg. to normal | | | | 8" | 250 | 2004 | 4. Carpenter | — | — | — | Gouge 4" × 13" | Smashed | Impact near edge, cracked to it. |
| | | | „ 35 deg. „ | | | | 10" | 500 | 1977 | 5. „ | — | — | — | Gouge 7"·3 × 18" | Broken up | Two wide through cracks, small piece bell. |
| | | | Normal. | | | | 10" | 500 | 1681 | 6. „ | 1246 | 1·35 | ·83 | 9" | Smashed | Three through cracks. |
| Carnegie nickel steel (Massachusetts' 8" B.L.R. barbette). | Apl. 2, '94 | „ | 21' 8"·5 | 5' 3"·5 | 6" | Curved radius 9' 7". | 6" | 100 | 1472 | 1. Carpenter | 1389 | 1·06 | 1·00 | 2" | „ | Uncracked. |
| | | | | | | | 6" | 100 | 1659 | 2. „ | „ | 1·20 | „ | 3"·5 estimated | „ | „ |
| | | | | | | | 6" | 100 | 1975 | 3. „ special | „ | 1·42 | „ | 6" estimated | Broken up | „ |
| | | | | | | | 6" | 100 | 2110 | 4. „ | „ | 1·52 | „ | 18" into backing | „ | „ |
| | | | | | | | 8" | 250 | 1472 | 5. „ | 1020 | 1·44 | 1·33 | 8" | „ | Two through cracks through line of impacts. |
| | | | No. 6, without backing. | | | | 6" | 100 | 2000 | 6. „ | 1292 | 1·55 | 1·00 | Through | „ | No cracks, one fragment of shell fell through [hole. |
| | | | No. 7, without backing. | | | | 6" | 100 | 1800 | 7. „ | „ | 1·39 | „ | 4" estimated | „ | One through crack. |
| Carnegie nickel steel (Brooklyn's side). | Apl. 12, '94 | „ | 13' 1"·5 | 8' 6" | 3" | Plane. | 4" | 33 | 1206 | 1. Carpenter | 1157 | 1·04 | 1·33 | 0·5" | Smashed | Light concentric surface cracks. |
| | | | | | | | 4" | 33 | 1357 | 2. „ | „ | 1·17 | „ | 0·5" | „ | „ „ „ „ |
| | | | Backing 21" thick. | | | | 4" | 33 | 1800 | 3. „ | „ | 1·56 | „ | 4" | „ | Back bulge broken away. |
| | | | | | | | 4" | 35 | 1700 | 4. Wheeler-Sterling soft cap | „ | 1·47 | „ | Through | Broken up | No cracks. |
| Bethlehem nickel steel (Indiana's side). | May 19, '94 | „ | 15' 11" | 7' 6" | 18" at top and for 3' 10" then tapered to 7"·7 at bottom. | Plane, curved to side. | 12" | 850 | 1465 | 1. Carpenter | 1374 | 1·07 | ·66 | 19" | Rebounded cracked | Two wide through cracks. |
| | | | | | | | 12" | 850 | 1926 | 2, „ | „ | 1·40 | „ | 16" | Broken up | Additional through cracks. |
| | | | | | | | 6" | 100 | 2000 | 3. „ | — | — | ·33 | 7" estimated | Smashed | No cracks. |
| Bethlehem nickel steel (Massachusetts' 18" B.L.R. barbette). | June 12, '94 | „ | 12' 1" | 7' 7" | 17" | Curved radius 15' 10". | 12" | 850 | 1410 | 1. Carpenter | 1322 | 1·07 | ·70 | 6"·3 estimated | Smashed | Uninjured. |
| | | | | | | | 12" | 850 | 1858 | 2. „ | „ | 1·41 | „ | 15" estimated | „ | One fine crack to edge. |
| | | | | | | | 10" | 500 | 1983 | 3. „ special | 1572 | 1·26 | ·59 | 10"·1 | „ | Two fine cracks. |
| | | | (Structure uninjured.) | | | | 10" | 500 | 1983 | 4. „ solid forg'd shot | „ | „ | „ | 5"·9 | „ | First cracks widened. |
| | | | | | | | 10" | 507 | 1930 | 5. „ special shell | „ | „ | „ | 12"·5 | Distorted and cracked | First cracks extended across plate. |
| | | | | | | | 10" | 509 | 1983 | 6. „ „ „ | „ | „ | „ | 6"·1 | Mushroomed | New through crack. |
| Carnegie nickel steel (Massachusetts' 8" B.L.R. barbette). | May 10, '94 | „ | 21' 8" | 5' 3"·5 | 6" | Curved radius 8' 9". | 6" | 100 | 1800 | 1. Carpenter | 1292 | 1·39 | 1·00 | 3"·2 | Smashed | Uncracked. |
| | Oct. 2, '94 | | | | | | 6" | 100 | 1800 | 2.* „ | „ | „ | „ | 2"·7 | „ | „ |
| | | | | | | | 6" | 100 | 2000 | 3.† „ | „ | 1·55 | „ | 4" | „ | „ |
| | | | Rejected on account of surface cracks formed in bending. Cracks ⅝" to ¾" deep. Mounted *without backing.* | | | | 6" | 100 | 2000 | 4. „ | „ | „ | „ | 4"·5 | „ | Uncracked, back bulge broken out. |
| | | | | | | | 6" | 100 | 1800 | 5. Wheeler-Sterling special. | „ | 1·39 | „ | 4" | „ | Uncracked. |
| | | | | | | | 6" | 100 | 1900 | 6. „ „ „ | „ | 1·47 | „ | 6" estimated | „ | Through crack to nearest edge. |
| | | | | | | | 6" | 108 | 2000 | 7. „ „ capped | 1237 | 1·62 | „ | 3"·5 estimated | „ | Surface cracks across plates. |
| | | | | | | | 6" | 100 | 2100 | 8. „ „ special | 1292 | 1·62 | „ | Through | „ | Old cracks opened. |
| | | | | | | | 6" | 104 | 1900 | 9. „ „ „ cap'd | 1264 | 1·50 | „ | Through | Uncracked | Unchanged. |
| | | | | | | | 6" | 104 | 1700 | 10. „ „ „ „ | „ | 1·34 | „ | Through | „ point 2" long rub'd off | „ |
| Bethlehem nickel steel (2nd Indiana's side). | July 20, '94 | „ | 16' 7"·5 | 7' 6" | 18" at top and for 4' 1" then tapered to 8" at bottom. | Plane. | 12" | 850 | 1465 | 1. Carpenter | 1374 | 1·07 | ·66 | 11" estimated | Broken up | Uncracked. |
| | | | | | | | 12" | 850 | 1926 | 2. „ | „ | 1·40 | „ | 17" estimated | „ | Through crack across plate. |
| | | | | | | | 12" | 850 | 1926 | 3 Wheeler-Sterling | „ | „ | „ | 15" estimated | „ | Additional through cracks. |
| | | | | | | | 10" | 507 | 1983 | 4. Johns'n cast steel shot, cap'd | 1635 | 1·21 | ·55 | 15"·6 | „ rebounded | Fragment broken out of plate. |
| | | | | | | | 10" | 502 | 1983 | 5. Johnson cast steel shot | „ | „ | „ | 9"·75 | „ „ | Two more cracks, old ones opened. |
| | | | (Structure uninjured.) | | | | 10" | 501 | 1983 | 6. „ „ „ „ | „ | „ | „ | 15"·5 | „ „ | Unchanged. |
| Bethlehem nickel steel (Maine's turret). | — | — | 15' 2" | 5' 3"·75 | 8" | Curved radius 11' 9". | 6" | 100 | 1702 | 1. Holtzer | 1660 | 1·06 | ·75 | 3" | Smashed | Uncracked. |
| | | | This plate had numerous bending cracks. | | | | 6" | 100 | 1968 | 2. „ | „ | 1·19 | „ | 4" | „ | „ |
| | | | | | | | 8" | 250 | 1835 | 3. „ | 1203 | 1·53 | 1·00 | 6" estimated | „ | Cracked through top to bottom. |
| | | | (Structure unhurt.) | | | | 8" | 250 | 2004 | 4. St. Chamond | „ | 1·67 | „ | 2' into backing | „ | Cracked into four pieces. |
| Carnegie nickel steel (Oregon's 13" B.L.R. barbette). | July 12, '94 | Indi'n Head | 13' 1" | 8' 8" | 17" | Curved radius 15' 10". | 12" | 850 | 1410 | 1. Carpenter | 1322 | 1·07 | ·70 | 15" | Rebounded whole | Uncracked—appeared too soft. |
| | | | | | | | 12" | 850 | 1858 | 2. Wheeler-Sterling | „ | 1·41 | „ | Through all | Point abraded | Uncracked. |
| | | | | | | | 12" | 850 | 1858 | 3. Carpenter | „ | „ | „ | 20" estimated | Welded into plate | One through crack. |
| | | | | | | | 12" | 850 | 1858 | 4. „ | „ | „ | „ | 19" estimated | Broken up | Crack continued across plate. |
| | | | | | | | 10" | 500 | 1983 | 5. Midvale-Holtzer | 1572 | 1·26 | ·59 | 20" | Rebounded, set up | Slight cracks. |
| | | | | | | | 10" | 500 | 1983 | 6. „ „ | „ | „ | „ | 12"·5 | „ „ scored | Additional through crack. |
| | | | | | | | 10" | 497 | 1883 | 7. Johnson cast steel shot | „ | „ | „ | 20" | Broken up | Old cracks widened. |
| Carnegie nickel steel (Brooklyn's 8" B.L.R. barbette). | Oct. 4, '94 | „ | 8' 6" | 4' 8"·5 | 4" | Curved radius 9' 6". | 4" | 33 | 1491 | 1. Carpenter | 1439 | 1·04 | 1·00 | 12" into backing | „ | One crack, shell struck sound part of plate. |
| | | | This plate was covered with a hatchwork of surface cracks, some having a width of ·05" to "·09 and 0·75" deep. There was also a so-called "soft trip" running across it. | | | | 4" | 33 | 1595 | 2. „ | „ | 1·11 | „ | 1"·6 | Smashed | No cracks, struck cluster of cracks. |
| | | | | | | | 4" | 33 | 1676 | 3. „ | „ | 1·16 | „ | Through all | Unhurt | No cracks, struck near several cracks. |
| | | | | | | | 4" | 33 | 1595 | 4. „ | „ | 1·11 | „ | 0·9" | Smashed | Concentric surface cracks. |
| | | | | | | | 4" | 33 | 1595 | 5. „ | „ | „ | „ | 1" | „ | Fine cracks near right end. |
| | | | | | | | 4" | 33 | 1595 | 6. „ | „ | „ | „ | 1"·5 | „ | Extended last crack. |
| | | | | | | | 4" | 33 | 1595 | 7. „ | „ | „ | „ | 1" | „ | Same, and a through crack to left edge. |
| | | | Backing 20". | | | | 4" | 33 | 2000 | 8. „ | „ | 1·39 | „ | 20" in backing | Broken up | Right end of plate cracked through. |
| Bethlehem nickel steel (Texas' side). | Oct. 6, '94 | Bethlehem | 18' 2"·5 | 6' 4"·5 | 12" for 3' 4" then tapered to 7" | Plane, shaped to side. | 8" | 250 | 1678 | 1. Holtzer | 1577 | 1·06 | ·66 | 5" estimated | Smashed | Uncracked. |
| | | | | | | | 8" | 250 | 2004 | 2. „ | „ | 1·27 | „ | 11" estimated | „ | „ |

* Inclined 13 deg. to normal.

† Inclined 12 deg. to normal.

## TANK LOCOMOTIVF, NIPPON RAILWAY, JAPAN

MESSRS. NEILSON AND CO., GLASGOW, ENGINEERS



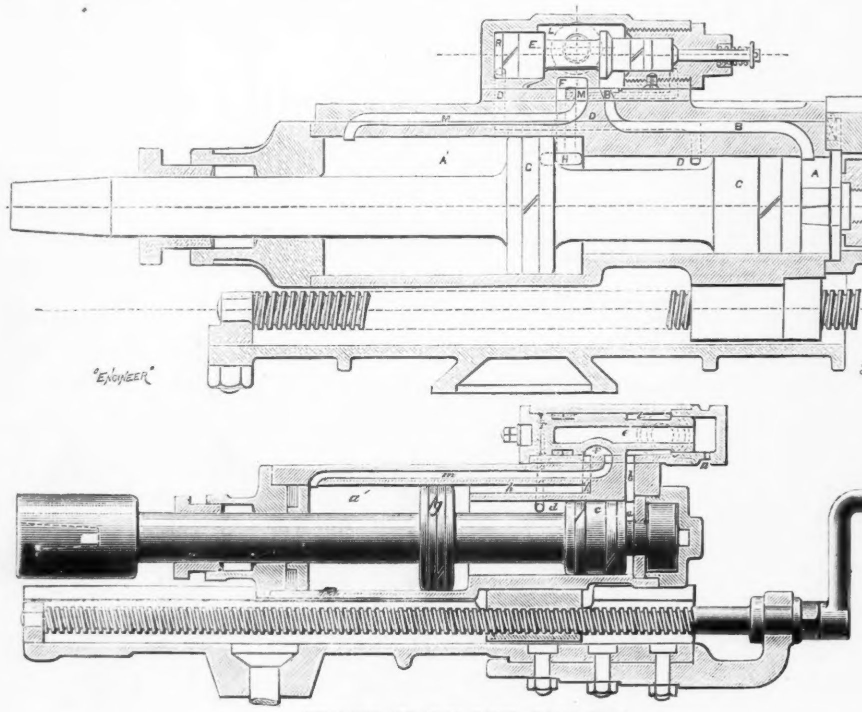
account of the softer body and back of the Harveyed plate. This argument is fallacious; the principle of a non-homogeneous hardened face, combined with a decrementally toughened body and back, is correct. The homogeneous plate, as compared with the non-homogeneous, must always be perforated in detail. Should the homogeneous plate of the future be greatly superior to the face-hardened plate of to-day, it will be made still more resisting by employing it as the foundation plate to which the process of face-hardening is applied.

Whatever conclusion is reached, the fact remains that Harveying in its present state has increased the resistance of armour fully 35 per cent., and perhaps 50 per cent., according to the thickness of the plate. It has also brought about a great improvement in the quality of our projectiles, and in doing so has perhaps lost some of the advantage it held over them at first when subjected to direct impact. Its superiority under inclined impact is nearly as great as it ever was, and it does not seem possible that in this respect the relation between gun and armour will, for a long time to come, take the old position held in the time of soft armour. Perhaps this relation may be restored, however, should the thickness of armour be reduced to a point allowing no more than the old resistance, in order to distribute it over a larger area or divert the weight thus saved to other uses.

## QUICK LOCOMOTIVE BUILDING.

Messrs. Neilson and Co., Hyde Park Locomotive Works, Glasgow, have succeeded in establishing what may be considered a record in locomotive engine building. On the 26th of September they received an order for twelve locomotives for the Nippon Railway Company of Japan, the penalty for late delivery being exceptionally severe, viz., £100 per week per engine for each and every week by which the contract dates might be exceeded. The delivery promised by the firm for the first four engines was the 15th of January, 1895; the second four engines by the 29th of January, 1895; and the third four by the 12th of February, 1895. The photograph which we reproduce above of the first engine was taken on the 30th of November, 1894, or just sixty-five days after the reception of the order. The first four engines were passed, after trial in steam on the railway in working order, on the 5th of December, 1894, or in seventy days from the receipt of the order. The fifth to the eighth engines were completed and tested on the 12th of December, 1894, or in seventy-seven days from the order; and the last four engines were passed in steam on the 19th of December, 1894, or in eighty-four days from the receipt of the order. The first four engines were despatched for shipment on the 15th of December, 1894; and it is expected that the whole order may be *en route* for Japan this year, or well within the time undertaken for delivery of the first engine.

Messrs. Neilson and Co. acknowledge that they would have been quite unable to accomplish the above result but for the strenuous exertions of their efficient staff and the co-operation of their own workmen, to whom the result is most creditable. Further, in the matter of inspection the contractors were greatly assisted by the consideration of the consulting engineer, Mr. T. R. Shervinton, and his staff of inspectors, who made it a personal matter to accelerate the inspection of the material of the engines, placed as it was with sub-contractors whose works are situated all over England and Scotland, and this notwithstanding that the inspection was as exacting as necessary to insure that nothing but material of the best quality should be built into the engines. As Messrs. Neilson and Co. had not built the same type of engine previously, new drawings, patterns, and templates had to be made, and the material ordered, inspected, and passed before a start could be made in the works. We believe that this is not only a record for Messrs. Neilson and Co., but also among locomotive builders; but it is almost certain that with other conditions prevailing, such as order books well filled up and sub-contractors busy, such a severe penalty as £100 per week per engine for late delivery could not be accepted under any consideration.

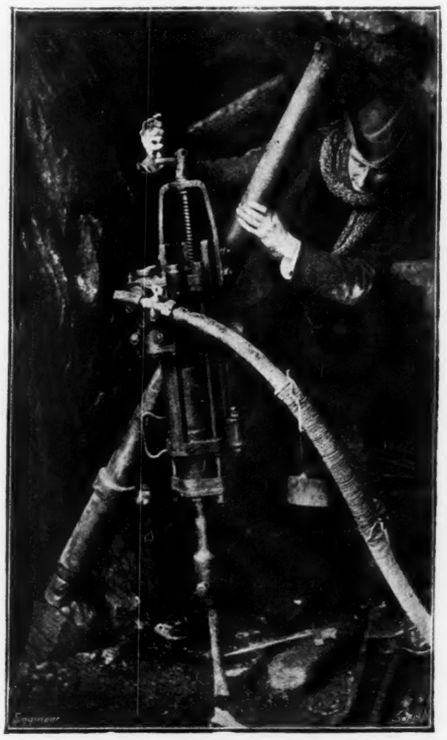


SECTIONS OF THE RAPID ROCK DRILL

## A RAPID ROCK DRILL.

We have recently been enabled to see at work an ingenious rock drill. The principle of this drill is not absolutely new—in fact, its invention dates about two years back, but since that time sundry alterations have been made which have gradually brought the working of the drill to its present state of efficiency.

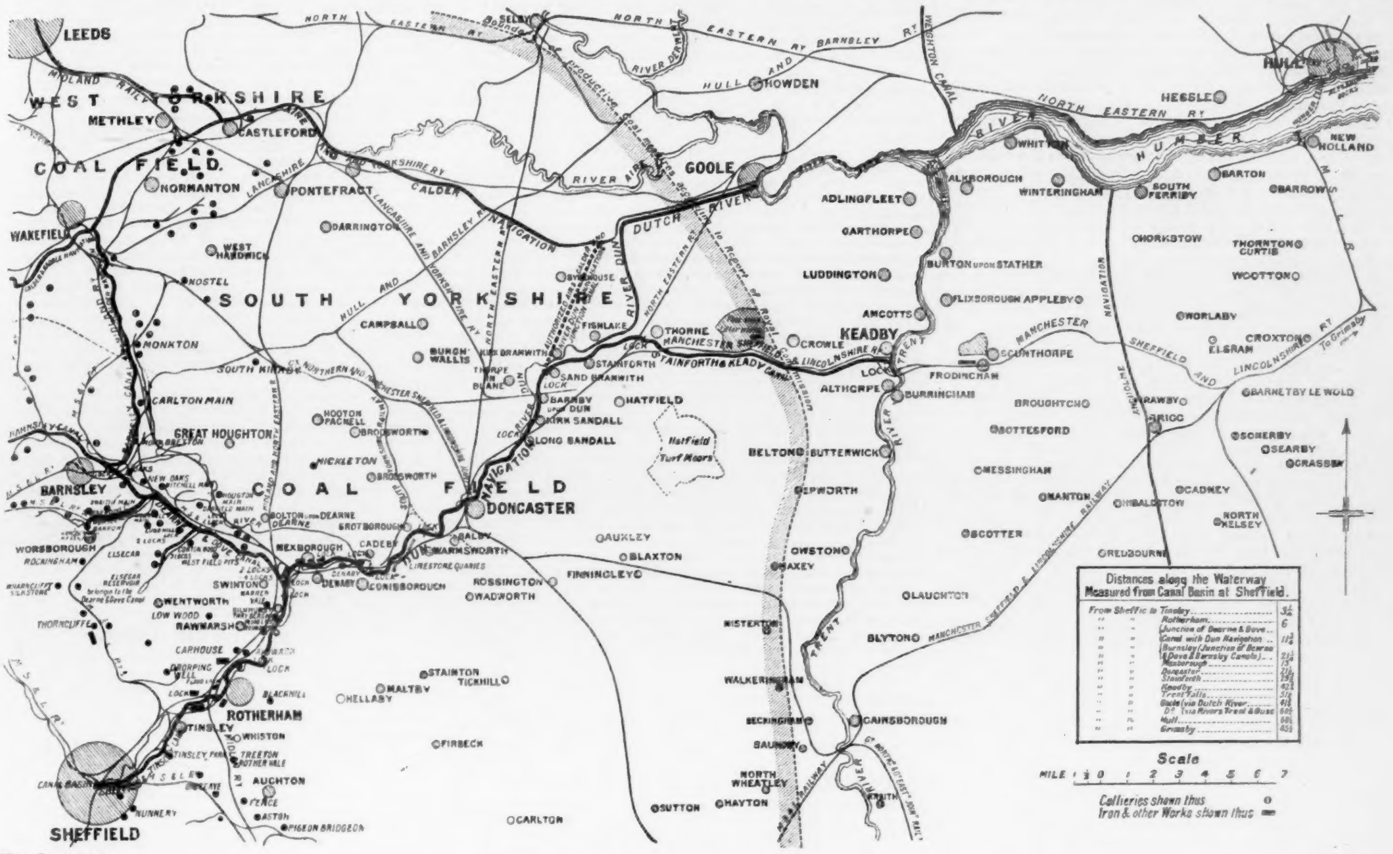
The compound action, which is the leading feature of the drill, was originally invented by Mr. P. J. Ogle, who sold his patent rights to R. Schram and Co. in consequence of the immediate recognition of its value bestowed by that firm on the invention, which recognition led to adoption, even at the cost of many pangs occasioned by the shelving of their old drill, which had already rendered and continued to render excellent services. This was only done reluctantly, but the old drill had had its day, and was obliged to give place. We are inclined to share Mr. Schram's opinion that the preference has been amply justified, and expect that the figures given lower down will convince our readers in a similar manner.



THE RAPID ROCK DRILL AT WORK

But we should at first explain the mechanism, a glance at the accompanying sections of which will be sufficient to show the main feature, namely, the two pistons of unequal sizes. The advantage of this over the simple method is plain to see—as the air that has been used to make the forward stroke, instead of being exhausted to the atmosphere, by being taken to the underside of the lower piston, is utilised for the backward stroke, a more powerful and rapid stroke being the inevitable result, in addition to a saving of compressed air consumption, according to Mr. Schram, of 40 per cent. The sections A and B are of two types of the drill—there being no difference in the principle between the two; B represents the more recent form.

# THE CANALS OF THE SHEFFIELD AND SOUTH YORKSHIRE NAVIGATION



"THE ENGINEER"

The operation is as follows:—Assuming the piston valve *c* to be in the position shown, the cylinder *a* will be in communication with the air under pressure through the port *b*, the cylinder *a'* being at the same time in communication with the atmosphere through the ports *m*, *f*, *h*, the result of which combination will be that the piston is forced forward, and, in its travel, uncovers the port *d d d*. Through this port some of the compressed air passes into the small cylinder *r* behind the valve, and acting on a larger area than that which is subject to the constant pressure at *l*, there being no resistance, as the other end communicates with the atmosphere, pushes the valve over, cutting off the air supply and placing the cylinders *a* and *a'* in communication through the ports *b* and *m*. Then the air that has acted on the piston *c* now passes into the cylinder *a'*, where it acts on the larger piston, thereby moving it back to its original position, the piston *c* at the same time uncovering the port *d* and placing the cylinder *r* again in communication with the atmosphere through the ports *d* and *h*, the constant pressure acting on the valve at *l* moving it over to the position as shown in the illustration, and thus the action is repeated.

It will be seen that the air used for the forward stroke is again utilised for the backward stroke without in any way impeding the piston in its forward stroke, and by being instantaneously admitted to the cylinder *a* while the cylinder *a'* is in free communication with the outlet, causes the piston to give a very powerful blow. At the end of each backward stroke there is still some pressure left behind the piston C, which, besides cushioning the piston, causes the space in the cylinder to be more quickly filled, thus causing a saving in air in addition to the increased power of blow. Briefly, what we saw was as follows:—

An "Optimus" drill was tested against one of the old Schram drills: firstly, with regard to depth of hole within a given time—namely, one minute—the rock being a block of Cornish granite; and secondly, with regard to air consumption. In the depth test, which lasted one minute, with 70 lb. air pressure, the Schram drill cut a hole 9¾in. deep. In the same time the Optimus cut a hole 11⅜in. deep. In the consumption test, which also lasted a minute, both drill stocks delivering blows on a log of wood at the end of the stroke, the Schram drill, with air pressure, maintained throughout at 60 lb., took 175 charges of the air compressor, the cylinder of which is 8in. diameter by 12in. stroke; the same air pressure could not be maintained with the Optimus drill, as this drill, requiring only 90 charges of the compressor, took the air so slowly that the combined engine and compressor on wheels when even working at 58 lb. betokened a strong dislike to its surroundings—by a visible and audible tendency to leave them. The dancing of this machine could only be stopped by working the drill at 56 lb. pressure. When the air supply to the Optimus was cut off—the drill continued to work—without the tool, be it rememberd—until the air pressure by the gauge fell to 17½ lb., thereby furnishing another proof of the much reduced amount of air required. Comparing the weights of the two drills, we find the Optimus somewhat in excess, weighing 295 lb., or 75 lb. more than the Schram. In considering this, the additional length of stroke of about 1in. should be borne in mind. The drills were tried at the works of Messrs. J. I. Thornycroft and Co., where they are manufactured for Richard Schram and Co., 17A, Great George-street, S.W.

---

## SHEFFIELD AND SOUTH YORKSHIRE NAVIGATION COMPANY.

In 1889 an Act of Parliament was obtained enabling a new company to be formed in Sheffield, with powers to acquire by compulsion the waterways between Sheffield and the Trent, as well as the Dearne and Dove Canal, which connects the main line of navigation with Barnsley and the intervening coal-field, all of which belong to the Manchester, Sheffield, and Lincolnshire Railway Company. These powers have not yet been put in force; but in the beginning of this year an agreement was arrived at by which the railway company agreed to sell to the canal company the navigations in question for the sum of £600,000 cash, and £510,000 fully paid-up ordinary shares in the new company. An arrangement was also completed defining the land which should attach to the railway and that which should remain the property of the canal, where both lines of communication are contiguous; thus dispensing with the necessity of calling in the Railway and Canal Commissioners, the tribunal prescribed by the Act of Parliament in case the parties were unable to come to any understanding between themselves. The new company has lately issued a prospectus, and as it is supported by the leading men of Sheffield and neighbourhood, who have subscribed £270,000 of the preference shares out of the £625,000 which it is proposed to raise, we hope that the balance will be obtained without any difficulty, and that an important line of water communication will be henceforward freed from railway control. The Navigation Company intends to raise money for certain improvements of the waterway by the issue of debentures hereafter.

We publish a map showing the district served by the waterways which it is intended to purchase from the Manchester, Sheffield, and Lincolnshire Railway Company, extending from the towns of Sheffield and Barnsley to the tidal waters of the Trent at Keadby. The length of these waterways, in parts canal and the remainder formed by the canalisation of the river Don, is from Sheffield to Keadby forty-five miles, with a branch to Barnsley nine miles, and subsidiary branches to Worsborough and Elsecar each two miles long, making a total of nearly sixty miles. These form a water communication between Sheffield, Rotherham, and Mexborough, and this portion of the Don Valley, which is inhabited by a large and industrious population numbering 600,000, as well as Barnsley and the South Yorkshire coal-fields, with Hull and the outside world. The traffic on the waterway is, however, comparatively small, about 500,000 tons passing to and from the Trent at Keadby, and another 400,000 tons being carried from place to place on the system. This compares with upwards of 2,000,000 tons carried on the neighbouring Aire and Calder, and upwards of 2,000,000 tons on the Bridgewater Canal, which has a much smaller sectional area, and is not navigated by barges that can be sailed in the estuary of the Mersey. All barges navigating the Bridgewater Canal are tugged by the canal company's steamboats if bound for Liverpool, whereas the barges locally known as keels on the Sheffield Navigation make their passages by sail, not merely to Hull and other ports on the estuary on the Humber, but also to the harbours and navigations of Lincolnshire and the adjoining coast.

The history of these navigations is a peculiar one. The first Act of Parliament goes back to 1726, five years after the Acts for making the Weaver, and Mersey, and Irwell navigable; twenty-seven years later than the Act for the Aire and Calder Navigation. The Act was granted to the Cutler's Company of Sheffield, with power to make the river Don navigable from Tinsley, two miles below Sheffield, to Doncaster—a small beginning indeed. In the following year the corporation of Doncaster obtained an Act to extend the navigation to Wilsick, six miles lower down the river; and the two undertakings having meanwhile amalgamated, obtained an Act in 1740 to extend their operations four miles, as far as Fishlake. As a spring tide flows to within four miles of Doncaster, the navigation overlapped the tide. No lock appears to have been built below Doncaster, so that the boats could only pass over this portion at high water of spring tides, and delivered their cargoes two miles away from Sheffield. This state of things appears to have lasted for fifty years till 1793, when Acts were obtained for making the Dearne and Dove Canal to the Barnsley coal-fields, and also for making a canal from the Don at Stainforth to the Trent at Keadby, which afforded a passage for barges at neap as well as at spring tides; and after these were completed an Act was obtained in 1815 to extend the waterway from Tinsley into Sheffield, and under the powers then conferred the canal, four miles in length, with twelve locks and a canal basin of 1½ acres in extent, was made, and Sheffield brought into contact with the sea for craft carrying fifty tons.

The difference in level between the Trent at high water and Sheffield Basin is 160ft., and the locks number thirty-one. Certain improvements were made from time to time below Tinsley, so that the burthen of vessels could be increased to 70 tons or 80 tons, and sailing craft with lowering masts were able to trade to Sheffield. The limit of draught, 6ft., is fixed by the depth of the Sheffield and Tinsley Canal. About 1847 the owners of the Dun Navigation, alarmed by competition of railways, became themselves the makers of a railway alongside a portion of their waterway, and obtained leave to make the South Yorkshire, Doncaster, and Goole line, and from that time the railway interest overshadowed the interest in the waterway. The company subsequently became possessors of the Dearne and Dove Navigation, and also of the Stainforth and Keadby Canal, and a few years later offered to place the whole of their property in the hands of the Great Northern Railway Company. This proposal fell through. Meanwhile, the Manchester, Sheffield, and Lincolnshire Railway Company purchased the Sheffield and Tinsley Canal, and having thus secured the terminus, they, in 1864, made arrangements for the lease for 999 years of the whole undertaking, including railways and navigations belonging to the South Yorkshire and River Dun Navigation Company. Ten years ago the latter company was dissolved and merged absolutely in the Manchester, Sheffield, and Lincolnshire Railway Company.

Up to 1847 the navigations were in a fair condition compared with others throughout the country; indeed, the lower portion from Keadby to Doncaster was, perhaps with the exception of the Gloucester and Berkeley Canal, the finest inland navigation in England; fixed bridges had been replaced by swing bridges, and vessels with fixed masts, drawing 8ft. of water, could trade to Doncaster; but after 1847, and especially since the lease of 1864, the railway has pressed sorely upon the navigation. Fixed railway bridges have been built by the company below Doncaster leaving no more than 12ft., while above bridges have been built with even less headway. Ugly bends have been made in the canal to pass it under railway bridges, and in at least one instance the canal has been filled up and a line of rails laid on its site, the waterway being elbowed out of its normal course, and the alternative route provided being much less convenient for the traffic by water.

Verily the mistakes made by former generations are being brought home to the men of to-day, who find that legislation has permitted the throttling of the old navigations, and their transfer to competing railway companies. Upwards of one-third the mileage still open to navigation in England is now in the hands of railway companies, whereas on the Continent the rule is for the State to own the waterways. In France, at any rate, the majority of them are toll free, intensifying the competition our traders have to contend with. The Mersey and Irwell might have been secured to the city of Manchester, but failing that it was held by independent canal owners, the trustees of the late Duke of Bridgewater, and it was due to their watchfulness and authority that swing bridge clauses were inserted in all the Acts of Parliament empowering lines of railway to cross the Mersey. This provision aided materially the promoters of the Manchester Ship Canal in obtaining the necessary power to raise the railways to a sufficient height to enable ships to pass under them. It was impossible to enforce the swing bridge clause on the face of the heavy traffic carried on these lines, and the canal company has been compelled to spend an enormous sum in raising the four lines of railway that crossed the Mersey Valley at a low level to the height of Runcorn Bridge, 75ft. above the canal, and, in addition, to compensate the railway companies for alterations entailed in the conduct of their traffic to the extent of over £100,000.

Sheffield and Doncaster, as we have seen, once owned the navigation, and had they retained possession of it would certainly have seen its interests better protected, and by free competition would have saved the district untold sums paid to the railway company for carriage. The neighbouring Ouse navigation, owned by the Corporation of York, is crossed by swing bridges, and the headway is preserved to the older line of traffic. The existing locks on the Sheffield navigation will accommodate a vessel 62ft. by 16ft., the depth to Sheffield being limited to 6ft. by the Tinsley Canal, below this there is a minimum of 6ft. 10in. on the shallowest lock sill; there are shoals and other obstructions which require removing on various parts of the navigation.

The result is that 80 tons to 90 tons is considered a fair cargo to carry to Sheffield, although the same craft will take 10 tons more by the Aire and Calder to Leeds, and as the charge made is at per ton, the difference of earning in the trip is 11 to 12 per cent. But of much more importance to the trade of the district, as well as to the boat owners, who fix the freight according to the earning power of their craft over a period of time, is the fact that owing to the want of accommodation at Sheffield and Keadby, and generally to the lethargic fashion in which the whole navigation and its surroundings have been worked, delays are the rule; and although the trip to Hull ought to be accomplished at need in about thirty hours, the time occupied varies from four days to three weeks, and a trip a month, or twelve trips annually, is considered fair work for a keel, as is a trip a week to a colliery only ten miles distant. Even Ireland beats this, for on the Grand Canal boats make trips from Dublin to Limerick and back, 94 miles, and discharge and load cargoes each week.

The Sheffield basin is still 1½ acres, as made in 1815, when the population was about 60,000. All the accommodation provided for the additional 260,000 inhabitants is to be found at the various goods depôts of several railway companies. The warehouses are unaltered; we were going to say the cranes were, but a fourth crane has of late years been added to the three small ones previously provided. None of these are worked by power, although the basin is usually so crowded with barges that they are kept waiting below Tinsley; and to accommodate the heavy trades of Sheffield, including armour-plates, guns, boilers, &c., a 5-ton crane is the maximum limit which the Manchester, Sheffield, and Lincolnshire Railway Company consider the carriers by water are entitled to. There is but one berth in which a vessel can unload perishable goods under cover—consequently rain stops the work on all the others loading or discharging such goods; and although the traffic is congested to a degree, the basin is closed regularly at 6 p.m. even in the long summer evenings.

The valley is, as we have stated, a populous one; its manufactures are mainly what are known as heavy, and there is abundance of coal—land-locked coal, as one of the witnesses who gave evidence in favour of the Bill termed it. Foreign ores are imported largely, including Swedish iron; and these have to be exported in a manufactured state. Two payments for carriage have therefore to be considered.

The railway rate for South Yorkshire coal to London, exclusive of truck hire, is about 8s. per ton, and it is calculated that with the improved navigation the cost will be considerably reduced, thus enabling the excellent gas coal raised in the neighbourhood to be brought into competition with the South Durham coal for supplying the Metropolitan and South Country Gas Companies. Messrs. Cory and Co. are building a number of barges to carry 200 tons to 300 tons dead weight. These can navigate for a long length on the Aire and Calder, and also to Keadby. It is proposed to alter this navigation so that they can be loaded at the Denaby Colliery Company's stages. This company has an output of 1,000,000 tons per annum, and has lately sunk a new pit on the banks of the Dun.

It appears from the evidence given before the Parliamentary Committee in 1889 that there is no scarcity of water on this navigation. The river Dun supplies the main line from Sheffield to Keadby, and as will be seen by reference to the map, there are large reservoirs on the Dearne and Dove Canal. The waterway is not so deep as the Aire and Calder is now, but we see no reason why it should not be improved in a similar manner. It would appear as if the promoters had contemplated doing this, for they, in conjunction with the Aire and Calder, have obtained power to make a canal, as shown by dotted lines connecting the Aire and Calder with the river Dun. This would shorten the distance between the colliery districts above Doncaster and the deep water of the Ouse by ten miles, and place the docks at Goole at the service of the Sheffield Navigation. Vessels drawing 15ft. and 16ft. of water can trade to these docks, the channel of the Ouse having recently been improved by training.

Large collieries have lately been opened out in the Dun Valley, and we have lately been told that the centre of the South Yorkshire coal-field will gravitate towards Doncaster, and ultimately be located there instead of at Barnsley. We think, therefore, there is every prospect of a large increase of trade being obtained for the navigation, if managed on modern principles and with modern appliances.

## LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

### LABOUR AND LUXURIES.

Sir,—I do not think that any good could be done by continuing this discussion so far as I am concerned; but before definitely withdrawing and leaving the field to others, I would like with your permission to summarise my statements, the gist and essence of which your correspondents seem to have entirely failed to understand. At the outset I referred to a certain grumble to the effect that a Government clerk spent more than the week's wages of a labourer on a bouquet, and I said that so far as the working population was concerned it made no difference on what the gold was spent. Thereupon your correspondent "W. A. S. B." and others joined issue, and began to argue on ethical grounds that I was wrong. I disclaimed all reference to ethics, and took the position taken by Lord Farrer. Turning back to commercial considerations, your correspondents next proceeded to argue that it was of very great importance to a country on what gold was spent.

Now in one sense this is quite true, and in that sense I have never traversed the proposition. What I did say and repeat is that so far as a working man—and by a working man I mean anyone, judge, physician, director, gardener, porter, or scavenger—is concerned it matters not a jot what kind of work he does so long as he receives gold for it, and I said that the benefit which the possession of gold can confer is quite independent of what has been given in return for it. To go over old ground once more, I say that the benefit which a sovereign can confer on a gardener in return for a bouquet is as great as the benefit which a sovereign can confer on a labourer who is employed in helping to make rifle cartridges. This seems to me to be absolutely incontrovertible on any commercial grounds. Ethically no doubt it is better to grow flowers than to make cartridges, but with this I have nothing to do.

In the next place, I have tried to show that the supply of gold being limited, if one individual obtains it another must go without. That, in a word, both the cartridge maker and the gardener cannot have the sovereign. Thereupon your readers argue that it is a matter of the most serious import to the nation that the sovereign should be properly spent; to which I reply that for various reasons it is of practically no importance at all save in one respect on what it is spent, so long as it is not spent on something that sends it out of the country, and this simply because the spending of gold is not a single operation. It is continually going on. Thus, it may be said, for example, that a sovereign spent on fireworks is wasted. That may be quite true in the sense that the individual buying the fireworks and letting them off does not get value for his money, but so far as the gold is concerned, it passing to the firework maker at once confers on him the power of buying bread for his family, and the gold will do him all the good that it can do if he spends it aright, although it has been earned by making fireworks. In one word, each sovereign during its life is engaged in a multitude of transactions, and so far as a nation is concerned, it can do no more than enable the man who earns it to buy food and clothes and the necessaries or luxuries of life, and no matter how it is earned it will do that. I cannot find a single proof in any of your correspondents' letters that I am wrong. Indeed, they never attempt, so far as I can see, to traverse the proposition at all.

But they do say that a sovereign may be spent to greater advantage in one way than another, commercially. Now I maintain the following proposition:—*Gold is best spent when the spending gives employment to the largest number of workers at fair wages.* Thus, for example, one man spends £50,000 on a great building; that building never decays, never gives employment subsequently to anyone, and is quite unsaleable, but by a mistaken notion it is regarded as so much national wealth. Another man spends £50,000 on a ship; that ship not only gives employment on her construction to a great number of workers, but subsequently she employs a crew and she uses coal, and has to be kept in repair, and finally wears out and has to be replaced. The spending of the money on the ship is infinitely more to the advantage of the nation than the spending of it on a great public building. The point turns on the meaning of the word "advantage." Let me take beer for instance. A man may spend a sovereign which he has earned, either on beer or on mutton. The first use would, I suppose, be regarded as a waste of the sovereign. The second use would be considered, I suppose, an advantageous use of the coin. If we come to sift the proposition thus stated, we see how extremely narrow it is. The advantage and disadvantage are wholly confined to the individual buying the beer or the mutton. But if we extend our range of observation, it will be found that the man spending the sovereign on beer is directing it into a far more useful channel than the man spending it on mutton, because the production of a sovereign's worth of beer gives employment to many more men than does the production of a sovereign's worth of mutton. In New South Wales there is a population of but 1,200,000 souls, yet there are, it is estimated, 60,000,000 of sheep and 2,000,000 of cattle. It is not remarkable that this enormous country is thinly populated, because there is little or no field for labour. No doubt "W. A. S. B." would say better so than growing barley and making beer. But on this point I certainly cannot agree with him.

There is a story told of a dozen men who sat at a table playing cards. After a time the meeting broke up, and accounts were squared; a single sovereign paid everything, and yet each man of the twelve owed a sovereign. Here we have an excellent instance of what gold can do. My contention is that so long as gold is kept, let me say, in England, it matters nothing whether it is spent on necessaries or luxuries, the exact measure of its utility will be the number of times it changes hands. If my antagonists are prepared to show that in the production of any given commodity the circulation of the sovereign is less than it would be in the production of some other commodity, then I am prepared to admit that in so far the gold is not used to the best advantage.

In any great commercial country such as this is, production of every kind is mixed up in a way that the older writers on political economy never dreamed of. Thus, for example, a man spends five sovereigns on a watch; that money is probably distributed among a hundred persons. Such is the division of labour that the man who makes watch cases will not make the hinges for them, which represent a totally different branch of trade. It is the most difficult thing in the world to misuse a sovereign, save in the sense of locking it up or taking it out of circulation.

But someone will say, why not spend the sovereign in paying for useful labour? Why not make more railways, for example? Will not this be better than spending it on flowers? The answer depends on whether it is better for the community as a whole to employ navvies or gardeners. So far as the gold is concerned, one is as good as the other; but it is conceivable that a condition might spring up in which employment being given to no one in the production of corn let us say, that gold had to be sent out of the country to buy it. This would be very bad policy indeed, and I think it will be seen that throughout the correspondence I have positively asserted that gold must be retained in a country, and I now repeat for the last time, that so long as it is retained it will do all the good it can do, no matter on what it is spent, the only measure of its utility being the rate at which it changes hands. As to the utility of what is given in exchange for it that is quite another affair, concerning which I have expressed no opinions of any kind. It is to be regretted that "W. A. S. B." did not quote from Mahan, instead of merely referring to him. Quoting from a writer of the period, Mahan gives the following most instructive passage:—"The mines of Brazil were the ruin of Portugal, as those of Mexico and Peru had been of Spain; all manufactures fell into insane contempt; ere long the English supplied the Portuguese not only with clothes, but with all merchandise, all commodities, even to salt fish and grain. After their gold, the Portuguese abandoned their very soil. The vineyards of Oporto were finally bought by the English with Brazilian gold, which had only passed through Portugal to be spread throughout England." "We are assured," says Mahan, "that in fifty years 500 millions of dollars were extracted from the mines of Brazil, and at the end of the time Portugal had not 25 millions in specie." We have precisely analogous cases in the present day. The discovery of gold in Australia, New Zealand, California, leads at once to the abandonment of agriculture, manufacturing, the sea. The mistake made by the Spaniards and Portuguese was that they sent their gold out of the country. Will "W. A. S. B." venture to say that they would not have been enormously better off if they had kept it? But they did not keep it, for reasons which "W. A. S. B." will find set forth in the pages of Buckle, if only he understands how to profit by the lesson which Buckle has taught.

As I have said, I do not intend to take any further part in this discussion. Indeed, I fear that I have repeated myself many times as it is, but I shall read with interest what your other correspondents may have to say on the subject. Mr. Allan Steward, I see, has raised a very nice question indeed. His views and mine are in the main so far identical. Y. X.

December 22nd.

### AMERICAN AND ENGLISH WOOD-WORKING MACHINERY.

Sir,—A few days ago I came across a letter in a recent issue of your journal under the presumptuous headlines of "Why American Wood-Working Machinery is Damaging English Manufacturing Interests." The said epistle dates from Cincinnati, Ohio, U.S.A., and is over the initials "J. T. B.," who must be exceedingly sensitive not to give us the benefit of his full name. Now, I should like to know what ground there is for such an extraordinary interrogation. Have the English at any time acknowledged such premises? I say decidedly not; on the contrary, the introduction of American machines here has only by comparison served to stimulate the demand for home-made.

While admitting the ingenuity of American machines generally, and the persistency of the makers in pushing their sale, I find from experience that as a rule they are unsuitable for our markets. They are in most cases too lightly constructed, and not fitted in the substantial manner English users insist on.

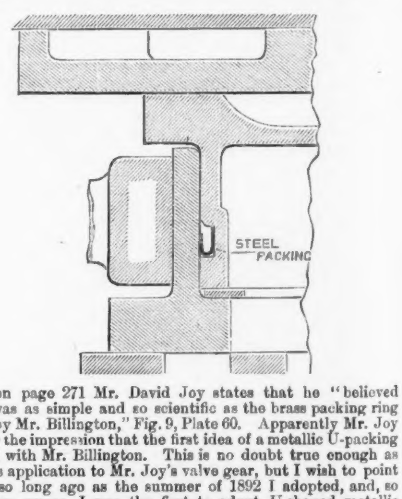
It is all very well as an excuse for these deficiencies to maintain that American iron, being much tougher than ours, less of it is requisite for the necessary strength and stability; this contention will not hold water. Formerly, when our cousins across the sea made the framing of their machines of wood, it was claimed as preferable to metal, inasmuch as it absorbed the vibrations of the machines arising from the high speeds of the various cutter heads. At present their justification of this lightness is the abnormal toughness of their iron. As a matter of fact, machines of this type and special design, running at exceedingly high velocities, must have framework of comparatively solid construction to counterbalance the effects of vibration. Light framing—irrespective of the toughness or strength of the material composing it—will not suffice to prevent this. Weight, dead weight, is a *sine quâ non*. To affirm that American machinery is rapidly edging the home-made out of the field is hyperbole, and very far from the real position of affairs.

Several transatlantic manufacturers have from time to time established show-rooms in this country for the display and sale of these "veritable wonders," but invariably with disastrous financial consequences. If these machines are so superior to ours why do not our people purchase them? They are, machine for machine, less expensive, so this cannot be the explanation; there must be something deeper to account for it. Most assuredly, the Englishman is *not* behind the times in the getting-up of up-to-date wood-working machinery. The pretentious Cincinnatian in this connection is illusive and fallacious, and doubtless my native contemporaries will unhesitatingly endorse my estimation of his assertions to the contrary. W. Samuel Worssam, Engineer.

7, Idol-lane, Eastcheap, London, E.C.,
December 22nd.

### METALLIC CUP PACKING.

Sir,—Living as I do in Japan, it is only a few days ago that I received the April number of the "Proceedings" of the Institute of Mechanical Engineers, containing among other things a very interesting paper and discussion on Mr. David Joy's fluid pressure reversing gear. As that discussion, so far as the Institute is concerned, is closed, I shall be much obliged if you will allow a little space in your columns upon one point which appears to have attracted some attention during the discussion. On page 258 of the "Proceedings" of the Institute of Mechanical Engineers Mr. David Joy mentions various kinds of packing which had been tested, including a simple ring of metals of U-section—Fig. 9, Plate 60—which had been suggested by Mr. Billington. On page 268 Mr. Basil H. Joy again alludes to the "simple form of packing suggested by Mr. Billington, consisting of a brass ring of U-section made with a very fine edge, which pressed against the ram, and was held up tight against it by the fluid pressure. It could be made absolutely tight, but it was so delicate that as soon as it was taken out for repairs the fine edge, which had to be practically like a razor, was difficult to preserve, and of course as soon as ever there was a little burr on the edge the whole efficiency was done away with."



Again on page 271 Mr. David Joy states that he "believed nothing was as simple and so scientific as the brass packing ring designed by Mr. Billington," Fig. 9, Plate 60. Apparently Mr. Joy was under the impression that the first idea of a metallic U-packing originated with Mr. Billington. This is no doubt true enough as regards its application to Mr. Joy's valve gear, but I wish to point out that so long ago as the summer of 1892 I adopted, and, so far as I am aware, I was the first to adopt, U-shaped metallic packing for my patent balanced slide valve, which was described and illustrated in the "Minutes" of the Institution of Civil Engineers, vol. cxvii., page 302. Although the illustration is only to a small scale, the U-packing can be clearly made out. My packing, however, is made of steel, as shown in the annexed full-size tracing.

In the autumn of the same year—1892—I sent a working tracing—full-size—and a sectional model—half-size—of my balanced valve to Mr. John Waddington, of 35, King William-street, E.C., by whom they were shown to Mr. Billington, I believe, in 1893, and this probably gave him the idea which, in a modified form to suit the circumstances of the case, he afterwards suggested to Mr. Joy. Mr. Billington would, I am sure, be the last man to claim or appropriate another man's invention without acknowledgment, but as he was apparently not present at the reading of Mr. Joy's paper—at any rate, he took no part in the discussion—it is not surprising that Mr. Joy's slight misunderstanding should pass unchallenged.

As regards Mr. Basil H. Joy's remark as to the extreme delicacy of this packing and its great liability to injury, this appears to be due to the fine razor edge adopted in the modified form, which is entirely unnecessary. A moderate flexibility is all that is required, and for sliding surfaces of which the motion is only slow or occasional the result is entirely satisfactory, as is proved by the instance given in the "Proceedings" of the Institute of Civil Engineers already referred to, to which I may add that in Engine 147 of the Imperial Government Railways—Messrs. Dubs and Co., No. 2528—the same packing has been working for upwards of two years without any attention or adjustment, and is now to all appearance as good as ever. Whether it would be equally successful for the packing of a piston or piston-rod is, of course, another question altogether. I may add that my communication to the Institute of Civil Engineers was dated December 6th, 1892. The first engine to which my packing was applied had its valves altered here July, 1892. The first batch of engines built in England with my balanced valves and metallic U-packing was made by Neilsons and Co., quickly followed by Messrs. Beyer and Peacock, Dubs and Co., and Nasmyth, Wilson and Co. The first of these was ordered December, 1892. John McDonald, M.I.M.E.,

Assistant Engineer, Imperial Government Railways.
Shenbasi, Tokio, Japan, November 14th.

(*For continuation of Letters see page 578*)

## RAILWAY MATTERS.

A PORTION of the Oussouri section of the Trans-Siberian Railway between Vladivostock and Mouraviewa Amoursky, a distance of 235 miles, was opened for traffic on December 20th.

IT is expected that the Mushkaf-Bolan Line, of which we gave particulars in our issue of 13th July last, will be completed in July, 1895. This does not refer to a second line of rails which is in contemplation.

A LINE to facilitate the coke traffic between Durham and the West Coast is under consideration, the scheme being to connect Hincaster, on the Furness line, to Hawes, thus giving direct communication with Darlington.

THE Furness Railway Extension from Barrow-in-Furness to Bardsee will join the main line about two miles below Ulverston. This line will obviate difficulty hitherto met with in the conveyance of mineral traffic, as it is almost entirely level.

THE construction of a railway between Hiroshima and Shimonosaki has been sanctioned by the Japanese Government. In addition to these, lines will be constructed to connect, firstly, Sasebo and Tsukayaki; and, secondly, Kumamoto and Mesumi. The first-mentioned of the above will be a branch of the Sango Railway—110 miles long; the estimated cost being 3,000,000 dols.

THE route of the proposed new railway from Bristol to London *viâ* Bath is over the Midland line from Bristol to Bath, where several streets would be crossed by viaducts, thence under and over the Great Western Railway, and, passing through a tunnel under the hills on the south-east side of Bath, emerge into Wiltshire at Limpley Stoke, and continue past Trowbridge on to Waterloo.

A DEPUTATION from Masham, including the Right Hon. Lord Masham, of Swinton Park, a few days ago waited upon the directors of the North-Eastern Railway Company at York to ask them to extend the line from Masham to Bedale, a distance of about seven miles. It was asserted that this would make a direct route from Mid-Yorkshire to the West Coast and Scotland, and could be very cheaply worked.

IT is stated that the Boards of the South-Eastern and London, Chatham, and Dover Railway Companies have arranged to revise the passenger fares between all competitive points, and on their system generally, so as to bring them more into conformity with the scale of charges for the respective classes of passengers which for a long time past has been in operation on the lines of the principal railways having their termini in London. This revised scale of fares will take effect on and from the 1st of January next.

THE following instances of electric railway development in Switzerland are given by the *Electrical Engineer*:—"It is proposed to construct an electric tramway from Interlaken Railway Station to Gsteig-Wilderswyl. Power will be taken from the central electricity works at Interlaken. A scheme is also on foot for an electric tramway from Schwyz to Brunnen, Axenstein, and Schwyz to Seewen. It is proposed to establish an electric tramway between Zofingen and Aarburg, current being obtained from the central station at Ruppoldingen.

THE Government of India having sanctioned a detailed survey being undertaken for a line of railway from Arsikere, *viâ* Hassan, to the port of Mangalore on the West Coast, the work has been placed under the control of the Madras Government, and the project will be designated the Arsikere-Mangalore Railway Survey. Another survey has been approved by the Government of India, which is intended to connect Tinnevelly with Quilon. The work will be undertaken on behalf of the Travancore Government, and the project is to be styled the Tinnevelly-Quilon Railway Survey.

THE death is announced of Mr. John Dent Dent, of Ribston Hall, near Knaresborough, the chairman of the North-Eastern Railway Company, and one of the directors of the Forth Bridge Railway Company. He was born in 1826, was educated at Eton and Cambridge, and was called to the Bar in 1851, but did not practice. He entered Parliament for Knaresborough in 1852, and became member for Scarborough in 1857, and with the exception of one short Parliament, sat for the latter borough till 1874. He succeeded Mr. George Leeman as chairman of the board of the North-Eastern, and on the whole has shown much ability in his oversight of its affairs.

THE Great Eastern Railway Company has been approached by Cambridgeshire landowners and farmers, who offer to provide the land and money for the construction of a light railway provided the company works it. After inspecting the district, which is a purely agricultural one with a sparse population, the directors conclude to make the railway themselves and work it, provided they get the necessary land at ordinary agricultural values, and that it shall be for the carriage of goods only. There will be no signals upon it except at the junction with the main line, and the necessary staff and engine power will be small. The line will run through a very rich district of the Fen country. If successful this example will no doubt be followed in many other parts of the country. The Bill will come forward next session.

WE read of a rather curious accident to a goods train on the Southern Mahratta Railway at Alandi station, fifteen miles from Poona. *Indian Engineering* says: "The goods train was on the way from Miraj to Poona. If left Rajewadi all right, but before it reached Alandi and after it had ascended the ghauts, the train somehow parted about the middle into two, without either guard or driver noticing it. The driver went on with the second half, the train running down the incline of the ghauts in pursuit of the first half. The driver pulled up on its arrival at Alandi, and as soon as he did so, the second half smashed into him, completely wrecking four wagons, and damaging others, and blocking the line for several hours. A relief train was sent out from Poona immediately the news was received. The mail train from Bangalore could not get through with the mails, the passengers having been transhipped into a mixed train. The mail train from Poona to Bangalore had passed through Alandi before the accident happened."

THE North-Western Railway of Switzerland has had a number of simple and compound locomotives built by the Winterthur shops; they are identical in all parts, with the exception that in the compound engines the normal cylinder on the left side, which is 15¾in. in diameter, is replaced by a cylinder 22⅞in. in diameter, taking steam from the right-hand cylinder by way of a pipe passing through the smoke-box. To facilitate the starting, an inner starting valve is used, which allows live steam to be admitted directly into the large cylinder when the throttle valve is opened. The object of this identity in the construction of the engines is to permit of comparative tests being made of the consumption of fuel, which have been carried on for about nine months, starting in August, 1893, and extending through to April, 1894. For this purpose two types of engines were successively detailed to haul the trains for the same number of trips. Furthermore, the engine crews were transferred alternately from one to the other. In a word, the conditions of running were kept rigorously the same throughout the whole of this period. The average monthly run to each engine was 2625 miles, with an average train load of 21.17 axles loaded to 5 tons each. The consumption of coal has been taken from month to month, and has resulted in showing a gain of from 15 to 16 per cent. in favour of the compound locomotive. The *Schweizerische Bauzeitung* says that, under these circumstances, the company has decided to extend the use of these engines over its system, and has ordered six new ones rom the Winterthur shops.

## NOTES AND MEMORANDA.

IN determining the density of melted magnesia, M. Henri Moissan found that the density of this substance increases with the temperature up to bright red. It is thus that by heating in his electric furnace some magnesia, which is irreducible by heat, he has been able to vary the density from 3·193 to 3·654. This is all the more noteworthy, as this substance affords the only example of such a variation.

THE following is a proposed solder for use with aluminium or aluminium alloys invented by B. I. Roman. Silver, nickel, aluminium, tin, and zinc are mixed in the following proportions:—Silver, 2 per cent.; nickel, 5 per cent.; aluminium, 9 per cent.; tin, 34 per cent.; zinc, 50 per cent. No flux is necessary, and any soldering iron or tool may be used, though one of aluminium is said to be preferable.

IN a recent number of the *Comptes Rendus* is a paper on "The Determination of the Molecular Weight of Liquids," by M. Ph. A. Guye. The author gives methods of determining molecular weights of substances from a knowledge of their critical coefficients and molecular refractions, and from their critical coefficients only. The relationships for a number of hydrocarbons are given, and the deduction is drawn that these hydrocarbons have the same molecular weights in the gaseous state, in the critical state, and in the liquid state.

THE Welsbach lamp has a large number of German competitors. The price in Germany has been maintained above 15s.; in Frankfürt it has stood at 20s. The Gautzch burner costs 10s., and the new lamp of the International Gas Glow Light Company will cost 12s. to the trade. The last-named is stated to be the most durable lamp. All three consume about the same quantity of gas. The last-named gives somewhat less light, but the greater durability may make up for this in the estimation of consumers. The firm of Elster, Berlin, is, according to the *American Manufacturer*, about to put a new incandescent lamp on the market. It is not yet known whether this is the Butzke patent, or something different.

IN a paper recently read before the Royal Society on "The Effects of Mechanical Stress on the Electrical Properties of Metals," by J. H. Gray and J. B. Henderson, we read that the density of a well-annealed copper wire of 98 per cent. conductivity, decreases about ½ per cent. if stretched 25 or 26 per cent. A lead wire also decreases about ½ per cent. just before breaking. A copper wire drawn through twelve holes of a draw-plate increases in density more than 1 per cent. A manganese-copper wire—10 per cent. of manganese—increases in density about 1 per cent. when drawn down to half its former diameter. Twisting causes copper to increase about ½ per cent. for 2·3 turns per cm. Heating the above wires causes no appreciable alteration. Hammering a copper wire increases its density about 0·2 per cent.

AT a recent meeting of the Cambridge Philosophical Society a paper on "A Model of the Twenty-seven Lines on a Cubic Surface" was read by Mr. W. H. Blythe. Mr. Blythe exhibited a model of the twenty-seven straight lines on a cubic surface, together with the drawings from which it was constructed. He stated that the 135 points of intersection of these lines can, in a special case, be determined by a simple geometrical construction without reference to any equation. Seven points taken at random on the edges of a tetrahedron are sufficient to give values to all necessary constants, and these points acting as pointers by pairs, fix the position of eleven other points; these eighteen points being used to determine others, and so on. This method *Nature* says, is also applicable to the general case, but determines fifteen lines only; when, however, the sixteenth line or one point on it is fixed by a process of adjustment the remaining points can be found in the same way.

A PAPER on "Researches on the Condensation of Electrolytic Gases by Porous Bodies, particularly by metals of the platinum group; Applications to the Gas Battery; Electric Accumulators under Pressure," was recently read before the Paris Academy of Sciences by MM. Cailletet and E. Collardeau. Platinum and palladium in the spongy condition, and ruthenium iridium, and gold in the finely divided state, form poles which condense electrolytic gases, and hence produce a gas battery, on subsequent connection of the poles, capable of giving up the stored energy during a short time. The storage capacity may be vastly increased by subjecting the poles to great pressure during charging. With spongy platinum and iridium a storage capacity may be attained greater than the practical capacity of lead accumulators per unit weight. Silver, tin, nickel, cobalt, and carbon do not form accumulators under these conditions with capacity increasing with the pressure.

A PATENT has been recently granted for an aluminium alloy consisting of copper, tungsten, aluminium, tin, and antimony, for either of the two latter manganese or nickel being at times substituted. The proportions preferred are somewhat as follows, expressed in percentages:—Copper, 0·375; tin, 0·105; antimony, 1·442; tungsten, 0·038; aluminium, 98·040. Tungstic acid and cryolite are melted together, equal proportions being employed. When the temperature reaches 1200 deg. C., aluminium is added so as to produce a 10 per cent. compound of aluminium and tungsten. A second alloy is made containing equal proportions of aluminium and copper. These two alloys are then melted together with pure aluminium in the proper proportions to form the alloy required as above; tin, antimony, or their substitutes being added in the necessary proportions, or they may be left out altogether when the copper and tungstic acid originally employed are chemically pure.

THE processes ordinarily used for covering metals with zinc, tin, and lead have not, up to the present, appeared to be applicable to aluminium. When a plate of aluminium, mechanically or chemically cleaned, is immersed in melted tin, zinc, or lead, these metals slide over the surface of the aluminium without alloying therewith. *Le Genie Civil* says that M. Oliven has found that, in order to fix the above-named metals, it is necessary to submit the surface of the aluminium to a vigorous brushing in the metallic bath. For this purpose a steel brush or any other analogous instrument may be used. Under these conditions the aluminium becomes covered with a regular layer of the molten metal. The want of success of the operation was due, it appears, not to the want of affinity of the aluminium for the metals in question, but to the immediate formation in contact with the air of a thin stratum of oxide of aluminium, which can be removed by friction.

MR. E. G. ACHESON, the inventor of carborundum, has recently produced a carbon for which he claims high fusing point combined with high luminosity. He takes pure carbon and carbide of silicon—carborundum—reduces both to fine powder and mixes them in the proportions of nine parts of the former to one of the latter, together with tar or any other good binding material. The mixture is then baked and moulded into the proper form for use. In order to get the full and complete effect of the illuminating qualities of the carbide of silicon more distinctly separated from that of the carbon, the ordinary cored carbon rod or point is used and the core is filled with the carbide of silicon, either alone or with a binding agent. For the filaments of incandescent lamps, the carbide of silicon in a very fine powder is mixed with and suspended in the oil used in the oil bath, for the treatment and building up of the carbons; and in the process of depositing the carbon from the oil bath on to the filament, the fine particles of carbide of silicon become fixed to the filament simultaneously with the deposit of carbon.

## MISCELLANEA.

MESSRS. JOSEPH EVANS AND SONS, Wolverhampton, announce that they have appointed Mr. R. H. Longbotham, of Bank Buildings, West Gate, Wakefield, as their Yorkshire agent.

THE Bethlehem Iron Co., Pennsylvania, has been awarded the contract for armour-plates for the new Russian warships Sebastopol and Petropavlovsk, the estimated value being four millions of dollars.

IF experiments at present being made on H.M.S. Indefatigable with armament altered so as to lighten her bow and stern ordnance are successful, all the cruisers of this class will undergo a similar change.

WE are informed that Mr. Frederick J. Marshall has retired from the firm of Ransome and Marshall, of Liverpool, and that the business will be carried on under the same style and title as heretofore, by the remaining partner, Mr. G. Frederick Ransome.

ANOTHER torpedo boat destroyer has been launched, this time by Mr. T. S. White, of Cowes. She is named the Conflict, and her length is 205ft. 6in., beam 20ft., depth 11ft. 6in. Mr. White's turnabout system for quick manœuvring and water-tube boilers are to be fitted.

MESSRS. COMYN CHING AND CO., Castle-street, Long Acre, have received orders to provide and fit the extensive steam and gas cooking apparatus for the kitchens in the new Post-office Buildings in St. Martin's-le-Grand, on the same principle as already supplied by them at the new Parcel Post Depôt, Mount Pleasant.

MESSRS. WILSON HARTNELL, of Volt Works, Leeds, and John A. Edmondson announce that they have amalgamated their separate businesses and entered into partnership as engineers and contractors, to trade under the style of Wilson Hartnell and Edmondson, but they also announce that they will continue to practice as consulting engineers.

NAVIGATION in frozen waters is, according to a recent Dutch patent, to be made possible by using saws mounted on an extension in front of the vessel, under the ice, which are driven by an engine on the vessel, the cut ice being collected in a chamber, from whence it is delivered under the unbroken ice at the sides of the passage thus formed. The inventor is J. J. Van Leeuwen, of Arnheim, and the builder J. A. Kruisbrink, Amsterdam.

A RECENT Admiralty circular directs that Temperley transporters shall be in charge of the engineer department. It was generally thought once that these would be included in the boatswain's stores, but we have always considered this unlikely, as we know well that wherever extra care and responsibility is involved, the unfortunate engineer officers always come in for it.

A MEETING of gentlemen has recently been held in Glasgow to consider the proposal of establishing an engineering laboratory for Glasgow University. Professor Barr explained the scheme, and in suggesting the appointment of a committee, advocated the bringing of the applied science department of the university into closer touch with the engineering practice of the district. Subscriptions have been raised to the amount of £3750.

MESSRS. GEORGE ELLIOT AND CO., of the Patent Wire Rope Works, Cardiff, announces that Mr. John I. Hopper, in whose name their works at Tyne Docks have been carried on for seventeen years, is retiring from the management on December 31st inst., and for the future the business will be conducted under the direct control of George Elliot and Co. from 16, Great George-street, London. Mr. A. G. Laker will be the manager at the works.

THE high-angle fire gun mountings of the Centurion and Barfleur are said to be giving satisfaction. The system finds favour on account of its independency of steam or hydraulic power. The Centurion's heavy guns, for instance, can be manipulated by hand with perfect ease, while in the Barfleur electro-motors are employed. The use of the latter in connection with these mountings will probably be extended. The 10in. breech-loaders of H.M.S. Renown will be fitted with these mountings.

WE have received from Mr. Henry Simon, milling engineer, of Manchester, a very handsome Calendar for 1895, with a "tear-off" for each day in the year, printed with large figures and letters, each day having a motto; which, judging by the Calendar of last year, will be an interesting feature. We have also received from Messrs. E. R. and F. Turner a handsomely prepared "tear-off" Calendar, the background of which carries Calendars for the whole year, and is illustrated with engravings of a few of Messrs. Turners' special milling machinery. The Magnolia Metal Company also send a handsome Calendar sheet.

RECENT Glasgow intelligence is to the effect that on the morning of the 15th inst. eighteen men were entombed in a subway a quarter of a mile from the outlet, in St. Enoch's-square. As smoke was issuing from the shaft the fire brigade was summoned. Six of the eighteen men were got out immediately, but the other twelve could not be reached. The workmen in the parallel iron tunnel communicated with them by knocking. The sides of the two iron tunnels were forced open after six hours' work, and the twelve men rescued safely. The air-pumps worked well, so that the men breathed freely. The fire arose from the ignition of the woodwork of the air lock. The tunnel passes under the river, and on to the south side of the Clyde.

A DESCRIPTION of a heavy fly-wheel composed of wire appears in the *American Manufacturer* as follows:—"Amongst the most recent and novel applications of wire, perhaps none has greater interest to the mechanical world than that presented by the new wire fly-wheel lately erected at the Mannesmann Tube Company's Works, Germany. Heavy fly-wheels driven at high velocities obviously present dangers of breaking asunder from the great centrifugal force developed. The wheel at the factory mentioned consists of a cast iron hub or boss, to which two steel plate discs or checks, about 20ft. in diameter, are bolted. The peripheral space between the discs is filled in with some 70 tons of No. 5 steel wire, completely wound round the hub, and the tensile resistance thus obtained is far superior to any casting. This huge fly-wheel is driven at a speed of 240 revolutions per minute or a peripheral velocity of about 2·8 miles per minute, which is nearly three times the average speed of any express train in the world. The length of wire upon such a constructed fly-wheel would be about 250 miles."

AFTER many experiments, extending over fifteen or twenty years, the Amu Darya, or Oxus, has at last been safely navigated by the Russians as far as Faizabad Kali, on the Afghan frontier. A vessel of the Amu Darya flotilla, the steamer Tsar, under the command of Admiral Baturin, reached a point close to the ruins of the Faizabad Fort, after passing the junction of the Kafirnahan river with the Amu Darya, on October 14th, sixteen days after leaving Karki. The steamer towed a barge behind it as far as the mouth of the river Surhani, where it halted to take in naphtha fuel. The navigable channel between Karki and Kilif was found to be incomparably wider than that between Karki and Charjui, and the depth of water was nowhere less than 4½ft. Beyond the mouth of the Surhani, however, there were only 4ft. of water, and the further progress of the steamer beyond Faizabad in the direction of the Pamir frontier was barred by the fact that the depth decreased to 3ft. The St. Petersburg correspondent of the *Times* says that no boat has ever before made its way so far up the great, but shallow, stream of the ancient Oxus.

# THIRD-CLASS TORPEDO BOAT FOR THE UNITED STATES NAVY

*For description see page 575*

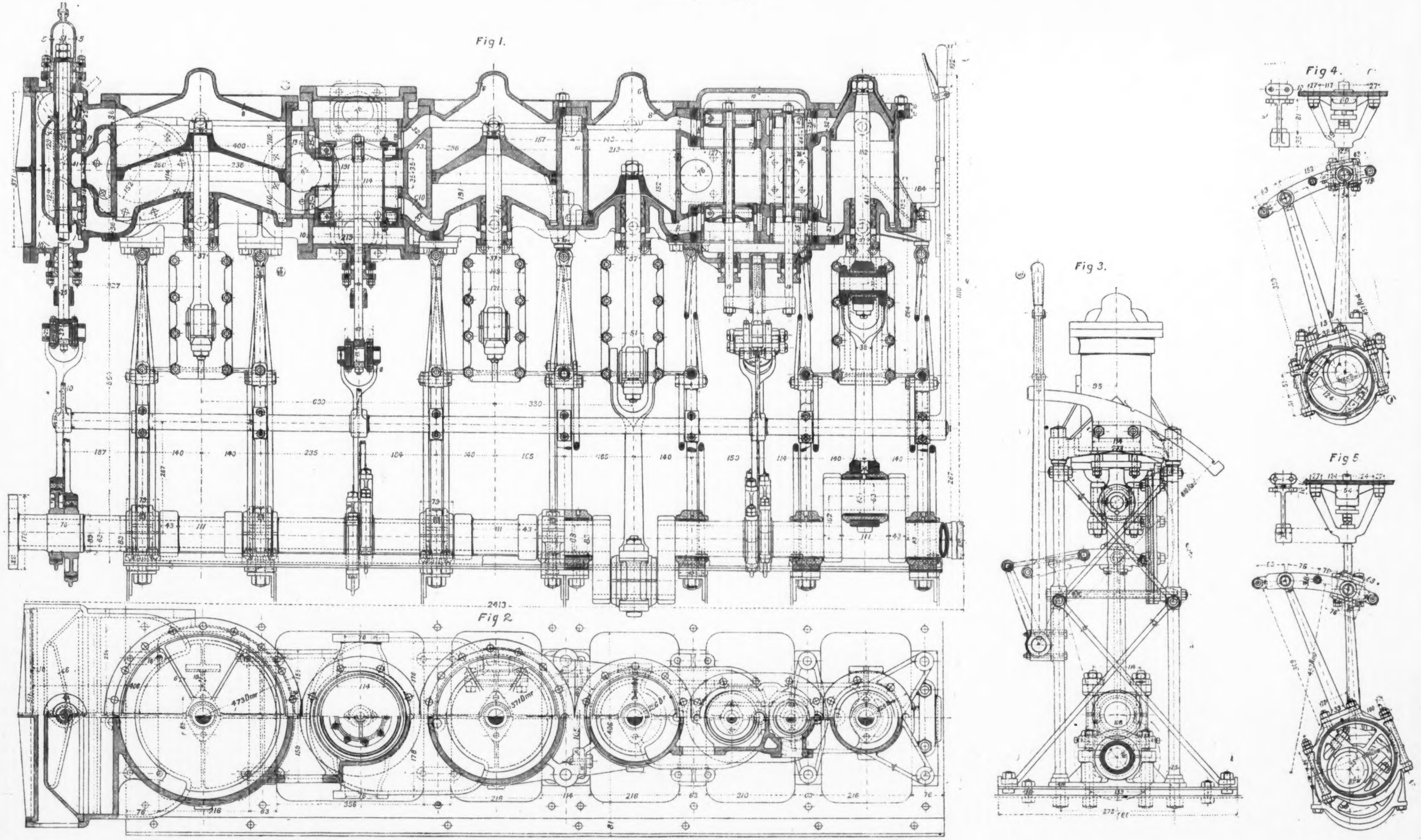


Fig 1.

Fig 2.

Fig 3.

Fig 4.

Fig 5.

## FOREIGN AGENTS FOR THE SALE OF THE ENGINEER

PARIS.—Boyveau and Chevillet, *Rue de la Banque.*
BERLIN.—Asher and Co., 5, *Unter den Linden.*
VIENNA.—Gerold and Co., *Booksellers.*
LEIPSIC.—A. Twietmeyer, *Bookseller.*
NEW YORK.—International News Company, 83 *and* 85, *Duane-street.*

## CONTENTS.

The Engineer, December 28th, 1894.

PAGE
The Railways of New South Wales. (Illustrated.) .. .. .. .. 563
Accidents on Public Electric Supply Mains .. .. .. .. .. 564
Abstracts of Consular and Diplomatic Reports .. .. .. .. 564
The Present State of Face-hardened Armour .. .. .. .. .. 565
Results of Trials of Experimental Harveyed Steel Plates in the United States .. .. .. .. .. .. .. .. .. .. 566
Quick Locomotive Building. (Illustrated.) .. .. .. .. .. .. 568
A Rapid Rock Drill. (Illustrated ) .. .. .. .. .. .. .. .. 568
Sheffield and South Yorkshire Navigation Co. .. .. .. .. 569
Letters to the Editor—Labour and Luxuries—American and English Woodworking Machinery—Metallic Cup Packing .. .. .. 570
Railway Matters—Notes and Memoranda—Miscellanea .. .. 571
Leading Articles—Railway Extension in Ceylon—Street Paving and Hygiene .. .. .. .. .. .. .. .. .. .. .. .. 573
Textile Machinery for India—The Truth about Belgian Competition 574
Literature .. .. .. .. .. .. .. .. .. .. .. .. .. .. .. 574
Books Received .. .. .. .. .. .. .. .. .. .. .. .. .. 575
Sir Joseph C. Lee .. .. .. .. .. .. .. .. .. .. .. .. 575
The Chelford Railway Accident .. .. .. .. .. .. .. .. 575
U.S. Third-class Torpedo Boat. (Illustrated.) .. .. .. .. .. 575
The Meigs Elevated Railway System. (Illustrated.) .. .. .. 576
Compensating Planimeter. (Illustrated.) .. .. .. .. .. .. 577
Letters to the Editor—Governing Electric Light Engines—Locomotives and Trains—Theory of the Steam Engine—Locomotive Cylinder Capacity .. .. .. .. .. .. .. .. .. .. .. .. 578
Letters from the Provinces—The Iron, Coal, and General Trades of Birmingham, Wolverhampton, and other Districts .. .. 578
Notes from Lancashire—The Sheffield District .. .. .. .. .. 579
The North of England—Notes from Scotland—Wales and Adjoining Counties—Notes from Germany .. .. .. .. .. .. .. .. 580
American Notes .. .. .. .. .. .. .. .. .. .. .. .. .. 581
Irrigation Settlements in Australia .. .. .. .. .. .. .. 581
The Patent Journal .. .. .. .. .. .. .. .. .. .. .. .. 581
Selected American Patents .. .. .. .. .. .. .. .. .. .. 582

## TO CORRESPONDENTS.

**Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."**

*** *All letters intended for insertion in* The Engineer, *or containing questions, should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must in all cases be accompanied by a large envelope legibly directed by the writer to himself, and bearing a penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

An Outsider.—*We fail to see that your long letter adds anything useful to the discussion. We have already explained why it is that modern locomotives weigh so much more than their predecessors. The cost of repairs and the loss by engines standing idle are thereby reduced. This consideration you and several other correspondents entirely ignore. Whatever you may think about locomotives and firemen, the fact remains that some days engines steam much worse than usual, from causes which no doubt exist but are not known.*

W. G. W. (Dunardagh).—*If the ship is at rest the torpedo will go straight if the controlling gear in the torpedo itself be properly balanced. Some torpedoes have a certain amount of deflection, which is known and can be allowed for. If the ship is going ahead there will be also a certain amount of deflection due to the direction and speed of the streams of water relative to the ship. Allowance has to be made for this by the officer who fires the torpedo, and as the result of a great number of experiments this can be allowed for with a fair amount of accuracy.*

**SUBSCRIPTIONS.**

The Engineer *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*
*Half-yearly (including double number)* .. .. £0 14s. 6d.
*Yearly (including two double numbers).* .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* The Engineer *is registered for transmission abroad.*

*A complete set of* The Engineer *can be had on application.*

*In consequence of the reduction of postage on newspapers to one uniform rate for any destination outside the United Kingdom, Foreign Subscriptions will, until further notice, be received at the rates given below. Foreign Subscribers paying in advance at these rates will receive* The Engineer *weekly and post free. Subscriptions sent by Post-office Order must be accompanied by letter of advice to the Publisher.*

Thin Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £0 18s. 0d.
*Yearly* .. .. .. .. .. .. .. .. .. £1 16s. 0d.
Thick Paper Copies—
*Half-yearly* .. .. .. .. .. .. .. .. £1 0s. 3d.
*Yearly* .. .. .. .. .. .. .. .. .. £2 0s. 6d.

Reading Cases.—*The Publisher has in stock reading cases which will hold thirteen copies of* The Engineer. *Price 2s. 6d. each.*

**ADVERTISEMENTS.**

*** *The charge for advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more, the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office Order in payment. Alternate Advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

*Prices for Displayed Advertisements in "ordinary" and "special" positions will be sent on application.*

**Advertisements cannot be inserted unless delivered before Six o'clock on Thursday evening; and in consequence of the necessity for going to press early with a portion of the edition, ALTERATIONS to standing advertisements should arrive not later than Three o'clock on Wednesday afternoon in each week.**

*Letters relating to Advertisements and the Publishing Department of the paper are to be addressed to the Publisher, Mr. Sydney White; all other letters to be addressed to the Editor of* The Engineer.

## MEETINGS NEXT WEEK.

Geologists' Association.—Friday, January 4th, at University College, Gower-street, W.C., at 8 p.m. Paper: "On the Analysis of Oölitic Structure," by George F. Harris, F.G.S., and will be illustrated by the oxyhydrogen lantern.

## DEATH.

On December 22nd, suddenly, of heart disease, Edward John Lloyd, M.I.C.E., of Hatton Hill, Warwickshire.

# THE ENGINEER.

*DECEMBER* 28, 1894.

### RAILWAY EXTENSION IN CEYLON.

They appear to manage their railway matters after a somewhat singular fashion in Ceylon. At the very time that the Government and railway companies in India are endeavouring to extend the system of feeders for their main lines, we hear that the latest extensions made in Ceylon have been opened with their stations almost unprovided with means of access to them. According to the *Ceylon Observer*, more than one of these stations have not even an ordinary road of approach. The consequence is—as might well have been foreseen—that the produce of many estates, the proprietors of which would gladly have availed themselves of railway facilities, is being sent by carts to the sea for shipment on the east coast of the island. Thence this is carried in small coasting steamers to Colombo on the west coast, whence it is dispatched by larger vessels to Europe. And yet these estates are situate within a few miles only of direct railway communication with the port last named; but this, owing to the circumstance indicated, remains unused, and a heavy loss must follow to the railway revenue.

Now railways in the mountainous districts of Ceylon are exceedingly costly things. Few regions of the world more severely tax the skill of the engineer for their construction or demand a greater outlay per mile. It would only seem to be natural, therefore, that roads to feed these lines should be constructed in advance of opening them for traffic. The Ceylon Government would appear to have a different conception of its duty, and to prefer "putting the cart before the horse." We have referred to the activity with which India is bestirring herself in the matter of feeding her main systems of railway. Evidence was very lately adduced that in the case of the Bombay and Baroda Railway Company, the exceptionally favourable condition of its finances is largely to be attributed to the energy with which its directors have exerted themselves in this direction. The Eastern Bengal Railway Company having determined upon following so profitable an example, has lately, we believe, added half a million sterling to its capital for this express purpose; while the Indian Government seems at length to be fully alive to the necessity for offering every encouragement to enterprise of a similar class. But it would seem to be the speciality of Ceylon to progress backwards—or at least to remain stationary — whenever India sees fit to go forward. There seems to be nothing more desired by the Colonial Government than to pose in every way as the antithesis to that of the adjacent continent. Any proposal put forward whereby the systems, administrative or fiscal, are likely to approach assimilation, is regarded with disfavour by the rulers of the colony. We have seen, for instance, extensive conversions of the former Indian railway gauge of 5ft. 6in. to a narrower type. It seems natural to the Ceylon Government, as the consequence of a desire for contrast, not only to adhere to that standard throughout its main systems—which was perhaps to be justified—but to contemplate running new lines of this abnormal gauge through wild and almost uninhabited districts to the further extremities of the island. With equal determination does it resent the proposal made to it to connect its territory by railway with that of India. The bare idea of becoming one, even to that extent, with its dreaded neighbour, appears seriously to affect the composure of its rulers.

One would have thought that the little colony would have rejoiced at all opportunity for closer intercourse with India. It is from thence that it obtains all the labour required for its great industry, while the larger proportion of its resident population is dependent upon imports of grain from the vast rice fields of India for its daily food. And yet, because India approves and supports the project of railway connection between the two countries, the administration in Ceylon does all it can to throw cold water upon it. The fact would cause us much surprise were we not aware of the idiosyncrasy to which we have alluded. This is of modern date, because there has recently been published evidence proving how thoroughly in accord were the Governors of Ceylon and Madras of a former period upon questions affecting the interest of the two provinces. It is to be feared that the latest extension made of the great hill railway of Ceylon must detract from rather than add to its profitableness. Should this result, we should perhaps hear more as to the unaccountable policy that has left stations without means of access, and compelled traffic to seek different outlets while the means for ready communication with the seaboard had been brought, relatively speaking, almost to the planters' doors. This unpleasant experience must, we should say, impose upon the Colonial Office the duty of asking how such things can be in a Crown Colony hitherto so progressive as Ceylon. It is not as if there was any narrowness of means to urge in excuse of so short-sighted a policy. While the railway constructed at so large a cost is being starved for the want of roads of approach to its stations, large sums are assigned for the restoration of ancient tanks, the justification for which has been extensively contested. With this last point, however, we have little to do. But we feel that the future of railway extension in what is perhaps the most important of our Crown Colonies must be seriously imperilled by a policy so extraordinary as that disclosed by the *Ceylon Observer*. Practically that policy has been to expend a very large sum on a railway, and while doing so to take every precaution that it shall have no chance of affording a remunerative return for the outlay made upon it. If we may accept this proceeding as typical of the influence now at work in Ceylon to retard her progress, we should say that the sooner some action in the direction of change is resolved upon by the Colonial Office the better it will be for the colony.

### STREET PAVING AND HYGIENE.

Asphalte for the public and wood for the horses fairly represent the general distinction we have drawn on previous occasions respecting the qualifications of these two descriptions of street paving. This line of demarcation which is becoming more apparent every day, assigns the former material to the pedestrian, and the latter to the vehicular traffic of the principal thoroughfares of the metropolis, and other cities of proportionate magnitude, importance, and population. Granite pitching is regarded as inadmissible for reasons with which we are not concerned in the present article, as a future method to be employed. A notable instance, nevertheless, of its use on a tolerably extensive scale, is afforded by the recent repaving of Blackfriars Bridge, and the torture to which the unfortunate horses are subjected in endeavouring to make good their footing on its slippery surface is deplorable, and a disgrace to the people of the most humane nation on the face of the globe. If we consider stone setts as out of the question, it is difficult to discover what other systems are left to us, after the sweeping denunciation of all macadamised roads by Sir Robert Rawlinson in his presidential address to the Institution of Civil Engineers. The president observed that the Thames Embankment was "a grand metropolitan improvement spoiled with broken stone. So many thousand tons of broken stone were carted on annually; so many thousand tons of mud, when it has done all the mischief possible, to be carted off. Macadam roads in London streets and squares should be abolished."

Those who have watched patiently and attentively, the operation of the re-metalling of any particular length of our riverain boulevard; will probably be inclined to agree with the remarks of Sir Robert, so far as that especial thoroughfare is concerned. But we doubt whether they will altogether endorse the wholesale condemnation of a method of street-making which, whatever may be its failings or deficiencies, possesses features of undoubted merit under certain conditions of traffic and maintenance. Our object at present is not, however, to inquire into or discuss, except indirectly, the relative merits from a purely traffic point of view of the numerous systems of street paving which have been experimented upon and laid down during the last thirty years or more in the main streets and roads of London. Timber, stone natural and artificial, iron cast and wrought, and almost every constructive material, have had a fair trial allowed them at different times, and yet how few have proved themselves to be endowed with the qualities indispensable for the purposes they were intended to fulfil. Our climate, it must be admitted, is terribly trying to every description of road and street paving which has to fulfil its duty in all weathers and under all circumstances. An essential requisite is that the surface should be easily cleaned. It should also be not reticent or absorbent of putrescible matter, either in the material itself or in the joints, presuming a system is employed entailing joints. These are points requiring and deserving close attention, for when we regard the large areas which are covered by paving, it is obvious that their sanitary or insanitary condition, or even tendency, becomes a serious question of public hygiene.

It is now some years since our own engineers, scientists, and sanitary authorities, as well as their professional *confrères* in France, Germany, and the United States, commenced a grave investigation respecting the probable dangerous results which might accrue to the health of the general community, by an indiscriminate employment of wood paving. Without entering into details which, no doubt, vary more or less in each particular case, the usual process of construction is familiar to most of us; but the effects, and the manner in which they are produced, are not so well known, and in a question of so much interest and importance a brief description will not be out of place. Upon a bed of Portland cement some 7in. or 8in. in depth are truly and accurately laid the wooden setts or blocks, which are either creosoted or dipped in boiling tar as a rule, but not always. At Charing Cross plain wood was used. Whether close-jointed or set with joints from ¼in. to ⅜in. in thickness, the whole surface is grouted with cement grouting. A blinding of sand is distributed as a top dressing, and the roadway thrown open to traffic. At first the action of the wheels of the heavier carts and vans is to consolidate the roadway by forcing the particles of gravel into the pores of the wood, thus forming a protection for it against the injurious effects of external attacks. In this preliminary stage of its existence the wood paving leaves little to be desired. It presents an excellent surface for running on, is comparatively noiseless; inodorous; easy for the feet of the horses, and has the great advantage of seldom cutting their knees should they have the misfortune to fall. It is, in fact, the *beau ideal* of a roadway for vehicular traffic; but we must not dilate upon its merits in this respect any further. As already stated, our business at present is with the physical causes which, sooner or later, bring about a change in this preliminary satisfactory state of the paving, and are — or at any rate may be — attended with injurious results to public sanitation. Assuming that the blocks have been dipped in creosote or tar or some preserving fluid, the coating applied will for a time preserve them from the rain and wet, but this preservation is of a very ephemeral character. It must be borne in mind that the wooden blocks are frequently dipped only in the protecting liquid, and not subjected to any actual preserving process as is the case with railway sleepers, although even with them the depth of penetration is sometimes comparatively trifling. In other respects there is no analogy between the two examples. Railway sleepers have exceptionally heavy crushing loads to withstand, but there is no absolute attrition or grinding action of horses' feet and wheels upon them, as occurs with road traffic.

The opponents of wood pavement hold that it is evidently not long before the ordinary wear and tear completely destroys the protecting crust formed on the surface of the wooden blocks, and now the mischief begins. There is now little or nothing to prevent the fibres and pores of the wood from becoming saturated with rain water and other far more noxious liquids, which enter with facility and rapidity, but are expelled tardily and with difficulty, if indeed, they are ever altogether got rid of. The preserving crust once removed, two physical changes become at the same time unpleasantly in evidence. One is the development in dry weather of a very fine description of dust, composed of minute disintegrated particles of wood, and any other impalpable portions of deleterious ingredients to hand. This highly dangerous, almost invisible product is disseminated in the air we breathe, and it is not difficult to predict its effect upon delicate and sometimes unsound pulmonary organs. Again, owing to the repetition of the same cause, the blocks become more absorbent, and eventually become completely saturated with every impurity and element of foul matter belonging to street traffic which is capable of being held in mechanical suspension, or imprisoned in a chemical solution. These liquids carry with them into the pores of the wood putrescible matters which subsequently escape in the form of poisonous gases and miasma, into the atmosphere, to its serious contamination and deterioration. If these noxious germs penetrated no further than the setts themselves, and restricted their dangerous action to one of a comparatively superficial character, the evil might not be—at least to any great extent—of a permanent nature. But they find their way through both close and open jointed paving, and gradually work down until they reach the solid substratum of concrete, where they establish for themselves a resting place, and for the community a fruitful source of incessant insalubrity. The degree to which this pestilential saturation might attain would be abundantly exemplified by taking up the setts of any of the public cab and carriage stands. While, therefore, the evil is always present, its effects may be accentuated or mitigated by the position and general features of the locality. In large spacious thoroughfares well exposed to both sun and wind, the sources of infection might be dispersed and swept away almost as quickly as they were formed. But in narrow streets, fenced in by houses of a height which do not permit much sunlight to enter, which constitute fully three quarters of London, the pestilential agents at work encounter little or nothing to interfere with their septic activity.

Some fifteen years ago, not to go further back, a terrible epidemic afflicted the city of New Orleans, and carried off in a couple of months over 10,000 of the inhabitants. One of the Officers of Public Health in the States, a man of position and experience, gave it as his deliberate opinion that the extraordinary intensity and virulence of the disease was due to the foul gases and pestilential emanations arising from and disseminated by the wood paving of the town. We are willing to admit that the lethal progress of almost any epidemic would probably be accelerated—or, in any case, not arrested or retarded—by the presence of the evil alleged; but, in the absence of corroborating evidence or further proofs, which are not at our command, we decline to return a verdict of guilty on all counts against wood paving. It may be observed, in confirmation of the conclusion we have arrived at, that a very large part of the city of New Orleans is situated below the flood level of the Mississippi, and therefore it presents rather a favourable mark for the attacks of epidemics; and it must not be forgotten that the health of our metropolis has steadily improved, notwithstanding the spread of wood paving. Indeed, it is easy to see that both macadam, and stone paving with more or less open joints, are both partially open to the same objection as wood.

In a hygienic point of view, asphalte paving is absolutely unassailable. Its very constitution is antiseptic, and it is no wonder that it is a powerful rival to the wooden system. No people have been more severe upon the insanitary nature of wood paving than the Germans. One and all condemn it. They assert that the dust of the blocks, mingled with a host of putrescible matters, is fatal to the respiratory organs, and a constant source of painful coughs and even of phthisis. The result of this national consensus is to be found in the statement that a couple of years ago it was estimated that the total area of the wood paving in Berlin did not exceed 18 acres, while that of compressed asphalte attained to 190 acres. Our own authorities are not by any means all at one regarding this question. It is barely six months since the proposition to re-pave Upper Thames-street with wood was rejected on the ground of the absorbent nature of the material. It was also stated before the Commission of Sewers that, of all the systems of paving, that of wood was the most injurious to the public health. After what has been remarked, it might not unreasonably be asked, are we to abandon, as the people of Berlin practically have done, the system of wood paving which, in respects other than we have regarded it in this article, is endowed with many advantages? Neglecting for the moment the question of durability under wear and tear, it would naturally occur on reflection that the evils complained of with regard to wood pavement are the inevitable accompaniments of employing a soft description of timber, which, always of a spongy and absorbent nature, becomes more so under the action of the deteriorating external agents already enumerated. Is the remedy to be found in the use of a hard close-grained timber such as is laid down in Australia? Partially, very probably yes; but altogether, we think not. There must be a certain amount of elasticity or resistance in all roadways and footways, which are after all only particular examples of solid flooring. If the material be of a degree of hardness so excessive as to merge into brittleness, then it defeats the very purpose it is intended to serve. It by no means follows that a heavy hard timber, for example, the tallow-wood, the red mahogany—both of which belong to the genus Eucalyptus—or the turpentine or blackbutt, all of which are stated to afford excellent results in their native country Australia, would be equally successful in England, or would to any appreciable extent mitigate the injurious effects produced by our softer woods. If we add to the terrible severity of our climate upon all outdoor works, the enormous number of the horses and vehicles plying in London; their large individual weights; the pounding, abrasion, and attrition which they must exercise upon the heads of the blocks, it is scarcely possible that the surface of the roadway should remain impervious for any length of time to the noxious action of liquid impurities. There is, we believe, one very remarkable fact in indirect connection with our subject—that is, that whereas wood pavement has been repeatedly taken up to make room for the laying of asphalte, there is no example on the *vice versâ* side in the city of London, exempting always some experimental lengths permitted to be tried many years ago.

◆◆◆

### TEXTILE MACHINERY FOR INDIA.

THE chief machinery imports entering India from England in connection with the cotton industry continue to be cotton machinery, engines and boilers, and shafting and gearing. The type of ginning machine in general use, it is pleasing to know, is the roller gin from England, though the saw gin from America is also employed there. A few years ago the roller gin was generally exported from Great Britain to India in a complete condition ready for working, but nearly all the ginning machines are now sent with bare shafts, and are covered with leather when they arrive out. We hear of a few cases in which only the frames of ginning machines have been ordered from British makers, with a well-known English firm's name cast upon them. The other parts, except the steel knives, have been made in Bombay and fitted to it. This has been done with the intention of selling the machine as an imported one at a somewhat lower price. The makers, however, found out what was going on, and declined to supply the framing only. A gradually increasing demand for ginning machinery is pretty certain to be experienced, and whether native manufacture will advance in that department or not, there are at any rate reasons for believing that as regards cotton presses, these will continue to be imported from England for many years to come. Almost entirely of English manufacture is the spinning and weaving machinery used in English mills, and it is likely to remain so for a long period. The Bombay firms seem at present content to be able to supply parts in cases of breakdown. We cannot agree with those who hold that the demonetisation of silver will increase the demand for machinery for India, China, Japan, Mexico, and other silver using countries. Statistics do not support this view so far. In fact, the increased silver cost of the plant tends to promote native manufacture. Somewhere about £80,000 a month is the normal value of the Indian imports of British textile machinery. Just now we are a little under the average. With reference to engines and boilers, there is no disguising the fact that some of the smaller kinds of engines are being increasingly made in Calcutta, Madras, Bombay, and other Indian towns, though England still retains the supremacy for motors of high power.

### THE TRUTH ABOUT BELGIAN COMPETITION.

A NEW light has been shed on the question of Belgian competition by the recently issued report of the Charleroi Ironmasters' Association. This body expresses surprise that the members of the British iron trade should take so serious a view of Belgian competition with English manufacturers, and they declare their desire to correct several false impressions which they say seem to have got abroad in England on the matter. Especially they feel hurt—and no wonder—at the suggestion that English trades' unionists should be sent across to raise Belgian wages to the English level, so as to stop competition. It is clear from their report that whatever may be the case as to their trade dealings with ourselves and with our foreign customers, they have as much as ever they can do to make a profit. In a word, they are not such formidable competitors as they have been made out to be—a truth which we have long since insisted upon in these pages. Low wages, they declare, are made up to their men by the very cheap continental food and clothing. The English opinion of rock-bottom Begian railway rates it seems is all a mistake—or next door to it. The 4f. 46c. per ton for Charleroi iron sent from Liège to Antwerp, which was the sheet anchor of those who wished to prove the great advantages enjoyed by our neighbours, has given way, since it now appears that the great bulk of the iron and steel manufactured at Liège is sent to Antwerp by rail at a very much higher rate of freight. The average cost of coal at the pit mouth in 1893 was 7s. 6d. a ton, or higher than in either England or Germany, and the profit was only 3d. per ton. In fact, the historic treatise upon "English as she is spoke" does not, we are fain to believe, convey a more faulty impression of the British tongue than do the reports lately brought home by the Iron and Steel Institute members of the state of the Belgian iron and steel trades.

## LITERATURE.

*A Text-Book of Ore and Stone Mining.* By C. LE NEVE FOSTER, D.Sc., F.R.S. 8vo, pp. 744. With illustrations. London: C. Griffin and Co. 1894.

THIS volume, whose object is to assist students in acquiring a knowledge of the art of mining, is a notable addition to the literature of a subject which is but scantily represented in this country. The author, combining his long experience of our home mines as a principal inspector of mines under the Metalliferous Mines Act, with that obtained in his numerous visits to those of foreign countries, has been able to bring together a large series of examples of the methods of stone and ore mining in use at the present time in different parts of the world. The subject of coal mining has been excluded, as that subject has been treated by Mr. H. W. Hughes in a companion volume published at an earlier date. The order of arrangement adopted is similar to that generally used in systematic treatises, the mode of occurrence of minerals taking the first place, and being followed in due order by descriptions of the methods of prospecting, boring, sinking, and driving, and so on to the thirteenth chapter, which is devoted to the consideration of the various processes employed on the dressing floor for making merchantable the minerals got in the mine. These are supplemented by chapters on economic and social matters—such as the systems of payment for mining labour, accidents in mines, the clothing and housing of miners, and a general view of the legislation affecting mines and quarries in the United Kingdom. This order—which, we believe, is that followed by the author in his lectures at South Kensington—is certainly well suited for promoting the methodical arrangement of ideas among students; and the value of the book as a guide to reading is much enhanced by the full and careful manner in which the references to the authorities quoted are given.

In the first and, with one exception, the most important section of the volume—that on the method of occurrence of minerals, which is only exceeded in extent by the chapter on dressing—the different types of mineral deposits are described and illustrated by examples from some of the most prominent of the great mines of the world—such as Hecla and Calumet, Mount Morgan, Rio Tinto, and the Kimberley Diamond Mines.

In defining the terms descriptive of mineral deposits, the author expresses himself very decidedly against the use of the term "gangue" for valueless constituents in a mineral lode; but he seems to have missed the most expressive of all the equivalents—namely, "waste." "Veinstone" and "lodestuff" seem to be more appropriate to the whole of the vein-filling—*i.e*, to ore and waste as they occur together, rather than to the latter alone. In the sections on breaking and securing ground, the newer developments in boring machinery, the use of metal props and arching in levels, and the methods of sinking through difficult ground by boring and tubbing, as well as by the use of the Poetsch and Gobert systems of freezing watery strata, receive notice in regular order, the first of these subjects especially being very fully treated. In these, however, as in the chapters on ventilation and lighting, and, indeed, in many other places, the dividing line between ore and stone, and coal-mining, has been so frequently overstepped, that we are forced to the conclusion that it would have been better had the conventional division been more completely disregarded, and the methods of working stratified mines been more thoroughly treated. As it is, some of the examples seem to be decidedly out of place, as, for instance, the large pit tram—Figs. 412-418—7ft. long, with spring drawhooks and other refinements, intended to carry two tons of coal, and weighing 52 cwt. loaded. Such a vehicle could only be used under very special circumstances even in a colliery, and in any average lead or tin mine it would be a very strange monster indeed. On the other hand, several characteristic specialities of metalliferous mines receive but scanty treatment, and one of them, the use of water power in direct-acting pumping engines, is entirely omitted.

The dressing and preparation of minerals are very fully treated in Chapter XIII., exactly one hundred pages being devoted to the consideration of the different operations involved in this very comprehensive term. It includes notices of crushing, grinding, sizing, and separating machines of all kinds, from the well-abused old stamps to the more refined centrifugal and other rotating mills, which are, mechanically, more efficient, but, somehow or other, seem to display that efficiency best on bones, chalk, phosphates, and similar substances, leaving the more severe business of quartz and tin-stuff crushing to the rougher contrivance of the past. Magnetic separators, as developed in Sweden, America, and elsewhere, receive a considerable amount of attention, but we should have liked in connection with this part of the subject to have had some more information as to the actual value of such contrivances. If we remember rightly, the general impression upon the visitors from this country, who saw these machines at work in America in 1890, was that they might be useful in gleaning over the waste of old workings, but that it would be scarcely worth while to be at the charge of mining fresh stuff to keep them at work. The amount of power also seemed in most cases to be rather large in regard to the work done.

The work is profusely illustrated. The frontispiece, representing a stope at the 274 fathom level in Carn Brea, is reproduced from one of Mr. Burrows' photographs taken underground in Cornwall, while the figures in the text are drawn from a great variety of sources, and, therefore, of variable degrees of excellence; most of those illustrating mining works are good, whereas those of machinery are often much the reverse. Figs. 544 to 550, illustrating a pumping plant in the Forest of Dean, are especially bad, and altogether unworthy of the character of the book. We suppose, however, that these may fairly be considered to be the shortcomings of the publisher rather than the author.

---

*Select Methods in Chemical Analysis.* By WILLIAM CROOKES, F.R.S. Third edition, rewritten and enlarged. Large 8vo, pp. 718, with 67 woodcuts. London: Longmans, Green, and Co. 1894.

A NEW edition of this well-known volume having been called for, the work has been gone over, and many additions recording the changes and improvements in inorganic analysis made during the past eight years have been made; and to find room for these without unduly increasing the size of the book, the descriptions of some of the processes in the earlier edition have been removed. The principle governing these removals has been to omit those processes whose value is too well known and have been so generally adopted that they can no longer be considered as novel; while others, again, have not proved so trustworthy as older ones, or have been superseded by more accurate methods of newer date. Assaying and volumetric processes have also to a great extent been omitted, partly because they do not come within the scope of the book, but more particularly because they are well provided with a special literature of their own. The space so gained has been to a great extent utilised for discussing methods of electrolytic separation as given in the standard work by Dr. Classen, of Aachen, on "Quantitative Chemical Analysis by Electrolysis," their application to individual separations being given under the heads of the different metals; while the apparatus required and general methods of manipulation form part of a special chapter, which, together with the illustrations, is reproduced from Dr. Classen's original work—but, unfortunately, not in the tongue of the original, a sort of "English as she is wrote" being preferred, as will be seen from the following extract:—"As it will appear below, for the performance of a quantitative determination or separation, a *quite definite* strength of current is not required; it always fluctuates within certain limits, so that in the majority of methods of determination several c.c. of detonating gas more or less per minute is not of importance. It is only thus possible for electrolytic analysis to be effected without further difficulties." The remainder of the extract, about nine pages, contains similar Anglo-Teutonic obscurities; after which a note by an electrician, Dr. Sloane, is given, criticising the description as insufficient, on account of the voltage of the current being neglected. This seems to be rather an odd way of rewarding Dr. Classen for his kindness in permitting the reproduction of his matter and illustrations in the present volume. A more practical method would have been to have presented it in a readable English form.

The chapter on cerium and the allied rare earthy metals has been considerably enlarged, as might be expected, this group of metals being the subject of some of the author's most interesting and successful lines of research, and it is in this part, and this only, that references to original publications and dates are systematically given, a circumstance which makes their absence elsewhere the more noticeable. Such omissions are much to be regretted, as they may in places make the book misleading to beginners, and irritating to those of larger knowledge. For instance, Dr. Lawrence Smith's excellent process for the determination of alkalies in silicates is described at length by reproducing the original paper, "as it appears to be almost unknown in England." This statement was not quite a proper one to make at the period of the first edition of this work, as the process was perfectly well known and used in London within twelve months of the time of the original publication in America, and the propriety is certainly not increased when it is produced twenty-three years later in a book said to be re-written. On page 37 a "recent note" by Professor Lawrence Smith is mentioned, that distinguished chemist having been dead for more than ten years, and in like manner, on page 252, Claudet's process for the extraction of silver from burnt pyrites is noticed as having proved a success after "nearly six months' experience at Widnes," a statement no doubt of historic interest, considering that the process has added millions of ounces of silver to the world's stock of that discredited metal, and that the patent covering it expired in 1889, but which seems out of place in a book whose main purpose is supposed to be the recording of new analytical processes and improvements in older ones. In these latter respects we are surprised at not finding a notice of Roth's process for separating iron without precipitation in the analysis of ferro-manganese and similar special iron alloys by the use of hydrochloric acid and ether, which seems to be one of the most notable advances in technical methods of analyses made of late years. The Eschka process for the assay of mercury ores has also been improved since the method described on page 257 was originally brought out.

We suppose that the index maker must be taken to be responsible for the mystification practised on the reader by the startling headline on page 433, "Employment of Cadmium in Cupellation," as it also appears in the index, but which turns out to be a description of the use of that metal as a substitute for silver in the parting assay of gold bullion.

Taken as a whole, the book is disappointing. The author's own contributions are of standard value, and must be mentioned with due respect and regard, but their effect is certainly diminished by the mass of ancient padding incrusting them.

## *BOOKS RECEIVED.*

*The Indian Engineer's Diary and Reference Book for* 1895. Calcutta and London: The *Indian Engineering* Offices. This is a quarto diary, four and three days on a page, interleaved with blotting paper. The reference part comprises an unusually large quantity of useful matter selected with a view to the requirements of engineers in or doing business with India. It also includes a valuable article on India as a field for industrial enterprise, which contains a great mass of statistical and other matter on industries and resources of India not easily otherwise obtainable.

*Notes on Concrete and Works in Concrete.* By John Newman, Assoc. M. Inst. C.E. Second edition. London: E. and F. N. Spon. 1894. The first edition of this book was published in 1887, and has proved very useful to those for whom it is intended, namely, those engaged on public works, but it has proved equally useful to any engineer called upon occasionally to use concrete for different purposes and under different conditions. During the past six or seven years great additions have been made to the literature of concrete and works in concrete, chiefly in papers read before engineering societies. These additions appear to have been carefully followed, and a digest judiciously incorporated in the new edition has increased its volume by a hundred pages, enabling it to retain its position of one of the most useful books on the subject. It would be improved, however, if it had a better index.

*Kitchen Boiler Explosions: Why They Occur and How to Prevent Their Occurrence.* A short treatise giving the results of practical experiments with red-hot boilers. By R. D. Munro, M.I.M.E. Price 3s. London: Charles Griffin and Co. 1895. In this brochure the author describes a series of experiments made with a form of kitchen boiler with water admitted under various conditions, imitating those which have been assumed to occur when kitchen boilers have exploded, the assumption being that empty boilers have been heated, the ice obstructions in the connected supply pipes melting and the water supply thus suddenly established. The whole of the author's experiments show that kitchen boilers explode as a result of the commonest cause, namely, too much pressure, and that the best preventer is a safety valve. Mr. Munro's experiments were carefully planned and made, and the results are confirmed by his experience as the chief engineer to the Scottish Boiler Insurance Company.

*Refuse Destructors, with Results up to the Present Time.* Second revised edition. By Charles Jones, M. Inst. C.E. With a paper on *The Utilisation of Town Refuse for Power Production.* By Thos. Tomlinson, A.M.I.C.E. 5s. London: Biggs and Co. 1894. Mr. Jones has so many years made this subject almost his own that his book must participate in the very general attention that is now being paid to it by municipal engineers by those who are looking to get at least the day load of an electric light station supplied with steam from the heat of town refuse destruction. Much greater hopes in this direction are sometimes indulged in than are warrantable, as shown by Mr. Jones and by the paper by Mr. T. W. Baker. which we recently published in our columns. Great advances are however, being made in the construction of destructor furnaces and in the conservation of the heat obtained, and Mr. Jones' book will be found valuable on the structural and particularly so on the statistical sides of the subject of refuse and its destruction.

## SIR JOSEPH C. LEE.

We regret to have to record the death of Sir Joseph Cocksey Lee, some time deputy chairman of the board of directors of the Ship Canal. For months his health has been failing, and we believe that he was last seen in Manchester on the occasion of her Majesty's visit to the canal in May. Since then he has travelled about visiting various health resorts, and at the time of his death on Monday, 17th inst., was staying at St. Leonards-on-Sea. Born in January, 1832, and educated at the Manchester Grammar School, Mr. Lee entered upon his business career in the house of which he subsequently became a partner. As a merchant and shipper he was always looked upon as an expert in all questions affecting tariffs, treaties of commerce, navigation, &c., and was frequently consulted by the Foreign-office. In 1881-82 Mr. Lee was appointed British delegate to the commission sitting at Paris relating to the Anglo-French treaty of commerce. It was in recognition of his eminent services and the unqualified success of his mission that he received the honour of knighthood in 1882.

Sir Joseph has all his life taken the keenest interest in Manchester enterprise, and as one of the originators and subsequently as chairman, without doubt contributed by his energy and business capacity to render the Royal Jubilee Exhibition the brilliant success it was. But it is in connection with the Ship Canal that Sir Joseph's name will ever be most remembered by Manchester. In 1884, as the representative of the Manchester Chamber of Commerce, he gave evidence in support of the Bill before the parliamentary committees, and joined the board of directors in the following year. In 1886 he was elected deputy-chairman of the company, a position which he continued to hold till June, 1893. Shortly after taking office, that unfortunate difference of opinion arose which subsequently led to the resignation of Mr. Daniel Adamson, the pioneer of the canal. As a matter of fact the dispute was almost a personal one between Sir Joseph and Mr. Adamson, and so keenly did the former feel at this crisis, that he actually tendered his resignation. Subsequently Mr. Adamson resigned, and Sir Joseph's policy was accepted by the board of directors.

It is now clear that whereas the obtaining of the Bill and the parliamentary fight owe much of their success to the dogged perseverance and tenacity of Mr. Adamson, the policy proposed by him for raising the capital must have resulted in failure. In fact it is doubtful whether any other man than Sir Joseph could have adjusted matters with the large financial houses of London at that time so satisfactorily and successfully. These long and difficult negotiations, and the great strain and anxiety following on the letting of the contracts were a most severe tax on Sir Joseph, and without doubt his death was hastened by his devotion to the duties of his office. Of the original directors of the company, we believe that only two now survive; the others, together with the first contractor, Mr. T. A. Walker, and the company's enthusiastic solicitor, Mr. W. J. Saxon, having fallen victims one by one to the cause of the great shipway. Sir Joseph Lee, the financial genius of the scheme, will ever be remembered for his successful efforts on behalf of the canal.

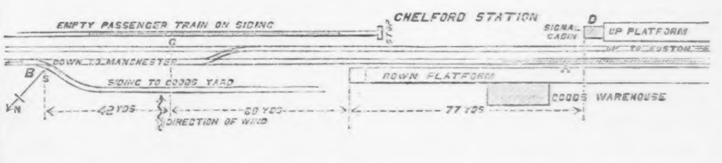
## THE CHELFORD RAILWAY ACCIDENT.

The frightful accident which occurred on Saturday evening last to the Manchester and London express is a most extraordinary affair in many ways. As most of our readers will have learned from the daily press, the 4.15 p.m. North-Western up express from Manchester to Birmingham and Euston was wrecked at Chelford, a country roadside station, 16½ miles south of Manchester, and about four miles north of Crewe.

The train was a heavy one, and consisted of two engines, No. 418 "Zygia" leading, and No. 520 "Express," one of Mr. Webb's patent compound type, behind were sixteen coaches made up in two portions, the forward half comprising certain Great Western stock being for Birmingham, and the rear portion for Euston. After leaving Stockport the road is almost level and very straight, so that a high speed was soon obtained, and reports vary between forty and fifty miles an hour as the estimated rate at the time of the accident.

The time allowed for this run to Crewe is only thirty-five minutes for a total distance of twenty-five miles, and this includes start and stop.

It must also be borne in mind that the great gale of Friday night was still raging, and, as a matter of fact, was blowing almost broadside on to the track at this point. The signals indicated a clear road, and it was already more than dusk when Chelford section was entered. Here shunting operations were in progress, and the "down" main line in the station was occupied by the rear and main portion of the "down" goods. Our representative has supplied us with a sketch plan of the station, and has to thank a member of the London and North-Western Manchester staff, for his courteous detailed account of the actual occurrence, as it appeared to the company's servants on duty at the time. It seems that the goods train was left standing at A, and that the engine and one or two leading trucks had been backed down the siding from the trailing points B to pick up a wagon in the yard. This empty truck—one of the company's ordinary 4½-ton wagons—with low sides had been shunted down to the main train at A, and the engine was again reversed and slowly steaming a second time into the same siding to set down, when the up express dashed past.



What actually took place is not quite clear, and pending the holding of the inquest and the Board of trade inquiry, it is not for us to theorise as to the cause of the catastrophe which followed. The official statement is, that this low-sided empty truck was not immediately coupled to its train, but was blown back by the force of the gale towards B, and that it collided with the trucks entering the siding, and being derailed, fouled the up main at the very moment that the passenger train came opposite the point B. That something of this kind did happen is probable from the injury sustained by the leading engine. The offside is completely battered, and the tender also has suffered.

It would seem as if the truck must have been thrown for a moment right across the express, for the footboards of an empty coach standing on the siding at C were smashed, while the coaches and engine nearer to the station were unhurt.

Apparently, however, the wagon must have been thrown back again from the six-foot by the standing wagons at A; for the front of the signal cabin at D has been carried away. The shock of this impact must have again thrown the first wagon towards the down metals, and possibly it was this, crushing in between the express up and the stationary trucks of the down goods, which caused the great damage to the central carriages of the train. Singularly enough the engines were not derailed immediately, but ran into the station before the pilot left the track. The train stopped in less than its own length, and the rear portion was practically unhurt. A wagon struck and carried away two of the iron pillars carrying the roof over the down platform; yet the station master and one or two passengers who happened to be standing on that side escaped injury.

No doubt the Board of Trade inquiry, opened on the 26th under Major Marindin, will clear up this and several other points. At the inquiry the station master said in reply to Major Marindin, after giving particulars of the shunting operations, "As soon as he saw the empty wagon, which was a high-sided North-Western one, come to a stand, he gave the brakesman a signal to go ahead. The driver with sixteen wagons drew ahead. Witness walked down to the points and gave the signalman a signal to pull over the points for the siding, so that the engine might knock more wagons back into the siding. He gave the brakesman a signal that the points were set, and he then called the driver back. The nearest wagons to witness were about seven or eight yards away. The brakesman uncoupled about six of the wagons from the engine. When the brakesman had called the driver back witness walked south along the six-foot to see that the wagons which had been detached were safe in the siding. As he was going back he observed the empty wagon which had previously been knocked down the main line running, on the move towards him. When he first saw it it was a yard or two short of fouling the crossings. He ran towards it with a view of stopping it, but found that he had not sufficient time to get to it before it fouled the crossing. He immediately turned round and waved a red light violently towards the engine of the up express, which was then approaching. He had heard it coming, and saw it as he waved the light. When he first waved the light he could see the tender of the up express about 80 or 100 yards away. He ran towards the express, and still kept waving his light till after the driver had passed, but before that six wagons that were being knocked back had struck the empty wagon and lifted the end up. He saw it plainly. The end of the empty wagon was lifted up, and the wagon was pushed round and across into the six-foot. It was thus foul of the up line, but not across it.

The result of the collision was that fourteen passengers were killed on the spot and a large number wounded.

## UNITED STATES THIRD CLASS TORPEDO BOAT.

We commence this week the publication of a series of engravings illustrating a third-class torpedo boat for the United States navy. So much has been said in this country about the theft of designs that these engravings will no doubt be regarded with considerable interest. We believe, however, that they have nothing in common with the abstracted plans. The torpedo boat in question has been designed as part of the equipment of the United States battleship Maine. We shall give a detailed description in future impressions.

Liverpool Engineering Society. — On Wednesday evening, December 19th, the President, Professor H. S. Hele-Shaw, M. Inst. C.E., presided over a numerously attended meeting of this Society at the Royal Institution, Colquitt-street, when Professor Oliver J. Lodge, D.Sc., F.R.S., read a paper entitled "The Second Law of Thermodynamics." The paper was extremely interesting, and was listened to with great attention, as well as the remarks of Professor Fitz-Gerald in the discussion which ensued.

The Yorkshire College Engineering Society.—At a recent meeting of the above Society, at which Mr. J. H. Wicksteed presided, a paper was read by Mr. Edward E. Matheson, Stud. Inst. C.E., upon "Gold Mining on the Witwatersrand in the Transvaal." The lecturer, who has recently spent some time amongst the various mines in South Africa, gave a graphic account of Johannesburg, describing how in six years it had become one of, if not the, mining centres of the world. It was described as 1000 miles from Cape Town and 5700ft. above the sea, and possessing a population of about 45,000 whites and blacks. This town in so short a time has become possessed of fine hotels, an installation of electric light and telephones, a stock exchange, a public press issuing its evening papers, and many other conveniences of an English town. The Rand was only proved to be a gold-bearing district in 1884, although its existence there had been known some years before. The geology of the Transvaal was described, showing how the gold reefs were formed. The "Blanket" reef, from which the gold was obtained, was about fifty miles long, striking from east to west, and dipping at an angle of 60 deg. from north to south, Johannesburg being a little north of its centre. The formation of this reef was quite different from that of any other in which gold was known to occur. When mining operations were first commenced it was not thought that the gold reef would hold out to any depth, but their doubt was dispelled by the "Great Bore Hole" which proved the existence of reefs at a depth of 2400ft. One of the most fascinating and wonderful features of the "Blanket" reef formation was the extraordinary regularity of the amount of gold found in it, there being an average of ½ oz. of gold per ton of material mined in all parts of the district. Some of the deep level mines were sunk to 1000ft. The mines numbered about sixty, each being the centre of a small town, all the hard work was done by the blacks or "boys," who received about 16s. besides food and lodging for the week. The skilled white workers earned from £5 to £7 per week. The mines had been developed in a marvellous manner owing to the discovery of large quantities of coal close by the mines. Mr. Matheson then described the construction of the shafts, the mining of the reef, and the various processes connected with the extraction of the precious metal. At present, he said, only 85 to 90 per cent. of the total gold in the reef was secured, the remainder being entirely lost.

## THE MEIGS ELEVATED RAILWAY SYSTEM.

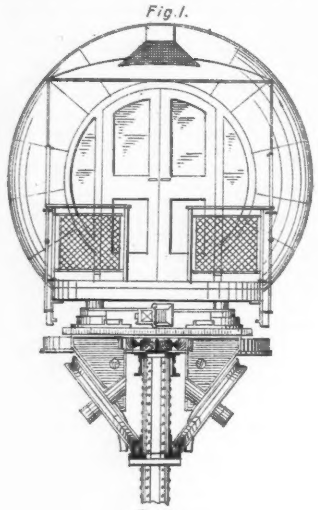
(*By our American Correspondent.*)

THE type of elevated railways invented and patented some years ago by Captain J. V. Meigs, of Boston, Mass., U.S.A., and which has come before the notice of the public from time to time, seems to be at last in a fair way of being put into actual execution, as it has been adopted for the new rapid transit system of Boston by a Bill passed during the summer of this year.

Since the time when the need of rapid transit for cities became apparent, inventors have turned their attention to elevated railways, and this has been more especially the case since the success of the first railways of this kind in New York. These inventions, however, have not, as a rule, met with much success; and the elevated railways as now constructed in New York, Brooklyn, Chicago, and other cities, are generally on the broad principle of a railway, with the ordinary form and construction of track or permanent way elevated on a continuous iron viaduct, with different kinds of supports. Such railways, although they are operated successfully and are a great convenience—in fact, New Yorkers especially would be lost without them—are yet open to a number of objections; one of the most serious of which is the annoyance to comfort and injury to property by the obstruction which the railway offers to light and air. The tracks, with closely spaced timbers, heavy guard timbers, and plank walks for the workmen, overshadow the streets and darken the houses and stores. This is particularly the case in narrow streets, and at places where stations, yards or additional tracks add to the obstruction offered by the main tracks.

Capt. Meigs, in designing his type of railway—which by the way is claimed to be adaptable for ordinary as well as city railways—took the above and other objections into account and endeavoured to avoid them. Having perfected his plans and protected his inventions by patents, he commenced negotiations for the right to construct a line to connect the adjacent cities of Boston and Cambridge, but met with opposition from the property owners and portagers—who wanted the railway but not on their own streets—and had the uphill work of introducing something novel and without precedent. Similar opposition was encountered in the Legislature, and it was only in 1884, after five years' fighting and reasoning, that the inventor secured the passage of an Act authorising the incorporation of the Meigs Elevated Railway Co. Having got his charter the inventor tried to start his line, but property-owners refused to give their consent for a road in front of their property, the aldermen declined to grant a location, and quasi-scientific people writing in the papers prejudiced popular opinion against the feasibility of the system. Capt. Meigs then decided to prove the practicability of his system, and secured a site in Cambridge for an experimental line about a quarter of a mile long, with sharp curves, heavy grades, and sudden changes of grades and curves. Different styles of construction for structure were also tried. A factory building adjacent was required, machinery put in, and a complete and full-sized locomotive, tender, and car built, complete in every detail. The first train was run in May, 1885. Some alterations were made in the engine later, and in 1886 the Board of Railroad Commissioners was requested to appoint an engineer—as required by the charter—to investigate, test, and report upon the system. The result was that after a prolonged examination and severe tests of the strength of the structure and the safety of operation of the trains, Gen. Stark, the engineer, made a very favourable report.

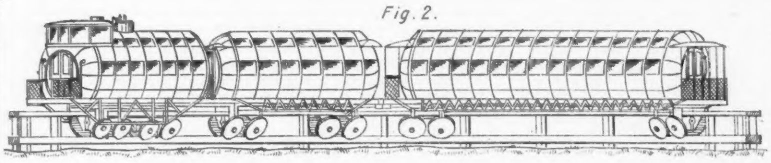
Fig. 1.



Still the city could not come to a decision as to the much-needed rapid transit system, and numerous projects for elevated and underground railways have been submitted from time to time. In July, 1894, however, the State Legislature passed a Bill incorporating the Boston Elevated Railway Company, which Bill has been approved by public vote of the city. The law of 1884 provided that the railways should not be built after the manner of the New York elevated railways, but according to the Meigs inventions. The new Bill does not so definitely specify the Meigs system, but prohibits structures similar to those of the New York roads. The Bill makes the company subject to all laws respecting railway corporations, provides for payment for land damages, and requires some return to the public for the franchise. In regard to the former Bill, it may be noted that the Railway Act provides only for gauges of 4ft. 8½in. and 3ft.; and the Bill had to make the Meigs Company exempt from that clause, as otherwise the railway commissioners could not grant a location, the widest part of the Meigs' track being only 22in. Charles A. Whittier is president of the company; Joe V. Meigs, chief engineer; and Herman Haupt, consulting engineer.

The structure consists of a single row of posts or columns—Fig. 1—carrying a single line of girders. For country lines wood may be used; but for city lines of course only steel or iron are used. The columns are 18in. by 12⅞in. in section, built up of two channel irons and two plates. The interior is filled with concrete, the top of which is covered by a plate, upon which rests the friction bearing forming the support for the end of the top chord of the girder; the weight being thus carried by the concrete mass. The longer dimension of the column section is parallel with the line of way. The columns will be normally 24ft. 4in. long, set 6ft. in the ground on a foundation of concrete or piling, and giving 14ft. clear headway under the girders. The columns will be 13½ft. to 45½ft. apart, centre to centre. The girders will be 12ft. to 44ft. long, according to location; they will be of the Warren or lattice girder type, 46in. deep, the single panels of Warren girders being 4ft. long. The top and bottom chords, or booms, of the girder are each composed of a vertical plate and two angle irons. On the top chord are two angle irons placed to receive the longitudinal timber of the top rail, and the angle irons of the lower chord carry the longitudinal timbers for the lower rails, the trucks, or "bogies," straddling the girder.

Fig. 2.



In an ordinary elevated railway the track is about 8ft. wide at least; that is over the sleepers, and not including the usual extra width of the footway for trackmen. There is therefore this continuous width—for the sleepers are very close together—of obstruction to light and air. Besides this, the track is carried by two lattice or plate-deck girders 4ft. to 5ft. deep, and about 5ft. apart. With two tracks laid side by side, and with the further obstruction of cross-girders over the columns, and of sleepers at crossover roads, &c., some idea of the general effect upon a narrow street may be imagined. In the line at Hoboken, N.J., an attempt has been made to reduce this obstruction by laying each rail upon blocks of wood resting upon brackets riveted between two deep channel irons, the sleepers being thus eliminated, and the channels forming inside and outside guards to each rail.

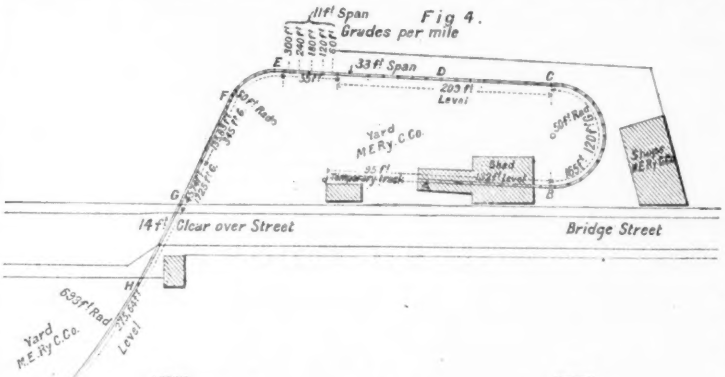
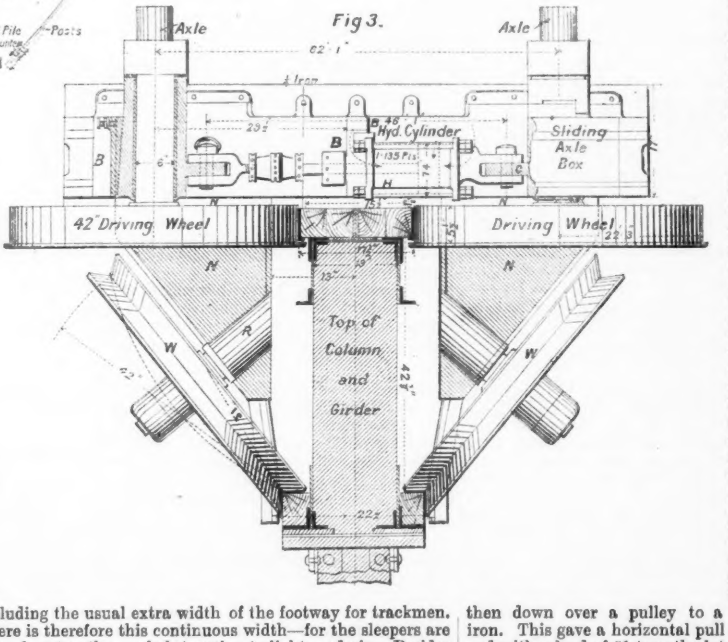


Fig 3.



In the Meigs system, however, there is but one line of girders, Fig. 2, to each track, the depth being about 4ft. The maximum width for each track is 17½in. over the rails on the top chord, and 22½in. over these on the lower chord. These lower rails are wooden longitudinals, with the top outer corner faced with angle irons fitting the V shaped rims or treads of the car wheels. The longitudinals may be bevelled and carry flange rails for wheels with grooved treads. The upper rails are either wooden longitudinals faced with iron for the horizontal balance and driving wheels, or may be flange rails laid on their sides. In this way the cars have a depth of 48in. to resist derailment, instead of about 1in. of a wheel flange, as in the ordinary system. The switching or shunting will be done by a pivoted girder. The inspection may, perhaps, be somewhat difficult, but maintenance repairs can be effected from a wagon with a platform adjustable at any desired height, such as is used by electric railway companies for repairs to the overhead wires.

A feature of the Meigs system, which is equally as important as the single-girder track, is the construction of the car trucks, "bogies," Figs. 3 and 7, which straddle the girder. Each truck has four loose carrying-wheels with grooved treads, running on the lower chord of the girder, each wheel being carried on a short independent axle and being inclined outward from the rail at an angle of 45 deg. This at first seems a rather unstable arrangement, but theoretical investigation and practical experiments have shown, it is said, that it is not objectionable. In the unlikely event of a wheel, or all four wheels, breaking or coming off or part of one of the rails being removed, the car truck would merely drop a few inches until it rested upon the girder, and the truck frame, extending down on each side of the girder, would, in any event, prevent the truck from falling off the track, or the car from overturning. Each truck has also a pair of horizontal balance or guide-wheels, placed between the carrying wheels and bearing on opposite sides of the upper rail. These wheels are set up to the rail by springs, and have each a flange on the lower edge, which runs under the rail and so prevents the truck from lifting.

The experimental track—Figs. 4 and 6—at Cambridge was built purposely with severe conditions of grade and curvature in order to demonstrate the capabilities of the system. It is composed as follows, the letters being marked on the accompanying plan—Fig. 4:—

O to A, 95ft.; cheap form of wooden track for yard use, with no iron rails. A to B, 132ft.; heavier wooden structure, with iron rails on upper and lower tracks; straight and level. B to C, 165ft.; similar construction, but on rather more than half a circle of 50ft. radius and a grade of 120ft. per mile. This curve is a very severe test of the engine, which, however, passes it very easily. C to E, 264ft.; wooden structure, straight and level, including a wooden truss girder of 33ft. span; followed by five wooden spans of 11ft. each, all on different grades changing abruptly, the grades being 60ft., 120ft., 180ft., 240ft., and 300ft. per mile. E to G, 181ft.; wooden structure from E to F, on a curve of 50ft. radius, nearly 80 degrees, with a grade of 345ft. per mile; then an iron structure with grades of 345ft. and 172ft. per mile. G to I, 276ft.; from G to H are two iron girders of 46ft. span, such as will be used for city railways. These cross the street, and are followed by an iron structure with short straight sections making a curve of about 700ft. radius. The total length is about 1114ft.

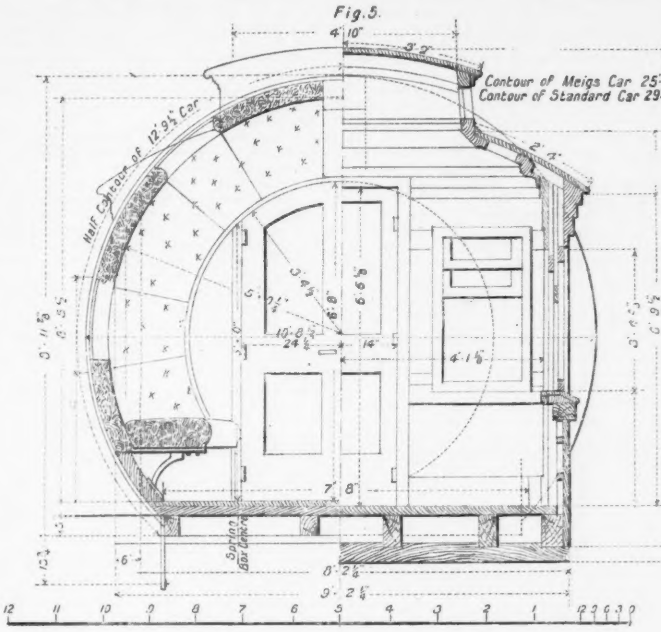
The iron girders, 46ft. long, are lattice girders built up of angles and bars, with angle iron diagonals under the bottom chord, and this was the character of the structure tested by General Stark for the railway commissioners. With a weight of 30 tons—cylindrical tanks filled with water—suspended by a chain from the middle of the girder, equal to a distributed load of 60 tons, the deflection was only $\frac{7}{16}$in., and there was no permanent set. To test the lateral strength of the structure in the event of a heavy gale blowing squarely against the side of a train, a cable was attached to a timber on one side of the girder, and carried horizontally to the top of an A frame, and then down over a pulley to a platform loaded with pig iron. This gave a horizontal pull on the middle of the girder, and with a load of 5¼ tons the lateral deflection at the middle was ⅜in., the movement causing the columns supporting the girder to bend ½in. at their tops. On the removal of the load the girder and columns returned to their normal positions. This would be the effect of a wind blowing at 33 lbs. per square foot against the train, equivalent to a hurricane of over 90 miles per hour.

The railway structure, the saddle truck, and the arrangement of the driving gear of the locomotive are the essential parts of the Meigs system, but in the train built a number of minor improvements in detail were introduced as noted later on. The bodies of the cars, Figs. 5 and 7, are of cylindrical form, with partially rounded ends, and the engine and tender are closed in with housings of the same form.

The locomotive is carried on two four-wheel trucks, each provided with a pair of horizontal balancing wheels, exactly the same as the car trucks. Between the two trucks or bogies is placed the pair of horizontal driving-wheels which grip the upper rail. To all intents and purposes the engine consists of a platform or flat car, upon which are mounted a boiler and a pair of horizontal stationary engines, so that the sizes of boiler and fire-box are not limited by the frames as in ordinary locomotives. The boiler is of steel, 5ft. in diameter, and 15ft. long, with 208 tubes, 2in. diameter and 7ft. long. The centre line is 5ft. 1in. above the floor. The fire-box is 54½in. long, and 54in. and 55in. wide, with the crown sheet inclined downward toward the rear end, so as to keep it covered with water on grades as steep as 800ft. to the mile. Anthracite coal is used for fuel.

A peculiar feature of the engine, which is especially striking when seen at work, is that there are no connecting-rods, but on the under side of each crosshead is a sliding box with a vertical pin, which is fitted into a horizontal crank-arm on top of the 6in. vertical axle the driving-wheel. The cylinders are 16in. by 22in., placed at the smoke-box end, and having the valve chests on top, in accordance with standard American practice. The cylinders are horizontal, and 61in. apart between centre lines. The piston-rods carry large crossheads, each travelling on two heavy bar guides, and driving the wheels in the manner above described, the arrangement being that known as the "slotted yoke" connection. The link motion valve gear is used, the excentrics and links being horizontal and under the crank arms, operating the valve rod through the intervention of bell cranks. The driving-wheels are 44½in. diameter, with cylindrical tires 6½in. wide, and flanges on the lower edge of the tires. At first it was not thought necessary to couple the drivers, but in practice it was found to be desirable in order to ensure steadiness of the engine. Gearing has been adopted for this purpose, there being a gear wheel on each driving axle and two intermediate gear wheels. The adhesion is obtained by hydraulic power, Fig. 3, each axle-box being carried in horizontal slides and attached to the piston-rod of an hydraulic cylinder, so that the pressure can be regulated according to the loads and the grades. The present engine can stop and start at will on a grade of 345ft. per mile, and sufficient pressure can be applied to crush the track itself. This pressure can be used as braking power. The blast pipe has a large nozzle, the exhaust being unobstructed.

Fig. 5.



The cylindrical form of the housing gives ample room inside for communication between the engine and tender and for attention to the machinery. At the front of the locomotive is the cab, being a raised platform enclosed, fitted with windows and covered by a monitor roof. From this station the engineman has a clear view of the track, and has ready to hand all the levers for controlling the engine, brakes, &c. The fireman's station is at the rear end, but, as before mentioned, there is convenient communication. An objection that may be made to the position of the cab is that it is liable to injury in case of any slight collision. It sometimes though rarely happens on elevated railways that in foggy weather a train will run into another which has been slow in getting away from a station. Owing to the low speed at such times there is usually very little damage done, except to the rear platform of the car, but the driver of a Meigs engine would stand a fair chance of being injured, or at least cut by broken glass, as he would be right in front of the engine instead of being protected by the length of the boiler. This objection might be eliminated by extending the front platform and building it heavily. The cab is reached by steps, and is accessible from doors in the front of the housing—opening out on the front platform—or from the interior of the engine.

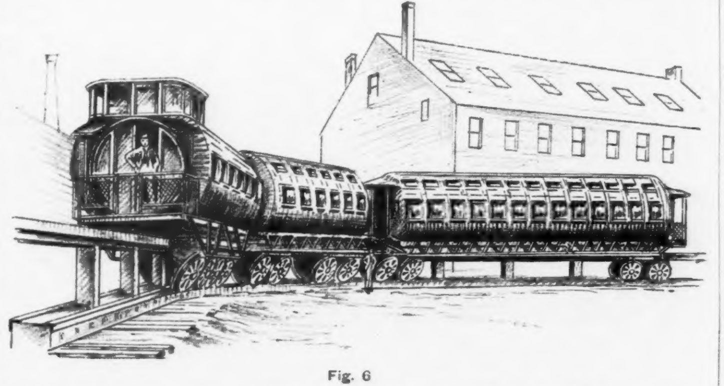


Fig. 6

The engine is 29ft. 3in. long over all and 7ft. 6in. wide, weighing 30 tons. Next to the engine is the tender, carried on two trucks of the type already described, and having a cylindrical housing. It contains two cylindrical water tanks, with a capacity of 1800 gallons each, and there is ample coal space. The size of the tender is 25ft. 9in. long and 7ft. 6in. wide across the floor, and its weight is 14 tons. On the experimental train there is no brake except the controllable grip of the driving wheels, which is amply sufficient as far as power goes, but for actual operation of trains some form of continuous automatic brake would be used, and it has been proposed to use an hydraulic brake acting on the balance wheels, and causing them to grip the upper rail.

The underframing of the passenger cars consists of a pair of Warren girders about 18in. deep, making a strong construction to resist collisions. The body is of the cylindrical form, with rounded end corners, and has end doors and platforms. The body framing consists of light ribs of T iron, bent to a circle 10ft. 8½in. diameter, the spaces between being filled in by panels of galvanised iron, lined with asbestos inside and sheathed with wood on the outside. The car is 51ft. 2in. long over all, 7ft. 6in. wide on the floor, and weighs 17 tons. The floor is of ⅝in. floor boards, laid diagonally, and nailed to an under floor of 1½in. planks carried by floor beams of 5in. channel irons. The car is very roomy and comfortable. Along each side is a row of seats as in street cars, but instead of the entire middle portion of the floor being left unoccupied, there is a single row of seats with the backs alternated, so that passengers face to right and left alternately. With this arrangement the car has seating capacity for eighty-four passengers, as compared with forty-eight on the cars of the New York and other elevated railways. The windows have hinges instead of sliding sashes, and by a device invented by Capt. Meigs, the window can be opened at either end, so that in whichever direction the car is moving the "rear" end of the window can be swung out, hinging at the "front" end, so that the passengers can have fresh air and at the same time exclude dust and cinders. The upholstering is carried right to the window space, and the sash fits against it, so that there is no draught when the windows are closed. A row of smaller windows is placed on each side of the upper portion of the car, being provided with curtains to shut out the sun. Ventilation is provided by an air-pipe, or trunk, along the top of the ceiling, having trumpet-mouth ends outside the car, and having valves in the lower part to regulate the draught. Semicircular pipes against the sides have openings under the seats and connect with the longitudinal trunk, so that as the car moves the interior air is drawn out from the top and bottom. Each end of the car has double swing doors opening on to an end platform, with the usual arrangement of roof and railings. The platform gates, however, instead of opening by swinging back on the platform, as on other cars—which is very troublesome when the cars are crowded—are made to slide vertically downward, being raised again by cords passed over a drum operated by springs. The upholstering is in red plush for the seats and old-gold plush for the sides and ends. Steam-heating pipes may be carried along under the seats, and lamps hung from the roof in the usual way.

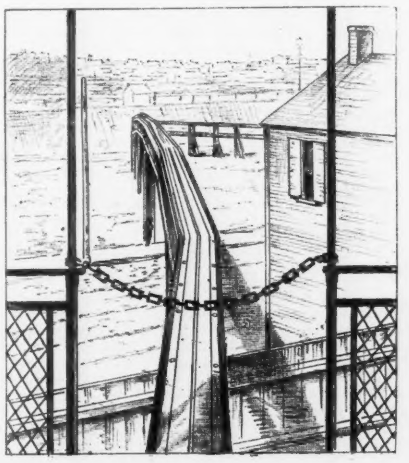


Fig. 7

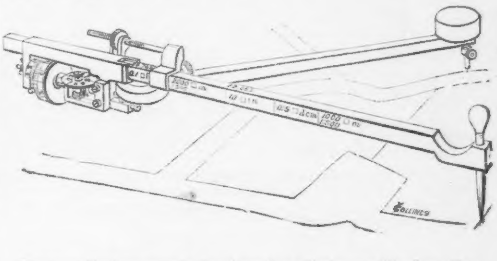
The car body is not attached to the truck by means of a centre-plate and king-pin or pivot, as in the ordinary type of car, with which arrangement it not unfrequently happens that in case of accident the car body is knocked off the trucks. Instead of this, another of Capt. Meigs' inventions is used. Attached to the under frame of the car, over the truck frame, are four hollow vertical cylinders, with the bottom diameter reduced by an interior flange. These carry a turntable which rests on two semicircular slides or bearings on the truck frame. On the truck frame are four vertical hollow cylinders, with the exterior diameter longer at the top. The inner flanges of the upper cylinders engage below the outer flanges of the lower cylinders, so that it is impossible for the car body to lift off the trucks. Coiled springs are placed in the cylinders. A rim on the turntable also engages the curved truck bearings. The usual form of king bolt connection is used for pivoting the truck or "bogie." The car couplings are an adaptation of the Miller automatic link coupling, as now almost universally used on the best passenger cars, but are controlled by the engineman by means of hydraulic connections.

In regard to speed, the existing line is too short for any high speeds, but the 50ft. curve has been easily taken at a speed of fifteen miles per hour on the down grade. Elevated railways as now built are but little hampered by snow, as it does not lie deep and is easily disposed of, and in Mr. Meigs' system there is even less space for it to lodge.

## COMPENSATING PLANIMETER.

The improvement in the planimeter illustrated by the accompanying engravings is the joint invention of the patentees, Mr. W. F. Stanley, of Great Turnstile, and Dr. A. Amsler, son of the inventor of the well-known instrument bearing his name. It consists in making the instrument adjustable to the shrunk scale of a printed ordnance map, or other plan which has shrunk in mounting, by providing means for making a correction equal to the difference between the standard and the shrunk scale of the map. The correction for shrinkage is made by means of a short scale upon the top of the planimeter divided to hundredths, which reads with a vernier to thousandths of the length of the tracing arm. The percentage of shrinkage is found by measuring the scale of the map by a true scale, and setting off double the percentage difference upon the vernier scale from zero. The planimeter adjusted in this way measures the area on the shrunk map, if care be taken in following the outline of the plan or map to be computed with the tracing point.

The following explanatory calculations have been furnished by Dr. A. Amsler:—Theory. Let A denote the area of a square, the side of which has the length $a$ expressed in any unit. Then $A = a^2$.



Suppose that square to be shrunk so that one side has the length $a - \alpha$, and the other side the length $a - \beta$. The area A′ of the shrunk square will then be expressed by

$$A' = (a-\alpha)(a-\beta) = a^2 - a(\alpha+\beta) + \alpha\beta = a^2 \left\{ 1 - \frac{\alpha+\beta}{a} + \frac{\alpha\beta}{a^2} \right\}$$

$\alpha$ and $\beta$ being small quantities compared with $a$, the term $\frac{\alpha\beta}{a^2}$ is of the second order in comparison with unity, and may be neglected, so that

$$A' = a^2 \left(1 - \frac{\alpha+\beta}{a}\right) = A\left(1 - \frac{\alpha+\beta}{a}\right) \quad . \quad (1)$$

As is well known, the area P of any diagram measured by means of a planimeter is equal to $P = r\,y$, $r$ denoting the length of the tracing arm, and $y$ the reading of the roller. The area of the same diagram, measured by means of the same planimeter, but with the tracing arm adjusted to the reduced length, $r\left(1 - \frac{\alpha+\beta}{a}\right)$ would be expressed by $P = r\left(1 - \frac{\alpha+\beta}{a}\right) y'$, $y'$ denoting the new reading.

Let now the diagram to which P refers be identical with the shrunk square, then $P = A'$ and $A' = r\left(1 - \frac{\alpha+\beta}{a}\right) y' = A\left(1 - \frac{\alpha+\beta}{a}\right)$

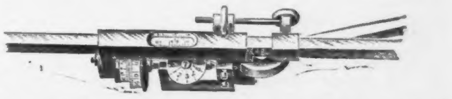
$$A = r\,y' \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This formula shows that the true area A is determined from the shrunk square by setting the tracing arm to the length $r\left(1 - \frac{\alpha+\beta}{a}\right)$ exactly in the same way as by setting the tracing arm to the length $r$ and measuring on the true square. The same reasoning holds good for any shape of diagram.

If $\alpha$ and $\beta$ are expressed in percentage of $a$ then

$$r\left(1 - \frac{\alpha+\beta}{a}\right) = r\left(1 - \frac{\alpha+\beta}{100}\right) = r - \frac{r(\alpha+\beta)}{100}$$

The illustration *above* shows the new planimeter is identical with the usual form with movable arm. The figure *below* shows the top face of the sliding bar with two short graduations and two verniers each corresponding to one mark on the side faces of the bar.



The use of the planimeter on shrunk plans is very simple. Suppose, for example, a 6in. to the mile plan. Measure on the shrunk plan by means of a true scale the length of 100 divisions of the scale printed at the bottom of the plan. Say, for example, that length may be 98·6 on the true scale, so that the deficiency is 1·4; multiply the deficiency by 2 — 2 × 1·4 = 2·8; then adjust the zero point of the vernier to 2·8 of the graduation on the top of the bar. This vernier and graduation corresponds to the mark.

0·5 ac. 10′ = 1 mile.
2 ac. 5′ = 1 mile.
50 ac. 12″ = 1 mile.
200 ac. 6″ = 1 mile.

The reading of the roller multiplied by 200 will then be the true area.

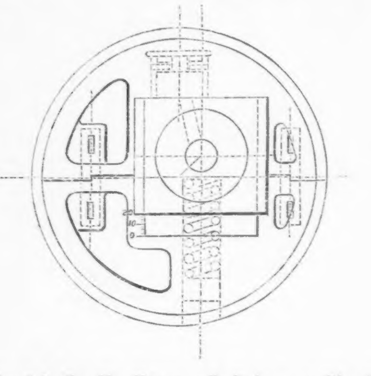
If a net of squares is printed on the map and it ha shrunk at different rates in the horizontal and vertical directions—say, for example, at such a rate that the deficiency in one direction is 1·4 and in the other direction 1·6—then add the two deficiencies 1·4 + 1·6 = 3 0 and adjust the vernier to 3 0 of the graduations on the top of the bar.

## LETTERS TO THE EDITOR.

(*Continued from page* 570)

### GOVERNING ELECTRIC LIGHT ENGINES.

Sir,—Mr. C. L. R. E. Menges in his last letter guesses quite correctly that my regulator must be inserted in a shunt, which in fact is really the case. From the main is shunted off one cable for all the lamps necessary for engine-room and stokehold, and this cable goes round the coil of the solenoid and regulates the voltage in the mains. What Mr. Menges puts down as the correct principle necessary to govern the voltage is realised by my patent governor. Let, for instance, 20-horse power be the total power required for feeding all the lamps, Mr. Joy's fluid pressure excentric is so placed that when at its maximum stroke the engines will give 20-horse power. Should now, for instance, half the number of lamps be turned out, we only require, say, about 10-horse power, and the governor will place the excentric disc in a position to admit steam to produce only 10-horse power, which means to say, to each number of lamps corresponds a certain position of excentric disc, and to place the disc in this position is the function of the governor.



This "variator," as Mr. Menges calls it, is so sensitive that it does not allow the excentric to rest in any other position except the one which corresponds to the prescribed normal voltage.

In my last letter my name was spelled—as usually foreign names are—entirely wrong, and I hope the compositor will be more successful this time.

F. Kodolitsch,
Lloyd Arsenal, Trieste.

Trieste, December 20th.

[Usually foreign names are almost, if not altogether, illegible as written. Compositors are not endowed with superhuman power, although there is reason to believe that they possess something closely akin to it.—Ed. E.]

### LOCOMOTIVES AND TRAINS.

Sir,—It may not be out of place if I say a few words concerning what you have not badly called a "sulky" engine. I have had my own turn at engine driving and firing, and know practically what I am writing about. The locomotive boiler is a very delicate affair, and requires much skill to get the best result out of it. It is used on land as a stationary boiler, and at sea. For all three purposes the working conditions are different. I shall speak only of its use on railways. On this point the amateur is hopelessly at sea, he can know nothing about it. I propose to enlighten some of your correspondents. I daresay many of them will take what a practical man has to say in good part.

The first thing to consider is the work the boiler has to do. Now the demand for steam continuously varies all along most roads. There are, of course, stretches like that from Paddington to Swindon, on which firing is child's play when you know how; but on most lines the demand for steam varies continuously, but the good fireman will keep the hand of the pressure gauge steady as a rock. This he manages by the use of his fire door, his ash-pan damper, and his injectors. Every engine has its peculiarities—why it should be so I cannot attempt to explain—and only the driver and fireman who understand those peculiarities can get the best result out of an engine. The consequence is that when a strange crew are put on an engine, even of the same class to which they are used, the result will be bad in all probability. Thus, for example, all locomotives run with the gauges showing a full glass. I have known an attempt made to use long glasses, but it came to nothing; only experience can tell the driver or fireman whether too much water is going in. Skilled men driving an engine to which they are accustomed could, I believe, get on without a glass at all. My practice was to run with one injector always on, and it is the usual practice. This did not throw quite feed enough. The rest is made up by using the other injector almost by instinct. The engine is running with a full glass of water, so high as to be out of sight; steam is shut off and the water instantly drops. There may not be half an inch in the glass, but when steam goes on again up goes the water. Now, Sir, some engines carry their water better than others; but a man on a strange engine cannot tell where he is, and very often his feeding becomes unequal, and his steam goes flying up and down.

Next as to the fire. A man gets away with his fire out of condition; there are holes in it, or the fire is too green—down goes the steam. If the fire is of the right sort and the driver not impatient, and they have confidence, all will come right by-and-bye, the driver sparing the engine all he can; but if the fireman takes to the dart and pulls his fire about, he is done. One thing must never be forgotten: If a locomotive can once get to blowing-off pressure, she can be kept there with much ease; but once let the steam get down, and it passes the art of man to get it up again. The reason is that the blast is much less effective, and that a much larger quantity of low-pressure steam is used—because the steam is used less economically.

In certain states of the weather locomotives often sulk. This is specially true of damp, muggy weather. There is no life in the air, and slipping takes place; this tears the fire to pieces and ruins it. There is a great deal in the shape of a fire, and shape is spoiled by rude variations in the force of the blast. One engine will steam better with a fire heaped up in the middle, and thin at the sides; another likes a hollow top fire—just the reverse. This depends in a measure on the shape and condition of the brick arch.

There is nothing so likely to beat a driver and fireman as a change in coal. I can call to mind how I came many years ago to grief in this way. I was firing an engine south of Stafford, and we had nothing but a bituminous coal with lots of flame and smoke in it. It was a thin fire or nothing. Fire heavy, and the coal all ran together and air could not get through. When you knew the coal it was grand. Well, one day, instead of changing engines at Stafford, we had to take the train on. We had to take about a ton of coal. In those days we did not think very much of the loss of a couple of minutes coaling. Well, this coal was not like any either I or my driver had used, and in a very short time the pressure began to fall. We got down to about ten miles an hour. Then I got desperate, and I began to fill the fire-box, and then the pressure began to rise. After that I had no trouble. The new coal wanted a very thick fire, for it was dry—not much flame in it. A man will sometimes have to take an engine at short notice, with coal out of another district, and then trouble may be expected.

But apart from sulky engines, just think of the difference between pulling a dozen coaches on a fine, bright, calm day, and doing the same thing in a hurricane of rain and wind. Instead of complaining that locomotives do not keep time, the wonder is that they are so punctual. As to big engines, there cannot be two opinions. The difference between feeling an engine under your feet that can run away with a train and one which is loaded within an inch of its life must be felt; it cannot be described. It is like driving a worn-out old horse scarcely able to drag his tail after him, and sitting behind a fine horse in the pride of life.

The proper driving of a modern locomotive with a heavy train behind it, not once or twice but all the year round, demands a display of skill and experience which are not understood by the public. The driving of metropolitan trains stopping every couple of miles or less is nothing to the running of express trains, as fast as they can be got to go. Your readers, Sir, I can assure them, may believe me when I say that every locomotive has its whims and its crotchets, its good days and its bad days. This is not a driver's superstition, it is a fact. No doubt it admits of explanation, but it is hard to explain. Why will one of two engines, so much alike that all the parts are interchangable, always burn a couple of pounds a mile more than the other, no matter how the firemen and drivers are changed? I daresay there is a simple explanation, but I do not know what it is. Things do turn up now and then that almost make one think that locomotives are alive and can reason, but with these I shall not worry you. If I can persuade your readers that there are more things in locomotive engine-driving than appear on the surface, and can be seen by any railway passenger who looks at an engine, I shall be content. I could say a good deal about pilots. There is a time to take them and one to let them alone, but I must not begin about them or many other things, or I shall not know when to stop.

Old Driver.

Warrington, December 17th.

Sir,—Whatever its practical value, Mr. C. Rous-Marten's article, rather whimsically entitled "Eighty-four Miles an Hour," is by far the most interesting contribution to the subject of railway speeds I have ever seen, and it will, as he says, dissipate a great many wild ideas hitherto entertained and believed. There used to be a tradition or legend of 12 miles in eight minutes having been done on the Great Northern, which, however could not be authenticated for fear of getting the engine driver into trouble. Mr. Rous-Marten rather leads us to infer that the rate of 84·1 miles an hour very closely approaches the limit of speed even of locomotives of the 8ft. single type, owing to back pressure, but I think this point requires some further elucidation.

Other things being equal, the back pressure would mainly appear to depend on the piston speed of the engine, and there is a wide discrepancy between the piston speeds of, say, the 6ft. 6in. coupled Caledonian engines and that of the 8ft. 1in. Great Northern singles.

Assuming for the sake of argument that eighty miles an hour is the limit of the former, the piston speed is something like 1625ft. per minute, while that of the latter is only about 1250ft. per minute when running eighty-four miles an hour. I should therefore think the limit of speed of the 8ft. single engine would, other things being equal, be that represented by a piston speed equal to that of the coupled engine, and this seems to be 101 miles an hour. Whether there is anything in this or not, nothing is more surprising than the closeness with which the coupled 6ft. 6in. engines approach the speed of the 7ft. 6in. and 8ft. 1in. engines.

It would be interesting to know from "C. R. M." what is the highest speed attained on the level with an average load, and also what is the best time done in ascending banks like Shap and Elvenfoot. I am under the impression that, going north, the latter—ten miles—has not been done in less than fourteen minutes. I hope the author will shortly give us the further particulars of the runs he briefly mentions.

Your correspondent "J. G." complains of the weight of modern engines in comparison to their boiler capacity, but he may be quite sure the weight would be done away with if that were possible. The increase of weight is due to greater boiler capacity combined with increasing pressure, rendering everything heavier. Some of this extra weight would be required for adhesion in any case. It appears to me the alterations he suggests would mean a large further increase of weight.

Is not the question of very large engines really a question of policy on the part of locomotive superintendents? If all the London and North-Western Railway trains were sixteen to eighteen coaches then it would be advisable to build engines to handle them; but they are not, and, *pace* the opinions of some correspondents, I say the modern engine is still quite equal to its work; indeed, trains are often over-engined, and it is no unusual thing to travel 100 miles with a white feather all the way.

Isolated or exceptional circumstances are nothing to go by, and the best locomotive is and always will be the best compromise between the special conditions to be met. For my part, the more I see of a locomotive the more I admire its perfection and the ability of the men who designed it.

R. C. Dowie.

December 19th.

Sir,—I owe an apology to you and your correspondents for my statement that the large engine was taken on to assist the small one in the case of the train in the Northallerton smash. I was misled by a condensed report of the Board of Trade inquiry in *The Scotsman*, which the North-Eastern Railway people tell me is wrong, and that 1622 was making steam badly—a failure which may occur at any moment to any engine from many causes. For instance, the first portion of an express out of Edinburgh was stuck for twenty-five minutes near Berwick the other night because a "Tennant" engine could not make nearly enough steam. I remember the words of the driver of 1622 were that the brake pump "was sticking," and he was short of steam.

I have travelled a good many hundreds of miles on different locomotives, and I find the new large North-Eastern engines are very good steamers indeed. For instance, the other day I rode on 1619—the only compound of the class—which weighs 94 tons, from Newcastle to Edinburgh in a tremendous gale of wind from the west, which the Meteorological Office said had a velocity of forty-five miles an hour, with gusts up to between fifty and sixty miles an hour and driving rain; the small lumps of coal were flying off the tender. We had eleven E.C.J.S. and one N.E.R.T.P.O. = twelve. We left Newcastle eight minutes late, and only lost three minutes till within three miles of Edinburgh, when we were stopped twice at the bottom of the steep bank into Waverley, arriving nineteen minutes late. The whole 124 miles the gauge remained at 200 lb. except on three or four occasions when it fell to 190 lb., but never lower—and then only for a minute or less. Considering that the train was the "Flying Scotsman," the gale, and a consequently prolonged stop at Berwick because our water was very low, and the perfect steadiness of the gauge at 200 lb., it can hardly be said that 1619 is not worth her weight.

Norman D. Macdonald.

Edinburgh, December 24th.

### THEORY OF THE STEAM ENGINE.

Sir,—Referring to the first paragraph of Mr. Cross's letter in your last issue, it is obvious that Mr. Cherry referred to cases in which inventors have claimed for their engines extreme efficiency (usually expressed in terms of a wonderfully small coal consumption per indicated horse-power), an efficiency far exceeding that which, according to Carnot's theorem, is even theoretically possible. Under such circumstances, Mr. Cherry would surely be justified in applying the laws of thermodynamics, and pointing out to interested persons the fallacy of these claims; also in stating that any practical tests which apparently proved the alleged efficiency must necessarily be unreliable. It is well known that such cases exist both in the simple form, and complicated with false or misleading trials. I have myself carried out tests with properly designed brakes which have entirely shattered the records of previous so-called "tests" made with improper apparatus, and upon which the alleged efficiency had been based. Had these inventions been subjected to a theoretical investigation or analysis in their earliest stages, the expenditure of much money and time could have been prevented. I cannot therefore see that it requires a "vivid imagination" to connect similar cases with Carnot's theorem when the latter is applied in the manner indicated for the useful purpose of demonstrating the fallacy of the exaggerated claims set forth; and I certainly consider that scientific men are well employed when exposing the sophistry of ignorant or of designing persons.

W. A. Granger.

102, Brooke-road, N., December 24th.

Sir,—I am much amused at a writer of the calibre Mr. Maurice Cross has shown himself to be, suggesting that I should accept his mere baseless *ipse dixit* in preference to the teachings of my own close study and practical experience. I repeat that which I have already asserted, and surely I should know better than Mr. Cross that I have found Carnot's theorem of great practical value for the reasons and purposes among others which I have specified. I have already given Mr. Maurice Cross abundance of material for cogitation and reply. On his complete failure to furnish any logical reply, your readers will make their own comment. He continues to supply with every letter he writes additional matter for unfavourable criticism, but it would be superfluous for me to follow him further in his acrobatic arithmetic.

Henry Cherry.

21, Festing-road, Putney, S.W.,
December 22nd.

### LOCOMOTIVE CYLINDER CAPACITY.

Sir,—We notice a letter from "Nemo" in your present issue stating that the first Mersey Tunnel engines, built by Messrs. Beyer, Peacock, and Company, had the largest cylinder capacity of any British locomotive.

But we would call to mind the express locomotive James Toleman, which we built last year for the patentee, Mr. F. C. Winby, and which was illustrated and described by you in your issues April 28th, May 5th, and May 12th, 1893. This engine has two inside cylinders 17in. by 22in., and two outside cylinders 16¼in. by 24in., giving a total cylinder capacity of 10,125 cubic inches, equal to about 12½ per cent. more than Mersey Tunnel engines referred to by "Nemo." Each pair of cylinders drives its own pair of wheels, 7ft. 6in. in diameter, on the go-as-you-please principle, there being no coupling rods.

(For R. and W. Hawthorn, Leslie, and Co.)
W. Cross, Director.

Forth Banks Works, Newcastle-on-Tyne, December 22nd.

## THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

The year which has now closed has been a singularly uneventful one for the iron trade of this part of the kingdom. There have been circumstances which have occurred to break the monotony of the absence of anything like vigorous demand. But these causes of temporary excitement have been quickly exhausted, and, taken generally, the year has been one of the most unsatisfactory that has had to be recorded. The passing of the new and reduced American Tariff Bill, the settlement of colliers' wages in the Federation districts of England upon a basis which is to endure as now up to August, 1896, the circumstances surrounding the history of the Earl of Dudley's Round Oak Iron and Steel Works, Limited, and the final closing and dismantling of the once celebrated and extensive works of the New British Iron Company, are events which loom largest to iron and steel masters hereabouts. As regards iron prices, sheets, both black and galvanised, and gas tube strips are the only departments in the rolled iron branch that have seen much change. Marked iron prices have been unaltered throughout the year, being a repetition in this respect of the experience of 1893; and common and merchant bar prices have fluctuated but slightly. Marked bars opened the year at £7 10s. to £8 2s. 6d., and close the year the same, the best branded hoops being £8, and boiler plates £8 10s. to £9. Common merchant bars opened the year at £6, at which they still stand, and best merchant sorts £6 5s. to £6 10s. A reduction of 2s. 6d. to 5s. per ton appears on common unmarked bars, the £5 12s. 6d. to £5 15s. quoted last January having now become £5 10s. singly. Thin strips and hoops continue at the nominal Association figure which has existed throughout the year of £6 5s. to £6 10s.; but gas-tube strip that was priced at £5 15s. as the Association price a twelvemonth back, may now be freely bought at £5 5s. Sheets of 24 w.g. have lost 5s. to 10s., and 27 w.g. 10s. to £1, while galvanised corrugated sheets have dropped £1 to £1 5s. per ton.

Throughout the first half of the year ironmasters were clamouring for a definite settlement of the coal-trade wages' question by the Federation Conciliation Board. Yet when in July the settlement did come, the improvement in trade which they had been looking for as the result was still absent; or at least was so transitory, that before the end of October it had spent itself. The revival, too, that did occur between July and September was not due to the coal trade settlement, but to the passing of the Wilson Tariff Bill. If anticipations had been realised in the arrival of the marked increase of orders that had been promised—as the context of the United States Customs revision—the "spurt" in trade might have been prolonged. But scarcely any increased demand succeeded.

Pig iron has shown more vitality than manufactured iron throughout 1894. Demand has been better, and prices have been proportionately stronger. Yet even in this department there has been nothing to boast about, and agents of Midland firms especially report the year as one of low prices. Staffordshire pigs opened the year at 95s. to 100s. for cold blast all mine sorts, 57s. 6d. to 60s. for hot blast, 44s. 6d. to 45s. for part mines, and 37s. 6d. to 38s., and occasionally 40s., for cinder sorts. These descriptions of metal now show a reduction of 5s. as regard, all mines, and 4s. 6d. to 6s. on part mines. Northampton, Derbyshire, Lincoln, Nottingham, and similar forge pigs have lost an equal amount. Between July and September, Midland pigs, which had previously been very low, rose 1s. 6d. to 2s. and in some cases 2s. 6d. per ton nominal, but since October the rise has had to be again sacrificed.

A comparison of the bi-monthly returns issued during the year by the accountants to the Midland Iron and Steel Wages Board shows that with the exception of the returns for March and April the selling prices of manufactured iron of all sorts—bars, sheets, plates, hoops, &c., have pursued a uniformly downward course. The return issued in February for the months of November and December, 1893, declared a net average selling price of £6 1s. 3d., and the return which has last been issued—namely, that for September and October—gave the true average at £5 16s. 5d. This last return caused great surprise, showing a drop on the previous two months of 2s. per ton.

Ironworkers' wages, which in February had fallen 2½ per cent., again dropped 2½ per cent., and the men are now being remunerated on this reduced scale, namely, 7s. 3d. per ton for puddling. The total drop in the average selling prices on the year has been 4s. 10d. per ton, following upon a reduction in the average of

4s. 2½d. for 1893, and 1s. 10d. for 1892, and of no less than 10s. 10d. for 1891.

This week the iron trade is quiet, most of the works being closed, and business being generally postponed until the new year. The hope is, however, entertained of considerable orders for iron and steel work in February or soon after, as the result of the decision lately come to by the War-office to construct important additional land fortifications.

The inauguration of active operations by Thomas Parker, Ltd., the new firm of electrical engineers at Wolverhampton, the start of whose extensive works was announced in this report a fortnight ago, seems likely to be rendered memorable by the invention of a new dynamo, for which great things are promised. Only one of the motors has yet been made by the firm, and it is believed that it possesses important electrical developments. It includes the Eickemeyer Patents, the more recent patents in connection with armatures, and new inventions by Thomas Parker, Ltd., which have just been patented. Great attention has been paid to the construction, and a large increase in the power of the electric light is obtained, as well as an advance in the regularity of the service. The dynamo, so far built, will be used to light the whole of the works, both inside and out, but the design, of which it is the earliest outcome, will be regularly employed in the execution of orders.

In a further communication from Mr. T. C. Sharp, of Corporation-street, Birmingham, with reference to the light railways question, this engineer concludes that it is absolutely necessary that the new railways should be owned and controlled by the public. If they are simply commercial undertakings they will, he opines, "soon become absorbed in the great railway monopolies of the kingdom, and thereby not be of the exceptional value to the depressed agriculturist it is intended they should be." Nearly one-third of the English canals are under the control of the railway companies, and therefore cease to be a competitive means of transit. The light railways must, Mr. Sharp thinks, be arranged so that, as well as being feeders to the present railways, they will also be in a position to compete with them. On their own systems they should be able to deliver goods and produce for distances of, say, forty miles around London, twenty miles around other large centres of industry, and about ten miles around the leading market towns. £1500 a mile is, in his opinion, ample for well-constructed tramways beside the highways, where the gradients of the public roads are moderately favourable.

In a report which Mr. E. D. Marten, engineer of the Severn Commissioners, presented to the Committee of Works, on a visit which he has just made to Paris to obtain information regarding the navigating of the Seine by sea-going vessels to that city, he states that no engineering difficulty exists to prevent a line of sea-going steamers being built and worked forthwith to trade between Worcester and Paris and other continental ports. Further, that everything points to such a trade being profitable. The Severn route possesses enormous advantages in the matter of railway competition compared with the Seine route between Rouen and Paris. If the latter can hold its own there is every reason to anticipate that the English scheme could. The distance between Dover and Paris, though only 70 miles as the crow flies, is 150 miles by river, and notwithstanding there is railway competition the whole way, about 4,000,000 tons of traffic were carried on the river in this section last year. This section of the river has been more or less canalised for many years in a similar manner to the Severn between Gloucester and Worcester, by means of nine locks and weirs. In 1878 the State, however, at a cost of £2,500,000, carried out improvement works by which the minimum depth of the channel has been increased from an uncertain 5½ft. to 6ft. to a constant depth of 10ft. 5in. The Severn has been increased by its Commissioners from 6ft. to 10ft. The Seine is now maintained toll free by the State.

I regret to have to record the death of Mr. Moses Bayliss, aged 77, the senior partner in the important firm of Bayliss, Jones, and Bayliss, Victoria Engineering Works, Wolverhampton. For a long time Mr. Bayliss took an active part in the affairs of the firm, but fourteen years ago he retired from active participation, and went to live at Bournemouth. He died a week ago at his residence at Hampstead, London.

## NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

*Manchester.*—Not more than a very nominal sort of business has been put through during the past week, and with business practically closed for the year, a brief review of the past twelve months' operations will perhaps be interesting. The most remarkable feature of the year has been the almost inappreciable effect, so far as giving any strength to the market, of the prolonged stoppage of production last year, and the three months miners' strike in Scotland this year. In the iron trade business, with the exception of one or two temporary fluctuations, has shown a very steady downward tendency; whilst in the coal trade, notwithstanding a combination of the coalowners to maintain and regulate prices, they have followed a persistent downward course all through the year, and even with pits working short time, stocks have again accumulated in almost as large quantities as ever. Other noticeable incidents have been the important development of the eight hours movement in the engineering trades, and the two years wages settlement in the coal trade, both of which are regarded with but scant favour by employers generally.

In the iron trade there were anticipations—with the commencement of the year—that the stoppage of production during the coal strike would tend to improve the position of makers and manufacturers, and that with the increased cost of fuel lower prices were scarcely possible. During the first two or three months a fairly active business was being put through in all descriptions of raw and manufactured material; but this was mainly due to makers and manufacturers being called upon to complete deliveries of contracts that had been suspended during the miners' strike, and to consumers having so run out their stocks that they were in pressing need of material to cover immediate requirements. For pig iron, makers were able to get advances of 6d. to 1s. per ton, local brands being quoted at 44s. 6d. to 45s. 6d., less 2½; Lincolnshire, 43s. 6d. to 44s. 6d. net cash for forge and foundry, with Middlesbrough about 45s. 4d. net cash delivered Manchester; and Eglinton, 48s. to 48s. 6d. net prompt cash, delivered Lancashire ports. There was, however, an absence of any real improvement in the principal iron-using industries to back up the market, and directly the special conditions which had brought about the increased activity of demand had passed away, there was a gradual relapse into a state of depression, prices steadily receding to an excessively low point. For a time makers, being fairly well sold, endeavoured to hold to their quoted rates, but merchants began to undersell, and makers were compelled to follow to secure what business there was offering, this downward progress going on until well into the second half of this year, when prices had got to so low a pitch that merchants and consumers, in view of the complete stoppage of production in Scotland, owing to the miners' strike, evidently came to the conclusion that any further giving away was practically out of the question. As a result there was a sudden spurt of buying, with an upward move in prices to the extent of about 2s. to 3s. per ton. Lancashire pig iron, which had receded to about 38s. for forge and 42s. for foundry, got up to 42s. and 44s. 6d., less 2½; Lincolnshire, from 37s. 6d. for forge and 39s. 6d. for foundry, to 39s. 6d. and 40s. and 41s. for forge and foundry, and Derbyshire foundry brands to about 45s. and 46s. net cash delivered Manchester, whilst Middlesbrough iron, from 43s. 10d., got up to 45s. 4d., net cash delivered, with Scotch iron prices necessarily very irregular, owing to the stoppage of the blast furnaces and the consequent scarcity of supplies. Although a very considerable weight of buying was put though, the spurt was of but short duration, and at the maximum figures little or no business of any moment was done. Makers, however, being tolerably well sold for two or three months ahead, were for the time being indifferent about further business, but as they had again to come upon the market, prices steadily gave way until the close of the year, when local brands got back to about 41s. for forge, and 44s. for foundry, Lincolnshire to 36s. 6d., and 37s. for forge, and 38s. 6d. to 39s. for foundry, and Derbyshire to about 43s. and 43s. 6d. for foundry, net cash, delivered Manchester. With regard to outside brands, one remarkable feature was the comparatively inappreciable effect which the complete stoppage of the furnaces throughout Scotland during the miners' strike had upon the market here. Eglinton, which had got down to 45s. and 45s. 6d. net cash, delivered Lancashire ports, prior to the strike, scarcely advanced more than 2s. 6d. and 3s. per ton upon this figure, and with the resumption of the output quickly returned to 46s. and 46s. 6d., whilst Middlesbrough, although there was necessarily an increased demand thrown upon this brand when Scotch was withdrawn from the market, did not get up to more than 45s. 4d., and with the close of the year has returned to about 43s. 7d. and 43s. 10d. net cash, delivered Manchester.

Finished iron makers also commenced the year fairly well supplied with orders, and firm for anything like prompt delivery at about £5 15s. for bars, £7 5s. for sheets, and £5 17s. 6d. for random to £6 2s. 6d. for special cut lengths of hoops, delivered Manchester or Liverpool. These prices gradually hardened during the next couple of months, hoop makers advancing their list rates 2s. 6d. per ton. A long spell of extremely quiet trade followed, with an almost complete absence of export, and bars gradually dropped to £5 7s. 6d., sheets to £7, and hoop makers had to take off their advance of 2s. 6d. per ton. Although during August there was some increased business, finished iron only very partially participated in the spurt of buying which came over the pig iron trade, and extreme depression followed throughout the remainder of the year, with forges scarcely working on more than about half their average production, and bars receded to £5 5s., sheets £6 15s., and hoops to £5 15s. for random, and £6 for special cut lengths, delivered Manchester or Liverpool.

Only a very slow sort of business has been reported generally throughout the steel trade during the year. In raw material, hematites, which in January were quoted about 53s. 6d., gradually receded to 51s., less 2½, but with the spurt in pig iron there came also a considerable weight of buying in hematites, some of the better brands getting up to 54s. and 54s. 6d., but they again quickly receded to not more than 52s., less 2½, delivered. Steel billets have also gradually receded from about £4 5s. in January to £3 15s. and £4 net cash for ordinary qualities in December. Manufactured steel has met with a moderate inquiry for general constructive work, but business has only been practicable at low prices, the only appreciable advance which local and district makers were able to secure being during the stoppage of the steel works in Scotland. Steel boiler plates, which in January were being quoted about £6 7s. 6d. to £6 10s., did not get appreciably above this figure, even when Scotch plates were out of the market, and they close this year at £6 2s. 6d. to £6 10s. per ton delivered.

Taking the engineering branches of industry all through, they may be said generally to have been moderately employed during the year, but for the most part establishments have only been kept going from hand to mouth. Some branches have gone through a period of rather severe depression. This has been especially the case in the locomotive building trade, whilst there has been a very serious decline in the shipbuilding industry on the Mersey, several of the yards which have hitherto turned out a large yearly tonnage having practically had no work of any moment whatever, and Messrs. Laird Brothers, of Birkenhead, have been the only shipbuilding firm that has kept up to anything like the average. During the first few months a rather hopeful tone prevailed as to the prospects of reviving activity amongst engineers generally, and most branches were securing a fairly large weight of orders. This, however, soon fell off, and except that establishments here and there have been kept tolerably busy on what may be termed special work, largely for abroad, slackness has more or less prevailed, many establishments having to work largely on stock to keep themselves anything like fully employed. The monthly returns of the engineering trades union societies have also given evidence of the generally unsatisfactory condition of trade, the number of out-of-work members all through the year having been above the average. The Amalgamated Society of Engineers started the year very badly, with 20 per cent. of their membership in this immediate district on the books in receipt of out-of-work support. This, however, was largely due to suspensions for the holidays, and at the close of the month the number had got down to about 10 per cent., the Steam Engine Makers' Society having about 6½ per cent. on donation benefit. During the next few months the number of unemployed members slightly decreased, the Amalgamated Society of Engineers getting down to about 9 per cent. and the Steam Engine Makers' to about 5 per cent. of the local membership in receipt of out-of-work support. There was, however, again an increase, the Amalgamated Society of Engineers getting back to about 10 per cent. of the membership in receipt of donation benefit, but with the close of the year there has been a slight but steady decrease, which is regarded by the trades' union societies as a satisfactory indication that with the ensuing spring there may be some revival of activity.

In the coal trade the year commenced with collieries generally altogether without stock, as the result of the previous four months' stoppage of the pits. The exceptional mildness of the weather and the depressed condition of the principal coal-using industries both, however, operated to prevent any real strain upon the market as regards supplies, which very quickly became plentiful, and prices, which it was hoped there would be no difficulty in maintaining at some substantial advance upon the low rates ruling prior to the strike, commenced a steady downward course until they touched as low if not a still lower point than those ruling when the coalowners felt themselves under the necessity of giving notices for a 40 per cent. reduction in wages. Housefire qualities have been in exceptionally poor demand all through the year, and before last winter had closed heavy stocks had accumulated. Prices, which in January had been fixed at something like 15s. for best Wigan Arley, 13s. for seconds Arley and Pemberton four feet, and 12s. for the commoner qualities of round coal, have steadily receded right on to the close of the year, when best Wigan Arley is scarcely fetching more than 10s. 6d., seconds Arley and Pemberton four-feet 9s. to 9s. 6d., and common house coals 7s. to 7s. 6d. per ton at the pit, these prices being quite 1s. under even those which were being quoted in July, and the leading Manchester firms have been under the necessity of reducing in December the "lowest summer rates" which they were quoting in October and November. The commoner qualities of round coal have also been in but very indifferent demand for iron making, steam, and general manufacturing purposes, and although during the Scotch strike large quantities were sent away into Scotland, for the time being clearing away a good deal of the surplus supplies, and enabling some of the collieries to work full time, no very appreciable advance in prices was, even during this period, obtainable, the effect being little more than to check the downward tendency of the market. Steam and forge coals, which in January were being quoted about 10s. to 10s. 6d., have gradually receded, until with the close of the year they do not average more than 6s. 6d. per ton at the pit mouth, and for shipment even as low as 5s. 6d. to 6s. is being taken. Engine classes of fuel have fluctuated somewhat, as supplies have been regulated by the demand for round coals, and during the earlier part of the year began to tend upwards, owing to the restricted production of slack, the better qualities getting up to 6s. 6d. and 7s. and common qualities to 5s. and 5s. 6d. at the pit-mouth; with however, the increased demand for round coal for shipment to Scotland during the miners' strike, supplies of engine fuel became plentiful, and soon a complete drug owing to the general restriction of requirements for manufacturing purposes, with the result that prices have steadily receded until common qualities of slack have got down to about 3s. and 3s. 6d. and the better qualities about 4s. 6d. and 5s. at the pit mouth. More than ordinary importance has been attached to the usual gas coal and locomotive fuel contracts during the year, as it was alleged by the officials of the Miners' Federation that the needlessly low prices taken for these in previous years had been the main cause of the demand for a reduction in wages. With a view of regulating prices generally, but chiefly with the object of preventing, if possible, needlessly keen competition for these contracts during the ensuing season, a combination of Lancashire coalowners was formed soon after the resumption of work at the collieries, and a sort of agreement was come to with the Yorkshire coalowners not to tender under the 1892 prices, which would have represented an advance of about 1s. per ton on the basis of the 1893 contracts. Early in the season one or two contracts were placed at advances of 6d. to 1s. per ton on 1893 prices, and a strong feeling was expressed that the gas coal collieries should hold out for a substantial advance over last year's basis, but this was soon found to be impracticable. With regard to the important Manchester gas coal contracts, an arrangement was come to that tenders should not be sent in except at prices 6d. above those of the previous year, but these contracts were ultimately settled on practically the basis of the 1893 rates. As the season advanced other large contracts had to be taken at very much the same prices as in 1893, and except upon a few of the smaller contracts, the maximum general advance maintained did not exceed 3d. per ton over the low prices of 1893. For the locomotive fuel contracts coalowners did rather better, and in some cases advances of 6d. to 9d. per ton on the previous year's rates were obtained.

*Barrow.*—There is still a very quiet tone in the hematite market, and orders are not offering to any marked extent. There has practically been no business done this week, as the holidays are being observed generally, a remark which applies as much to industrial as to commercial matters. Makers have fewer orders in hand than even at this time last year, when trade was admittedly dull; and although only 31 furnaces are in blast out of 75, and compared with 33 in the corresponding period of last year, stocks are gradually increasing, and now stand at about 175,000 tons, compared with 94,000 tons this time last year. Prices are easier at 42s. per ton net sellers, and 42s. 9d. buyers. Makers are quoting 43s. 6d. to 44s. for mixed Bessemer numbers, net f.o.b.

Iron ore is in quiet demand. Indeed the local consumption, which is the mainstay of the trade, has fallen off lately. Prices are easy at 8s. 6d. for ordinary and 13s. 6d. for best sorts net at mines.

The steel trade is practically at a standstill. Makers are fairly sold forward in plates, but in rails and tin bars very little is doing, and in other branches of the trade orders are, generally speaking, either very scarce or absolutely nil.

Shipbuilders and marine engineers remain very busy. A rather long holiday is being observed at local yards, but there is any amount in hand for the New Year, and it is confidently expected there will be a renewal of orders next year as the work in hand gets finished.

Coal and coke are a very poor and quiet market, and the consumption lately has been much below the average of previous years. Prices are steadily maintained.

Shipping is very quiet, and the recent storm has accentuated the depression. Cargoes are few, and freights are at low and unprofitable rate.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

During the last few days business in the South Yorkshire coalfield has been somewhat better, owing to the orders for prompt delivery having been more numerous. Prices are firmer, although there is no possibility of making more money. The Christmas season requirements, which have now passed, have had a good deal to do with the improved trade, which will only be of short duration unless the weather changes. The metropolis has been taking a fair average tonnage of Silkstones and thick seam coal. The demand, however, still continues dull, sales being slow, and the competition of seaborne coal causing prices to remain very weak. The improved business with London was no doubt owing to the anticipated stoppage during the holidays, rather than to any real advance in trade. Eastern counties are taking but a poor tonnage. Quotations are as follows:—Silkstones, 9s. 6d. to 11s. per ton; Barnsley House, 8s. 3d. to 9s.; Flockton, 8s. to 8s. 3d.; and thin seam coal, 7s. to 7s. 6d.

The steam coal trade continues in a fair state. Considering that this is the last month of the year, the tonnage sent to Hull and the other Humber ports is good, the open weather favouring the sale of bunker coal. The Hull and Barnsley Railway is taking more than the average at this period of the year. Grimsby is also taking a fair amount, but considerably less is being sent to Goole.

Quotations range from 7s. 6d. to 8s. for best qualities of steam coal, and 7s. to 7s. 3d. per ton for secondary sorts. Railway companies in this locality are generally receiving heavy supplies of coal, under contract arrangements. The North-Eastern Company have placed a considerable portion of their contracts for locomotive coal. Part of the business has come into South Yorkshire, the prices obtained ranging from 7s. 6d. to 7s. 9d. per ton, free on rails at the pits. It is understood that the Durham coalowners, in making their arrangements to supply the same company, have fared rather better, the prices they have secured varying from 7s. 9d. to 8s. per ton. These rates exhibit a decline of about 1s. a ton as compared with last year. Gas coal is in large demand at from 7s. to 8s. per ton. Manufacturing fuel is in a better request, supplies being less abundant owing to the shorter time worked at the collieries. Riddled slack makes from 5s. to 6s. per ton, and unriddled or ordinary pit slack fetches about 3s. per ton at the pits. The coke trade is in a fairly good condition and prices range from 9s. to 11s. per ton, a large quantity being forwarded to Derbyshire, North Lincolnshire, and adjoining districts.

The decline in the value of steam coal is rather a serious factor in the South Yorkshire coalfield, of which it constitutes so large a part. The rates now ruling are lower than that which prevailed when the miners received their second 10 per cent. advances in 1889. The price was then 8s. 6d. per ton. In 1890-91 the North-Eastern Railway Company paid 11s. per ton of 21 cwt.; then values fell by about 1s. per ton per year until the stoppage of last season altered everything. Again, coal is falling through the all-powerful reason of supply exceeding demand.

Business for the year is now practically at an end. Some of the works were opened on Monday, but generally the trading operations of 1894 terminated last Saturday. With the single exception of armour-plates, it has been a decided disappointment in all the heavy industries. In regard to iron, West Coast hematite pig was at 53s. 6d. in January of 1894, as compared with 55s. in the corresponding month of 1893. On April 1st the value remained at 53s. 6d., against 52s. 6d. in April of the previous year. On July 1st the price dropped to 52s. 6d., which was the same rate as was quoted in July of 1893. This rate was continued during October, but dropped to 52s. on December 18th, at which figure it still stands. In October and December of 1893 the prices were 52s. 6d. and 53s. These quotations refer in every instance to West Coast brands. East Coast iron can be bought at about 2s. per ton less. Common forge iron on January 1st was 40s. 6d.; on April 1st, 40s.; July 1st, 39s.; October 1st, 38s.; December 21st, 38s. At the corresponding periods of 1893 the prices were 39s. 6d., 38s., 38s., 40s.—during coal strike—and 41s. Prices are very weak at the present time. Stocks have been increasing for the past two months.

In armour during 1894 orders have been placed by the English Admiralty with the three Sheffield firms for about 18,000 tons of Harveyed steel plates, the armour being required for the battleships Magnificent, Majestic, Victorious, Prince George, Hannibal, Jupiter, and Mars, and the cruisers Powerful, Terrible, Dido, and Isis. The armour for two Japanese battleships, altogether about 4600 tons, has also been ordered from Sheffield during the past year. Railway and marine material has been in very light request. Not one-third of the productive plant has been employed during the year. Altogether there is very great depression in the general trade, but for some weeks past commercial men have been encouraged by the prospect of inquiries coming forward at the commencement of the New Year from our Colonies—India, South Africa, Australia, &c., and hopes are entertained that the Sheffield houses will be doing at least a greater volume of work during the year 1895 than in that now drawing to a close.

Only two features of the lighter staple trades call for special mention. The settlement of the American tariff has doubled the business done in cutlery with the States during the last three months. In the quarter ending June the total value of cutlery exports to the States was only £6518. In July, the last month under the McKinley tariff, the value was £4822. The new duties came into force in August, and cutlery at once rose to £21,892, and in September to £15,962—a total of £42,677 for the third quarter of the year, against £25,146 for the similar period of 1893. Steel also rose to £52,089, against £40,613 for the corresponding quarter of 1893. The figures for the last quarter of the year will not be obtainable until the beginning of January; but the United States Consul here has been good enough to get them out for me as far as they have gone. The exports for October last are as follows:—Cutlery, £15.928; steel, £22,553; for November, cutlery, £18,691; steel, £29,499. The trading for December shows that the results will compare favourably with that for October and November.

The other point is the preference given to silver goods, owing to the low value of the sterling metal during 1894. Silver has never been so cheap, and this has encouraged householders to pay the little extra sum for the luxury of real silver appointments.

## THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE year is closing with business very quiet; but, on the whole, traders are more sanguine about an improvement next year than they were a month ago—though it must be acknowledged that they do not take as rosy a view of the situation as they did at this time last year. The better tone is brought about by the greater activity in shipbuilding, owners this month having given out orders more freely for new vessels, and it is expected that 1895 will be a brisker year at the shipyards than the closing year has been. Last week Messrs. Blumer and Co., Sunderland, obtained an order for a 3000-ton cargo steamer; and Messrs. William Gray and Co., West Hartlepool, have contracted to build two large steamers, for the carriage of oil and general cargo. Messrs. Doxford, Sunderland, have been commissioned to construct two more steamers of the turret type—of which they were the originators—and on which principle they have built eleven steamers. Most firms will begin the new year with a larger number of orders than last month they had reason to look for, and this is very favourably influencing various departments of the iron and steel industries, inducing traders to believe that we have seen the worst of the depression. The year just ending has been a moderately satisfactory one for shipbuilders in respect to the amount of work they have executed, but as prices have been very low, profits will have been extremely small; indeed, by reason of strikes, many vessels will not have been built for the money the shipbuilder received for them. The output at the shipyards this year has exceeded that of last year, but it falls a good deal short of what could have been executed if trade had called for it. When, however, we consider how seriously operations were hampered at the shipyards during the spring and summer because of the prolonged strikes of moulders, engineers, and patternmakers, it is surprising to see the production as large as it is in this district. There have been no strikes of any moment in the shipbuilding trade proper, all disputes being settled amicably, but the strikes of men outside this particular trade have sadly affected it, for the supplies of castings giving out through the strike of moulders, operations at the yards had in many cases to be suspended for a time. We must characterise these strikes of moulders and patternmakers as disastrous failures—the men after remaining out for nearly half a year for heavy advances of wages, having to resume at the old rates of wages. There was never from the very first any likelihood of the strikes being successful, for the trade was going back instead of improving, and the engineers who also came out quickly recognised the hopelessness of the fight and went back to work where they could get it. The men will have learnt at great cost the lesson that they cannot coerce the market—they cannot force advances of wages if selling prices are declining and work is scarce.

Yet, in spite of these strikes, the output of tonnage at the shipyards on the North-East Coast this year in each district shows a considerable advance, that on the Tyne being 43,415 tons; on the Wear, 44,713 tons; on the Tees, 6718 tons; at the Hartlepools, 12,552 tons; at Whitby, 31 tons; and at Blyth, 2034 tons, a total increase of 109,463 tons as compared with last year. The following table shows the total tonnage of vessels launched on the North-East Coast during each of the last five years:—

| | 1890. Tons. | 1891. Tons. | 1892. Tons. | 1893. Tons. | 1894. Tons. |
|---|---|---|---|---|---|
| Tyne .. .. .. | 234,866 .. | 185,257 .. | 207,211 .. | 147,249 .. | 190,664 |
| Wear .. .. .. | 193,893 .. | 192,150 .. | 190,775 .. | 121,790 .. | 166,503 |
| Tees .. .. .. | 127,740 .. | 121,032 .. | 99,279 .. | 95,115 .. | 101,833 |
| Hartlepools .. | 99,847 .. | 96,983 .. | 90,924 .. | 76,641 .. | 79,183 |
| Blyth .. .. .. | 7,377 .. | 7,005 .. | 8,071 .. | 2,225 .. | 4,260 |
| Whitby .. .. | 8,682 .. | 4,781 .. | 13,267 .. | 2,784 .. | 2,753 |
| | 672,405 .. | 606,392 .. | 609,477 .. | 445,805 .. | 545,206 |

The improvement reported in shipbuilding this month is leading to a better demand for plates and angles, and this is extending to the hematite pig iron trade, but this week, owing to the holidays, there is very little buying. Prices certainly are firmer. Last week some No. 3 Cleveland g.m.b. pig iron was sold by merchants at 35s. per ton—the lowest price of the year, but this brought in a lot of people anxious to purchase, and the price was advanced again until now not less than 35s. 3d. per ton will be taken. There are plenty of consumers ready to buy for delivery over the first three months of next year at 35s., but sellers will not accept that, and it seems to be thought that prices are now as low as we are likely to see them. The warrant market has been closed for two days this week, but prices have been stronger than last week, Cleveland warrants having advanced to 35s. 2½d. No. 4 Cleveland foundry pigs are stiff at 34s. 6d. and grey forge at 33s. 6d. Makers of hematite pig iron in this district expect to find business more tolerable next year, because a heavier demand will follow the improvement in the plate and angle trades, and besides this the price of foreign ore is easing owing to the decline in the rates of freight. Owners of steamers have taken as low as 4s. 7½d. Bilbao-Middlesbrough, where during the summer they got 5s. 6d., and only last month 5s. 1½d. Good Rubio ore can now be bought at 11s. 10½d. delivered on Tees, a price which can leave little to the merchant who has to pay 7s. for the ore f.o.b. at Bilbao. Over half a million tons have just been sold at that figure for delivery over the next quarter.

Most of the finished iron and steel works are closed this week for the holidays, but manufacturers expect when they resume operations to be more regularly employed than they have been in the current quarter. Iron and steel ship-plates are quoted at £4 15s., and iron and steel angles at £4 10s., both less 2½ per cent. and f.o.t. The improvement is not likely to be so much felt in the iron as in the steel-plate trade, because so few of the vessels are built of iron now. Manufacturers would much rather have orders for steel than iron-plates at the above-named price, for the latter cost more. Common iron bars are steady at £4 17s. 6d., less 2½ per cent. f.o.t., and producers are fairly supplied with work for next month. The Tees-side Iron and Engine Works Company, Middlesbrough, have secured an order for about 1000 tons of bridge work, &c., for India. Bridge builders generally are fairly well occupied, as are also the wagon builders. Marine engineers are not doing well, but expect to share in the improvement in the shipbuilding industry. Meantime they are turning their attention more to the production of engines for other work, such as for driving dynamos, rolling mill machinery, &c.

On Wednesday the death took place of Mr. William Middlemass, of Middlesbrough, one of the most extensive of ore importers in the North of England. He was a native of Alnwick.

The coal trade is quiet on the whole, but the output is larger this week than is usual in Christmas week, for a large number of miners are not taking their usual week's holiday. The deliveries on the whole are restricted, as less manufacturing and house coal is required. The consumption of manufacturing fuel has been lessened by the stoppage of so many works, and the extraordinarily mild weather accounts for the poor sale of house coal. Best steam coal is about 9s. per ton f.o.b., and small 3s. 6d. to 4s. The Durham Coal Sales Association keep up the price of gas coals to 7s. 3d. f.o.b. There are now thirty-four of the leading firms connected with this association, and outsiders practically adopt the syndicates' prices. The price of coke is also ruled by a sellers' combination, which maintains it at about 12s. 3d. per ton, delivered to the furnaces on Teesside, a figure considerably above what has formerly been paid when pig iron prices were about the present rates. But as long as the present number of furnaces is kept in operation, and there is no decrease in the consumption, coke is not likely to be reduced in value.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been comparatively little doing in the iron market this week. Business was completely suspended on Christmas Day and the day following, and on the other days of the week the meetings on 'Change in Glasgow were largely formal, with little disposition to buy or sell. The transactions in Scotch warrants were at 41s. 11d. to 42s. cash, and in Cleveland 35s. 1d. to 35s. 1½d. No speculative business is recorded in hematite, and the nominal quotations are for Cumberland warrants 43s., and Middlesbrough 42s. cash.

The furnaces in blast number 71, the same as last week, compared with 28 at this time last year, and there are 25 making hematite and 46 ordinary pig iron.

The week's pig iron shipments were 4310 tons, against 2944 in the same week of 1893.

For makers' special brands the demand is quiet, and the prices in several instances are about 6d. lower. G.M.B., f.o.b. at Glasgow, No. 1, is quoted 43s. per ton; No. 3, 41s. 6d.; Monkland, No. 1, 44s. 6d.; No. 3, 41s. 6d.; Carnbroe, No. 1, 45s. 6d.; No. 3, 43s. 6d.; Clyde, No. 1, 49s. 6d.; No. 3, 46s. 6d.; Gartsherrie, No. 1, 51s. 6d.; No. 3, 47s.; Calder, No. 1, 51s. 6d.; No. 3, 47s. 6d.; Summerlee, No. 1, 53s. 6d.; No. 3, 47s. 6d.; Coltness, No. 1, 54s. 6d.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 50s.; No. 3, 47s.; Eglinton, No. 1, 47s.; No. 3, 45s.; Dalmellington at Ayr, No. 1, 47s.; No. 3, 45s.

The shipments of pig iron from Scottish ports in the past week amounted to 4310 tons, against 2944 tons in the same week of 1893.

In the manufactured iron and steel branches few transactions have been taking place this week. The demand is quiet, and values unaltered. The shipments of iron and steel manufactures from Glasgow embraced sewing machines to the value of £9271; other machinery, £12,814; steel goods, £12,483; and general iron goods, £30,540.

There is a quiet business in coals; about former prices. The home demand is practically met until after the New Year holidays, and the export business is inactive. The past week's coal shipments from the whole of the Scottish ports reached 136,037 tons, which shows an increase of 5201 tons compared with those of the preceding week, but is 38,328 tons less than in the corresponding week.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE tradition of the coal trade, of a spurt before Christmas, and increased activity at all the collieries, steam and house, have been well maintained. Coalowners and shippers are well aware that, when the collier begins his national holiday, there is no dependence upon a speedy resumption of work, and so a pressure is put on to get as much coal out and shipped as possible, and the last week's arrivals show this in a marked degree. At the collieries, on the various lines, and at the ports, good energetic work has been the leading and predominant feature.

Newport showed a good deal of vigorous work. Swansea totalled 50,000 tons instead of its usual averages, which rarely touch 40,000 tons; and the ports of Cardiff, in which I include Barry, sent away the enormous quantity of 325,000 tons. In stating this, it will be seen that at the collieries, and at ports, there was a great degree of activity shown, and it is as certain that this week will afford a very considerable contrast.

The opinion on 'Change, Cardiff, on Monday, was that the great spurt of last week must not be taken as showing improved prospects, good authorities, commenting upon the condition of things, and regarding especially the unsettled views of the colliers respecting the sliding scale, considered the outlook as rather a gloomy one. The business now in hand for January is meagre, unless a speedy alteration takes place, and prices are weaker. Best steam this week is quoted in Cardiff at 11s., good seconds 10s. 3d. to 10s. 6d., and good dry coal 9s. 9d. to 10s., small 4s. 6d. to 5s.

In the matter of house coal it is still not up to the expectations of the principal men in the trade, and the shortest day has been passed without the usual improvement in price. One cause of this is the mildness of the season, and hopes are held out that if this be the only cause, the next three months may bring about a change and improve matters. The best house coal is now only realising from 10s. 9d. to 11s. Cardiff. No. 3 Rhondda sells at 10s. 3d., brush 8s. 6d., small 6s. 6d., No. 2 Rhondda 8s. 9d., thorough 6s. 6d., small 4s. 6d.

In patent fuel there has been increased activity at all ports, especially Swansea, and I am pleased to note that makers are well booked ahead, and prices firm at 10s. 9d. to 11s. Cardiff. So, too, in coke, but while there is more briskness in this trade prices remain, the latest Cardiff being 14s. to 15s.; furnace, foundry, ordinary 15s. to 16s., and special 21s. to 21s. 6d. Swansea anthracite quotations remain at 12s. 3d. to 12s. 6d. for best malting samples.

The best feature of last week in the tin-plate district of Swansea was the great shipment that took place, amounting to 138,865 boxes, or 8000 tons. This made a serious inroad upon stocks, which are now down to 226,000 boxes. There was a large quantity brought from works, 83,325 boxes, and yet I am unable to chronicle any improved signs. Wage questions are still in abeyance in many places, and prices are in the old rut. It will be well, however, to suspend opinion for another week or two, and to note especially if shipments show a steady, not a spasmodic character.

The large consignments of tin-plates from Swansea last week indicated a greater degree of briskness at the steel works, the Cyfarthfa Works in particular exceeding last week their ordinary average make of steel bar. In other branches little has been doing worth noting, the only rails despatched of late have been under 200 tons, principally to Highbridge, on Great Western account.

Iron and steel quotations remain with scarcely the slightest change. In rails a small reduction is perceptible, and instead of £3 12s. 6d. being quoted as the lowest, £3 11s. 6d. is named for heavy rails. This shows how closely makers are "cutting." In Bessemer bars also there is a little difference, and instead of £4 being the minimum, makers quote £3 18s. 6d. to £4, and Siemens best bars at £4 2s. 6d.

I shall not be surprised, as the tin-plate outlook improves after a time—and at the time of my dispatch I hear of important works having come to terms at Llanelly with their men—that an endeavour will be made to get important forward booking at these prices; which certainly are as low as it is possible to get, and could only be managed by a low-wage market.

The wages settlement in the tin-plate trade, to which I have referred, will, I hope, be a precedent for all other works, so that uniformity of price and wage can be maintained. It was brought about at a meeting held in the Athenæum, Llanelly, on Sunday evening. The masters' offer of a 10 per cent. reduction was, after a discussion, agreed to, and now only one trifling matter remains, which is not expected to upset the arrangement; this is that the masters want the men to work forty boxes per shift, and the men only wish to do thirty-five.

The iron ore trade continues very quiet. Best Rubio is now obtainable at 11s., and Tafna and Garucha are quoted at 10s. 6d. to 10s. 9d. The principal ore imports of the week have been, one cargo to Blaenavon, and two to Dowlais.

There was a general meeting of colliers' representatives on Monday at Cardiff, under the presidency of Mr. D. Morgan. With reference to the new society or Union, which is being worked up, the chairman observed that in six months' time it would be composed of between 40,000 and 50,000 members. The society is to be called "The Amalgamated Society of the Colliery Workmen of the South Wales Coalfield," which is about as blundering a title as could be given. A simpler one could easily be named. During the meeting the rules were all reported as passed, and the officers elected. Mr. D. Morgan becomes president, Mr. Grace vice-president; Mr. J. Williams, Ynysybwl, secretary; and Mr. Onions treasurer.

With reference to the contention about the Albion funds, a committee has been formed to endeavour to get concessions from the Provident Fund, but so far no arrangement has been brought about. The committee of the Provident are willing to give an additional 50 per cent. to the Albion widows and orphans if the outstanding monies are paid into their hands, and this is how the question is left at present.

I hear that a meeting will take place in the course of a few days between the selected members of the colliers' representatives on the sliding scale and Mr. Dalziel, secretary of the Coalowners' Association, in order to discuss the revision of the agreement, and all must cordially hope that a peaceable arrangement will be brought about.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE best that can be said of the iron trade in general is that during the week now past no further reductions in price have taken place, and that taking it all through a moderate but rather regular employment has been maintained at the works.

The news received from the Silesian iron market is still anything but good, although a slightly better feeling has been perceptible in some instances, which may be accounted for by a temporary improvement in the demand for some special articles of manufactured iron.

There is little of interest to note in connection with the Austro-Hungarian iron and steel trades. Consumers have been very slow in placing orders, and there is consequently an exceedingly weak tone in the quotations for most articles. The only branch with a little more life in it is the hardware business, demand in Austria and Bohemia and also in the Vienna market having slightly improved upon the week.

In France demand and sale have partially improved; on the whole, however, business on the iron market is dull, and only a very small number of substantial orders have been received at the works. Concerning the condition of prices in the different departments, the general tone is, if anything, rather more weak than formerly.

There is scarcely any change noticeable in the situation of the Belgian iron industry, a quiet tone prevailing in all branches. Official quotations have not altered since former letters. Import in pig iron amounted to 4463 t. in October of present year, against 7237 t. in the year before, and against 4769 t. in 1892. During the first ten months of present year 174,945 t. were imported, against 106,661 t. for the same period the previous year, and against 113,584 t. in 1892. The figures of import in pig iron from Germany are 32,836 t., 27,274 t. and 28,991 t. for the present year and the two preceding years.

The Belgian coal trade shows decidedly more firmness, owing to the cold weather which set in last week. Stocks have been almost cleared in some instances, especially those of medium sorts. Prices for all classes of fuel are maintained with much firmness, and concessions are but rarely agreed to now. In the Moirs district small coal fetches 7·50f. p.t.; house coal, 9f. p.t.; best steam, 11·50f. p.t. In the Liège district higher prices are obtained, best house coal being paid with 13f. to 14f. p.t. Engine classes of fuel are somewhat neglected of late. Export in artificial coal has again considerably increased; in October 46,511 t. were exported, against 26,757 t. in previous year, and against 31,080 t. in October, 1892. Export in artificial coal during the first ten months of present year was 488,392 t., against 397,663 t. for the corresponding period last year, and against 248,121 t. in 1892.

The blast furnace works in the Siegerland report a good amount of fresh orders coming in, some of the larger rolling mills having already covered their demand for the first two quarters of 1895. Prices noted upon the week are: for spiegeleisen, 10 to 12 p.c. grade, M. 51 p.t.; Rhenish-Westphalian forge pig, No. 1, M. 46 p.t.; No. 3, M. 42 p.t.; Siegerland good forge quality, M. 44 p.t.; hematite, M. 63 p.t.; foundry, No. 1, M. 63 p.t.; No. 3, M. 54 p.t.; basic, M. 45 p.t.; German Bessemer, M. 50 to 51 p.t.; iron, for making steel, M. 45 to 46 p.t.; Luxemburg forge pig, 48f. p.t., free Luxemburg. Considerable depression still exists in the malleable iron department, the demand for bars and girders becoming more flat from week to week. Hoops are in pretty fair request, both dealers and consumers buying rather largely at the present reduced quotations. The plate and sheet mills are only partially well occupied; sheets especially meet with an extremely poor request. Wire and wire nails, as well as rivets, continue very dull; even the lowest offers fail to attract the buyers.

Construction shops as well as iron foundries continue, on the whole, but insufficiently employed. Latest list quotations, per ton at works, are as follows:—Good merchant bars, M. 100 to 105; angles, M. 110 to 115; girders, M. 85 to 90; hoops, M. 105 to 108; billets in basic and Bessemer, M. 73 to 77; heavy plates for boiler-making purposes, M. 140 to 145; tank ditto, M. 130 to 135; steel plates, M. 120 to 125; tank ditto, M. 110 to 115; sheets, M. 115 to 130; Sieger thin sheets, M. 120 to 125. Iron wire rods, common quality, M. 92 to 107; wire nails, M. 113 to 115; rivets, M. 145 to 150; complete sets of wheels and axles, M. 270 to 280; axles, M. 220; steel tires, M. 215 to 230; steel rails, M. 108 to 110; steel sleepers, M. 106; fish-plates, M. 112 to 120.

The works of the Saar and Mosel district produced in November, 1894, 28,333 t. forge pig; 58,128 t. basic; and 7022 t. foundry, together 93,483 t. Output is higher by 0·5 p.c. than that of the preceding month of October, when it was 92,999 t. only. In November, 1893, total production was 85,156 t., showing an increase of 9·8 p.c. for same month this year.

## AMERICAN NOTES.

*(From our own Correspondent.)*

NEW YORK, December 18th.

A FATALLY defective currency scheme is to be carried through Congress, which will actually destroy the present national banking system. The Government have lost fourteen million dollars in gold since the bond sales, and another sale is contemplated. General business is now 7 per cent. better than a year ago, but 14 per cent. less than two years ago. An improvement in the iron trade is probable next month. Pig iron production is increasing, and is now 170,000 tons per week against 195,000 tons—the maximum production in good times. The turning point in the manufacturing situation will be reached when the railroads begin to buy and build. There are 175,000 miles of road in need of equipments, and not less than 25,000 miles of projected road to be built. If enterprise dare manifest itself without fear, a pig iron production of eleven million tons will barely meet the requirements. Forge iron is quiet. Inquiries are numerous for billets. Considerable structural material is in demand for delivery during the first quarter of the year.

## IRRIGATION SETTLEMENTS IN AUSTRALIA.

AT the monthly meeting of the Leeds Association of Engineers, the president—Mr. S. Thornton—in the chair, Mr. Henry McLaren, M.I.M.E., read a paper on "The Chaffey Bros.' Irrigation Settlements in Australia." He said that in 1885, Messrs. Chaffey, the leading exponents of irrigation in South California, were invited to visit Victoria with the object of founding a settlement there similar to those in America. Active operations were commenced in October, 1887. With the aid of maps Mr. McLaren explained the scheme of irrigation at Mildura, which, like the sister colony — Renmark — is advantageously situated on the Murray River. No fewer than 25,000 acres are at present laid out; about 15,000 acres have been sold, and 10,000 are under cultivation.

The needs of the irrigators are met by a system of open earthwork channels, conveying the river water to their various allotments, where it is sluiced into ploughed furrows and allowed to permeate the soil. The pumping engines represent 2450 horse-power, the pumps having a capacity of 50,000 gallons a minute. The methods employed in clearing the virgin soil of the eucalypti and other native trees, the processes of scarifying and planting, and the cultivation and treatment of citrous fruit up to stoning, drying, and packing, were severally explained, numerous photographic enlargements serving the purpose of illustration. Fruits such as grapes, figs, oranges, lemons, plums, almonds, apricots, apples, peaches, pomegranates, quinces, passion fruit, &c., are grown in separate orchards, which being laid out geometrically and under constant cultivation, present a strangely beautiful appearance, whilst the homesteads of the English settlers are surrounded by a paradise of fruit and flowers.

Nothing could be more remarkable than the rapid growth of vegetation and the prolific yield of fruit. In six years the land has not only been cleared and planted, but the trees have reached mature size, producing several crops a year, their number being regulated by the frequency of periodic irrigation. During the last season the output from Mildura alone represented a value of £50,000. A population of 3500 is now settled in the colony, including about 500 school children. Mr. McLaren said that there was money in the undertaking so far as the fruit growers themselves were concerned. A discussion followed, in which Messrs. Thornton, Towler, Bowers, Lupton, and Atkinson took part.

NAVAL ENGINEERING APPOINTMENTS. — The following appointments have been made at the Admiralty:—Staff engineer: James J. Frost, to the Sybille. Chief Engineer: W. Pleming, to the Dryad. Engineers: R. St. J. Raper, to the Skate; Charles E. Shorey, to the Contest. Assistant engineers: Edward E. Lewis, to the Hood; Frank S. Moss, to the Dryad; J. B. Huddy and F. A. Gordon (Proby.), to the Sybille.

HULL AND DISTRICT INSTITUTION OF ENGINEERS AND NAVAL ARCHITECTS.—On Monday evening, the 17th inst, Mr. R. B. Kennedy, of Grimsby, read a paper on "Mechanical Refrigeration, with an Outline of its Application," before the members of the above Institution; the President, Mr. F. H. Pearson, being in the chair. Refrigeration dates as far back as 1550, in which year a Roman physician produced an artificial reduction of temperature by dissolving saltpetre in water. In 1607 a combination of snow and saltpetre was used for maintaining low temperatures, and to-day a similar mixture, *i.e.*, pounded ice and common salt, is used for the same purpose in most towns by the ice cream vendors, &c. In the course of the paper Mr. Kennedy explained the various mechanical processes of refrigeration, including the dry rarefied air machine, cold air compression machine, and the gaseous, or liquid, compression and absorption processes, in which anhydrous ammonia, sulphurous oxide, carbonic acid, or ether are largely used by the various manufacturers. The vacuum system, and the two methods of utilising cold, viz, the brine and direct expansion systems, had to be omitted through want of time. The application of refrigerating machinery for cold storage, meat freezing, ice making, extraction of paraffin, brewing, distilling, chocolate making, cooling rooms, hospitals, &c., were then gone into, and many interesting details given as to imports which refrigeration has made possible, such as meat, fruit, butter, eggs, &c. The Australians appear at last to have discovered a method of utilising the rabbit pest, for now large quantities are being killed and forwarded to this country in cold storage vessels, and have so far realised a handsome profit. In the discussion that followed the following gentlemen took part:—Messrs. F. H. Pearson, S. Simpson, W. B. Dixon, and A. N. Somerscales, the lecturer replying to the points raised. At the close a hearty vote of thanks was accorded Mr. Kennedy for his able and most interesting paper.

## THE PATENT JOURNAL.

*Condensed from "The Illustrated Official Journal of Patents."*

### Application for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

*11th December*, 1894.

24,064. SPINNING FLAX, R. H. S. Beade and H. McKibbin, Manchester.
24,065. MACHINERY for DRYING GRAIN, C. Mallinson, Liverpool.
24,066. UMBRELLAS, S. G. Rawson, Liverpool.
24,067. ORGANS, &c., R. Hope-Jones, Liverpool.
24,068. AUTOMATICALLY LOCKING CARRIAGE DOORS, J. Trantom, Liverpool.
24,069. CLOSING DEVICE for WATER PASSAGES, H. Kägi, Liverpool.
24,070. SUPPLYING AIR in DRYING MACHINES, J. Higginbottom, Liverpool.
24.071. MANUFACTURE of BARRELS, &c., J. Polke, London.
24,072 WIRE MATTRESSES, H. Reinhold, London.
24 073. WRAPPING MACHINES, I. R. Hutchinson, London.
24,074. FLUID METERS, A. J. Boult.—(*Hegenscheidt Bros. and T. Derichs, Belgium*.)
24 075. REGULATING ELECTRIC DYNAMOS, T. D. and F. W. Hollick, London.
24 076 TELEGRAPHIC TRANSMITTING APPARATUS, B. Hoffmann, London.
24,077. FASTENINGS for DOOR KNOBS, F. H. Richards, London.
24,078. FLUID BRAKE MECHANISM, C. G. Emery, London.
24,079. CLEANING COFFEE, H. H. Lake.—(*D. B. Fraser, United States*.)
24,080. OIL PURIFIERS, D. H. McClelland and R. D. Jackson, London.
24 081. HEATING ATTACHMENTS for STOVES, J. Guy, London.
24,082. BOX for LANTERN SLIDES, T. Clement, London.
24 083. SWING BACK for PHOTOGRAPHIC CAMERAS, H. H. O'Farrell, London.
24 084. GAS ENGINES, V. Holliday, London.
24,085. WASH for CATTLE TRUCKS, C. T. Macadam, London.
24,086. HANDLES for MINERS' PICKS, T. H. Thacker, London.
24,087. ROASTING COFFEE BERRIES, N. H. Jensen, London.
24,088. VELOCIPEDES, P. H. J. Willis.—(*W. C. Foster, United States.*)
24,089. GAS ENGINES, G. C. Marks.—(*F. Hirsch, United States.*)
24,090. WHEELS for VELOCIPEDES, R. W. Thomas, London.
24,091. HANDLES BARS for BICYCLES, R. W. Thomas, London.
24,092. DISINTEGRATING THOMAS SLAG, E. Meyer, London.
24,093. BOOTS and SHOES, H. H. Lake.—(*Lincoln Sewing Machine Company, United States.*)
24,094. PORTABLE SEAT for SPORTSMEN, E. Keller, London.
24,095. COLOURING MATTERS, F. B. Aspinall, London.
24,096. MANUFACTURE of CARPETS, F. A. Bontor, London.
24,097. PUMPS for COMPRESSING FLUIDS, S. Puplett, London.
24,098. METALLIC STRUCTURES, G. E. Church and G. W. Ettenger, London.
24.099. ENVELOPES, W. M. Walker, London.
24.100. BOOTS, A. Wisotzky, London.
24,101. SEXTANT ATTACHMENTS, A. M. Clark.—(*T. T. H. Ferguson, China.*)
24.102. PREVENTION of SEA-SICKNESS, F. W. Kimball, London.
24,103. OXIDATION of FIXED OILS and FATS, S. Banner, Liverpool.
24,104 CARDING APPARATUS, W. P. Thompson.—(*Messrs. Seydel and Co.*, ——.)
24,105. NET TRAP, J. Morris, London.
24,106. CAGE TRAP, J. Morris, London.
24,107. PURSES, H. de Vere Pery, London.
24,108. GRIP for ROPE HAULAGE, S. Oliver and T. Ainsley, London.
24,109. DARK SLIDES for CAMERAS, M. A. Stubel, London.
24,110. CIRCULAR PETROLEUM BURNER, O. Wollenberg, London.
24,111. TUBULAR STEAM BOILERS, A. F. L. Reussner, London.
24,112. "SULKY" SPRING-TOOTH HARROWS, G. G. M. Hardingham.—(*The J. W. Mann Manufacturing Company, Canada.*)
24,113. MANUFACTURE of VINEGAR, J. Holt and J. G. Lorrain, London.

*12th December*, 1894.

24,114. REGULATING FEED-WATER, H. Bowman, T. S. McDonald, and G. F. Ross, London.
24 115. CASTORS, A. Bruce, Dundee.
24,116. TIRES, J. Almond, Manchester.
24,117. SEA-SHORE RESCUE APPARATUS, F. Wellington, London.
24,118. MECHANISM for PRODUCING MOTION, G. J. Stoney, London.
24,119 SAFETY APPARATUS for BESSEMER CONVERTERS, G. R. H. Bowden, Merthyr Tydvil.
24,120. CORD GUIDES for BLIND ROLLERS, J. Robertshaw, Manchester.
24,121. KNIFE-CLEANING MACHINES, J. A. Samuels, London.
24,122. WASTE-PREVENTING FUNNEL, J. A. McPherson, Bristol.
24,123. SOUND-PRODUCING APPARATUS, T. Mudd, West Hartlepool.
24,124. SPRINGS for CYCLE SADDLES, J. B. Brooks, Birmingham.
24,125. TOY, J. Quarton, Birmingham.
24,126. MANUFACTURE of BEDSTEADS, S. Wilson, Birmingham.
24,127. APPLIANCES for TABLE GAMES, R. Wallwork, Manchester.
24,128. WINDOWS, J. Barton, Glasgow.
24,129. DRIVING BELTS, W. Muir, Glasgow.
24,130. FASTENINGS for SLEEVE LINKS, F. Griffith, Birmingham.
24,131. VELOCIPEDES, W. F. Taylor and G. J. Philpott, Croydon.
24,132. RAILWAY FOG SIGNALLING APPARATUS, R. Reed, Lincoln.
24,133. GAS ENGINES, W. E. Heys.—(*L. Letombe, France.*)
24,134. BALL-POINTED HAIR-PINS, W. E. Heys.—(*C. Beaumont, France.*)
24,135. LAWN MOWERS, O. E. Zohe and H. A. Knapp, London.
24.136. REVERSIBLE SWITCH WALL SOCKET, W. J. Fryer, London.
24,137. FUEL ECONOMISERS, A. Lowcock, Manchester.
24,138. DUTCH OVENS, W. J. Porter, Birmingham.
24,139. UTILISING SLAG, J. Bromilow, Wellingborough.
24,140. APPARATUS for RAISING WRECKS, G. A. Russell, Newport.
24,141. LOOM SHUTTLES, J. Waddington, Bradford.
24,142. STARTING, &c., MACHINERY, J. H. Scott, Glasgow.
24,143. SPINNING TOPS, S. Erhard, Halifax.
24,144 VENTILATING BOOTS and SHOES, H. J. Pond, Norwich.
24,145. CONSTRUCTION of HAIR-PINS, C. Beaumont, Manchester.
24,146. HIGH-PRESSURE SAFETY BALL-VALVE, S. Shears, Exeter.
24,147. FIRE-DOORS for BOILER FURNACES, G. H. Pilling, Manchester.
24 148. COOKING RANGES, L. H. Teale and R. M. Somers, Leeds.
24,149. BRUSH and BLACKING BOX, J. Hunter, Renfrewshire.
24,150. APPLIANCES for FEEDING BOILERS, A. W. Binning, Glasgow.
24,151. REST for BILLIARDS, G. R. Short, Merthyr Tydvil.
24,152. DRIVING GEAR for BICYCLES, J. J. Raggett, Birmingham.
24,153. LIQUID STRAINERS, P. Watson, Keighley.
24,154. LAVATORIES, J. T. Twist, Glasgow.
24,155. REEL or WINCH for TOWING LINES, W. H. A. Theed, Penzance.
24,156. MAKING LEATHER, R. Pope and A. Cleaves, Bristol.
24,157. SHIRT FRONT STIFFENER, W. E. and B. A. Manning, London.
24,158. DRIVING ACTION, J. Turnbull, Plumstead, Kent.
24,159. BOOT HEELS, M. Schweiger and N. Becker, Halifax.
24,160. SIZING and SLASHING MACHINES, T. Crook, London.
24,161. SUPPORTS for SIGNAL, &c., RODS, A. G. Evans, London.
24,162. GEARING for DRIVING CYCLES, A. van Noorden, London.
24,163. TUBULAR FRAMES for CYCLES, R. S. Lovelace, London.
24,164. SEWING MACHINES, W. P. Thompson.—(*C. Clausen, Germany.*)
24,165. MEANS for SECURING DOORS, A. B. Buckland, London.
24,166. PENS and PENCILS, E. Whitworth, London.
24,167. PREVENTING JOURNALS HEATING, G. A. Mower, London.
24,168. BOAT RELEASING APPARATUS, J. C. Robinson, London.
24,169. STACK and ROOT-LUMP PROTECTORS, L. H. de V. Shaw, London.
24 170. SELF-REGISTERING THERMOMETERS, S. Richardson, London.
24 171. WEATHER CHECKS, W. Youlten, London.
24,172. SPINNING BOBBINS, L. Oliven, London.
24.173. ELECTRIC MOTORS, H. H. Lake.—(*H. Guttman, Germany.*)
24,174. FEEDING PRINTING MACHINES, H. C. Watson, London.
24,175. PAPER-FOLDING MACHINES, H. C. Watson, London.
24,176. SHIRTS, A. E King, London.
24.177. STARTING TRAMCARS, &c., E. Chadwick, Liverpool.
24,178. CLEANING SURFACES, J. Waterhouse and W. G. Naylor, Liverpool.
24,179. RECORDING PIECES of MUSIC, A. Simon, London.
24,180. WASHING-MACHINES, A. Panne, London.
24,181. BRACELET-FASTENING DEVICE, G. Dattlebaum, London.
24,182. POLISHING SHEET METAL, Ingall, Parsons, Clive, and Co., Ld, and W. H. Elkington, London.
24,183. BUTTONS, T. Cook and J. H. Ingle, London.
24,184. NECKTIE-FASTENERS, J. H. Hines, jun, London.
24,185. DRIVING-GEAR for CYCLES, H. P. Villevé, London.
24,186. SHIRTS, J. Hatfield, London.
24,187. SECURING HOLLOW RINGS in POSITION, B. Willcox.—(*The firm of C. Zeiss, Germany.*)
24,188. REAPING, &c., MACHINES, A. and J. Shanks, London.
24,189. STOP-VALVES, E. Edwards.—(*A. Anders, Germany.*)
24,190. ADJUSTABLE SPANNERS, E. Edwards.—(*O. Schach, Germany.*)
24 191. DAMPING PRESS-COPYING LETTERS, J. R. Greenhalgh, London.
24,192. PROTECTING TYPE-WRITERS from DUST, J. R. Greenhalgh, London.
24,193. DRYING GARDEN TURF, J. O. McQuone and W. J. Baker, Scarborough.
24,194. MULTIPLE FUSE BOX, E. A. Parson and H Millar, Philadelphia.
24,195. CONTROLLING MAGNETIC ENERGY, H. M. Paine and A. R. Brandley, Philadelphia.
24,196. DRILLING MACHINES, W. W. Hulse, London.
24,197. SYSTEM of SIGNALLING on RAILWAYS, E. Prew, London.
24,198. ELECTRICAL RESISTANCES, A. J. Marquand, E. Hancock, and D. Lowdon, London.
24,199. COMPOSITIONS for COATING BOILERS, J. A. Fisher, London.
24,200. WASHING MACHINES, C. E. Halls, London.
24,201. CUFFS, G. H. Halley, London.
24,202. PENHOLDERS, H J. Griffith, London.
24,203 DETACHABLE PIPE COVERS, S. H. Crocker, London.
24,204. MOWING MACHINES, W. G. Sidley, London.
24,205. PASTRY BOARD, H. J. Griffith, London.
24,206. INKSTAND, A. Howell, London.
24,207. TOBACCO PIPES, F. D. Jones, London.

*13th December*, 1894.

24,208. INDICATOR for GAUGES, T. Gibson, R. H. Ealey, and J. Thorpe, Huddersfield.
24,209. COUNTING ATTACHMENT, S. A. N. Deluce, Manchester.
24,210. BALLING INSTRUMENT for HORSES, H. Sewell, Northamptonshire.
24,211. RAILWAY PERMANENT WAY, A. J. Hamilton-Smythe, London.
24,212. METHOD of SIGNALLING, G. Blakeley, Bournemouth.
24,213. LADIES' PURSES, H. A. Wanklyn, London.
24,214. CARDBOARD BOXES, H. A. Wanklyn, London.
24,215. CYCLISTS' TROUSER RETAINER, R. S. Boyer, London.
24.216. COMPOSING STICKS, R. W. Barker.—(*N. S Perkins, United States.*)
24,217. SPINNING FRAME TRAVELLERS, H. Whittaker, Halifax.
24,218. CASH CARRIERS, The Henderson Store Railway, Ld.—(*The Barr Cash and Package Carrier Company, United States.*)
24,219. RAILWAY SIGNALLING APPLIANCES, E. Williamson, Nottingham.
24,220 STUD and SOLITAIRE FASTENINGS, T. Wall, Birmingham.
24,221. METALLIC GLAND PACKING RINGS, C. Geddes, Hartlepool.
24,222. ADDITIONS to WAIST BELTS, &c., P. A. Martin, Birmingham.
24,223 SPINNING and DOUBLING COTTON, H. Stuttard, Oldham.
24,224. VALVE GEAR for MOTIVE-POWER ENGINES, W. Walker, Erith, Kent.
24,225. DRESS HOLDERS or SUSPENDERS, E. A. Rickett, Liverpool.
24,226. LOCKING DEVICES for CYCLES, T. E. Weaver, Wolverhampton.
24.227. FASTENINGS of UMBRELLAS, W. Holland, jun., Birmingham.
24,228. GOLF BALLS, J. H. Exley, Bradford.
24,229. PORTABLE INCANDESCENT GAS LIGHT APPARATUS for PHOTOS, P. H. D. Buttrum and W. Thorneycroft, Newport Pagnell, Bucks.
24,230. GULLY TRAPS and GRATINGS, R. Taylor and J. S. Green, Manchester.
24,231. COIN PREPAYMENT METERS, D. B. Peebles, Glasgow.
24 232. CLEARING HOOK for ANGLERS, H. Warry, Totnes.
24,233. GRINDING and CRUSHING MILLS, P. A. Cook, Liverpool.
24 234. REFLECTORS, P. Körber, Glasgow.
24,235. AMMUNITION, A. F. Hargreaves, Midlothian.
24,236. PENDANTS, W. Beal, Birmingham.
24,237. STRETCHING, G. F. Butterworth, Manchester.
24,238. SEWING MACHINE NEEDLES, L. H. Smith, Glasgow.
24,239. GAS ENGINE, S. Withers, London.
24,240. APPARATUS for FLYING, W. Smith, Aberdeen.
24,241. CYCLE SADDLES, R. E. Phillips, London.
24,242. AFFIXING STAMPS, A. Welsh and W. Muir, Glasgow.
24,243. CHAIRS, G. Taggart, Glasgow.
24,244. STOCKINGS, W. Munro, Glasgow.
24,245. PREVENTING SHUTTLES FLYING OUT, W. Aitken and J. Angus, Galashiels.
24,246. CHANGE GIVER, W. Busse, London.
24,247. UMBRELLA FASTENER, E. C. Lea and D. Parker, London.
24,248. CHEEK PLUMPER, E. Bowland, London.
24,249. PACKAGE for TRANSPORTING LIQUIDS, H. B. Care, London.
24,250. WHEELS for VEHICLES, T. S. Truss, London.
24,251. CULTIVATOR TEETH, L. M. Jones and W. F. Johnston, London.
24,252. STARTING TRAMCARS, J. C. Fisher, London.
24,253. TOBACCO PIPES, W. R. Yates, London.
24 254. TORPEDOES, E. O'Neill, London.
24,255. GAME, H. T. Berry, London.
24,256. GASHOLDER, W. H. Westwood, E. T. Wright and W. W. S. Westwood, London.
24,257. LIFEBOAT, J. H. Raffety, West Worthing.
24,258. BUCKLE, W. Pritchard and T. E. Williams, London.
24 259. CYCLE WHEELS, M. Kohl and L. Serwotka, London.
24,260. SWING, C. Zeisberg, London.
24,261. CYCLE CRANK, J. Boyd, Dublin.
24.262. SURGICAL INSTRUMENTS, J. E. Arnold, London.
24,263. HORSESHOE, J. L. Ley, A. C. McIver, and G. M. Gordon, London.
24,264. PLATEN PRESSES, G. Eastwood, London.
24,265. GAS STOVES, W. Dresser, London.
24,266. ELECTRO-MOTORS, A. Bergtheil and R. A. Marples, London.
24,267. BOILERS, Simpson, Strickland, and Co, and F. Strickland, London.
24 268 EYEGLASSES, T. Smith, London.
24,269. LIFTING TACKLES, A J. Boult.—(*C. Foccroulle, Belgium.*)
24,270. EMBOSSING STAMPS, W. R. Mudd, London.
24,271. BOTTLE, W. V. Bokern and H. Heatley, London.
24,272. LETTER HOLDER, R. K. Birkbeck, London.
24,273. SUPPORTS, J. D. Reed, London.
24,274. COLLECTING DUNG, E. M. Milborne Swinnerton-Pilkington, London.
24,275. SELF-ACTING MULES, G. Josephy, London.
24,276. ROPES, B. Kirsch and A. Pessl, London.
24,277. WARP BEAM TENSION APPARATUS, J. Taylor London.
24,278. METALS, C. D. Abel.—(*Electricitäts Gesellschaft Gelnhausen mit beschrankter Haftung, Germany.*)
24,279. TIRES, W. Mackintosh, London.
24,280. BICYCLES, E. Jonckheer, London.
24,281. SHIPS' DAVITS, S. O. Cowper-Coles, London.
24,282. GLASS GAUGES, H. H. Lake.—(*The Penberthy Injector Company, United States.*)
24,283. STEAM PLOUGHS, R. Pearson, London.
24 284 PREVENTING WITHDRAWAL of CORKS, J. Eskdale, London.
24,285. ELECTIC LIGHTING, A. G. New and A. J. Mayne, London.
24,286. COAT HANGER, W. J. Cowley, London.
24,287. SMOKELESS FURNACE, C. A Jensen.—(*R. Müller, Norway.*)
24,288. CARDING, E. Gessner, London.
24,289. GUNS, H. H. Lake.—(*J. B. G. A. Canet, France.*)
24,290. SPANNERS, H. Salsbury, London.
24,291. SECURING TERMINAL WIRES, F. A. and N. von Alimonda, London.

*14th December*, 1894.

24,292. COOKING RANGE, J. A. Pearce, Tavistock.
24,293. DETERMINING HEAT, W. E. Ayrton and H. C. Haycraft, London.
24,294. PROPELLER SHAFTS, W. B. Thompson, Dundee.
24,295. FLANGING FURNACES, W. Deighton, Leeds.
24,296. SIGNALS, V. L. Baven and C. Baister, Stockton-on-Tees.
24,297. POROUS CELL, W. McChleary, Glasgow.
24,298. FILLING PASTE, J. McMaster, Liverpool.
24.299. INFLATOR CLIPS, H. Hill, Sheffield.
24,300 MOP, C. T. and M. D Hale, Birmingham.
24,301. TALLY MARKER, R. D. O'Brien, Birmingham.
24,302. TURN-TILE, W. T. Ellison, Manchester.
24,303. GAS FITTINGS, J. and J. Parkes, Birmingham.
24,304. SLIDING SASHES, J. Donnelly, Longport.
24,305. COMBS, A. N. Sharp, and S. Metcalfe, Bingley.
24,306. LIQUID-SPREADING MACHINES, E. Wilkinson, Norwich.
24,307. FLANGE WATER-PIPE COUPLINGS, J. Graham, Workington.
24,308. GERM EXTRACT, T. Chamings, Exeter.
24,309. LOOM PICKING APPARATUS, B. Ross, E. Moorhouse, and M. O'Neill, Bradford.
24.310. PRODUCING ANTISEPTICS by OZONE, E. Andreoli, London.
24,311. GRINDING CARD FILLETING, J. S. and J. Dronsfield, Manchester.
24.312. LACE HOLDER for BOOTS, E. F. Haynes and T. S. Griesbach, Birmingham.
24.313. ALUMINATES of ALKALIES, A. G. von Grätz, London.
24,314. BLOCKS and GINS, T. V. Moody, Mill-on-Tyne.
24,315. BLACK LEAD SHARPENER, E. T. John and A. Charles, Cardiff.
24,316. LOCOMOTIVE ENGINES, J. W. Willans, Leeds.
24,317. BOTTLES, P. S. Brown and H. J. S. Brown, Glasgow.
24,318. STEAM ENGINES, J. R. Bird, Glasgow.
24,319. WHEELS for CYCLES, &c, J. L. Corbett, Glasgow.
24 320. FEED-WATER HEATERS, C. A. Knight and G. W. Thode, Glasgow.
24,321. MOTORS, H. D. Fitzpatrick, R. McL. McDonald, and A. Nimmo, Glasgow.
24,322. CURING SORES, &c., on ANIMALS, J. Smith, Glasgow.
24,323. GAS GENERATORS for FURNACES, W. Muirhead, Glasgow.
24,324. REGULATING WATER in PIPES, J. Tweeddale, Paisley.
24,325. TERICYCLE, R. Milligan, Hawick.
24,326. MEASURING and MARKING TUCKS, E. Grimes, Norfolk.
24,327. NECKTIES, W. Ruttenau and C. Hahlo, Manchester.
24,328. PIANOFORTE PEDAL ATTACHMENT, T. Smith, Liverpool.
24,329. A SANITARY DOMESTIC FILTER, F. Thomas, London.
24,330. PREVENTING CYCLES SLIPPING, W. A. Medland and W. C. Shillito, Twickenham.
24,331. A NEW CAP, E. Iredale and W. H. Iredale, London.
24,332. DRIVING GEAR for CYCLES, &c., E. A. Seyd, London.
24,333. RAZOR STROPS, S. D. Lacey, London.
24,334. CHALK HOLDER for BILLIARDS, A. Stewart, London.
24,335. VELOCIPEDES, S. J. Kent, London.
24,336. VELOCIPEDES, S. J. Kent, London.
24,337. FASTENING BOOTS and SHOES, F. J. Tregoning, London.
24,338. TEATS, F. T. Fletcher, London.
24,339. CHIMNEY POTS, F. T. Myerson and T. Lane, London.
24,340. ELECTRICAL NAIL DETECTOR, F. Jones, London.
24,341. TRANSMITTING POWER from PRIME MOVERS, A. B. Greig, London.
24,342. CONDENSING PHOTOGRAPHIC LENSES, J. Harrington, London.
24.343. SUPPORT for RAILWAY TRAVELLERS, C. Larue, London.
24.344 DECORTICATING FIBROUS PLANTS, J. C. Walker, London.
24,345. MOTORS, A. Gardon and A. Butavent, London.
24 346. DRAUGHT EXCLUDERS, E. J. Sherman, London.

24,347. Manufacturing Cycle Wheels, M. Pedersen, London.
24,348. Manufacturing Boots and Shoes, C. Lewis, London.
24,349. Pianofortes, J. L. Courtice and J. Wood, London.
24,350 Steam Traps, J. H. Brinjes London.
24,351. Manufacture of Cigarettes, W. S. Holding, London.
24 352. Fixing Tubes in the Barrels of Fire-arms, H Ehrhardt, London.
24 353. Brackets for Poles, Siemens Bros. and Co , Ld., and G. W. Perry, London.
24,354. Saucepan Handles, C. F. Clark, J. Sanders, and J. Webster, London.
24,355 Cords for Blinds and the like, A. B. Dashwood, London.
24,356. Tobacco Pipes, G. Sant London.
24 357. Paper Weight, A. Pritchard, London.
24 358 Machines for Mincing, &c., W. F. Anderson, London.
24,359. Driving Gear for Velocipedes, A. F. Bowers, London.
24.360. Coating Iron with Nickel, The Cowper-Coles Galvanising Syndicate, Ld., and S. O. Cowper-Coles, London.
24,361. Transposing Music, G. E. Prince, London.
24,362. Construction of Ships, &c., A. M. Wood, Surrey.
24 363. Bicycle, A. Lambert, London.
24,364. Treating Battery Slimes, P. De Wilde, London.
24,365. Composition for Use with Fertilising Substances, A. L. Radford and M. F. Hutton, London.
24,366. Mouthpiece for Musical Instruments, W. P. Thompson.—(*C. G Schuster, Germany* )
24,367. Mangles, I. Braithwaite and E J. Stanley.—(*Messrs. A. T. Hagen and Co., United States* )
24,368. Joining the Ends of Machine Belting, W. Davidson and T. Denholm, Liverpool.
24,369. Electric Bells or Alarms, J. T. Brierley, Liverpool.
24 370. Bags for Keeping Bottles Hot, S. G. Edmonds, Liverpool.
24,371. Driving Belts for Machinery, T. C. Dennison, London.
24,372. Shade Holders for Gas, S. Sinauer.—(*The Utility Shade Company, United States* )
24,373. Propelling Screw Steamers, M. Sandison, London.
24,374. Insulation of Electric Wires, F. Clouth, London.
24,375. Tandem and other Bicycles, E. C. Hill, London.
24,376. Brake for Wheels of Cycles, S. Hilton, London.
24,377. Direct-acting Pumping Engine, J. Patterson, London.
24,378. Doll, F. G. Lloyd.—(*W. Bevan, New Zealand.*)
24,379. Drying Coffee and other Grain, A. F. Ramos, London.
24,380. Repairing Damaged Natural Teeth, M. Salier, London.
24,381. Curing Tobacco, H. Neill.—(*H. A. Wickham, Australia.*)
24,382. Flushing Tanks, L. Janlet, London.
24,383. Flushing Tanks, L. Janlet, London.
24,384. Sieve, W. P. Thompson.—(*E. Picard, Belgium.*)

*15th December*, 1894.

24,385. Electric Supply Meters, J. Perry, London.
24 386. Driving Gear, W. J. Hamilton and W. Leatham, Belfast.
24,387. Card or Pattern Cylinder, P. H. Hartley, Lancashire.
24,388. Bi-autographic Check Tills, E. M. Sellors, Dublin.
24,389. Hat and Umbrella Holder, G. H. McKay, Glasgow.
24,390. Spoons, P. McInnes, Glasgow.
24,391. Poker, J. V. Moore and T. E. Dunnett, London.
24,392. Castor Pegs for Bedsteads, S. Wilson, Birmingham.
24,393. Card Stampers, J. Cash, S. Cash, and T. Cash, London.
24,394. Fluid Pressure Motors, J. Mackintosh, Dundee.
24,395. Manufacturing Block Tin Piping, A. Barraclough, Yorks.
24,396. Safety Appliances for Lifts, C. and A. Musker, Liverpool.
24,397. Boxes for Holding Twine, &c., G. C. Paton, Glasgow.
24,398. Manufacturing Traverse Net Lace, R. Scott, Nottingham.
24,399. Lubricators, W. Greenhalgh, Leeds.
24,400. Machine for Bundling Firewood, E. Needham, Shepton Mallet.
24,401. Clip for Marking Music, &c., G. H. Davies, London.
24,402. Portrait or Picture Frames, R. Hall, Manchester.
24,403. Curtain Poles and Brackets, T. Little, Manchester.
24,404. Separating Hair from Hides, J. Marshall, Manchester.
24,405. Ink Eraser, E. T. John and C. W. Chabrel, Cardiff.
24,406. Ventilating Cyclists' Clothing, J. B. Smith, Birmingham.
24,407. Urinals, F. A. Wells, Manchester.
24,408. Forming Box Pleats, H. M. Speakman and W. E. Kerslake, Liverpool.
24,409. Axle-box for Cycles, E. Hettich, Berlin.
24.410. Cigarette Cases, J. and J. Wertheimer, Manchester.
24,411 Manufacturing Raw Spirit, K. von Radziszewski, Berlin.
24,412. Couplings for Railway Wagons, A. Cameron, Glasgow.
24,413. Lubricators, G. B. Goodfellow and E. A. Pickup, Manchester.
24,414. Pumping Apparatus, J. Gwynne, London.
24.415 Slides of Presses, J. W. Hunt and The Chillington Tool Company, Ld., Wolverhampton.
24,416. Handle-bars of Bicycles, W. H. Boyington, London.
24,417. Keyboards for Pianofortes, J. Clarkson and F. W. Merridew, Manchester.
24,418. Draw-off Cock and Safety-valve, A. Marriage, London.
24,419. Puzzle, E. G. Stevens, London.
24,420. Fastening Hats and Bonnets, R. H. Courtenay, London.
24,421. Adjustment of Lamp Chimneys, R. Campe, London.
24,422. Grip for Carrying Parcels, F. Mann and H. H. Akers, London.
24,423. Railway Signalling Devices, A W. Ellis and S. A Payne, London.
24,424. Railway Signalling Apparatus, C. M. Hope, London.
24,425. Lamps for Cycles, F. E Wilkins, London.
24 426. Feeding-troughs for Pigstyes, G. Brain, jun , London.
24,427. Combination Tool, J. Boorer, London.
24,428. Stoves or Fireplaces, A. R. Smith, London.
24,429. Binding of Sheets and Cards, E. B. Smith, Harrow-on-the-Hill.
24,430. Pumping Well Bores, W. Mather, London.
24 431. Posts, Siemens Bros. and Co. and G. W. Perry, London.
24,432. Driving Gear of Bicycles, R. Blackburn and A. B. Spring, London.
24,433. Boxes for Tooth Brushes, T. Bellis, London.
24,434. Toasting Forks, H. E. Aspinall and W. Barwell, London.
24,435. Door-closer and Lubricator, H. Kühn, London.
24,436. Sash Fastener, J. Eastham, London.
24.437. Pails, W. H. Brookes and Moodys and Kelly, London.
24,438. Lamp Globes and Lamp Glasses, C. Jousset, London.
24.439. Moving Wheeled Carriages, J. W. Couchman, London.
24 440. Connecting Telegraph Wires, W. B. Shaw, Liverpool.
24,441. Preventing Electrical Sparks, W. Ostwald, London.
24,442. Gelatine Sheets, F. Blenkins and F. G. Bate, London.
24,443. Cleansing Tires, J. Argylle and A. Argylle, London.
24,444. Sweater, P. O'Neil. London.
24,445. Pneumatic Tires for Wheels, P. A. Craven, London.
24,446. Manufacture of Perfumes, M. Otto and A. Verley, London.
24,447. Distilling, M. Otto. London.
24,448. Hair-pin, T. A. Nixon and C. V. Craster, London.
24,449. Connecting Belts, J. Gothard and L. A. Parrock, Birmingham.
24,450. Watches, W. Cross, London.
24 451. Indicating Distances Travelled, W. Vernum, London.
24,452. Grain Binders, W. C. Barker, London.
24,453. Disintegrators, J. H. Carter, London.
24,454. Apparatus for Dyeing Hair, A. Gasthuys, London.
24,455. Cigarettes and Cigars, J. Horwitz, London.
24,456. Securing Flanges to Pipes, C. Wellin.—(*C. Vassel, France* )
24,457. Evaporating Liquors, &c , E. G. Scott, London.
24,458. Announcing the Departure of Trains, H. Stockheim and O. Strohbach, London.
24,459. Tobacco Pipes, C. Weissenborn and W. Feige, London.
24,460. Elastic Springs for Dobby Machines, R. H. Attwater, London.
24,461. Making Armour Plates, S. O. Cowper-Coles, London.

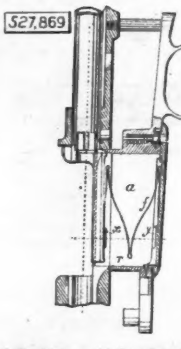
## SELECTED AMERICAN PATENTS.

*From the United States Patent Office Official Gazette.*

**527,869.** Magazine for Breech-loading Fire-arms, *P. Mauser, Oberndorf, Germany.—Filed September 15th*, 1893.

*Claim.*—(1) In a breech-loading bolt gun, the receiver, the magazine, and bolt, in combination with a trigger-guard consisting of a single integral piece of metal having the fixed cartridge magazine *a* in its forward part said guard having upright walls surrounding said magazine and seating at top against the under side of said receiver, said guard having grooves *s* at bottom, and the bottom plate for said magazine removably connected thereto, and having lugs *r* entering said grooves and retaining said plate in position on said magazine, and a snap catch carried by said guard and engaging said plate for preventing separation of the latter. (2) In a breech-loading bolt gun, the receiver and bolt, in combination with a magazine *a* and a carrier plate *b* thereon having a rib $b^1$ on its upper face, and projections *x* on its under face, of a trigger guard having said magazine formed in its forward part, a bottom plate *c* closing said magazine, and having projections *y*, and a leaf spring *f* in said magazine connected to said bottom plate by said projections *y* and to said carrier plate by said projections *x*, substantially as set forth.

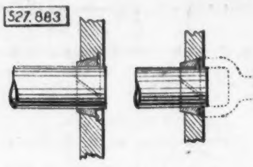
527,869



**527,883.** Tube Joint for Sectional Boilers, *N. W. Pratt. Brooklyn, N.Y.—Filed March 28th*, 1891.

*Claim.*—(1) A means of securing a tube in its seat, a divided ring or collar of ductile material having its inner bearing surface conformed to the tube and its outer surface to a tapered seat in the sheet, plate, or header to which the tube is secured. (2) The herein described tube connection, consisting of a tube seat therefor of tapered form and having an annular groove therein, and a soft metal annulus adapted to the tube and its seat and having a projection for caulking the annulus in place and adapted to interlock with said annular groove.

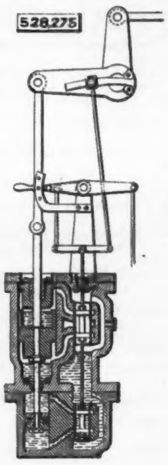
527.883



**528,275.** Engine Reversing Gear, *C. E. R. Martin, Philadelphia, Pa.—Filed March 29th*, 1894.

*Claim.*—(1) The combination of the cylinders and pistons, of the link controlling lever connected to said pistons, valves for said cylinders, a valve stem, two pivoted levers, one connected to said valve stem, and the other to a speed governing mechanism, and means for locking said levers together, substantially as described. (2) The combination of the cylinders, pistons therein, a piston-rod extending from said pistons and connected to the link controlling lever of the engine, the valves, a valve stem, a floating lever centrally connected to said valve stem, a reversing lever connected to one end of said floating lever, and the opposite end thereof being operatively connected to the link controlling lever, an automatic speed-governing mechanism and a lever operatively connected thereto and adapted to be locked to the reversing lever, substantially as described.

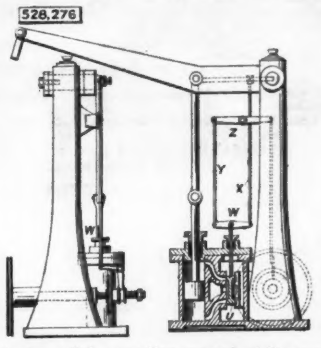
528,275



**528,276.** Engine Governor, *C. E. R. Martin, Philadelphia, Pa.—Filed February* 1st, 1893.

*Claim.*—(1) In a steam engine governor, the combination of a threaded spindle driven by the engine, a sleeve loosely mounted on the said spindle and driven by an independent motor, a piston connected with the reversing gear of the engine, a valve controlling said piston, connections between said valve and the loose sleeve, and connections between said valve and the reversing gear of the engine. (2) The combination of a piston connected with the reversing lever of the engine. a valve controlling said piston, a vibratory crosshead pivoted to the upper end of the stem of said valve, a link connecting one end of the crosshead with the engine reversing lever, and mechanism connected with the opposite end of said crosshead to actuate the same upon a variance in the speed of the engine. (3) The combination of the threaded spindle driven by the engine, the sleeve mounted thereon and driven by an independent motor, the levers N and *b*, the links X, Y, and M, connecting-rod *a*, arm Z, crosshead W, valve U, and piston L, all arranged and operating substantially as specified.

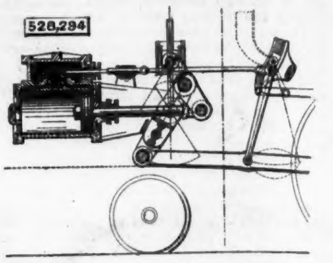
528,276



**528,294.** Means for Counterbalancing Momentum of Reciprocating Elements, *M. N. Forney, New York N Y.—Filed February 13th*, 1894.

*Claim.*—(1) The combination, with a reciprocating piston and piston-rod, of a primary lever connected at one end to the piston-rod and at the other to a sliding member, a fixed guide on which the sliding member moves rectilinearly, a secondary lever journalled in fixed bearings and having one of its arms pivotally connected to the primary lever at the middle thereof, and a connecting rod connected to the opposite arm of the secondary lever, and to a crank, substantially as set forth. (2) The combination of a cylinder, a piston secured to a piston-rod and reciprocating in said cylinder, a distribution valve working on a valve face above the lower line of said cylinder, a counterbalancing lever system, substantially as set forth, coupled to the piston-rod, a connecting rod coupled to said counterbalancing lever system and to a crank pin, a link oscillating in fixed bearings, a block fitted to slide therein, a lever coupled to said block and to the connecting rod, and connections coupling said link with a distribution valve, substantially as set forth.

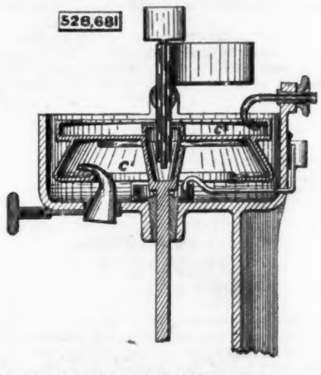
528,294



**528,681.** Churn, *O. Ohlsson, Newark, N.J.—Filed September 16th*, 1890.

*Claim* —(1) In a centrifugal churn, the combination, with an outer stationary casing, of a cream chamber, a shaft upon which said cream chamber is mounted, chambers C′ and C² carried by and connecting with said cream chamber, a pipe having transverse bars on the inside thereof and connecting with said cream chamber and the chamber C′, a conduit connecting said chambers C′ and C² and means for collecting and delivering the butter and the butter-milk into vessels arranged to receive the same as described for the purposes set forth. (2) In a centrifugal churn, the combination of a cream receptacle, upper and lower chambers communicating with each other, a pipe or conduit leading from the cream receptacle to the lower chamber, said pipe having devices for churning the cream, and mechanism for revolving the said receptacle, chambers and pipe, for the purpose described.

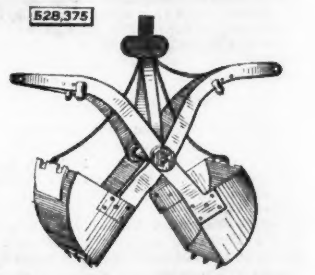
528,681



**528,375.** Dredging Implement, *C. Meier, San Francisco, Cal.—Filed October 19th*, 1893.

*Claim.*—(1) In a dredging machine of the class herein-described, the combination, with the hinged scoops, of the fixed bottom plate on the leading edge of each scoop, the removable top plate on the inner side of the scoop over the fixed bottom plate, the edge whereof is bevelled in the opposite direction to the corresponding edge of the said bottom plate, and the wedge shape teeth or projections secured under the bottom plate and extending forward beyond the cutting edge formed by the bevelled plates, the said teeth being recessed for the bottom plate and having a curved bottom face tapering from the heel upward to the point, substantially as hereinbefore set forth. (4) The combination, with the scoop or bucket. of the removable plate having a bevelled cutting edge and the bottom plate having a cutting edge bevelled oppositely to the edge on the upper plate, substantially as hereinbefore set forth.

528,375



Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided for our breakfast and supper a delicately flavoured beverage which may save us many heavy doctors bills."—*Civil Service Gazette.*—Made simply with boiling water or milk. Sold only in packets, by Grocers, labelled, "James Epps and Co, Homœopathic Chemists, London."

END OF VOL. LXXVIII.